

2. **Findings:** Posterior acoustic shadowing in cholelithiasis. Nonshadowing echogenic foci if stone disease, polyps, other masses. Gallbladder wall thickening (>3 mm), positive sonographic Murphy's sign (localized tenderness with transducer palpation over gallbladder), sludge, and pericholecystic fluid with cholelithiasis in acute cholecystitis.¹

M. Pancreatitis

1. **Initial imaging:** US.
2. **Other imaging:** CT with IV contrast if lack of clinical improvement or equivocal US. MRCP for detecting choledocholithiasis and biliary/pancreatic duct anomalies.¹³
3. **US findings:** Pancreatic duct dilation, abnormal echogenicity, peripancreatic fluid.^{1,7}

VIII. GENITOURINARY TRACT

Renal and bladder ultrasound (RBUS): first-line imaging modality; evaluates kidneys, ureters, and bladder; can assess calculi. **Fluoroscopic voiding cystourethrogram (VCUG), radionuclide cystourethrography (RNC), and contrast-enhanced voiding urosonography (ceVUS)** assess for vesicoureteral reflux. **Nuclear renal scintigraphy (Mag-3 scan)** assesses renal perfusion, function, and excretion. **Cross-sectional imaging** (CT, MR, MR urography) assesses for genitourinary (GU) tract tumors or obstruction. Additionally, MR urography can evaluate renal function and unenhanced CT can assess collecting system calculi.⁷

A. Urinary Tract Infection

See Chapter 19.

B. Nephrolithiasis/Urolithiasis

1. **Preferred imaging:** US
2. **Other imaging:** Noncontrast CT if US equivocal.^{1,7}
3. **US findings:** Echogenic, shadowing foci.⁷
4. **CT findings:** Radiodense stones, dilated ureteral or collection system, asymmetric enlargement of kidney.¹

C. Testicular Pathology

1. **Preferred imaging:** Duplex US.¹
2. **Testicular torsion findings:** Absence of blood flow to center of testicle.¹
3. **Acute epididymitis findings:** Enlarged epididymis, scrotal thickening, reactive hydrocele, increased blood flow.¹

D. Ovarian Pathology

1. **Preferred imaging:** Pelvic US.
2. **Ovarian cyst findings:** Well-circumscribed anechoic structures within pelvis measuring more than 3 cm in diameter. Hyperechoic material within cyst indicates possible hemorrhage.⁹
3. **Ovarian torsion findings:** Variable appearance, usually unilateral enlarged solid ovary with multiple peripheral follicles.⁹ Absence or presence of flow on duplex not a reliable indicator of torsion.⁷

E. Congenital Hydronephrosis

1. Normally first detected on fetal US, defined as AP renal pelvis diameter greater than 4 mm in second trimester and greater than 7 mm in third trimester.
2. **Preferred imaging:** US to confirm postnatally, as can resolve spontaneously. Do not perform until at least 48 hours after delivery given risk of false negatives or underestimation of severity.¹
3. **Findings:** Moderate-to-severe hydronephrosis (>10 mm) with clinical suspicion or family history warrants further evaluation with VCUG. Repeat US at age 4 to 6 weeks to confirm absence of hydronephrosis.^{1,14}

IX. MUSCULOSKELETAL

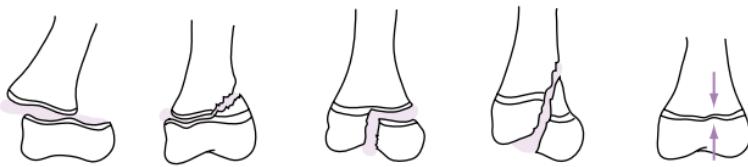
CR is the primary imaging modality; used in trauma, infection, and suspected bone lesions.⁷ **MRI** provides superior contrast resolution of soft tissue and bone marrow; preferred for patellar dislocation and avulsion fractures. Use IV contrast to delineate inflammation, ischemia, revascularization, and tumors.¹ **US** used for superficial soft-tissue masses and suspected joint effusions.

A. Fractures and Trauma

1. **Preferred imaging:** CR. For long bones, obtain at least two projections. For joints, obtain at least three projections and evaluate proximal and distal joint. Fractures may not be seen on initial XR; consider repeat XRs in 7 to 10 days as may visualize periosteal reactions around healing fracture.^{1,7}
2. **Findings:** Abrupt disruption of the cortex or acute angulation of smooth contour of normal bone.¹⁰ *Indirect signs:* soft-tissue swelling, joint effusion, periosteal reaction (if subacute or healing).
3. Describing fractures.¹⁰
 - a. **Location:** Laterality, location on bone, relation to joint (intra-articular, extra-articular).
 - b. **Type:** Complete (through whole cortex), incomplete (retains some continuity [e.g., plastic, bowing, torus, greenstick]), Salter-Harris (involves growth plate) (**Table 26.4**)
 - c. **Number of fragments:** Simple (two fragments) or comminuted (>2).
 - d. **Direction of fracture lines:** Transverse (perpendicular to long axis), oblique/diagonal (diagonal in orientation relative to long axis), spiral (corkscrew, twisting).
 - e. **Relationship** (distal fracture fragment to proximal fragment): Displacement (amount distal fragment is offset in nonlongitudinal axis), angulation (angle between fragments), apposition (amount of contact between fragments), shortening (amount of overlap between fragments, change in bone length), distraction (distance fragments are separated in longitudinal axis), rotation (orientation of joint at one end of fracture relative to joint at other end).
 - f. **Open versus closed:** Open or compound (communication between fracture and outside atmosphere), closed or simple.

TABLE 26.4**SALTER-HARRIS CLASSIFICATION OF GROWTH PLATE INJURY**

Class I	Class II	Class III	Class IV	Class V
Fracture along growth plate	Fracture along growth plate with metaphyseal extension	Fracture along growth plate with epiphyseal extension	Fracture across growth plate, including metaphysis and epiphysis	Crush injury to growth plate without obvious fracture
I	II	III	IV	V



4. Common pediatric fracture patterns: see [Chapter 2](#).

A. Elbow XRs.

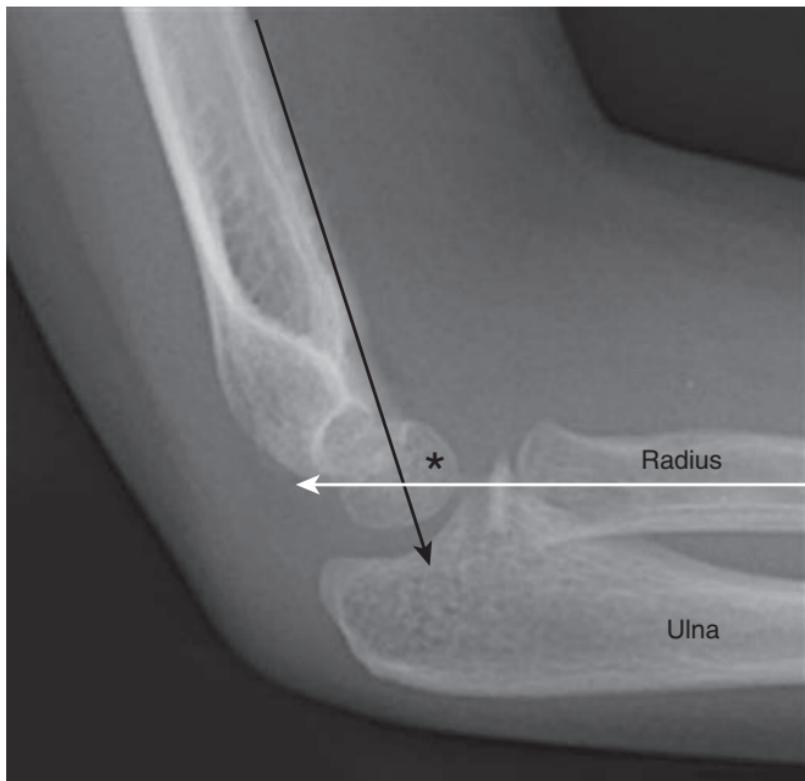
- Anterior humeral line:** Line drawn tangential to anterior humeral cortex should bisect middle third of capitellum. If line more anterior, supracondylar fracture should be suspected ([Figs. 26.7 and 26.8](#)).¹⁰
- Radiocapitellar line:** Line drawn through the center of radial neck should pass through the center of capitellum. If it does not, dislocation should be suspected ([see Figs. 26.7 and 26.8](#)).¹⁴
- Ossification centers:** Mnemonic CRITOE commonly used to remember sequential order of appearance ([Table EC 26.B](#) and [Fig. EC 26.I](#)).¹⁵
- Fat pad:** Normal lateral view of flexed elbow shows only anterior fat pad (lucency). Elevated anterior fat pad and visible posterior fat pad indicates intra-articular injury and possible radial head fracture (*positive fat-pad sign*) ([Fig. 26.9](#)).¹²
- Hourglass sign** ('figure-of-eight'): On a true lateral view, an hour-glass or figure-of-eight configuration can be visualized on the distal humerus ([see Fig. 26.9](#)).

B. Osteomyelitis

- Initial imaging:** CR. Findings often lag 7 to 14 days after symptom onset; however, may rule out or identify alternative diagnosis.¹
- Preferred imaging:** MRI. Findings can be seen as early as 24 to 48 hours after symptom onset.^{1,16}
- Findings:** Metaphysis of long bones most frequently affected. CR: soft-tissue swelling, bony destruction, cortical loss, periosteal reaction.¹⁶

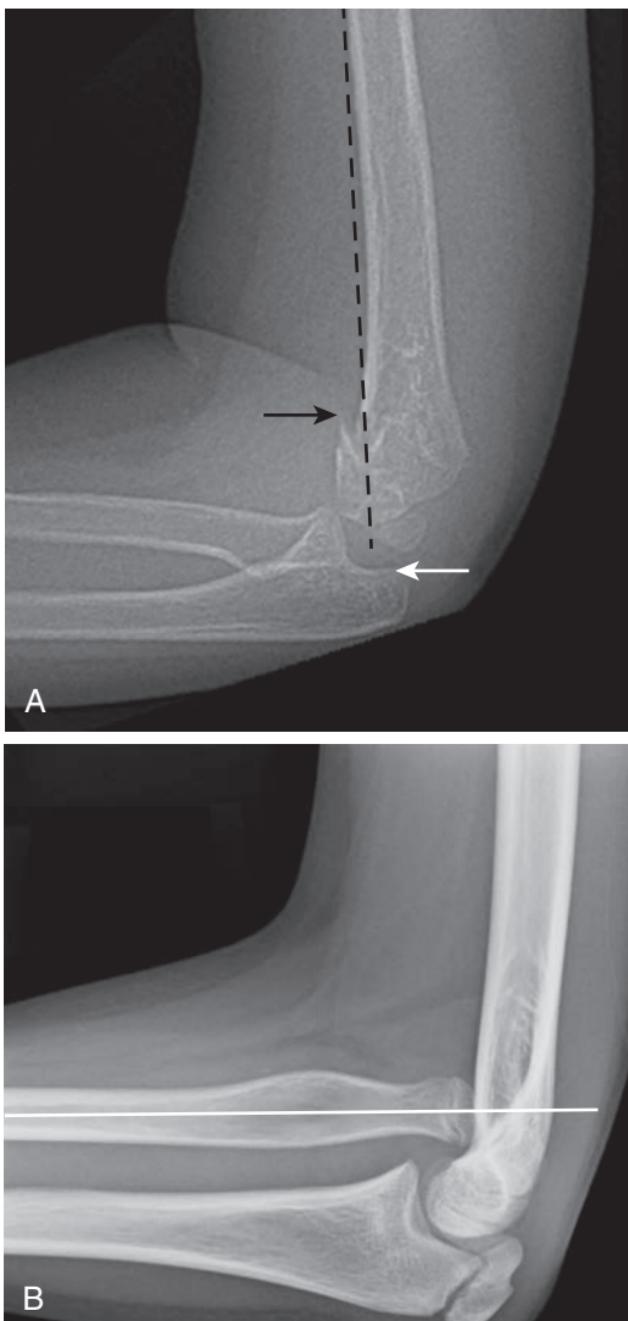
C. Hip Disorders

- Developmental dysplasia of the hip
 - Preferred imaging:** US, typically around 6 weeks of age.
 - Other imaging:** Once femoral heads ossify (within 3 to 6 months), CR more helpful.⁷

**FIGURE 26.7**

Normal elbow alignment on lateral radiograph. The anterior humeral line (black arrow) is drawn along the anterior cortex of the humerus and should intersect the middle third of the capitellum (asterisk). The radiocapitellar line (white arrow) is drawn along the axis of the radius. (Modified from Coley, BD. *Caffey's Pediatric Diagnostic Imaging*. 13th ed. Philadelphia: Elsevier; 2019, p. 1439, Fig. 142.19.)

2. Idiopathic avascular necrosis of femoral head (Legg-Calvé-Perthes disease).
 - a. **Initial imaging:** CR, AP pelvis and frog-leg lateral hip.
 - b. **Other imaging:** MRI, more sensitive for early disease, useful if CR is nondiagnostic.⁷
 - c. **Findings:** Small capital femoral epiphysis, sclerotic femoral head, widened joint space, curvilinear subchondral lucency from subchondral fracture (*crescent sign*).⁷
3. Slipped capital femoral epiphysis (SCFE)
 - a. **Initial imaging:** CR, AP and frog-leg lateral views of pelvis.
 - b. **Findings:** Asymmetric widening and/or lucency of proximal femoral physis, posterior and inferomedial displacement of femoral head relative to femoral neck (ice cream falling off cone). Can assess femoral head position by drawing line along lateral aspect of the femoral neck (Klein's line), which should intersect the capital femoral epiphysis in normal anatomy (Fig. EC 26.J).⁷

**FIGURE 26.8**

(A) Abnormal anterior humeral line seen in a supracondylar humeral fracture. The anterior humeral line (*dashed line*) courses anterior to the capitellum (*white arrow*). (B) Abnormal radiocapitellar line in a radial head dislocation. Radiocapitellar line (*white line*) drawn along the axis of the radius courses superior to the capitellum instead of intersecting the capitellum.

TABLE EC 26.B**ELBOW OSSIFICATION CENTERS USING MNEMONIC “CRITOE”**

Ossification Center	Age at which appears (highly variable)
Capitellum	1–2
Radial head	3–4
Internal (medial) epicondyle	5–6
Trochlea	7–8
Olecranon	9–10
External (lateral) epicondyle	11–12

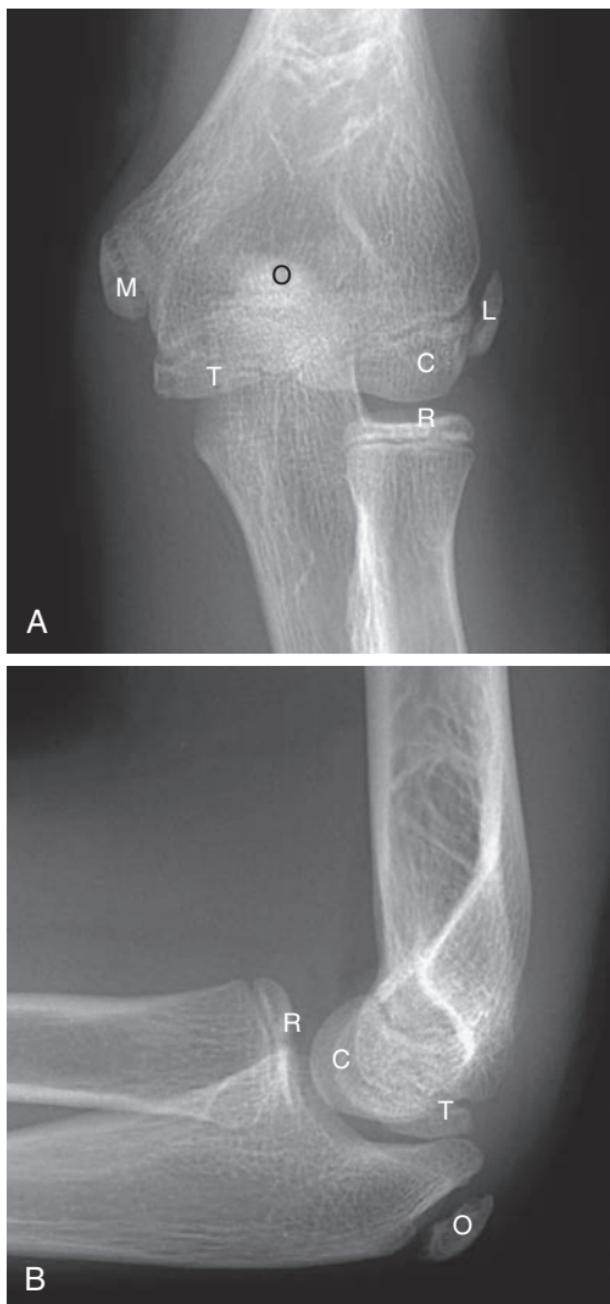
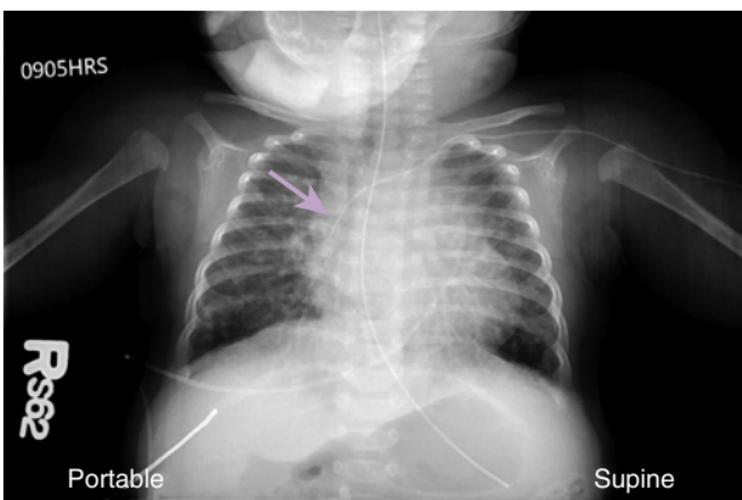


FIGURE EC 26.I

Ossification centers of normal elbow of 14-year-old boy. Anteroposterior (A) and lateral (B) radiographs. C, capitellum; L, lateral epicondyle; M, medial epicondyle; O, olecranon; R, radial head; T, trochlea (From Coley, BD. *Caffey's Pediatric Diagnostic Imaging*. 13th ed. Philadelphia: Elsevier; 2019, p. 1438, Fig. 142.17.)

**FIGURE 26.9**

Lateral radiograph of elbow demonstrates visible posterior fat pad (white arrow), “positive fat-pad sign.” Note the “hourglass sign” (dashed line).

**FIGURE 26.10**

Central line placement on anteroposterior chest radiograph for line inserted in arm or neck. Arrow indicates termination of catheter at junction of superior vena cava and right atrium.

D. Scoliosis

1. **Initial imaging:** CR, upright PA view. Sitting or supine reserved for nonambulatory patients. Lateral view not necessary for initial screening; include if known scoliosis.⁹
2. **Findings:** Lateral spinal curvature greater than 10 degrees as measured by Cobb method.⁹

E. Bone Lesions

1. **Initial imaging:** CR, usually diagnostic.
2. **Other imaging:** MRI defines extent of lesion and staging of malignant lesions.¹
3. **Findings:** *Benign lesions:* demarcated from normal bone, sclerotic margin around lesion, nonaggressive growth pattern. *Pathologic lesions:* not well demarcated from surrounding normal bone, possible accompanying soft-tissue mass, periosteal reaction, destructive bone changes. (Fig. EC 26.K to Fig. EC 26.O).¹

F. Skeletal Survey in Suspected Nonaccidental Trauma

1. **Imaging:** CR at presentation and 2 weeks after presentation. Follow-up surveys may identify initially missed trauma by identifying healing fractures (Fig. EC 26.P).⁵
2. Evaluate for fractures inconsistent with history or developmental stage. Certain findings suspicious for nonaccidental trauma (NAT) (see Chapter 2).

X. CONFIRMING TUBE PLACEMENT AND LINE INSERTION

A. Central Venous Catheter

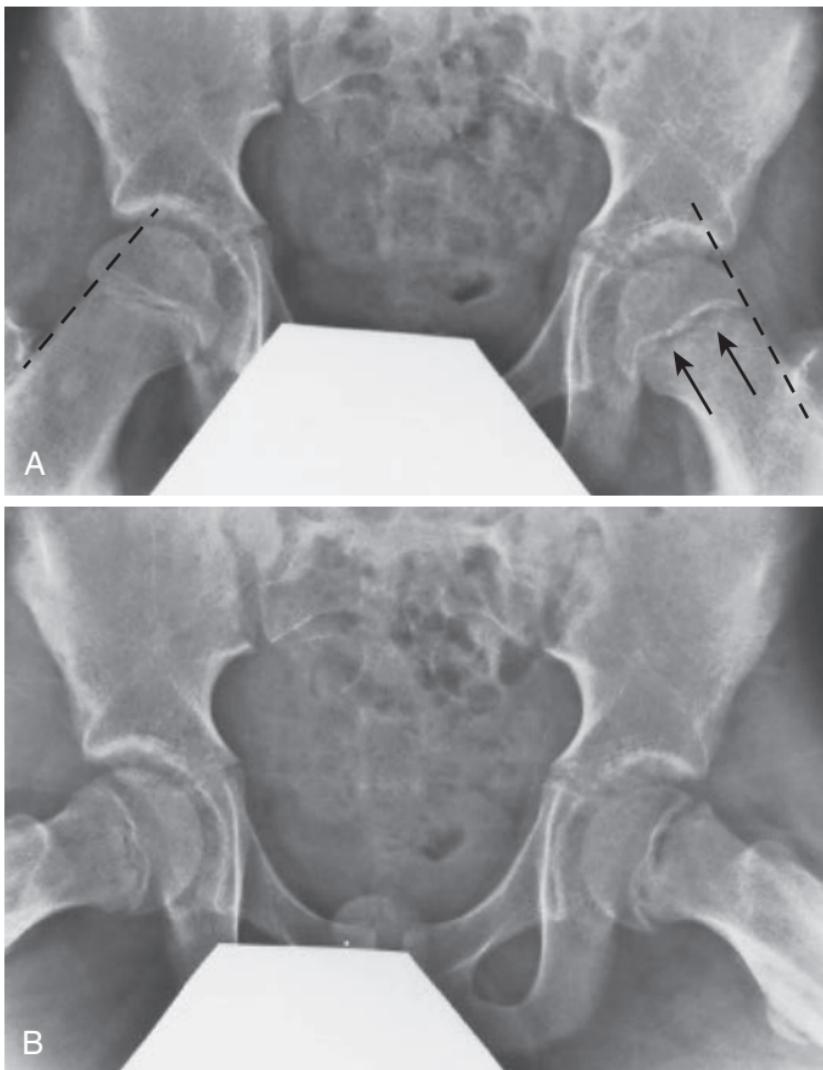
1. *Upper extremity:* Tip in superior vena cava (SVC) at cavoatrial junction or proximal atrium (Fig. 26.10).
2. *Lower extremity:* Tip in inferior vena cava (IVC) within 1 cm of diaphragm.

B. Umbilical Lines (Fig. 26.11)

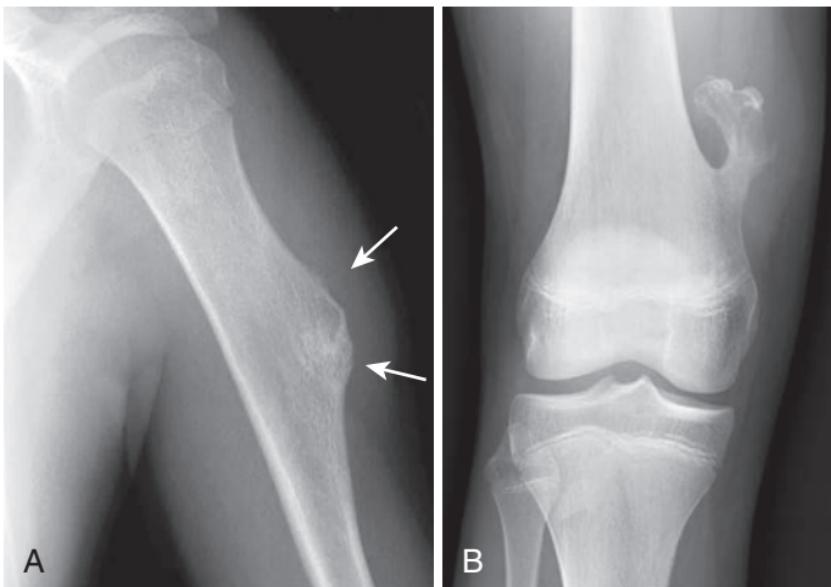
1. Umbilical artery catheter (UAC): *High-lying (preferred):* Tip above diaphragm between T6 and T9. *Low-lying:* Tip just above bifurcation of aorta between L3 and L5.
2. Umbilical venous catheter (UVC): Tip within 1 cm of diaphragm between T8 and T10 at junction of right atrium and inferior vena cava.
3. UACs distinguished from UVCs by initial downward course from umbilicus into internal iliac artery, whereas UVCs extend immediately superior from umbilicus.

C. Nasogastric Tube

1. Tip below diaphragm in stomach, overlying gastric bubble, at least 10 cm beyond gastroesophageal junction.

**FIGURE EC 26.J**

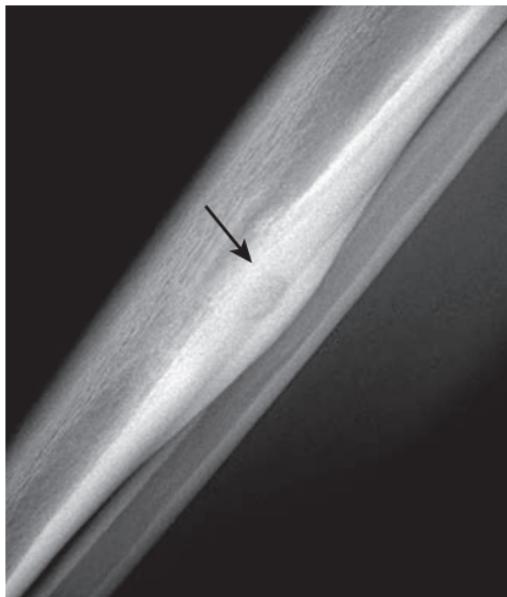
Slipped capital femoral epiphysis. (A) Anteroposterior radiograph of the pelvis shows asymmetric physeal widening on the left (double arrows). The Klein line (dotted lines) does not cross the epiphysis on the affected side. (B) Frog-leg lateral image confirms inferomedial slip of the femoral head relative to the proximal femoral metaphysis. (From Walters, MM, Robertson RL. *Pediatric Radiology: The Requisites*. 4th ed. Philadelphia: Elsevier; 2017, p. 220, Figure 7.60.)

**FIGURE EC 26.K**

(A) Sessile osteochondroma (arrows) of proximal humeral diaphysis in a 16-year-old patient. (B) Pedunculated osteochondroma of the right distal femoral metaphysis in a 16-year-old patient. (From Coley, BD. *Caffey's Pediatric Diagnostic Imaging*. 13th ed. Philadelphia: Elsevier; 2019, p. 1375, Figs. 138.14–138.15.)

**FIGURE EC 26.L**

Nonossifying fibroma in a 12-year-old patient. The lesion is well defined, with a "soap bubble" appearance and sclerotic margins (arrow). (From Coley, BD. *Caffey's Pediatric Diagnostic Imaging*. 13th ed. Philadelphia: Elsevier; 2019, p. 1382, Fig. 138.30.)

**FIGURE EC 26.M**

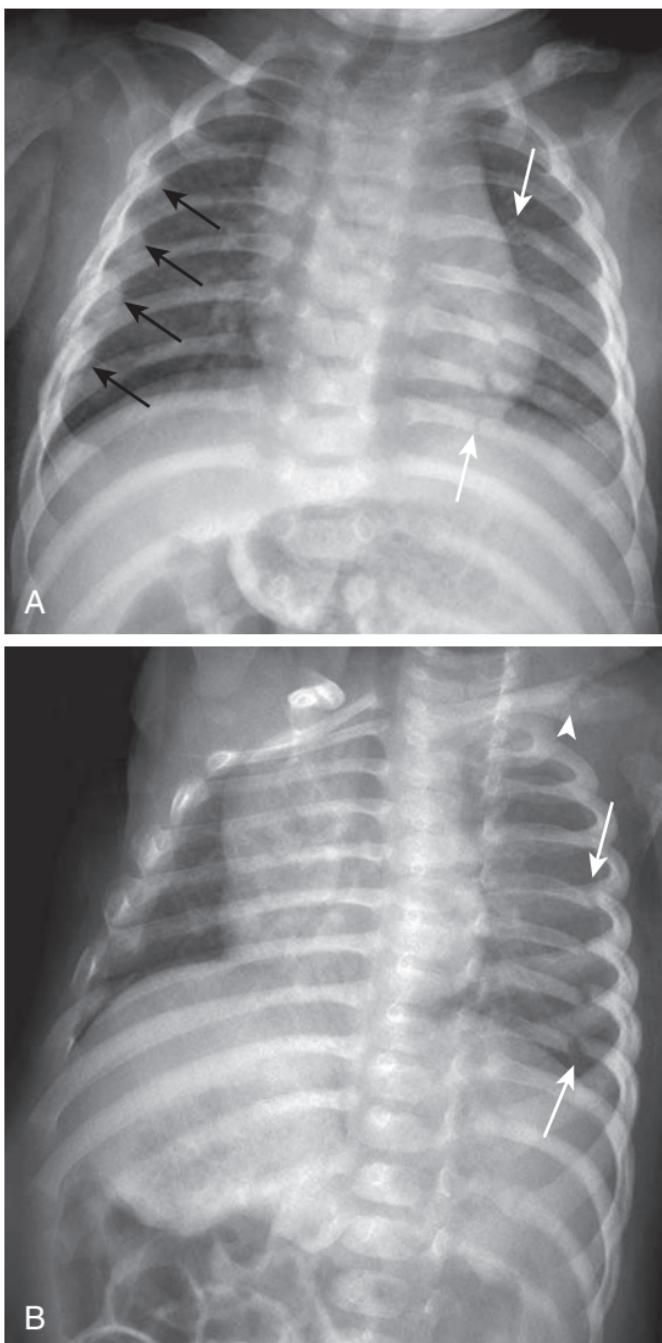
Osteoid osteoma of tibia in a 15-year-old patient. Radiograph shows cortical thickening posteriorly. Lucent nidus is faintly seen (arrow). (From Coley, BD. *Caffey's Pediatric Diagnostic Imaging*. 13th ed. Philadelphia: Elsevier; 2019, p. 1387, Fig. 138.38.)

**FIGURE EC 26.N**

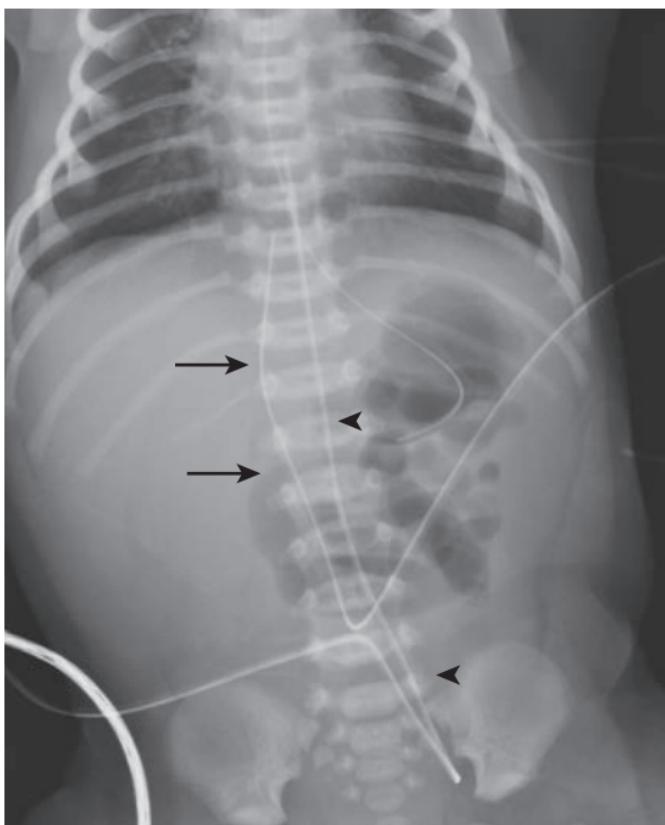
Proximal tibial osteosarcoma. Radiograph demonstrates osteoblastic osteosarcoma with osteoid matrix (arrow) and “sunburst” periostitis (arrowhead). (Modified from Coley, BD. *Caffey's Pediatric Diagnostic Imaging*. 13th ed. Philadelphia: Elsevier; 2019, p. 1390, Fig. 138.41.)

**FIGURE EC 26.0**

Anteroposterior (A) and lateral (B) radiographs of femur of a 6-year-old child show Ewing sarcoma arising from mid-diaphysis. Lamellar periosteal reaction and new bone formation are present, with Codman triangles at proximal and distal ends of tumor. Faint periosteal new bone extends perpendicularly into soft-tissue component of tumor. Medulla is not expanded. (From Slovis, TL. *Caffey's Pediatric Diagnostic Imaging*. 11th ed. Philadelphia: Mosby; 2008.)

**FIGURE EC 26.P**

Frontal (A) and oblique (B) radiographs show healing fractures (black arrows) of right third, fourth, fifth, and sixth ribs. There are acute fractures (white arrows) of the posterior left fifth, sixth, seventh, eighth, and ninth ribs. Fractures are better appreciated on the oblique view. Note subacute healing left clavicular fracture (arrowhead). (From Donnelly, LF. *Fundamentals of Pediatric Imaging*. 2nd ed. Philadelphia: Elsevier; 2017, p. 56, Fig. 3.39.)

**FIGURE 26.11**

Umbilical catheters. Umbilical venous catheter (UVC) terminates at inferior cavoatrial junction (arrows). The umbilical arterial catheter (UAC) first descends the iliac artery before it ascends the aorta and terminates in a typical "high" position, at T7 (arrowheads).

D. Nasoduodenal Tube

1. Tip should pass through stomach, cross midline, and pass into duodenal bulb, tip ends approximately 10 to 12 cm into small bowel.

E. Endotracheal Tube

1. Tip about midway between thoracic inlet/interclavicular line and carina.

XII. WEB RESOURCES

- American College of Radiology Appropriateness Criteria: <http://www.acr.org/Quality-Safety/Standards-Guidelines/Practice-Guidelines-by-Modality/Pediatric>
- Image Gently Alliance: www.imagegently.org
- Society for Pediatric Radiology: <http://www.pedrad.org>

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A complete list of references can be found online at www.expertconsult.com.

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Chapter 27

Rheumatology

Shani Jones, MD

I. BRIEF OVERVIEW OF CLINICAL CHARACTERISTICS OF RHEUMATOLOGIC DISEASES

A. Juvenile Idiopathic Arthritis (JIA)^{1–5}

1. JIA involves joint swelling or limitation/tenderness upon range of motion lasting at least 6 weeks, shown not to be due to another identifiable cause, and presenting in children less than 16 years of age.
2. See [Table 27.1](#) for information organized by the divisions of the disease.

B. Reactive Arthritis^{6–8}

1. Affects males more than females (3:1).
2. Sterile inflammatory arthritis as a response to preceding (1 to 4 weeks) bacterial or viral infection, particularly of the respiratory, gastrointestinal, or genitourinary tracts.
3. Involves acute asymmetrical oligoarticular arthritis of larger joints, often the lower extremities.
4. Associated with fever, weight loss, fatigue, tendinitis, bursitis, anterior uveitis, conjunctivitis, erythema nodosum, urethritis, and cervicitis.

C. Systemic Lupus Erythematosus (SLE)^{1,9–11}

1. SLE typically affects women of childbearing age (occurring nine times more often in women than men).
2. People of African descent and Native Americans are affected more commonly than Caucasians.
3. See [Box 27.1](#) for clinical criteria for diagnosis.

D. Drug-Induced Systemic Lupus Erythematosus^{1,6,9}

1. Manifests as polyarthritis, myalgia, fever, and serositis, which resolve after discontinuation of the inciting drug.
2. Inciting drugs include but are not limited to hydralazine, minocycline, procainamide, quinidine, isoniazid, interferon-alfa, chlorpromazine, ethosuximide, carbamazepine, therapy against tumor necrosis factor alpha (anti-TNF α therapy).

E. Neonatal Systemic Lupus Erythematosus^{1,12}

1. Neonates born to mothers with active SLE can develop a transient lupus-like syndrome due to transplacental passage of anti-Ro (anti-SS-A) and anti-La (anti-SS-B) antibodies.
2. Inflammatory features resolve within 6 months as maternal autoantibodies are cleared.

TABLE 27.1**CLASSIFICATION OF JUVENILE IDIOPATHIC ARTHRITIS (JIA)**

ILAR JIA Subtype (% of Total Patients)		Demographics	Typical Joint Involvement	Occurrence of Uveitis	Other Features
Oligoarticular	F > M	≤4 joints	Common (30%), especially if ANA-positive	ANA positive in 60%–80%	
• Persistent	Early childhood	Large joints: knees, ankles, wrist			
• Extended (40%–50%)		Persistent disease: <4 joints affected	Usually asymptomatic		
		Extended disease: Involves >4 joints after first 6 months of disease			
Polyarticular (RF-negative) (20%–25%)	F > M 2 peaks: 2–4 years and 6–12 years	≥5 joints Symmetric	Common (15%)	ANA positive in 25%	May also involve cervical spine and TMJ
Polyarticular (RF-positive) (5%)	F > M Late childhood/early adolescence	Symmetric small and large joints Erosive joint disease	Rare (<1%)	ANA positive in 75% Rheumatoid nodules: Nontender subcutaneous nodules found on bony prominences, extensor surfaces, or adjacent to joints	
Systemic (5%–10%)	M = F Throughout childhood	Poly- or oligoarticular	Rare (<1%)	Daily (quotidian) fever for ≥2 weeks Evanescence rash, lymphadenopathy, hepatosplenomegaly, serositis	
Enthesitis-related arthritis (5%–10%)	M > F Late childhood/adolescence	Weight-bearing joints, especially hip and intertarsal joints History of inflammatory back pain or sacroiliac joint tenderness	Symptomatic acute uveitis (~7%)	Enthesitis: HLA-B27 positive, axial involvement (including sacroiliitis), family history of HLA-B27-associated disease	

TABLE 27.1—cont'd**CLASSIFICATION OF JUVENILE IDIOPATHIC ARTHRITIS (JIA)**

ILAR JIA Subtype (% of Total Patients)	Demographics	Typical Joint Involvement	Occurrence of Uveitis	Other Features
Psoriatic arthritis (5%–10%)	F > M 2 peaks: 2–4 years and 9–11 years	Asymmetric or symmetric small or large joints	Common (10%)	Juvenile ankylosing spondyloarthritis: Subgroup requiring radio- logic evidence of bilateral sacroiliitis Nail pits, onycholysis, dactylitis Psoriasis: May appear after arthritis Family history of psoriasis may be present
Undifferentiated (10%)				Does not fulfill criteria for any other category or fulfills criteria for >1 category

ANA, Antinuclear antibodies; F, female; HLA, human leukocyte antigen; ILAR, International League of Associations for Rheumatology; M, male; RF, rheumatoid factor; TMJ, temporomandibular joint.

Data from Gowdie, Tse, *Pediatric Clinics of North America* 2012. Based on International League of Associations for Rheumatology (ILAR) Classification of JIA: Second Revision Edmonton, 2001.

BOX 27.1**CLINICAL CRITERIA FOR THE DIAGNOSIS OF SYSTEMIC LUPUS ERYTHEMATOSUS¹⁰**

1. Patient satisfies at least four of the following criteria, including at least one clinical criterion and one immunologic criterion:

Clinical criteria: Cutaneous findings, oral/nasopharyngeal ulcers, nonscarring alopecia, synovitis, serositis, renal manifestations, neurologic manifestations, hemolytic anemia, leukopenia/lymphopenia, thrombocytopenia
 Immunologic criteria: Antinuclear antibody (ANA), anti-dsDNA, anti-Sm, antiphospholipid antibody, low complement (C3, C4, CH50), direct Coombs test (in the absence of hemolytic anemia)

OR

2. The patient has biopsy-proven nephritis compatible with SLE and with ANA or anti-dsDNA antibodies

3. Clinical features include rash (annular erythema on eyelids and scalp, papular or plaque-like lesions), hepatomegaly, thrombocytopenia, hemolytic anemia, congenital atrioventricular heart block, and hydrops fetalis.

F. Vasculitis (Table 27.2)^{1,6,13-23}**G. Sarcoidosis^{6,14,24-26}**

1. Before puberty (very rare): primarily affects Caucasians. During and after puberty: predominantly affects African Americans. Males and females affected equally.
2. Multisystem, infiltrative, noncaseating granulomatous disease of unknown etiology.
3. Lung is the organ most commonly involved; however, it can involve nearly all organ systems and have widespread manifestations including but not limited to:
 - a. Pulmonary: Bilateral hilar adenopathy, restrictive and obstructive disease.
 - b. CNS: Bilateral or unilateral Bell palsy, seizures, aseptic meningitis.
 - c. Cutaneous: Erythema nodosum, plaques, alopecia.

H. Scleroderma^{6,14,27}

1. Both juvenile localized scleroderma and juvenile systemic sclerosis typically present in mid-childhood between 6 and 11 years of age with a female predominance.
2. Localized (limited) scleroderma: More common than systemic; sclerosis limited to skin, muscle, and bone.
3. Diffuse cutaneous systemic scleroderma: Fibrous degenerative changes of skin, synovium, digital arteries, and internal organs (gastrointestinal tract, heart, lungs, kidneys, and esophagus).

I. Sjögren Syndrome^{1,6,14,28}

1. Female-to-male ratio 5:1 in children.
2. Widespread lymphocytic infiltration of salivary and lacrimal glands with secondary atrophy and obliteration of secretory acini.
3. Keratoconjunctivitis sicca (dry eyes secondary to decreased tear production by lacrimal glands).
4. Xerostomia (dry mouth from decreased salivary gland production).
5. May present as parotid gland swelling in children.

II. INTERPRETATION OF LABORATORY STUDIES USED IN THE DIAGNOSIS AND MONITORING OF RHEUMATOLOGIC DISEASES

Most laboratory studies used to diagnose rheumatic diseases are nonspecific, and results must be interpreted within the context of the full clinical picture. Once a diagnosis is established, however, they can be used to follow the condition's clinical course, indicating flares or remission of the rheumatic disease.

A. Acute-Phase Reactants

Indicate presence of inflammation when elevated. Elevation is nonspecific and can result from trauma, infection, rheumatic diseases, or malignancy.¹ Markers include erythrocyte sedimentation rate (ESR), C-reactive protein (CRP), platelet count, ferritin, haptoglobin, fibrinogen, serum amyloid A, and complement.^{1,6}

TABLE 27.2**CHILDHOOD VASCULITIS SYNDROMES**

Vasculitis Syndrome	Involved Vessels	Epidemiology	Clinical Manifestations
Takayasu arteritis	Large arteries	Young women	Aneurysms, thrombosis, and stenosis of large arteries; hypertension is common
Giant cell (temporal) arteritis	Aorta and large branches—extracranial branches of carotid artery	Rare in children	Fever, weight loss, partial or total blindness, headache, jaw claudication, stiffness in neck and shoulders
Kawasaki disease	Medium-sized arteries	Children less than 5 years old	Mucocutaneous lymph node syndrome (see Chapter 7)
Polyarteritis nodosa	Renal, hepatic, coronary, and mesenteric arteries	Juvenile polyarteritis with a mean age of 9 years	Cutaneous lesions (livedo reticularis, tender nodules, purpura), hypertension, renal failure, abdominal pain, intestinal infarction, peripheral neuropathy, stroke
Microscopic polyangiitis (MPA)	Small arterioles and venules	Associated with streptococcal infections or URIs	Necrotizing glomerulonephritis and pulmonary capillaritis leading to alveolar hemorrhage and hemoptysis
Henoch-Schönlein purpura	Venules, capillaries, arterioles, and intraparenchymal distal arteries; IgA-dominant immune deposits within vessel walls	Most common pediatric vasculitis; frequently affects males 2–7 years old; preceding viral URI common	Palpable purpura involving buttocks and lower extremities, colicky abdominal pain, subcutaneous or scrotal edema, migratory arthralgias/arthritis, proteinuria, glomerulonephritis, intussusception (frequently ileoileal) Treatment: Supportive care with hydration and analgesics; consider corticosteroids if severe abdominal pain or nephritis Follow-up: serial urinalyses and blood pressure measurements up to 6 months after diagnosis
Granulomatosis with polyangiitis (GPA)	Small and medium-sized arteries	Rare in childhood; has female predominance and presents in adolescence	Respiratory tract: Recurrent epistaxis, chronic purulent nasal discharge, lung nodules, cavities, infiltrates Kidney involvement: proteinuria, hematuria, glomerulonephritis

Continued

TABLE 27.2—cont'd**CHILDHOOD VASCULITIS SYNDROMES**

Vasculitis Syndrome	Involved Vessels	Epidemiology	Clinical Manifestations
Eosinophilic granulomatosis with polyangiitis (Churg-Strauss syndrome)	Vessels of respiratory tract	More prevalent in those of European descent	Associated with asthma, nasal polyps and allergic rhinitis
Juvenile dermatomyositis	Capillary vasculopathy affecting skin, GI tract, and striated muscle	Peak onset 5–14 years; females affected more commonly	Heliotrope or malar rash, Gottron papules, dystrophic calcifications, photosensitivity (skin findings required for diagnosis), symmetric proximal muscle pain or weakness More severe disease with dysphagia, skin ulcers, and restrictive lung disease
Behçet disease	Systemic vasculitis affecting arteries and veins	Most prevalent in Turkey; peak age in young adulthood but up to 26% of cases <16 years	Recurrent oral ulcers, genital ulcers, ocular disease, skin lesions, positive skin pathergy test (traumatic injury to skin results in development of a sterile pustule in 24–48 hr)
Raynaud phenomenon	Exaggeration of vasoconstriction due to increase in α -2 adrenergic response	More common in women age 15–30; family history common	Response to cold or emotional stress: sudden onset color change in digits with demarcated skin pallor due to constricted blood flow, followed by cyanotic skin, and finally erythema with reperfusion

GI, Gastrointestinal; URI, upper respiratory infection.

1. ESR

- Measure of the rate of fall of red blood cells in anticoagulated blood within a vertical tube; reflects level of rouleaux formation caused by acute-phase reactants.¹
- Can be falsely lowered in afibrinogenemia, polycythemia, and sickle cell disease; these states interfere with rouleaux formation.²
- Can be outside normal range for age due to obesity, pregnancy, and anemia.²⁹
- Serial measurements may help in monitoring disease severity or activity in conditions such as SLE and JIA.

2. CRP^{1,30}

- a. Synthesized by the liver, assists in clearance of pathologic bacteria and damaged cells via activation of complement-mediated phagocytosis, and mediates acute inflammation by altering cytokine release.
- b. Increases and decreases rapidly owing to short half-life (approximately 18 hours).¹⁴
- c. Elevation is nonspecific, indicating only inflammation:
 - (1) Most active phases of rheumatic disease result in elevation to 1 to 10 mg/dL.
 - (2) Level greater than 10 mg/dL raises concern for bacterial infection or systemic vasculitis.³¹

B. Autoantibodies (Table 27.3)¹⁴

The positive predictive value of any autoantibody assay depends on clinical context. These studies can prove valuable in confirming clinical suspicion. Sensitivities and specificities must be considered with any clinical decision.

1. Antinuclear antibody (ANA)

- a. ANA is a nonspecific test for SLE and other rheumatic disease.¹
- b. Positive in approximately 60% to 70% of children with an autoimmune disease, but can be seen in about 25% of the normal population.^{32,33}
- c. If positive, consider ordering individual autoantibodies.⁶
- d. Can be positive in nonrheumatologic diseases³³:
 - (1) Malignancy (e.g., acute lymphoblastic leukemia)
 - (2) Infections (transiently positive): Mononucleosis, endocarditis, hepatitis, malaria
- e. If positive in JIA, there is increased risk of chronic uveitis.²⁹

2. Rheumatoid factor (RF)^{1,29}

- a. M antibodies to the Fc portion of IgG.
- b. Positive in rheumatic and nonrheumatic diseases:
 - (1) Rheumatic diseases: Rheumatoid arthritis, SLE, mixed connective tissue disease, scleroderma, and primary Sjögren syndrome.
 - (2) Infections: Hepatitis B/C, subacute bacterial endocarditis, tuberculosis, toxoplasmosis, rubella, cytomegalovirus, herpes.
- c. Negative RF does not rule out rheumatic disease.
- d. Prognostic importance in polyarticular JIA: Positive RF suggests more aggressive disease.²⁹

3. Anticyclic citrullinated peptide (anti-CCP) antibodies

- a. Known to be highly specific for rheumatoid arthritis in adults; found primarily in children with polyarticular JIA.²⁹
- b. Anti-CCP positivity correlates with erosive joint disease in JIA.^{34,35}

TABLE 27.3**COMMON RHEUMATOLOGIC DISEASES AND AUTOANTIBODIES**

Disease	Associated Antibody	Interpretation of Results	Clinical Considerations
SLE	ANA Anti-double-stranded DNA Anti-Smith Anti-phospholipids	ANA sensitivity >95% Anti-dsDNA specificity is 97% Anti-Smith specificity 55%–100%	Most patients with positive ANA do not have SLE, but almost all patients with SLE have a positive ANA Measure anti-dsDNA when ANA positive Anti-phospholipids present in up to 50% of SLE patients; associated with thrombosis and fetal loss
Juvenile idiopathic arthritis	ANA	ANA positive in 80% of those with oligoarticular type	Typically RF and CCP negative; when positive may indicate erosive disease
Vasculitis	ANCA-cytoplasmic/ PR3 (proteinase-3) ANCA-perinuclear/ MPO (myeloperoxidase)	90% of patients with active GPA and MPA are ANCA positive	c-ANCA associated with GPA p-ANCA associated with MPA and Churg-Strauss
Dermatomyositis/ Polymyositis	ANA Anti-Jo-1	Specificity of Anti-Jo-1 99% ANA may be normal	Anti-Jo-1 associated with polymyositis with interstitial lung disease and JDM
Mixed connective tissue disease	Anti-RNP	The presence of antibodies to RNP is required for diagnosis	Also present in SLE, systemic sclerosis
Scleroderma	ANA Anticentromere Anti-Scl-70	ANA sensitivity >85% Anticentromere specificity >98%	Anti-Scl-70 associated with diffuse systemic sclerosis, while anti-centromere with limited disease
Sjögren syndrome	Anti-Ro/SS-A Anti-La/SS-B	Anti-Ro sensitivity 75%	Associated with neonatal cutaneous lupus Incidence of congenital heart block increased for infants born to mothers with high titers of anti-Ro and anti-La
Drug-induced SLE	Anti-histone	Sensitivity >95%	Anti-histone antibodies do not distinguish drug-induced lupus from SLE

ANA, Antinuclear antibody; ANCA, antineutrophil cytoplasmic antibodies; CCP, cyclic citrullinated peptide; GPA, granulomatosis with polyangiitis; JDM, juvenile dermatomyositis; MPA, microscopic polyangiitis; SLE, systemic lupus erythematosus.

Data from Imboden, JB, Hellman DB, Stone, JH. *Current Diagnosis & Treatment in Rheumatology*. 3rd ed. McGraw-Hill Medical; 2013.

C. Complement^{1,5}

The complement system is composed of a series of plasma proteins and cellular receptors that function together to mediate host defense and inflammation. Inflammatory processes may increase the synthesis of complement proteins or increase their consumption.

1. Total hemolytic complement level (CH_{50})

- a. Immune complex disease leads to depletion of complement components and decreased level of CH_{50} .
- b. Increased in the acute phase response of numerous inflammatory states.
- c. Useful screening test for homozygous complement deficiency states which have the strongest association with SLE.²⁹
- d. Typically decreased in SLE, acute poststreptococcal glomerulonephritis, subacute bacterial endocarditis.¹⁴

2. C3 and C4

- a. Most common complement proteins assayed.
- b. May be increased or decreased in rheumatic diseases, depending on disease stage or severity.

c. Decreased levels of complement proteins:

- (1) Indicator of immune complex formation.
- (2) Complete deficiency of C3 manifests as severe, recurrent infections with pyogenic organisms.¹⁴
- (3) Can occur in active SLE, some vasculitides, and multiple infections, including gram-negative sepsis, hepatitis, and pneumococcal infections.
- (4) Decreased levels typically signify more severe SLE, particularly with regard to renal disease.
- (5) Persistently low C3 associated with lupus nephritis.
- (6) Severe hepatic failure: Synthesis of complement proteins occurs primarily in the liver.
- (7) Congenital complement deficiency, which may predispose to development of autoimmune disease.

d. Increased levels of complement proteins:

- (1) Indicates the active phase of most rheumatic diseases (e.g., JIA, dermatomyositis).
- (2) May be seen in multiple infections (e.g., hepatitis, pneumococcal pneumonia) as part of the acute-phase response.

III. PRIMARY CARE MANAGEMENT OF RHEUMATOLOGIC DISEASES^{36,38,39}

A. Vaccination

1. Patients on immunosuppressive therapies cannot receive live vaccines, but can receive killed/inactivated vaccines.
2. Special considerations should be made for immunocompromised patients on biologic or immunosuppressive therapy (see Chapter 16).

TABLE 27.4**ANTIARTHRITIC DRUG TOXICITY AND RECOMMENDED SURVEILLANCE**

Agent	Major Side Effects	Recommended Surveillance
DMARDs		
Methotrexate	GI upset, liver toxicity, oral ulcers, bone marrow toxicity, teratogenic	Baseline CMP, then every 2–3 months CBC with differential every 4–6 weeks
Hydroxychloroquine	Retinal toxicity, GI upset, neuropathy, myopathy, tinnitus	Ophthalmologic monitoring every 6 months
Sulfasalazine	Hematologic toxicity, hepatic toxicity, hypogammaglobulinemia	CBC with differential, liver enzymes and urinalysis every 2–3 months IgG levels every 6 months
Leflunomide	Hepatic toxicity, hematologic, mucositis, teratogenic, neuropathy	Baseline CBC and LFTs, monthly for 6 months, then every 8–12 weeks
Mycophenolate mofetil	GI upset, cytopenias, teratogenic, future malignancy, progressive multifocal leukoencephalopathy	CBC with differential every 4–6 weeks
CYTOTOXIC AGENTS		
Azathioprine	Bone marrow, liver and lung toxicity	CBC with differential weekly until stable dose established, then monthly Baseline hepatic enzymes, BUN, and serum creatinine, then monthly
Cyclophosphamide	Leukopenia, thrombocytopenia, bladder toxicity, SIADH, teratogenicity, fertility issues	Vitals when administering IV formulation (pretreatment with Mesna) Urinalysis pre- and postinfusion Urine output monitoring CBC with differential days 7, 10, 14 s/p infusion
Cyclosporine	Hypertension, immune suppression, renal toxicity, liver toxicity, hirsutism	Baseline renal function (BUN, urinalysis, creatinine), then monthly Hepatic enzymes, CBC with differential monthly
BIOLOGIC AGENTS		
Anti-TNF agents	Opportunistic infections, drug-induced lupus, malignancy, autoantibody production	Baseline TB screening Routine CBC Routine autoantibody screening

ALT, Alanine aminotransferase; *AST*, aspartate aminotransferase; *BUN*, blood urea nitrogen; *CBC*, complete blood count; *CMP*, comprehensive metabolic panel; *DMARD*, disease-modifying antirheumatic drug; *GI*, gastrointestinal; *IV*, intravenous; *LFT*, liver function test; *SIADH*, syndrome of inappropriate antidiuretic hormone; *s/p*, status post; *TB*, tuberculosis; *TNF*, tumor necrosis factor.

Data from McMillan JA, Feigin RD, DeAngelis CD, et al. *Oski's Pediatrics*, 4th ed. Philadelphia: Lippincott Williams & Wilkins; 2006.

B. Weight Management

1. Obesity and cushingoid fat distribution often result from chronic steroid use.
2. In addition to physical health consequences, this may also cause psychologic issues.

C. Bone and Skin Health

1. Patients with arthritis or on chronic steroids are at increased risk of osteopenia. Ensure adequate calcium and vitamin D intake and weight-bearing activities.
2. Patients with SLE and dermatomyositis are particularly vulnerable to ultraviolet radiation. They should not be exposed to the sun without wearing a broad-spectrum sunscreen with a high sun-protection factor (SPF) and should not use tanning booths.

D. Reproductive Health

1. Disease-modifying antirheumatic drugs (DMARDs) and biologics, especially methotrexate, are teratogenic.
2. Teenage patients should receive counseling on the use of contraception.

E. Other Aspects of Primary Care Coordination

1. Children with JIA have an increased risk of developing uveitis, which is often insidious and asymptomatic. Routine pediatric ophthalmologic screening is required.³⁷
 - a. The first ophthalmologic exam should occur within 1 month of diagnosis.
 - b. In active disease, exams should occur every 3 months regardless of ANA status.
 - c. In inactive disease, frequency varies based on ANA status, disease duration, and age of diagnosis.
2. Patients require supportive therapies in the form of physical therapy, occupational therapy, and input from rehabilitation specialists, psychologists, and social workers.

F. Laboratory Monitoring

See Table 27.4 for information on antiarthritic drug toxicity and recommended surveillance.

IV. WEB RESOURCES

American College of Rheumatology: <http://www.rheumatology.org/>

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A complete list of references can be found online at www.expertconsult.com.

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PART III

REFERENCE



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Chapter 28

Blood Chemistry and Body Fluids

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 See additional content on Expert Consult

Determining normal reference ranges of laboratory studies in pediatric patients poses some major challenges. Available literature is often limited due to small sample sizes of patients used to derive these suggested reference ranges.

The following values have been compiled from both published literature and the Johns Hopkins Hospital Department of Pathology. Reference range values vary with the analytic method used. Consult your laboratory for its analytic method and range of reference values, and for less commonly used parameters that are beyond the scope of this text. **Additional reference laboratory values may be found in Chapters 10 (Endocrinology), Chapter 14 (Hematology), and Chapter 15 (Immunology and Allergy).**

Special thanks to Lori Sokoll, PhD, and Stefani Thomas, PhD, for their guidance in preparing this chapter.

I. REFERENCE VALUES

(Table 28.1)

II. EVALUATION OF BODY FLUIDS

A. Evaluation of Cerebrospinal Fluid

(Table 28.2)

B. Evaluation of Urine

(Table 28.3)

C. Evaluation of Transudate / Exudate

(Table EC 28.A)

D. Evaluation of Synovial Fluid

(Table EC 28.B)

TABLE 28.1
REFERENCE VALUES

	Conventional Units	SI Units
ALANINE AMINOTRANSFERASE (ALT)^{a,1}		
0 to <1 year	5–33 U/L	5–33 U/L
1 to <13 years	9–25 U/L	9–25 U/L
13–19 years (male)	9–24 U/L	9–24 U/L
13 to <19 years (female)	8–22 U/L	8–22 U/L
ALBUMIN^{b,1}		
0–14 days	3.3–4.5 g/dL	33–45 g/L
15 days to <1 year	2.8–4.7 g/dL	28–47 g/L
1 to <8 years	3.8–4.7 g/dL	38–47 g/L
8 to <15 years	4.1–4.8 g/dL	41–48 g/L
15 to <19 years (male)	4.1–5.1 g/dL	41–51 g/L
15 to <19 years (female)	4.0–4.9 g/dL	40–49 g/L
ALKALINE PHOSPHATASE¹		
0–14 days	90–273 U/L	90–273 U/L
15 days to <1 year	134–518 U/L	134–518 U/L
1 to <10 years	156–369 U/L	156–369 U/L
10 to <13 years	141–460 U/L	141–460 U/L
13 to <15 years (male)	127–517 U/L	127–517 U/L
13 to <15 years (female)	62–280 U/L	62–280 U/L
15 to <17 years (male)	89–365 U/L	89–365 U/L
15 to <17 years (female)	54–128 U/L	54–128 U/L
17 to <19 years (male)	59–164 U/L	59–164 U/L
17 to <19 years (female)	48–95 U/L	48–95 U/L
AMMONIA⁵		
0–14 days	35.8–161.8 mCg/dL	21–95 mcmmol/L
15 days to 6 years	27.2–115.8 mCg/dL	16–68 mcmmol/L
>6 years	30.7–122.6 mCg/dL	18–72 mcmmol/L
AMYLASE¹		
0–14 days	3–10 U/L	3–10 U/L
15 days to <13 weeks	2–22 U/L	2–22 U/L
13 weeks to <1 year	3–50 U/L	3–50 U/L
1 year to <19 years	25–101 U/L	25–101 U/L
ANTISTREPTOLYSIN O TITER¹		
0 to <6 months	0 IU/mL	0 IU/mL
6 months to <1 year	0–30 IU/mL	0–30 IU/mL
1 to <6 years	0–104 IU/mL	0–104 IU/mL
6 to <19 years	0–331 IU/mL	0–331 IU/mL
ASPARTATE AMINOTRANSFERASE (AST)^{c,1}		
0–14 days	32–162 U/L	32–162 U/L
15 days to <1 year	20–67 U/L	20–67 U/L
1 to <7 years	21–44 U/L	21–44 U/L
7 to <12 years	18–36 U/L	18–36 U/L
12 to <19 years (male)	14–35 U/L	14–35 U/L
12 to <19 years (female)	13–26 U/L	13–26 U/L
BICARBONATE¹		
0–14 days	5–20 mEq/L	5–20 mmol/L
15 days to <1 year	10–24 mEq/L	10–24 mmol/L

TABLE 28.1—CONT'D

	Conventional Units	SI Units		
1 to <5 years	14–24 mEq/L	14–24 mmol/L		
5 to <15 years	17–26 mEq/L	17–26 mmol/L		
Male 15 to <19 years	18–28 mEq/L	18–28 mmol/L		
Female 15 to <19 years	17–26 mEq/L	17–26 mmol/L		
BILIRUBIN (TOTAL)¹				
See Chapter 18 for more complete information about neonatal hyperbilirubinemia.				
0–14 days	0.19–16.60 mg/dL	3.25–283.92 mcmol/L		
15 days to <1 year	0.05–0.68 mg/dL	0.86–11.63 mcmol/L		
1 to <9 years	0.05–0.40 mg/dL	0.86–6.84 mcmol/L		
9 to <12 years	0.05–0.55 mg/dL	0.86–9.41 mcmol/L		
12 to <15 years	0.10–0.70 mg/dL	1.71–11.97 mcmol/L		
15 to <19 years	0.10–0.84 mg/dL	1.71–14.37 mcmol/L		
BILIRUBIN (CONJUGATED)¹				
0–14 days	0.33–0.71 mg/dL	5.64–12.14 mcmol/L		
15 days to <1 year	0.05–0.30 mg/dL	0.86–5.13 mcmol/L		
1 to <9 years	0.05–0.20 mg/dL	0.86–3.42 mcmol/L		
9 to <13 years	0.05–0.29 mg/dL	0.86–4.96 mcmol/L		
13 to <19 years (female)	0.10–0.39 mg/dL	1.71–6.67 mcmol/L		
13 to <19 years (male)	0.11–0.42 mg/dL	1.88–7.18 mcmol/L		
BLOOD GAS, ARTERIAL (BREATHING ROOM AIR)⁶				
	pH	PaO ₂ (mmHg)	PaCO ₂ (mmHg)	HCO ₃ ⁻ (mEq/L)
Cord blood	7.28 ± 0.05	18.0 ± 6.2	49.2 ± 8.4	14–22
Newborn (birth)	7.11–7.36	8–24	27–40	13–22
5–10 min	7.09–7.30	33–75	27–40	13–22
30 min	7.21–7.38	31–85	27–40	13–22
60 min	7.26–7.49	55–80	27–40	13–22
1 day	7.29–7.45	54–95	27–40	13–22
Child/adult	7.35–7.45	83–108	32–48	20–28
NOTE: Venous blood gases can be used to assess acid-base status, not oxygenation. PvCO ₂ averages 6–8 mmHg higher than PaCO ₂ , and pH is slightly lower. Peripheral venous samples are strongly affected by the local circulatory and metabolic environment. Capillary blood gases correlate best with arterial pH and moderately well with PaCO ₂ .				
C-REACTIVE PROTEIN (HIGH SENSITIVITY)¹				
0–14 days	0.3–6.1 mg/L	0.3–6.1 mg/L		
15 days to <15 years	0.1–1.0 mg/L	0.1–1.0 mg/L		
15 to <19 years	0.1–1.7 mg/L	0.1–1.7 mg/L		
CALCIUM (IONIZED)⁷				
0–1 month	3.9–6.0 mg/dL	1.0–1.5 mmol/L		
1–6 months	3.7–5.9 mg/dL	0.95–1.5 mmol/L		
1–19 years	4.9–5.5 mg/dL	1.22–1.37 mmol/L		
CALCIUM (TOTAL)¹				
0 to <1 year	8.5–11.0 mg/dL	2.1–2.7 mmol/L		
1 year to <19 years	9.2–10.5 mg/dL	2.3–2.6 mmol/L		
CARBON MONOXIDE (CARBOXYHEMOGLOBIN)⁶				
Nonsmoker	0–2% of total hemoglobin			
Smoker	0–9% of total hemoglobin			

TABLE 28.1—CONT'D

	Conventional Units	SI Units
CHLORIDE (SERUM)⁸		
3–5 years	100–107 mEq/L	100–107 mmol/L
6–11 year	101–107 mEq/L	101–107 mmol/L
12–29 years (male)	101–106 mEq/L	101–106 mmol/L
12–29 years (female)	100–107 mEq/L	100–107 mmol/L
CHOLESTEROL		
(See LIPIDS, further on)		
COPPER⁹		
6 months to 2 years	72–178 mCg/dL	11.3–28.0 mcmol/L
3–4 years	80–160 mCg/dL	12.6–25.2 mcmol/L
5–6 years	76–167 mCg/dL	12.0–26.3 mcmol/L
7–8 years	79–147 mCg/dL	12.4–23.1 mcmol/L
9–10 years	84–154 mCg/dL	13.2–24.2 mcmol/L
11–12 years	73–149 mCg/dL	11.5–23.4 mcmol/L
13–14 years	66–137 mCg/dL	10.4–21.6 mcmol/L
15–16 years	60–132 mCg/dL	9.4–20.8 mcmol/L
17–18 years	59–146 mCg/dL	9.3–23.0 mcmol/L
CREATINE KINASE¹⁰		
6 months to 2 years (male)	50–292 U/L	50–292 U/L
6 months to 2 years (female)	38–260 U/L	38–260 U/L
3–5 years (male)	59–296 U/L	59–296 U/L
3–5 years (female)	42–227 U/L	42–227 U/L
6–8 years (male)	54–275 U/L	54–275 U/L
6–8 years (female)	50–231 U/L	50–231 U/L
9–11 years (male)	55–324 U/L	55–324 U/L
9–11 years (female)	52–256 U/L	52–256 U/L
12–14 years (male)	63–407 U/L	63–407 U/L
12–14 years (female)	45–257 U/L	45–257 U/L
15–17 years (male)	68–914 U/L	68–914 U/L
15–17 years (female)	45–458 U/L	45–458 U/L
CREATININE (SERUM) (ENZYMATIC)¹¹		
0–14 days	0.32–0.92 mg/dL	28.29–81.33 mcmol/L
15 days to <2 years	0.10–0.36 mg/dL	8.84–31.82 mcmol/L
2 to <5 years	0.20–0.43 mg/dL	17.68–38.01 mcmol/L
5 to <12 years	0.31–0.61 mg/dL	27.40–53.93 mcmol/L
12 to <15 years	0.45–0.81 mg/dL	39.78–71.61 mcmol/L
15 to <19 years (male)	0.62–1.08 mg/dL	54.81–95.47 mcmol/L
15 to <19 years (female)	0.49–0.84 mg/dL	43.32–74.26 mcmol/L
ERYTHROCYTE SEDIMENTATION RATE (ESR)⁶		
Child	0–10 mm/hr	
Adult male	0–15 mm/hr	
Adult female	0–20 mm/hr	
FERRITIN¹		
4 to <15 days	100–717 ng/mL	224–1611 pmol/L
15 days to <6 months	14–647 ng/mL	31–1454 pmol/L
6 months to <1 year	8–182 ng/mL	19–409 pmol/L

TABLE 28.1—CONT'D

	Conventional Units	SI Units
1 to <5 years	5–100 ng/mL	12–224 pmol/L
5 to <14 years	14–79 ng/mL	31–177 pmol/L
14 to <19 years (female)	6–67 ng/mL	12–152 pmol/L
14 to <16 years (male)	13–83 ng/mL	28–186 pmol/L
16 to <19 years (male)	11–172 ng/mL	25–386 pmol/L
FOLATE (RBC)⁵		
Deficient	≤3.9 ng/mL	≤8.7 nmol/L
Indeterminate	4.0–5.8 ng/mL	9.1–13.1 nmol/L
Normal	≥5.9 ng/mL	≥13.4 nmol/L
FOLATE (SERUM)⁵	≥366 ng/mL	≥831 nmol/L
GAMMA-GLUTAMYL TRANSFERASE (GGT)^{d,1}		
0–14 days	23–219 U/L	23–219 U/L
15 days to <1 year	8–127 U/L	8–127 U/L
1 to <11 years	6–16 U/L	6–16 U/L
11 to <19 years	7–21 U/L	7–21 U/L
GLUCOSE		
See Chapter 10.		
HAPTOGLOBIN¹		
0–14 days	0–10 mg/dL	0–0.10 g/L
15 days to <1 year	7–221 mg/dL	0.07–2.21 g/L
1 to <12 years	7–163 mg/dL	0.07–1.63 g/L
12 to <19 years	7–179 mg/dL	0.07–1.79 g/L
HEMOGLOBIN A1C		
See Chapter 10.		
HEMOGLOBIN F, % TOTAL HEMOGLOBIN⁵		
0–1 month	45.8–91.7	
2 months	32.7–85.2	
3 months	14.5–73.7	
4 months	4.2–56.9	
5 months	1.0–38.1	
6–8 months	0.9–19.4	
9–12 months	0.6–11.6	
13–23 months	0.0–8.5	
2 years and older	0.0–2.1	
IRON¹		
0 to <14 years	16–128 mCg/dL	2.8–22.9 mcmol/L
14–19 years (male)	31–168 mCg/dL	5.5–40.0 mcmol/L
14–19 years (female)	20–162 mCg/dL	3.5–29.0 mcmol/L
LACTATE⁷		
0–90 days	9–32 mg/dL	1.0–3.5 mmol/L
3–24 months	9–30 mg/dL	1.0–3.3 mmol/L
2–18 years	9–22 mg/dL	1.0–2.4 mmol/L
LACTATE DEHYDROGENASE¹		
0–14 days	309–1222 U/L	309–1222 U/L
15 days to <1 year	163–452 U/L	163–452 U/L
1 to <10 years	192–321 U/L	192–321 U/L

Continued

TABLE 28.1—CONT'D

	Conventional Units	SI Units	
10 to <15 years (male)	170–283 U/L	170–283 U/L	
10 to <15 years (female)	157–272 U/L	157–272 U/L	
15 to <19 years	130–250 U/L	130–250 U/L	
LEAD			
See Chapter 3.			
LIPASE¹			
0 to <19 years	4.0–39.0 U/L	4.0–39.0 U/L	
LIPIDS¹¹			
	Desirable	Borderline	High¹⁰
Total cholesterol	<170 mg/dL (4.4 mmol/L)	170–199 mg/dL (4.4–5.2 mmol/L)	≥200 mg/dL (5.2 mmol/L)
LDL	<110 mg/dL (2.8 mmol/L)	110–129 mg/dL (2.8–3.3 mmol/L)	≥130 mg/dL (3.4 mmol/L)
Non-HDL	<120 mg/dL (3.1 mmol/L)	120–144 mg/dL (3.1–3.7 mmol/L)	≥145 mg/dL (3.8 mmol/L)
HDL	>45 mg/dL (1.2 mmol/L)	40–45 mg/dL (1.0–1.2 mmol/L)	≤40 mg/dL (1.0 mmol/L)
Triglycerides (0–9 years)	<75 mg/dL (0.8 mmol/L)	75–99 mg/dL (0.8–1.1 mmol/L)	≥100 mg/dL (1.1 mmol/L)
Triglycerides (10–19 years)	<90 mg/dL (1.0 mmol/L)	90–129 mg/dL (1.0–1.5 mmol/L)	≥130 mg/dL (1.5 mmol/L)
MAGNESIUM¹			
0–14 days	1.99–3.94 mg/dL	0.82–1.62 mmol/L	
15 days to <1 year	1.97–3.09 mg/dL	0.81–1.27 mmol/L	
1 to <19 years	2.09–2.84 mg/dL	0.86–1.17 mmol/L	
OSMOLALITY⁵			
0–16 years	271–296 mOsm/kg	271–296 mmol/kg	
17 years and older	280–303 mOsm/kg	280–303 mmol/kg	
PHOSPHORUS¹			
0–14 days	5.6–10.5 mg/dL	1.8–3.4 mmol/L	
15 days to <1 year	4.8–8.4 mg/dL	1.5–2.7 mmol/L	
1 to <5 years	4.3–6.8 mg/dL	1.4–2.2 mmol/L	
5 to <13 years	4.1–5.9 mg/dL	1.3–1.9 mmol/L	
13 to <16 years (male)	3.5–6.2 mg/dL	1.1–2.0 mmol/L	
13 to <16 years (female)	3.2–5.5 mg/dL	1.0–1.8 mmol/L	
16 to <19 years	2.9–5.0 mg/dL	0.9–1.6 mmol/L	
PORCELAIN¹²			
Male	5.28–20.15 mg/dL	6.15–20.13 mmol/L	
Female	7.20–19.21 mg/dL	7.01–20.15 mmol/L	
POTASSIUM⁶			
Preterm	3.0–6.0 mEq/L	3.0–6.0 mmol/L	
Newborn	3.7–5.9 mEq/L	3.7–5.9 mmol/L	
Infant	4.1–5.3 mEq/L	4.1–5.3 mmol/L	

TABLE 28.1—CONT'D

	Conventional Units	SI Units
Child	3.4–4.7 mEq/L	3.4–4.7 mmol/L
Thereafter	3.5–5.1 mEq/L	3.5–5.1 mmol/L
PREALBUMIN¹		
0–14 days	2–12 mg/dL	0.02–0.12 g/L
15 days to <1 year	5–24 mg/dL	0.05–0.24 g/L
1 to <5 years	12–23 mg/dL	0.12–0.23 g/L
5 to <13 years	14–26 mg/dL	0.14–0.26 g/L
13 to <16 years	18–31 mg/dL	0.18–0.31 g/L
16 to <19 years (male)	20–35 mg/dL	0.20–0.35 g/L
16 to <19 years (female)	17–33 mg/dL	0.17–0.33 g/L
RHEUMATOID FACTOR¹		
0–14 days	9.0–17.1 IU/mL	9.0–17.1 IU/mL
15 days to <19 years	0–9.0 IU/mL	0–9.0 IU/mL
SODIUM⁸		
3–5 years	135–142 mEq/L	135–142 mmol/L
6–15 years	136–143 mEq/L	136–143 mmol/L
16–49 years (male)	137–143 mEq/L	137–143 mmol/L
16–49 years (female)	137–142 mEq/L	137–142 mmol/L
TOTAL IRON-BINDING CAPACITY (TIBC)⁵		
0–2 months	59–175 mCg/dL	11–31 μmol/L
3 months to 17 years	250–400 mCg/dL	45–72 μmol/L
18 years and older	240–450 mCg/dL	43–81 μmol/L
TOTAL PROTEIN¹		
0–14 days	5.3–8.3 g/dL	53–83 g/L
15 days to <1 year	4.4–7.1 g/dL	44–71 g/L
1 to <6 years	6.1–7.5 g/dL	61–75 g/L
6 to <9 years	6.4–7.7 g/dL	64–77 g/L
9 to <19 years	6.5–8.1 g/dL	65–81 g/L
TRANSFERRIN¹		
0 to <9 weeks	104–224 mg/dL	1.04–2.24 g/L
9 weeks <1 year	107–324 mg/dL	1.07–3.24 g/L
1 to <19 years	220–337 mg/dL	2.2–3.37 g/L
TRIGLYCERIDES		
(See LIPIDS, earlier)		
UREA NITROGEN¹		
0 to <14 days	2.8–23.0 mg/dL	1.0–8.2 mmol/L
15 days to <1 year	3.4–16.8 mg/dL	1.2–6.0 mmol/L
1 to <10 years	9.0–22.1 mg/dL	3.2–7.9 mmol/L
Male 10 to <19 years	7.3–21 mg/dL	2.6–7.5 mmol/L
Female 10 to <19 years	7.3–19 mg/dL	2.6–6.8 mmol/L
URIC ACID¹		
0–14 days	2.8–12.7 mg/dL	0.2–0.8 mmol/L
15 days to <1 year	1.6–6.3 mg/dL	0.1–0.4 mmol/L
1 to <12 years	1.8–4.9 mg/dL	0.1–0.3 mmol/L

Continued

TABLE 28.1—CONT'D

	Conventional Units	SI Units
Male 12 to <19 years	2.6–7.6 mg/dL	0.2–0.5 mmol/L
Female 12 to <19 years	2.6–5.9 mg/dL	0.2–0.4 mmol/L
VITAMIN A (RETINOL)¹		
0 to <1 year	8.0–53.6 mg/dL	0–2 mcg/L
1 to <11 years	27.5–44.4 mg/dL	1–2 mcg/L
11 to <16 years	24.9–55.0 mg/dL	1–2 mcg/L
16 to <19 years	28.7–75.1 mg/dL	1–3 mcg/L
VITAMIN B₁ (THIAMINE) RBC⁶		
	4.5–10.3 mCg/dL	106–242 nmol/L
VITAMIN B₂ (RIBOFLAVIN)⁶		
	4–24 mCg/dL	106–638 nmol/L
VITAMIN B₁₂ (COBALAMIN)¹		
5 days to <1 year	259–1576 pg/mL	191–1163 pmol/L
1 to <9 years	283–1613 pg/mL	209–1190 pmol/L
9 to <14 years	252–1125 pg/mL	186–830 pmol/L
14 to <17 years	244–888 pg/mL	180–655 pmol/L
17 to <19 years	203–811 pg/mL	150–599 pmol/L
VITAMIN C (ASCORBIC ACID)⁶		
	0.4–2.0 mg/dL	23–114 mcg/L
VITAMIN D (1,25-DIHYDROXY-VITAMIN D)¹³		
0 to <1 year	32.1–196.2 pg/mL	77–471 pmol/L
1 to <3 years	47.1–151.2 pg/mL	113–363 pmol/L
3 to <19 years	45.0–102.5 pg/mL	108–246 pmol/L
VITAMIN D (25-HYDROXY-VITAMIN D)^{14,15}		
Deficient	<12 ng/mL	<30 nmol/L
Insufficient	12–20 ng/mL	30–50 nmol/L
Sufficient ^f	≥20 ng/mL	≥50 nmol/L
Excess	>50–60 ng/mL	>125–150 nmol/L
VITAMIN E (α-TOCOPHEROL)¹		
0 to <1 year	0.2–2.1 mg/dL	5.0–50.0 mcg/L
1 to <19 years	0.6–1.4 mg/dL	14.5–33.0 mcg/L
ZINC⁹		
6 months to 2 years	56–125 mCg/dL	8.6–19.1 mcg/L
3–4 years	60–120 mCg/dL	9.2–18.4 mcg/L
5–6 years	64–117 mCg/dL	9.8–17.9 mcg/L
7–8 years	65–125 mCg/dL	9.9–19.1 mcg/L
9–10 years	66–125 mCg/dL	10.1–19.1 mcg/L
11–12 years	66–127 mCg/dL	10.1–19.4 mcg/L
13–14 years	69–124 mCg/dL	10.6–19.0 mcg/L
15–16 years	62–123 mCg/dL	9.5–18.8 mcg/L
17–18 years	62–133 mCg/dL	9.5–20.3 mcg/L

^aThese reference ranges are similar to data from the SAFETY study,² which examined 12- to 17-year-old NHANES participants and identified the 95th percentile of ALT in boys to be 25.8 U/L and in girls to be 22.1 U/L. In all age groups, similar yet slightly higher ALT cutoffs were published in Bussler et al.³ (LIFE Child cohort) and in Zierk et al.⁴

^bAssay with bromocresol green.

^cIn all age groups, similar, yet slightly higher AST cutoffs were published in Bussler et al.³ (LIFE Child cohort) and in Zierk et al.⁴

^dSimilar data can also be referenced for all age groups in Bussler et al.³ (LIFE Child cohort) and Zierk et al.⁴

^eIt is important to note that these values have not been validated to demonstrate increased risk of atherosclerosis or cardiovascular events.

^fControversy exists regarding optimal 25-hydroxyvitamin D level. Some experts recommend a level ≥30 ng/mL as sufficient.¹⁶

TABLE 28.2**EVALUATION OF CEREBROSPINAL FLUID**

WBC		
Age	Count/mcL (median)	95th Percentile
0–28 days ¹⁷	0–12 ^a (4)	16
29–60 days ¹⁷	0–8 ^a (2)	11
Child ¹⁸	0–7	
GLUCOSE		
Age	Median	5th Percentile
0–28 days ¹⁷	45 mg/dL	35 mg/dL
29–60 days ¹⁷	47 mg/dL	37 mg/dL
Conventional Units		SI Units
Infant, child ⁶	60–80 mg/dL	3.3–4.4 mmol/L
Adult ⁶	40–70 mg/dL	2.2–3.9 mmol/L
PROTEIN		
Age	Median	95th Percentile
0–28 days ¹⁷	66 mg/dL	118 mg/dL
29–60 days ¹⁷	49 mg/dL	91 mg/dL
Conventional Units		SI Units
6 months to 2 years ¹⁹	6–25 mg/dL	60–250 mg/L
2–6 years ¹⁹	5–25 mg/dL	50–250 mg/L
6–12 years ¹⁹	5–28 mg/dL	50–280 mg/L
12–18 years ¹⁹	6–34 mg/dL	60–340 mg/L
OPENING PRESSURE (LATERAL RECUMBENT POSITION^{18,20})		
Newborn	8–11 cm H ₂ O	
1–18 years	11.5–28 cm H ₂ O ^a	
Respiratory variations	0.5–1 cm H ₂ O	

^aUp to 90th percentile.

WBC, White blood cell

TABLE 28.3**EVALUATION OF URINE**

Urine Analyte	Normal Range
ALBUMIN^{18,21}	
Random	<30 mg urine albumin/g creatinine (on first morning urine)
24-hr collection	
4–16 years (male)	3.35–13.15 mg/1.73 m ² /day
4–16 years (female)	3.75–18.34 mg/1.73 m ² /day
CALCIUM²¹	
Random	
0–6 months	<0.8 mg/mg creatinine
7–12 months	<0.6 mg/mg creatinine
≥2 years	<0.21 mg/mg creatinine
24-hr collection	<4 mg/kg/day
CHLORIDE⁶	
Random	
Male	25–253 mEq/g creatinine
Female	39–348 mEq/g creatinine
24-hr collection	
Infant	2–10 mEq/day
Child <6 years	15–40 mEq/day
6–10 years (male)	36–110 mEq/day
6–10 years (female)	18–74 mEq/day
10–14 years (male)	64–176 mEq/day
10–14 years (female)	36–173 mEq/day
Adult	110–250 mEq/day
CREATININE⁶	
Random	
Male <40 years	24–392 mg/dL
Female <40 years	16–327 mg/dL
24-hr collection	
Infant	8–20 mg/kg/day
Child	8–22 mg/kg/day
Adolescent	8–30 mg/kg/day
Adult (male)	14–26 mg/kg/day
Adult (female)	11–20 mg/kg/day
POTASSIUM⁶	
Random	
Male	13–116 mEq/g creatinine
Female	8–129 mEq/g creatinine
24-hr collection	
6–10 years (male)	17–54 mEq/day
6–10 years (female)	8–37 mEq/day
10–14 years (male)	22–57 mEq/day
10–14 years (female)	18–58 mEq/day
Adult	25–125 mEq/day

TABLE 28.3—CONT'D**PROTEIN^{18,21}**

Random

6 months to 24 months	<0.5 mg protein/mg creatinine
>2 years	<0.2 mg protein/mg creatinine

24-hr collection

At rest	50–80 mg/day
After intense exercise	<250 mg/day

SODIUM⁶

Random

Male	23–229 mEq/g creatinine
Female	26–297 mEq/g creatinine

24-hr collection

Full-term, 7–14 days	~20% that of adults
6–10 years (male)	41–115 mEq/day
6–10 years (female)	20–69 mEq/day
10–14 years (male)	63–177 mEq/day
10–14 years (female)	48–168 mEq/day
Adult	40–220 mEq/day

UREA NITROGEN⁶

Random

Male	2,864–9,851 mg/g creatinine
Female	3,129–11,639 mg/g creatinine

24-hr collection

12–20 g/day

URINE OSMOLALITY⁶

Random

On average fluid intake	50–1,200 mOsm/kg H ₂ O, depending on fluid intake
After 12 hr fluid restriction	300–900 mOsm/kg H ₂ O

24-hr collection

>850 mOsm/kg H₂O~300–900 mOsm/kg H₂O

TABLE EC 28.A**EVALUATION OF TRANSUDATE VERSUS EXUDATE (PLEURAL, PERICARDIAL, OR PERITONEAL FLUID)**

Measurement ^a	Transudate	Exudate ^b
Protein (g/dL)	<3.0	>3.0
Fluid/serum protein ratio	<0.5	≥0.5
LDH (IU/L)	<200	≥200
Fluid/serum LDH ratio	<0.6	≥0.6
WBCs (mm^3) ^c	<10,000 (PMN)	>10,000 (PMN)
RBCs (mm^3)	<5,000	>5,000
Glucose (mg/dL)	>40	<40
pH ^d	>7.2	<7.2

^aAlways obtain serum for glucose, LDH, protein, amylase, etc. for comparison.

^bAll of the following criteria do not have to be met for consideration as an exudate.

^cIn peritoneal fluid, WBC count >800/mcL suggests peritonitis.

^dCollect anaerobically in a heparinized syringe.

Amylase >5000 U/mL or pleural fluid/serum ratio >1 suggests pancreatitis.

LDH, Lactate dehydrogenase; RBCs, red blood cells; WBCs, white blood cells

Data from Nichols DG, Ackerman AD, Carcillo JA, et al. *Rogers Textbook of Pediatric Intensive Care*. 4th ed. Baltimore: Williams & Wilkins; 2008.

TABLE EC 28.B
CHARACTERISTICS OF SYNOVIAL FLUID

Group	Condition	Synovial Complement	Color/Clarity	Viscosity	Mucin Clot	WBC Count	PMN (%)	Miscellaneous Findings
Noninflammatory	Normal	N	Yellow Clear	↑↑	G	<200	<25	
Traumatic arthritis	N	Xanthochromic Turbid	↑	F-G	<2,000	<25		
Osteoarthritis	N	Yellow Clear	↑	F-G	1,000	<25	Debris	
Inflammatory	Systemic lupus erythematosus Rheumatic fever	Yellow Cloudy	N	N	5,000	10	Lupus cells	
Juvenile rheumatoid arthritis	N-↓	Yellow Cloudy	↓	F	5,000	10-50		
Reactive arthritis	↑	Yellow Opaque	↓	Poor	15,000-20,000	75		
Pyogenic	Tuberculous arthritis	N-↑	Yellow-white Cloudy	Poor	20,000	80		
Septic arthritis	↑	Serosanguineous Turbid	↓	Poor	25,000	50-60	Acid-fast bacteria	
					50,000-300,000	>75	Low glucose, bacteria	

F, Fair; G, good; H, high; N, normal; PMN, polymorphonuclear leukocyte; WBC, white blood cell; ↓, decreased; ↑, increased.

From Cassidy J, Petty RE. *Textbook of Pediatric Rheumatology*. 5th ed. Philadelphia: WB Saunders; 2005.

III. CONVERSION FORMULAS

A. Temperature

1. To convert degrees Celsius to degrees Fahrenheit:

$$[(9/5) \times \text{Celsius}] + 32$$

2. To convert degrees Fahrenheit to degrees Celsius:

$$(\text{Fahrenheit} - 32) \times (5/9)$$

B. Length and Weight

1. **Length:** To convert inches to centimeters, multiply by 2.54
2. **Weight:** To convert pounds to kilograms, divide by 2.2

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A complete list of references can be found online at www.expertconsult.com.

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Chapter 29

Biostatistics and Evidence-Based Medicine

Matthew Molloy, MD, MPH

I. EVIDENCE-BASED MEDICINE

Evidence-based medicine refers to the method of integrating individual clinical expertise with the best available evidence from the literature. The following is a framework on how to formulate a clinical question and appraise the evidence¹:

A. Formulate the Clinical Question (PICO Process)

1. **P: Describe the patient or problem**, deciding whether the evidence you seek is regarding therapy, diagnosis, prognosis, etiology, or cost effectiveness.
2. **I: Describe the intervention** under consideration.
3. **C: Compare the intervention** with an alternative or current standard of care.
4. **O: Formulate a specific outcome** of interest.

B. Search for the Evidence to Answer the Question

1. **Define search terms** that fit the clinical question.
2. **Develop your search strategy** using primary search sources such as PubMed and secondary sources such as Cochrane.
3. **Review your results**, and apply methodological filters to target the right type of study.

C. Critically Appraise the Evidence

1. Therapy

- a. Were patient groups randomized for treatment?
- b. Were groups comparable and treated equally, aside from the allocated treatment?
- c. Were study subjects and investigators blinded?
- d. Were all patients entering the trial accounted for in the groups they were randomized to (intention to treat)?
- e. How large was the treatment effect?

2. Diagnosis

- a. Was the test compared with an independent reference standard?
- b. Was the test evaluated in an appropriate spectrum of patients?

3. Prognosis

- a. Were study patients defined early in their course and followed up over a sufficient time?
- b. How likely is it that the outcomes occur during a defined time period?
- c. How precise are the estimates of prognosis?

4. **Guidelines for judging causality between a variable and outcome²**
 - a. Is there a temporal relationship?
 - b. What is the strength of association?
 - c. Is there a dose-response relationship?
 - d. Were the findings replicated?
 - e. Are the findings biologically plausible?
 - f. What happens with cessation of exposure?
 - g. Is this explanation consistent with other knowledge?
5. **Bias:** Consider these types of bias that may influence results or distort statistical findings².
 - a. *Selection bias:* Caused by a nonrandom or dissimilar sample (between cases/controls or exposed/unexposed) from a population. Examples include sampling bias, loss to follow-up, and exclusion bias. Mitigated by randomization and selection of participants who are representative of the target population.
 - b. *Information bias:* Caused by flawed collection of information about exposures or outcomes. Examples include recall bias, observer bias, and lead-time bias. Mitigated by blinding researchers to subject status and standardizing data collection procedures.

D. Apply the Evidence to the Clinical Question

If the evidence is valid and important, integrate it with your clinical expertise and decide whether:

1. The patient will benefit from the therapy and be able to tolerate potential harms.
2. The test is available, affordable, accurate, and precise.

II. BIOSTATISTICS AND EPIDEMIOLOGY

A. Statistical Tests

The following statistical tests are used to determine whether observed differences are statistically significant ([Table 29.1](#)).³⁻⁵

1. *Parametric tests* are used when data follow a particular distribution (e.g., a normal distribution—a bell-shaped distribution where the median, mean, and mode are all equal). These tests are generally more powerful.
2. *Nonparametric tests* are used when a particular distribution cannot be assumed; they rank data rather than taking absolute differences into account.
3. *Unpaired tests* compare values from independent samples.
4. *Paired tests* are performed on paired data. For example, where the same parameter is measured on each patient before and after an intervention.
5. *Two-tailed tests* should be used when an intervention could potentially lead to either an increase or decrease of the outcome.
6. *One-tailed tests* should be used when an intervention can have only one plausible effect on the outcome.

TABLE 29.1**COMMONLY USED STATISTICAL TESTS**

Purpose of Test	Parametric Test	Nonparametric Test	Example
Compares two independent samples	Two-sample (unpaired) <i>t</i> test	Mann-Whitney <i>U</i> test	To compare girls' heights with boys' heights
Compares two sets of observations on a single sample	One-sample (paired) <i>t</i> test	Wilcoxon matched pairs test	To compare weight of infants before and after a feeding
Compares three or more sets of observations made on a single sample	One-way analysis of variance (<i>F</i> test) using total sum of squares	Kruskal-Wallis analysis of variance by ranks	To determine whether plasma glucose level is higher 1 hr, 2 hr, or 3 hr after a meal
As above, but tests the influence (and interaction) of two different variables	Two-way analysis of variance (ANOVA)	Two-way analysis of variance by ranks	In the above example, to determine whether the results differ in male and female subjects
Tests the null hypothesis that the distribution of a categorical variable is the same in two (or more) independent samples	χ^2 (chi square) test	Fisher exact test	To assess whether acceptance into medical school is more likely if the applicant was born in Britain
Assesses the strength of the straight-line association between two continuous variables	Product moment correlation coefficient (Pearson <i>r</i>)	Spearman rank correlation coefficient (r_s)	To assess whether and to what extent plasma HbA1C concentration is related to plasma triglyceride concentration in diabetic patients
Describes the numerical relation between two quantitative variables, allowing one value to be predicted from the other	Regression by least squares method	Nonparametric regression (various tests)	To see how peak expiratory flow rate varies with height
Describes the numerical relationship between a dependent variable and several predictor variables (covariates)	Multiple regression by least squares method	Nonparametric regression (various tests)	To determine whether and to what extent a person's age, body fat, and sodium intake determine his or her blood pressure

Adapted from Greenhalgh T. How to read a paper: Statistics for the non-statistician. I: Different types of data need different statistical tests. *BMJ*. 1997;315(7104):364–366.

B. Statistical Terminology

1. α (Alpha): Significance level of a statistical test^{3,6}

- α : Probability of making a **type I error**; the probability of rejecting the null hypothesis when the null hypothesis is true (i.e., a difference is seen by chance alone).

- b. α is typically set at less than 0.05 in medical research, which allows interpretation with 95% certainty that a detected association is true.
- c. The **P value** is the probability of obtaining the observed values if the null hypothesis is true. For example, if $P = 0.01$, there is a 1 in 100 chance of the values being from chance alone. The P value is judged against α , the preset level of significance. If P is less than the significance level α , the detected association is considered significant.

2. β (Beta): Power of a statistical test

- a. **β :** Probability of making a **type II error**; the probability of accepting the null hypothesis when the alternative hypothesis is true (i.e., no difference is seen even though there is one).

- b. **Power = 1 – β :** Probability of correctly rejecting the null hypothesis (i.e., finding a difference when there truly is one).

- c. **Power** is typically set at a minimum of 0.80, which allows interpretation with 80% certainty that a detected lack of association is true.

3. Sample size: The number of subjects required in a study to detect an effect with a predetermined power and α .

4. 95% confidence interval: Describes the values between which there is a 95% chance that the true population value falls. When confidence intervals for groups overlap, they have no statistically significant difference.

5. Confounder: A variable associated with both the disease and the exposure (risk factor), leading to detection of a false relationship between the disease and exposure if the confounder is not accounted for. Can be controlled for by adjustment, matching, blinding, and randomization.

6. Effect modifier (interaction): A variable that modifies the observed effect of an exposure on disease. For example, if a new drug is effective in female children but not male children, then sex is an effect modifier. Can be controlled by stratification.

C. Types of Study Designs⁷ (see Table 29.2)

D. Measurement of Disease Occurrence and Treatment Effects²:

See Table 29.3 for equations in this section.

1. Prevalence: Proportion of population who has a disease at a point in time. Obtained in cross-sectional studies.

$$\text{Prevalence} = \frac{\text{Number of total cases}}{\text{Population size}}$$

2. Incidence: Rate of people developing a disease in the population during a defined time period. Obtained in cohort studies and clinical trials.

$$\text{Incidence} = \frac{\text{Number of new cases}}{\text{Population size}} \text{ per unit of time}$$

TABLE 29.2**STUDY DESIGN COMPARISON^a**

Design Type	Cross-Sectional	Case-Control (Retrospective)	Cohort (Usually Prospective, Occasional Retrospective)	Clinical Trial (Experimental)	Meta-Analysis
Definition	In study population, concurrently measure outcome (disease) and risk factor	Define cases (with outcome of interest) and controls (without outcome)	In study population, define exposed group (with risk factor) and nonexposed group (without risk factor)	In study population, randomly assign subjects to receive intervention or receive no intervention	Combines data from multiple independent studies to maximize precision and power in testing for statistical significance
	Compare proportion of diseased group with risk factor to proportion of nondiseased group with risk factor	Compare proportion of cases with exposure (risk factor) to proportion of controls with exposure (risk factor)	Over time, compare proportion of exposed group with outcome (disease) to proportion of nonexposed group with outcome (disease)	Compare rate of outcomes between intervention and control groups	
Advantages	Defines prevalence Short time to complete Inexpensive	Good for rare diseases/outcomes Small sample size Shorter study times Less expensive Can study association of multiple exposures with outcome	Defines incidence Stronger evidence for causality Decreases biases (sampling, measurement, reporting) Can study association of exposure with multiple outcomes	Randomized controlled trial is gold standard Randomization reduces confounding Best evidence for causality	Higher statistical power Can control for inter-study variation
Disadvantages	Selection bias Weak evidence for causality	Highest potential for biases Weak evidence for causality Unable to determine prevalence, incidence	Expensive Long study times May not be feasible for rare diseases/ outcomes Factors related to exposure and outcome may falsely alter effect of exposure on outcome (confounding)	Expensive Risks of experimental treatments in humans Longer study time Not suitable for rare diseases/ outcomes	Publication bias

^aListed in order of strength of evidence, with cross-sectional studies generally providing the weakest evidence and meta-analyses the strongest.

Adapted from Hulley SB, Cummings SR, Browner WS, et al. Designing Clinical Research. 4th ed. Philadelphia: Lippincott Williams & Wilkins; 2013:84–207.

TABLE 29.3**GRID FOR CALCULATIONS IN CLINICAL STUDIES**

Exposure or Risk Factor or Treatment	Disease or Outcome	
	Positive	Negative
Positive	A	B
Negative	C	D

Also known as a contingency table.

3. **Relative risk (RR):** The ratio of incidence of disease among people with an exposure to incidence of disease among people without the exposure. Obtained in cohort studies and clinical trials; cannot be obtained in case-control studies.

$$RR = \frac{A}{(A+B)} / \frac{C}{(C+D)}$$

- a. RR = 1: No effect of exposure or treatment on outcome
 - b. RR <1: Exposure or treatment protective against outcome
 - c. RR >1: Exposure or treatment increases the outcome
 - d. The **relative risk reduction (RRR)**, which measures the strength of the impact of an exposure or treatment, is equal to $1 - RR$.
4. **Odds ratio (OR):** The ratio of the odds of an exposed person developing a disease to the odds of a nonexposed person developing the disease. Obtained in case-control studies, cohort studies, and clinical trials.

$$OR = \frac{A}{B} / \frac{C}{D} = \frac{A \times D}{B \times C}$$

- a. OR approximates RR when the disease is rare (incidence <0.10)
 - b. OR =1: No association between risk factor and disease
 - c. OR <1: Suggests that risk factor is protective against disease
 - d. OR >1: Suggests positive association between risk factor and disease
5. **Risk difference:** The difference between the risk of the outcome in control and the risk of the outcome in treatment group. If the risk of the outcome is decreased by the treatment, **absolute risk reduction (ARR)** is used. If the risk of the outcome is increased by the treatment, **absolute risk increase (ARI)** is used.

$$ARR = \frac{C}{(C+D)} - \frac{A}{(A+B)}$$

$$ARI = \frac{A}{(A+B)} - \frac{C}{(C+D)}$$

6. **Number needed to treat (NNT):** Number of patients who need to be treated to prevent one undesired outcome, expressed as the inverse of ARR.

$$NNT = \frac{1}{ARR}$$

TABLE 29.4**GRID FOR EVALUATING A CLINICAL TEST**

Test Result	Disease Status	
	Has Disease	Does Not Have Disease
Positive	TP (true positive)	FP (false positive)
Negative	FN (false negative)	TN (true negative)

7. **Number needed to harm (NNH):** Number of patients who need to be treated to cause one additional patient harm, expressed as the inverse of ARI.

$$\text{NNH} = \frac{1}{\text{ARI}}$$

E. Measurements of Test Performance²

See Table 29.4 for equations in this section.

1. **Validity:** The ability of a test to indicate which patients have or do not have disease. Intrinsic to the test—not affected by disease prevalence.

- a. **Sensitivity:** Proportion of all patients with disease who have a positive test. Measures the ability of the test to correctly identify those who have the disease. Use a highly sensitive test to help rule out a disease. Good for screening.

$$\text{Sensitivity} = \frac{\text{TP}}{\text{TP} + \text{FN}}$$

- b. **Specificity:** Proportion of all patients without disease who have a negative test. Measures the ability of the test to correctly identify those who do not have the disease. Use a highly specific test to help confirm a disease.

$$\text{Specificity} = \frac{\text{TN}}{\text{TN} + \text{FP}}$$

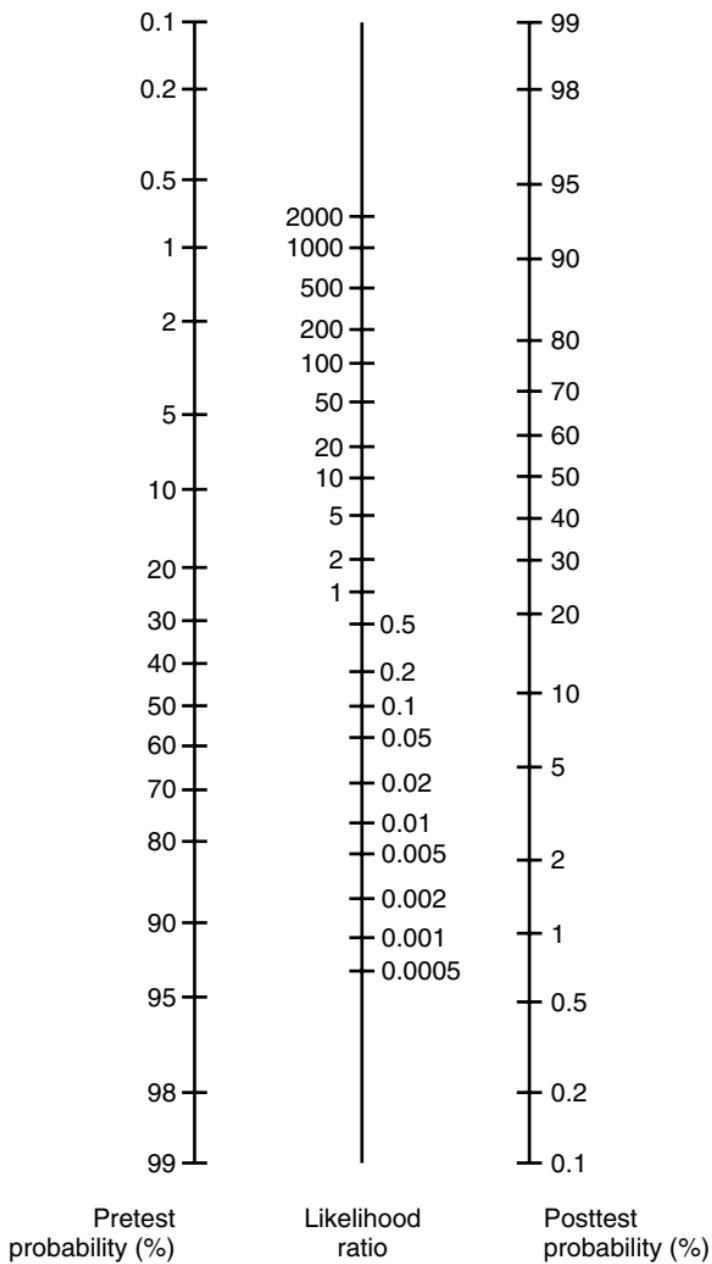
2. **Positive predictive value (PPV):** Proportion of those with positive tests who truly have disease. PPV is increased with higher disease prevalence.

$$\text{PPV} = \frac{\text{TP}}{\text{TP} + \text{FP}}$$

3. **Negative predictive value (NPV):** Proportion of those with negative tests who truly do not have disease. NPV is increased with lower disease prevalence.

$$\text{NPV} = \frac{\text{TN}}{\text{TN} + \text{FN}}$$

4. **Likelihood ratio (LR):** Incorporates the validity of a test (sensitivity and specificity) to determine the magnitude of the effect of a test result on changing the pretest probability. Used with Bayes nomogram (Fig. 29.1)

**FIGURE 29.1**

Bayes nomogram: Draw a line connecting the baseline probability (pretest probability) with the value for the likelihood ratio for the test used. Extend this line to the right to find the posttest probability. (Adapted from Fagan TJ. Nomogram for Bayes Theorem. *N Engl J Med*. 1975;293(5):257.)

to estimate posttest probability of a disease based on a given test result. Tests that provide the greatest impetus to changing clinical management are those with an LR ≥ 10 (or LR ≤ 0.1 for negative tests). LR is unaffected by disease prevalence.

$$\text{LR for positive test} = \frac{\text{Sensitivity}}{1 - \text{Specificity}}$$

$$\text{LR for negative test} = \frac{1 - \text{Sensitivity}}{\text{Specificity}}$$

III. WEB RESOURCES

A. Evidence-Based Resources

- Agency for Healthcare Research and Quality: www.ahrq.gov/research/findings/evidence-based-reports/index.html
- Centre for Evidence Based Medicine: www.cebm.net
- Cochrane Reviews: www.cochranelibrary.com
- JAMA evidence: www.jamaevidence.com
- PubMed: www.ncbi.nlm.nih.gov/pubmed
- U.S. Preventive Services Task Force: www.uspreventiveservicestaskforce.org/BrowseRec/Index

B. Biostatistics and Epidemiology Resources

- BMJ Statistics at Square One: www.bmjjournals.com/collections/statsbk/index.dtl
- Centers for Disease Control and Prevention Epi Info: www.cdc.gov/epiinfo/

REFERENCES

A complete list of references can be found online at www.expertconsult.com.

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Chapter 30

Drug Dosages

Carlton K.K. Lee, PharmD, MPH

I. NOTE TO READER

The author has made every attempt to check dosages and medical content for accuracy. Because of the incomplete data on pediatric dosing, many drug dosages will be modified after the publication of this text. We recommend that the readers check product information and published literature for changes in dosing, especially for newer medicines. The US Food and Drug Administration (FDA) provides the following pediatric drug information data sources:

- New Pediatric Labeling Information: www.fda.gov/NewPedLabeling
- Drug Safety Report Updates: www.fda.gov/PedDrugSafety
- Pediatric Study Characteristics Database: www.fda.gov/PedStudies
Ongoing and completed clinical research study information of pediatric medicines in development is located in www.Clinicaltrials.gov.

To prevent prescribing errors, the use of abbreviations has been greatly discouraged. The following is a list of abbreviations that The Joint Commission considers prohibited for use.

THE JOINT COMMISSION**Official “Do Not Use” List^a**

Do Not Use	Potential Problem	Use Instead
U (unit)	Mistaken for “0” (zero), the number “4” (four) or “cc”	Write “unit”
IU (International Unit)	Mistaken for IV (intravenous) or the number 10 (ten)	Write “International Unit”
Q.D., QD, q.d., qd (daily) Q.O.D., QOD, q.o.d., qod (every other day)	Mistaken for each other Period after the Q mistaken for “I” and the “O” mistaken for “I”	Write “daily” Write “every other day”
Trailing zero (X.0 mg) ^b Lack of leading zero (.X mg)	Decimal point is missed	Write X mg Write 0.X mg
MS	Can mean morphine sulfate or magnesium sulfate	Write “morphine sulfate” Write “magnesium sulfate”
MSO ₄ and MgSO ₄	Confused for one another	

^aApplies to all orders and all medication-related documentation that is handwritten (including free-text computer entry) or on preprinted forms.

^bException: A “trailing zero” may be used only where required to demonstrate the level of precision of the value being reported, such as for laboratory results, imaging studies that report size of lesions, or catheter/tube sizes. It may not be used in medication orders or other medication-related documentation.

Additional Abbreviations, Acronyms, and Symbols (For possible future inclusion in the Official “Do Not Use” List)

Do Not Use	Potential Problem	Use Instead
> (greater than) < (less than)	Misinterpreted as the number “7” (seven) or the letter “L” Confused for one another	Write “greater than” Write “less than”
Abbreviations for drug names	Misinterpreted due to similar abbreviations for multiple drugs	Write drug names in full
Apothecary units	Unfamiliar to many practitioners Confused with metric units	Use metric units
@	Mistaken for the number “2” (two)	Write “at”
cc	Mistaken for U (units) when poorly written	Write “mL” or “ml” or “milliliters” (“mL” is preferred)
µg	Mistaken for mg (milligrams), resulting in one thousand-fold overdose	Write “mCg” or “micrograms”

II. SAMPLE ENTRY

Pharmacogenomics: Indicates need for assessing patient genotype or genetic polymorphism affecting dosing, drug selection, or anticipated pharmacological effects.

Liver: Indicates need for caution or need for dose adjustment in hepatic impairment.

Kidney: Indicates need for caution or need for dose adjustment in renal impairment (see also Chapter 31).

Breast: Refer to explanation of breast-feeding categories (see p. 668).

Pregnancy: Refer to explanation of pregnancy categories (see p. 668).

How Supplied

ALLOPURINOL	Generic name					
Zyloprim, Alopurinol, and generics	Trade name and other names	C	2	Yes	Yes	Yes
<i>Uric acid-lowering agent, xanthine oxidase inhibitor</i>	Drug category					

Tabs: 100, 300 mg

Oral suspension: 20 mg/mL



Mortar and pestle: Indicates need for extemporaneous compounding by a pharmacist

Injection (Alopurinol and generics): 500 mg

Contains ~ 1.45 mEq Na/500 mg drug

For use in tumor lysis syndrome, see Chapter 22 for additional information.

**Child:**

Oral: 10 mg/kg/24 hr PO ÷ BID–QID; **max. dose:** 800 mg/24 hr

Injectable: 200 mg/m²/24 hr IV ÷ Q6–12 hr; **max. dose:** 600 mg/24 hr

Adult:

Oral: 200–800 mg/24 hr PO ÷ BID–TID

Injectable: 200–400 mg/m²/24 hr IV ÷ Q6–12 hr; **max. dose:** 600 mg/24 hr

Drug dosing

Discontinue use at the first appearance of skin rash or other signs of an allergic reaction. Avoid use in individuals with HLA-B*58:01 allele as they are at significant risk for developing severe cutaneous adverse reactions (e.g., Stevens Johnson Syndrome and TEN). Side effects include rash, neuritis, hepatotoxicity, GI disturbance, bone marrow suppression, and drowsiness. **Adjust dose in renal insufficiency (see Chapter 31).** Must maintain adequate urine output and alkaline urine.

Drug interactions: increases serum theophylline level; may increase the incidence of rash with ampicillin and amoxicillin; increased risk of toxicity with azathioprine, didanosine and mercaptopurine; and increased risk of hypersensitivity reactions with ACE inhibitors and thiazide diuretics. Use with didanosine is **contraindicated** due to increased risk for didanosine toxicity. Rhabdomyolysis has been reported with clarithromycin use. IV dosage form is very alkaline and must be **diluted to a minimum concentration** of 6 mg/mL and infused over 30 min.

Brief remarks about side effects, drug interactions, precautions, therapeutic monitoring, and other relevant information

III. EXPLANATION OF BREASTFEEDING CATEGORIES

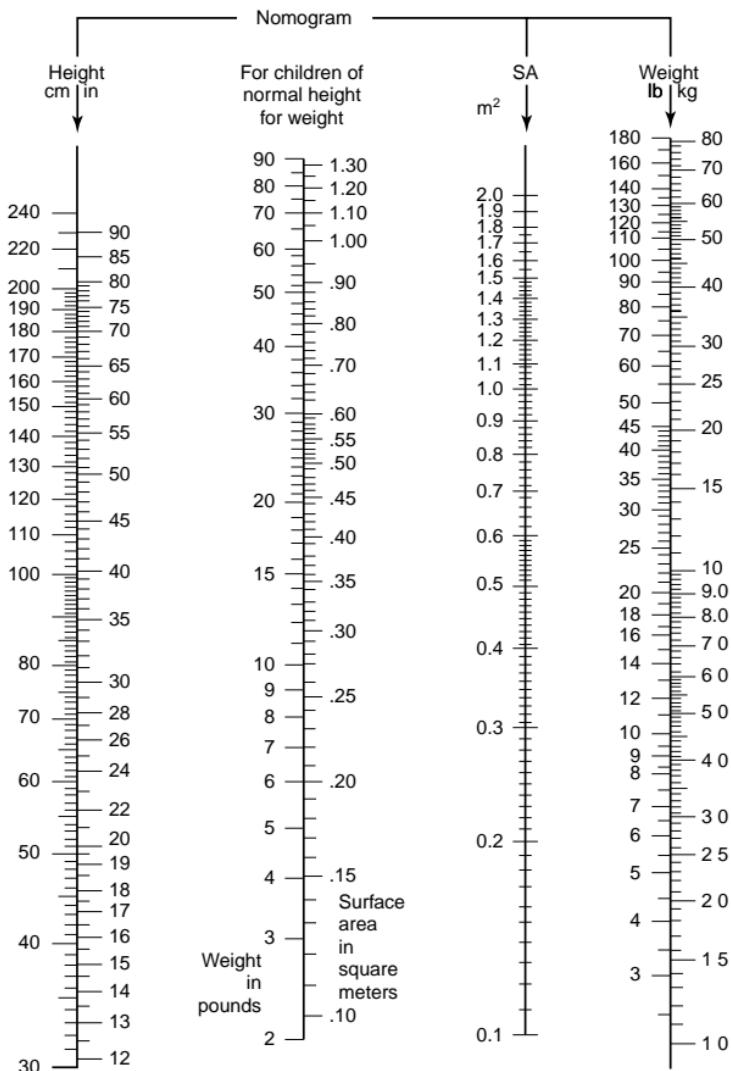
See sample entry on page previous page.

- 1** Compatible
- 2** Use with caution
- 3** Unknown with concerns
- X** Contraindicated
- ?** Safety not established

IV. EXPLANATION OF PREGNANCY CATEGORIES

- A** Adequate studies in pregnant women have not demonstrated a risk to the fetus in the first trimester of pregnancy, and there is no evidence of risk in later trimesters.
- B** Animal studies have not demonstrated a risk to the fetus, but there are no adequate studies in pregnant women; or animal studies have shown an adverse effect, but adequate studies in pregnant women have not demonstrated a risk to the fetus during the first trimester of pregnancy, and there is no evidence of risk in later trimesters.
- C** Animal studies have shown an adverse effect on the fetus, but there are no adequate studies in humans; or there are no animal reproduction studies and no adequate studies in humans.
- D** There is evidence of human fetal risk, but the potential benefits from the use of the drug in pregnant women may be acceptable despite its potential risks.
- X** Studies in animals or humans demonstrate fetal abnormalities or adverse reaction; reports indicate evidence of fetal risk. The risk of use in pregnant women clearly outweighs any possible benefit.

V. NOMOGRAM AND EQUATION FOR BODY SURFACE AREA

**FIG. 30.1**

Nomogram and equation for body surface area. (From Kliegman RM, Stanton BF, Schor NF, et al., eds. *Nelson Textbook of Pediatrics*. 20th ed. Philadelphia, PA: Elsevier; 2016.)

VI. DRUG INDEX

Trade Names	Generic Name
1,25-dihydroxycholecalciferol	Calcitriol
2-PAM ^a	Pralidoxime Chloride
3TC ^a	Lamivudine
5-aminosalicylic acid	Mesalamine
5-ASA	Mesalamine
5-FC ^a	Flucytosine
5-Fluorocytosine ^a	Flucytosine
8-Arginine Vasopressin ^a	Vasopressin
9-Fluorohydrocortisone ^a	Fludrocortisone Acetate
27% Elemental Ca	Calcium Chloride
A-200	Pyrethrins
Abelcet	Amphotericin B Lipid Complex
Absorica	Isotretinoin
Abstra	Fentanyl
Accolate	Zafirlukast
AccuNeb (prediluted nebulized solution)	Albuterol
Accutane	Isotretinoin
Acetadote	Acetylcysteine
Acticin	Permethrin
Actigall	Ursodiol
Actiq	Fentanyl
Activase	Alteplase
Acular, Acular LS	Ketorolac
Acuvail	Ketorolac
Aczone	Dapsone
Adalat CC	Nifedipine
Adderall, Adderall XR	Dextroamphetamine + Amphetamine
Adenocard	Adenosine
Adoxa	Doxycycline
Adrenaline	Epinephrine HCl
Advair Diskus, Advair HFA	Fluticasone Propionate and Salmeterol
Advil, Children's Advil	Ibuprofen
Aerospan	Flunisolide
Afrin	Oxymetazoline
AK-Poly-Bac Ophthalmic	Bacitracin + Polymyxin B
AK-Spore H.C. Otic	Polymyxin B Sulfate, Neomycin Sulfate, Hydrocortisone
AK-Sulf	Sulfacetamide Sodium Ophthalmic
AKTob	Tobramycin
AK-Tracin Ophthalmic	Bacitracin
Albuminar	Albumin, Human
Albutein	Albumin, Human
Aldactone	Spironolactone
Aleve [OTC]	Naproxen/Naproxen Sodium
Allegra, Allegra ODT	Fexofenadine
Allegra-D 12 Hour, Allegra-D 24 Hour	Fexofenadine + Pseudoephedrine
Allergen Ear Drops	Antipyrine and Benzocaine

Trade Names	Generic Name
Allopurin	Allopurinol
Almacone, Almacone II Double Strength	Aluminum Hydroxide with Magnesium Hydroxide
Alsuma	Sumatriptan Succinate
AlternaGEL	Aluminum Hydroxide
Alu-Cap	Aluminum Hydroxide
Alvesco	Ciclesonide
AmBisome	Amphotericin B, Liposomal
Amicar	Aminocaproic Acid
Amikin	Amikacin Sulfate
Amnesteem	Isotretinoin
Amoclan	Amoxicillin-Clavulanic Acid
Amoxil	Amoxicillin
Amphadase	Hyaluronidase
Amphocin	Amphotericin B
Amphojel	Aluminum Hydroxide
Anacin	Aspirin
Anaprox	Naproxen/Naproxen Sodium
Ancef	Cefazolin
Ancobon	Flucytosine
Anectine	Succinylcholine
Antilirium	Physostigmine Salicylate
Antipyrine and Benzocaine Otic	Antipyrine and Benzocaine
Antizol	Fomepizole
Anzemet	Dolasetron
Apresoline	Hydralazine Hydrochloride
Apriso	Mesalamine
Aquachloral Supp rettes	Chloral Hydrate
Aquasol A	Vitamin A
Aquasol E	Vitamin E
Aquavit-E	Vitamin E
Aralen	Chloroquine HCl/Phosphate
Aranesp	Darbepoetin Alfa
Arbinoxia	Carbinoxamine
Arestin	Minocycline
Aridol	Mannitol
Aristospan	Triamcinolone
ASA ^a	Aspirin
Asacol, Asacol HD	Mesalamine
Asmanex Twisthaler	Mometasone Furoate
Asprin Free Anacin	Acetaminophen
Astelin	Azelastine
Astepro	Azelastine
Astragraf XL	Tacrolimus
Ativan	Lorazepam
AtroPen	Atropine Sulfate
Atrovent	Ipratropium Bromide
Augmentin, Augmentin ES-600, Augmentin XR	Amoxicillin-Clavulanic Acid
Auralgan (available in Canada)	Antipyrine and Benzocaine
Auro Ear Drops	Carbamide Peroxide
Avinza	Morphine Sulfate

Trade Names	Generic Name
Avita	Tretinoin
Ayr Saline	Sodium Chloride—Inhaled Preparations
Azactam	Aztreonam
Azasan	Azathioprine
Azasite	Azithromycin
Azo-Standard [OTC]	Phenazopyridine HCl
Azulfidine, Azulfidine EN-Tabs	Sulfasalazine
Baciguent Topical	Bacitracin
Bactrim	Sulfamethoxazole and Trimethoprim
Bactroban, Bactroban Nasal	Mupirocin
BAL ^a	Dimercaprol
Beconase AQ	Betamethasone Dipropionate
Benadryl	Diphenhydramine
Benzac AC Wash 2½, 5, 10; Benzac 5, 10	Benzoyl Peroxide
Beta-Val	Betamethasone
Bethkis	Tobramycin
Biaxin, Biaxin XL	Clarithromycin
Bicillin C-R, Bicillin C-R 900/300	Penicillin G Preparations—Penicillin G Benzathine and Penicillin G Procaine
Bicillin L-A	Penicillin G Preparations—Benzathine
Bio-Statin	Nystatin
Bioxiverz	Neostigmine
Bleph 10	Sulfacetamide Sodium Ophthalmic
Brevibloc	Esmolol HCl
Brevoxyl Creamy Wash	Benzoyl Peroxide
Brisdelle	Paroxetine
British anti-Lewisite	Dimercaprol
Bufferin	Aspirin
Bumex	Bumetanide
Buminate	Albumin, Human
Cafcit	Caffeine Citrate
Cafergot	Ergotamine Tartrate + Caffeine
Calcidol	Ergocalciferol
Caldolor	Ibuprofen
Calan, Calan SR	Verapamil
Calciferol	Ergocalciferol
Calcijex	Calcitriol
Calcionate	Calcium Glubionate
Calciquid	Calcium Glubionate
Cal-Citrate	Calcium Citrate
Calcium disodium versenate	Edetate (EDTA) Calcium Disodium
Cal-Glu	Calcium Gluconate
Cal-Lac	Calcium Lactate
Calphron	Calcium Acetate
Camphorated opium tincture	Paregoric
Canasa	Mesalamine
Cancidas	Caspofungin
Cankaid	Carbamide Peroxide
Capoten	Captopril

Trade Names	Generic Name
Carafate	Sucralfate
Carbatrol	Carbamazepine
Cardene, Cardene SR	Nicardipine
Cardizem, Cardizem SR, Cardizem CD, Cardizem LA	Diltiazem
Carnitor	Carnitine
Catapres, Catapres TTS	Clonidine
Cathflo Activase	Alteplase
Caysten	Aztreonam
Ceclor, Ceclor CD	Cefaclor
Cecon	Ascorbic Acid
Cedax	Ceftibuten
Cefotan	Cefotetan
Ceftin	Cefuroxime Axetil
Cefzil	Cefprozil
Celestone	Betamethasone
CellCept	Mycophenolate Mofetil
Cephulac	Lactulose
Ceptaz	Ceftazidime
Cerebyx	Fosphenytoin
Chemet	Succimer
Chloromycetin	Chloramphenicol
Chlor-Trimeton	Chlorpheniramine Maleate
Cholestyramine Light	Cholestyramine
Chronulac	Lactulose
Ciloxan ophthalmic	Ciprofloxacin
Cipro, Cipro XR, Ciprodex, Cipro HC Otic	Ciprofloxacin
CitraceI	Calcium Citrate
Claforan	Cefotaxime
Claravis	Isotretinoin
Claritin, Claritin Children's Allergy, Claritin RediTabs	Loratadine
Claritin-D 12 Hour, Claritin-D 24 Hour	Loratadine + Pseudoephedrine
Cleocin-T, Cleocin	Clindamycin
Cogentin	Benztropine Mesylate
Colace	Docusate
Colocort	Hydrocortisone
CoLyte	Polyethylene Glycol—Electrolyte Solution
Compazine	Prochlorperazine
Concerta	Methylphenidate HCl
Copegus	Ribavirin
Cordarone	Amiodarone HCl
Cordron-D NR, Cordon-D	Carboxinamine + Pseudoephedrine
Coreg, Coreg CR	Carvedilol
Cortef	Hydrocortisone
Cortenema	Hydrocortisone
Cortifoam	Hydrocortisone
Cortisporin Otic	Polymyxin B Sulfate, Neomycin Sulfate, Hydrocortisone
Co-Trimoxazole	Sulfamethoxazole and Trimethoprim

Trade Names	Generic Name
Coumadin	Warfarin
Covera-HS	Verapamil
Cozaar	Losartan
Crolom	Cromolyn
Cruex	Clotrimazole
Cuprimine	Penicillamine
Curosurf	Surfactant, Pulmonary/Poractant Alfa
Cutivate	Fluticasone Propionate
Cuvposa	Glycopyrrolate
Cyanoject	Cyanocobalamin/Vitamin B ₁₂
Cyclogyl	Cyclopentolate
Cyclomydril	Cyclopentolate with Phenylephrine
Cyomin	Cyanocobalamin/Vitamin B ₁₂
Cytovene	Ganciclovir
D-3, D3-5, D3-50	Cholecalciferol
Dantrium	Dantrolene
Daraprim	Pyrimethamine
Daytrana	Methylphenidate HCl
DDAVP ^a	Desmopressin Acetate
DDS ^a	Dapsone
D Drops	Cholecalciferol
Debrox	Carbamide Peroxide
Decadron	Dexamethasone
Deltasone	Prednisone
Delzicol	Mesalamine
Deodorized tincture of opium	Opium Tincture
Depacon	Valproic Acid
Depakene	Valproic Acid
Depakote, Depakote ER	Divalproex Sodium
Depen	Penicillamine
Depo-Medrol	Methylprednisolone
Depo-Provera	Medroxyprogesterone
Depo-Sub Q Provera 104	Medroxyprogesterone
Desquam-E 5, Desquam-E 10	Benzoyl Peroxide
Desyrel (previously available as)	Trazodone
Dexedrine Spansules	Dextroamphetamine
DexFerrum	Iron—Injectable Preparations (iron dextran)
Dexpak Taperpak	Dexamethasone
DextroStat	Dextroamphetamine ± Amphetamine
Di-5-ASA ^a	Olsalazine
Dialume	Aluminum Hydroxide
Diaminodiphenylsulfone	Dapsone
Diamox	Acetazolamide
Diastat, Diastat AcuDial	Diazepam
Diflucan and others	Fluconazole
Digibind, DigiFab	Digoxin Immune Fab (Ovine)
Digitek	Digoxin
Dilacor XR	Diltiazem
Dilantin, Dilantin Infatab	Phenytoin
Dilauidid, Dilaudid-HP	Hydromorphone HCl

Trade Names	Generic Name
Di-mesalazine	Olsalazine
Dimetapp Children's Cold and Allergy	Brompheniramine with Phenylephrine
Diovan	Valsartan
Dipentum	Olsalazine
Diprolene, Diprolene AF	Betamethasone
Diprosone	Betamethasone
DisperMox	Amoxicillin
Ditropan, Ditropan XL	Oxybutynin Chloride
Diuril	Chlorothiazide
DMSA [dimercaptosuccinic acid] ^a	Succimer
Dobutrex (previously available as)	Dobutamine
Dolophine	Methadone HCl
Dopram	Doxapram HCl
Doryx	Doxycycline
Doxidan	Bisacodyl
Dramamine, Children's Dramamine	Dimenhydrinate
Drisdol	Ergocalciferol
Dulcolax	Bisacodyl
Dulera	Mometasone Furoate + Formoterol Fumarate
Duraclon	Clonidine
Duragesic	Fentanyl
Duramist 12-Hr Nasal	Oxymetazoline
Duricef	Cefadroxil
Dycill	Dicloxacillin Sodium
Dynacin	Minoxycline
Dyrenium	Triamterene
EC-Naprosyn	Naproxen
Efidac/24-Pseudoephedrine	Pseudoephedrine
Elavil	Amitriptyline
Elidel	Pimecrolimus
Elimite	Permethrin
Eliphos	Calcium Acetate
Elitek	Rasburicase
Elixophyllin	Theophylline
Elocon	Mometasone Furoate
Emfamil D-Vi-Sol	Cholecalciferol
EMLA, Eutectic mixture of lidocaine and prilocaine	Lidocaine and Prilocaine
E-Mycin	Erythromycin Preparations
Enbrel	Etanercept
Endocet	Oxycodone and Acetaminophen
Endodan	Oxycodone and Aspirin
Enemeez	Docusate
Enlon	Edrophonium Chloride
Entocort EC	Budesonide
Enulose	Lactulose
Epaned	Enalapril Maleate
EpiPen	Epinephrine HCl
Epitol	Carbamazepine
Epiriv, Epiriv-HBV	Lamivudine

Trade Names	Generic Name
Epogen	Epoetin Alfa
Epsom salts	Magnesium Sulfate
Ergomar	Ergotamine Tartrate
Ery-Ped	Erythromycin
Erythrocin, Pediamycin, E-Mycin, Ery-Ped	Erythromycin
Erythropoietin	Epoetin Alfa
Eryzole	Erythromycin Ethylsuccinate and Acetylsulfisoxazole
Exalgo	Hydromorphone HCl
Extina	Ketoconazole
Famvir	Famciclovir
Fansidar	Pyrimethamine + Sulfadoxine
Felbatol	Felbamate
Fentora	Fentanyl
Feosol	Iron—Oral Preparations (Ferrous sulfate)
Fergon	Iron—Oral Preparations (Ferrous sulfate)
Fer-In-Sol	Iron—Oral Preparations (Ferrous gluconate)
Ferrlecit	Iron—Injectable Preparations (Ferric gluconate)
Feverall	Acetaminophen
Fiberall	Psyllium
First-Lansoprazole	Lansoprazole
First-Omeprazole	Omeprazole
FK506	Tacrolimus
Flagyl, Flagyl ER	Metronidazole
Flebogamma DIF	Immune Globulin
Fleet Babylax	Glycerin
Fleet Laxative, Fleet Bisacodyl	Bisacodyl
Fleet Mineral Oil	Mineral Oil
Fleet, Fleet Phospho-Soda	Sodium Phosphate
Fletcher's Castoria	Senna/Sennosides
Flonase HFA	Fluticasone Propionate
Florinef Acetate	Fludrocortisone Acetate
Flovent Diskus	Fluticasone Propionate
Floxin, Floxin Otic	Ofloxacin
Flumadine	Rimantadine
Fluohydristone	Fludrocortisone Acetate
Fluoritab	Fluoride
Focalin, Focalin XR	Dexmethylphenidate
Folvite	Folic Acid
Foradil Aerolizer	Formoterol
Fortamet	Metformin
Fortaz	Ceftazidime
Fortical Nasal Spray	Calcitonin—Salmon
Foscavir	Foscarnet
Fulvicin U/F, Fulvicin P/G	Griseofulvin
Fungizone	Amphotericin B
Furadantin	Nitrofurantoin
Gabitril	Tiagabine
Gablofen	Baclofen

Trade Names	Generic Name
Galzin	Zinc Salts, Systemic
Gamaplex	Immune Globulin
Gamma benzene hexachloride ^a	Lindane
Gammaked	Immune Globulin
Garamycin	Gentamicin
Gastrocrom	Cromolyn
Gas-X	Simethicone
Gengraf	Cyclosporine Modified
GlucaGen, Glucagon Emergency Kit	Glucagon HCl
Glucophage, Glucophage XR	Metformin
Gly-Oxide	Carbamide Peroxide
Glycate	Glycopyrrolate
GoLYTELY	Polyethylene Glycol—Electrolyte Solution
Gralise	Gabapentin
Granisol	Granisetron
Grifulvin V	Griseofulvin
Grisactin	Griseofulvin
Gris-PEG	Griseofulvin
Gyne-Lotrimin 3, Gyne-Lotrimin	Clotrimazole
H.P. Acthar Gel	Corticotropin
Haldol, Haldol Decanoate 50, Haldol Decanoate 100	Haloperidol
Hecoria	Tacrolimus
Hexadrol	Dexamethasone
Horizant	Gabapentin
Humatin	Paromomycin Sulfate
Hydro-Tussin CBX	Carbinoxamine + Pseudoephedrine
Hylenex	Hyaluronidase
Hypersal	Sodium Chloride—Inhaled Preparations
Imitrex	Sumatriptan Succinate
Imodium, Imodium AD	Loperamide
Imuran	Azathioprine
Inapsine	Droperidol
Inderal, Inderal LA	Propranolol
Indocin, Indocin SR, Indocin IV	Indometacin
Infasurf	Surfactant, Pulmonary/Calfactant
INFeD	Iron—Injectable Preparations (iron dextran)
INH ^a	Isoniazid
Intal (previously available as)	Cromolyn
Intropin (previously available as)	Dopamine
Intuniv	Guanfacine
Invanz	Ertapenem
Iosat	Potassium Iodide
Iquix	Levofloxacin
IsonaRif	Isoniazid
Isoptin SR	Verapamil
Isopto Carpine	Pilocarpine HCl
Isopto Hyoscine	Scopolamine Hydrobromide
Isuprel	Isoproterenol
Jantoven	Warfarin

Trade Names	Generic Name
Kadian	Morphine Sulfate
Kantrex	Kanamycin
Kaopectate	Bismuth Subsalicylate
Kao-Tin	Bismuth Subsalicylate
Kapvay	Clonidine
Kayexalate	Sodium Polystyrene Sulfonate
Keflex	Cephalexin
Kemstro	Baclofen
Kenalog	Triamcinolone
Keppra, Keppra XR	Levetiracetam
Ketalar	Ketamine
Kionex	Sodium Polystyrene Sulfonate
Klonopin	Clonazepam
Klout	Pyrethrins with Piperonyl Butoxide
Kondremul	Mineral Oil
Konsyl	Psyllium
K-PHOS Neutral	Phosphorus Supplements
Kristalose	Lactulose
Kytril	Granisetron
Lamictal, Lamictal ODT, Lamictal XR	Lamotrigine
Laniazid	Isoniazid
Lanoxin	Digoxin
Lariam	Mefloquine HCl
Lasix	Furosemide
Lax-Pills	Senna/Sennosides
Lazanda	Fentanyl
L-Carnitine	Carnitine
Levaquin, Quixin, Iquix	Levofloxacin
Levacarnitine	Carnitine
Levophed and others	Norepinephrine Bitartrate
Lialda	Mesalamine
Licide	Pyrethrins with Piperonyl Butoxide
Lidoderm	Lidocaine
Lioresal	Baclofen
Liquid Pred	Prednisone
Lithobid	Lithium
L-M-X	Lidocaine
Loniten (previously available as)	Minoxidil
Lopressor, Toprol-XL	Metoprolol
Lotrimin AF	Clotrimazole
Lotrimin AF	Miconazole
Lovenox	Enoxaparin
Luminal	Phenobarbital
Luride	Fluoride
Luvox CR	Fluvoxamine
Maalox, Maalox Maximum Strength Liquid	Aluminum Hydroxide with Magnesium Hydroxide
Macrobid	Nitrofurantoin
Macrodantin	Nitrofurantoin
Mag-200, Mag-Ox 400, Uro-Mag	Magnesium Oxide

Trade Names	Generic Name
Marinol	Dronabinol
Maxidex	Dexamethasone
Maxipime	Cefepime
Maxivate	Betamethasone
Maxolon	Metoclopramide
Medrol, Medrol Dosepack	Methylprednisolone
Mefoxin	Cefoxitin
Mephyston	Phytonadione/Vitamin K ₁
Mepron	Atovaquone
Merrem	Meropenem
Mestinon	Pyridostigmine Bromide
Metadate ER	Methylphenidate HCl
Metamucil	Psyllium
Methadose	Methadone HCl
Methylin, Methylin ER	Methylphenidate HCl
Metozolv	Metoclopramide
MetroCream	Metronidazole
MetroGel, MetroGel-Vaginal	Metronidazole
MetroLotion	Metronidazole
Miacalcin, Miacalcin Nasal Spray	Calcitonin—Salmon
Micatin	Miconazole
Microzide	Hydrochlorothiazide
Milk of Magnesia	Magnesium Hydroxide
Millipred	Prednisolone
Minocin	Minocycline
Mintezol	Thiabendazole
Mintox	Aluminum Hydroxide with Magnesium Hydroxide
MiraLax	Polyethylene Glycol—Electrolyte Solution
Monistat	Miconazole
Motrin, Children's Motrin	Ibuprofen
MS Contin	Morphine Sulfate
Mucomyst	Acetylcysteine
Mucosol	Acetylcysteine
Murine Ear	Carbamide Peroxide
Myambutol	Ethambutol HCl
Mycamine	Micafungin Sodium
Mycelex, Mycelex-7	Clotrimazole
Mycobutin	Rifabutin
Mycostatin	Nystatin
Myfortic	Mycophenolate Sodium
Mylanta Gas	Simethicone
Mylanta, Mylanta Extra Strength	Aluminum Hydroxide with Magnesium Hydroxide
Mylicon	Simethicone
Myorisan	Isotretinoin
Mysoline	Primidone
Nallpen	Nafcillin
Naprelan	Naproxen/Naproxen Sodium
Naprosyn, Naprosen DR	Naproxen/Naproxen Sodium
Narcan	Naloxone
Nasacort AQ	Triamcinolone

Trade Names	Generic Name
Nasalcrom	Cromolyn
Nasarel	Flunisolide
Nascobal	Cyanocobalamin/Vitamin B ₁₂
Nasonex	Mometasone Furoate
Nebcin	Tobramycin
NebuPent	Pentamidine Isethionate
Nembutal	Pentobarbital
NeoBenz Micro	Benzoyl Peroxide
Neo-fradin	Neomycin Sulfate
Neo-Polycin	Neomycin/Polymyxin B/Bacitracin
NeoProfen (IV)	Ibuprofen
Neoral	Cyclosporine
Neosporin, Neosporin Ophthalmic, Neo To Go	Neomycin/Polymyxin B/Bacitracin
Neosporin GU Irrigant	Neomycin/Polymyxin B
Neo-Synephrine	Phenylephrine HCl
Neo-Synephrine 12-Hr Nasal	Oxymetazoline
Nephron	Epinephrine, Racemic
Neupogen, G-CSF	Filgrastim
Neurontin	Gabapentin
Neut	Sodium Bicarbonate
Nexilon XR	Clonidine
Nexium	Esomeprazole
Nexterone	Amiodarone HCl
Niacor	Niacin (Vitamin B ₃)
Niaspan	Niacin (Vitamin B ₃)
Nicotinic acid	Niacin (Vitamin B ₃)
Nifediac CC	Nifedipine
Niferex	Iron—Oral Preparations
Nilstat	Nystatin
Nipride (previously available as)	Nitroprusside
Nitro-Bid	Nitroglycerin
Nitro-Dur	Nitroglycerin
Nitro-Mist	Nitroglycerin
Nitropress	Nitroprusside
Nitrostat	Nitroglycerin
Nitro-Time	Nitroglycerin
Nix	Permethrin
Nizoral, Nizoral A-D	Ketoconazole
Noriate	Metronidazole
Normal Serum Albumin (Human)	Albumin, Human
Normodyne	Labetalol
Noroxin	Norfloxacin
Norvasc	Amlodipine
Nostrilla	Oxymetazoline
NuCort	Hydrocortisone
NuLYTELY	Polyethylene Glycol—Electrolyte Solution
Nutr-E-Sol	Vitamin E/α-Tocopherol
NVP ^a	Nevirapine
Nydrazid	Isoniazid
OCL ^a	Polyethylene Glycol—Electrolyte Solution
led Preparations	
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Trade Names	Generic Name
Ocuflox	Ofloxacin
Ocusulf-10	Sulfacetamide Sodium Ophthalmic
Omnaris	Ciclesonide
Ofirmev	Acetaminophen
Omeprazole and Syrspend SF Alka	Omeprazole
Omnicef	Cefdinir
Omnipaque 140, Omnipaque 180, Omnipaque 240, Omnipaque 300, and Omnipaque 350	Iohexol
Omnipen	Ampicillin
Onfi	Clobazam
Onmel	Itraconazole
Opticrom	Cromolyn
Optivar	Azelastine
Oralone	Corticosteroid
Oramorph SR	Morphine Sulfate
Orapred, Orapred ODT	Prednisolone
Oraqix	Lidocaine and Prilocaine
Orasone	Prednisone
OraVerse	Phentolamine Mesylate
Orazinc	Zinc Salts, Systemic
Os-Cal	Calcium Carbonate
Osmotrol	Mannitol
OsmoPrep	Sodium Phosphate
Oxtellar	Oxcarbazepine
Oxy-5, Oxy-10	Benzoyl Peroxide
OxyContin	Oxycodone
Oxytrol	Oxybutynin Chloride
Pacerone	Amiodarone HCl
Palbumin	Albumin, Human
Palgic	Carbinoxamine
Pamelor	Nortriptyline Hydrochloride
Pamix	Pyrantel Pamoate
Panadol	Acetaminophen
Paracetamol	Acetaminophen
Pataday	Olopatadine
Patanase	Olopatadine
Patanol	Olopatadine
Pathocil	Dicloxacillin Sodium
Paxil, Paxil CR	Paroxetine
Pediaflor	Fluoride
Pedia-Lax	Glycerin
Pediamycin	Erythromycin Preparations
Pediapred	Prednisolone
Pediazole	Erythromycin Ethylsuccinate and Acetylsulfisoxazole
PediOtic	Polymyxin B Sulfate, Neomycin Sulfate, Hydrocortisone
Pentam 300	Pentamidine Isethionate
Pentasa	Mesalamine

Trade Names	Generic Name
Pepcid, Pepcid AC [OTC], Maximum Strength Pepcid AC [OTC], Pepcid Complete [OTC], Pepcid RPD	Famotidine
Pepto-Bismol	Bismuth Subsalicylate
Percocet	Oxycodone and Acetaminophen
Percodan	Oxycodone and Aspirin
Perforomist	Formoterol
Periactin (previously available as)	Cyproheptadine
Periostat	Doxycycline
Pexeva	Paroxetine
Pfizerpen	Penicillin G Preparations—Aqueous Potassium and Sodium
PGE ₁ ^a	Alprostadil
Phazyme	Simethicone
Phenergan	Promethazine
Phenyték	Phenytoin
PhosLo	Calcium Acetate
Phoslyra	Calcium Acetate
Pilopine HS	Pilocarpine HCl
Pima	Potassium Iodide
Pin-Rid	Pyrantel Pamoate
Pin-X	Pyrantel Pamoate
Pipracil	Piperacillin
Pitressin	Vasopressin
Plaquenil	Hydroxychloroquine
Polymox	Amoxicillin
Polysporin Ophthalmic	Bacitracin + Polymyxin B
Polysporin Topical	Bacitracin + Polymyxin B
Polytrim Ophthalmic Solution	Polymyxin B Sulfate and Trimethoprim Sulfate
Posture-D	Calcium Phosphate, Tribasic
Potassium Phosphate	Phosphorus Supplements
Precidex	Dexmedetomidine
Prelonde	Prednisolone
Prevacid, Prevacid SoluTab	Lansoprazole
Prevalite	Cholestyramine
Prilosec, Prilosec OTC	Omeprazole
Primacor	Milrinone
Primaxin IV	Imipenem and Cilastatin
Principen	Ampicillin
Prinivil	Lisinopril
Privigen	Immune Globulin
ProAir HFA	Albuterol
Procanbid	Procainamide
Procardia, Procardia XL	Nifedipine
ProCentra	Dextroamphetamine Sulfate
Procrit	Epoetin Alfa
Proglycem	Diazoxide
Prograf	Tacrolimus
Pronestyl	Procainamide
Pronto	Pyrethrins

Trade Names	Generic Name
Prostaglandin E ₁	Alprostadil
Prostigmin	Neostigmine
Prostin VR Pediatric	Alprostadil
Protonix	Pantoprazole
Protopam	Pralidoxime Chloride
Protopic	Tacrolimus
Protostat	Metronidazole
Proventil, Proventil HFA (aerosol inhaler)	Albuterol
Provera	Medroxyprogesterone
Prozac, Prozac Weekly	Fluoxetine Hydrochloride
Pseudo Carb Pediatric	Carbinoxamine + Pseudoephedrine
PTU ^a	Propylthiouracil
Pulmicort Respules, Pulmicort Flexhaler	Budesonide
Pulmozyme	Dornase Alfa/DNase
Pyrazinoic acid amide	Pyrazinamide
Pyridium	Phenazopyridine HCl
Pyrinyl	Pyrethrins
Qnasl	Beclomethasone Dipropionate
Quelicin, Quelicin-1000	Succinylcholine
Questran, Questran Light	Cholestyramine
Quinidex	Quinidine
Quixin	Levofloxacin
QVAR ^a	Beclomethasone Dipropionate
Raniclor	Cefaclor
Rapamune	Sirofim
Rayos	Prednisone
Rebetol	Ribavirin
Reese's Pinworm	Pyrantel Pamoate
Regitine	Phentolamine Mesylate
Reglan	Metoclopramide
Regional	Pyridostigmine Bromide
Renova	Tretinoin
Resectisol	Mannitol
Restasis	Cyclosporine, Cyclosporine Microemulsion, Cyclosporine Modified
Retin-A, Retin-A Micro	Tretinoin
Retrovir, AZT	Zidovudine
Revatio	Sildenafil
Reversol	Edrophonium Chloride
Revonto	Dantrolene
R-Gene 10	Arginine Chloride
Rhinaris	Sodium Chloride—Inhaled Preparations
Rhinocort Aqua Nasal Spray	Budesonide
Ribaspheres	Ribavirin
RID	Pyrethrins
Rifadin	Rifampin
Rifamate	Isoniazid + Rifampin
Rifater	Pyrazinamide + Isoniazid + Rifampin
Rimactane	Rifampin
Riomet	Metformin

Trade Names	Generic Name
Risperdal, Risperdal M-Tab, Risperdal Consta	Risperidone
Ritalin, Ritalin SR, Ritalin LA	Methylphenidate HCl
Robinul	Glycopyrrolate
Rocaltrol	Calcitriol
Rocephin	Ceftriaxone
Rogaine, Men's Rogaine Extra Strength	Minoxidil
Romazicon	Flumazenil
Rowasa, StRowasa	Mesalamine
Roxanol	Morphine Sulfate
Roxicet	Oxycodone and Acetaminophen
Roxicodone	Oxycodone
Roxilox	Oxycodone and Acetaminophen
RuLox Plus	Aluminum Hydroxide with Magnesium Hydroxide
S-2 Inhalant	Epinephrine, Racemic
Sabril	Vigabatrin
Salagen	Pilocarpine HCl
Salicylazosulfapyridine	Sulfasalazine
Sal-Tropine	Atropine Sulfate
Sancuso	Granisetron
Sandimmune	Cyclosporine
Sandostatin, Sandostatin LAR Depot	Octreotide Acetate
Sani-Supp	Glycerin
Sarafem	Fluoxetine Hydrochloride
SAS ^a	Sulfasalazine
Scopace	Scopolamine Hydrobromide
Selsun and others	Selenium Sulfide
Senna-Gen	Senna/Sennosides
Senokot	Senna/Sennosides
Septra	Sulfamethoxazole and Trimethoprim
Serevent Diskus	Salmeterol
Sildec	Carbinoxamine + Pseudoephedrine
Silvadene	Silver Sulfadiazine
Simply Saline	Sodium Chloride—Inhaled Preparations
Singulair	Montelukast
Slo-Niacin	Niacin (Vitamin B ₃)
Slow FE	Iron—Oral Preparations
Sodium Phosphate	Phosphorus Supplements
Solodyn	Minocycline
Solu-cortef	Hydrocortisone
Solu-Medrol	Methylprednisolone
Soluspan	Betamethasone
Sporanox	Itraconazole
SPS ^a	Sodium Polystyrene Sulfonate
SSD Cream, SSD AF Cream	Silver Sulfadiazine
SSKI ^a	Potassium Iodide
Stadol	Butorphanol
Stavzor	Valproic Acid
Stimate	Desmopressin Acetate
Stomach Relief, Stomach Relief Max St, Stomach Relief Plus	Bismuth Subsalicylate

Trade Names	Generic Name
Strattera	Atomoxetine
Streptase	Streptokinase
Sublimaze	Fentanyl
Sudafed	Pseudoephedrine
Sulfatrim	Sulfamethoxazole and Trimethoprim
Sulfazine, Sulfazine EC	Sulfasalazine
Sunkist Vitamin C	Ascorbic Acid
Suprax	Cefixime
Surfak	Docusate
Surfaxin	Surfactant, Pulmonary/Lucinactant
Survanta	Surfactant, Pulmonary/Beractant
Symbicort	Budesonide and Formoterol
Symmetrel	Amantadine Hydrochloride
Synagis	Palivizumab
Synercid	Quinupristin and Dalfopristin
Synthroid	Levothyroxine T ₄
Tagamet, Tagamet HB [OTC]	Cimetidine
Tambocor	Flecainide Acetate
Tamiflu	Oseltamivir Phosphate
Tapazole	Methimazole
Tazicef	Ceftazidime
Tazidime	Ceftazidime
Tegretol, Tegretol-XR	Carbamazepine
Tempra	Acetaminophen
Tenex	Guanfacine
Tenormin	Atenolol
Tensilon	Edrophonium Chloride
Tetrahydrocannabinol	Dronabinol
THC ^a	Dronabinol
Theo-24	Theophylline
Theochron	Theophylline
Thera-Ear	Carbamide Peroxide
Therazene	Silver Sulfadiazine
Thorazine	Chlorpromazine
ThyroSave	Potassium Iodide
ThyroShield	Potassium Iodide
Tiazac	Diltiazem
Tigan	Trimethobenzamide HCl
Timentin	Ticarcillin and Clavulanate
Tinactin	Tolnaftate
Tirosint	Levothyroxine
Tisit	Pyrethrins
TMP-SMX ^a	Sulfamethoxazole and Trimethoprim
TOBI, TOBI Podhaler	Tobramycin
Tobrex	Tobramycin
Tofranil, Tofranil-PM	Imipramine
Topamax	Topiramate
Topiragen	Topiramate
Toprol-XL	Metoprolol
Totacillin	Ampicillin

Trade Names	Generic Name
tPA ^a	Alteplase
Trandate	Labetalol
Transderm Scop	Scopolamine Hydrobromide
Trianex	Corticosteroid
Triaz	Benzoyl Peroxide
Triderm	Corticosteroid
Trileptal	Oxcarbazepine
Trilisate and others	Choline Magnesium Trisalicylate
TriLyte	Polyethylene Glycol—Electrolyte Solution
Trimethoprim-Sulfamethoxazole	Sulfamethoxazole and Trimethoprim
Trimox	Amoxicillin
Trokenndi XR	Topiramate
Tums	Calcium Carbonate
Tylenol	Acetaminophen
Tylenol #1, #2, #3, #4	Codeine and Acetaminophen
Tylox	Oxycodone and Acetaminophen
Uceris	Budesonide
Unasyn	Ampicillin/Sulbactam
Unithroid, Unithroid Direct	Levothyroxine
Urecholine	Bethanechol Chloride
Uro-KP-Neutral	Phosphorus Supplements
Urolene Blue	Methylene Blue
Urso 250, Urso Forte	Ursodiol
Vagistat-3	Miconazole
Valcyte	Valganciclovir
Valium	Diazepam
Valtrex	Valacyclovir
Vancocin	Vancomycin
Vantin	Cefpodoxime Proxetil
VariZig	Varicella-Zoster Immune Globulin (Human)
Vasotec	Enalapril Maleate
Vasotec IV	Enalaprilat
Veetids	Penicillin V Potassium
Venofer	Iron—Injectable Preparations (iron sucrose)
Ventolin HFA	Albuterol
Veramyst	Fluticasone Propionate
Verelan, Verelan PM	Verapamil
Veripred	Prednisolone
Vermox	Mebendazole
Versed (previously available as)	Midazolam
VFEND	Voriconazole
Viagra	Sildenafil
Vibramycin	Doxycycline
Vimpat	Lacosamide
Viramune, Viramune XR	Nevirapine
Virazole	Ribavirin
Visicol	Sodium Phosphate
Visine LR	Oxymetazoline
Vistaril	Hydroxyzine
Vistide	Cidofovir

Trade Names	Generic Name
Vitamin B ₁	Thiamine
Vitamin B ₂	Riboflavin
Vitamin B ₁₂	Cyanocobalamin/Vitamin B ₁₂
Vitamin B ₃	Niacin/Vitamin B ₃
Vitamin B ₆	Pyridoxine
Vitamin C	Ascorbic Acid
Vitrase	Hyaluronidase
Virasert	Ganciclovir
VoSpire ER	Albuterol
Vyvanse	Lisdexamfetamine
VZIG	Varicella-Zoster Immune Globulin (Human)
WinRho-SDF	Rh _O (D) Immune Globulin Intravenous (Human)
Wycillin	Penicillin G Preparations—Procaine
Wymox	Amoxicillin
Xolegel	Ketoconazole
Xopenex, Xopenex HFA	Levalbuterol
Xylocaine	Lidocaine
Zantac, Zantac 75 [OTC], Zantac 150 Maximum Strength [OTC]	Ranitidine HCl
Zarontin	Ethosuximide
Zaroxolyn	Metolazone
Zegerid	Omeprazole
Zemuron	Rocuronium
Zenatane	Isotretinoin
Zenedi	Dextroamphetamine Sulfate
Zestril	Lisinopril
Zetonna	Ciclesonide
Zinacef	Cefuroxime
Zirgan	Ganciclovir
Zithromax, Zithromax TRI-PAK, Zithromax Z-PAK, Zmax	Azithromycin
Zoderm	Benzoyl Peroxide
Zofran	Ondansetron
Zolicef	Cefazolin
Zoloft	Sertraline HCl
Zonegran	Zonisamide
ZORprin	Aspirin
Zosyn	Piperacillin with Tazobactam
Zovirax	Acyclovir
Zyloprim	Allopurinol
Zyrtec, Children's Zyrtec	Cetirizine
Zyrtec-D 12 Hour	Cetirizine + Pseudoephedrine
Zyvox	Linezolid

^aCommon abbreviation or other name (not recommended for use when writing a prescription)

TABLE 30.1

EXAMPLES OF INDUCERS AND INHIBITORS OF CYTOCHROME P450 SYSTEM

Isoenzyme	Substrates (Drugs Metabolized by Isoenzyme)	Inhibitors ^a	Inducers
CYP1A2	Caffeine, theophylline, estradiol, propranolol	Cimetidine, quinolones, fluvoxamine, ketoconazole, lidocaine	Carbamazepine, smoking, phenobarbital, rifampin
CYP2B6	Cyclophosphamide, efavirenz, propofol	Paroxetine, sertraline	Carbamazepine, (fos)phenytoin, phenobarbital, rifampin
CYP2C9/10	Warfarin, phenytoin, tolbutamide, fluoxetine, sulfamethoxazole, fosphenytoin	Amiodarone, fluconazole, ibuprofen, indomethacin, nicardipine	Carbamazepine, (fos)phenytoin, rifampin, phenobarbital
CYP2C19	Diazepam, PPIs, phenytoin, desogestrel, ifosfamide, phenobarbital, sertraline, voriconazole	Cimetidine, fluvoxamine, fluconazole, isoniazid, PPIs, sertraline	Carbamazepine, (fos)phenytoin, rifampin
CYP2D6	Captopril, codeine, haloperidol, dextromethorphan, tricyclic antidepressants, hydrocodone, oxycodone, phenothiazines, metoprolol, propranolol, paroxetine, venlafaxine, risperidone, flecainide, sertraline, aripiprazole, fluoxetine, lidocaine, fosphenytoin, ritonavir	Chlorpromazine, cinacalcet, dexmedetomidine, cocaine, cimetidine, quinidine, ritonavir, fluoxetine, sertraline, amiodarone	None known
CYP2E1	Acetaminophen, alcohol, isoniazid, theophylline, isoflurane	Disulfiram	Alcohol
CYP3A4	Amlodipine, aripiprazole, budesonide, cocaine, clonazepam, diltiazem, efavirenz, erythromycin, estradiol, fentanyl, fluticasone, nifedipine, verapamil, cyclosporine, carbamazepine, cisapride, tacrolimus, midazolam, alfentanil, diazepam, ifosfamide, imatinib, itraconazole, ketoconazole, cyclophosphamide, PPIs, haloperidol, lidocaine, medroxyprogesterone, methadone, methylprednisolone, salmeterol, theophylline, quetiapine, ritonavir, indinavir, sildenafil, ivacaftor	Erythromycin, cimetidine, clarithromycin, isoniazid, ketoconazole, itraconazole, metronidazole, sertraline, ritonavir, indinavir, imatinib, nicardipine, propofol, quinidine	Rifampin, (fos)phenytoin, phenobarbital, carbamazepine, dexamethasone, lumacaftor

Note: The cytochrome P450 enzyme system is composed of different isoenzymes. Each isoenzyme metabolizes a unique group of drugs or substrates. When an *inhibitor* of a particular isoenzyme is introduced, the serum concentration of any drug or *substrate* metabolized by that particular isoenzyme will *increase*. When an *inducer* of a particular isoenzyme is introduced, the serum concentration of drugs or *substrates* metabolized by that particular isoenzyme will *decrease*.

PPI, Proton pump inhibitor.

^aOnly strong and some moderate inhibitors are listed here. Weak inhibitors also exist.

Data from Taketomo CK, Hodding JH, Kraus DM. *American Pharmaceutical Association Pediatric Dosage Handbook*. 16th ed. Hudson, OH: Lexi-Comp; 2009; Zevin S, Benowitz NL. Drug interactions with tobacco smoking.

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For explanation of icons, see p. 667

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A**ACETAMINOPHEN**

Tylenol, Tempra, Panadol, Feverall, Anacin Asprin Free, Paracetamol, Ofirmev, and many others

Analgesic, antipyretic



C



1



Yes



Yes



No

Tabs and Caplets [OTC]: 325, 500, 650 mg

Chewable tabs [OTC]: 80 mg; some may contain phenylalanine

Child suspension/syrup [OTC]: 160 mg/5 mL; may contain sodium benzoate

Oral liquid [OTC]: 160 mg/5 mL; may contain sodium benzoate and propylene glycol

Elixir [OTC]: 160 mg/5 mL; may contain sodium benzoate and propylene glycol

Extended-release caplets [OTC]: 650 mg

Capsules [OTC]: 325, 500 mg

Dispersible tabs (Tylenol Children's Meltaways) [OTC]: 80, 160 mg; contains sucralose

Suppositories [OTC]: 80, 120, 325, 650 mg

Injection:

Ofirmev: 10 mg/mL (100 mL); preservative free



PO/PR (maximum daily doses include all routes of acetaminophen administration):

Neonate: 10–15 mg/kg/dose PO/PR Q6–8 hr. Some advocate loading doses of 20–25 mg/kg/dose for PO dosing or 30 mg/kg/dose for PR dosing.

Pediatric: 10–15 mg/kg/dose PO/PR Q4–6 hr; **max. dose:** 90 mg/kg/24 hr or 4 g/24 hr. For rectal dosing, some may advocate a 40–45 mg/kg/dose loading dose.

Dosing by weight (preferred) or age (PO/PR Q4–6 hr):

Weight (lbs)	Weight (kg)	Age	Dosage (mg)
6–11	2.7–5	0–3 mo	40
12–17	5.1–7.7	4–11 mo	80
18–23	7.8–10.5	1–2 yr	120
24–35	10.6–15.9	2–3 yr	160
36–47	16–21.4	4–5 yr	240
48–59	21.5–26.8	6–8 yr	320
60–71	26.9–32.3	9–10 yr	400
72–95	32.4–43.2	11 yr	480

Adult: 325–650 mg/dose

Max. dose: 4 g/24 hr, 5 doses/24 hr

IV (maximum daily doses include all routes of acetaminophen administration):

Neonate and infant:

≤28 days old: 12.5 mg/kg/dose Q6 hr IV up to a **maximum** of 50 mg/kg/24 hr

≥29 days old to <2 yr: 15 mg/kg/dose Q6 hr IV up to a **maximum** of 60 mg/kg/24 hr.

Child (>2–12 yr) and adolescent (>13 yr)/adult <50 kg: 15 mg/kg/dose Q6 hr, **OR** 12.5 mg/kg/dose Q4 hr IV up to a **maximum** of 75 mg/kg/24 hr up to 3750 mg/24 hr with a **maximum** single dose of 15 mg/kg/dose up to 750 mg.

Adolescent (>13 yr) and adult (>50 kg): 1000 mg Q6 hr, **OR** 650 mg Q4 hr up to a **maximum** of 4000 mg/24 hr with a **maximum** single dose of 1000 mg/dose.

Does not possess antiinflammatory activity. **Use with caution** in patients with known G6PD deficiency.



T_{1/2}: 1–3 hr, 2–5 hr in neonates; metabolized in the liver; see [Chapter 3](#) and acetylcysteine for management of drug overdose.

Some preparations contain alcohol (7%–10%) and/or phenylalanine; all suspensions should be shaken before use.

ACETAMINOPHEN *continued*

May be used for the treatment of patent ductus arteriosus when standard NSAID is contraindicated or has failed. Most commonly reported dosage is 15 mg/kg dose Q6 hr IV/PO for 3 days (may be given up to 7 days or with a repeated 3-day course).

May decrease the activity of lamotrigine and increase the activity/toxicity of busulfan, warfarin, and zidovudine. Barbiturates, phenytoin, rifampin, and anticholinergic agents (e.g., scopolamine) may decrease the effect of acetaminophen. Increased risk for hepatotoxicity may occur with barbiturates, carbamazepine, phenytoin, carmustine (with high acetaminophen doses), chronic alcohol use, and inducers of CYP 450 2E1 (e.g., isoniazid). **Adjust dose in renal failure (see Chapter 31).**

FOR IV USE: administer dose undiluted over 15 min. Most common side effects with IV use include nausea, vomiting, constipation, pruritus, agitation and atelectasis in children; and nausea, vomiting, headache and insomnia in adults. Rare risk of serious skin reactions (e.g., SJS, TEN) has been reported.

ACETAZOLAMIDE

Various generics; previously available as Diamox

Carbonic anhydrase inhibitor, diuretic



Tabs: 125, 250 mg

Oral suspension: 25 mg/mL

Capsules (extended release): 500 mg

Injection (sodium): 500 mg

Contains 2.05 mEq Na/500 mg drug

Diuretic (PO, IV)

Child: 5 mg/kg/dose once daily or every other day

Adult: 250–375 mg/dose once daily or every other day

**Glaucoma**

Child:

PO: 8–30 mg/kg/24 hr ÷ Q6–8 hr; **max. dose:** 1000 mg/24 hr

IM/IV: 20–40 mg/kg/24 hr ÷ Q6 hr; **max. dose:** 1000 mg/24 hr

Adult:

PO (Simple chronic; open angle): 1000 mg/24 hr ÷ Q6 hr

IV (Acute secondary; closed angle): For rapid decrease in intraocular pressure, administer 500 mg/dose IV

Seizures (extended-release product not recommended):

Child and adult: 8–30 mg/kg/24 hr ÷ Q6–12 hr PO; **max. dose:** 1 g/24 hr

Urine alkalinization:

Adult: 5 mg/kg/dose PO repeated BID-TID over 24 hr.

Management of hydrocephalus (see remarks): Start with 20 mg/kg/24 hr ÷ Q8 hr PO/IV; may increase to 100 mg/kg/24 hr up to a **max. dose** of 2 g/24 hr

Pseudotumor cerebri (PO; see remarks):

Child: Start with 25 mg/kg/24 hr ÷ once daily-QID, increase by 25 mg/kg/24 hr until clinical response or as tolerated up to a **maximum** of 100 mg/kg/24 hr.

Adolescent: Start with 1 g/24 hr ÷ once daily-QID, increase by 250 mg/24 hr until clinical response or as tolerated up to a **maximum** of 4 g/24 hr.

Contraindicated in hepatic failure, severe renal failure (GFR <10 mL/min), and hypersensitivity to sulfonamides.



T_{1/2}: 2–6 hr; **do not use** sustained release capsules in seizures; **IM** injection may be painful; bicarbonate replacement therapy may be required during long-term use (see Citrate or Sodium Bicarbonate).

ACETAZOLAMIDE continued

Possible side effects (more likely with long-term therapy) include GI irritation, paresthesias, sedation, hypokalemia, acidosis, reduced urate secretion, aplastic anemia, polyuria, and development of renal calculi.

May increase toxicity of carbamazepine, and cyclosporine. Aspirin may increase toxicity of acetazolamide. May decrease the effects of salicylates, lithium and phenobarbital. False-positive urinary protein may occur with several assays. **Adjust dose in renal failure (see Chapter 31).**

ACETYLCYSTEINE

Various generics, Acetadote, previously available as Mucomyst

Mucolytic, antidote for acetaminophen toxicity



B

?

No

Yes

No

Solution for inhalation or oral use: 100 mg/mL (10%) (4, 10, 30 mL) or 200 mg/mL (20%) (4, 10, 30 mL); may contain EDTA

Injectable (Acetadote and generics): 200 mg/mL (20%) (30 mL); may contain EDTA 0.5 mg/mL Preservative-free versions of the inhalation and oral solutions and injectable forms exist.

Acetaminophen poisoning (see Chapter 3 for additional information):

PO: 140 mg/kg (max. 15 g/dose) × 1, followed by 70 mg/kg/dose (max. 7.5 g/dose) Q4 hr for a total of 17 doses. Repeat dose if vomiting occurs with 1 hr of administration.

IV: 150 mg/kg (max. 15 g/dose) × 1 diluted in D₅W or D₅W ½ NS administered over 60 min, followed by 50 mg/kg (max. 5 g/dose) diluted in D₅W administered over 4 hr, then 100 mg/kg (max. 10 g/dose) diluted in D₅W administered over 16 hr. Recommended weight-based drug dilution volumes:

Weight (kg)	Volume of D ₅ W or D ₅ W%NS for 150 mg/kg Loading Dose Administered Over 60 min	Volume of D ₅ W for 50 mg/kg Second Dose Administered Over 4 hr	Volume of D ₅ W for 100 mg/kg Third Dose Administered Over 16 hr
	Administered Over 60 min	Administered Over 4 hr	Administered Over 16 hr
≤20	3 mL/kg	7 mL/kg	14 mL/kg
>20 to ≤40	100 mL	250 mL	500 mL
>40	200 mL	500 mL	1000 mL

Nebulizer:

Infant: 1–2 mL of 20% solution (diluted with equal volume of H₂O, or sterile saline to equal 10%), or 2–4 mL of 10% solution; administered TID-QID

Child: 3–5 mL of 20% solution (diluted with equal volume of H₂O, or sterile saline to equal 10%), or 6–10 mL of 10% solution; administer TID-QID.

Adolescent: 5–10 mL of 10% or 20% solution; administer TID-QID

Distal intestinal obstruction syndrome in cystic fibrosis:

Adolescent and adult: 10 mL of 20% solution (diluted in a sweet drink) PO QID with 100 mL of 10% solution PR as an enema once daily-QID

Use with caution in asthma. For nebulized use, give inhaled bronchodilator 10–15 min before use and follow with postural drainage and/or suctioning after acetylcysteine administration. Prior hydration is essential for distal intestinal obstruction syndrome treatment.

May induce bronchospasm, stomatitis, drowsiness, rhinorrhea, nausea, vomiting, and hemoptysis.

Serious hypersensitivity reactions have been reported with IV use in children. Be aware of potential fluid overload resulting in hyponatremia with IV volume dilution; reduce diluent volume if needed.

For IV use, elimination T_{1/2} is longer in newborns (11 hr) than in adults (5.6 hr). T_{1/2} is increased by 80% in patients with severe liver damage (Child-Pugh score of 7–13) and biliary cirrhosis (Child-Pugh score of 5–7).

For oral administration, chilling the solution and mixing with carbonated beverages, orange juice, or

ACTH

See Corticotropin

ACYCLOVIR

Zovirax, Avacyl, and generics

Antiviral

B

2

Yes

No

No

Capsules: 200 mg**Tabs:** 400, 800 mg**Oral suspension:** 200 mg/5 mL (473 mL); may contain parabens**Ointment:** 5% (5, 15, 30 g)**Cream:** 5% (5 g); may contain propylene glycol**Ophthalmic ointment (Avacyl):** 3% (3.5 g)**Injection in solution (with sodium):** 50 mg/mL (10, 20 mL)

Contains 4.2 mEq Na/1 g drug

**IMMUNOCOMPETENT:****Neonatal (HSV and HSV encephalitis; birth–3 mo):***Initial IV therapy (duration of therapy: 14 days for cutaneous/mucous membrane infection or 21 days for CNS/disseminated infection):**<34 wk postmenstrual age:* 40 mg/kg/24 hr ÷ Q12 hr IV*≥34 wk postmenstrual age:* 60 mg/kg/24 hr ÷ Q8 hr IV**Oral therapy for HSV suppression and neurodevelopment following treatment with IV acyclovir for 14–21 days:** 300 mg/m²/dose Q8 hr PO × 6 mo**HSV encephalitis (duration of therapy: 14–21 days):****Birth–3 mo:** use aforementioned IV dosage**3 mo–12 yr:** 30–45 mg/kg/24 hr ÷ Q8 hr IV**≥12 yr:** 30 mg/kg/24 hr ÷ Q8 hr IV**Mucocutaneous HSV (including genital, ≥12 yr):****Initial infection:****IV:** 15 mg/kg/24 hr or 750 mg/m²/24 hr ÷ Q8 hr × 5–7 days**PO:** 1000–1200 mg/24 hr ÷ 3–5 doses per 24 hr × 7–10 days. For pediatric dosing, use 40–80 mg/kg/24 hr ÷ Q6–8 hr × 5–10 days (**max. pediatric dose:** 1000 mg/24 hr)**Recurrence (≥12 yr):****PO:** 1000 mg/24 hr ÷ 5 doses per 24 hr × 5 days, or 1600 mg/24 hr ÷ Q12 hr × 5 days, or 2400 mg/24 hr ÷ Q8 hr × 2 days**Chronic suppressive therapy (≥12 yr):****PO:** 800 mg/24 hr ÷ Q12 hr for up to 1 yr**Zoster:****IV (all ages):** 30 mg/kg/24 hr or 1500 mg/m²/24 hr ÷ Q8 hr × 7–10 days**PO (≥12 yr):** 4000 mg/24 hr ÷ 5×/24 hr × 5–7 days**Varicella:****IV (≥2 yr):** 30 mg/kg/24 hr or 1500 mg/m²/24 hr ÷ Q8 hr × 7–10 days**PO (≥2 yr):** 80 mg/kg/24 hr ÷ QID × 5 days (begin treatment at earliest signs/symptoms); **max. dose:** 3200 mg/24 hr**Max. dose** of oral acyclovir in children = 80 mg/kg/24 hr.

ACYCLOVIR continued**IMMUNOCOMPROMISED:****HSV:**

IV (all ages): 750–1500 mg/m²/24 hr ÷ Q8 hr × 7–14 days

PO (≥2 yr): 1000 mg/24 hr ÷ 3–5 times/24 hr × 7–14 days; **max. dose** for child: 80 mg/kg/24 hr

HSV prophylaxis:

IV (all ages): 750 mg/m²/24 hr ÷ Q8 hr during risk period

PO (≥2 yr): 600–1000 mg/24 hr ÷ 3–5 times/24 hr during risk period; **max. dose** for child: 80 mg/kg/24 hr

Varicella or zoster:

IV (all ages): 1500 mg/m²/24 hr ÷ Q8 hr × 7–10 days

PO (consider using valacyclovir or famciclovir for better absorption):

Infant and child: 20 mg/kg/dose (**max.** 800 mg) Q6 hr × 7–10 days

Adolescent and adult: 20 mg/kg/dose (**max.** 800 mg) 5 times daily × 7–10 days

Max. dose of oral acyclovir in children = 80 mg/kg/24 hr.

TOPICAL:**Cream (see remarks):**

Herpes labialis (≥12 and adult): Apply to affected areas 5 times a day × 4 days

Ointment:

Immunocompromised genital or mucocutaneous HSV: Apply 0.5-inch ribbon of 5% ointment for

4-inch square surface area 6 times a day × 7 days.

OPHTHALMIC:

Herpes simplex keratitis (≥2 yr and adolescent): Apply 1 cm (½-inch) ribbon onto the lower eyelid of affected eye(s) 5 times a day while awake (~Q3 hr) until corneal ulcer heals then reduce dosage to TID for 7 days.

See most recent edition of the AAP Red Book for further details. Use with **caution** in patients with preexisting neurologic or **renal impairment** (**adjust dose**; see Chapter 31) or dehydration. Adequate hydration and slow (1 hr) IV administration are essential to prevent crystallization in renal tubules. **Do not use** topical product on the eye or for the prevention of recurrent HSV infections. Oral absorption is unpredictable (15%–30%); consider using valacyclovir or famciclovir for better absorption. Use ideal body weight for obese patients when calculating dosages. Resistant strains of HSV and VZV have been reported in immunocompromised patients (e.g., advanced HIV infection).

Inflammation or phlebitis at the injection site and transient elevations of sCr and BUN are the most frequent IV use side effects. Can cause renal impairment and has been associated with headache, vertigo, insomnia, encephalopathy, GI tract irritation, elevated liver function tests, rash, urticaria, arthralgia, fever, and adverse hematologic effects. Probenecid decreases acyclovir renal clearance. Acyclovir may increase the concentration of tenofovir, and meperidine and its metabolite (normeperidine).

Topical cream acyclovir 5% in combination with hydrocortisone 1% (Xerese) is indicated for herpes labialis (≥6 yr and adults) at a dosage of 5 applications per day for 5 days. Use a finger cot or rubber glove when applying topical cream or ointment.

Ophthalmic ointment: patient should close his or her eyes for 1–2 min after each application and wipe away any excess ointment. Most common side effects include stinging, punctate keratitis, and follicular conjunctivitis. Blepharitis and hypersensitivity reactions have been reported.

ADAPALENE ± BENZOYL PEROXIDE

Differin and generics

In combination with benzoyl peroxide: Epiduo, Epiduo Forte

Synthetic retinoic acid derivative; topical acne product



C

?

No

No

No

Topical cream: 0.1% (45 g)

Topical gel: 0.1% [OTC], 0.3% (45 g); some preparations may contain methylparabens and propylene glycol

Topical lotion: 0.1% (59 mL); some preparations may contain methylparabens and propylene glycol

ADAPALENE ± BENZOYL PEROXIDE continued**Topical solution as a swab:** 0.1% (1.2 g per swab; 14 or 30 unit of use swabs per box)**In combination with benzoyl peroxide as a topical gel:****Epiduo:** 0.1% adapalene +2.5% benzoyl peroxide (45 g)**Epiduo Forte:** 0.3% adapalene +2.5% benzoyl peroxide (15, 30, 45, 60, 70 g)**Adapalene (≥ 12 yr and adult):** Apply a thin film of cream, gel or lotion to affected areas of cleansed and dried skin QHS**Adapalene and benzoyl peroxide:** Apply a thin film to affected areas of cleansed and dried skin once daily**Epiduo:** Indicated for children ≥ 9 yr and adults with limited data in children 7– <9 yr**Epiduo Forte:** Indicated for children ≥ 12 yr and adults.**Avoid** contact with eyes, mucous membranes, abraded skin and open wounds; excessive sun exposure; and use of other irritating topical products. A mild transitory warm or stinging sensation of the skin may occur during the first 4 wk of use. Clean and dry the skin before each use.**ADAPALENE:** Onset of therapeutic benefits seen in 8–12 wk. Common side effects include dry skin, erythema, and scaly skin. When compared with tretinoin in clinical trials for acne vulgaris, adapalene was as effective and had a more rapid onset of clinical effects with less skin irritation.**ADAPALENE + BENZOYL PEROXIDE:** Onset of therapeutic benefits seen in 4–8 wk. Side effects reported in placebo-controlled studies include dry skin, erythema, skin irritation, and contact dermatitis. When compared with isotretinoin in a clinical trial for nodulocystic acne, adapalene + benzoyl peroxide plus doxycycline was not inferior to isotretinoin and was less effective in reducing the number of total lesions (nodules, papules/pustules, and comedones).**ADDERALL**See Dextroamphetamine \pm Amphetamine**ADENOSINE**

Adenocard and generics

Antiarrhythmic

C

?

No

No

No

Injection: 3 mg/mL (2, 4 mL); preservative free**Supraventricular tachycardia (see remarks):****Neonate:** 0.05–0.1 mg/kg by rapid IV push over 1–2 sec; may increase dose by 0.05–0.1 mg/kg increments every 2 min to a **max single dose** of 0.3 mg/kg or until termination of SVT.**Child:** 0.1 mg/kg (**initial max. dose:** 6 mg) by rapid IV/IO push over 1–2 sec; may repeat in 2 min at 0.2 mg/kg IV/IO, then 0.3 mg/kg IV/IO after 2 min (**all subsequent max. single doses:** 12 mg), or until termination of SVT.**Adolescent and adult ≥ 50 kg:** 6 mg rapid IV push over 1–2 sec; if no response after 1–2 min, give 12 mg rapid IV push. May repeat a second 12 mg dose after 1–2 min if required. **Max. single dose:** 12 mg.**Contraindicated** in 2nd and 3rd degree AV block or sick-sinus syndrome unless pacemaker placed. **Use with caution** in combination with digoxin (enhanced depressant effects on SA and AV nodes). If necessary, doses may be administered IO.Follow each dose with NS flush. $T_{1/2} < 10$ sec.

May precipitate bronchoconstriction, especially in asthmatics. Side effects include transient asystole, facial flushing, headache, shortness of breath, dyspnea, nausea, chest pain, and lightheadedness.

Carbamazepine and dipyridamole may increase the effects/toxicity of adenosine. Methylxanthines (e.g., caffeine and theophylline) may decrease the effects of adenosine.

D

ALBUMIN, HUMAN

Albumin-ZLB, Albutein, Buminate, Plasbumin, and many others

Blood product derivative, plasma volume expander



C

?

No

No

No

Injection: 5% (50 mg/mL) (50, 100, 250, 500, mL); 25% (250 mg/mL) (20, 50, 100 mL); both concentrations contain 130–160 mEq Na/L

Hypoalbuminemia:

Child: 0.5–1 g/kg/dose IV over 30–120 min; repeat Q1–2 days PRN

Adult: 25 g/dose IV over 30–120 min; repeat Q1–2 days PRN

Max. dose: 2 g/kg/24 hr

**Hypovolemia:**

Child: 0.5–1 g/kg/dose IV rapid infusion; may repeat PRN; **max. dose:** 6 g/kg/24 hr

Adult: 12.5–25 g/dose IV rapid infusion; may repeat PRN; **max. dose:** 250 g/48 hr



Contraindicated in cases of CHF or severe anemia; rapid infusion may cause fluid overload; hypersensitivity reactions may occur; may cause rapid increase in serum sodium levels.

Recommended maximum infusion rates:

Product Concentration	Patients with Normal Plasma Volume	Patients with Hypoproteinemia
5%	2–4 mL/min	5–10 mL/min
25%	1 mL/min	2–3 mL/min

Caution: 25% concentration is considered **contraindicated** in preterm infants due to risk of IVH. Use product specific recommended in-line filter size. Both 5% and 25% products are isotonic but differ in oncotic effects. Dilutions of the 25% product should be made with D₅W or NS; **avoid sterile water as a diluent.**

ALBUTEROL

VoSpire ER (sustained release tabs); ProAir HFA, Proventil HFA, Ventolin HFA (aerosol inhaler); ProAir RespiClick, ProAir Digihaler (breath activated aerosol powder inhaler); AccuNeb (prediluted nebulized solution); and many generics

β₂-Adrenergic agonist



C

1

No

No

No

Tabs: 2, 4 mg

Sustained release tabs: 4, 8 mg

Oral solution: 2 mg/5 mL (473 mL)

Aerosol inhaler (HFA): 90 mCg/actuation (60 actuations/inhaler) (8.5 g)

Breath activated aerosol powder inhaler:

ProAir RespiClick and ProAir Digihaler: 90 mCg/actuation (200 actuations/inhaler) (0.65 g); contains milk proteins and small amounts of lactose. ProAir Digihaler contains an electronic event monitor which detects, records, and stores data on inhaler use events, including peak inspiratory flow rate.

Nebulization solution (dilution required): 0.5% (5 mg/mL) (0.5, 20 mL)

Prediluted nebulized solution: 0.63 mg in 3 mL NS, 1.25 mg in 3 mL NS, and 2.5 mg in 3 mL NS (0.083%); some preparations may be preservative free

Inhalations (nonacute use; see remarks):

Aerosol (HFA): 2 puffs (90 mCg/puff) Q4–6 hr PRN



Breath activated aerosol: 2 inhalations (90 mCg/inhalation) Q4–6 hr PRN

ALBUTEROL *continued***Nebulization:**

- <1 yr: 0.05–0.15 mg/kg/dose Q4–6 hr
- 1–5 yr: 1.25–2.5 mg/dose Q4–6 hr
- 5–12 yr: 2.5 mg/dose Q4–6 hr
- >12 yr: 2.5–5 mg/dose Q4–8 hr

For use in acute exacerbations, more aggressive dosing may be used.

Exercise-induced bronchospasm (administered 15–30 min before exercise):

Aerosol (HFA): 2 puffs (90 mCG/puff)

Breath activated aerosol: 2 inhalations (90 mCG/inhalation)

Oral (highly discouraged—see remarks):

2–6 yr: 0.3 mg/kg/24 hr PO ÷ TID; **max. dose:** 12 mg/24 hr

6–12 yr: 6 mg/24 hr PO ÷ TID; **max. dose:** 24 mg/24 hr

>12 yr and adult: 2–4 mg/dose PO TID-QID; **max. dose:** 32 mg/24 hr

Inhaled doses may be given more frequently than indicated. In such cases, consider cardiac monitoring and monitoring of serum potassium (hypokalemia). Systemic effects are dose related. Please verify the concentration of the nebulization solution used.

Safety and efficacy for the treatment of symptoms or bronchospasms associated with obstructive airway disease have not been demonstrated for children <4 yr of age (either dose studied was not optimal in this age or drug is not effective in this age group).

Use of oral dosage form is discouraged due to increased side effects and decreased efficacy compared with inhaled formulations.

Possible side effects include tachycardia, palpitations, tremor, insomnia, nervousness, nausea, and headache.

The use of tube spacers or chambers may enhance efficacy of the HFA metered dose inhalers and have been proven to be just as effective and sometimes safer than nebulizers. **Do not** use a spacer device with any of the breath activated inhaler dosage forms. Breath-activated dosage forms require patients to generate a minimum inspiratory flow rate of ≥30 L/min for proper dose activation.

ALLOPURINOL

Zyloprim, Alopurin, and generics

Uric acid lowering agent, xanthine oxidase inhibitor



C



2



Yes



Yes



Yes

Tabs: 100, 300 mg

Oral suspension: 20 mg/mL

Injection (Alopurin and generics): 500 mg

Contains ~1.45 mEq Na/500 mg drug

For use in tumor lysis syndrome, see Chapter 22 for additional information.

Child:

Oral: 10 mg/kg/24 hr PO ÷ BID-QID; **max. dose:** 800 mg/24 hr

Injectable: 200 mg/m²/24 hr IV ÷ Q 6–12 hr; **max. dose:** 600 mg/24 hr

Adult:

Oral: 200–800 mg/24 hr PO ÷ BID-TID

Injectable: 200–400 mg/m²/24 hr IV ÷ Q 6–12 hr; **max. dose:** 600 mg/24 hr



ALLOPURINOL *continued*

Discontinue use at the first appearance of skin rash or other signs of an allergic reaction. **Avoid** use in individuals with HLA-B*58:01 allele as they are at significant risk for developing severe cutaneous adverse reactions (e.g., Stevens-Johnson syndrome and TEN).

Side effects include rash, neuritis, hepatotoxicity, GI disturbance, bone marrow suppression, and drowsiness.

Adjust dose in renal insufficiency (see Chapter 31). Must maintain adequate urine output and alkaline urine.

Drug interactions: increases serum theophylline level; may increase the incidence of rash with ampicillin and amoxicillin; increased risk of toxicity with azathioprine, didanosine and mercaptopurine; and increased risk of hypersensitivity reactions with ACE inhibitors and thiazide diuretics. Use with didanosine is **contraindicated** due to increased risk for didanosine toxicity. Rhabdomyolysis has been reported with clarithromycin use.

IV dosage form is very alkaline and must be **diluted to a minimum concentration** of 6 mg/mL and infused over 30 min.

ALMOTRIPTAN MALATE

Generics; previously available as Axert

Antimigraine agent, selective serotonin agonist



C



3



Yes



Yes



No

Tabs: 6.25, 12.5 mg

Treatment of acute migraines with or without aura:

Oral (Safety of an average of >4 headaches in a 30-day period has not been established; see remarks):

Child ≥12 and adult: Start with 6.25–12.5 mg PO × 1. If needed in 2 hr, a second dose may be administered. **Max. daily dose:** 2 doses/24 hr and 25 mg/24 hr.

Contraindicated in ischemic/vasospastic coronary artery disease, significant underlying cardiovascular disease, cerebrovascular syndromes, peripheral vascular disease, uncontrolled hypertension, or hemiplegic/basilar migraine. **Do not** administer with any ergotamine-containing medication ergot-type medication, any other 5-HT₁ agonist (e.g., triptans), methylene blue, or with/within 2 wk of discontinuing an MAO inhibitor or linezolid.

FDA-labeled indication for adolescents is acute migraine treatment in patients with a history of migraine lasting ≥4 hr when left untreated. Efficacy for the treatment of migraine associated symptoms of nausea, photophobia, and phonophobia were not established for adolescents.

Most common side effects include dizziness, somnolence, headache, paresthesia, nausea, and vomiting. Reported serious adverse effects include coronary artery spasm, ischemia (myocardial, gastrointestinal, peripheral vascular), cerebral/subarachnoid hemorrhage, cerebrovascular accident/disease, and vision loss.

Use with **caution** in renal impairment ($\text{CrCl} \leq 30 \text{ mL/min}$) or hepatic impairment; use initial dose of 6.25 mg dose with a max. daily dose of 12.5 mg/24 hr.

Almotriptan is a minor substrate for CYP 450 2D6 and 3A4. Use lower initial single dose of 6.25 mg with maximum daily dose of 12.5 mg if receiving a potent CYP 450 3A4 inhibitor (e.g., itraconazole, ritonavir). **Do not use** almotriptan in the presence of renal or hepatic impairment and receiving a potent CYP 3A4 inhibitor.

Doses may be administered with or without food.

ALPROSTADIL

Prostin VR Pediatric, prostaglandin E₁, PGE₁
Prostaglandin E1, vasodilator



Injection: 500 mCg/mL (1 mL); contains dehydrated alcohol

Neonate:

Initial: 0.05–0.1 mCg/kg/min. Advance to 0.2 mCg/kg/min if necessary.



Maintenance: When increase in PaO₂ is noted, decrease immediately to lowest effective dose. Usual dosage range: 0.01–0.4 mCg/kg/min; doses >0.4 mCg/kg/min not likely to produce additional benefit.

To prepare infusion: see inside front cover.

For palliation only. Continuous vital sign monitoring essential. May cause apnea (10%–12%; especially in those weighing <2 kg at birth), fever, seizures, flushing, bradycardia, hypotension, diarrhea, gastric outlet obstruction, and reversible cortical proliferation of long bones (with prolonged use). May decrease platelet aggregation.

**ALTEPLASE**

Activase, Cathflo Activase, tPA
Thrombolytic agent, tissue plasminogen activator

**Injection:**

Cathflo Activase: 2 mg

Activase: 50 mg (29 million unit), 100 mg (58 million unit)

All products contain: L-arginine and polysorbate 80

**Occluded IV catheter:**

Aspiration method: Use 1 mg/1 mL concentration as follows:

Central venous line (dosage per lumen, treating one lumen at a time):

<30 kg: Instill a volume equal to 110% of internal lumen volume of the catheter **NOT exceeding** 2 mg.

≥30 kg: 2 mg each lumen.

Subcutaneous port: Instill a volume equal to 110% of internal lumen and line volume of the port **NOT exceeding** 2 mg.

Instill into catheter over 1–2 min and leave in place for 2 hr before attempting blood withdrawal.

After 2 hr, attempts to withdraw blood may be made every 2 hr for 3 attempts. Dose may be repeated once in 24 hr using a longer catheter dwell time of 3–4 hr. After 3–4 hr (repeat dose), attempts to withdrawal blood may be made every 2 hr for 3 attempts. **DO NOT** infuse into patient.

Systemic thrombolytic therapy (limited data, use in consultation with a hematologist; see remarks):

Low-dose initial infusion:

<90 days old: 0.06 mg/kg/hr; **max. dose:** 2 mg/hr

≥90 days old–21 yr: 0.03 mg/kg/hr; **max. dose:** 2 mg/hr

High-dose initial infusion: 0.1–0.5 mg/kg/hr; **max. dose:** 25 mg/hr

Dosage regimens ranging from lower dosages (0.01 mg/kg/hr) to higher dosages (0.1–0.6 mg/kg/hr) have been reported (Chest 2008;133:887–968S). The length of continuous infusion is variable as patients may respond to longer or shorter courses of therapy.

Current use in the pediatric population is limited. May cause bleeding, rash, angioedema, and increase prothrombin time. Rare fatal hypersensitivity reaction has been reported.



THROMBOLYTIC USE: History of stroke, transient ischemic attacks, other neurologic disease and hypertension are **contraindications for adults** but considered **relative contraindications for children**. Monitor fibrinogen, thrombin clotting time, PT and aPTT when used as a thrombolytic. For

ALTEPLASE *continued*

systemic thrombosis therapy, efficacy has been reported at 40%–97% with the risk for bleeding at 3%–27%. Poor efficacy in VTE in children has been recently reported. **Use with caution** in severe hepatic or renal dysfunction (systemic use only).

Newborns have reduced plasminogen levels (~50% of adult values) which decrease the thrombolytic effects of alteplase. Plasminogen supplementation may be necessary.

ALUMINUM HYDROXIDE

Various generics; previously available as Amphojel
Antacid, phosphate binder



Oral suspension [OTC]: 320 mg/5 mL (473 mL)

Each 5 mL suspension contains <0.13 mEq Na.

Antacid (see remarks):

Child: 320–960 mg PO 1–3 hr PC and QHS

Adult: 640 mg PO 1–3 hr PC and HS; **max. dose:** 3840 mg/24 hr

Hyperphosphatemia (administer all doses with meals and titrate to normal serum phosphorus):

Child: 50–150 mg/kg/24 hr ÷ Q4–6 hr PO

Adult: 300–600 mg TID–QID PO between meals and QHS

Max. dose (all ages): 3000 mg/24 hr



Chronic antacid use is not recommended for children with GERD. **Use with caution** in patients with renal failure and upper GI hemorrhage.

Interferes with the absorption of several orally administered medications, including digoxin, ethambutol, indomethacin, isoniazid, naproxen, mycophenolate, tetracyclines, fluoroquinolones (e.g., ciprofloxacin), and iron. In general, **do not** take oral medications within 1–2 hr of taking aluminum dose unless specified.

May cause constipation, decreased bowel motility, encephalopathy, and phosphorus depletion.

**ALUMINUM HYDROXIDE WITH MAGNESIUM HYDROXIDE**

Maalox, Maalox Advanced Maximum Strength Liquid, Mylanta Maximum Strength, Almacone Antacid Antigas, Almacone Double Strength, RuLox, and many other generics (see remarks)

Antacid

Chewable tabs [OTC]: $(\text{Al}[\text{OH}]_3 \cdot \text{Mg}[\text{OH}]_2)$

Almacone and generics: 200 mg AlOH, 200 mg MgOH, and 25 mg simethicone

Oral suspension [OTC] (see remarks):

Maalox, Almacone Antacid Antigas, RuLox and generics: each 5 mL contains 200 mg AlOH, 200 mg MgOH, and 20 mg simethicone (150, 360, 720 mL); some preparations may contain 0.2% alcohol, benzyl alcohol, or propylene glycol

Mylanta Maximum Strength, Maalox Advanced Maximum Strength liquid, Almacone Double Strength, and generics: each 5 mL contains 400 mg AlOH, 400 mg MgOH, and 40 mg simethicone (360, 480 mL); some preparations may contain benzyl alcohol

Many other combinations exist

Contains 0.03–0.06 mEq Na/5 mL

ALUMINUM HYDROXIDE WITH MAGNESIUM HYDROXIDE *continued*

Antacid (mL volume dosages are based on the 200 mg AlOH, 200 mg MgOH, and 20 mg simethicone per 5 mL oral suspension concentration):



Child ≤12 yr: 0.5–1 mL/kg/dose (**max. dose:** 20 mL/dose) PO 1–3 hr PC and HS

>12 yr and adult: 10–20 mL PO 1–3 hr PC and HS; **max. dose:** 80 mL/24 hr

Chronic antacid use is not recommended for children with GERD. May have laxative effect.



May cause hypokalemia. **Use with caution** in patients with renal insufficiency (magnesium), gastric outlet obstruction. **Do not use** for hyperphosphatemia.

Interferes with the absorption of the benzodiazepines, chloroquine, digoxin, naproxen, mycophenolate, phenytoin, quinolones (e.g., ciprofloxacin), tetracyclines, and iron. In general, do not take oral medications within 1–2 hr of taking antacid dose unless specified.

DO NOT use Maalox Total Relief (bismuth subsalicylate), Mylanta New Tonight Soothing Liquid (calcium carbonate + magnesium hydroxide + simethicone), Maalox Regular Strength Chewable Tablets and Children's Mylanta Chewable Tablets (calcium carbonate), Maalox Maximum Strength Chewable (calcium carbonate and simethicone), and Mylanta Gas (simethicone) as these products do not contain aluminum hydroxide and magnesium hydroxide.

AMANTADINE HYDROCHLORIDE

Immediate release dosage forms: Symmetrel and generics



C



3



Yes



Yes

Extended-release dosage forms: Gocovri, Osmolex ER

No

Antiviral agent

Capsule: 100 mg

Tabs: 100 mg

Extended-release capsule (Gocovri; see remarks): 68.5, 137 mg

Extended-release tabs (Osmolex ER; see remarks): 129, 193, 258 mg

Oral solution or syrup: 50 mg/5 mL (480 mL); may contain parabens



Influenza A prophylaxis and treatment (for treatment, it is best to initiate therapy immediately after the onset of symptoms; within 2 days; see remarks):

1–9 yr: 5 mg/kg/24 hr PO ÷ BID; **max. dose:** 150 mg/24 hr

≥10 yr:

<40 kg: 5 mg/kg/24 hr PO ÷ BID; **max. dose:** 200 mg/24 hr

≥40 kg: 200 mg/24 hr PO ÷ BID

Duration of therapy:

Prophylaxis:

Single exposure: at least 10 days

Repeated/uncontrolled exposure: up to 90 days

Use with influenza A vaccine when possible.

Symptomatic treatment:

Continue for 24–48 hr after disappearance of symptoms.



The CDC has reported resistance to influenza A and does not recommend its use for treatment and prophylaxis. Check with local microbiology laboratories and the CDC for seasonal susceptibility/resistance. Individuals immunized with live attenuated influenza vaccine should not receive amantadine prophylaxis for 14 days after the vaccine.

Do not use in the first trimester of pregnancy. **Use with caution** in patients with liver disease, seizures, renal disease, congestive heart failure, peripheral edema, orthostatic hypotension, history of recurrent eczematoid rash, and in those receiving CNS stimulants. **Adjust dose in patients with renal insufficiency (see Chapter 31).**

AMANTADINE HYDROCHLORIDE *continued*

Extended-release capsule and tablet dosage forms are indicated for the treatment of dyskinesia in patients with Parkinson disease receiving levodopa-based therapy.

May cause dizziness, anxiety, depression, mental status change, rash (livedo reticularis), nausea, orthostatic hypotension, edema, CHF, and urinary retention. Impulse control disorder has been reported. Neuroleptic malignant syndrome has been reported with abrupt dose reduction or discontinuation (especially if patient is receiving neuroleptics).

AMIKACIN SULFATE

Various generics; previously available as Amikin

Antibiotic, aminoglycoside



D

1

Yes

No

No

Injection: 250 mg/mL (2, 4 mL); may contain sodium bisulfite

Initial empirical dosage; patient specific dosage defined by therapeutic drug monitoring (see remarks). 

Neonate: See the following table.

Postconceptual Age (wk)	Postnatal Age (days)	Dose (mg/kg/dose)	Interval (hr)
$\leq 29^a$	0–7	18	48
	8–28	15	36
	>28	15	24
30–34	0–7	18	36
	>7	15	24
≥ 35	ALL	15	24 ^b

^aOr significant asphyxia, PDA, indomethacin use, poor cardiac output, reduced renal function.

^bUse Q36 hr interval for HIE patients receiving whole-body therapeutic cooling.

Infant and child: 15–22.5 mg/kg/24 hr ÷ Q8 hr IV/IM; infants and patients requiring higher doses (e.g., cystic fibrosis) may receive initial doses of 30 mg/kg/24 hr ÷ Q8 hr IV/IM

Cystic fibrosis (if available, use patient's previous therapeutic mg/kg dosage):

Conventional Q8 hr dosing: 30 mg/kg/24 hr ÷ Q8 hr IV

High-dose extended interval (once daily) dosing (limited data): 30–35 mg/kg/24 hr Q24 hr IV

Nontuberculous mycobacterium (part of a multiple drug regimen):

Infant and child: 15–30 mg/kg/dose Q24 hr IV; **max. dose:** 1500 mg/24 hr

Adolescent: 10–15 mg/kg/dose Q24 hr IV; **max. dose:** 1500 mg/24 hr

Adult: 15 mg/kg/24 hr ÷ Q8–12 hr IV/IM

Initial max. dose: 1.5 g/24 hr, then monitor levels

Use with **caution** in preexisting renal, vestibular, or auditory impairment; concomitant anesthesia or neuromuscular blockers, neurotoxic; concomitant neurotoxic, ototoxic, or nephrotoxic drugs; sulfite sensitivity; and dehydration. **Adjust dose in renal failure (see Chapter 31).** Longer dosing intervals may be necessary for neonates receiving indomethacin for PDAs and for all patients with poor cardiac output. Rapidly eliminated in patients with cystic fibrosis, burns, and in febrile neutropenic patients. CNS penetration is poor beyond early infancy.

Continued

AMIKACIN SULFATE *continued*

Therapeutic Drug Monitoring Goals:

Dosing Method/ Indication	Peak Level	Trough Level	Recommended Serum Sampling Time
Conventional dosing	20–30 mg/L; 25–30 mg/L for CNS, pulmonary, bone, life-threatening, <i>Pseudomonas</i> infections and febrile neutropenia.	5–10 mg/L	Trough within 30 min before the third consecutive dose and peak 30–60 min after the administration of the third consecutive dose (at steady state)
High-Dose Extended Interval (Q24 hr) for Cystic Fibrosis	80–120 mg/L	<10 mg/L	Trough within 30 min before the 2nd dose and peak 30–60 min after administration of 2nd dose
Extended Interval (Q24 hr) for nontuberculous mycobacterium	20–40 mg/L	<10 mg/L	Trough within 30 min before the 2nd dose and peak 30–60 min after administration of 2nd dose

For initial dosing in obese patients, use an adjusted body weight (ABW). ABW = ideal body weight + 0.4 (total body weight – ideal body weight).

May cause ototoxicity, nephrotoxicity, neuromuscular blockade, and rash. Loop diuretics may potentiate the ototoxicity of all aminoglycoside antibiotics.

AMINOCAPROIC ACID

Amicar and generics

Hemostatic agent

C

?

Yes

No

No

Tabs: 500, 1000 mg**Oral liquid/syrup:** 250 mg/mL (240, 480 mL); may contain 0.2% methylparaben and 0.05% propylparaben**Injection:** 250 mg/mL (20 mL); may contain 0.9% benzyl alcohol**Child (IV/PO):****Loading dose:** 100–200 mg/kg**Maintenance:** 100 mg/kg/dose Q4–6 hr; **max. dose:** 30 g/24 hr**Adult (IV/PO):** 4–5 g during the first hour, followed by 1 g/hr × 8 hr or until bleeding is controlled. **Max. dose:** 30 g/24 hr.**Contraindications:** DIC, hematuria. **Use with caution** in patients with cardiac or renal disease.

Should not be given with factor IX complex concentrates or antiinhibitor coagulant concentrates because of risk for thrombosis. Dose should be reduced by 75% in oliguria or end stage renal disease.

Hypercoagulation may be produced when given in conjunction with oral contraceptives.

May cause nausea, diarrhea, malaise, weakness, headache, decreased platelet function, hypotension, and false increase in urine amino acids. Elevation of serum potassium may occur, especially in patients with renal impairment. Prolonged use may increase risk for skeletal muscle weakness and rhabdomyolysis.

AMINOPHYLLINE

Various generics

Bronchodilator, methylxanthine

C



1



No



Yes



No

Injection: 25 mg/mL (79% theophylline) (10, 20 mL)**Note:** Pharmacy may dilute IV dosage forms to enhance accuracy of neonatal dosing.***Neonatal apnea:******Loading dose:*** 5–6 mg/kg IV***Maintenance dose:*** 1–2 mg/kg/dose Q6–8 hr, IV***Asthma exacerbation and reactive airway disease:******IV loading:*** 6 mg/kg IV over 20 min (each 1.2 mg/kg dose raises the serum theophylline concentration 2 mg/L)***IV maintenance: Continuous IV drip:******Neonate:*** 0.2 mg/kg/hr***6 wk–6 mo:*** 0.5 mg/kg/hr***6 mo–1 yr:*** 0.6–0.7 mg/kg/hr***1–9 yr:*** 1–1.2 mg/kg/hr***9–12 yr and young adult smoker:*** 0.9 mg/kg/hr***>12 yr healthy nonsmoker:*** 0.7 mg/kg/hr

The above total daily doses may also be administered IV ÷ Q4–6 hr.

Consider milligrams of theophylline available when dosing aminophylline. For oral route of administration, use theophylline.



Monitoring serum levels is essential, especially in infants and young children. Intermittent dosing for infants and children 1–5 yr may require Q4 hr dosing regimen due to enhanced metabolism/clearance. Side effects: restlessness, GI upset, headache, tachycardia, seizures (may occur in absence of other side effects with toxic levels).

Therapeutic level (as theophylline): for asthma, 10–20 mg/L; for neonatal apnea, 6–13 mg/L.

Recommended guidelines for obtaining levels:

IV bolus: 30 min after infusion**IV continuous:** 12–24 hr after initiation of infusion**PO liquid, immediate-release tab (theophylline product):*****Peak:*** 1 hr post dose***Trough:*** just before dose**PO sustained-release (theophylline product):*****Peak:*** 4 hr post dose***Trough:*** just before doseIdeally, obtain levels after steady state has been achieved (after at least one day of therapy). Liver impairment, cardiac failure, and sustained high fever may increase theophylline levels. See *Theophylline* for drug interactions.

Use in breast feeding may cause irritability in infant. It is recommended to avoid breast feeding for 2 hr after IV or 4 hr after immediate-release oral intermittent dose.

AMIODARONE HCL

Pacerone, Nexterone, and various generics

Antiarrhythmic, Class III

D



3



Yes



No

Tabs: 100, 200, 400 mg**Oral suspension:** 5 mg/ml **Injection:** 50 mg/mL (3, 9, 18 mL) (contains 20.2 mg/mL benzyl alcohol and 100 mg/mL polysorbate 80 or Tween 80)**Premixed injection (Nexterone):** 1.5 mg/mL (100 mL) (iso-osmotic solution, each 1 mL contains 15 mg sulfbutylether β -cyclodextrin [SBECD; see remarks], 0.362 mg citric acid, 0.183 mg sodium citrate and 42.1 mg dextrose), 1.8 mg/mL (200 mL) (iso-osmotic solution, each 1 mL contains 18 mg SBECD, 0.362 mg citric acid, 0.183 mg sodium citrate and 41.4 mg dextrose)

Contains 37.3% iodine by weight.

See algorithms in front cover of book for arrest dosing. **Child PO for tachyarrhythmia:****<1 yr:** 600–800 mg/1.73 m²/24 hr \div Q12–24 hr \times 4–14 days and/or until adequate control achieved, then reduce to 200–400 mg/1.73 m²/24 hr.**≥1 yr:** 10–15 mg/kg/24 hr \div Q12–24 hr \times 4–14 days and/or until adequate control achieved, then reduce to 5 mg/kg/24 hr \div Q12–24 hr if effective.**Child IV for tachyarrhythmia (limited data):**5 mg/kg (**max. dose:** 300 mg) over 30 min followed by a continuous infusion starting at 5 micrograms (mCg)/kg/min; infusion may be increased up to a **max. dose** of 15 mCg/kg/min or 20 mg/kg/24 hr or 2200 mg/24 hr.**Adult PO for ventricular arrhythmias:****Loading dose:** 800–1600 mg/24 hr \div Q12–24 hr for 1–3 wk**Maintenance:** 600–800 mg/24 hr \div Q12–24 hr \times 1 mo, then 200 mg Q12–24 hr

Use lowest effective dose to minimize adverse reactions.

Adult IV for ventricular arrhythmias:**Loading dose:** 150 mg over 10 min (15 mg/min) followed by 360 mg over 6 hr (1 mg/min); followed by a maintenance dose of 0.5 mg/min. Supplemental boluses of 150 mg over 10 min may be given for breakthrough VF or hemodynamically unstable VT, and the maintenance infusion may be increased to suppress the arrhythmia. **Max. dose:** 2.1 g/24 hr.

Used in the resuscitation algorithm for ventricular fibrillation/pulseless ventricular tachycardia (see front cover for arrest dosing and back cover for PALS algorithm).

Overall use of this drug may be limited to its potentially life-threatening side effects and the difficulties associated with managing its use.

Contraindicated in severe sinus node dysfunction, marked sinus bradycardia, second- and third-degree AV block. **Use with caution** in hepatic impairment.

Long elimination half-life (40–55 days). Major metabolite is active. Use of premixed injection (Nexterone) is not recommended in renal insufficiency due to accumulation of cyclodextrin excipient. Increases cyclosporine, digoxin, phenytoin, tacrolimus, warfarin, calcium channel blockers, theophylline, and quinidine levels. Amiodarone is a CYP P450 3A3/4 substrate and inhibits CYP 3A3/4, 2C9, and 2D6. Risk of rhabdomyolysis is increased when used with simvastatin at doses greater than 20 mg/24 hr and lovastatin at doses greater than 40 mg/24 hr. Serious symptomatic bradycardia has been reported when used with sofosbuvir.

Proposed therapeutic level with chronic oral use: 1–2.5 mg/L.

Asymptomatic corneal microdeposits should appear in all patients. Alters liver enzymes, thyroid function. Pulmonary fibrosis reported in adults. May cause worsening of preexisting arrhythmias with bradycardia and AV block. May also cause hypotension, anorexia, nausea, vomiting, dizziness, paresthesias, ataxia, tremor, SIADH, and hypothyroidism or hyperthyroidism. Drug rash with eosinophilia and systemic symptoms (DRESS) and acute respiratory distress syndrome have been reported.

AMIODARONE HCL continued

Correct hypokalemia, hypocalcemia or hypomagnesemia whenever possible before use as these conditions may exaggerate QTc prolongation.

Intravenous continuous infusion concentration for peripheral administration should not exceed 2 mg/mL and **must be** diluted with D₅W. The intravenous dosage form can leach out plasticizers such as DEHP. It is recommended to reduce the potential exposure to plasticizers in pregnant women and children at the toddler stages of development and younger by using alternative methods of IV drug administration.

Oral administration should be consistent with regards to meals because food increases the rate and extent of oral absorption.

AMITRIPTYLINE

Generics; previously available as Elavil

Antidepressant, tricyclic (TCA)



C



2



No



Yes



Yes

Tabs: 10, 25, 50, 75, 100, 150 mg

Oral syrup: 1 mg/mL

Antidepressant:

Child: Start with 1 mg/kg/24 hr ÷ TID PO for 3 days; then increase to 1.5 mg/kg/24 hr. Dose may be gradually increased to a **max. dose** of 5 mg/kg/24 hr if needed. Monitor ECG, BP, and heart rate (HR) for doses >3 mg/kg/24 hr.



Adolescent: 10 mg TID PO and 20 mg QHS; dose may be gradually increased up to a **max. dose** of 200 mg/24 hr if needed.

Adult: 40–100 mg/24 hr ÷ QHS-BID PO; dose may be gradually increased up to 300 mg/24 hr if needed; gradually decrease dose to lowest effective dose when symptoms are controlled.

Augment analgesia for chronic pain:

Child: Initial: 0.1 mg/kg/dose QHS PO; increase as needed and tolerated over 2–3 wk to 0.5–2 mg/kg/dose QHS

Migraine prophylaxis (limited data):

Child: Initial 0.1–0.25 mg/kg/dose QHS PO; increase as needed and tolerated every 2 wk by 0.1–0.25 mg/kg/dose up to a **max. dose** of 2 mg/kg/24 hr or 75 mg/24 hr. For doses >1 mg/kg/24 hr, divide daily dose BID and monitor ECG.

Adult: Initial 10–25 mg/dose QHS PO; reported range of 10–400 mg/24 hr.



Contraindicated in narrow-angle glaucoma, seizures, severe cardiac disorders, and patients who received MAO inhibitors within 14 days. See **Chapter 3** for management of TCA toxic ingestion.

T_{1/2} = 9–25 hr in adults. **Maximum** antidepressant effects may not occur for 2 wk or more after initiation of therapy. **Do not abruptly discontinue therapy in patients receiving high doses for prolonged periods.**

Therapeutic levels (sum of amitriptyline and nortriptyline): 100–250 ng/mL. Recommended serum sampling time: obtain a single level 8 hr or more after an oral dose (following 4–5 days of continuous dosing). Amitriptyline is a substrate for CYP 450 1A2, 2C9, 2C19, 2D6, and 3A3/4 and inhibitor for CYP 450 1A2, 2C19, 2C9, 2D6 and 2E1. Rifampin can decrease amitriptyline levels. Amitriptyline may increase side effects of tramadol.

Pharmacogenomic dosing considerations for CYP 2D6 and 2C19 phenotype (Clinical Pharmacology and Therapeutics. 2016;102[1]:37–44): see next page.

Continued

AMITRIPTYLINE *continued*

Phenotype	CYP 2D6 Ultra-Rapid Metabolizer	CYP 2D6 Normal Metabolizer	CYP 2D6 Intermediate Metabolizer	CYP 2D6 Poor Metabolizer
CYP 2C19 Ultra-rapid or Rapid Metabolizer	Avoid use; use alternative therapy	Consider alternative therapy not metabolized by CYP 2C19	Consider alternative therapy not metabolized by CYP 2C19	Avoid use; use alternative therapy
CYP 2C19 Normal Metabolizer	Avoid use but if use necessary, titrate to higher target dose	Use recommended initial dose	Consider a 25% initial dose reduction	Avoid use but if use necessary, consider 50% initial dose reduction
CYP 2C19 Intermediate Metabolizer	Avoid use; use alternative therapy	Use recommended initial dose	Consider a 25% initial dose reduction	Avoid use but if use necessary, consider 50% initial dose reduction
CYP 2C19 Poor Metabolizer	Avoid use; use alternative therapy	Avoid use but if use necessary, consider 50% initial dose reduction	Avoid use; use alternative therapy	Avoid use; use alternative therapy

Side effects include sedation, urinary retention, constipation, dry mouth, dizziness, drowsiness, liver enzyme elevation, and arrhythmia. May discolor urine (blue/green). QHS dosing during first weeks of therapy will reduce sedation. Monitor ECG, BP, CBC at start of therapy and with dose changes. Decrease dose if PR interval reaches 0.22 sec, QRS reaches 130% of baseline, HR rises greater than 140/min, or if BP is >140/90. Tricyclics may cause mania. **For antidepressant use, monitor for clinical worsening of depression and suicidal ideation/behavior following the initiation of therapy or after dose changes.**

AMLODIPINE Norvasc and generics <i>Calcium channel blocker, antihypertensive</i>					
	C	2	No	Yes	No

Tabs: 2.5, 5, 10 mg

Oral suspension: 1 mg/mL 

Child:

Hypertension: Start with 0.1 mg/kg/dose (**max. dose:** 5 mg) PO once daily—BID; dosage may be gradually increased to a **max. dose** of 0.6 mg/kg/24 hr up to 20 mg/24 hr. An effective antihypertensive dose for 6–17-yr-olds of 2.5–5 mg once daily has been reported and doses >5 mg have not been evaluated.

Adult:

Hypertension: 5–10 mg/dose once daily PO; use 2.5 mg/dose once daily PO in patients with hepatic insufficiency. **Max. dose:** 10 mg/24 hr.

AMLODIPINE *continued*

Use with caution in combination with other antihypertensive agents. Younger children (<6 yr) may require higher mg/kg doses than older children and adults. A BID dosing regimen may provide better efficacy in children.

Reduce dose in hepatic insufficiency. Allow 5–7 days of continuous initial dose therapy before making dosage adjustments because of the drug's gradual onset of action and lengthy elimination half-life. Amlodipine is a substrate for CYP 450 3A4 and **should be used with caution** with 3A4 inhibitors such as protease inhibitors and azole antifungals (e.g., fluconazole and ketoconazole). May increase levels and toxicity of cyclosporine, tacrolimus and simvastatin.

Dose-related side effects include edema, dizziness, flushing, fatigue, and palpitations. Other side effects include headache, nausea, abdominal pain, and somnolence.

Limited data reports amlodipine present in breast milk at low levels, undetectable in infant plasma with no adverse effects to breastfed infants.



C ? Yes Yes No

AMMONIUM CHLORIDE

Various generics

Diuretic, urinary acidifying agent**Injection:** 5 mEq/mL (26.75%) (20 mL); contains EDTA

1 mEq = 53 mg

Urinary acidification:**Child:** 75 mg/kg/24 hr ÷ Q6 hr IV; **max. dose:** 6 g/24 hr**Adult:** 1.5 g/dose Q6 hr IV**Drug administration:** Dilute to concentration \leq 0.4 mEq/mL. Infusion **not to exceed** 50 mg/kg/hr or 1 mEq/kg/hr.**Contraindicated** in severe hepatic or renal insufficiency and primary respiratory acidosis.**Use with caution** in infants.

May produce acidosis, hyperammonemia, and GI irritation. Monitor serum chloride level, acid/base status, and serum ammonia.

**AMMONUL**

See Sodium Phenylacetate + Sodium Benzoate

AMOXICILLIN

Various generics; previously available as Amoxil and Trimox

Antibiotic, aminopenicillin

B 1 Yes No No

Oral suspension: 125, 250 mg/5 mL (80, 100, 150 mL); and 200, 400 mg/5 mL (50, 75, 100 mL)**Caps:** 250, 500 mg**Tablets:** 500, 875 mg**Chewable tabs:** 125, 250 mg; may contain phenylalanine*Continued*

AMOXICILLIN continued**Neonate – ≤3 mo:** 20–30 mg/kg/24 hr ÷ Q12 hr PO**Child:****Standard dose:** 25–50 mg/kg/24 hr ÷ Q8–12 hr PO**High dose (resistant *Streptococcus pneumoniae*; see remarks):** 80–90 mg/kg/24 hr ÷ Q8–12 hr PO**Max. dose:** 2–3 g/24 hr; some experts recommend a **maximum** dosage up to 4 g/24 hr**Adult:****Mild/moderate infections:** 250 mg/dose Q8 hr PO OR 500 mg/dose Q12 hr PO**Severe infections:** 500 mg/dose Q8 hr PO OR 875 mg/dose Q12 hr PO**Max. dose:** 2–3 g/24 hr**Tonsillitis/pharyngitis (*S. pyogenes*):** 50 mg/kg/24 hr ÷ Q12 hr PO × 10 days; **max. dose:** 1 g/24 hr.**SBE prophylaxis:** administer dose 1 hr before procedure**Child:** 50 mg/kg PO × 1; **max.** 2 g/dose**Adult:** 2 g PO × 1**Early Lyme disease:****Child:** 50 mg/kg/24 hr ÷ Q8 hr PO × 14–21 days; **max. dose:** 1.5 g/24 hr**Adult:** 500 mg/dose Q8 hr PO × 14–21 daysRenal elimination. **Adjust dose in renal failure (see Chapter 31).** Serum levels about twice

those achieved with equal dose of ampicillin. Fewer GI effects, but otherwise similar to ampicillin. Side effects: rash and diarrhea. Rash may develop with concurrent EBV infection.

May increase warfarin's effect by increasing INR.

High-dose regimen is recommended in respiratory infections (e.g., CAP), acute otitis media, and sinusitis, owing to increasing incidence of penicillin resistant pneumococci. **Chewable tablets may contain phenylalanine and should not be used by phenylketonurics.****AMOXICILLIN-CLAVULANIC ACID**Augmentin, Augmentin ES-600, and generics;
previously available as Augmentin XR**Antibiotic, aminopenicillin with β-lactamase inhibitor**

B



1



Yes



No



No

Tabs:**For TID dosing:** 250, 500 mg (with 125 mg clavulanate);**For BID dosing:** 875 mg amoxicillin (with 125 mg clavulanate)**Extended-release tabs (previously available as Augmentin XR):** 1 g amoxicillin (with 62.5 mg clavulanate);**Chewable tabs:****For BID dosing (7:1 amoxicillin:clavulanate):** 200, 400 mg amoxicillin (28.5 and 57 mg clavulanate, respectively); contains saccharin and aspartame**Oral suspension:****For TID dosing (4:1 amoxicillin:clavulanate):** 125, 250 mg amoxicillin/5 mL (31.25 and 62.5 mg clavulanate/5 mL, respectively) (75, 100, 150 mL); contains saccharin**For BID dosing:****7:1 amoxicillin:clavulanate:** 200, 400 mg amoxicillin/5 mL (28.5 and 57 mg clavulanate/5 mL, respectively) (50, 75, 100 mL)**14:1 amoxicillin:clavulanate (Augmentin ES-600 and generics):** 600 mg amoxicillin/5 mL; contains 42.9 mg clavulanate/5 mL (75, 125, 200 mL); contains saccharin and/or aspartameContains 0.63 mEq K⁺ per 125 mg clavulanate (Augmentin ES-600 contains 0.23 mEq K⁺ per 42.9 mg clavulanate)

AMOXICILLIN-CLAVULANIC ACID continued

Dosage based on amoxicillin component (see remarks for resistant *S. pneumoniae*).

Infant 1–<3 mo: 30 mg/kg/24 hr ÷ Q12 hr PO (recommended dosage form is 125 mg/5 mL suspension)

Child ≥3 mo:

Non-high-dose amoxicillin regimens:

<40 kg:

TID dosing (see remarks): 20–40 mg/kg/24 hr ÷ Q8 hr PO

BID dosing (see remarks): 25–45 mg/kg/24 hr ÷ Q12 hr PO

≥40 kg: use adult dosage

High-dose amoxicillin regimens:

≥3 mo and <40 kg (use 14:1 amoxicillin:clavulanate dosage form, Augmentin ES-600 or generic oral suspension): 90 mg/kg/24 hr ÷ Q8–12 hr PO; Q8 hr recommended for CAP, orbital cellulitis, and severe infections

≥40 kg: use adult dosage

Adult: 250–500 mg/dose Q8 hr PO or 875 mg/dose Q12 hr PO for more severe and respiratory infections

Extended-release tablet:

≥16 yr and adult: 2 g Q12 hr PO × 10 days for acute bacterial sinusitis or × 7–10 days for community-acquired pneumonia

See Amoxicillin for additional comments. **Adjust dose in renal failure (see Chapter 31).**



Contraindicated in patients with a history of cholestatic jaundice/hepatic dysfunction associated with amoxicillin-clavulanic acid. Extended-release tablet dosage form is **contraindicated** in patients with CrCl <30 mL/min.

Clavulanic acid extends the activity of amoxicillin to include β-lactamase-producing strains of *Haemophilus influenzae*, *Moraxella catarrhalis*, *Neisseria gonorrhoeae*, and some *Staphylococcus aureus* and may increase the risk for diarrhea.

The BID dosing schedule is associated with less diarrhea. For BID dosing, the 875 mg, 1 g tablets, the 200 mg, 400 mg chewable tablets or the 200 mg/5mL, 400 mg/5 mL, 600 mg/5 mL suspensions should be used. These BID dosage forms contain phenylalanine and **should not be used** by phenylketonurics. For TID dosing, the 250 mg, 500 mg tablets, the 125 mg 250 mg chewable tablets or the 125 mg/5 mL, 250 mg/5 mL suspensions should be used.

Higher doses of 80–90 mg/kg/24 hr (amoxicillin component) have been recommended for resistant strains of *S. pneumoniae* in acute otitis media and pneumonia (use BID formulations containing 7:1 or 14:1 ratio of amoxicillin to clavulanic acid or Augmentin ES-600, respectively).

The 250 or 500 mg tablets **cannot** be substituted for Augmentin XR tablets.

AMPHETAMINE

Evekeo, Adzenys ER, Adzenys XR-ODT,

Dyanavel XR

CNS stimulant



C



3



No



No



No

Tabs, immediate release:

Evekeo and generics: 5, 10 mg; both tablets are scored

Extended-release dispersible tabs:

Adzenys XR-ODT: 3.1, 6.3, 9.4, 12.5, 15.7, 18.8 mg

Extended-release oral suspension:

Adzenys ER: 1.25 mg/mL (450 mL); contains parabens and propylene glycol

Dyanavel XR: 2.5 mg/mL (464 mL); contains parabens and polysorbate 80

Continued

AMPHETAMINE *continued*

DO NOT substitute extended-release formulations for other amphetamine products on a milligram per milligram basis due to differences in potency and pharmacokinetic profiles. If converting from other amphetamine products, discontinue that treatment first and titrate new dosage form as indicated in the drug dosage section.

Attention-deficit/hyperactivity disorder:**Immediate release tabs (Evekeo and generics; PO):**

3–5 yr: 2.5 mg/24 hr QAM; increase by 2.5 mg/24 hr at weekly intervals until desired response.

Incremental dosages may be administered BID-TID with the first dose at awakening and subsequent doses spaced at 4–6 hr intervals. Doses rarely exceed 40 mg/24 hr.

≥6 yr and adolescent: 5 mg once daily or BID; increase by 5 mg/24 hr at weekly intervals until desired response. Incremental dosages may be administered BID-TID with the first dose at awakening and subsequent doses spaced at 4–6 hr intervals. Doses rarely exceed 40 mg/24 hr.

Extended-release suspension (see how supplied section, earlier):

Product	Dosage (PO)	Maximum Daily Dosage
Adzenys ER ^a	6–17 yr: Start at 6.25 mg/24 hr QAM; increase by 3.125–6.25 mg every 7 days until desired response up to the maximum dose	6–12 yr: 18.75 mg/24 hr 13–17 yr: 12.5 mg/24 hr
Dyanavel XR	≥6 yr and adolescent: Start at 2.5 or 5 mg/24 hr QAM; increase by 2.5–10 mg/24 hr every 4–7 days until desired response up to a maximum dose	20 mg/24 hr

^aIf converting from Adderall XR, see dosage equivalent information in Adzenys ER product information.

Extended-release dispersible tabs (see how supplied section, earlier; Adzenys XR-ODT; PO):

6–17 yr: 6.3 mg/24 hr QAM; increase by 3.1 or 6.3 mg/24 hr at weekly intervals until desired response. **Maximum** dose: 6–12 yr: 18.8 mg/24 hr; 13–17 yr: 12.5 mg/24 hr.

Adult: 12.5 mg/24 hr QAM

If converting from Adderall XR, see dosage equivalent information in Adzenys XR-ODT product information.

Narcolepsy:**Immediate release tabs (Evekeo and generics; PO):**

6–12 yr: 5 mg QAM; increase by 5 mg/24 hr at weekly intervals until desired response. Incremental doses may be administered with the first dose at awakening and subsequent doses (5 or 10 mg) spaced at 4–6 hr intervals. Usual daily dosage range: 5–60 mg/24 hr in divided doses.

≥13 yr and adult: 10 mg QAM; increase by 10 mg/24 hr at weekly intervals until desired response.

Incremental doses may be administered with the first dose at awakening and subsequent doses (5 or 10 mg) spaced at 4–6 hr intervals. Usual daily dosage range: 5–60 mg/24 hr in divided doses.

Use with caution in presence of hypertension or cardiovascular disease. **Avoid use** in known serious structural cardiac abnormalities, cardiomyopathy, serious heart rhythm abnormalities, coronary artery disease, or other serious cardiac problems that may increase risk of sympathomimetic effects of amphetamines (sudden death, stroke, and MI have been reported). **Contraindicated** with MAO inhibitors, including linezolid and IV methylene blue, as a hypertensive crisis may occur if used within 14 days of discontinuance of MAO inhibitor. Serotonin syndrome may occur with used in combination with MAO inhibitors, SSRIs, serotonin norepinephrine reuptake inhibitors (SNRIs), triptans, TCAs, fentanyl, lithium, tramadol, tryptophan, buspirone and St. John's Wort.

Amphetamine is a minor substrate of CYP 450 2D6. Alkalizing agents should be **avoided** as they can increase the effects/toxicity of amphetamine by decreasing its secretion. **Avoid use** of GI acid blockers (e.g., PPIs) with Adzenys ER as amphetamine dose dumping may occur.



AMPHETAMINE *continued*

Not recommended for patients <3 yr of age. Medication should generally not be used in children <5 yr, because diagnosis of ADHD in this age group is extremely difficult (use in consultation with a specialist). Interrupt administration occasionally to determine need for continued therapy.

Common side effects include headache, insomnia, anorexia (monitor growth), abdominal pain, anxiety, mood swings, and agitation. Psychotic disorder, peripheral vascular disease (including Raynaud phenomenon), and cerebrovascular accident have been reported.

Evekeo has an additional labeled indication for the treatment of exogenous obesity in ≥12 yr and adults. Doses may be administered with or without food. **Do not** crush or chew the extended-release dispersible tabs (Adzenys XR-ODT). Shake oral suspension bottle (Adzenys ER and Dyanavel XR) well before dispensing and administering each dose.

AMPHOTERICIN B (CONVENTIONAL)

Various generics; previously available as Fungizone

Antifungal, polyene



B

?

Yes

Yes

No

Injection: 50 mg vials

IV: mix with D₅W to concentration 0.1 mg/mL (peripheral administration) or 0.25 mg/mL (central line only). pH >4.2. Infuse over 2–6 hr.



Optional test dose: 0.1 mg/kg/dose IV up to **max. dose** of 1 mg (followed by remaining initial dose).

Initial dose: 0.5–1 mg/kg/24 hr; if test dose NOT used infuse first dose over 6 hr and monitor frequently during the first several hours.

Increment: Increase as tolerated by 0.25–0.5 mg/kg/24 hr once daily or every other day. Use larger dosage increment (0.5 mg once daily) for critically ill patients.

Usual maintenance:

Once daily dosing: 0.5–1 mg/kg/24 hr once daily

Every other day dosing: 1.5 mg/kg/dose every other day

Max. dose: 1.5 mg/kg/24 hr

Intrathecal (limited data): 25–100 mCg Q48–72 hr. Increase to 500 mCg as tolerated. Dosages as high as 1500 mCg have been recommended by the 2018 AAP Red Book.

Bladder irrigation for urinary tract mycosis (limited data): 5–15 mg in 100 mL sterile water for irrigation at 100–300 mL/24 hr. Instill solution into bladder, clamp catheter for 1–2 hr then drain; repeat TID–QID for 2–5 days.



Monitor renal, hepatic, electrolyte, and hematologic status closely. Hypercalcuria, hypokalemia, hypomagnesemia, RTA, renal failure, acute hepatic failure, hypotension, and phlebitis may occur. **For dosing information in renal failure, see Chapter 31.**

Common infusion-related reactions include fever, chills, headache, hypotension, nausea, and vomiting; may premedicate with acetaminophen and diphenhydramine 30 min before and 4 hr after infusion. Meperidine useful for chills. Hydrocortisone, 1 mg/mg ampho (**max.:** 25 mg) added to bottle may help to prevent immediate adverse reactions. Use total body weight for obese patients when calculating dosages.

Salt loading with 10–15 mL/kg of NS infused prior to each dose may minimize the risk of nephrotoxicity. Maintaining sodium intake of >4 mEq/kg/24 hr in premature neonates may also reduce risk for nephrotoxicity. Nephrotoxic drugs such as aminoglycosides, chemotherapeutic agents, and cyclosporine may result in synergistic toxicity. Hypokalemia may increase the toxicity of neuromuscular blocking agents and cardiac glycosides.

Although there is no breast-feeding data for amphotericin, many experts believe it is compatible since the drug is highly protein bound, has a large molecular weight and is not absorbed orally.

AMPHOTERICIN B LIPID COMPLEX

Abelcet, ABLC

Antifungal, polyene

B



?



Yes



Yes



No

Injection: 5 mg/mL (20 mL)

(formulated as a 1:1 molar ratio of amphotericin B to lipid complex comprised of dimyristoylphosphatidylcholine and dimyristoylphosphatidylglycerol)

IV: 3–5 mg/kg/24 hr once daily

For visceral leishmaniasis that failed to respond to or relapsed after treatment with antimony compound, a dosage of 1–3 mg/kg/24 hr once daily × 5 days has been used.

Mix with D₅W to concentration 1 or 2 mg/mL for fluid restricted patients.**Infusion rate:** 2.5 mg/kg/hr; shake the infusion bag every 2 hr if total infusion time exceeds 2 hr. **Do not** use an in-line filter.

Monitor renal, hepatic, electrolyte, and hematologic status closely. Thrombocytopenia, anemia, leukopenia, hypokalemia, hypomagnesemia, diarrhea, respiratory failure, skin rash, nephrotoxicity, and increases in liver enzymes and bilirubin may occur. See conventional amphotericin for drug interactions.

Highest concentrations achieved in spleen, lung, and liver from human autopsy data from one heart transplant patient. CNS/CSF levels are lower than amphotericin b, liposomal (AmBisome).

In animal models, concentrations are higher in the liver, spleen, and lungs but the same in the kidneys when compared with conventional amphotericin B. Pharmacokinetics in renal and hepatic impairment have not been studied.

Common infusion-related reactions include fever, chills, rigors, nausea, vomiting, hypotension, and headache; may premedicate with acetaminophen, diphenhydramine and meperidine (see Conventional *Amphotericin B* remarks).**AMPHOTERICIN B, LIPOSOMAL**

AmBisome

Antifungal, polyene

B



?



Yes



No

Injection: 50 mg (vials); contains soy, 900 mg sucrose(formulated in liposomes composed of hydrogenated soy phosphatidylcholine, cholesterol, distearoylphosphatidylglycerol, and α -tocopherol)**Systemic fungal infections:** 3–5 mg/kg/24 hr IV once daily; an upper dosage limit of 10 mg/kg/24 hr has been suggested based on pharmacokinetic endpoints and risk for hypokalemia. However, dosages as high as 15 mg/kg/24 hr have been used. Dosages as high as 10 mg/kg/24 hr have been used in patients with Aspergillus.**Empiric therapy for febrile neutropenia:** 3 mg/kg/24 hr IV once daily**Cryptococcal meningitis in HIV:** 6 mg/kg/24 hr IV once daily**Leishmaniasis (a repeat course may be necessary if infection does not clear):****Immunocompetent:** 3 mg/kg/24 hr IV on days 1 to 5, 14, and 21**Immunocompromised:** 4 mg/kg/24 hr IV on days 1 to 5, 10, 17, 24, 31, and 38.Mix with D₅W to concentration 1–2 mg/mL (0.2–0.5 mg/mL may be used for infants and small children).**Infusion rate:** Administer dose over 2 hr; infusion may be reduced to 1 hr if well tolerated. A ≥1-micron inline filter may be used.

AMPHOTERICIN B, LIPOSOMAL *continued*

Closely monitor renal, hepatic, electrolyte, and hematologic status. Thrombocytopenia, anemia, leukopenia, tachycardia, hypokalemia, hypomagnesemia, hypocalcemia, hyperglycemia, diarrhea, dyspnea, skin rash, low back pain, nephrotoxicity, and increases in liver enzymes and bilirubin may occur. Rhabdomyolysis has been reported. Safety and effectiveness in neonates have not been established. See conventional amphotericin for drug interactions.

Compared with conventional amphotericin B, higher concentrations found in the liver and spleen; and similar concentrations found in the lungs and kidney. CNS/CSF concentrations are higher than other amphotericin B products. Pharmacokinetics in renal and hepatic impairment have not been studied.

Common infusion-related reactions include fever, chills, rigors, nausea, vomiting, hypotension, and headache; may premedicate with acetaminophen, diphenhydramine, and meperidine (see Conventional Amphotericin B remarks).

False elevations of serum phosphate have been reported with the PHOSm assay (used in Beckman Coulter analyzers).

AMPICILLIN

Many generics

Antibiotic, aminopenicillin

B



1



Yes



No



No

Caps: 500 mg**Injection:** 125, 250, 500 mg; 1, 2, 10 g

Contains 3 mEq Na/1 g IV drug

Neonate (IM/IV):

<7 days:

<2 kg: 100 mg/kg/24 hr ÷ Q12 hr

≥2 kg: 150 mg/kg/24 hr ÷ Q8 hr

Group B streptococcal meningitis: 200–300 mg/kg/24 hr ÷ Q8 hr

≥7 days:

<1.2 kg: 100 mg/kg/24 hr ÷ Q12 hr

1.2–2 kg: 150 mg/kg/24 hr ÷ Q8 hr

>2 kg: 200 mg/kg/24 hr ÷ Q6 hr

Group B streptococcal meningitis: 300 mg/kg/24 hr ÷ Q4–6 hr**Infant/child (see remarks):****Mild-moderate infections:****IM/IV:** 100–200 mg/kg/24 hr ÷ Q6 hr**PO:** 50–100 mg/kg/24 hr ÷ Q6 hr; **max. PO dose:** 4 g/24 hr**Severe infections:** 200–400 mg/kg/24 hr ÷ Q4–6 hr IM/IV; **max. dose:** 12 g/24 hr**Community-acquired pneumonia in a fully immunized patient (IV/IM):****S. pneumoniae penicillin MIC ≤2.0 or H. influenzae (β-lactamase negative):** 150–200 mg/kg/24 hr ÷ Q6 hr**S. pneumoniae penicillin MIC ≥4.0:** 300–400 mg/kg/24 hr ÷ Q6 hr**Max. IV/IM dose:** 12 g/24 hr**Adult:****IM/IV:** 500–3000 mg Q4–6 hr**PO:** 250–500 mg Q6 hr**Max. IV/IM dose:** 14 g/24 hr*Continued*

AMPICILLIN continued**SBE prophylaxis:****Moderate risk patients:**

Child: 50 mg/kg/dose (**max. dose:** 2 g/dose) \times 1 IV/IM 30 min before procedure

Adult: 2 g/dose \times 1 IV/IM 30 min before procedure

High risk patients with GU and GI procedures: Aforementioned doses PLUS gentamicin 1.5 mg/kg \times 1 (**max. dose:** 120 mg) IV within 30 min of starting procedure. Followed by ampicillin 25 mg/kg/dose IV (or PO amoxicillin) \times 1, 6 hr later.

Use higher doses with shorter dosing intervals to treat CNS disease and severe infection. CSF penetration occurs only with inflamed meninges. **Adjust dose in renal failure (see Chapter 31).**

Produces the same side effects as penicillin, with cross-reactivity. Rash commonly seen at 5–10 days and rash may occur with concurrent EBV infection or allopurinol use. May cause interstitial nephritis, diarrhea, and pseudomembranous enterocolitis. Chloroquine reduces ampicillin's oral absorption.

AMPICILLIN/SULBACTAM

Unasyn and generics

Antibiotic, aminopenicillin with β -lactamase inhibitor



B

1

Yes

Yes

No

Injection:

1.5 g = ampicillin 1 g + sulbactam 0.5 g

3 g = ampicillin 2 g + sulbactam 1 g

15 g = ampicillin 10 g + sulbactam 5 g

Contains 5 mEq Na per 1.5 g drug combination

Dosage based on ampicillin component:**Neonate:**

Premature (based on pharmacokinetic data): 100 mg/kg/24 hr \div Q12 hr IM/IV

Full term: 100 mg/kg/24 hr \div Q8 hr IM/IV

Infant \geq 1 mo and child (see remarks):

Mild/moderate infections: 100–200 mg/kg/24 hr \div Q6 hr IM/IV; **max. dose:** 2 g ampicillin/dose

Meningitis/severe infections: 200–400 mg/kg/24 hr \div Q4–6 hr IM/IV; **max. dose:** 2 g ampicillin/dose

Adult: 1–2 g Q6–8 hr IM/IV

Max. dose: 8 g ampicillin/24 hr

Similar spectrum of antibacterial activity to ampicillin with the added coverage of β -lactamase producing organisms. Total sulbactam dose **should not exceed** 4 g/24 hr.

Use higher doses with shorter dosing intervals to treat CNS disease and severe infection. Hepatic dysfunction, including hepatitis and cholestatic jaundice, has been reported. Monitor hepatic function in patients with hepatic impairment.

Adjust dose in renal failure (see Chapter 31). Similar CSF distribution and side effects to ampicillin.

Postmarketing adverse reactions reported include abdominal pain, melena, gastritis, stomatitis, dyspepsia, black hairy tongue, dizziness, dyspnea, TEN, and urticaria.

ANTIPYRINE AND BENZOCAINE (OTIC)

Antipyrine and Benzocaine Otic and many generics; previously available as Auralgan

Otic analgesic, cerumenolytic



C

2

No

No

No

Otic solution: antipyrine 5.4%, benzocaine 1.4% (15 mL); may contain oxyquinoline sulfate

Otic analgesia: Fill external ear canal (2–4 drops) Q1–2 hr PRN. After instillation of the solution, a cotton pledge should be moistened with the solution and inserted into the meatus.

1 Egypt for 10 days.

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ANTIPYRINE AND BENZOCAINE (OTIC) continued

Benzocaine sensitivity may develop and not intended for prolonged use. **Contraindicated** if tympanic membrane perforated or PE tubes in place. Local reactions (e.g., burning, stinging) and hypersensitivity reactions may occur. Risk of benzocaine-induced methemoglobinemia may be increased in infants aged ≤ 3 mo.

**ARGININE CHLORIDE—INJECTABLE PREPARATION**

R-Gene 10

Metabolic alkalosis agent, urea cycle disorder treatment agent, growth hormone diagnostic agent



B



?



Yes



Yes



No

Injection: 10% (100 mg/mL) arginine hydrochloride, contains 47.5 mEq chloride per 100 mL (300 mL)

Osmolality: 950 mOsmol/L



Used as a secondary alternative agent for patients that are unresponsive or unable to receive sodium chloride and potassium chloride.

Correction of hypochloremia: Arginine chloride dose in milliequivalents (mEq) = $0.2 \times$ patient's weight (kg) $\times (103 - \text{patient's serum chloride in mEq/L})$. Administer $\frac{1}{2}$ to $\frac{2}{3}$ of the calculated dose and reassess.

Drug administration: Do not exceed an IV infusion rate of 1 g/kg/hr (4.75 mEq/kg/hr). Drug may be administered without further dilution but should be diluted to reduce risk of tissue irritation.

Hyperammonemia in metabolic disorders: See Chapter 13



Contraindicated in renal or hepatic failure. Use with **extreme caution** as overdoses may result in hyperchloremic metabolic acidosis, cerebral edema, and death. Hypersensitivity reactions, including anaphylaxis, and hematuria have been reported.

Arginine hydrochloride is metabolized to nitrogen-containing products for renal excretion. Excess arginine increases the production of nitric oxide (NO) to cause vasodilation/hypotension. Closely monitor acid/base status. Hyperglycemia, hyperkalemia, GI disturbances, IV extravasation, headache, and flushing may occur.

In addition to its use for chloride supplementation, arginine is used in urea cycle disorder therapy (increase arginine levels and prevent breakdown of endogenous proteins) and as a diagnostic agent for growth hormone (stimulates pituitary release of growth hormone).

ARIPIPRAZOLE

Abilify, Abilify Maintena, Abilify MyCite, and generics

Atypical antipsychotic (2nd generation)



C



3



No



No



Yes

Tabs: 2, 5, 10, 15, 20, 30 mg

Ability MyCite: 2, 5, 10, 15, 20, 30 mg; contains an ingestible event marker sensor inside the tablet to monitor adherence

Tabs, orally disintegrating (ODT): 10, 15 mg; contains phenylalanine

Oral solution: 1 mg/mL (150, 237 mL); may contain parabens

Intramuscular suspension for injection (extended release):

Ability Maintena: 300, 400 mg



Irritability Associated with Autistic Disorder:

6–17 yr: Start at 2 mg PO once daily \times 7 days, then increase to 5 mg PO once daily. If needed, dose may be increased in 5 mg increments \geq 7 days in duration up to a **maximum** dose of 15 mg/24 hr. Patients should be periodically evaluated to determine the continued need for maintenance treatment.

Continued

ARIPIPRAZOLE *continued****Schizophrenia:***

13–17 yr: Start at 2 mg PO once daily \times 2 days, followed by 5 mg PO once daily \times 2 days, then to the recommended target dose of 10 mg PO once daily. If necessary, dose may be increased in 5 mg increments up to a **maximum** of 30 mg/24 hr (30 mg/24 hr was not shown to be more effective than 10 mg/24 hr in clinical trials). Patients should be periodically evaluated to determine the continued need for maintenance treatment.

Bipolar 1 disorder (monotherapy or adjunctive therapy):

10–17 yr: Start at 2 mg PO once daily \times 2 days, followed by 5 mg PO once daily \times 2 days, then to the recommended target dose of 10 mg PO once daily. If necessary, dose may be increased in 5 mg increments up to a **maximum** of 30 mg/24 hr.

Tourette Disorder:

6–18 yr (Patients should be periodically evaluated to determine the continued need for maintenance treatment):

<50 kg: Start at 2 mg PO once daily \times 2 days, then increase to the target dose of 5 mg PO once daily. If necessary after 7 days, dose may be increased to 10 mg PO once daily.

≥ 50 kg: Start at 2 mg PO once daily \times 2 days, followed by 5 mg PO once daily \times 5 days, and then 10 mg PO once daily. If necessary after 7 days, dose may be increased in 5 mg increments of ≥ 7 days in duration **up to a maximum** of 20 mg/24 hr.

Monitor for clinical worsening of depression and suicidal ideation/behavior after initiation of therapy or after dose changes. **Avoid** use of extended-release IM injection with CYP 450 inducers, including carbamazepine, for >14 days. Higher cumulative doses and longer treatment duration may increase risk for irreversible tardive dyskinesia.



Weight gain, constipation, GI discomfort, akathisia, dizziness, extrapyramidal symptoms, headaches, insomnia, sedation, blurred vision, and fatigue are common. May cause leukopenia, neutropenia, agranulocytosis, hiccups, hyperthermia, neuroleptic malignant syndrome, hyperglycemia, orthostatic hypotension (risk for falls), and prolongation of the QT interval (use considered contraindicated with other medications prolonging the QT interval). Rare impulse-control problems such as compulsive or uncontrollable urges to gamble, binge eat, shop, and have sex has been reported.

Primarily metabolized by the CYP 450 2D6 and 3A4 enzymes. Dosage reduction for using half of the usual dose has been recommended for those who are either known CYP 450 2D6 poor metabolizers; or nonpoor CYP 450 2D6 metabolizers taking strong CYP 450 2D6 (e.g., quinidine, fluoxetine, paroxetine) or 3A4 (e.g., itraconazole, clarithromycin) inhibitors. Use of $\frac{1}{4}$ the usual dose has been recommended for known CYP 2D6 poor metabolizers taking either a strong 2D6 or 3A4 inhibitor; or nonpoor CYP 450 2D6 metabolizers taking both strong 2D6 AND 3A4 inhibitors.

Consult with a pediatric psychiatrist for use in ADHD, conduct disorder, and PDD-NOS. Oral doses may be administered with or without meals. Do not split orally disintegrating tablet dosage form.

ARNUTY ELLIPTA

See Fluticasone Preparations

ASCORBIC ACID

Vitamin C and many others
Water soluble vitamin



Tabs [OTC]: 100, 250, 500 mg, 1, g

Chewable tabs (Sunkist Vitamin C and others) [OTC]: 100, 250, 500 mg; some may contain aspartame

Tabs (timed release) [OTC]: 0.5, 1, 1.5 g

Caps [OTC]: 500, 1000 mg

Extended-release caps [OTC]: 500, 1000 mg

Injection: 500 mg/mL (50 mL); may contain sodium hyrosulfite or edetate disodium

Oral liquid [OTC]: 500 mg/5 mL (236, 473 mL); may contain propylene glycol, saccharin, sodium benzoate

Oral syrup [OTC]: 500 mg/5 mL (118 mL)

Crystals [OTC]: 1 g per 1/4 teaspoonful (120 g, 480 g)

Some products may contain approximately 5 mEq Na/1 g ascorbic acid

**Scurvy (PO/IM/IV/SC):**

Child: 100–300 mg/24 hr ÷ once daily-BID for at least 2 wk

Adult: 100–250 mg once daily-BID for at least 2 wk

**U.S. Recommended Daily Allowance (RDA):**

See Chapter 21.

Adverse reactions: nausea, vomiting, heartburn, flushing, headache, faintness, dizziness, and hyperoxaluria. Use high doses with **caution** in G6PD patients. May cause false-negative and false-positive urine glucose determinations with glucose oxidase and cupric sulfate tests, respectively.

May increase the absorption of aluminum hydroxide and increase the adverse/toxic effects of deferoxamine. May reduce the effects of amphetamines.

Oral dosing is preferred with or without food. IM route is the preferred parenteral route. Protect the injectable dosage form from light.

Pregnancy Category changes to “C” if used in doses greater than the RDA.

ASPIRIN

ASA, various trade names and generics
Nonsteroidal antiinflammatory agent, antiplatelet agent, analgesic



Tabs/Caplet [OTC]: 325, 500 mg

Tabs, enteric-coated [OTC]: 81, 325, 500, 650 mg

Tabs, time-release [OTC]: 81, 325 mg

Tabs, buffered [OTC]: 325 mg; may contain magnesium, aluminum, and/or calcium

Caplet, buffered [OTC]: 500 mg; may contain magnesium, aluminum, and/or calcium

Tabs, chewable [OTC]: 81 mg

Suppository [OTC]: 300, 600 mg (12s)



Analgesic/antipyretic: 10–15 mg/kg/dose PO/PR Q4–6 hr up to total of 60–80 mg/kg/24 hr

Max. dose: 4 g/24 hr

Antiinflammatory: 60–100 mg/kg/24 hr PO ÷ Q6–8 hr

Kawasaki disease (see remarks): 80–100 mg/kg/24 hr PO ÷ QID during febrile phase up until defervesces for 48–72 hr then decrease to 3–5 mg/kg/24 hr PO QAM. Continue for at least 8 wk or until both platelet count and ESR are normal.

ASPIRIN *continued*

Do not use in children <16 yr for treatment of varicella or flulike symptoms (risk for Reye syndrome), in combination with other NSAIDs, or in severe renal failure. **Use with caution** in bleeding disorders, renal dysfunction, gastritis, and gout. May cause GI upset, allergic reactions, liver toxicity, and decreased platelet aggregation.

Drug interactions: may increase effects of methotrexate, valproic acid, and warfarin which may lead to toxicity (protein displacement). Buffered dosage forms may decrease absorption of ketoconazole and tetracycline. GI bleeds have been reported with concurrent use of SSRIs (e.g., fluoxetine, paroxetine, sertraline).

A moderate initial febrile phase dosage of 30–50 mg/kg/24 hr PO ÷ QID for Kawasaki disease is used in Japan and Western Europe because there are no data to suggest this or the higher dosage regimen is superior.

Therapeutic levels: antipyretic/analgesic: 30–50 mg/L, antiinflammatory: 150–300 mg/L. Tinnitus may occur at levels of 200–400 mg/L. Recommended serum sampling time at steady state: obtain trough level just prior to dose following 1–2 days of continuous dosing. Peak levels obtained 2 hr (for nonsustained release dosage forms) after a dose may be useful for monitoring toxicity. **Adjust dose in renal failure (see Chapter 31).**

For breast-feeding considerations:

High-dose aspirin regimens: use an alternative drug is recommended.

Low-dose (75–162 mg/24 hr) aspirin regimens: avoid breastfeeding for 1–2 hr after a dose.

**ATENOLOL**

Tenormin and generics

β_1 selective adrenergic blocker



D



2



Yes



No



No

Tab: 25, 50, 100 mg

Oral suspension: 2 mg/mL

Hypertension:

Child and adolescent: 0.5–1 mg/kg/dose PO once daily–BID; **max. dose:** 2 mg/kg/24 hr up to 100 mg/24 hr.



Adult: 25–100 mg/dose PO once daily; **max. dose:** 100 mg/24 hr

Contraindicated in pulmonary edema and cardiogenic shock. May cause bradycardia, hypotension, second- or third-degree AV block, dizziness, fatigue, lethargy, and headache.



Use with caution in diabetes and asthma. Wheezing and dyspnea have occurred when daily dosage exceeds 100 mg/24 hr. Postmarketing evaluation reports a temporal relationship for causing elevated LFTs and/or bilirubin, hallucinations, psoriatic rash, thrombocytopenia, visual disturbances, and dry mouth. **Avoid** abrupt withdrawal of the drug. Does not cross the blood-brain barrier; lower incidence of CNS side effects compared with propranolol. Neonates born to mothers receiving atenolol during labor or while breastfeeding may be at risk for hypoglycemia.

Use with disopyramide, amiodarone or digoxin may enhance bradycardic effects. **Adjust dose in renal impairment (see Chapter 31).**

ATOMOXETINE

Strattera

Norepinephrine reuptake inhibitor, ADHD agent**Capsules:** 10, 18, 25, 40, 60, 80, 100 mg**Child ≥6 yr and adolescent ≤70 kg (see remarks):**

Start with 0.5 mg/kg/24 hr PO QAM and increase after a minimum of 3 days to approximately 1.2 mg/kg/24 hr PO ÷ QAM or BID (morning and late afternoon/early evening).

Max. daily dose: 1.4 mg/kg/24 hr or 100 mg, whichever is less.

If used with a strong CYP 450 2D6 inhibitor (e.g., fluoxetine, paroxetine, quinidine) or in patients with reduced CYP 450 2D6 activity: Maintain aforementioned initial dose for 4 wk and increase to a max. of 1.2 mg/kg/24 hr only if symptoms do not improve and initial dose is tolerated.

**Child ≥6 yr and adolescent >70 kg (see remarks):**

Start with 40 mg PO QAM and increase after a minimum of 3 days to approximately 80 mg/24 hr PO ÷ QAM or BID (morning and late afternoon/early evening). After 2–4 wk, dose may be increased to a max. of 100 mg/24 hr if needed.

If used with a strong CYP 450 2D6 inhibitor (e.g., fluoxetine, paroxetine, quinidine) or in patients with reduced CYP 450 2D6 activity: Maintain aforementioned initial dose for 4 wk and increase to 80 mg/24 hr only if symptoms do not improve and initial dose is tolerated.



Contraindicated in patients with narrow-angle glaucoma, pheochromocytoma, and severe cardiac disorders. **Do not** administer with or within 2 wk after discontinuing an MAO inhibitor; fatal reactions have been reported. **Use with caution** in hypertension, tachycardia, cardiovascular or cerebrovascular diseases, or with concurrent albuterol therapy. Increased risk of suicidal thinking has been reported; closely monitor for clinical worsening, agitation, aggressive behavior, irritability, suicidal thinking or behaviors, and unusual changes in behavior when initiating (first few months) or at times of dose changes (increases or decreases). Atomoxetine is a CYP 450 2D6 substrate; poor 2D6 metabolizers compared with normal has been reported to have higher rates of adverse effects (insomnia, weight loss, constipation, depression, tremor, and excoriation), greater improvement of ADHD symptoms with lower final dose requirements. Alopecia and hyperhidrosis have been reported.

Doses >1.2 mg/kg/24 hr in patients ≤70 kg have not been shown to be of additional benefit. Reduce dose (initial and target doses) by 50% and 75% for patients with moderate (Child-Pugh Class B) and severe (Child-Pugh Class C) hepatic insufficiency, respectively.

Major side effects include GI discomfort, vomiting, fatigue, anorexia, dizziness, and mood swings. Hypersensitivity reactions, aggression, irritability, priapism, allergic reactions, and severe liver injury have also been reported. Consider interrupting therapy in patients who are not growing or gaining weight satisfactorily.

Doses may be administered with or without food. Atomoxetine can be discontinued without tapering.

ATOVACUONE

Mepron and generics

Antiprotozoal**Oral suspension:** 750 mg/5 mL (210 mL); contains benzyl alcohol*Continued*

ATOVAQUONE continued***Pneumocystis jiroveci (carinii) pneumonia (PCP):*****Treatment (21-day course):**

Child: 30–40 mg/kg/24 hr PO ÷ BID with fatty foods; **max. dose:** 1500 mg/24 hr. Infants

3–24 mo may require higher doses of 45 mg/kg/24 hr.

Adult: 750 mg/dose PO BID

Prophylaxis (1st episode and recurrence):

Child 1–3 mo or >24 mo: 30 mg/kg/24 hr PO once daily; **max. dose:** 1500 mg/24 hr

Child 4–24 mo: 45 mg/kg/24 hr PO once daily; **max. dose:** 1500 mg/24 hr

Adult: 1500 mg/dose PO once daily

Toxoplasma gondii:**Child:**

First episode prophylaxis and recurrence prophylaxis: use *P. jiroveci* prophylaxis dosages ± pyrimethamine 1 mg/kg/dose (**max.** 25 mg/dose) PO once daily PLUS leucovorin 5 mg PO Q3 days.

Adult:

Treatment: 1500 mg/dose PO BID ± (sulfadiazine 1000–1500 mg PO Q6 hr or pyrimethamine PLUS leucovorin).

First episode prophylaxis: 1500 mg/dose PO once daily ± pyrimethamine 25 mg PO once daily PLUS leucovorin 10 mg PO once daily.

Recurrence prophylaxis: 750 mg/dose PO Q6–12 hr ± pyrimethamine 25 mg PO once daily PLUS leucovorin 10 mg PO once daily.

Not recommended in the treatment of severe *P. jiroveci* (lack of clinical data). Patients with

GI disorders or severe vomiting and who cannot tolerate oral therapy should consider alternative IV therapies. Rash, pruritus, sweating, GI symptoms, LFT elevation, dizziness, headache, insomnia, anxiety, cough, and fever are common. Anemia, Stevens-Johnson syndrome, hepatitis, renal/urinary disorders, and pancreatitis have been reported.

Metoclopramide, rifampin, rifabutin, and tetracycline may decrease atovaquone levels. Shake oral suspension well before dispensing all doses. Take all doses with high-fat foods to maximize absorption.

ATROPINE SULFATE

AtroPen, and many generic products

Anticholinergic agent



C



2



No



No



No

Injection (vials): 0.4, 1 mg/mL

Injection (prefilled syringe): 0.25 mg/5 mL, 0.5 mg/5 mL, 1 mg/10 mL

Injection (autoinjector for IM use):

AtroPen 0.25 mg: delivers a single 0.25 mg (0.3 mL) dose (yellow colored pen)

AtroPen 0.5 mg: delivers a single 0.5 mg (0.7 mL) dose (blue colored pen)

AtroPen 1 mg: delivers a single 1 mg (0.7 mL) dose (dark red colored pen)

AtroPen 2 mg: delivers a single 2 mg (0.7 mL) dose (green colored pen)

Ophthalmic Dosage Forms:

Ointment: 1% (3.5 g)

Solution: 1% (2, 5, 15 mL)

Preintubation dose (use 1 mg/mL concentration for IM route; see remarks):

Neonate: 0.01–0.02 mg/kg/dose IV (over 1 min)/IM prior to other premedications.

Child: 0.02 mg/kg/dose IV/IO/IM; **max. dose:** 0.5 mg/dose

Adult: 0.5 mg/dose IV/IM

Cardiopulmonary resuscitation/bradycardia (see remarks):

Child: 0.02 mg/kg/dose IV/IO/IM (use 1 mg/mL for IM) Q5 min × 2–3 doses PRN; **max. single dose:**

0.5 mg in children, 1 mg in adolescents; **max total dose:** 1 mg children, 2 mg adolescents

Dyptang

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ATROPINE SULFATE *continued*

Bronchospasm: 0.025–0.05 mg/kg/dose (**max. dose:** 2.5 mg/dose) in 2.5 mL NS Q6–8 hr via nebulizer
Nerve agent and insecticide poisoning for muscarinic symptoms (organophosphate or carbamate poisoning) (IV/IO/IM/ET; dilute in 1–2 mL NS for ET administration):

Child: 0.05–0.1 mg/kg Q 5–10 min until bronchial or oral secretions terminate.

Adolescent: 1–3 mg/dose Q 3–5 min until bronchial or oral secretions terminate.

Adult: 2–5 mg/dose Q3–5 min until bronchial or oral secretions terminate.

AtroPen device (IM route): Inject as soon as exposure is known or suspected. Give one dose for mild symptoms and two additional doses (total three doses) in rapid succession 10 min after the first dose for severe symptoms as follows:

Child <6 mo (<7 kg): 0.25 mg

Child 6 mo–4 yr (7–18 kg): 0.5 mg

Child 4–10 yr (18–41 kg): 1 mg

Child >10 yr and adult (≥41 kg): 2 mg

Ophthalmic (uveitis):

Child: (0.5% solution; prepared by diluting equal volume of the 1% atropine ophthalmic solution with artificial tears) 1–2 drops in each eye once daily-TID

Adult: (1% solution) 1–2 drops in each eye once daily-QID

Contraindicated in glaucoma, obstructive uropathy, tachycardia, and thyrotoxicosis, except for severe or life-threatening muscarinic symptoms. Use with **caution** in patients sensitive to sulfites.

Use in neonatal bradycardia is no longer recommended. Data suggest the use of a minimum 0.1-mg dose may not be warranted for the preintubation indication. Use of the minimum 0.1-mg dose could result in an overdose in younger patients.

Side effects include: dry mouth, blurred vision, fever, tachycardia, constipation, urinary retention, CNS signs (dizziness, hallucinations, restlessness, fatigue, headache).

In case of bradycardia, may give via endotracheal tube at 0.04–0.06 mg/kg (dilute with NS to volume of 1–2 mL and follow each dose with 1 mL NS). Use injectable solution for nebulized use; can be mixed with albuterol for simultaneous administration. AtroPen dosage form is designed of IM administration to the outer thigh.

Ophthalmic use is not recommended for children less than 3 mo of age due to risk for systemic absorption.

AURALGAN

See Antipyrine and Benzocaine

AZATHIOPRINE

Imuran, Azasan, and generics

Immunosuppressant



D



3



Yes



Yes



Yes

Oral suspension: 50 mg/mL

Tabs:

Imuran and generic: 50 mg (scored)

Azasan: 75, 100 mg (scored)

Injection: 100 mg

Immunosuppression (see remarks):

Child and adult:

Initial: 3–5 mg/kg/24 hr IV/PO once daily

Maintenance: 1–3 mg/kg/24 hr IV/PO once daily



AZATHIOPRINE *continued*

Increased risk for hepatosplenic T-cell lymphoma has been reported in adolescents and young adults. Toxicity: bone marrow suppression, rash, stomatitis, hepatotoxicity, alopecia, arthralgias, and GI disturbances.



Use $\frac{1}{4}$ – $\frac{1}{3}$ dose when given with xanthine oxidase inhibitors (e.g., allopurinol). Patients with low or absent thiopurine methyl transferase (TPMT) or nucleotide diphosphatase (NUDT15) may be at increased risk for severe and life-threatening myelotoxicity. Consider alternative therapy in patients with homozygous TPMT or NUDT15 deficiency and reduced dosages in patients with heterozygous deficiency. Individuals with the low functioning alleles for NUDT15 are common among Asian ancestry and Hispanic ethnicity.

Severe anemia has been reported when used in combination with captopril or enalapril. Monitor CBC, platelets, total bilirubin, alkaline phosphatase, BUN, and creatinine. Pancytopenia and bone marrow suppression have been reported with concomitant use of pegylated interferon and ribavirin in patients with hepatitis C. Progressive multifocal leukoencephalopathy (PML) has been reported. **Adjust dose in renal failure (see Chapter 31).**

Administer oral doses with food to minimize GI discomfort. To minimize infant exposure via breast-milk, avoid breastfeeding for 4–6 hr after administering a maternal dose.

AZELASTINE

Astelin, Astepro, and generics

Antihistamine

C



?



No



No



No

Nasal spray:

0.1% (Astelin, Astepro, and generics): 137 mCg/spray (200 actuations per 30 mL); contains benzalkonium chloride and EDTA

0.15% (Astepro and generics): 205.5 mCg/spray (200 actuations per 30 mL); contains benzalkonium chloride and EDTA

Ophthalmic drops (generics; previously available as Optivar): 0.05% (0.5 mg/mL) (6 mL); contains benzalkonium chloride

**Seasonal allergic rhinitis:****0.1% strength:**

Child 2–11 yr: 1 spray each nostril BID

≥12 yr and adult: 1–2 sprays each nostril BID

0.15% strength:

Child 6–12 yr: 1 spray each nostril BID

≥12 yr and adult: 1–2 sprays each nostril BID or 2 sprays each nostril once daily

Perennial allergic rhinitis:**0.1% strength:**

≥6 mo–<12 yr: 1 spray each nostril BID

0.15% strength:

6–<12 yr: 1 spray each nostril BID

≥12 yr and adult: 2 sprays each nostril BID

Ophthalmic:

≥3 yr and adult: Instill 1 drop into each affected eye BID

NASAL USE: Drowsiness may occur despite nasal route of administration (**avoid** concurrent use of alcohol or CNS depressants). Bitter taste, nausea, nasal burning, pharyngitis, weight gain, fatigue, nasal sores, and epistaxis may also occur. Also available in combination with fluticasone as Dymista with labeled dosing information of 1 spray each nostril BID for seasonal allergic rhinitis ($≥$ 6 yr and adult).



AZELASTINE *continued*

OPHTHALMIC USE: Eye burning and stinging have been reported in about 30% of patients receiving the ophthalmic dosage form. **Should not be used** to treat contact lens-related irritation. Soft contact lens users should wait at least 10 min after dose instillation before they insert their lenses.

AZITHROMYCIN

Zithromax, Zithromax TRI-PAK, Zithromax Z-PAK,
Zmax (extended-release oral suspension),
Azasite, and generics

Antibiotic, macrolide



B



2



Yes



Yes



No

Tablets: 250, 500, 600 mg

TRI-PAK: 500 mg (3s as unit dose pack)

Z-PAK: 250 mg (6s as unit dose pack)

Oral suspension: 100 mg/5 mL (15 mL), 200 mg/5 mL (15, 22.5, 30 mL)

Oral Powder (Sachet): 1 g (3s, 10s)

Injection: 500 mg; contains 9.92 mEq Na/1 g drug

Ophthalmic solution (Azasite): 1% (2.5 mL); contains benzalkonium chloride

Infant and child (see remarks):



Community acquired pneumonia (≥ 3 mo):

Tablet or oral suspension: 10 mg/kg PO on day 1 (**max. dose:** 500 mg), followed by 5 mg/kg/24 hr once daily (**max. dose:** 250 mg/24 hr) on days 2–5

IV and PO regimen: 10 mg/kg/dose IV once daily for at least 2 days followed by 5 mg/kg/dose PO once daily to complete a 5-day course (**max. dose:** 500 mg/24 hr)

Pharyngitis/tonsillitis (Group A streptococcal; 2–15 yr): 12 mg/kg/24 hr PO once daily \times 5 days (**max. dose:** 500 mg/24 hr). Alternatively, 12 mg/kg/24 hr (**max. dose:** 500 mg/24 hr) PO once daily on day 1 followed by 6 mg/kg/dose (**max. dose:** 250 mg/dose) PO once daily on days 2–5 has been recommended by the IDSA.

Acute sinusitis (≥ 6 mo): 10 mg/kg/dose (**max. dose:** 500 mg) PO once daily \times 3 days

Pertussis:

$1- <6$ mo: 10 mg/kg/dose PO once daily \times 5 days

≥ 6 mo: 10 mg/kg/dose (**max. dose:** 500 mg) PO \times 1, followed by 5 mg/kg/ (b) (**max. dose:** 250 mg) PO once daily on days 2–5.

Mycobacterium avium complex in HIV (see www.aidsinfo.nih.gov/guidelines for most current recommendations):

Prophylaxis for first episode: 20 mg/kg/dose PO Q 7 days (**max. dose:** 1200 mg/dose); alternatively, 5 mg/kg/24 hr PO once daily (**max. dose:** 250 mg/dose) with or without rifabutin.

Prophylaxis for recurrence: 5 mg/kg/24 hr PO once daily (**max. dose:** 250 mg/dose), plus ethambutol 15 mg/kg/24 hr (**max. dose:** 900 mg/24 hr) PO once daily with or without rifabutin 5 mg/kg/24 hr (**max. dose:** 300 mg/24 hr).

Treatment: 10–12 mg/kg/24 hr PO once daily (**max. dose:** 500 mg/24 hr) \times 1 mo or longer, plus ethambutol 15–25 mg/kg/24 hr (**max. dose:** 1 g/24 hr) PO once daily with or without rifabutin 10–20 mg/kg/24 hr (**max. dose:** 300 mg/24 hr).

Endocarditis prophylaxis: 15 mg/kg/dose (**max. dose:** 500 mg) PO \times 1, 30–60 min before procedure.

Antiinflammatory agent in cystic fibrosis:

$25-39$ kg: 250 mg PO every Mondays, Wednesdays, and Fridays.

≥ 40 kg: 500 mg PO every Mondays, Wednesdays, and Fridays.

Continued

AZITHROMYCIN continued**Adolescent and adult:**

Pharyngitis, tonsillitis, skin, and soft tissue infection: 500 mg PO day 1, then 250 mg/24 hr PO on days 2–5

Mild/moderate bacterial COPD exacerbation: aforementioned 5-day dosing regimen OR 500 mg PO once daily \times 3 days

Community acquired pneumonia:

Tablets: 500 mg PO day 1, then 250 mg/24 hr PO on days 2–5

IV and tablet regimen: 500 mg IV once daily \times 2 days followed by 500 mg PO once daily to complete a 7- to 10-day regimen (IV and PO)

Sinusitis:

Tablets: 500 mg PO once daily \times 3 days

Uncomplicated chlamydial cervicitis or urethritis: Single 1-g dose PO

Gonococcal cervicitis or urethritis: Single 2-g dose PO

Acute PID (chlamydia): 500 mg IV once daily \times 1–2 days followed by 250 mg PO once daily to complete a 7-day regimen (IV and PO).

Mycobacterium avium complex in HIV (see www.aidsinfo.nih.gov/guidelines for most recent recommendations):

Prophylaxis for first episode: 1200 mg PO Q 7 days with or without rifabutin 300 mg PO once daily

Prophylaxis for recurrence: 500 mg PO once daily, plus ethambutol 15 mg/kg/dose PO once daily, with or without rifabutin 300 mg PO once daily

Treatment: 500–600 mg PO once daily with ethambutol 15 mg/kg/dose PO once daily with or without rifabutin 300 mg PO once daily.

Endocarditis prophylaxis: 500 mg PO \times 1, 30–60 min before procedure

Antiinflammatory agent in cystic fibrosis: use same dosing in children.

Ophthalmic:

≥ 1 yr and adult: Instill one drop into the affected eye(s) BID, 8–12 hr apart, \times 2 days, followed by one drop once daily for the next 5 days.

No longer recommended for otitis media due to increased resistant pathogens.

Contraindicated in hypersensitivity to macrolides and history of cholestatic jaundice/hepatic

dysfunction associated with prior use. **Use with caution** in impaired hepatic function, GFR <10 mL/min (limited data), hypokalemia, hypomagnesemia, bradycardia, arrhythmias, prolonged QT intervals, and receiving medications that can cause the aforementioned conditions of caution. May cause increase in hepatic enzymes, cholestatic jaundice, GI discomfort, and pain at injection site (IV use). Compared with other macrolides, less risk for drug interactions. Nelfinavir may increase azithromycin levels; monitor for liver enzyme abnormalities and hearing impairment. Vomiting, diarrhea, and nausea have been reported at higher frequency in otitis media with 1-day dosing regimen. Exacerbations of myasthenia gravis/syndrome, serious skin reactions (e.g., SJS and TEN), infantile hypertrophic pyloric stenosis, decreased lymphocytes, and elevated bilirubin, BUN, and creatinine have been reported. CNS penetration is poor. Aluminum- and magnesium-containing antacids decrease absorption. Tablet and oral suspension dosage forms may be administered with or without food. Extended-release oral suspension should be taken on an empty stomach (at least 1 hr before or 2 hr following a meal). Intravenous administration is over 1–3 hr; **do not** give as a bolus or IM injection.

Ophthalmic Use: Do not wear contact lenses. Eye irritation is the most common side effect.

**AZTREONAM**

Azactam, Cayston, and generic intravenous products

Antibiotic, monobactam



B



2



Yes



No



No

Injection: 1, 2 g

Frozen injection (Azactam): 1 g/50 mL 3.4% dextrose, 2 g/50 mL 1.4% dextrose (iso-osmotic solutions); each 1 g drug contains approximately 780 mg L-arginine

Nebulizer solution (Cayston): 75 mg powder to be reconstituted with the supplied diluent of 1 mL 0.17%

AZTREONAM continued**Neonate:****30 mg/kg/dose IV/IM:****<1.2 kg and 0–4 wk age:** Q12 hr**1.2–2 kg:****0–7 days:** Q12 hr**>7 days:** Q8 hr**>2 kg:****0–7 days:** Q8 hr**>7 days:** Q6 hr**Child:** 90–120 mg/kg/24 hr \div Q6–8 hr IV/IM; **max. dose:** 8 g/24 hr**Cystic Fibrosis:** 150–200 mg/kg/24 hr \div Q6–8 hr IV/IM (**max. dose:** 8 g/24 hr). Alternatively, higher doses have been used at 200–300 mg/kg/24 hr \div Q6 hr IV/IM (**max. dose:** 12 g/24 hr)**Adult:****Moderate infections:** 1–2 g/dose Q8–12 hr IV/IM**Severe infections:** 2 g/dose Q6–8 hr IV/IM**Max. dose:** 8 g/24 hr**Inhalation:****Cystic fibrosis prophylaxis therapy:****≥7 yr and adult:** 75 mg TID (minimum 4 hr between doses) administered in repeated cycles of 28 days on drug followed by 28 days off drug. Administer each dose with the Altera Nebulizer System.

Typically indicated in multidrug resistant aerobic gram-negative infections when β -lactam therapy is contraindicated. Well-absorbed IM. **Use with caution** in arginase deficiency. Low cross-allergenicity between aztreonam and other β -lactams. Adverse reactions: thrombophlebitis, eosinophilia, leukopenia, neutropenia, thrombocytopenia, elevation of liver enzymes, hypotension, seizures, and confusion. Good CNS penetration. Probencid and furosemide increase aztreonam levels. **Adjust dose in renal failure** (see Chapter 31).

INHALATIONAL USE: Cough, nasal congestion, wheezing, pharyngolaryngeal pain, pyrexia, chest discomfort, abdominal pain, and vomiting may occur. Bronchospasm has been reported. Use the following order of administration: bronchodilator first, chest physiotherapy, other inhaled medications (if indicated), and aztreonam last.

B**BACITRACIN ± POLYMYXIN B**

Various ophthalmic and topical generic products

In combination with polymyxin b: AK-Poly-Bac

Ophthalmic, Double Antibiotic Topical,

Polysporin Topical and others

Antibiotic, topical

C



?



No



No



No

BACITRACIN:

Ophthalmic ointment: 500 units/g (3.5 g)

Topical ointment (OTC): 500 units/g (1, 15, 30, 113.4, 454 g)

Topical cream (OTC): 500 units/g (14, 28 g)

BACITRACIN IN COMBINATION WITH POLYMYXIN B:

Ophthalmic ointment (AK-Poly-Bac Ophthalmic): 500 units bacitracin +10,000 units polymyxin B/g (3.5 g)

Topical ointment (OTC): 500 units bacitracin +10,000 units polymyxin B/g (15, 30 g)

BACITRACIN ± POLYMYXIN B continued**BACITRACIN****Child and adult:**

Topical: Apply to affected area once daily to TID

Ophthalmic: Apply 0.25- to 0.5-inch ribbon into the conjunctival sac of the infected eye(s) Q 3–12 hr; frequency depends on severity of infection. Administer Q3–4 hr × 7–10 days for mild/moderate infections.

BACITRACIN + POLYMYXIN B**Child and adult:**

Topical: Apply ointment to affected area once daily to TID

Ophthalmic: Apply 0.25- to 0.5-inch ribbon into the conjunctival sac of the infected eye(s) Q 3–12 hr; frequency depends on severity of infection. Administer Q3–4 hr × 7–10 days for mild/moderate infections.

Hypersensitivity reactions to bacitracin and/or polymyxin b can occur. **Do not use** topical ointment for the eyes or for a duration of >7 days. Side effects may include rash, itching, burning, and edema.



Ophthalmic dosage form may cause temporary blurred vision and retard corneal healing. For ophthalmic use, wash hands before use and **avoid contact** with tube tip with skin or eye.

For neomycin containing products, see Neomycin/Polymyxin B/± Bacitracin.

BACLOFEN

Lioresal, Gablofen, Kemstro, and generic tablets

Centrally acting skeletal muscle relaxant



C

2

Yes

No

No

Tabs: 5, 10, 20 mg

Disintegrating oral tabs (Kemstro): 10, 20 mg; contains phenylalanine

Oral suspension: 5, 10 mg/mL

Intrathecal injection:

Gablofen: 50 mCG/mL (1 mL), 0.5 mg/mL (20 mL), 1 mg/mL (20 mL), 2 mg/mL (20 mL); preservative free

Lioresal: 50 mCG/mL (1 mL), 0.5 mg/mL (20 mL), 2 mg/mL (5, 20 mL); preservative free

Oral: Dosage increments, if tolerated, are made at 3-day intervals until desired effect or max. dose is achieved. Initiate first dosage level at QHS, followed by Q12 hr and then Q8 hr.



Dosage increments are made by first increasing the QHS dosage, followed by the morning dosage and then the remaining mid-day dosage.

Child (PO, see remarks):

<20 kg: Start at 2.5 mg QHS, increase in 2.5 mg increments if needed up to the recommended max. dose, below.

≥20–50 kg: Start at 5 mg QHS, increase in 5 mg increments if needed up to the recommended max. dose, below.

>50 kg: Start at 10 mg QHS, increase in 10 mg increments if needed up to the recommended max. dose, below.

Recommended max. PO dose:

2 yr–<8 yr: 60 mg/24 hr

8–16 yr: 80 mg/24 hr

>16 yr: 120 mg//24 hr

Adult (PO):

Start at 5 mg TID, increase in 5-mg increments if needed up to a maximum of 80 mg/24 hr.

BACLOFEN continued**Intrathecal continuous infusion maintenance therapy (not well established):**

<12 yr: average dose of 274 mCg/24 hr (range: 24–1199 mCg/24 hr) has been reported.

≥12 yr and adult: most required 300–800 mCg/24 hr (range: 12–2003 mCg/24 hr with limited experience at doses >1000 mCg/24 hr)

Avoid abrupt withdrawal of drug. **Use with caution** in patients with seizure disorder or impaired renal function. Approximately 70%–80% of the drug is excreted in the urine unchanged. Administer oral doses with food or milk.

Adverse effects: Drowsiness, fatigue, nausea, vertigo, psychiatric disturbances, rash, urinary frequency, and hypotonia. **Avoid** abrupt withdrawal of intrathecal therapy to prevent potential life-threatening events (rhabdomyolysis, multiple organ-system failure, and death).

Cases of intrathecal mass at the tip of the implanted catheter leading to withdrawal symptoms have been reported. Inadvertent subcutaneous injection may occur with improper access of the reservoir refill septum and may result in an overdose. Sterile techniques must be used with intrathecal use accounting for all nonsterile external surfaces.

Usual maintenance oral dosage range observed from a collection of smaller prospective and retrospective studies suggest following (see dosage section for initial dose titration):

<2 yr: 10–20 mg/24 hr ÷ Q8 hr to a **maximum** of 40 mg/24 hr

2–7 yr: 20–40 mg/24 hr ÷ Q8 hr to a **maximum** of 60 mg/24 hr

≥8 yr: 30–40 mg/24 hr ÷ Q8 hr to a **maximum** of 200 mg/24 hr

BALOXAVIR MARBOXIL

Xofluza

Antiviral, endonuclease inhibitor

Tabs: 20 mg (2 or 4 tablet blister card), 40 mg (1 or 2 tablet blister card)

Oral suspension: in development

Treatment of influenza (initiate therapy within 48 hr of onset of symptoms):**Child 1–<12 yr:**

<20 kg: 2 mg/kg/dose PO once

≥20 kg: 40 mg PO once

≥12 yr and adult:

40–<80 kg: 40 mg PO once

≥80 kg: 80 mg PO once



Recent pediatric phase 3 comparison trial with oseltamivir (MINISONE-2) showed comparable efficacy and baloxavir was well tolerated. Influenza prophylaxis use and human pregnancy information are currently not available.

Adverse effects reported in clinical trials include diarrhea, bronchitis, nasopharyngitis, headache, and nausea.

Baloxavir marboxil is a prodrug that is rapidly converted to the active baloxavir following oral administration. No clinically meaningful pharmacokinetics differences with moderate hepatic impairment (Child-Pugh class B) or with creatinine clearances ≥50 mL/min. Pharmacokinetics have not been evaluated in severe hepatic and/or severe renal impairment.

Primarily metabolized by UGT1A3 with minor contribution from CYP3A4. May reduce the efficacy of intranasal live attenuated influenza vaccine.

Dose may be administered with or without food. **Avoid** coadministration with dairy products, calcium, aluminum, magnesium, multivitamins with minerals, iron, selenium, or zinc, because decreased absorption of baloxavir may occur.



BECLOMETHASONE DIPROPIONATE

QVAR Redihaler, Beconase AQ,
Qnasl Children's, Qnasl
Corticosteroid

**Breath-Activated Inhalation Aerosol, oral:**

QVAR Redihaler: 40 mCg/inhalation (10.6 g provides 120 inhalations), 80 mCg/inhalation (10.6 g provides 120 inhalations)

Inhalation Aerosol, nasal:

Beconase AQ: 42 mCg/inhalation (25 g provides 180 metered doses); contains benzalkonium chloride

Qnasl Children's: 40 mCg/inhalation (6.8 g provides 60 metered doses)

Qnasl: 80 mCg/inhalation (10.6 g provides 120 metered doses)

Oral inhalation (QVAR Redihaler) (see remarks):

4–11 yr: Start at 40 mCg BID. If response is inadequate after 2 wk, may increase dose to the recommended **maximum dose** of 80 mCg BID.

≥12 yr and adult:

Corticosteroid naïve: Start at 40–80 mCg BID; **max. dose:** 320 mCg BID

Previous corticosteroid use: Start at 40–160 mCg BID; **max. dose:** 320 mCg BID

Nasal inhalation:**Beconase AQ:**

6–12 yr: Start with 1 spray (42 mCg) each nostril BID, may increase to the **maximum dose** of 2 sprays each nostril BID if needed. Once symptoms are controlled, decrease dose to 1 spray each nostril BID.

>12 yr and adult: 1–2 spray(s) (42–84 mCg) each nostril BID

Qnasl Children's:

4–11 yr: 1 spray (40 mCg) each nostril once daily; **max. dose:** 2 sprays total (80 mCg)/24 hr

Qnasl:

12 yr and adult: 2 sprays (160 mCg) each nostril once daily; **max. dose:** 4 sprays (320 mCg)/24 hr.

Not recommended for children <4 yr with oral inhalation and <6 yr (Beconase AQ) or <4 yr (Qnasl Children's) with the nasal administration because of unknown safety and efficacy.

Dose should be titrated to lowest effective dose. **Avoid** using higher than recommended doses.

Avoid use of nasal dosage form in recent nasal ulcers, nasal surgery or nasal trauma. Nasal septal perforation has been reported with nasal product. Psychiatric and behavioral changes have been reported in children with the oral inhalation product. Routinely monitor growth of pediatric patients with chronic use of all dosage form.

When converting from fluticasone to beclomethasone for oral inhalation use, consider the following:

Fluticasone MDI (Flovent HFA)	Fluticasone DPI (Flovent Diskus)	Beclomethasone BAI (QVAR Redihaler)
44 mCg: 2 puffs BID	50 mCg: 2 inhalations BID	40 mCg: 1 puff BID
110 mCg: 2 puffs BID	100 mCg: 2 inhalations BID	40 mCg: 2 puffs BID
220 mCg: 2 puffs BID	250 mCg: 2 inhalations BID	80 mCg: 2 puffs BID

BAI, Breath-activated inhaler; DPI, dry powder inhaler; MDI, metered dose inhaler.

CYP 450 3A4 inhibitors (e.g., ketoconazole, erythromycin, and protease inhibitors) or significant hepatic impairment may increase systemic exposure of beclomethasone.

Monitor for hypothalamic, pituitary, adrenal, or growth suppression, and hypercorticism. Rinse mouth and gargle with water after oral inhalation; may cause thrush.

QVAR Redihaler is a breath-activated inhaler device and requires the patient to have a minimum inspiratory flow rate of 30 L/min for proper dose activation and does not require priming. Do not shake the Redihaler device with the cap open, and do not use it with a tube spacer or volume holding chamber.

BENZOYL PEROXIDE

BP Wash, NeoBenz Micro, Oxy-5, Oxy-10, PanOxyl, and many other products

Topical acne product



C



?



No



No



No

Liquid wash [OTC]: 5% (120, 150, 200 mL), 6% (180, 360 mL), 7% (473 mL), 10% (120, 150, 240 mL)

Liquid cream wash [OTC]: 4% (170 g), 7% (180 g)

Bar [OTC]: 5% (113 g), 10% (113 g)

Lotion [OTC]: 4% (297 g), 5% (30 mL), 6% (170, 340 g), 8% (297 g), 10% (30 mL, 85, 170, 340 g)

Cream [OTC]: 5% (18 g), 10% (30 g)

Gel [OTC]: 2.5% (60 g), 5% (42.5, 60, 90 g), 6.5% (113 g), 8% (113g), 10% (42.5, 56, 60, 90 g)

NOTE: Some preparations may contain alcohol and come in combination packs of cleansers and creams at various strengths.

Combination product with erythromycin (Benzamycin and others):

Gel: 30 mg erythromycin and 50 mg benzoyl peroxide per g (23.3, 46 g); some preparations may contain 20% alcohol

Combination product with clindamycin:

Gel:

BenzaClin and generics: 10 mg clindamycin and 50 mg benzoyl peroxide per g (25, 35, 50 g); some preparations may contain methylparaben.

Duac: 12 mg clindamycin and 50 mg benzoyl peroxide per g (45 g)

Acanya: 12 mg clindamycin and 25 mg benzoyl peroxide per g (50 g)

Combination product with adapalene: see Adapalene ± Benzoyl Peroxide



Acne (child ≥12 yr and adult, see remarks):

Cleansers (liquid wash, or bar): Wet affected area prior to application. Apply and wash once daily—BID; rinse thoroughly, and pat dry. Modify dose frequency or concentration to control the amount of drying or peeling.

Lotion, cream, or gel: Cleanse skin, and apply small amounts over affected areas once daily initially; increase frequency to BID—TID, if needed. Modify dose frequency or concentration to control drying or peeling.

Combination products:

Benzamycin, BenzaClin and generics: Apply BID (morning and evening) to affected areas after washing and drying skin.

Duac: Apply QHS to affected areas after washing and drying skin.

Acanya: Apply pea-sized amount once daily.



Contraindicated in known history of hypersensitivity to product's components

(benzoyl peroxide, clindamycin, or erythromycin). **Avoid** contact with mucous membranes and eyes. May cause skin irritation, stinging, dryness, peeling, erythema, edema, and contact dermatitis. Anaphylaxis have been reported with products containing clindamycin and benzoyl peroxide.

Concurrent use with tretinoin (Retin-A) will increase risk of skin irritation. Products containing clindamycin and erythromycin should not be used in combination.

Any single application resulting in excessive stinging or burning may be removed with mild soap and water. Lotion, cream, and gel dosage forms should be applied to dry skin.

Data are limited for use <12 yr of age.

BENZTROPINE MESYLATE

Cogentin and generics

Anticholinergic agent, drug-induced dystonic reaction antidote, anti-Parkinson agent

?



?



No



No



No

Injection: 1 mg/mL (2 mL)**Tabs:** 0.5, 1, 2 mg**Drug-induced extrapyramidal symptoms (PO/IM/IV):**

>3 yr: 0.02–0.05 mg/kg/dose once daily–BID

Adult: 1–4 mg/dose once daily–BID**Acute dystonic reaction (phenothiazines) (IM/IV):****Child:** 0.02 mg/kg/dose (**max. dose:** 1 mg) × 1**Adult:** 1–2 mg/dose × 1

Contraindicated in myasthenia gravis, GI/GU obstruction, untreated narrow-angle glaucoma and peptic ulcer. Use IV route **only** when PO and IM routes are not feasible. May cause anticholinergic side effects, especially constipation and dry mouth. Drug interactions include: potentiation of CNS depressant effects when used with CNS depressants; enhance CNS side effects of amantadine; and inhibit the response of neuroleptics. This medication has not been formally assigned a pregnancy category by the FDA. The Australian pregnancy ratings have deemed use in pregnancy to a limited number of women without an increase in frequency of malformation or other direct/indirect harmful effects.



Onset of action: 15 min for IV/IM and 1 hr for PO.

Oral doses should be administered with food to decrease GI upset.

BERACTANT

See Surfactant, pulmonary.

BETAMETHASONE**Injection:** Celestone Soluspan, ReadySharp Betamethasone, and generics

C



3



No



No



No

Topical: Diprolene, Diprolene AF, Luxiq, Sernivo, and generics**Corticosteroid****Na Phosphate and Acetate:****Injection suspension (Celestone Soluspan, ReadySharp Betamethasone and generics):** 6 mg/mL (3 mg/mL Na phosphate +3 mg/mL betamethasone acetate) (5 mL); may contain benzalkonium chloride and EDTA.**Dipropionate:****Topical cream:** 0.05% (15, 45 g)**Topical emulsion (Sernivo):** 0.05% (120 mL); contains parabens**Topical lotion:** 0.05% (60 mL); may contain 46.8% alcohol and propylene glycol**Topical ointment:** 0.05% (15, 45 g)**Valerate:****Topical cream:** 0.1% (15, 45 g)**Topical foam (Luxiq and generics):** 1.2 mg/g (50, 100 g); may contain 60.4% ethanol, cetyl alcohol, stearyl alcohol, and propylene glycol

BETAMETHASONE continued

Topical lotion: 0.1% (60 mL); may contain 47.5% isopropyl alcohol

Topical ointment: 0.1% (15, 45 g)

Dipropionate augmented:

Topical cream (Diprolene AF and generics): 0.05% (15, 50 g); contains propylene glycol

Topical gel: 0.05% (15, 50 g); contains propylene glycol

Topical lotion (Diprolene and generics): 0.05% (30, 60 mL); contains 30% isopropyl alcohol

Topical ointment (Diprolene and generics): 0.05% (15, 45, 50 g); contains propylene glycol

All dosages should be adjusted based on patient response and severity of condition (see remarks).

**Antiinflammatory:****Child:**

IM: 0.0175–0.125 mg/kg/24 hr or 0.5–7.5 mg/m²/24 hr Q6–12 hr

Adolescent and adult:

IM: 0.6–9 mg/24 hr ÷ Q12–24 hr

Topical (use smallest amount for shortest period of time to avoid adrenal suppression and reassess diagnosis if no improvement is achieved after 2 wk; see remarks):

Valerate and dipropionate forms:

Child and adult: Apply to affected areas once daily–BID

Dipropionate augmented forms (see remarks):

≥13 yr–adult: Apply to affected areas once daily–BID

Max. dose: 14 days and the following specific dosage form maximum amount

Cream, ointment and gel: 50 g/wk

Lotion: 50 mL/wk



Use with caution in hypothyroidism, cirrhosis, ulcerative colitis, and history of allergic reactions to corticosteroids. See Chapter 8 for relative steroid potencies and doses based on body surface area. Betamethasone is inadequate when used alone for adrenocortical insufficiency because its minimal mineralocorticoid properties. Like all steroids, may cause hypertension, pseudotumor cerebri, acne, Cushing syndrome, adrenal axis suppression, GI bleeding, hyperglycemia, and osteoporosis.

Betamethasone is a substrate for CYP 450 3A4, and use with a strong inhibitor (e.g., ketoconazole and itraconazole) may lead to increased exposure and side effects of betamethasone.

Na phosphate and acetate injectable suspension recommended for IM, intra-articular, intrasynovial, intralesional, soft tissue use only; but **not** for IV use. Topical betamethasone dipropionate augmented (Diprolene and Diprolene AF) is **not recommended** in children ≤12 yr owing to the higher risk for adrenal suppression.

Injectable IM dosage form is used in premature labor to stimulate fetal lung maturation.

BICITRA

See Citrate Mixtures.

BISACODYL

Dulcolax, Ducodyl, Bisacodyl EC, Fleet Bisacodyl, and various other names
Laxative, stimulant



B



1



No



No



No

Tabs (enteric-coated) [OTC]: 5 mg

Suppository [OTC]: 10 mg

Enema (Fleet Bisacodyl) [OTC]: 10 mg/30 mL (37.5 mL)

Delayed released tabs [OTC]: 5 mg

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ued

BISACODYL continued

Oral (administered 6 hr before desired effect):

Child (3–10 yr): 5 mg once daily

>10 yr and adolescent: 5–10 mg once daily

Adult: 5–15 mg once daily



Rectal suppository (see remarks):

2–10 yr: 5 mg once daily

>10 yr and adolescent: 5–10 mg once daily

Adult: 10 mg once daily



Rectal enema (as a single dose):

≥12 yr and adult: 10 mg (30 mL) × 1

Do not use in newborn period. Instruct patient/parent that tablets should be swallowed whole, not chewed or crushed; **not** to be given within 1 hr of antacids or milk. May cause abdominal cramps, nausea, vomiting, and rectal irritation. Oral usually effective within 6–10 hr; rectal usually effective within 15–60 min.

Antacids may decrease the effect of bisacodyl and may cause the premature release of the delayed-release formulation prior to reaching the large intestine. Use of suppository should be retained in the rectum for 15–20 min.

BISMUTH SUBSALICYLATE

Pepto-Bismol, Geri-Pectate, Bismatrol, Kao-Tin, Stomach Relief, Stomach Relief Max St, and many others (see remarks)



D

3

Yes

No

No

Antidiarrheal, gastrointestinal ulcer agent

Liquid [OTC]:

Pepto-Bismol, Geri-Pectate, Bismatrol, Kao-Tin, Stomach Relief, and others: 262 mg/15 mL (240, 360, 480 mL)

Stomach Relief Max St: 525 mg/15mL (240, 480 mL)



Chewable tabs [OTC]: 262 mg; may contain aspartame

Contains 102 mg salicylate per 262 mg tablet; or 129 mg salicylate per 15 mL of the 262 mg/15 mL liquid.

Diarrhea:

Child: 100 mg/kg/24 hr ÷ 5 equal doses for 5 days; **max. dose:** 4.19 g/24 hr

Dosage by age: give following dose Q30 min to 1 hr PRN up to a **max. dose** of 8 doses/24 hr:

3–5 yr: 87.3 mg (1/3 tablet or 5 mL of 262 mg/15 mL)

6–8 yr: 174.7 mg (2/3 tablet or 10 mL of 262 mg/15 mL)

9–11 yr: 262 mg (1 tablet or 15 mL of 262 mg/15 mL)

≥12 yr–adult: 524 mg (2 tablets or 30 mL of 262 mg/15 mL)

Helicobacter pylori **gastric infection** (as part of a 3 or 4 drug combination therapy; doses not well established for children):

Child: 8 mg/kg/24 hr PO ÷ BID × 10–14 days, or 262 mg PO QID X 7–14 days have been reported.

Adult: 300 mg PO QID × 10–14 days

Generally not recommended in children <16 yr with chicken pox or flulike symptoms (risk for Reye syndrome), in combination with other nonsteroidal antiinflammatory drugs,

anticoagulants, or oral antidiabetic agents or in severe renal failure. **Use with caution** in

bleeding disorders, renal dysfunction, gastritis, and gout. May cause darkening of tongue and/or black stools, GI upset, impaction, and decreased platelet aggregation.



BISMUTH SUBSALICYLATE *continued*

Drug combination appears to have antisecretory and antimicrobial effects with some antiinflammatory effects. Absorption of bismuth is negligible, whereas approximately 80% of the salicylate is absorbed. Decreases absorption of tetracycline.

DO NOT use Children's Pepto (calcium carbonate) because it does not contain bismuth subsalicylate. Avoid use in renal failure (see Chapter 31).

BOSENTAN

Tracleer

Endothelin receptor antagonist

X

3

No

Yes

No

Tabs: 62.5, 125 mg**Dispersible tabs (to be dissolved in water to make an oral suspension):** 32 mg (scored); contains aspartame**Oral suspension:** 6.25 mg/mL **Pulmonary arterial hypertension (see remarks):****2015 AHA/ATS Pediatric Pulmonary Hypertension Guidelines:****<10 kg:** Start at 1 mg/kg/dose PO BID then increase to 2 mg/kg/dose PO BID**10–20 kg:** Start at 15.625 mg PO BID then increase to 31.25 mg PO BID**>20–40 kg:** Start at 31.25 mg PO BID then increase to 62.5 mg PO BID**>40 kg:** Start at 62.5 mg PO BID then increase to 125 mg PO BID**Alternative FDA-labeled dosing by age and weight (PO):**

Age	Weight (kg)	Dosage (PO)
≤12 yr	4–8	16 mg BID
	>8–16	32 mg BID
	>16–24	48 mg BID
	>24–40	64 mg BID
>12 yr	≤40	62.5 mg BID
	>40	62.5 mg BID X 4 wk, then 125 mg BID

Dosage Modification for Transaminase Elevation:

ALT/AST Levels	Dosage Adjustment
>3 to ≤5× ULN	Reconfirm by another aminotransferase test; if confirmed, modify dosage regimen (always reassess aminotransferase levels within 3 days and Q 2 wk thereafter to any dosage reintroduction or reduction):
	≤12 yr, and >12 yr and ≤40 kg: Interrupt therapy. If aminotransferase returns to pretreatment levels, reintroduce with dosage prior to interruption
	>12 yr and >40 kg, and adult: Reduce dosage to 62.5 mg PO BID; or interrupt therapy and monitor aminotransferase levels Q 2 wk (if aminotransferase levels return to pretreatment levels, continue with most recent dosage or 62.5 mg PO BID)
>5 to ≤8× ULN	Reconfirm by another aminotransferase test; if confirmed, stop treatment and monitor aminotransferase at least Q 2 wk. Once aminotransferase returns to pretreatment levels, consider reintroduction of bosentan and reassess aminotransferase within 3 days and Q 2 wk thereafter to any dosage reintroduction or reduction:
	≤12 yr, and >12 yr and ≤40 kg: Dosage prior to discontinuing
	>12 yr and >40 kg, and adult: 62.5 mg PO BID
>8× ULN	All ages: Discontinue treatment permanently

ULN, Upper limit of normal

BOSENTAN *continued*

Contraindicated in women who are or may become pregnant and with concurrent use of cyclosporine (increases bosentan concentrations) or glyburide (increases risk for hepatotoxicity). Due to these risks, bosentan is available only through the Tracleer REMS program where prescribers and pharmacies need to be certified. See www.tracleerrems.com or call 1-866-228-3546 for more information.



Baseline and monthly monitoring of serum aminotransferases and bilirubin; and pregnancy tests for females of reproductive potential (two forms of birth control required) are required. Use should be **avoided** in patients with preexisting hepatic impairment (baseline aminotransferases >3 times the usual normal limit).

May cause respiratory tract infections, anemia (dose related), edema, increased liver aminotransferases (see dosage modification; higher incidence in adults) and pyrexia. Decreased sperm counts, liver cirrhosis, liver failure, DRESS, thrombocytopenia, and sinusitis have been reported.

Bosentan is substrate for the CYP2C9 and 3A4 enzymes, and OATP1B1/SLCO1B1 transporter. It also induces CYP2C9 and 3A4; may decrease sildenafil levels. Reduces the effectiveness of hormonal contraceptives.

Doses may be administered orally with or without food.

BREO ELLIPTA

See Fluticasone Furoate + Vilanterol.

BROMPHENIRAMINE WITH PHENYLEPHRINE

Dimetapp Children's Cold and Allergy, Brohist D,

Ru-Hist D, and many other products

Antihistamine + decongestant



C



3



No



No



No

Oral liquid/syrup (Dimetapp Children's Cold and Allergy and others) [OTC]: Brompheniramine 1 mg + phenylephrine 2.5 mg/5 mL (118, 237 mL); contains propylene glycol and sodium benzoate

Tabs (Brohist-D, Ru-Hist D) [OTC]: Brompheniramine 4 mg + phenylephrine 10 mg

NOTE: other combination products exist using the Dimetapp name; always check the specific ingredients with each specific product

All doses based on brompheniramine component (see remarks).



2 to <6 yr: 1 mg Q4 hr PRN PO up to a **max. dose** of 6 mg/24 hr

6–12 yr: 2 mg Q4 hr PRN PO up to a **max. dose** of 12 mg/24 hr

≥12 yr and adult: 4 mg Q4 hr PRN PO up to a **max. dose** of 24 mg/24 hr

Alternatively, dosing based on specific dosage forms/products. CAUTION: These products may be available in different concentrations (see remarks).

Oral, liquid/syrup (Dimetapp Children's Cold and Allergy):

6 to <12 yr: 10 mL Q4 hr PRN PO up to a **max. dose** of 60 mL/24 hr

≥12 yr and adult: 20 mL Q4 hr PRN PO up to a **max. dose** of 120 mL/24 hr

Oral, tab (Brohist-D, Ru-Hist D):

6 to <12 yr: 0.5 tab Q4 hr PRN PO not to exceed 3 tablets/24 hr

≥12 yr and adult: 1 tab Q4 hr PRN PO not to exceed 6 tablets/24 hr

Generally not recommended for treating URIs for infants. No proven benefit for infants and young children with URIs. Over the counter (OTC or nonprescription) use of this product is **not recommended** for children <6 yr old due to reports of serious adverse effects (cardiac and respiratory distress, convulsions, and hallucinations) and fatalities (from unintentional overdosages, including combined use of other OTC products containing the same active ingredients).

Contraindicated with use of MAO inhibitors (concurrent use and within 14 days after discontinuing MAO inhibitor). **Use with caution** in narrow-angle glaucoma, bladder neck obstruction, asthma, pyloroduodenal obstruction, symptomatic prostatic hypertrophy, hypertension, coronary artery disease, diabetes mellitus, and thyroid disease. Discontinue use 48 hr prior to allergy skin testing. May cause drowsiness, fatigue, CNS excitation, xerostomia, blurred vision, and wheezing.

BUDESONIDE

Pulmicort Respules, Pulmicort Flexhaler,
Rhinocort Allergy Nasal Spray, Entocort EC,
Uceris, and generics

Corticosteroid



B/C



2/?



No



Yes



No

Nasal spray (Rhinocort Allergy and generics) [OTC]: 32 mCg/actuation (5 mL delivers 60 sprays, 8.43 mL delivers 120 sprays); may contain disodium EDTA and polysorbate 80

Nebulized inhalation suspension (Pulmicort Respules and generics): 0.25 mg/2 mL, 0.5 mg/2 mL (30s); may contain disodium EDTA and polysorbate 80

Oral breath activated inhalation powder (Pulmicort Flexhaler): 90 mCg/metered dose (165 mg, delivers 60 doses), 180 mCg/metered dose (225 mg, delivers 120 doses); contains lactose

Enteric coated granules in a capsule (Entocort EC and generics): 3 mg

Extended release tablet (Uceris and generics): 9 mg

Rectal foam (Uceris): 2 mg per metered dose (33.4 g, delivers 14 doses; 2 canisters per kit)

Nebulized inhalation suspension:

Child 1–8 yr:

No prior steroid use: 0.5 mg/24 hr ÷ once daily–BID; **max. dose:** 0.5 mg/24 hr

Prior inhaled steroid use: 0.5 mg/24 hr ÷ once daily–BID; **max. dose:** 1 mg/24 hr

Prior oral steroid use: 1 mg/24 hr ÷ once daily–BID; **max. dose:** 1 mg/24 hr

NIH Asthma Guideline 2007 recommendations (divide daily doses once daily–BID):

Child 0–4 yr:

Low dose: 0.25–0.5 mg/24 hr

Medium dose: >0.5–1 mg/24 hr

High dose: >1 mg/24 hr

Child 5–11 yr:

Low dose: 0.5 mg/24 hr

Medium dose: 1 mg/24 hr

High dose: 2 mg/24 hr

Oral inhalation:

Pulmicort Flexhaler (see remarks):

Child ≥6 yr: Start at 180 mCg BID; **max. dose:** 720 mCg/24 hr.

Adult: Start at 180–360 mCg BID; **max. dose:** 1440 mCg/24 hr.

Continued

BUDESONIDE continued**Nasal inhalation:**

≥6 to <12 yr: Start at 1 spray in each nostril once daily. If needed, increase to 2 sprays each nostril once daily. Then reduce dose back to initial dose when symptoms improve. **Max. nasal dose:** 128 mCg/24 hr (4 sprays/24 hr).

≥12 yr to adult: Start at 2 sprays in each nostril once daily. When symptoms improve, reduce dose to 1 spray each nostril once daily. Usual **max. dose** is 128 mCg/24 hr (4 sprays/24 hr) but some may require 256 mCg/24 hr (8 sprays/24 hr) initially with a subsequent reduced dosage to improve symptoms.

Crohn disease (Encort EC and generics):

Child ≥6 yr (see remarks): Data are limited; only the following dosages have been reported.

Additional studies are needed.

Active disease: 9 mg PO once daily × 7–8 wk

Maintenance of remission: 6 mg PO once daily × 3–4 wk

In addition, a report in 10–19 yr old children demonstrated higher remission rates with an induction dose of 12 mg PO once daily × 4 wk, followed by 9 mg PO once daily × 3 wk, followed by 6 mg PO once daily × 3 wk.

Adult:

Active disease: 9 mg PO QAM × 8 wk; if remission is not achieved, a second 8-wk course may be given.

Maintenance of remission: 6 mg PO once daily for up to 3 mo. If symptom control is maintained at 3 mo, taper dosage to complete cessation. Remission therapy beyond 3 mo has not shown to provide substantial clinical benefit.

Ulcerative colitis, induction of remission (Uceris and generics):**Adult:**

Extended release oral tablet: 9 mg PO QAM for up to 8 wk

Rectal foam: 2 mg PR BID × 2 wk followed by 2 mg PR once daily × 4 wk

Reduce maintenance dose to as low as possible to control symptoms. May cause pharyngitis, cough, epistaxis, nasal irritation, and HPA-axis suppression. Rinse mouth after each use via the oral inhalation route. Nebulized budesonide has been shown effective in mild to moderate croup at doses of 2 mg × 1. Ref: *N Engl J Med* 331(5):285.



Hypersensitivity reactions, including anaphylaxis, have been reported with the inhaled route.

Anaphylactic reactions, rectal bleeding, peripheral edema, mood swings, increased blood pressure, rash, and benign intracranial hypertension have been reported with oral route of administration.

Safety and effectiveness for mild/moderate Crohn disease have been established for children 8–17 yr old weighing ≥25 kg. Safety and efficacy have NOT been established in pediatric patients for the maintenance of clinical remission of mild/moderate Crohn disease. Although the reported safety profile in pediatric Crohn disease is consistent with adults, there may be increased risk for decreased growth velocity due to higher systemic absorption of corticosteroids in children with Crohn disease.

CYP 450 3A4 inhibitors (e.g., ketoconazole, erythromycin, protease inhibitors) or significant hepatic impairment may increase systemic exposure of budesonide (inhalation and PO routes).

Onset of action for oral inhalation and nebulized suspension is within 1 day and 2–8 days, respectively, with peak effects at 1–2 wk and 4–6 wk, respectively.

For nasal use, onset of action is seen after 1 day with peak effects after 3–7 days of therapy. Discontinue therapy if no improvement in nasal symptoms after 3 wk of continuous therapy.

Pulmicort Flexhaler is a breath activated device which requires the patient to have an inspiratory flow rate of approximately 60 L/min for optimal drug delivery.

Pregnancy category is “B” for inhalation routes of administration and “C” for the oral and rectal routes. **Breast feeding category is “2” for inhalation routes and “?” for the rectal route.**

Breast feeding with the oral route of administration may result in budesonide exposure to the infant up to 10 times higher than that by the inhalation route. **Do not** crush or chew the oral capsule dosage form.

BUDESONIDE AND FORMOTEROL

Symbicort

Corticosteroid and long-acting β_2 -adrenergic agonist



C



2



No



Yes



No

Aerosol inhaler:

80 mCg budesonide + 4.5 mCg formoterol fumarate dihydrate (6.9 g delivers 60 inhalations, 10.2 g delivers approximately 120 inhalations)

160 mCg budesonide + 4.5 mCg formoterol fumarate dihydrate (6 g delivers 60 inhalations, 10.2 g delivers approximately 120 inhalations)

5–11 yr (NIH Asthma Guideline 2007 recommendations) and 6 to <12 yr (FDA labeling); see

remarks: Two inhalations BID of 80 mCg budesonide + 4.5 mCg formoterol; **max. dose:** 4 inhalations/24 hr.



≥ 12 yr and adult:

No prior inhaled steroid use: Start with two inhalations BID of 80 mCg budesonide + 4.5 mCg formoterol **OR** 160 mCg budesonide + 4.5 mCg formoterol, depending on severity.

Prior low to medium doses of inhaled steroid use: Start with two inhalations BID of 80 mCg budesonide + 4.5 mCg formoterol.

Prior medium to high doses of inhaled steroid use: Start with two inhalations BID of 160 mCg budesonide + 4.5 mCg formoterol.

Max. dose: 2 inhalations of 160 mCg budesonide + 4.5 mCg formoterol BID

See Budesonide and Formoterol for remarks. Should only be used for patients not adequately controlled on other asthma-controller medications (e.g., low-to-medium dose inhaled corticosteroids) or whose disease severity requires the use of two maintenance therapies.



Titrate to the lowest effective strength after asthma is adequately controlled.

Reported side effects at $\geq 3\%$ and more frequently compared with budesonide alone include URI, pharyngitis, headache, and rhinitis.

As needed rescue therapy with budesonide/formoterol was found to be noninferior to maintenance budesonide and PRN terbutaline for controlling symptoms in mild asthmatics ≥ 12 yr old (Ref. *N Engl J Med* 378[20]:1877).

Proper patient education including dosage administration technique is essential; see patient package insert for detailed instructions. Rinse mouth after each use.

BUMETANIDE

Generics; previously available as Bumex

Loop diuretic

C

?

No

Yes

No

Tabs: 0.5, 1, 2 mg**Injection:** 0.25 mg/mL (4, 10 mL); some preparations may contain 1% benzyl alcohol**Neonate and infant (see remarks):** PO/IM/IV**≤6 mo:** 0.01–0.05 mg/kg/dose once daily or every other day**Infant and child:** PO/IM/IV**>6 mo:** 0.015–0.1 mg/kg/dose once daily-QID; **max. dose:** 10 mg/24 hr**Adult:****PO:** 0.5–2 mg/dose once daily–BID**IM/IV:** 0.5–1 mg over 1–2 min. May give additional doses Q2–3 hr PRN**Usual max. dose (PO/IM/IV):** 10 mg/24 hr

Cross-allergenicity may occur in patients allergic to sulfonamides. Dosage reduction may be necessary in patients with hepatic dysfunction. Administer oral doses with food.



Side effects include cramps, dizziness, hypotension, headache, electrolyte losses (hypokalemia, hypocalcemia, hyponatremia, hypochloremia), and encephalopathy. May also lead to metabolic alkalosis. Serious skin reactions (e.g., Stevens-Johnson, TEN) have been reported.

Drug elimination has been reported to be slower in neonates with respiratory disorders compared with neonates without. May displace bilirubin in critically ill neonates. **Maximal** diuretic effect for infants ≤6 mo has been reported at 0.04 mg/kg/dose with greater efficacy seen at lower dosages.

BUTORPHANOL

Generics; previously available as Stadol

Narcotic, analgesic

C

3

Yes

Yes

No

Injection: 1 mg/mL (1 mL), 2 mg/mL (1, 2 mL)**Nasal solution:** 10 mg/mL (2.5 mL); 1 mg per spray**Child (limited data):** 0.01–0.02 mg/kg/dose (**max. dose:** 2 mg/dose) IV Q3–4 hr PRN. Use of a single dose of 0.03 mg/kg IV has been reported in postoperative patients.**Adult:****IV:** 1 mg/dose Q3–4 hr PRN; **usual dosage range:** 0.5–2 mg Q3–4 hr PRN**IM:** 2 mg/dose Q3–4 hr PRN; **usual dosage range:** 1–4 mg Q3–4 hr PRN

Intranasal: 1 spray (1 mg) in one nostril × 1; an addition 1 mg dose may be given at 1–1.5 hr if needed. This 2-dose sequence may be repeated in 3–4 hr if needed. Alternatively, the patient may receive 2 mg initially (1 mg in each nostril) only if they remain recumbent if drowsiness or dizziness occurs; an additional dose may be given 3–4 hr later.

A synthetic mixed agonist/antagonist opioid analgesic. **Contraindicated** in patients hypersensitive to benzethonium chloride. **Use with caution** in hypotension, thyroid dysfunction, renal or hepatic impairment, and concomitant CNS depressants. **Suggested dosage reduction** in renal impairment (IV/IM): 75% of usual dose for GFR 10–50 mL/min and 50% of usual dose for GFR <10 mL/min with an increase in dosage interval based on duration of clinical effects. A 50% IV/IM dosage reduction with increased dosage interval has been recommended in hepatic dysfunction. Reduced dosage for intranasal administration for both renal and hepatic impairment: initial dose should not exceed 1 mg.



Butorphanol is a P450 3A4 substrate. Cytochrome P450 3A4 inhibitors may increase butorphanol's effects and toxicity (fatal respiratory depression).

BUMETANIDE *continued*

Common side effects include drowsiness, dizziness, insomnia (nasal spray), nausea, vomiting, nasal congestion (nasal spray). Severe respiratory depression has been reported with use of nasal solutions.

Onset of action: 5–10 min (IV); 0.5–1 hr (IM); and within 15 min (intransal). **Duration:** 3–4 hr (IV/IM) and 4–5 hr (intransal).

C**CAFFEINE CITRATE**

Cafcit and generics

Methylxanthine, respiratory stimulant**Injection:** 20 mg/mL (3 mL)**Oral liquid:** 20 mg/mL (3 mL), also available as powder for compounding 10 or 20 mg/mL

20 mg/mL caffeine citrate salt = 10 mg/mL caffeine base

Doses expressed in mg of caffeine citrate.**Neonatal apnea:****Loading dose:** 20–25 mg/kg IV/PO × 1**Maintenance dose:** 5–10 mg/kg/dose PO/IV Q24 hr, to begin 24 hr after loading dose

Avoid use in symptomatic cardiac arrhythmias. **Do not use** caffeine benzoate formulations; it has been associated with kernicterus in neonates. **Use with caution** in impaired renal or hepatic function.



Therapeutic levels: 5–25 mg/L. Cardiovascular, neurologic, or GI toxicity reported at serum levels >50 mg/L. Recommended serum sampling time: obtain trough level within 30 min prior to a dose. Steady state is typically achieved 3 wk after initiation of therapy. Levels obtained prior to steady state are useful for preventing toxicity.

For IV administration, give loading dose over 30 min and maintenance dose over 10 min.

CALCITONIN—SALMON

Miacalcin (injection) and generic nasal sprays; nasal

sprays previously available as Fortical and Miacalcin

Hypercalcemia antidote, antiosteoporotic**Injection (Miacalcin):** 200 U/mL (2 mL); contains phenol**Nasal spray:** 200 U/metered dose (3.7 mL provides at least 30 doses); may contain benzyl alcohol**Osteogenesis imperfecta:**

>6 mo–adolescent: 2 U/kg/dose IM/SC 3 times per week

Hypercalcemia (see remarks):

Adult: Start with 4 U/kg/dose IM/SC Q12 hr; if response is unsatisfactory after 1 or 2 days, may increase dose to 8 U/kg/dose Q12 hr. If response remains unsatisfactory after 2 more days, increase to a **max. dose** of 8 U/kg/dose Q6 hr.

Paget disease (see remarks):

Adult: Start with 100 U IM/SC once daily initially, followed by lower maintenance dose of 50 U 3 times per week if sufficient.

CALCITONIN—SALMON *continued*

Contraindicated in patients sensitive to salmon protein or gelatin. Because of hypersensitivity risk (e.g., bronchospasm, airway swelling, anaphylaxis), skin test is recommended before initiating IM/SC therapy. For skin test, prepare a 10-U/mL dilution with normal saline (NS), administer 0.1 mL intradermally, and observe for 15 min for wheal or significant erythema. Tachyphylaxis has been reported after 2–3 days of use for the treatment of hypercalcemia of malignancy.

Nausea, abdominal pain, diarrhea, flushing, and inflammation/urticaria at the injection site have been reported with IM/SC route of administration. May decrease lithium levels via enhanced urinary clearance. Hypocalcemia and increased risk for malignancies have been reported in a meta-analysis.

Intranasal use currently indicated for postmenopausal osteoporosis in adults. Nasal irritation (alternate nostrils to reduce risk), rhinitis, and epistaxis may occur with the intranasal product.

Tremors have been reported with both intranasal and injectable routes of administration.

If the injection volume exceeds 2 mL, use IM route and multiple sites of injection.

**CALCITRIOL**

1,25-dihydroxycholecalciferol, Rocaltrol, and generics

Active form vitamin D, fat soluble



C



2



No



No



No

Caps (Rocaltrol and generics): 0.25, 0.5 mCg; may contain parabens

Oral solution (Rocaltrol and generics): 1 mCg/mL (15 mL)

Injection (generics; previously available as Calcijex): 1 mCg/mL (1 mL); contains EDTA



Hypoparathyroidism (evaluate dosage at 2- to 4-wk intervals):

Child >1 yr and adult: Initial dose of 0.25 mCg/dose PO once daily. May increase daily dosage by 0.25 mCg at 2- to 4-wk intervals. Usual maintenance dosage as follows:

<1 yr (limited data): 0.02–0.06 mCg/kg/dose PO once daily

1–5 yr: 0.25–0.75 mCg/dose PO once daily

>6 yr and adult: 0.5–2 mCg/dose PO once daily

Renal failure: See the National Kidney Foundation guidelines at https://www.kidney.org/professionals/guidelines/guidelines_commentaries/bone-metabolism-ckd



Most potent vitamin D metabolite available. Should not be used to treat 25-OH vitamin D deficiency; use cholecalciferol or ergocalciferol. Monitor serum calcium and phosphorus, and parathyroid hormone (PTH) in dialysis patients. **Avoid** concomitant use of Mg²⁺-containing antacids. IV dosing applies if patient is undergoing hemodialysis.

Contraindicated in patients with hypercalcemia or vitamin D toxicity. Side effects include: weakness, headache, vomiting, constipation, hypotonia, polydipsia, polyuria, myalgia, metastatic calcification, etc. Allergic reactions, including anaphylaxis, have been reported. May increase serum creatinine in predialysis patients.

CALCIUM ACETATE

Calphron, Eliphos, Phoslyra, and generics (previously available as PhosLo); 25% elemental Ca

Calcium supplement, phosphorous-lowering agent



C



2



Yes



No



No

Tabs (Calphron, Eliphos, and generics): 667 mg (169 mg elemental Ca)

Capsules (Generics; previously available as PhosLo): 667 mg (169 mg elemental Ca)

Oral solution (Phoslyra): 667 mg/5 mL (473 mL) (169 mg elemental Ca per 5 mL); contains methylparabens and propylene glycol

Each 1 g of salt contains 12.7 mEq or 6.34 mmol (250 mg) elemental Ca.

D

CALCIUM ACETATE *continued***Doses expressed in mg of calcium acetate.****Hyperphosphatemia (see remarks):**

Child and adolescent: Start with 667–1000 mg PO with each meal. If needed, dosage may be titrated every 2–4 wk up to the recommended limits from the KDOQI guidelines:

Calcium intake as phosphate binders: 1500 mg elemental calcium/24 hr

Total calcium intake from all sources: 2000 mg elemental calcium/24 hr

Adult: Start with 1334 mg PO with each meal. Dosage may be increased gradually every 2–3 wk to bring serum phosphorous levels below 6 mg/dL, as long as hypercalcemia does not occur. Most patients require 2001–2668 mg PO with each meal.



Contraindicated in ventricular fibrillation. **Use with caution** in renal impairment, as hypercalcemia may develop in end-stage renal failure. Nausea and hypercalcemia may occur. Approximately 40% of dose is systemically absorbed under fasting conditions and up to 30% in nonfasting conditions. May reduce absorption of fluoroquinolones, tetracyclines, iron, and effectiveness of polystyrene sulfonate. May potentiate effects of digoxin.

1 g calcium acetate binds to 45 mg phosphorus.

Administer with meals and plenty of fluids for use as a phosphorus-lowering agent. Calcium is excreted in breast milk and is not expected to harm the infant provided maternal serum calcium is appropriately monitored.

CALCIUM CARBONATE

Tums, Children's Pepto, and many others including generics; 40% elemental Ca

Calcium supplement, antacid



C



2



Yes



No



No

Tab, chewable [OTC]: 400, 500, 600, 750, 1000, 1250 mg; may contain aspartame

Children's Pepto [OTC]: 400 mg

Tab [OTC]: 648, 1250, 1500 mg

Oral suspension [OTC]: 1250 mg/5 mL; may contain parabens

Powder [OTC]: 800 mg/2 g (480 g)

Each 1 g of salt contains 20 mEq or 10 mmol (400 mg) elemental Ca.

Some products may be combined with vitamin D; check package labeling.

Hypocalcemia (Doses expressed in mg of elemental calcium. To convert to mg of salt, divide elemental dose by 0.4):

Neonate: 50–150 mg/kg/24 hr ÷ Q4–6 hr PO; **max. dose:** 1 g/24 hr

Child: 45–65 mg/kg/24 hr PO ÷ QID

Adult: 1–2 g/24 hr PO ÷ TID–QID



Antacid (Doses expressed in mg of calcium carbonate; chronic use NOT recommended in GERD):

2–5 yr and ≥10.9 kg: 375–400 mg PO as symptoms occur; **max. dose:** 1500 mg/24 hr

>6–11 yr: 750–800 mg PO as symptoms occur; **max. dose:** 3000 mg/24 hr

>11 yr and adult: 500–3000 mg PO as symptoms occur; **max. dose:** 7500 mg/24 hr.



See *Calcium acetate* for **contraindications, precautions, and drug interactions**. Side effects:

constipation, hypercalcemia, hypophosphatemia, hypomagnesemia, nausea, vomiting, headache, and confusion. Some products may contain trace amounts of sodium.

Administer with plenty of fluids. For use as a phosphorus-lowering agent, administer with meals. Calcium is excreted in breast milk and is not expected to harm the infant, provided maternal serum calcium is appropriately monitored.

CALCIUM CHLORIDE

Various generics; 27% elemental Ca

Calcium supplement

C



2



Yes



No



No

Injection: 100 mg/mL (10%) (1.36 mEq Ca/mL) (10 mL)**Prefilled syringe for injection:** 100 mg/mL (10%) (1.36 mEq Ca/mL) (10 mL)

Each 1 g of salt contains 13.6 mEq or 6.8 mmol (273 mg) elemental Ca.

Doses expressed in mg of calcium chloride.**Cardiac arrest or calcium channel blocker toxicity:****Neonate, infant, and child:** 20 mg/kg/dose (**max. dose:** 1000 mg/dose) IV/IO Q10 min PRN, if effective, an infusion of 20–50 mg/kg/hr may be used**Adult:** 500–1000 mg/dose IV Q10 min PRN or 2–4 mg/kg/dose Q10 min PRN**MAXIMUM IV ADMINISTRATION RATES:****IV push:** Do not exceed 100 mg/min (over 10–20 sec in cardiac arrest)**IV infusion:** Do not exceed 45–90 mg/kg/hr with a **max. concentration** of 20 mg/mL.

Contraindicated in ventricular fibrillation. **Not recommended** for asystole and electromechanical dissociation. **Use with caution** in renal impairment, as hypercalcemia may develop in end stage renal failure. May potentiate effects of digoxin.



Use IV with extreme caution. Extravasation may lead to necrosis. Hyaluronidase may be helpful for extravasation. Central line administration is preferred IV route of administration. **Do not use** scalp veins. **Do not administer IM or SC routes.**

Rapid IV infusion associated with bradycardia, hypotension, and peripheral vasodilation. May cause hyperchloremic acidosis.

Calcium is excreted in breast milk and is not expected to harm the infant, provided maternal serum calcium is appropriately monitored.

CALCIUM CITRATE

Calcitrade, Citracal, Viactiv, and generics;

21% elemental Ca

Calcium supplement

C



2



Yes



No

**Tabs:****Calcitrade, Citracal, and generics [OTC]:** 950 mg (200 mg elemental Ca)**Generics [OTC]:** 1040 mg (218 mg elemental Ca)

Some products may be combined with vitamin D; check package labeling

Chewable tabs:**Citracal [OTC]:** 950 mg (200 mg elemental Ca) and 500 IU vitamin D3**Viactiv [OTC]:** 650 mg elemental Ca and 500 IU vitamin D3 with 40 mCg vitamin K, and 10 mg sodium

Each 1 g of salt contains 10.5 mEq or 5.25 mmol (211 mg) elemental Ca.

Doses expressed as mg of elemental calcium. To convert to mg of salt, divide elemental dose by 0.21.**Hypocalcemia:****Neonate:** 50–150 mg/kg/24 hr ÷ Q4–6 hr PO; **max. dose:** 1 g/24 hr**Child:** 45–65 mg/kg/24 hr PO ÷ QID**Adult:** 1–2 g/24 hr PO ÷ TID-QID

CALCIUM CITRATE *continued*

See Calcium Acetate for **contraindications, precautions, and drug interactions**. Side effects: constipation, hypercalcemia, hypophosphatemia, hypomagnesemia, nausea, vomiting, headache, and confusion.

Administer with meals for use as a phosphorus-lowering agent. For hypocalcemia, do not administer with or before meals/food and take plenty of fluids.

Calcium is excreted in breast milk and is not expected to harm the infant, provided maternal serum calcium is appropriately monitored.

CALCIUM GLUCONATE

Cal-Glu and generics; 9.3% elemental Ca

Calcium supplement



C

2

Yes

No

No

Tabs [OTC]: 50 mg

Caps (Cal-Glu) [OTC]: 500 mg

Injection: 100 mg/mL (10%) (0.465 mEq Ca/mL) (10, 50, 100 mL); may contain 400 mCg aluminum per 1000 mL (0.4 mCg per 100 mg calcium gluconate); see remarks

Each 1 g of salt contains 4.65 mEq or 2.33 mmol (93 mg) elemental Ca

Doses expressed in mg calcium gluconate.

Maintenance/hypocalcemia:



Neonate: IV: 200–800 mg/kg/24 hr ÷ Q6 hr

Infant:

IV: 200–500 mg/kg/24 hr ÷ Q6 hr

PO: 400–800 mg/kg/24 hr ÷ Q6 hr

Child: 200–500 mg/kg/24 hr IV or PO ÷ Q6 hr

Adult: 0.5–8 g/24 hr IV or PO ÷ Q6 hr

For cardiac arrest:

Infant and child: 100 mg/kg/dose (**max.** 3000 mg/dose) IV Q10 min PRN

Adult: 1.5–3 g/dose IV Q10 min PRN

Max. dose: 3 g/dose

For tetany:

Neonate, infant, child: 100–200 mg/kg dose IV over 5–10 min, repeat dose 6 hr later if needed; **max. dose:** 500 mg/kg/24 hr

Adult: 0.5–2 g IV over 10–30 min, repeat dose 6 hr later if needed.

MAXIMUM IV ADMINISTRATION RATES:

IV push: Do not exceed 100 mg/min (over 10–20 sec in cardiac arrest)

IV infusion: Do not exceed 200 mg/min with a **maximum** concentration of 50 mg/mL



Contraindicated in ventricular fibrillation. **Use with caution** in renal impairment, as hypercalcemia may develop in end-stage renal failure. **Avoid** peripheral infusion because extravasation may cause tissue necrosis. IV infusion associated with hypotension and bradycardia. Also associated with arrhythmias in digitalized patients. May reduce absorption of fluoroquinolones, tetracyclines, iron, and effectiveness of polystyrene sulfonate with oral route of administration.

Do not administer IV dosage form via scalp veins and the IM or SC routes. IV dosage form may precipitate when mixed with bicarbonate or ceftriaxone. IV dosage form may also contain aluminum (see how supplied section), and patients with renal impairment (including premature infants) receiving >4–5 mCg/kg/24 hr aluminum have been associated with CNS and bone toxicities.

Calcium is excreted in breast milk and is not expected to harm the infant provided maternal serum calcium is appropriately monitored.

D

CALCIUM LACTATE

Cal-Lac and various generics; 13% elemental Ca

Calcium supplement

C

2

Yes

No

No

Tabs [OTC]: 100, 648 mg**Caps (Cal-Lac) [OTC]:** 500 mg

Each 1 g salt contains 6.48 mEq or 3.24 mmol (130 mg) elemental Ca.

Doses expressed in mg of calcium lactate.**Hypocalcemia:****Neonate/Infant:** 400–500 mg/kg/24 hr PO ÷ Q4–6 hr**Child:** 500 mg/kg/24 hr PO ÷ Q6–8 hr**Adult:** 1.5–3 g PO Q8 hr**Max. dose:** 9 g/24 hrSee *Calcium Acetate* for **contraindications, precautions, and drug interactions**. May cause constipation, headache, and hypercalcemia.Administer with or following meals and with plenty of fluids. **Do not** dissolve tablets in milk.

Calcium is excreted in breast milk and is not expected to harm the infant, provided maternal serum calcium is appropriately monitored.

**CALCIUM PHOSPHATE, TRIBASIC**

Posture-D; 39% elemental Ca

Calcium supplement

C

2

Yes

No

No

Tabs [OTC]: 600 mg elemental calcium and 280 mg phosphorus; with 500 IU vitamin D and 50 mg magnesium**Oral suspension:** 20 mg elemental calcium/1 mL **NOTE:** Pharmacy may crush tablets into a powder to enhance drug delivery for children unable to swallow tablets and to accommodate smaller doses.

Each 1 g of salt contains 19.3 mEq or 9.65 mmol (390 mg) elemental Ca.

**Doses expressed as mg of elemental calcium.****Hypocalcemia:****Neonate:** 20–80 mg/kg/24 hr ÷ Q4–6 hr PO; **max. dose:** 1 g/24 hr**Child:** 45–65 mg/kg/24 hr PO ÷ Q6 hr**Adult:** 1–2 g/24 hr PO ÷ Q6–8 hr**Contraindicated** in ventricular fibrillation. **Use with caution** in renal impairment, because hypercalcemia may develop in end-stage renal failure (**avoid use** in dialysis with hypercalcemia), history of kidney stones, and parathyroid disorders. May cause constipation, GI disturbances, and hypercalcemia. See *Calcium Acetate* for drug interactions.

Give with or following meals and with plenty of fluids. Keep in mind the amounts of vitamin D and magnesium your respective dosage may provide.

Calcium is excreted in breast milk and is not expected to harm the infant, provided maternal serum calcium is appropriately monitored.

CALFACTANT

See Surfactant, pulmonary

CANNABIDIOL
Epidiolex
Anticonvulsant**Oral solution:** 100 mg/mL (100 mL); contains ethanol and sesame oil**Lennox-Gastaut syndrome or Dravet syndrome (see remarks):**

Child ≥2 yr and adult: Start at 2.5 mg/kg/dose PO BID × 1 wk, dosage may be increased to a maintenance dose of 5 mg/kg/dose PO BID. Dose may be further increased after 1 wk if needed and tolerated at weekly increments of 2.5 mg/kg/dose BID (5 mg/kg/24 hr) up to the maximum of 20 mg/kg/24 hr. Those requiring a more rapid titration from 10 mg/kg/24 hr to 20 mg/kg/24 hr may be titrated no more frequent than Q48 hr.

Dosage reduction in moderate and severe hepatic impairment prior to initiation of therapy (slower dose titration has been suggested):

Child-Pugh Category for Hepatic Impairment	Initial PO Dose (mg/kg/dose BID)	Maintenance PO Dose (mg/kg/dose BID)	Maximum PO Dose (mg/kg/dose BID)
B (moderate)	1.25	2.5	5
C (severe)	0.5	1	2

Epidiolex is a schedule V controlled substance. Common side effects include somnolence, decreased appetite, diarrhea, elevated transaminase (dose related), fatigue, malaise and asthenia, rash, insomnia, and sleep disorder. Suicidal behavior and ideation and respiratory failure have been reported.

Monitor ALT, AST, and total bilirubin at baseline and 1, 3, 6 mo initially and periodically thereafter. More frequent monitoring is recommended with concurrent valproic acid or clobazam. Reduce dose or discontinue use in the presence of hepatic impairment.

Epidiolex is a substrate for CYP 450 2C19 and 3A4; other moderate/strong inducers or inhibitors for these enzymes may affect its overall exposure. May increase the effects/toxicity of clobazam and diazepam because it may inhibit CYP 450 1A2, 2B6, 2C8, 2C9, and 2C19. May inhibit the UGT 1A9 and 2B7 transporters.

Teratogen data limited only to animal studies with evidence of developmental toxicities at similar exposure concentrations in humans receiving therapeutic doses. Patients exposed to cannabidiol during pregnancy are encouraged to register with the North American Antiepileptic Drug Pregnancy Registry at www.aedpregnancyregistry.org.

Administration with high-fat or high-calorie meals may increase absorption. Gradually taper when discontinuing medication; **avoid** abrupt discontinuation.

Each bottle of oral solution must be stored in the original bottle in the upright position at 59–86°F. Discard the unused portion of each bottle 12 wk after first opening.

CAPTOPRIL

Various generics; previously available as Capoten
Angiotensin-converting enzyme inhibitor, antihypertensive

**Tabs:** 12.5, 25, 50, 100 mg**Oral suspension:** 1 mg/ml **Neonate:** 0.01–0.05 mg/kg/dose PO Q8–12 hr**Infant aged <6 mo:** Initially 0.01–0.5 mg/kg/dose PO BID–TID; titrate upward if needed; **max. dose:** 6 mg/kg/24 hr. *Continued*

CAPTOPRIL continued

Child: Initially, 0.3–0.5 mg/kg/dose PO BID–TID; titrate upward if needed; **max. dose:** 6 mg/kg/24 hr up to 450 mg/24 hr.

Adolescent and adult: Initially, 12.5–25 mg/dose PO BID–TID; increase weekly if necessary by 25 mg/dose to **max. dose:** 450 mg/24 hr. Usual dosage range: 25–100 mg/24 hr ÷ BID.

Onset within 15–30 min of administration. Peak effect within 1–2 hr. **Adjust dose with renal failure** (see **Chapter 31**). Should be administered on an empty stomach 1 hr before or 2 hr after meals. Titrate to minimal effective dose. Lower doses should be used in patients with sodium and water depletion because of diuretic therapy.



Use with caution in collagen vascular disease and concomitant potassium sparing diuretics. **Avoid use** with dialysis with high-flux membranes as anaphylactoid reactions have been reported. May cause rash, proteinuria, neutropenia, cough, angioedema (head, neck and intestine), hyperkalemia, hypotension, or diminution of taste perception (with long term use). Known to decrease aldosterone and increase renin production. **Do not** coadminister with angiotensin receptor blockers or aliskiren as use has been associated with increased risks for hypotension, hyperkalemia, and acute renal failure. Captopril is a CYP 450 2D6 substrate. Use with sirolimus, everolimus, temsirolimus, or sacubitril may increase risk for angioedema.

Captopril should be discontinued as soon as possible when pregnancy is detected.

CARBAMAZEPINE

Epitol, Tegretol, Tegretol-XR, Carbatrol, Equetro, Carnexiv, and various generics

Anticonvulsant



D 2 Yes Yes Yes

Tabs: 200 mg

Chewable tabs: 100 mg

Extended-release tabs (Tegretol-XR and generics): 100, 200, 400 mg

Extended-release caps (Carbatrol, Equetro, and generics): 100, 200, 300 mg

Oral suspension: 100 mg/5 mL (450 mL); may contain propylene glycol

Injection (Carnexiv): 10 mg/mL (20 mL); contains betadex sulfobutyl ether sodium (preservative-free)

See remarks regarding dosing intervals for specific dosage forms:



<6 yr:

Initial: 10–20 mg/kg/24 hr PO ÷ BID–TID (QID for suspension)

Increment: Q5–7 days up to **max. dose** of 35 mg/kg/24 hr PO

6–12 yr:

Initial: 10 mg/kg/24 hr PO ÷ BID up to **max. dose:** 100 mg/dose BID

Increment: 100 mg/24 hr at 1-wk intervals (÷ TID–QID) until desired response is obtained

Maintenance: 20–30 mg/kg/24 hr PO ÷ BID–QID; usual maintenance dose is 400–800 mg/24 hr; **max. dose:** 1000 mg/24 hr

>12 yr and adult:

Initial: 200 mg PO BID

Increment: 200 mg/24 hr at 1-wk intervals (÷ BID–QID) until desired response is obtained

Maintenance: 800–1200 mg/24 hr PO ÷ BID–QID

Max. dose:

Child 12–15 yr: 1000 mg/24 hr

Child >15 yr: 1200 mg/24 hr

Adult: 1.6–2.4 g/24 hr

Intravenous dosage form (Carnexiv; see remarks):

Child: pediatric PK, efficacy, and safety data currently not available

CARBAMAZEPINE continued**Intravenous dosage form (Carnexiv; see remarks) cont.:**

Adult (IV); indicated as replacement therapy for PO carbamazepine when PO route is not feasible).

Determine IV daily dose by taking 70% of the established total daily oral dosage and dividing into 4 equal doses to be administered Q6 hr. Each dose is further diluted in 100 mL of compatible fluid and infused over 30 min. **Use is NOT recommended >7 days.**

Contraindicated for patients taking monoamine oxidase (MAO) inhibitors or who are sensitive to tricyclic antidepressants. Should not be used in combination with clozapine, owing to increased risk for bone marrow suppression and agranulocytosis. Increased risk for severe dermatologic reactions (e.g., Stevens-Johnson syndrome [SJS] and toxic epidermal necrolysis [TEN]) has been associated with the HLA-B*1502 (prevalent among Asian descent) and HLA-A*3101 (prevalent among Japanese, Native American, Southern Indian, and some Arabic ancestry) alleles.

Erythromycin, diltiazem, verapamil, cefixime, cimetidine, itraconazole, aprepitant, and INH may increase serum levels. Carbamazepine may decrease activity of warfarin, direct-acting oral anticoagulants (e.g., rivaroxaban, apixaban), doxycycline, oral contraceptives, cyclosporine, theophylline, phenytoin, benzodiazepines, ethosuximide, and valproic acid. Carbamazepine is a CYP 450 3A4 substrate and inducer of CYP 450 1A2, 2C, and 3A4. The enzyme-inducing effects may increase effects/toxicity of cyclophosphamide. CYP 450 3A4 inhibitors may increase carbamazepine levels/toxicity.

Suggested dosing intervals for specific dosage forms: extended-release tabs or caps (BID); chewable and immediate-release tablets (BID–TID); suspension (QID).

Doses may be administered with food. **Do not** crush or chew extended-release dosage forms. Shake bottle well prior to dispensing oral suspension dosage form, and **do not** administer simultaneously with other liquid medicines or diluents.

Drug metabolism typically increases after the first month of therapy initiation due to hepatic autoinduction.

Therapeutic blood levels for seizures: 4–12 mg/L. Recommended serum sampling time: obtain trough level within 30 min prior to an oral dose. Steady state is typically achieved 1 mo following the initiation of therapy (following enzymatic autoinduction). Levels obtained prior to steady state are useful for preventing toxicity. Blood trough levels of 7–10 mg/L have been recommended for bipolar disorders.

Side effects include sedation, dizziness, diplopia, aplastic anemia, neutropenia, urinary retention, nausea, SIADH, and SJS. Suicidal behavior or ideation, hypogammaglobulinemia, and onychomadesis have been reported. Approximately one-third of patients who had hypersensitivity reactions will also experience the hypersensitivity to oxcarbazepine. Pretreatment complete blood counts (CBCs) and liver function tests (LFTs) are suggested. Patient should be monitored for hematologic and hepatic toxicity. Most common side effects with the IV route, dizziness, somnolence, blurred vision, diplopia, headache, infusion-related reaction, infusion site pain, and anemia.

Adjust dose in renal impairment (see Chapter 31). Do not use IV dosage form in moderate/severe renal impairment (GFR <30 mL/min) due to accumulation of betadex sulfobutyl ether sodium, which may be nephrotoxic.

CARBAMIDE PEROXIDE

Otic solution: Debrox, Auraphene-B, Earwax Removal Drops, and many generic products

Oral liquid: Gly-Oxide

Cerumenolytic, topical oral analgesic



Otic solution (OTC): 6.5% (15 mL); may contain propylene glycol or alcohol

Oral liquid (OTC): 10% (Gly-Oxide) (15, 60 mL)

Continued

Carbamide Peroxide *continued***Cerumenolytic:**

<12 yr: Tilt head sideways and instill 1–5 drops (according to patient size) into affected ear; retain drops in ear for several minutes. Remove wax by gently flushing the ear with warm water, using a soft rubber bulb ear syringe. Dose may be repeated BID PRN for up to 4 days.

≥12 yr: Following the same instructions as aforementioned, instill 5–10 drops into affected ear BID PRN for up to 4 days.

**Oral analgesic (see remarks):**

≥2 yr (able to follow instructions): Instill several drops of the oral liquid to affected area and expectorate after 2–3 min, OR place 10 drops on tongue and mix with saliva, swish for several minutes, and expectorate. Administer up to QID, after meals and QHS, for up to 7 days.



Otic solution: Contraindicated if tympanic membrane perforated; following otic surgery; ear discharge, drainage, pain, irritation, or rash; or PE tubes in place. Tip of applicator should not enter ear canal when used as a cerumenolytic.

Oral liquid: Prolonged use may result in fungal overgrowth. **Do not** rinse the mouth or drink for at least 5 min when using oral preparation.

Pregnancy category has not been formally assigned by the FDA.

CARBINOXAMINE

Karbinal ER, RyVent, and many generics

Antihistamine

C

3

No

No

No

Oral liquid: 4 mg/5 mL (473 mL); may contain propylene glycol

Extended-release oral suspension (Karbinal ER): 4 mg/5 mL (480 mL); contains parabens and metasulfite

Tabs: 4, 6 mg

RyVent: 6 mg

**Child (PO; see remarks):**

Immediate-release dosage forms: 0.2–0.4 mg/kg/24 hr PO ÷ TID–QID; alternative dosing by age (**do not exceed** 0.4 mg/kg/24 hr):

2–5 yr: 1–2 mg TID–QID

6–11 yr: 2–4 mg TID–QID

≥12 yr: 4–8 mg TID–QID

Extended-release oral suspension (Karbinal ER; approximately 0.2–0.4 mg/kg/24 hr):

2–3 yr: 3–4 mg Q12 hr

4–5 yr: 3–8 mg Q12 hr

6–11 yr: 6–12 mg Q12 hr

≥12 yr: 6–16 mg Q12 hr

Adult (PO):

Immediate-release dosage forms: 4–8 mg TID–QID

Extended-release oral suspension (Karbinal ER): 6–16 mg Q12 hr

Generally not recommended for treating upper respiratory tract infections (URIs) for infants.

No proven benefit for infants and young children with URIs. **The FDA does not recommend use for URIs in children <2 yr because of reports of increased fatalities.** Carbinal ER use is **contraindicated** in <2 yr and in nursing mothers.



Contraindicated in acute asthma, hypersensitivity with other ethanolamine antihistamines, MAO inhibitors, severe hypertension, narrow-angle glaucoma, severe coronary artery disease, and urinary retention. Be aware that combination products containing a decongestant may exist.

May cause drowsiness, vertigo, dry mucus membranes, and headache. Paradoxical excitation reac-

CARNITINE

Levcarnitine, Carnitor, Carnitor SF, L-Carnitine, and generics

Nutritional supplement, amino acid



B



?



Yes



No



No

Tabs: 330 mg

Caps: 250 mg

Oral solution: 100 mg/mL (118 mL); contains methylparabens and propylparabens; Carnitor SF is a sugar-free product

Injection: 200 mg/mL (5 mL); preservative free

Primary carnitine deficiency:

Oral:

Child: 50–100 mg/kg/24 hr PO ÷ Q8–12 hr; increase slowly as needed and tolerated to **max. dose** of 3 g/24 hr

Adult: 330 mg to 1 g/dose BID–TID PO; **max. dose:** 3 g/24 hr

IV:

Child and adult: 50 mg/kg as loading dose; may follow with 50 mg/kg/24 hr IV infusion (for severe cases); maintenance: 50 mg/kg/24 hr ÷ Q4–6 hr; increase to **max. dose** of 300 mg/kg/24 hr if needed.

May cause nausea, vomiting, abdominal cramps, diarrhea, and body odor. Seizures have been reported in patients with or without a history of seizures.



Safety in end-stage renal disease (ESRD) has not been established. High doses to severely compromised renal function or ESRD on dialysis may result in accumulation of potentially toxic metabolites (trimethylamine and trimethylamine-*N*-oxide). Serious hypersensitivity reactions, including anaphylaxis, have been reported with IV use mostly in ESRD patients undergoing dialysis.

Give bolus IV infusion over 2–3 min.

CARVEDILOL

Coreg, Coreg CR, and generics

Adrenergic antagonist (α and β), antihypertensive



C



?



Yes



Yes



No

Tabs: 3.125, 6.25, 12.5, 25 mg

Extended-release caps (Coreg CR and generics): 10, 20, 40, 80 mg

Oral suspension: 0.1, 1.25, 1.67 mg/mL

Heart failure:

Immediate-release dosage forms (tablets and oral suspension; see remarks):

Infant, child, adolescent (2013 Canadian Cardiovascular Society Guidelines):

<62.5 kg: Start at 0.1 mg/kg/24 hr PO ÷ Q12 hr. Dose may be doubled every 2 wk if needed and tolerated up to 0.8–1 mg/kg/24 hr ÷ Q12 hr. Divide daily dosage by Q8 hr if child is <4 yr old due to altered pharmacokinetics.

≥62.5 kg: Start at 3.125 mg PO BID. Dose may be doubled every 2 wk if needed and tolerated up to 25 mg BID. 25 mg PO TID may be needed for patients weighing >75 kg.

Adult: Start at 3.125 mg PO BID × 2 wk, if needed and tolerated, may increase to 6.25 mg BID. Dose may be doubled every 2 wk if needed to the following **max. doses**:

<85 kg: 25 mg BID

≥85 kg: 50 mg BID

Extended-release capsules:

Adult: Start at 10 mg PO once daily × 2 wk, if needed and tolerated, double the dose every 2 wk up to a **maximum** of 80 mg once daily.

D com
ted



CARVEDILOL *continued***Hypertension:****Adult:**

Immediate-release dosage forms: Start at 6.25 mg PO BID; dose may be doubled every 1–2 wk up to a **maximum** of 25 mg PO BID.

Extended-release capsules: Start at 20 mg PO once daily \times 1–2 wk, if needed and tolerated, increase to 40 mg PO once daily. If needed, dose may be further increased in 2-wk intervals up to a **maximum** of 80 mg/24 hr.

Immediate-release and extended-release products are NOT interchangeable on a mg-to-mg basis.

Contraindicated in asthma or related bronchospastic disease, sick sinus syndrome, 2nd- or 3rd-degree heart block, severe bradycardia, cardiogenic shock, decompensated cardiac failure requiring IV inotropic therapy, and severe hepatic impairment (Child-Pugh class C).

Use with caution mild/moderate hepatic impairment (Child-Pugh class A or B), renal insufficiency, thyrotoxicosis, ischemic heart disease, diabetes, and cataract surgery. **Avoid abrupt withdrawal** of medication. Children <3.5 yr old may have faster carvedilol clearance and may require higher dosages or TID dosing. Carvedilol is a CYP 450 2D6 substrate. Digoxin, disopyramide, and dipyridamole may increase bradycardic effects.

Bradycardia, postural hypotension, peripheral edema, weight gain, hyperglycemia, diarrhea, dizziness, and fatigue are common. Hypersensitivity reactions have been reported. Chest pain, headache, vomiting, edema, and dyspnea have also been reported in children. Administering doses with food can reduce risk for orthostatic hypotension.

**CASPOFUNGIN**

Cancidas and generics

Antifungal, echinocandin

C

?

No

Yes

No

Injection: 50, 70 mg; contains sucrose (39 mg in 50 mg vial and 54 mg in 70 mg vial) and mannitol (26 mg in 50 mg vial and 36 mg in 70 mg vial)

Preterm neonate to <3 mo infant:

BSA dosing (based on a small pharmacokinetic study, achieving similar plasma exposure as seen in adults receiving 50 mg/24 hr): 25 mg/m²/dose IV once daily.



Weight-based dosing (based on a prospective, randomized, double-blinded, controlled, and case series data): 2 mg/kg/dose IV once daily for at least 2 wk after first negative blood culture and resolution of signs/symptoms for invasive candidiasis have been reported to be more efficacious with fewer side effects than conventional amphotericin B.

3 mo infant–17 yr (see remarks): 70 mg/m²/dose IV loading dose on day 1 followed by 50 mg/m²/dose IV once daily maintenance dose. Increase the maintenance dose to 70 mg/m²/dose if response is inadequate or if the patient is receiving an enzyme-inducing medication (see remarks).

Maximum loading and maintenance dose: 70 mg/dose.

Adult (see remarks):

Loading dose: 70 mg IV \times 1

Maintenance dose:

Usual: 50 mg IV once daily. If tolerated and response is inadequate or if patient is receiving an enzyme-inducing medication (see remarks), increase to 70 mg IV once daily.

Hepatic insufficiency (Child-Pugh score 7–9): 35 mg IV once daily.

Use with caution in hepatic impairment and concomitant enzyme-inducing drugs. Higher maintenance doses (70 mg/m²/dose in children and 70 mg in adults) are recommended for concomitant use of enzyme inducers such as carbamazepine, dexamethasone, phenytoin, nevirapine, efavirenz, or rifampin. Use Mosteller formula for calculating body surface area (BSA). D



CASPOFUNGIN *continued*

Most common adverse effects (>10%) in children include fever, diarrhea, rash, elevated aspartate transaminase/alanine transaminase (ALT/AST), hypokalemia, hypotension, and chills. May also cause facial swelling, nausea/vomiting, headache, infusion site phlebitis, and LFT elevation.

Anaphylaxis, TEN, SJS, and possible histamine-related reactions (angioedema, bronchospasm, and warmth sensation) have been reported. Hepatobiliary adverse effects have been reported in pediatric patients with serious underlying medical conditions.

Reduce daily dose by 30% in moderate hepatic impairment (Child-Pugh score 7–9).

Use with cyclosporine may cause transient increase in LFTs and caspofungin level elevations. May decrease tacrolimus levels.

Administer doses by slow IV infusion over 1 hr. **Do not mix or co-infuse** with other medications, and **avoid** using dextrose-containing diluents (e.g., D₅W).

CEFACLOR

Generics; previously available as Ceclor

Antibiotic, cephalosporin (second generation)



B

1

Yes

No

No

Caps: 250, 500 mg

Extended-release tabs: 500 mg

Oral suspension: 125 mg/5 mL (150 mL); 250 mg/5 mL (150 mL); 375 mg/5 mL (100 mL)

Child >1 mo old (use regular-release dosage forms): 20–40 mg/kg/24 hr PO ÷ Q8 hr; **max.**

dose: 1 g/24 hr

Q12 hr dosage interval option for pharyngitis (use oral suspension dosage form):

20 mg/kg/24 hr PO ÷ Q12 hr; **max. dose:** 1 g/24 hr



Adult: 250–500 mg/dose PO Q8 hr

Extended-release tablets: 500 mg/dose PO Q12 hr



Not recommended for otitis media or pharyngitis/tonsillitis. **Use with caution** in patients with penicillin allergy or renal impairment. Side effects include elevated LFTs, bone marrow suppression, and moniliasis. Probenecid may increase cefaclor concentrations. May cause positive Coombs test or false-positive test for urinary glucose. Serum sickness reactions have been reported in patients receiving multiple courses of cefaclor.

Do not crush, cut, or chew extended-release tablets. Doses should be given on an empty stomach.

Extended-release tablets not recommended for children. Adjust dose in renal failure (see Chapter 31).

CEFADROXIL

Generics; previously available as Duricef

Antibiotic, cephalosporin (first generation)



B

1

Yes

No

No

Oral suspension: 250 mg/5 mL (50, 100 mL), 500 mg/5 mL (75, 100 mL)

Tabs: 1 g

Caps: 500 mg



Infant and child: 30 mg/kg/24 hr PO ÷ Q12 hr (daily dose may be administered once daily for group A β-hemolytic streptococci pharyngitis/tonsillitis); **max. dose:** 2 g/24 hr

Bacterial endocarditis prophylaxis for dental and upper airway procedures: 50 mg/kg/dose (**max. dose:** 2 g) × 1 PO 1 hr before procedure.

CEFADROXIL continued

Adolescent and adult: 1–2 g/24 hr PO ÷ Q12–24 hr (administer Q12 hr for complicated UTIs);
max. dose: 2 g/24 hr

Bacterial endocarditis prophylaxis for dental and upper airway procedures: 2 g × 1 PO 1 hr before procedure.

See **Cephalexin** for **precautions** and interactions. Rash, nausea, vomiting, and diarrhea are common. Transient neutropenia and vaginitis have been reported. **Adjust dose in renal failure (see Chapter 31).**

**CEFAZOLIN**

Generics; previously available as Ancef

Antibiotic, cephalosporin (first generation)



B

1

Yes

Yes

No

Injection: 0.5, 1, 10, 20, 100 g

Frozen injection: 1 g/50 mL (contains 2 g dextrose to make an iso-osmotic solution), 2 g/100 mL (contains 4 g dextrose to make an iso-osmotic solution)

Contains 2.1 mEq Na/g drug



Neonate (IM/IV):

Postnatal age ≤7 days:

≤2000 g: 50 mg/kg/24 hr ÷ Q12 hr

>2000 g: 100 mg/kg/24 hr ÷ Q12 hr

Postnatal age >7–28 days:

≤2000 g: 75 mg/kg/24 hr ÷ Q8 hr

>2000 g: 150 mg/kg/24 hr ÷ Q8 hr

Infant >1 mo and child (IM/IV):

Mild/moderate infection: 25–100 mg/kg/24 hr ÷ Q6–8 hr; **max. dose:** 6 g/24 hr

Severe infection: 100–150 mg/kg/24 hr ÷ Q6–8 hr (**max. dose:** 12 g/24 hr); 150 mg/kg/24 hr ÷ Q6–8 hr has been recommended for bone/joint infections

Adult: 2–6 g/24 hr ÷ Q6–8 hr IV/IM; **max. dose:** 12 g/24 hr

Bacterial endocarditis prophylaxis for dental and upper respiratory procedures:

Infant and child: 50 mg/kg IV/IM (**max. dose:** 1 g) 30 min before procedure

Adult: 1 g IV/IM 30 min before procedure

Use with caution in renal impairment or in penicillin-allergic patients. Does not penetrate well into cerebrospinal fluid (CSF). May cause phlebitis, leukopenia, thrombocytopenia, transient liver enzyme elevation, and false-positive urine-reducing substance (Clinitest) and Coombs test.

For dosing in obese patients, use higher end of the dosing recommendation. **Adjust dose in renal failure (see Chapter 31).**

**CEFDINIR**

Generics; previously available as Omnicef

Antibiotic, cephalosporin (third generation)



B

1

Yes

Yes

No

Caps: 300 mg

Oral suspension: 125 mg/5 mL (60, 100 mL), 250 mg/5 mL (60, 100 mL)



6 mo–12 yr:

Otitis media, sinusitis (not recommended as empiric monotherapy), pharyngitis/tonsillitis:

14 mg/kg/24 hr PO ÷ Q12–24 hr; **max. dose:** 600 mg/24 hr

Uncomplicated skin infections (see remarks): 14 mg/kg/24 hr PO ÷ Q12 hr; **max. dose:** 600 mg/24 hr

CEFDINIR continued **≥ 13 yr and adult:****Bronchitis, sinusitis, pharyngitis/tonsillitis:** 600 mg/24 hr PO \div Q12–24 hr**Community-acquired pneumonia, uncomplicated skin infections (see remarks):** 600 mg/24 hr PO \div Q12 hr

Use with caution in penicillin-allergic patients or in presence of renal impairment. Good gram-positive cocci activity but may be inadequate for penicillin-resistant pneumococci. May cause diarrhea (especially in children <2 yr), headache, vaginitis, and false-positive urine-reducing substance (Clinitest) and Coombs test. Eosinophilia and abnormal LFTs have been reported with higher than usual doses.

Once-daily dosing has not been evaluated in pneumonia and skin infections. Probenecid increases serum cefdinir levels. **Avoid** concomitant administration with iron and iron-containing vitamins and antacids containing aluminum or magnesium (space 2 hr apart) to reduce the risk for decreasing antibiotic's absorption. May cause red stools when administered with iron and iron-containing products. Doses may be taken without regard to food. **Adjust dose in renal failure (see Chapter 31).**

**CEFEPIME**

Maxipime and generics

Antibiotic, cephalosporin (fourth generation)

B

1

Yes

Yes

No

Injection: 1, 2 g**Premixed injection:** 1 g/50 mL, 2 g/100 mL (iso-osmotic dextrose solutions)

Each 1 g drug contains 725 mg L-Arginine.

**Neonate (IV/IM):** <14 days old: 60 mg/kg/24 hr \div Q12 hr ≥ 14 days old: 100 mg/kg/24 hr \div Q12 hr**Meningitis or Pseudomonas infections:** <1 kg and 0–14 days old, or 1–2 kg and <0 –7 days old: 100 mg/kg/24 hr \div Q12 hr <1 kg and >14 days old, or 1–2 kg and >7 days old, or >2 kg and 0–30 days old: 150 mg/kg/24 hr \div Q8 hr**Child ≥ 2 mo (IV/IM):** 100 mg/kg/24 hr \div Q12 hr**Meningitis, fever, and neutropenia, or serious infections:** 150 mg/kg/24 hr \div Q8 hr**Max. dose:** 2 g/single dose or 6 g/24 hr**Cystic fibrosis:** 150 mg/kg/24 hr \div Q8 hr IV/IM, up to a **max. dose** of 6 g/24 hr. Higher dose of 200 mg/kg/24 hr \div Q6 hr (**max. dose:** 8 g/24 hr) has been recommended for resistant pseudomonas isolates.**Adult:** 1–4 g/24 hr \div Q12 hr IV/IM**Severe infections:** 6 g/24 hr \div Q8 hr IV/IM**Max. dose:** 6 g/24 hr

Use with caution in patients with penicillin allergy or renal impairment. Good activity against *Pseudomonas aeruginosa* and other gram-negative bacteria plus most gram-positives (methicillin-sensitive *Staphylococcus aureus*). Extended/continuous infusion administration is an option for treating resistant isolates.



May cause thrombophlebitis, GI discomfort, transient increases in liver enzymes, and false-positive urine-reducing substance (Clinitest) and Coombs test. Probenecid increases serum cefepime levels. Encephalopathy, myoclonus, seizures (including nonconvulsive status epilepticus), aphasia, transient leukopenia, neutropenia, agranulocytosis, and thrombocytopenia have been reported.

Adjust dose in renal failure (see Chapter 31).

CEFIXIME

Suprax and generics

Antibiotic, cephalosporin (third generation)

B



1



Yes



Yes



No

Oral suspension: 100 mg/5 mL (50 mL), 200 mg/5 mL (50, 75 mL), 500 mg/5 mL (10, 20 mL)**Chewable tabs:** 100, 200 mg; contains aspartame**Caps:** 400 mg**Infant (>6 mo) and child:** 8 mg/kg/24 hr ÷ Q12–24 hr PO; **max. dose:** 400 mg/24 hr. May be used in infants ≥3 mo old for community-acquired pneumonia.**Alternative dosing for acute UTI:** 16 mg/kg/24 hr ÷ Q12 hr on day 1, followed by8 mg/kg/24 hr Q24 hr PO × 13 days. **Max. dose:** 400 mg/24 hr**Adolescent and adult:** 400 mg/24 hr ÷ Q12–24 hr PO**Uncomplicated cervical, urethral, or rectal infections due to Neisseria gonorrhoeae (not recommended as first-line cephalosporin by the CDC; ceftriaxone is preferred, use only when ceftriaxone is not available):** 400 mg × 1 PO plus azithromycin 1 g PO × 1 OR doxycycline 100 mg PO BID × 7 days.

Use with caution in patients with penicillin allergy or renal failure. Adverse reactions include diarrhea (16% incidence reported in clinical trials), abdominal pain, nausea, and headaches. Transient increase in AST/ALT has been reported. Activity is inadequate against penicillin-resistant pneumococci.



Because of reduced bioavailability, do not use tablets for the treatment of otitis media. Probenecid increases serum cefixime levels. Unlike most cephalosporins, drug is excreted unchanged in the bile (5%–10%) and urine (50%). May increase carbamazepine serum concentrations. May cause false-positive urine-reducing substance (Clinitest), Coombs test, and nitroprusside test for ketones. **Adjust dose in renal failure (see Chapter 31).**

CEFOTAXIME

Generics; previously available as Claforan

Antibiotic, cephalosporin (third generation)

B



1



Yes



No

Injection: 0.5, 1, 2, 10 g

Contains 2.2 mEq Na/g drug

Neonate, IV/IM:**Postnatal age ≤7 days (all weights):** 100 mg/kg/24 hr ÷ Q12 hr**Postnatal age 8–28 days:****<1000 g:****8–14 days postnatal:** 100 mg/kg/24 hr ÷ Q12 hr**15–28 days postnatal:** 150 mg/kg/24 hr ÷ Q8 hr**≥1000 g:** 150 mg/kg/24 hr ÷ Q8 hr**Meningitis (minimum 21 days of therapy):**

Postnatal age ≤7 days and ≥2 kg: 100–150 mg/kg/24 hr ÷ Q8–12 hr

Postnatal age >7 days and ≥2 kg: 150–200 mg/kg/24 hr ÷ Q6–8 hr.

Infant and child (1 mo–12 yr and <50 kg): 150–200 mg/kg/24 hr ÷ Q6–8 hr IV/IM. Higher doses of 150–225 mg/kg/24 hr ÷ Q6–8 hr have been recommended for infections outside the CSF due to penicillin-resistant pneumococci.**Meningitis:** 200 mg/kg/24 hr ÷ Q6 hr IV/IM. Higher doses of 225–300 mg/kg/24 hr ÷ Q6–8 hr (some recommend 300 mg/kg/24 hr ÷ Q4–6 hr), in combination with vancomycin (dosed at CNS target levels), have been recommended for meningitis due to penicillin-resistant pneumococci.**Max. dose:** 12 g/24 hr

CEFOTAXIME *continued***Child (>12 yr or ≥50 kg) and adult:** 1–2 g/dose Q6–8 hr IV/IM**Severe infection:** 2 g/dose Q4–6 hr IV/IM**Max. dose:** 12 g/24 hr

Use with caution in penicillin allergy and renal impairment (reduce dosage). Toxicities similar to other cephalosporins: allergy, neutropenia, thrombocytopenia, eosinophilia, false-positive urine-reducing substance (Clintest) and Coombs test, elevated BUN, creatinine, and liver enzymes. Probencid increases serum cefotaxime levels.

Good CNS penetration. **Adjust dose in renal failure** (see [Chapter 31](#)).**CEFOTETAN**

Cefotan and generics

Antibiotic, cephalosporin (second generation)

B

1

Yes

Yes

No

Injection: 1, 2, 10 g**Frozen injection:** 1 g/50 mL 3.8% dextrose, 2 g/50 mL 2.2% dextrose (iso-osmotic solutions)

Contains 3.5 mEq Na/g drug

**Infant and child (IV/IM, limited data):****Mild/moderate infection:** 60 mg/kg/24 hr ÷ Q12 hr; max. single dose: 2 g/dose**Severe infection:** 100 mg/kg/24 hr ÷ Q12 hr; max. single dose: 2–3 g/dose**Intra-abdominal infection:** 40–80 mg/kg/24 hr ÷ Q12 hr**Adolescent and adult:** 2–4 g/24 hr ÷ Q12 hr IV/IM; **max. dose:** 6 g/24 hr**PID:** 2 g Q12 hr IV × 24–48 hr after clinical improvement. Doxycycline 100 mg Q12 hr PO/IV × 14 days is also initiated at the same time.**Max. dose (all ages):** 6 g/24 hr**Preoperative prophylaxis (30–60 min before procedure; may repeat dose in 6 hr if lengthy procedure or excessive blood loss):****Child:** 40 mg/kg/dose (**max. dose:** 2 g/dose) IV**Adult:** 1–2 g IV

Use with caution in penicillin-allergic patients or in presence of renal impairment. May cause disulfiram-like reaction with ethanol, increase effects/toxicities of anticoagulants, false-positive urine-reducing substance (Clintest), and false elevations of serum and urine creatinine (Jaffe method). Hemolytic anemia and liver enzyme elevations have been reported. Good anaerobic activity but poor CSF penetration. **Adjust dose in renal failure** (see [Chapter 31](#)).

CEFOXITIN

Generics; previously available as Mefoxin

Antibiotic, cephalosporin (second generation)

B

1

Yes

Yes

No

Injection: 1, 2, 10 g**Frozen injection:** 1 g/50 mL 4% dextrose, 2 g/50 mL 2.2% dextrose (iso-osmotic solutions)

Contains 2.3 mEq Na/g drug

**Neonate (limited data):** 90–100 mg/kg/24 hr ÷ Q8 hr IM/IV**Infant and child:****Mild/moderate infections:** 80–100 mg/kg/24 hr ÷ Q6–8 hr IM/IV**Severe infections:** 100–160 mg/kg/24 hr ÷ Q4–6 hr IM/IV

CEFOXITIN continued**Adult:** 1–2 g/dose Q6–8 hr IM/IV**PID:** 2 g IV Q6h \times 24–48 hr after clinical improvement. Doxycycline 100 mg Q12 hr PO/IV \times 14 days is also initiated at the same time.**Max. dose (all ages):** 12 g/24 hr**Preoperative prophylaxis (30–60 min before procedure; may repeat dose in 2 hr for lengthy procedure or excessive blood loss):****Child:** 40 mg/kg/dose (**max. dose:** 2 g/dose) IV**Adult:** 2 g IV

Use with caution in penicillin-allergic patients or in presence of renal impairment. Has good anaerobic activity but poor CSF penetration. May cause injection site reaction and thrombophlebitis. Transient increases in LFTs have been reported.



Probenecid increases serum cefoxitin levels. May cause false-positive urine-reducing substance (Clinitest and other copper reduction method tests) and false elevations of serum and urine creatinine (Jaffe and KDA methods).

Adjust dose in renal failure (see [Chapter 31](#)).

CEFPODOXIME PROXETIL

Generics; previously available as Vantin

Antibiotic, cephalosporin (third generation)

B

1

Yes

Yes

No

Tabs: 100, 200 mg**Oral suspension:** 50, 100 mg/5 mL (50, 100 mL)**2 mo–11 yr:****Otitis media:** 10 mg/kg/24 hr PO \div Q12 hr \times 5 days; **max. dose:** 400 mg/24 hr**Pharyngitis/tonsillitis:** 10 mg/kg/24 hr PO \div Q12 hr \times 5–10 days; **max. dose:** 200 mg/24 hr**Acute maxillary sinusitis:** 10 mg/kg/24 hr PO \div Q12 hr \times 10 days; **max. dose:** 400 mg/24 hr **\geq 12 yr–adult:****Exacerbation of chronic bronchitis, community-acquired pneumonia, and sinusitis:** 400 mg/24 hr PO \div Q12 hr \times 10 days (14 days for pneumonia)**Pharyngitis/tonsillitis:** 200 mg/24 hr PO \div Q12 hr \times 5–10 days**Skin/skin structure infection:** 800 mg/24 hr PO \div Q12 hr \times 7–14 days**Uncomplicated UTI:** 200 mg/24 hr PO \div Q12 hr \times 7 days

Use with caution in penicillin-allergic patients or in presence of renal impairment. May cause diarrhea, nausea, vomiting, vaginal candidiasis, and false-positive Coombs test.



Transient elevation of ALT/SGPT has been reported in clinical trials.

Tablets should be administered with food to enhance absorption. Suspension may be administered without regard to food. High doses of antacids or H₂ blockers may reduce absorption. Probenecid increases serum cefpodoxime levels.Cefpodoxime proxetil is a prodrug that is deesterified in the GI tract to the active cefpodoxime. **Adjust dose in renal failure** (see [Chapter 31](#)).**CEFPROZIL**

Generics; previously available as Cefzil

Antibiotic, cephalosporin (second generation)

B

1

Yes

Yes

No

Tabs: 250, 500 mg**Oral suspension:** 125 mg/5 mL, 250 mg/5 mL (50, 75, 100 mL); contains aspartame and

CEFPROZIL continued**Otitis media:****6 mo–12 yr:** 30 mg/kg/24 hr PO ÷ Q12 hr; **max. dose:** 1 g/24 hr**Pharyngitis/tonsillitis:****2–12 yr:** 15 mg/kg/24 hr PO ÷ Q12 hr; **max. dose:** 1 g/24 hr**≥13 yr:** 500 mg PO Q24 hr**Acute sinusitis:****6 mo–12 yr:** 15–30 mg/kg/24 hr PO ÷ Q12 hr; **max. dose:** 1 g/24 hr**>12 yr:** 250 or 500 mg PO Q12 hr**Uncomplicated skin infections:****2–12 yr:** 20 mg/kg/24 hr PO Q24 hr; **max. dose:** 500 mg/dose**>12 yr:** 250 mg PO Q12 hr or 500 mg PO Q12–24 hr**UTI:****2–24 mo:** 30 mg/kg/24 hr PO ÷ Q12 hr

Use with caution in penicillin-allergic patients or in presence of renal impairment. Oral suspension contains aspartame and phenylalanine and should not be used by phenylketonurics. May cause nausea, vomiting, diarrhea, liver enzyme elevations, and false-positive urine-reducing substance (Clintest and other copper reduction method tests) and Coombs test. Probenecid increases serum cefprozil levels. Absorption is not affected by food. **Adjust dose in renal failure** (see Chapter 31).

**CEFTAROLINE FOSAMIL**

Teflaro

Antibiotic, cephalosporin (fifth generation)

B



1



Yes



Yes



No

Injection: 400, 600 mg; contains L-arginine**Child (2 mo–<18 yr):****Acute bacterial skin and skin structure infection (ABSSSI) and community-acquired bacterial pneumonia (CABP):****2 mo–<2 yr:** 8 mg/kg/dose IV Q8 hr**≥2 yr–<18 yr:****≤33 kg:** 12 mg/kg/dose IV Q8 hr**>33 kg:** 400 mg IV Q8 hr or 600 mg IV Q12 hr**Adult:** 600 mg IV Q12 hr**Cystic fibrosis (limited data):****Child ≥6 yr and adolescent:** 15 mg/kg/dose IV Q8 hr (**max. dose:** 600 mg/dose) infused over 2 hr in 7 patients (mean age: 20.3 ± 8.0) achieved the targeted serum concentration time greater than the MIC of 60%.**Adult:** pharmacokinetic simulations in 8 patients revealed dosages of 600 mg IV Q8 hr infused over 1 hr or 600 mg IV Q12 hr infused over 3 hr would achieve the targeted serum concentration time greater than the MIC of 60%.

Use with caution in penicillin allergy and renal impairment. Common side effects from pediatric trials include diarrhea, rash, vomiting, pyrexia, and nausea. Leukopenia and liver enzyme elevations have been reported.

Probenecid increases serum ceftaroline levels. Direct Coombs test seroconversion has been reported with use.

Adjust dose in renal failure (see Chapter 31).



CEFTAZIDIME

Fortaz, Tazicef, and generics

Antibiotic, cephalosporin (third generation)

B

1

Yes

Yes

No

Injection: 0.5, 1, 2, 6 g**Frozen injection:** 1 g/50 mL 4.4% dextrose, 2 g/50 mL 3.2% dextrose (iso-osmotic solutions)

Contains 2.3 mEq Na/g drug

Neonate (IV/IM):**Postnatal age ≤7 days:** 50 mg/kg/dose Q12 hr**Postnatal age >7–28 days:****<1000 g:****Postnatal age 8–14 days:** 50 mg/kg/dose Q12 hr**Postnatal age 15–28 days:** 50 mg/kg/dose Q8–12 hr**1000–2000 g:** 50 mg/kg/dose Q8–12 hr**>2000 g:** 50 mg/kg/dose Q8 hr**Meningitis:****Postnatal age ≤7 days:** 50 mg/kg/dose Q8–12 hr**Postnatal age >7 days:** 50 mg/kg/dose Q8 hr**Infant (>1 mo) and child (IV/IM):** 100–150 mg/kg/24 hr ÷ Q8 hr; **max. dose:** 6 g/24 hr**Cystic fibrosis and meningitis (IV/IM):** 150–200 mg/kg/24 hr ÷ Q6–8 hr (**max. dose:** 6 g/24 hr). Higher dosage of 200–400 mg/kg/24 hr ÷ Q6–8 hr (**max. dose:** 12 g/24 hr) has been used for cystic fibrosis.**Adult (IV/IM):** 1–2 g/dose Q8–12 hr; **max. dose:** 6 g/24 hr

Use with caution in penicillin-allergic patients or in presence of renal impairment. Good *Pseudomonas* coverage and CSF penetration. May cause rash, liver enzyme elevations, and false-positive urine-reducing substance (Clinitest and other copper reduction method tests) and Coombs test. Probenecid increases serum ceftazidime levels. **Adjust dose in renal failure** (see Chapter 31). Nonconvulsive status epilepticus, neuromuscular excitability, and myoclonia may occur with elevated levels of ceftazidime.

**CEFTAZIDIME WITH AVIBACTAM**

Avycz

*Antibiotic, cephalosporin**(third generation with β-lactamase inhibitor)*

?

?

Yes

No

No

Injection: 2 g ceftazidime and 0.5 g avibactam

Contains 3.2 mEq Na/g ceftazidime

**All doses based on ceftazidime component and are infused over 2 hr.****Complicated UTI (including pyelonephritis; treat for 7–14 days):****≥3 mo to <6 mo:** 40 mg/kg/dose IV Q8 hr**≥6 mo, child, and adolescent:** 50 mg/kg/dose (**max.** 2 g/dose) IV Q8 hr**Adult:** 2 g IV Q8 hr**Complicated intra-abdominal infections:** use same dosage for complicated UT in combination with metronidazole and treat for 5–14 days.**Nosocomial pneumonia (including VAP):****Adult:** 2 g IV Q8 hr × 7–14 days

See ceftazidime for additional remarks. Avibactam is a novel β-lactamase inhibitor of serine β-lactamases to improve ceftazidime's susceptibility to Enterobacteriaceae.



Clinical trial safety profile in children and adults are similar, which include common side effects of vomiting, diarrhea, rash, and infusion site reactions.

CEFTAZIDIME WITH AVIBACTAM *continued*

Dosage Based on Ceftazidime Component		Maximum Ceftazidime Dose
eGFR (mL/min/1.73m ²)		
31–50	25 mg/kg/dose IV Q8 hr	1000 mg/dose
16–30	19 mg/kg/dose IV Q12 hr	750 mg/dose
6–15	19 mg/kg/dose IV Q24 hr	750 mg/dose
≤5	19 mg/kg/dose IV Q48 hr	750 mg/dose

If receiving hemodialysis (HD), administer doses after dialysis with a dosage schedule of 19 mg ceftazidime/kg/dose (**max. dose:** 750 mg) IV Q24 hr. Approximately 55% of drug is removed after a 4-hr dialysis session.

Australian Therapeutic Goods Administration reports animal reproductive toxicity without evidence of teratogenic effects with avibactam. Human studies of ceftazidime/avibactam are incomplete.

CEFTIBUTEN

Generics; previously available as Cedax

Antibiotic, cephalosporin (third generation)



B

1

Yes

Yes

No

Oral suspension: 90 mg/5 mL (60, 90, 120 mL); contains sodium benzoate

Caps: 400 mg

Child (>6 mo): 9 mg/kg/24 hr (**max. dose:** 400 mg/24 hr) PO once daily

≥12 yr and adult: 400 mg PO once daily; **max. dose:** 400 mg/24 hr



Not recommended as a treatment option for otitis media or pharyngitis/tonsillitis. **Use with caution** in penicillin-allergic patients or in presence of renal impairment. May cause GI symptoms and elevations in eosinophils and BUN. SJS and elevated liver enzymes have been reported. Gastric acid-lowering medications (e.g., ranitidine and omeprazole) may enhance bioavailability of ceftibutin.



Oral suspension should be administered 2 hr before or 1 hr after a meal. **Adjust dose in renal failure (see Chapter 31).**

CEFTRIAXONE

Generics; previously available as Rocephin

Antibiotic, cephalosporin (third generation)



B

1

Yes

Yes

No

Injection: 0.25, 0.5, 1, 2, 10 g

Frozen injection: 1 g/50 mL 3.8% dextrose, 2 g/50 mL 2.4% dextrose (iso-osmotic solutions)

Contains 3.6 mEq Na/g drug



Neonate:

Gonococcal ophthalmia or prophylaxis: 25–50 mg/kg/dose IM/IV × 1; **max. dose:** 125 mg/dose

Infant (>1 mo) and child:

Mild/moderate infections: 50–75 mg/kg/24 hr ÷ Q12–24 hr IM/IV; **max. dose:** 2 g/24 hr

Severe infections/meningitis (including penicillin-resistant pneumococci): 100 mg/kg/24 hr IM/IV ÷ Q12 hr; **max. dose:** 2 g/dose and 4 g/24 hr

Penicillin-resistant pneumococci outside of the CSF: 80–100 mg/kg/24 hr ÷ Q12–24 hr (max. dose: 2 g/dose and 4 g/24 hr)

Lyme disease: 50–75 mg/kg/dose (**max. dose:** 2 g/dose) IV once daily

CEFTRIAXONE continued**Infant (>1 mo) and child (cont.):**

Acute otitis media: 50 mg/kg IM/IV (**max. dose:** 1 g) \times 1; for persistent or relapse cases use 50 mg/kg IM/IV (**max. dose:** 1 g) Q24 hr \times 3 doses.

Adult: 1–2 g/dose Q12–24 hr IV/IM; **max. dose:** 2 g/dose and 4 g/24 hr

Uncomplicated gonorrhea or chancroid: 250 mg IM \times 1

Bacterial endocarditis prophylaxis for dental and upper respiratory procedures:

Infant and child: 50 mg/kg IV/IM (**max. dose:** 1 g) 30 min before procedure

Adult: 1 g IV/IM 30 min before procedure

Contraindicated in neonates with hyperbilirubinemia. **Do not** administer with IV calcium-containing solutions or products (mixed or administered simultaneously via different lines) in neonates (<28 days old) because of risk of precipitation of ceftriaxone-calcium salt.

Cases of fatal reactions with calcium-ceftriaxone precipitates in lung and kidneys in preterm and full-term neonates have been reported. **Do not** administer simultaneously with IV calcium-containing solutions via a Y-site for any age group. IV calcium-containing products may be administered sequentially only when the infusion lines are thoroughly flushed between infusions with a compatible fluid.

Use with caution in penicillin allergy; patients with gallbladder, biliary tract, liver, or pancreatic disease; presence of renal impairment; or in neonates with continuous dosing (risk for hyperbilirubinemia). In neonates, consider using an alternative third-generation cephalosporin with similar activity. Unlike other cephalosporins, ceftriaxone is significantly cleared by the biliary route (35%–45%).

Rash, injection site pain, diarrhea, and transient increase in liver enzymes are common. May cause reversible cholelithiasis, sludging in gallbladder, and jaundice. May interfere with serum and urine creatinine assays (Jaffe method) and cause false-positive urinary protein and urinary reducing substances (Clinitest).

For IM injections, dilute drug with either sterile water for injection or 1% lidocaine to a concentration of 250 or 350 mg/mL (250 mg/mL has lower incidence of injection site reactions). Assess the potential risk/benefit for using lidocaine as a diluent; see Lidocaine for additional remarks especially risk for methemoglobinemia.

CEFUROXIME (IV, IM)/CEFUROXIME AXETIL (PO)

IV: Generics; previously available as Zinacef

PO: Generics; previously available as Ceftin

Antibiotic, cephalosporin (second generation)



B



1



Yes



Yes



No

Injection: 0.75, 1.5, 7.5 g

Injectable dosage forms contain 2.4 mEq Na/g drug

Tabs: 250, 500 mg

IM/IV:**Neonate:**

Postnatal age \leq 7 days: 100 mg/kg/24 hr \div Q12 hr

Postnatal age > 7 days:

$< 1\text{ kg}$:

$8 \text{ to } \leq 14 \text{ days old}$: 100 mg/kg/24 hr \div Q12 hr

$\geq 15 \text{ days old}$: 150 mg/kg/24 hr \div Q8 hr

$\geq 1\text{ kg}$: 150 mg/kg/24 hr \div Q8 hr

Infant (>3 mo)/child:

Mild/moderate infection: 75–100 mg/kg/24 hr \div Q8 hr; **max. dose:** 1500 mg/dose

Severe infection: 100–200 mg/kg/24 hr \div Q6–8 hr; **max. dose:** 1500 mg/dose

Adult: 750–1500 mg/dose Q8 hr; **max. dose:** 9 g/24 hr

PO (see remarks):

CEFUXIME (IV, IM)/CEFUXIME AXETIL (PO) *continued*

Pharyngitis and tonsillitis (oral suspension): 20 mg/kg/24 hr ÷ Q12 hr; **max. dose:** 500 mg/24 hr

Impetigo (oral suspension): 30 mg/kg/24 hr ÷ Q12 hr; **max. dose:** 1 g/24 hr

Otitis media and sinusitis:

Oral suspension: 30 mg/kg/24 hr ÷ Q12 hr; **max. dose:** 1 g/24 hr

Oral tablet: 250 mg BID

Lyme disease (alternative to doxycycline or amoxicillin):

Oral suspension: 30 mg/kg/24 hr (**max. dose:** 1 g/24 hr) ÷ Q12 hr × 14–28 days.

Child (≥13 yr):

Sinusitis, otitis media, pharyngitis, and tonsillitis:

Tab: 250 mg Q12 hr

Adult: 250–500 mg BID; **max. dose:** 1 g/24 hr

Use with caution in penicillin-allergic patients or in presence of renal impairment. May cause GI discomfort; thrombophlebitis at the infusion site; false-positive urine-reducing substance (Clinitest and other copper reduction method tests) and Coombs test; and may interfere with serum and urine creatinine determinations by the alkaline picrate method. Transient increases in liver enzymes have been reported. Not recommended for meningitis. Oral suspension dosage form currently not available. Tablets and oral suspension are NOT bioequivalent and CANNOT be substituted on a mg/mg basis. Concurrent use of antacids, H₂ blockers, and proton pump inhibitors may decrease oral absorption. **Adjust dose in renal failure** (see [Chapter 31](#)).

**CELECOXIB**

Celebrex and generics

Nonsteroidal antiinflammatory agent (COX-2 selective)



C/D



2



Yes



Yes



Yes

Capsules: 50, 100, 200, 400 mg



Juvenile rheumatoid arthritis (JRA; ≥2 yr and adolescent; see remarks):

10–25 kg: 50 mg PO BID

>25 kg: 100 mg PO BID

Adult (see remarks): 100–200 mg PO BID

Contraindicated for perioperative pain with coronary artery bypass graft (CABG) surgery. **Use with caution** in patients with systemic-onset JRA due to risk for serious adverse reactions (e.g., disseminated intravascular coagulation). In adults, serious cardiovascular and GI risks reported include thrombosis, myocardial infarction (MI), stroke, GI bleed, GI ulceration, and GI perforation. Common adverse effects include headache, diarrhea, nausea, and hypertension. TEN, SJS, acute kidney injury, and hyperkalemia have also been reported.



Celecoxib is a substrate of CYP 450 2C9. Poor metabolizers of 2C9 should start with half the lowest recommended dose and use with caution, or consider alternative therapy. Angiotensin-converting enzyme (ACE) inhibitors, loop diuretics, and sodium phosphates may increase risk for renal dysfunction. Oral corticosteroids, antiplatelet drugs (e.g., aspirin), anticoagulants, SSRIs, smoking, alcohol use, older age, and poor health status may increase risk for GI bleeds with prolonged treatment courses. Celecoxib may reduce the antihypertensive effects of ACE inhibitors and increase the levels/toxicity of lithium, metoprolol, and methotrexate.

Not recommended for use in severe renal dysfunction and severe hepatic impairment (Child-Pugh Class C). Reduce dose by 50% and monitor patient closely in moderate hepatic impairment (Child-Pugh Class B).

Pregnancy category is “C” for prior to 30 wk’s gestation and “D” for 30 wk and greater.

If unable to swallow capsules whole, contents of the capsule may be added to applesauce (stable for

CEPHALEXIN

Keflex and generics

Antibiotic, cephalosporin (first generation)

B

1

Yes

Yes

No

Caps: 250, 500, 750 mg**Tabs:** 250, 500 mg**Oral suspension:** 125 mg/5 mL, 250 mg/5 mL (100, 200 mL)**Infant and child:**

Mild/moderate infection: 25–50 mg/kg/24 hr PO ÷ Q6 hr; **max. dose:** 2 g/24 hr. Less frequent dosing (Q8–12 hr) may be used for uncomplicated infections.



Severe infection: 75–100 mg/kg/24 hr PO ÷ Q6 hr; **max. dose:** 4 g/24 hr

Streptococcal pharyngitis and skin infections: 25–50 mg/kg/24 hr PO ÷ Q6–12 hr. Total daily dose may be divided Q12 hr for streptococcal pharyngitis (>1 yr).

UTI: 50–100 mg/kg/24 hr PO ÷ Q6 hr

Adult: 1–4 g/24 hr PO ÷ Q6 hr

Max. dose (all ages): 4 g/24 hr

Bacterial endocarditis prophylaxis for dental and upper respiratory procedures:

Infant and child: 50 mg/kg PO (**max. dose:** 2 g) 1 hr before procedure

Adult: 2 g PO 1 hr before procedure



Some cross-reactivity with penicillins. **Use with caution** in renal insufficiency. May cause GI discomfort, false-positive urine-reducing substance (Clinitest and other copper reduction method tests) and Coombs test; false elevation of serum theophylline levels (HPLC method); and false urinary protein test. Hemolytic anemia and slight increases in AST and ALT have been reported.

Probenecid increases serum cephalexin levels, and concomitant administration with cholestyramine may reduce cephalexin absorption. May increase the effects of metformin.

Administer doses on an empty stomach; 2 hr prior or 1 hr after meals. **Adjust dose in renal failure (see Chapter 31).**

CETIRIZINE ± PSEUDOEPHENDRINE

Zyrtec, Zyrtec Allergy, Zyrtec Children's

Allergy, Zerviate, and generics

In combination with pseudoephedrine:

Zyrtec-D 12 hr and generics

Antihistamine, less-sedating

B/C

?

Yes

Yes

No

Oral solution or syrup (OTC): 5 mg/5 mL (120, 473 mL); contains parabens**Tabs (OTC):** 5, 10 mg**Capsule (Liquid filled; OTC):** 10 mg**Dispersible/disintegrating tabs (OTC):** 10 mg**Ophthalmic solution (Zerviate):** 2.4 mg/1 mL (0.2 mL; 5 single use vials per box)**In combination with pseudoephedrine (PE):****Extended-release tabs (OTC):** 5 mg cetirizine + 120 mg PE**Cetirizine (see remarks for dosing in hepatic impairment):**

6 mo and <2 yr: 2.5 mg PO once daily; dose may be increased for children 12–23 mo to a **max. dose** of 2.5 mg PO Q12 hr.



2–5 yr: **Initial dose:** 2.5 mg PO once daily; if needed, may increase dose to a **max. dose**

of 5 mg/24 hr once daily or divided BID.

CETIRIZINE ± PSEUDOEPHEDRINE continued

≥6 yr–adult: 5–10 mg PO once daily

Ophthalmic use:

≥2 yr and adult: Instill 1 drop to affected eye(s) BID (approximately 8 hr apart)

Cetirizine in combination with pseudoephedrine (PE) (see remarks for dosing in hepatic impairment):

≥12 yr and adult:

Zyrtec-D 12 hr: 1 tablet PO BID

Generally not recommended for treating URIs for infants. No proven benefit for infants and young children with URIs. The FDA does not recommend use for URIs in children <2 yr because of reports of increased fatalities.

May cause headache, pharyngitis, GI symptoms, dry mouth, and sedation. Aggressive reactions and convulsions have been reported. Has NOT been implicated in causing cardiac arrhythmias when used with other drugs that are metabolized by hepatic microsomal enzymes (e.g., ketoconazole, erythromycin).

In hepatic impairment, the following doses have been recommended:

Cetirizine:

<6 yr: Use not recommended

6–11 yr: <2.5 mg PO once daily

≥12 yr–adult: 5 mg PO once daily

Cetirizine in combination with pseudoephedrine:

≥12 yr–adult: 1 tablet PO once daily

Doses may be administered regardless to food. For Zyrtec-D 12 Hr, see Pseudoephedrine for additional remarks. Pregnancy category is "B" for cetirizine and "C" when combined with pseudoephedrine.

Dosage adjustment is recommended in renal impairment (see Chapter 31).

OPHTHALMIC USE: Common side effects include application site pain, ocular hyperemia, and reduced visual acuity. Oculogyric crisis has been reported. Do not touch dropper tip to anything, and remove contact lenses prior to administration (wait 10 min before inserting lenses).

CHARCOAL, ACTIVATED

See Chapter 3

CHLORAMPHENICOL

Generics

Antibiotic



C

3

Yes

Yes

No

Injection: 1 g

Contains 2.25 mEq Na/g dru

Neonate IV:

Loading dose: 20 mg/kg

Maintenance dose (first dose should be given 12 hr after loading dose):

≤7 days: 25 mg/kg/24 hr Q24 hr

>7 days:

≤2 kg: 25 mg/kg/24 hr Q24 hr

>2 kg: 50 mg/kg/24 hr ÷ Q12 hr

Infant/child/adult: 50–75 mg/kg/24 hr IV ÷ Q6 hr

Meningitis: 75–100 mg/kg/24 hr IV ÷ Q6 hr



CHLORAMPHENICOL *continued*

Max. dose (all ages): 4 g/24 hr

Dose recommendations are just guidelines for therapy; monitoring of blood levels is essential.

Follow hematologic status for dose-related or idiosyncratic marrow suppression. "Gray baby" syndrome may be seen with levels >50 mg/L. **Use with caution** in G6PD deficiency, renal or hepatic dysfunction, and neonates.

Concomitant use of phenobarbital and rifampin may lower chloramphenicol serum levels. Phenytoin may increase chloramphenicol serum levels. Chloramphenicol may increase the effects/toxicity of phenytoin, chlorpropamide, cyclosporine, tacrolimus, and oral anticoagulants and decrease absorption of vitamin B₁₂. Chloramphenicol is an inhibitor of CYP 450 2C9.

Therapeutic levels: Peak: 15–25 mg/L for meningitis and 10–20 mg/L for other infections. Trough: 5–15 mg/L for meningitis and 5–10 mg/L for other infections. Recommended serum sampling time: trough within 30 min prior to next dose; peak 30 min after the end of infusion. Time to achieve steady state: 2–3 days for newborns; 12–24 hr for children and adults.

**CHLOROQUINE PHOSPHATE**

Generics; previously available as Aralen
Amebicide, antimalarial



Tabs: 250, 500 mg as phosphate (150, 300 mg base, respectively)

Oral suspension: 16.67 mg/mL as phosphate (10 mg/mL base), 15 mg/mL as phosphate (9 mg/mL base)

**Doses expressed in mg of chloroquine base:**

Malaria prophylaxis (start 1–2 wk prior to exposure and continue for 4 wk after leaving endemic area):

Infant and child: 5 mg/kg/dose PO every week; **max. dose:** 300 mg/dose

Adult: 300 mg/dose PO every week

Malaria treatment (chloroquine sensitive strains):

For treatment for malaria, consult with ID specialist or see the latest edition of the AAP Red Book.

Infant and child: 10 mg/kg/dose (**max. dose:** 600 mg/dose) PO × 1; followed by 5 mg/kg/dose (**max. dose:** 300 mg/dose) 6, 24, and 48 hr after the initial dose.

Adult: 600 mg/dose PO × 1; followed by 300 mg/dose 6, 24, and 48 hr after the initial dose.



Contraindicated in the presence of retinal or visual field changes and known hypersensitivity to 4-aminoquinoline compounds. **Use with caution** in liver disease, preexisting auditory damage or seizures, G6PD deficiency, psoriasis, porphyria, or concomitant hepatotoxic drugs. May cause nausea, vomiting, electrocardiogram (ECG) abnormalities, prolonged QT interval, blurred vision, retinal and corneal changes (reversible corneal opacities), headaches, confusion, skeletal muscle weakness, increased liver enzymes, and hair depigmentation. SJS, TEN, anaphylactic reactions, and maculopathy and macular degeneration have been reported. False-positive test for urine amphetamine screen may occur.

Antacids, ampicillin, and kaolin may decrease the absorption of chloroquine (allow 4-hr interval between these drugs and chloroquine). Cimetidine may increase effects/toxicity of chloroquine. May increase serum cyclosporine levels. Coadministration with mefloquine may increase risk of convulsions. May reduce the antibody response to intradermal human diploid-cell rabies vaccine.

Monitor CBCs periodically with therapies of prolonged duration. **Adjust dose in renal failure (see Chapter 31).**

CHLOROTHIAZIDE

Diuril and generics

Thiazide diuretic

C/D



2



Yes



Yes



No

Tabs: 250, 500 mg**Oral suspension:** 250 mg/5 mL (237 mL); contains 0.5% alcohol, 0.12% methylparaben, 0.02% propylparaben, and 0.1% benzoic acid**Injection:** 500 mg; contains 5 mEq Na/1 g drug**<6 mo:****PO:** 20–40 mg/kg/24 hr ÷ Q12 hr**IV:** Start at 5–10 mg/kg/24 hr ÷ Q12 hr, may increase to 20–40 mg/kg/24 hr ÷ Q12 hr if needed.**≥6 mo:****PO:** 10–40 mg/kg/24 hr ÷ Q12 hr; **maximum PO dose by age:****6 mo–2 yr:** 375 mg/24 hr**2–12 yr:** 1 g/24 hr**>12 yr:** 2 g/24 hr**IV:** Start at 5–10 mg/kg/24 hr ÷ Q12–24 hr, may increase to 20 mg/kg/24 hr ÷ Q12 hr if needed.**Adult:** 500–2000 mg/24 hr ÷ Q12–24 hr PO/IV; alternative IV dosing, some may respond to intermittent dosing on alternate days or on 3–5 days each week.**Adjunct therapy for neonatal hyperinsulinemia/hypoglycemia (limited data):** 7–10 mg/kg/24 hr ÷ BID PO with diazoxide PO**Contraindicated** in anuria. **Use with caution** in liver and severe renal disease and sulfonamide hypersensitivity. May increase serum calcium, bilirubin, glucose, and uric acid. May cause alkalosis, pancreatitis, dizziness, hypokalemia, and hypomagnesemia.**Avoid IM or subcutaneous administration.**

Pregnancy category changes to "D" if used in pregnancy-induced hypertension.

CHLORPHENIRAMINE MALEATE

Chlor-Trimeton and generics

Antihistamine

C



3



No



No



No

Tabs [OTC]: 4 mg**Sustained-release tabs [OTC]:** 12 mg**Syrup [OTC]:** 2 mg/5 mL (120, 473 mL); may contain 5% alcohol and/or parabens**Doses may be administered as scheduled or PRN (see remarks).****Child <12 yr:** 0.35 mg/kg/24 hr PO ÷ Q4–6 hr or dose based on age as follows:**2–5 yr:** 1 mg/dose PO Q4–6 hr; **max. dose:** 6 mg/24 hr**6–11 yr:** 2 mg/dose PO Q4–6 hr; **max. dose:** 12 mg/24 hr**≥12 yr-adult:** 4 mg/dose Q4–6 hr PO; **max. dose:** 24 mg/24 hr

Sustained release: 12 mg PO Q 12 hr

Use with caution in asthma. May cause sedation, dry mouth, blurred vision, urinary retention, polyuria, and disturbed coordination. Young children may be paradoxically excited.Found in many combinations over-the-counter (OTC, or nonprescription) cough and cold products and are **not recommended** for children <6 yr old due to reports of serious adverse effects (cardiac and respiratory distress, convulsions, and hallucinations) and fatalities (from unintentional overdosages, including combined use of other OTC products containing the same active ingredients). Administer doses with food. Sustained-release forms are **NOT** recommended in children <6 yr and should **NOT** be crushed, chewed, or dissolved.

CHLORPROMAZINE

Generics; previously available as Thorazine
Antiemetic, antipsychotic, phenothiazine derivative



Tabs: 10, 25, 50, 100, 200 mg

Oral suspension: 30 mg/mL

Injection: 25 mg/mL (1, 2 mL); may contain sodium metabisulfite and sodium sulfite.

Psychosis:**Child >6 mo:**

PO: 2.5–6 mg/kg/24 hr ÷ Q4–6 hr; **max. PO dose:** 500 mg/24 hr

IM/IV: 2.5–4 mg/kg/24 hr ÷ Q6–8 hr

Max. IM/IV dose:

<5 yr: 40 mg/24 hr

5–12 yr: 75 mg/24 hr

**Adult:**

PO: 10–25 mg/dose Q4–6 hr; **max. dose:** 2 g/24 hr

IM/IV: Initial: 25 mg; repeat with 25–50 mg/dose, if needed, Q1–4 hr up to a **max. dose** of 400 mg/dose Q4–6 hr

Antiemetic:**Child (≥6 mo):**

IV/IM/PO: 0.5–1 mg/kg/dose Q6–8 hr PRN

Max. IM/IV/PO dose:

<5 yr: 40 mg/24 hr

5–12 yr: 75 mg/24 hr

Adult:

IV/IM: 25–50 mg/dose Q4–6 hr PRN

PO: 10–25 mg/dose Q4–6 hr PRN



Adverse effects include drowsiness, jaundice, lowered seizure threshold, extrapyramidal/anticholinergic symptoms, hypotension (more with IV), arrhythmias, agranulocytosis, and neuroleptic malignant syndrome. May potentiate effect of narcotics, sedatives, and other drugs. Monitor BP closely. ECG changes include prolonged PR interval, flattened T waves, and ST depression; **do not use** in combination with fluoxetine, haloperidol, citalopram, and other drugs that can prolong the QT interval. **Do not administer oral liquid dosage form simultaneously with carbamazepine oral suspension;** an orange rubbery precipitate may form.

CHOLECALCIFEROL

D–3, D3–5, D3–50, Decara, D Drops, Emfamil D-Vi-Sol, Replesta, and many others

Vitamin D3

Tablet (OTC): 400; 1000; 2000; 3000; 5000; 50,000 IU

Caps (OTC): 1000; 2000; 5000; 10,000; 25,000; 50,000 IU

D3-5: 5000 IU

Decara: 25,000; 50,000 IU

D3-50: 50,000 IU

Chewable tablet (OTC): 400; 1000; 2000; 5000 IU

Chewable wafer (Replesta; OTC): 50000 IU (8)

CHOLECALCIFEROL continued

Oral drops (D Drops and others) [OTC]: 400 IU/drop (2.5, 10.3 mL), 600 IU/drop (2.8 mL), 1000 IU/drop (5, 10.3 mL), 2000 IU/drop (5, 10.3 mL), 4000 IU/drop (10.3 mL), 6000 IU/drop (10.3 mL)

Oral liquid: (Emfamil D-Vi-Sol and generics) [OTC]: 400 IU/mL (50 mL)

Conversion: 1000 IU is equivalent to 25 mCG of cholecalciferol

Dietary supplementation (see Chapter 21 for additional information):

Preterm: 200–400 IU/24 hr PO



Infant (<1 yr): 400 IU/24 hr PO

Breastfed neonate and infant: 400 IU/24 hr PO

Child (≥1 yr) and adolescent: 400–600 IU/24 hr PO

Vitamin D deficiency:

Non–cystic fibrosis patients:

Age	Vitamin D (25-OH) Level		
	>20–<30 ng/mL (Insufficiency)	10–20 ng/mL (Deficiency)	<10 ng/mL (Severe Deficiency)
<6 mo	1000 IU once daily	1000 IU once daily	Contact Pediatric Endocrinologist and assess for rickets
>6–<12 mo	400–1000 IU once daily	2000 IU once daily	50,000 IU once daily × 3 days followed by 2000 IU once daily ^a
1–2 yr	600–1000 IU once daily	2000 IU once daily	50,000 IU once daily × 3 days followed by 2000 IU once daily ^a
>2 yr with no risk factors ^b	1000–2000 IU once daily	5000 IU once daily	50,000 IU once daily × 3 days followed by 5000 IU once daily ^a
>2 yr with any risk factor ^b	2000–4000 IU once daily	10,000 IU once daily	50,000 IU once daily × 3 days followed by 10,000 IU once daily ^a

^a50,000 IU daily loading dose may be avoided for patients with hyperphosphatemia.

^bRisk factors include malabsorption syndromes, obesity (BMI ≥95th percentile), chronic use of antiepileptics, glucocorticoids, antifungals (systemic), or antiretrovirals.

Cystic fibrosis patients (supplementation in addition to cystic fibrosis specialty multivitamin unless indicated):

Age	Vitamin D (25-OH) Level			
	≥30 ng/mL (Sufficiency)	21–29 ng/mL (Insufficiency)	≤20 ng/mL (Deficiency)	<10 ng/mL (Severe Deficiency)
<12 mo	CF multivitamin only (to provide 600 IU once daily)	2000 IU once daily	5000 IU once daily	5000 IU once daily ^a
≥1–<10 yr	CF multivitamin (to provide 1200 IU once daily) plus 2000 IU once daily	6000 IU once daily	10,000 IU once daily	50,000 IU once daily × 1 mo followed by 10,000 IU once daily
≥10 yr	CF multivitamin only (to provide 6000 IU once daily)	10,000 IU once daily	50,000 IU once daily × 1 mo followed by 10,000 IU once daily	50,000 IU once daily × 1 mo followed by 10,000 IU once daily

^aAssess for rickets.

CHOLECALCIFEROL continued

Rickets (with calcium supplementation; decrease to maintenance dosage when radiologically proven healing is achieved):

Infant: 2000 IU PO once daily $\times \geq 3$ mo, followed by 400 IU once daily maintenance

Child: 3000–6000 IU PO once daily $\times \geq 3$ mo, followed by 600 IU once daily maintenance

Adolescent: 6000 IU PO once daily $\times \geq 3$ mo, followed by 400 IU once daily maintenance.

Renal failure (CKD stages 2–5) and 25-OH vitamin D levels ≤ 30 ng/mL (monitor serum 25-OH vitamin D and corrected calcium/phosphorus 1 mo after initiation and Q 3 mo thereafter):

Child (PO):

25-OH vitamin D <5 ng/mL: 8000 IU/24 hr \times 4 wk followed by 4000 IU/24 hr \times 2 mo; OR 50,000 IU weekly \times 4 wk followed by 50,000 IU twice monthly for 3 mo

25-OH vitamin D 5–15 ng/mL: 4000 IU/24 hr \times 12 wk; OR 50,000 IU every other week \times 12 wk

25-OH vitamin D 16–30 ng/mL: 2000 IU/24 hr \times 3 mo; OR 50,000 IU monthly \times 3 mo

Maintenance dose (after repletion): 200–1000 IU once daily

Biologic potency and oral absorption may be greater than ergocalciferol (vitamin D₂).

Requires activation by the liver (25-hydroxylation) and kidney (1-hydroxylation) to the active form, calcitriol. Recommended time period to recheck serum 25-OH vitamin D is 3 mo after initiation or change in dosage.

Monitor serum Ca²⁺, PO₄, 25-OH vitamin D (goal level for infant and child: ≥ 20 ng/mL) and alkaline phosphate. Serum Ca²⁺, PO₄ product should be <70 mg/dL to avoid ectopic calcification. Serum 25-OH vitamin D level of ≥ 35 ng/mL has been used in cystic fibrosis patients to decrease the risk of hyperparathyroidism and bone loss.

Serum 25-OH vitamin D levels ≥ 100 ng/mL is considered toxic. Toxic effects in infants may result in nausea, vomiting, constipation, abdominal pain, loss of appetite, polydipsia, polyuria, muscle weakness, muscle/joint pain, confusion, and fatigue; renal damage may also occur.

Pregnancy category changes to "D" if used in doses above the U.S. RDA.

**CHOLESTYRAMINE**

Questran, Questran Light, Cholestyramine Light, Prevalite, and generics
Antilipemic, binding resin



C

1

No

No

No

Powder for oral suspension:

Questran and generics: 4 g anhydrous resin per 9 g powder (9 g—box of 60 packets, 378 g can)

Questran Light: 4 g anhydrous resin per 5 g powder (5 g—box of 60 packets, 210 g can)

Cholestyramine Light: 4 g anhydrous resin per 5.7 g powder with aspartame (5.7 g—box of 60 packets, 239 g can)

Prevalite: 4 g anhydrous resin per 5.5 g powder with aspartame (5.5 g—box of 42 or 60 packets, 231 g can)

All doses based in terms of anhydrous resin. Titrate dose based on response and tolerance.

**Hypercholesterolemia:**

Child and adolescent: 240 mg/kg/24 hr \div TID PO; doses normally do not exceed 8 g/24 hr (higher doses do not provide additional benefit). Give PO as slurry in water, juice, or milk before meals.

Adult: 4 g once daily—BID PO; **max. dose:** 24 g/24 hr

Pruritis associated with cholestasis:

Child: 240 mg/kg/24 hr \div BID—TID PO; suggested **max. dose:**

≤ 10 yr: 4–10 g/24 hr; higher doses may cause steatorrhea

> 10 yr and adolescent: 16 g/24 hr

Adult: 4 g once daily or BID PO; may gradually increase dose to 16 g/24 hr.

CHOLESTYRAMINE *continued*

In addition to the use for managing hypercholesterolemia, drug may be used for itching associated with elevated bile acids, and diarrheal disorders associated with excess fecal bile acids or *Clostridium difficile* (pseudomembranous colitis). May also be applied topically for diaper dermatitis by preparing a 5% or 10% topical product with hydrophilic topical ointment (Aquaphor); other compounded topical formulations exist (e.g., Butt paste: Cholestyramine, sucralfate, zinc oxide, and Eucerin).



May cause constipation, abdominal distention, vomiting, vitamin deficiencies (A, D, E, K), and rash.

Hyperchloremic acidosis may occur with prolonged use.

Give other oral medications 4–6 hr after cholestyramine or 1 hr before dose to avoid decreased absorption.

CHOLINE MAGNESIUM TRISALICYLATE

Generic; previously available as Trilisate

Nonsteroidal antiinflammatory agent



C/D

3

Yes

Yes

No

Combination of choline salicylate and magnesium salicylate (1:1.24 ratio, respectively); strengths expressed in terms of mg salicylate:

Oral liquid: 500 mg/5 mL (240 mL); may contain methylparaben



Dose based on total salicylate content.

Child: 30–60 mg/kg/24 hr PO ÷ BID–TID

Adult: 500 mg–1.5 g/dose PO once daily–TID

Avoid use in patients with suspected varicella or influenza due to concerns of Reye syndrome.

Use with caution in severe hepatic or renal (hypermagnesemia risk) failure, asthma, or peptic ulcer disease. Less GI irritation than aspirin and other NSAIDs. No antiplatelet effects.

Pregnancy category changes to “D” if used during the third trimester.

Therapeutic salicylate levels, see *Aspirin*. 500 mg choline magnesium trisalicylate is equivalent to 650 mg aspirin. May be mixed with fruit juices just before ingestion. Do not administer with antacids.

**CICLESONIDE**

Alvesco, Omnaris, Zetonna

Corticosteroid



C

2

No

Yes

No

Aerosol inhaler (Alvesco): 80 mCg/actuation (6.1 g = 60 doses), 160 mCg/actuation (6.1 g = 60 doses)

Nasal spray:

Omnaris (nasal suspension): 50 mCg/actuation (12.5 g = 120 doses)

Zetonna (nasal aerosol solution): 37 mCg/actuation (6.1 g = 60 doses)



Intranasal (allergic rhinitis):

Omnaris:

2–11 yr (limited data): 1 or 2 sprays (50 or 100 mCg) per nostril once daily. **Max. dose:** 200 mCg/24 hr. 2 sprays (100 mCg) per nostril once daily is FDA approved for use in children ≥ 6 yr for seasonal allergic rhinitis.

≥ 12 yr and adult: 2 sprays (100 mCg) per nostril once daily. **Max. dose:** 200 mCg/24 hr.

Zetonna:

≥ 12 yr and adult: 1 spray (37 mCg) per nostril once daily. **Max. dose:** 74 mCg/24 hr.

CICLESONIDE *continued***Oral inhalation (asthma; Alvesco):**

Dosage recommended by the Global Initiative for Asthma (GINA) guidelines (current FDA labeled dosage information is for ≥ 12 yr and is listed below). All daily doses divided BID:

Age	Low Dose (mCg/24 hr)	Medium Dose (mCg/24 hr)	High Dose (mCg/24 hr)
6–11 yr	80	>80–160	>160 up to 640 mCg/24 hr
≥ 12 yr and adult	80–160	>160–320	>320 up to 640 mCg/24 hr

 ≥ 12 yr and adult (FDA labeling):

Prior use with bronchodilator only: 80 mCg/dose BID; **max. dose:** 320 mCg/24 hr

Prior use with inhaled corticosteroid: 80 mCg/dose BID; **max. dose:** 640 mCg/24 hr

Prior use with oral corticosteroid: 320 mCg/dose BID; **max. dose:** 640 mCg/24 hr



Ciclesonide is a prodrug hydrolyzed to an active metabolite, des-ciclesonide via esterases in nasal mucosa and lungs; further metabolism via hepatic CYP3A4 and 2D6. Concurrent use with ketoconazole and other CYP 450 3A4 inhibitors may increase systemic des-ciclesonide levels. **Use with caution** and monitor in hepatic impairment.

Oral inhalation (asthma): Rinse mouth after each use. May cause headache, arthralgia, nasal congestion, nasopharyngitis, and URIs. Routinely monitor growth of pediatric patients. Maximum therapeutic benefit may not be achieved until 4 wk after initiation; consider dose increase if response is inadequate after 4 wk after initial dosage.

Intranasal (allergic rhinitis): Clear nasal passages prior to use. May cause otalgia, epistaxis, nasopharyngitis, and headache. Nasal septal perforation has been reported. Patients should be free of nasal disease, except for allergic rhinitis, before starting therapy. Monitor linear growth of pediatric patients routinely. Onset of action: 24–48 hr; further improvement observed over 1–2 wk in seasonal allergic rhinitis or 5 wk in perennial allergic rhinitis. Discontinue use if nasal erosion, ulceration, or perforation occurs.

CIDOVIR

Generics; previously available as Vistide

Antiviral

C



3



Yes



No



No

Injection: 75 mg/mL (5 mL); preservative free

Safety and efficacy have not been established in children.

**CMV retinitis:****Adolescent and adult:**

Induction: 5 mg/kg IV once weekly \times 2 with probenecid and hydration

Maintenance: 5 mg/kg IV Q2 weeks with probenecid and hydration

Adenovirus infection in immunocompromised oncology patients (limited data and other regimens exist; see remarks):

Child:

Induction: 5 mg/kg/dose IV once weekly until PCR negative. Administer oral probenecid 1–1.25 g/m²/dose (rounded to the nearest 250-mg interval) 3 hr before and 1 hr and 8 hr after each dose of cidofovir. Also give IV NS via IV at maintenance fluid concentration, 3 times, 1 hr before and 1 hr after cidofovir, followed by 2 times maintenance fluid for an additional 2 hr. For patients with renal dysfunction (see remarks), give 1 mg/kg/dose IV three times weekly until PCR negative.

Maintenance: 5 mg/kg/dose IV Q2 weeks with probenecid and hydration.

CIDOFOVIR *continued*

BK virus hemorrhagic cystitis (limited data and other regimens exist): 1 mg/kg/dose IV once weekly WITHOUT probenecid.

Contraindicated in hypersensitivity to probenecid or sulfa-containing drugs; sCr >1.5 mg/dL,

CrCl ≤55 mL/min, urine protein ≥100 mg/dL (2+ proteinuria), direct intraocular injection

of cidofovir, and concomitant nephrotoxic drugs. **Renal impairment is the major dose-limiting toxicity.** IV NS prehydration and probenecid must be used (unless not indicated) to

reduce risk of nephrotoxicity. May also cause nausea, vomiting, headache, rash, metabolic acidosis, uveitis, decreased intraocular pressure, and neutropenia.

Reported criteria for defining renal dysfunction in children include a sCr >1.5 mg/dL, GFR <90 mL/min/1.73 m², and >2+ proteinuria. For adults, reduce dose to 3 mg/kg if sCr increases 0.3–0.4 mg/dL from baseline. Discontinue therapy if sCr increases ≥0.5 mg/dL from baseline or development of ≥3+ proteinuria.

Administer doses via IV infusion over 1 hr at a concentration ≤8 mg/mL.

**CIMETIDINE**

Tagamet HB and generics

Histamine-2 antagonist



B

2

Yes

Yes

No

Tabs: 200, 300, 400, 800 mg

OTC (Tagamet HB and generics): 200 mg

Oral solution: 300 mg/5 mL (237 mL); may contain 2.8% alcohol, propylene glycol, and parabens



Neonate: 5–20 mg/kg/24 hr PO ÷ Q6–12 hr

Infant: 10–20 mg/kg/24 hr PO ÷ Q6–12 hr

Child: 20–40 mg/kg/24 hr PO ÷ Q6 hr

Adult: 300 mg/dose PO QID OR 400 mg/dose PO BID OR 800 mg/dose PO QHS

Ulcer prophylaxis: 400–800 mg PO QHS

Diarrhea, rash, myalgia, confusion, neutropenia, gynecomastia, elevated LFTs, or dizziness may occur. **Use with caution** in hepatic and renal impairment (**adjust dose in renal failure; see Chapter 31**).

Inhibits CYP 450 1A2, 2C9, 2C19, 2D6, 2E1, and 3A4 isoenzymes, therefore increases levels and effects of many hepatically metabolized drugs (i.e., theophylline, phenytoin, lidocaine, nicardipine, diazepam, warfarin). Cimetidine may decrease the absorption of iron, ketoconazole, and tetracyclines.

**CIPROFLOXACIN**

Cipro, Cipro XR, Ciloxan ophthalmic, Cetraxal, Ciprorex, Cipro HC Otic, Otovel Otic, and generics

Antibiotic, quinolone



C

2

Yes

Yes

No

Tabs: 100, 250, 500, 750 mg

Extended-release tabs (Cipro XR and generics): 500, 1000 mg

Oral suspension: 250 mg/5 mL (100 mL), 500 mg/5 mL (100 mL)

Premixed injection: 200 mg/100 mL 5% dextrose, 400 mg/200 mL 5% dextrose (iso-osmotic solutions)

Ophthalmic solution (Ciloxan and generics): 0.3% (2.5, 5, 10 mL); may contain benzalkonium chloride

CIPROFLOXACIN *continued*

Ophthalmic ointment (Ciloxan): 0.3% (3.5 g)

Otic suspension:

Cetraxal and generics: 0.5 mg/0.25 mL or 0.2% (14s)

With dexamethasone (Ciprodex): 3 mg/mL (0.3%) ciprofloxacin + 1 mg/mL (0.1%) dexamethasone (7.5 mL); contains benzalkonium chloride

With hydrocortisone (Cipro HC Otic): 2 mg/mL (0.2%) ciprofloxacin + 10 mg/mL (1%) hydrocortisone (10 mL); contains benzyl alcohol

With fluocinolone (Otovel Otic): 3 mg/mL (0.3%) ciprofloxacin + 0.25 mg/mL (0.025%) fluocinolone acetonide (0.25 mL; carton of 14s)



Neonate:

32–37 weeks' gestation: 10 mg/kg/dose IV Q12 hr

≥38 weeks' gestation: 15 mg/kg/dose IV Q12 hr

Child:

PO:

Mild/moderate infection: 20 mg/kg/24 hr ÷ Q12 hr; **max. dose:** 1 g/24 hr

Severe infection: 30–40 mg/kg/24 hr ÷ Q12 hr; **max. dose:** 1.5 g/24 hr

IV:

Severe infection: 10 mg/kg/dose Q8–12 hr; **max. dose:** 400 mg/dose

Complicated UTI or pyelonephritis (x 10–21 days):

PO: 20–40 mg/kg/24 hr ÷ Q12 hr; **max. dose:** 1.5 g/24 hr

IV: 18–30 mg/kg/24 hr ÷ Q8 hr; **max. dose:** 1.2 g/24 hr

Cystic fibrosis:

PO: 40 mg/kg/24 hr ÷ Q12 hr; **max. dose:** 2 g/24 hr

IV: 30 mg/kg/24 hr ÷ Q8 hr; **max. dose:** 1.2 g/24 hr

Anthrax (see remarks):

Inhalational/systemic/cutaneous: Start with 20–30 mg/kg/24 hr ÷ Q12 hr IV (**max. dose:** 800 mg/24 hr) and convert to oral dosing with clinical improvement at 20–30 mg/kg/24 hr ÷ Q12 hr PO (**max. dose:** 1 g/24 hr). Duration of therapy: 60 days (IV and PO combined)

Post exposure prophylaxis: 20–30 mg/kg/24 hr ÷ Q12 hr PO × 60 days; **max. dose:** 1 g/24 hr

Adult:

PO:

Immediate release: 250–750 mg/dose Q12 hr

Extended-release tabs (Cipro XR and generics):

Uncomplicated UTI/Cystitis: 500 mg/dose Q24 hr

Complicated UTI/Uncomplicated pyelonephritis: 1000 mg/dose Q24 hr

IV: 400 mg/dose Q12 hr; 400 mg/dose Q8 hr for more severe/complicated infections

Anthrax (see remarks):

Inhalational/systemic/cutaneous: Start with 400 mg/dose Q12 hr IV and convert to oral dosing with clinical improvement at 500 mg/dose Q12 hr PO. Duration of therapy: 60 days (IV and PO combined).

Post exposure prophylaxis: 500 mg/dose Q12 hr PO × 60 days.

Ophthalmic solution:

≥1 yr and adult: 1–2 drops Q2 hr while awake × 2 days, then 1–2 drops Q4 hr while awake × 5 days.

Clinical efficacy for bacterial conjunctivitis has been demonstrated for neonates <31 days old in a randomized, double-blinded, multicenter, parallel-group clinical trial.

Ophthalmic ointment:

≥2 yr and adult: Apply 0.5-inch ribbon TID × 2 days, then BID × 5 days

Otic:

Cetraxal and generics:

Acute otitis externa (≥1 yr and adult): 0.25 mL to affected ear(s) BID × 7 days

CIPROFLOXACIN continued***Ciprodex:***

Acute otitis media with tympanostomy tubes or acute otitis externa (≥ 6 mo and adult): 4 drops to affected ear(s) BID \times 7 days

Cipro HC Otic:

Otitis externa (>1 yr and adult): 3 drops to affected ear(s) BID \times 7 days

Otovel Otic:

Acute otitis media with tympanostomy tubes (≥ 6 mo): 0.25 mL to affected ear(s) BID \times 7 days

Systemic fluoroquinolones are associated with disabling and potentially permanent side effects of the tendons, muscles, joints, nerves, and central nervous system.



Can cause GI upset, renal failure, and seizures. GI symptoms, headache, restlessness, and rash are common side effects. Peripheral neuropathy, pseudotumor cerebri, severe hepatic necrosis, and psychiatric reactions have been reported. **Use with caution** in children <18 yr (like other quinolones, tendon rupture can occur during or after therapy, especially with concomitant corticosteroid use), alkalinized urine (crystalluria), seizures, excessive sunlight (photosensitivity), and renal dysfunction (adjust systemic dose in renal failure; see **Chapter 31**). Blood glucose disturbances (hypoglycemia and hyperglycemia) have been reported in diabetic patients receiving insulin or oral hypoglycemic agent.

Do not use otic suspension with perforated tympanic membranes and with viral infections of the external ear canal.

For dosing in obese patients, use an adjusted body weight (ABW). ABW = ideal body weight + 0.45 (total body weight – ideal body weight).

Combinational antimicrobial therapy is recommended for anthrax. For penicillin-susceptible strains, consider changing to high-dose amoxicillin (25–35 mg/kg/dose TID PO). See www.bt.cdc.gov for the latest information.

Inhibits CYP 450 1A2. Ciprofloxacin can increase effects and/or toxicity of caffeine, methotrexate, theophylline, warfarin, tizanidine (excessive sedation and dangerous hypotension), and cyclosporine. Probenecid increases ciprofloxacin levels.

Do not administer antacids or other divalent salts with or within 2–4 hr of oral ciprofloxacin dose.

Do not administer oral suspension through feeding tubes, because this dosage form adheres to the tube.

CITRATE MIXTURES

Alkalizing agent, electrolyte supplement



?



?



Yes



No



No

Oral liquid:

Each mL of oral solution contains the following mEq of electrolyte:

	Na	K	Citrate or HCO ₃
Tricitrates ^a or Sodium Citrate/Potassium Citrate and Citric Acid (473 mL)	1	1	2
Potassium Citrate and Citric Acid ^a (473 mL)	0	2	2
Sodium Citrate and Citric Acid ^a (30, 473 mL)	1	0	1
Oracit (15, 30, 500 mL)	1	0	1

^aSugar free.

Oral powder for oral solution:

Cytra-K: each packet of sugar-free powder contains 30 mEq each of potassium and citrate/HCO₃ (100 packets per box) and must be diluted in at least 6 ounces of cold water or juice.

CITRATE MIXTURES *continued***Dilute dose in water or juice.****All mEq doses based on citrate.****Infant and child (PO):** 2–3 mEq/kg/24 hr ÷ Q6–8 hr or 5–15 mL/dose Q6–8 hr (after meals and before bedtime) and adjust dose to desired serum bicarbonate level**Adult (PO):** 100–200 mEq/24 hr ÷ Q6–8 hr or 15–30 mL/dose Q6–8 hr (after meals and before bedtime)

Contraindicated in severe renal impairment and acute dehydration. **Use with caution** in patients already receiving potassium supplements or who are sodium restricted. May have laxative effect and cause hypocalcemia and metabolic alkalosis.

Adjust dose to maintain desired pH. 1 mEq of citrate is equivalent to 1 mEq HCO₃ in patients, as citrate is converted to CO₂ via the citric acid cycle in the mitochondria.

Potassium citrate has a pregnancy category of "C"; otherwise the pregnancy category is unknown for the other components to this medication.

**CLARITHROMYcin**

Generics; previously available as Biaxin and Biaxin XL

Antibiotic, macrolide



C

2

Yes

Yes

No

Film tablets: 250, 500 mg**Extended-release tablets:** 500 mg**Granules for oral suspension:** 125, 250 mg/5 mL (50, 100 mL)**Infant and child:**

Acute otitis media, pharyngitis/tonsillitis, pneumonia, acute maxillary sinusitis, or uncomplicated skin infections: 15 mg/kg/24 hr PO ÷ Q12 hr; **max. dose:** 1 g/24 hr

Pertussis (≥1 mo): 15 mg/kg/24 hr PO ÷ Q12 hr × 7 days; **max. dose:** 1 g/24 hr

Bacterial endocarditis prophylaxis: 15 mg/kg (**max. dose:** 500 mg) PO 1 hr before procedure

Helicobacter pylori: 20 mg/kg/24 hr PO ÷ Q12 hr × 7–14 days; **max. dose:** 1 g/24 hr with amoxicillin and proton pump inhibitor with/without metronidazole

Mycobacterium avium complex (MAC):

Prophylaxis (1st episode and recurrence): 15 mg/kg/24 hr PO ÷ Q12 hr

Treatment: 15 mg/kg/24 hr PO ÷ Q12 hr with other antimycobacterial drugs

Max. dose (prophylaxis and treatment): 1 g/24 hr

**Adolescent and adult:**

Pharyngitis/tonsillitis, acute maxillary sinusitis, bronchitis, pneumonia, or uncomplicated skin infections:

Immediate release: 250–500 mg/dose Q12 hr PO

Extended-release tablet: 1000 mg Q24 hr PO (currently not indicated for pharyngitis/tonsillitis or uncomplicated skin infections)

Adult:

Pertussis: 500 mg (immediate release)/dose Q12 hr PO × 7 days

Bacterial endocarditis prophylaxis: 500 mg PO 1 hr before procedure

MAC:

Prophylaxis (1st episode and recurrence): 500 mg/dose Q12 hr PO

Treatment: 500 mg Q12 hr PO with other antimycobacterial drugs

Helicobacter pylori GI infection: 500 mg Q12 hr PO with proton pump inhibitor (lansoprazole or omeprazole) and amoxicillin

CLARITHROMYCIN *continued*

Contraindicated in patients allergic to erythromycin and history of cholestatic jaundice/hepatic dysfunction with prior use. As with other macrolides, clarithromycin has been associated with QT prolongation (**avoid use** with other drugs known to prolong QT interval) and ventricular arrhythmias, including ventricular tachycardia and torsades de pointes. May cause cardiac arrhythmias in patients also receiving cisapride. Side effects: diarrhea, nausea, abnormal taste, dyspepsia, abdominal discomfort (less than erythromycin but greater than azithromycin), and headache. Anaphylaxis, angioedema, hepatic dysfunction, rhabdomyolysis, SJS, and TEN have been reported. May increase effects/toxicity of carbamazepine, theophylline, cyclosporine, digoxin, ergot alkaloids, fluconazole, midazolam, selected oral hypoglycemic agents, tacrolimus, triazolam, quetiapine, and warfarin. Substrate and inhibitor of CYP 450 3A4, and inhibits CYP 1A2.

Adjust dose in renal failure (see [Chapter 31](#)). Doses, regardless of dosage form, may be administered with food.

CLINDAMYCIN

Cleocin-T, Cleocin, Clindagel, Evoclin, Clindesse, and generics

Antibiotic, lincomycin derivative



B

2

Yes

Yes

No

Caps: 75, 150, 300 mg

Oral solution: 75 mg/5 mL (100 mL); may contain ethyl parabens

Injection: 150 mg/mL (2, 4, 6, 60 mL); contains 9.45 mg/mL benzyl alcohol

Premixed injection in 5% dextrose or NS: 300 mg/50 mL, 600 mg/50 mL, 900 mg/50 mL; contains edetate disodium and may contain benzyl alcohol

Solution, topical (Cleocin-T and generics): 1% (30, 60 mL); may contain 50% isopropyl alcohol and propylene glycol

Gel, topical (Cleocin-T, Clindagel, and generics): 1% (30, 60 g); may contain methylparaben and propylene glycol

Lotion, topical (Cleocin-T and generics): 1% (60 mL); may contain methylparaben

Foam, topical (Evoclin): 1% (50, 100 g); contains 58% ethanol

See *benzoyl peroxide* for combination topical product (clindamycin and benzoyl peroxide)

See *tretinoin* for combination topical product (clindamycin and tretinoin)

Vaginal cream (Cleocin, Clindesse, and generics): 2% (40 g); may contain benzyl alcohol

Vaginal suppository: 100 mg (3s)

Neonate:

IV/IM: 5 mg/kg/dose with the following dosage intervals:

≤7 days:

<2 kg: Q12 hr

>2 kg: Q8 hr

>7–28 days:

<1 kg: Q12 hr for 8–14 days old and Q8 hr for ≥15–28 days old

1–2 kg: Q8 hr

>2 kg: Q6 hr

**Child and adolescent:**

PO: 10–40 mg/kg/24 hr ÷ Q6–8 hr; **max. dose:** 1.8 g/24 hr

IM/IV: 20–40 mg/kg/24 hr ÷ Q6–8 hr; **max. dose:** 2.7 g/24 hr

Bacterial endocarditis prophylaxis: 20 mg/kg (**max. dose:** 600 mg) × 1 PO, IV or IM; 1 hr before procedure with PO route and 30 min before procedure with IV or IM route.

CLINDAMYCIN *continued***Adult:**

PO: 150–450 mg/dose Q6–8 hr; **max. dose:** 1.8 g/24 hr

IM/IV: 1200–2700 mg/24 hr IM/IV ÷ Q6–12 hr; **max. IV dose:** 4.8 g/24 hr. **Max. IM dose:** 600 mg/dose

Bacterial endocarditis prophylaxis: 600 mg × 1 PO, IV or IM; 1 hr before procedure with PO route and 30 min before procedure with IV or IM route.

Topical for acne (≥ 12 yr and adult; administer after washing and fully dry the affected skin):

Solution, lotion, or gel (Cleocin-T and generics): apply to affected area BID.

Clindagel or Evoclin (foam): apply to affected area once daily.

Bacterial vaginosis (adolescent and adult):

Suppositories: 100 mg/dose QHS × 3 days

Vaginal cream (2%): 1 applicator dose (5 g) QHS for 3 or 7 days in nonpregnant patients and for 7 days in pregnant patients in second and third trimesters.

Not indicated in meningitis; CSF penetration is poor.

Pseudomembranous colitis may occur up to several weeks after cessation of therapy.

May cause diarrhea, rash, granulocytopenia, thrombocytopenia, or sterile abscess at injection site. Anaphylaxis, DRESS, SJS, severe taste alterations including metallic taste (with high IV doses), and TEN have been reported with systemic use. Eye pain and contact dermatitis have been reported with topical use.

Clindamycin may increase the neuromuscular blocking effects of tubocurarine and pancuronium.

Do not exceed IV infusion rate of 30 mg/min because hypotension and cardiac arrest have been reported with rapid infusions. May diminish the effects of erythromycin when administered together. In vitro studies indicate clindamycin is a substrate and inhibitor for CYP 450 3A4.

Dosage reduction may be required in severe renal or hepatic disease but not necessary in mild/moderate conditions. Oral liquid preparation may not be palatable; consider use of oral capsules as a sprinkle onto applesauce or pudding.

CLOBAZAM

Onfi, Sympazan, and generics

Benzodiazepine, anticonvulsant



C

3

No

Yes

Yes

Tabs (Onfi and generics): 10, 20 mg

Oral film (Sympazan): 5, 10, 20 mg (60s)

Oral suspension (Onfi and generics): 2.5 mg/mL (120 mL); contains parabens, polysorbate 80, and propylene glycol

Lennox-Gastaut (adjunctive therapy; see remarks):

Child (≥ 2 yr) and adult (PO): Dosage increments (if needed) should not be more rapid than every 7 days.



Weight (kg)	Initial Dose	Dose at Day 8, if Needed	Dose at Day 15, if Needed
≤ 30 kg	5 mg once daily	5 mg BID	10 mg BID (max. dose)
> 30 kg	5 mg BID	10 mg BID	20 mg BID (max. dose)

CLOBAZAM continued

Dosage adjustment for mild/moderate hepatic impairment (Child-Pugh score 5–9) and individuals with poor CYP 450 2C19 activity (PO):

Weight (kg)	Initial Dose	First Dose Increment, If Needed	Second Dose Increment, If Needed	Third Dose Increment, If Needed
≤30 kg	5 mg once daily x ≥14 days	5 mg BID × ≥7 days	10 mg BID (max. dose)	N/A
>30 kg	5 mg once daily x ≥7 days	5 mg BID × ≥7 days	10 mg BID × ≥7 days	20 mg BID (max. dose)

N/A, Not applicable.

Seizures (generalized or partial, as monotherapy or adjunctive therapy; limited data and prescribing information from Canada and the United Kingdom):

Infant and child (<2 yr): Start at 0.5–1 mg/kg/24 hr (**max. dose:** 5 mg/24 hr) PO ÷ BID, if needed and tolerated, slowly increase dosage at 5–7 days intervals up to the **maximum** of 10 mg/kg/24 hr.

2–16 yr: Start at 5 mg PO once daily, if needed and tolerated, slowly increase dosage at 5–7 day intervals up to the **maximum** of 40 mg/kg/24 hr. Usual dosage range: 10–20 mg/24 hr or 0.3–1 mg/kg/24 hr ÷ BID.

Use with caution in hepatic impairment (dose adjustment may be needed). Do not discontinue use abruptly, as seizures/withdrawal symptoms may occur. Common side effects include constipation, drooling, ataxia, drowsiness, insomnia, aggressive behavior, cough, and fever. SJS, TEN, urinary retention, hypothermia, leukopenia, and thrombocytopenia have been reported.



Do not use in combination with azelastine, olanzapine, sodium oxybate, and thioridazine; increased risk of adverse events. Proton pump inhibitors, azole antifungal agents (e.g., itraconazole and ketoconazole), St. John's Wort, grapefruit juice, CNS depressants, cimetidine, and calcium channel blockers may increase the effects/toxicity of clobazam. Use with opioids may result in profound sedation, respiratory depression, coma, and mortality. Carbamazepine, rifamycin derivatives (e.g., rifampin), and theophylline may decrease the effects of clobazam. Clobazam is a major substrate for CYP 450 2C19 and P-glycoprotein, minor substrate for CYP 450 2B6 and 3A4, inhibitor of CYP 450 2D6, and inducer of CYP 3A4. Carefully review the patient's medication profile for other drug interactions each time clobazam is initiated or when a new drug is added to a regimen containing clobazam.

Doses may be taken with or without food. Tablets may be crushed and mixed with applesauce. Oral film (Sympazan) uses same PO dosage with the following method for administration: apply film on top of the tongue, allow it to dissolve, and swallow saliva in a normal manner. **Do not chew, spit, or talk while film is dissolving.** Doses may be taken with or without food but **do not administer with liquids.**

CLONAZEPAM

Klonopin and generics

Benzodiazepine, anticonvulsant



D



3



Yes



No

Tabs: 0.5, 1, 2 mg

Disintegrating oral tabs: 0.125, 0.25, 0.5, 1, 2 mg; contains phenylalanine

Oral suspension: 100 mCg/mL

Continued

CLONAZEPAM *continued***Infant and child:** <10 yr or <30 kg:**Initial:** 0.01–0.03 mg/kg/24 hr PO ÷ BID–TID; **maximum initial dose:** 0.05 mg/kg/24 hr.**Increment:** 0.25–0.5 mg/24 hr Q3 days, up to **maximum maintenance dose of**

0.1–0.2 mg/kg/24 hr ÷ TID

**Child ≥10 yr or ≥30 kg and adult:****Initial:** 1.5 mg/24 hr PO ÷ TID**Increment:** 0.5–1 mg/24 hr Q3 days; **max. dose:** 20 mg/24 hr

Contraindicated in severe liver disease and acute narrow-angle glaucoma. Drowsiness, behavior changes, increased bronchial secretions, GI, CV, GU, and hematopoietic toxicity (thrombocytopenia, leukopenia) may occur. Monitor for depression, suicidal behavior/ideation, and unusual changes in behavior/mood. **Use with caution** in patients with compromised respiratory function, porphyria, and renal impairment. **Do not discontinue abruptly.** $T_{1/2} = 24\text{--}36$ hr.

Proposed therapeutic levels (not well established): 20–80 ng/mL. Recommended serum sampling time: Obtain trough level within 30 min prior to an oral dose. Steady state is typically achieved after 5–8 days continuous therapy using the same dose.

Carbamazepine, phenytoin, and phenobarbital may decrease clonazepam levels and effect. Drugs that inhibit CYP-450 3A4 isoenzymes (e.g., erythromycin) may increase clonazepam levels and effects/toxicity.

CLONIDINE

Catapres, Kapvay, Catapres TTS, Duraclon, and generics

Central α-adrenergic agonist, antihypertensive

C

3

Yes

No

No

Tabs (Catapres and generics): 0.1, 0.2, 0.3 mg**Extended-release oral tab (Kapvay and generics):** 0.1 mg**Oral suspension:** 20, 100, 1000 mCg/mL**Transdermal patch (Catapres TTS and generics):** 0.1, 0.2, 0.3 mg/24 hr (7-day patch); contains metallic components (see remarks)**Injection, epidural (Duraclon and generics):** 100, 500 mCg/mL (10 mL); preservative free**Hypertension (use immediate-release products unless noted):****Child (PO):** 5–10 mCg/kg/24 hr ÷ Q8–12 hr initially; if needed, increase at 5- to 7-day intervals to 5–25 mCg/kg/24 hr ÷ Q6 hr; **max. dose:** 25 mCg/kg/24 hr up to 0.9 mg/24 hr.**≥12 yr and adult (PO):** 0.1 mg BID initially; increase in 0.1 mg/24 hr increments at weekly intervals until desired response is achieved (usual range: adolescent: 0.2–0.6 mg/24 hr ÷ BID; adult: 0.1–0.8 mg/24 hr ÷ BID), **max. dose:** 2.4 mg/24 hr**Transdermal patch (each patch lasts 7 days by rotating application sites but more frequent patch change at every 5 days may be needed for children):****Child:** conversion to patch only after establishing an optimal oral dose first. Use a transdermal dosage closest to the established total oral daily dose.**Adult:** Initial 0.1 mg/24 hr patch for first week. May increase dose by 0.1 mg/24 hr at 1–2 wk intervals PRN. Usual range: 0.1–0.3 mg/24 hr. Doses >0.6 mg/24 hr do not provide additional benefit.**ADHD (Child ≥6 yr and adolescent):****Immediate-release product (PO):****≤45 kg:** Start with 0.05 mg QHS; if needed, increase by 0.05 mg/24 hr every 3–7 days as increments with BID, TID, and then QID dosing up to the following **max. dose:****27–40.5 kg:** 0.2 mg/24 hr**40.5–45 kg:** 0.3 mg/24 hr

CLONIDINE *continued*

>45 kg: Start with 0.1 mg QHS; if needed, increase by 0.1 mg/24 hr every 3–7 days as increments with BID, TID, and then QID dosing up to the **max. dose** of 0.4 mg/24 hr.

Extended-release product (Kapvay and generics, PO): Start with 0.1 mg QHS; if needed, increase by 0.1 mg every 7 days by administering the dose BID up to a **maximum** of 0.4 mg/24 hr. Depending on dosage level, BID dosing should be either the same amount or with the higher dosage given at bedtime. If therapy is to be discontinued, slowly reduce dosage at ≤ 0.1 mg every 3 to 7 days to avoid withdrawal.

Neonatal abstinence syndrome, adjunctive therapy (use immediate-release product; limited data): 0.5–1 mCg/kg/dose Q4–6 hr PO; use Q6 hr interval for preterm neonates.

Side effects: Dry mouth, dizziness, drowsiness, fatigue, constipation, anorexia, arrhythmias, and local skin reactions with patch. Somnolence, fatigue, URIs irritability, throat pain, insomnia, nightmares, and emotional disorder were reported as common side effects in ADHD clinical trials. May worsen sinus node dysfunction and AV block especially for patients taking other sympatholytic drugs. **Do not abruptly discontinue;** signs of sympathetic overactivity may occur; taper gradually over >1 wk.

β -blockers may exacerbate rebound hypertension during and following the withdrawal of clonidine. If patient is receiving both clonidine and a β -blocker and clonidine is to be discontinued, the β -blocker should be withdrawn several days prior to tapering the clonidine. If converting from clonidine over to a β -blocker, introduce the β -blocker several days after discontinuing clonidine (after taper).

Monitor heart rate when used with digitalis, calcium channel blockers, and β -blockers. Use with diltiazem or verapamil may result in sinus bradycardia. Use with neuroleptics may induce/exacerbate orthostatic hypotension, dizziness, and fatigue. Consider using lower dosages in renal impairment because the drug is primarily eliminated unchanged in the urine and signs of bradycardia, sedation, and hypotension may occur.

T_½: 44–72 hr (neonate), 6–20 hr (adult). Onset of action (antihypertensive): 0.5–1 hr for oral route, 2–3 days for transdermal route. **Do not** use transdermal route while patient is undergoing a magnetic resonance imaging (MRI) procedure; transdermal patches contains metals and may result in serious patient burns when undergoing MRI.

CLOTRIMAZOLE

Alevazol, Lotrimin AF, Gyne-Lotrimin 3, Gyne-Lotrimin 7, and generics

Antifungal, imidazole



B/C

?

No

Yes

No

Oral troche: 10 mg

Cream, topical (Lotrimin AF and generics; OTC): 1% (15, 30, 45 g); may contain benzyl alcohol

Ointment, topical (Alevazol; OTC): 1% (56.7 g)

Solution, topical (OTC): 1% (10, 30 mL)

Vaginal cream (OTC):

Gyne-Lotrimin 7 and generics: 1% (45 g)

Gyne-Lotrimin 3 and generics: 2% (21 g)

Topical (cream, ointment, or solution):

≥ 2 yr-adult: Apply to affected skin areas BID; $\times 2$ wk for cutaneous candidiasis,

$\times 4$ –8 wk for tinea corporis/pedis.

Vaginal cream (>12 yr and adult; in addition to intravaginal use, may also apply to external vaginal area BID $\times 7$ days PRN for itching and irritation):

1 applicator dose (5 g) of 1% cream intravaginally QHS $\times 7$ –14 days, or

1 applicator dose of 2% cream intravaginally QHS $\times 3$ days



CLOTRIMAZOLE *continued***Thrush:**

>3 yr–adult: Dissolve slowly (15–30 min) one troche in the mouth 5 times/24 hr × 14 days

Systemic use: Do not use troches for systemic infections. Liver enzyme elevation, nausea, and vomiting may occur with troches.



Topical use: May cause erythema, blistering, or urticaria with topical use. **Avoid use** of tampons, douches, spermicides, other vaginal products, condoms, and diaphragms with vaginal cream. Vaginal cream can weaken latex.

Pregnancy code is a “B” for topical and vaginal dosage forms and “C” for troches.

CORTICOTROPIN

Acthar Gel, ACTH

Adrenocorticotrophic hormone



C

?

No

No

No

Injection, repository gel: 80 U/mL (5 mL); contains phenol

1 unit = 1 mg

**Infantile spasms (many regimens exist):**

20–40 U/24 hr IM once daily × 6 wk or 150 U/m²/24 hr ÷ BID for 2 wk, followed by a gradual 2 wk taper of 30 U/m²/dose QAM × 3 days, followed by 15 U/m²/dose QAM × 3 days, followed by 10 U/m²/dose QAM × 3 days and 10 U/m²/dose every other morning × 6 days.

Antiinflammatory:

≥2 yr and adolescent: 0.8 U/kg/24 hr ÷ Q12–24 hr IM



Contraindicated in acute psychoses, CHF, Cushing disease, TB, peptic ulcer, ocular herpes, fungal infections, recent surgery, and sensitivity to porcine products. **Use with caution** in osteoporosis. Repository gel dosage form is only for IM route.

Hypersensitivity reactions and injection site reactions may occur. Similar adverse effects as corticosteroids.

CORTISONE ACETATE

Various generics

Corticosteroid



C/D

?

No

No

No

Tabs: 25 mg

**Antiinflammatory/immunosuppressive:**

Child: 2.5–10 mg/kg/24 hr ÷ Q6–8 hr PO

Adult: 25–300 mg/24 hr ÷ Q12–24 hr PO



May produce glucose intolerance, Cushing syndrome, edema, hypertension, adrenal suppression, cataracts, hypokalemia, skin atrophy, peptic ulcer, osteoporosis, and growth suppression.

Pregnancy category changes to “D” if used in the first trimester.

CO-TRIMOXAZOLE

See SULFAMETHOXAZOLE AND TRIMETHOPRIM

CROMOLYN

Nasalcrom, Gastrocrom, and generics; previously available as Intal
Antiallergic agent, mast cell stabilizer



B



1



Yes



Yes



No

Nebulized solution: 10 mg/mL (2 mL)

Oral concentrate (Gastrocrom and generics): 100 mg/5 mL (5 mL)

Ophthalmic solution: 4% (10 mL)

Nasal spray (NasalCrom and generics) [OTC]: 4% (5.2 mg/spray) (100 sprays, 13 mL; 200 sprays, 26 mL); contains benzalkonium chloride and EDTA

Nebulization:

Child ≥ 2 yr and adult: 20 mg Q6–8 hr

Exercise-induced asthma: 20 mg × 1, 10–15 min prior to and no longer than 1 hr before exercise.

Nasal:

Child ≥ 2 yr and adult: 1 spray each nostril TID–QID; **max. dose:** 1 spray 6 times/24 hr.

Ophthalmic:

Child > 4 yr and adult: 1–2 gtt 4–6 times/24 hr

Food allergy/inflammatory bowel disease:

2–12 yr: 100 mg PO QID; give 15–20 min AC and QHS; **max. dose:** 40 mg/kg/24 hr

>12 yr and adult: 200–400 mg PO QID; give 15–20 min AC and QHS

Systemic mastocytosis (taper to lowest effective maintenance dose once desired effect is achieved):

Infant and child < 2 yr: 20 mg/kg/24 hr ÷ QID PO; **max. dose:** <6 mo: 20 mg/kg/24 hr, ≥6 mo to <2 yr: 40 mg/kg/24 hr

2–12 yr: 100 mg PO QID; give 30 min AC and QHS; **max. dose:** 40 mg/kg/24 hr

>12 yr and adult: 200 mg PO QID; give 30 min AC and QHS; **max. dose:** 40 mg/kg/24 hr

May cause rash, cough, bronchospasm, and nasal congestion. May cause headache, diarrhea with oral use. **Use with caution** in patients with renal or hepatic dysfunction because cromolyn is equally excreted unchanged in the urine and feces (bile).

Therapeutic response often occurs within 2 wk; however, a 4- to 6-wk trial may be needed to determine maximum benefit. Oral concentrate can only be diluted in water. Nebulized solution can be mixed with albuterol nebs.

CYANOCOBALAMIN/VITAMIN B₁₂

B-12 Compliance, Physicians EZ Use B-12, Nascobal, vitamin B₁₂, and generics
Vitamin (synthetic), water soluble



A/C



1



Yes



No



No

Tabs (OTC): 100, 250, 500, 1000 mCg

Extended-release tabs: 1000 mCg

Sublingual tabs: 2500 mCg

Sublingual liquid: 3000 mCg/mL (52 mL)

Lozenges (OTC): 50, 100, 250, 500 mCg

Nasal spray (Nascobal): 500 mCg/spray (1.3 mL delivers 4 doses); contains benzalkonium chloride

Injection: 1000 mCg/mL (1, 10, 30 mL); may contain benzyl alcohol

Injection kit (B-12 Compliance, Physicians EZ Use B-12, and generics): 1000 mCg/mL (1 mL); may contain benzyl alcohol

Contains cobalt (4.35%)

CYANOCOBALAMIN/VITAMIN B₁₂ *continued***U.S. RDA:** See Chapter 21.**Vitamin B₁₂ deficiency, treatment:****Child (IM or deep SC):** 100 mCg/24 hr × 10–15 days followed by 100 mCg once or twice weekly for several months**Maintenance:** At least 60 mCg/mo**Adult (IM or deep SC):** 100 mCg/24 hr × 6–7 days, if improvement, 100 mCg/dose every 3–4 days × 2–3 wk. Use maintenance dose when hematologic values return to normal.**Maintenance:** 100 mCg/mo**Pernicious anemia:****Child (IM or deep SC):** 30–50 mCg/24 hr for at least 14 days to a total dose of 1000–5000 mCg**Maintenance:** 100 mCg/mo**Adult (IM or deep SC):** 100 mCg/24 hr × 6–7 days, if improvement, 100 mCg/dose every 3–4 days × 2–3 wk. Use maintenance dose when hematologic values return to normal.**Maintenance:****IM/deep SC:** 100 mCg/mo**Intranasal:** 500 mCg in one nostril once weekly**Sublingual:** 1000–2000 mCg/24 hr**Contraindicated** in optic nerve atrophy. May cause hypokalemia, hypersensitivity (anaphylaxis shock and death reported with parenteral use), pruritis, and vascular thrombosis. Vitamin B₁₂ use may mask folate deficiency and unmask polycythemia vera.

Prolonged use of acid-suppressing medications may reduce cyanocobalamin oral absorption.

Pregnancy category changes to "C" if used in doses greater than the RDA or if administered by the intranasal route.

Protect product from light. Some products may contain aluminum and may accumulate in renal impairment. Oral route of administration is generally **not recommended** for pernicious anemia and B₁₂ deficiency due to poor absorption. IV route of administration is **NOT recommended** because of a more rapid elimination. See Chapter 21 for multivitamin preparations.**CYCLOPENTOLATE**

Cyclogyl and generics

Anticholinergic, mydriatic agent

C

?

No

No

No

Ophthalmic solution: 0.5% (15 mL), 1% (2, 5, 15 mL), 2% (2, 5, 15 mL); may contain benzalkonium chloride

Administer dose approximately 40–50 min prior to examination/procedure.

Infant: Use of cyclopentolate/phenylephrine (Cyclomydril) due to lower cyclopentolate concentration and reduced risk of systemic side effects.**Child and adolescent:** 1 drop of 0.5%–1% solution OU, followed by repeat drop, if necessary, in 5 min. Use 2% solution for heavily pigmented iris.**Adult:** 1 drop of 1% solution OU followed by another drop OU in 5 min. Use 2% solution for heavily pigmented iris.**Do not use** in narrow-angle glaucoma. May cause a burning sensation, behavioral disturbance, tachycardia, and loss of visual accommodation. Psychotic reactions and behavioral disturbances have been reported in children. To minimize absorption, apply pressure over nasolacrimal sac for at least 2 min. CNS and cardiovascular side effects are common with the 2% solution in children. **Avoid** feeding infants within 4 hr of dosing to prevent potential feeding intolerance.**Onset of action:** 15- to 60-min duration of action: 6–24 hr; complete recovery of accommodation may

CYCLOPENTOLATE WITH PHENYLEPHRINE

Cyclomydril

*Anticholinergic/sympathomimetic,
mydriatic agent*

C



?



No



No



No

Ophthalmic solution: 0.2% cyclopentolate and 1% phenylephrine (2, 5 mL); contains 0.1% benzalkonium chloride, EDTA, and boric acid

Neonate (administer dose approximately 40–50 min prior to examination/procedure; see remarks): 1 drop OU Q5–10 min; **max. dose:** 3 drops per eye



Infant, child, and adolescent (administer dose at least 15 min prior to examination; see remarks): 1 drop OU Q5–10 min PRN



Used to induce mydriasis. See *cyclopentolate* for additional remarks.

Onset of action: 15–60 min. Duration of action: 4–12 hr.

Apply pressure over the nasolacrimal sac for 2–3 min after administration to minimize systemic absorption.

**CYCLOSPORINE, CYCLOSPORINE MICROEMULSION,
CYCLOSPORINE MODIFIED**

Sandimmune, Gengraf, Neoral, Restasis, Cequa, and generics

Immunosuppressant



C



X



Yes



Yes



No

CYCLOSPORINE (Sandimmune and generics):

Injection: 50 mg/mL (5 mL); contains 32.9% alcohol and 650 mg/mL polyoxyethylated castor oil

Oral solution: 100 mg/mL (50 mL); contains 12.5% alcohol

Caps: 25, 50, 100 mg; contains 12.8% alcohol

CYCLOSPORINE MICROEMULSION (Neoral):

Caps: 25, 100 mg

Oral solution: 100 mg/mL (50 mL)

Neoral products contain 11.9% alcohol

CYCLOSPORINE MODIFIED (Gengraf):

Caps: 25, 100 mg; contains 12.8% alcohol

Oral solution: 100 mg/mL (50 mL); contains propylene glycol

Ophthalmic emulsion (Restasis): 0.05% (0.4 mL as 30 single-use vials/box, 1.5 mL, 5.5 mL); contains polysorbate 80

Ophthalmic solution/drops (Cequa): 0.09% (0.25 mL in boxes of 60s); preservative free



Neoral manufacturer recommends a 1:1 conversion ratio with Sandimmune. Because of its better absorption, lower doses of Neoral and Gengraf may be required. Exact dosing will vary depending on transplant type.

Oral: 15 mg/kg/24 hr as a single dose given 4–12 hr pretransplantation; give same daily dose ÷ Q12–24 hr for 1–2 wk posttransplantation, then reduce by 5% per week to 3–10 mg/kg/24 hr ÷ Q12–24 hr

IV: 5–6 mg/kg/24 hr as a single dose given 4–12 hr pretransplantation; administer over 2–6 hr; give same daily dose posttransplantation until patient able to tolerate oral form

Ophthalmic:

≥16 yr and adult: Instill one drop onto affected eye(s) Q12 hr.

May cause nephrotoxicity, hepatotoxicity, hypomagnesemia, hyperkalemia, hyperuricemia, hypertension, hirsutism, acne, GI symptoms, tremor, leukopenia, sinusitis, gingival



CYCLOSPORINE, CYCLOSPORINE MICROEMULSION, CYCLOSPORINE MODIFIED *continued*

hyperplasia, and headache. Encephalopathy, convulsions, lower extremity pain, vision and movement disturbances, and impaired consciousness have been reported, especially in liver transplant patients. Psoriasis patients previously treated with PUVA and, to a lesser extent, methotrexate or other immunosuppressive agents, UVB, coal tar, or radiation therapy are at increased risk for skin malignancies when taking Neoral or Gengraf.

Opportunistic infections and activation of latent viral infections have been reported.

BK virus-associated nephropathy has been observed in renal transplant patients.

Use caution with concomitant use of other nephrotoxic drugs (e.g., amphotericin B, aminoglycosides, nonsteroidal antiinflammatory drugs, and tacrolimus).

Plasma concentrations increased with the use of boceprevir, telaprevir, fluconazole, ketoconazole, itraconazole, erythromycin, clarithromycin, voriconazole, nefazodone, diltiazem, verapamil, nicaldipine, carvedilol, and corticosteroids. Plasma concentrations decreased with the use of carbamazepine, naftacinil, rifampin, oxcarbazepine, bosentan, phenobarbital, octreotide, and phenytoin. May increase bosentan, dabigatran, methotrexate, repaglinide, and anthracycline antibiotics (e.g., doxorubicin, mitoxantrone, daunorubicin) levels/effects/toxicity. Use with nifedipine may result in gingival hyperplasia. Cyclosporine is a substrate and inhibitor for CYP 450 3A4 and P-glycoprotein.

Children may require dosages 2–3 times higher than adults. Plasma half-life 6–24 hr.

Monitor trough levels (just prior to a dose at steady state). Steady state is generally achieved after 3–5 days of continuous dosing. Interpretation will vary based on treatment protocol and assay methodology (RIA monoclonal vs. RIA polyclonal vs. HPLC), as well as whole blood vs. serum sample. Additional monitoring and dosage adjustments may be necessary in renal and hepatic impairment or when changing dosage forms.

For ophthalmic use: Ocular burning may occur. Remove contact lens prior to use; lens may be inserted 15 min after dose administration. May be used with artificial tears but need to be separated by 15 min for one another.

CYPROHEPTADINE

Various generics; previously available

as Periactin

Antihistamine



B

3

No

Yes

No

Tabs: 4 mg

Syrup: 2 mg/5 mL (473 mL); may contain alcohol 5%

Antihistaminic uses:

Child: 0.25 mg/kg/24 hr or 8 mg/m²/24 hr ÷ Q8–12 hr PO or by age:

2–6 yr: 2 mg Q8–12 hr PO; **max. dose:** 12 mg/24 hr

7–14 yr: 4 mg Q8–12 hr PO; **max. dose:** 16 mg/24 hr

≥15 yr: 4 mg Q8 hr PO; usual range 12–16 mg/24 hr; **max. dose:** 0.5 mg/kg/24 hr

Adult: Start with 12 mg/24 hr ÷ TID PO; dosage range: 12–32 mg/24 hr ÷ TID PO; **max. dose:** 0.5 mg/kg/24 hr



Migraine prophylaxis: 0.25–0.4 mg/kg/24 hr ÷ BID–TID PO up to following **max. doses:**

2–6 yr: 12 mg/24 hr

7–14 yr: 16 mg/24 hr

Adult: 0.5 mg/kg/24 hr or 32 mg/24 hr

Appetite stimulation (see remarks):

≥2 yr and adolescent: 0.25 mg/kg/24 hr ÷ Q12 hr PO up to the following **max. dose** by age: 2–6 yr:

12 mg/24 hr, 7–14 yr: 16 mg/24 hr, ≥15 yr: 32 mg/24 hr.

CYPROHEPTADINE *continued***Alternative dosing by age:****4–8 yr (limited data):** 2 mg Q8 hr PO**>13 yr and adult:** Start with 2 mg Q6 hr PO; dose may be gradually increased to 8 mg Q6 hr over a 3-wk period.

Contraindicated in neonates, patients currently on MAO inhibitors, and patients suffering from asthma, glaucoma, or GI/GU obstruction. May produce anticholinergic side effects including sedation and appetite stimulation. Consider reducing dosage with hepatic insufficiency.

Allow 4 to 8 wk of continuous therapy for assessing efficacy in migraine prophylaxis. For use as an appetite stimulant, a dosing cycle of 3 wk on therapy followed by 1 wk off of therapy may enhance efficacy.

**D****DANTROLENE**Dantrium, Revonto, Ryanodex,
and generics**Skeletal muscle relaxant**

C



?



No



Yes



No

Cap: 25, 50, 100 mg**Oral suspension:** 5 mg/mL **Injection:****Dantrium and Revonto:** 20 mg; injectable solution containing 3 g mannitol per 20 mg drug**Ryanodex :** 250 mg; injectable suspension containing 125 mg mannitol, 25 mg polysorbate 80, 4 mg povidone K12 per 250 mg drug**Chronic spasticity:****Child:** (≥ 5 yr)**Initial:** 0.5 mg/kg/dose (**max. dose:** 25 mg/dose) PO BID**Increment:** Increase frequency to TID–QID at 4- to 7-day intervals, then increase doses by 0.5 mg/kg/dose**Max. dose:** 3 mg/kg/dose PO BID–QID, up to 400 mg/24 hr**Malignant hyperthermia:****Prevention:****PO:** 4–8 mg/kg/24 hr \div Q6 hr \times 1–2 days before surgery with last dose administered 3–4 hr prior to surgery**IV (see remarks for specific dosage form administration rates):** 2.5 mg/kg beginning 1.25 hr before anesthesia, additional doses PRN**Treatment (see remarks for specific dosage form administration rates):** 1 mg/kg IV, repeat PRN to **maximum cumulative dose** of 10 mg/kg, followed by a post-crisis regimen of 4–8 mg/kg/24 hr PO \div Q6 hr for 1–3 days**Contraindicated** in active hepatic disease. Monitor transaminases for hepatotoxicity. **Use with caution** with cardiac or pulmonary impairment. May cause change in sensorium, drowsiness, weakness, diarrhea, constipation, incontinence, and enuresis. Rare cardiovascular collapse has been reported in patients receiving concomitant verapamil. May potentiate vecuronium-induced neuromuscular block.*Continued*

DANTROLENE *continued*

Avoid unnecessary exposure of medication to sunlight. **Avoid** extravasation into tissues. A decrease in spasticity sufficient to allow daily function should be therapeutic goal. Discontinue if benefits are not evident in 45 days.

IV administration rates for malignant hyperthermia:

Dosage Form	Prevention Use	Treatment Use
Injectable solution	Over 1 hr	IV push
Injectable suspension	Over at least 1 min	IV push

DAPSONE

Aczone, Diaminodiphenylsulfone, DDS, and generics

Antibiotic, sulfone derivative



C

2

Yes

Yes

No

Tabs: 25, 100 mg

Oral suspension: 2 mg/ml

Topical gel: 5% (60, 90 g)

Aczone: 7.5% (60, 90 g)

Pneumocystis jiroveci (formerly carinii) treatment:

Child and adult: 2 mg/kg/24 hr PO once daily (**max. dose:** 100 mg/24 hr) with trimethoprim 15 mg/kg/24 hr PO ÷ TID × 21 days

**P. jiroveci (formerly carinii) prophylaxis (first episode and recurrence):**

Child ≥1 mo: 2 mg/kg/24 hr PO once daily; **max. dose:** 100 mg/24 hr. Alternative weekly dosing, 4 mg/kg/dose PO Q7 days; **max. dose:** 200 mg/dose

Adult: 100 mg/24 hr PO ÷ once daily–BID with or without pyrimethamine 50 mg PO Q7 days and leucovorin 25 mg PO Q7 days; other combination regimens with pyrimethamine and leucovorin may be used (see <https://www.aidsinfo.gov>).

Toxoplasma gondii prophylaxis (prevent first episode):

Child ≥1 mo: 2 mg/kg/24 hr (**max. dose:** 25 mg/24 hr) PO once daily with pyrimethamine 1 mg/kg/24 hr (**max.** 25 mg/dose) PO once daily and leucovorin 5 mg PO Q3 days

Adult: 50 mg PO once daily with pyrimethamine 50 mg PO Q7 days and leucovorin 25 mg PO Q7 days; other combination regimens with pyrimethamine and leucovorin may be used (see <https://www.aidsinfo.gov>).

Leprosy (See www.who.int/en/ for the WHO latest recommendations including combination regimens such as rifampin ± clofazimine):

Child: 1–2 mg/kg/24 hr PO once daily; **max. dose:** 100 mg/24 hr

Adult: 100 mg PO once daily

Acne vulgaris (topical gel):

≥12 yr:

5% gel: Apply small amount (pea size) of topical gel onto clean, acne-affected areas BID.

7.5% gel: Apply small amount (pea size) of topical gel onto clean, acne-affected areas once daily

Patients with HIV, glutathione deficiency, or G6PD deficiency may be at increased risk for developing methemoglobinemia. Side effects include hemolytic anemia (dose related), agranulocytosis, methemoglobinemia, aplastic anemia, nausea, vomiting, hyperbilirubinemia, headache, nephrotic syndrome, and hypersensitivity reaction (sulfone syndrome). Cholestatic jaundice, hepatitis, peripheral neuropathy, and suicidal intent have been reported with systemic use.



DAPSONE continued

Didanosine, rifabutin, and rifampin decrease dapsone levels. Trimethoprim increases dapsone levels. Pyrimethamine, nitrofurantoin, primaquine, and zidovudine increase risk for hematological side effects.

Oral suspension may not be absorbed as well as tablets.

TOPICAL USE: Dry skin, erythema, and peeling of the skin may occur. Use of topical gel, followed by benzoyl peroxide for acne, has resulted in temporary local discoloration (yellow/orange) of the skin and facial hair. **Avoid use** of topical gel in G6PD deficiency or congenital/idiopathic methemoglobinemia.

DARBEPoETIN ALFA

Aranesp

Erythropoiesis stimulating protein



Injection: 25, 40, 60, 100, 200, 300 mCg/1 mL (1 mL)

Single dose pre-filled injection syringe (27 gauge ½-inch needle): 10 mCg/0.4 mL (0.4 mL), 25 mCg/0.42 mL (0.42 mL), 40 mCg/0.4 mL (0.4 mL), 60 mCg/0.3 mL (0.3 mL), 100 mCg/0.5 mL (0.5 mL), 150 mCg/0.3 mL (0.3 mL), 200 mCg/0.4 mL (0.4 mL), 300 mCg/0.6 mL (0.6 mL), 500 mCg/1 mL (1 mL)

Both dosage forms contain polysorbate 80 (0.05 mg/mL), albumin free and preservative free.

Anemia in chronic renal failure (see remarks):

Receiving dialysis (initial dosage and adjust dose according to the table that follows;

IV route is recommended for patients on hemodialysis):

Infant, child, and adolescent: Start with 0.45 mCg/kg/dose IV/SC once weekly

Adult: Start with 0.45 mCg/kg/dose IV/SC once weekly, **OR** 0.75 mCg/kg/dose IV/SC once every 2 wk

Not receiving dialysis (initial dosage; adjust dose according to the table that follows):

Infant, child, and adolescent: Start with 0.45 mCg/kg/dose IV/SC once weekly, **OR** 0.75 mCg/kg/dose IV/SC once every 2 wk

Adult: Start with 0.45 mCg/kg/dose IV/SC once every 4 wk

**DARBEPoETIN ALFA DOSE ADJUSTMENT IN ANEMIA ASSOCIATED WITH CHRONIC RENAL FAILURE**

Response to Dose	Dose Adjustment
<1 g/dL increase in hemoglobin and below target range after 4 wk of therapy	Increase dose by 25% not more frequently than once monthly. Further increases, if needed, may be done at 4-wk intervals. Among those who do not adequately respond over a 12-wk escalation period, further dose increase is unlikely to improve response and may increase risks.
>1 g/dL increase in hemoglobin in any 2-wk period, or if hemoglobin exceeds and approaches 11 g/dL	Decrease dose by 25% or more
Hemoglobin continues to increase despite dosage reduction	Discontinue therapy; reinitiate therapy at a 25% lower dose of the previous dose after the hemoglobin starts to decrease

Continued

DARBEOPOETIN ALFA *continued***Anemia associated with chemotherapy (patients with nonmyeloid malignancies):**

Child (limited data) and adult (see remarks): Start with 2.25 mCg/kg/dose SC once weekly and adjust dose according to the table that follows:

DARBEOPOETIN ALFA DOSE ADJUSTMENT IN ANEMIA ASSOCIATED WITH CHEMOTHERAPY

Response to Dose	Dose Adjustment
<1 g/dL increase in hemoglobin and remains below 10 g/dL after 6 wk of therapy	Increase dose to 4.5 mCg/kg/dose once weekly SC/IV
>1 g/dL increase in hemoglobin in any 2-wk period, or when hemoglobin reaches a level needed to avoid transfusion	Decrease dose by 40%
If hemoglobin exceeds a level needed to avoid transfusion	Hold therapy until hemoglobin approaches a level where transfusions may be required and restart at a reduced dose by 40%
Lack or response after 8 wk or completion of chemotherapy	Discontinue therapy

Conversion from epoetin alfa to darbepoetin alfa (see table below):

Previous Weekly Epoetin Alfa Dose (units/wk) ^a	Pediatric Weekly Darbepoetin Alfa Dose (mCg/wk) Administered SC/IV Once Weekly ^b	Adult Weekly Darbepoetin Alfa Dose (mCg/wk) Administered SC/IV Once Weekly ^b	Adult Once Every 2 wk Darbepoetin Alfa Dose (mCg Every 2 wk) Administered SC/IV Once Every 2 wk
<1,500	Insufficient data	6.25	12.5
1,500–2,499	6.25	6.25	12.5
2,500–4,999	10	12.5	25
5,000–10,999	20	25	50
11,000–17,999	40	40	80
18,000–33,999	60	60	120
34,000–89,999	100	100	200
≥90,000	200	200	400

^a200 units of epoetin alfa is equivalent to 1 mCg darbepoetin alfa.^bIf patient was receiving epoetin alfa 2–3 times weekly, darbepoetin alfa should be administered once weekly.

If patient was receiving epoetin alfa once weekly, darbepoetin alfa should be administered once every 2 wk.

Contraindicated in uncontrolled hypertension and patients hypersensitive to albumin/

polysorbate 80 or epoetin alfa. Darbepoetin alfa is not intended for patients requiring acute correction of anemia. **Use with caution** in seizures and liver disease. Erythema multiforme, SJS, and TEN have been reported. Evaluate serum iron, ferritin, and TIBC; concurrent iron supplementation may be necessary. Red cell aplasia and severe anemia associated with neutralizing antibodies to erythropoietin have been reported.



USE IN CHRONIC RENAL FAILURE: Higher doses may be needed for pediatric patients being switched from epoetin alfa than those for naïve patients. May cause edema, fatigue, GI disturbances, headache, blood pressure changes, fever, cardiac arrhythmia/arrest, infections and myalgia. Higher risk for mortality and serious cardiovascular events have been reported with higher targeted hemoglobin levels (>11 g/dL). If hemoglobin levels do not increase or reach targeted levels despite appropriate dose titrations over a 12 wk period, (1) **do not** administer higher doses and use the lowest dose that will maintain hemoglobin levels to avoid the need for recurrent blood transfusions; (2) evaluate and

DARBEPOETIN ALFA *continued*

treat other causes of anemia; (3) always follow the dose adjustment instructions; and (4) discontinue use if patient remains transfusion dependent.

USE IN CANCER: Use only for anemia due to myelosuppressive chemotherapy; not effective in reducing the need for transfusions in patients with anemia not due to chemotherapy. Shortened survival and time to tumor progression have been reported in patients with various cancers. May cause fatigue, fever, edema, dizziness, headache, GI disturbances, arthralgia/myalgia, and rash. Use lowest dose to avoid transfusions and **do not exceed hemoglobin levels >12 g/dL**; increased frequency of adverse events, including mortality and thrombotic vascular events, have been reported. **Prescribers and hospitals must enroll in and comply with the ESA APPRISE Oncology Program to prescribe and/or dispense this drug to cancer patients.**

Monitor hemoglobin, BP, serum chemistries, and reticulocyte count. Increases in dose should not be made more frequently than once a mo. For IV administration, infuse over 1–3 min.

DEFEROXAMINE MESYLATE

Desferal and generics

Chelating agent

C

2

Yes

Yes

No

Injection: 500, 2000 mg

Acute iron poisoning (if using IV route, convert to IM as soon as the patient's clinical condition permits; see remarks):

**Child:****IV:** 15 mg/kg/hr**IM:** 50 mg/kg/dose Q6 hr**Max. IV or IM dose:** 6 g/24 hr**Adult:****IV:** 15 mg/kg/hr**IM:** 1 g ×1, then 0.5 g Q4 hr ×2; may repeat 0.5 g Q4–12 hr**Max. dose:** 6 g/24 hr**Chronic iron overload (see remarks):****Child and adolescent:****IV:** 20–40 mg/kg/dose over 8–12 hr once daily ×5–7 days per week; usual **max. dose:** 40 mg/kg/24 hr (child) or 60 mg/kg/24 hr (adolescent)**SC:** 20–40 mg/kg/dose once daily as infusion over 8–12 hr ×3–7 days per week; **max. dose:** 2 g/24 hr**Adult:****IV:** 40–50 mg/kg/dose over 8–12 hr once daily ×5–7 days per week; **max. dose:** 6 g/24 hr**IM:** 0.5–1 g/dose once daily; **max. dose:** 1 g/24 hr**SC:** 1–2 g/dose once daily as infusion over 8–24 hr**Contraindicated** in severe renal disease or anuria. **Not approved** for use in primary

hemochromatosis. May cause flushing, erythema, urticaria, hypotension, tachycardia, diarrhea, leg cramps, fever, cataracts, hearing loss, nausea, and vomiting. Iron mobilization may be poor in children <3 yr. Serum creatinine elevation, acute renal failure, renal tubular disorders, and hepatic dysfunction have been reported.

**Avoid** use if glomerular filtration rate (GFR) <10 mL/min and administer 25%–50% of usual dose if

GFR is 10–50 mL/min or patient is receiving continuous renal replacement therapy (CRRT).

High doses and concomitant low ferritin levels have also been associated with growth retardation.

Growth velocity may resume to pretreatment levels by reducing the dosage. Acute respiratory distress

DEFEROXAMINE MESYLATE continued

syndrome (ARDS) has been reported following treatment with excessively high IV doses in patients with acute iron intoxication or thalassemia. Toxicity risk has been reported with infusions >8 mg/kg/hr for >4 days for thalassemia, and with infusions of 15 mg/kg/hr for >1 day for acute iron toxicity. Pulmonary toxicity was not seen in 193 courses.

For IV infusion, **maximum rate:** 15 mg/kg/hr. Infuse IV infusion over 6–12 hr for mild/moderate iron intoxication and over 24 hr for severe cases, then reassess. SC route is via a portable controlled-infusion device and is **not recommended** in acute iron poisoning.

DESMOPRESSIN ACETATE

DDAVP, Stimate, and generics

Vasopressin analog, synthetic, hemostatic agent

B



2



Yes



No



No

Tabs: 0.1, 0.2 mg**Nasal solution (with rhinal tube):** 100 mCg/mL (2.5, 5 mL); contains 9 mg NaCl/mL and 5 mg chlorbutanol/mL**Injection:** 4 mCg/mL (1, 10 mL); contains 9 mg NaCl/mL**Nasal spray:**

100 mCg/mL, 10 mCg/spray (50 sprays, 5 mL); contains 7.5 mg NaCl/mL and 0.2 mg benzalkonium chloride/mL

Stimate: 1500 mCg/mL, 150 mCg/spray (25 sprays, 2.5 mL); contains 7.5 mg NaCl/mL and 0.1 mg benzalkonium chloride/mL

Conversion: 100 mCg = 400 IU arginine vasopressin***Diabetes insipidus (see remarks):*****Oral:****Child ≤12 yr:** Start with 0.05 mg/dose BID; titrate to effect; usual dose range: 0.1–0.8 mg/24 hr.**Child >12 yr and adult:** Start with 0.05 mg/dose BID; titrate dose to effect; usual dose range: 0.1–1.2 mg/24 hr ÷ BID–TID.**Intranasal (titrate dose to achieve control of excessive thirst and urination. Morning and evening doses should be adjusted separately for diurnal rhythm of water turnover):****3 mo–12 yr:** 5–30 mCg/24 hr ÷ once daily–BID**>12 yr and adult:** 5–40 mCg/24 hr ÷ once daily–TID**IV/SC:****<12 yr (limited data):** 0.1–1 mCg/24 hr ÷ once daily–BID; start with lower dose and increase as needed.**≥12 yr and adult:** 2–4 mCg/24 hr ÷ BID***Hemophilia A and von Willebrand disease:*****Intranasal:** 2–4 mCg/kg/dose 2 hr before procedure**IV:** 0.2–0.4 mCg/kg/dose over 15–30 min, administered 30 min before procedure***Nocturnal enuresis (≥6 yr; see remarks):*****Oral:** 0.2 mg at bedtime, if needed, titrate to achieve desired effect by 0.2 mg Q3 days up to a **max. dose** of 0.6 mg/24 hr.

Use with caution in hypertension, patients at risk for water intoxication with hyponatremia, and coronary artery disease. May cause headache, nausea, seizures, blood pressure changes, hyponatremia, nasal congestion, abdominal cramps, and hypertension.

Desmopressin is primarily excreted in the urine, and renal impairment may increase the elimination half-life (some consider use contraindicated when GFR is <50 mL/min).

NOCTURNAL ENURESIS: Intranasal formulations are no longer indicated by the FDA for primary **nocturnal enuresis** (children are susceptible for severe hyponatremia and seizures) or in patients with a

DESMOPRESSIN ACETATE *continued*

history of hyponatremia. Patients using tablets should reduce their fluid intake to prevent potential water intoxication and hyponatremia, and have their therapy interrupted during acute illnesses that may lead to fluid and/or electrolyte imbalance.

Injection may be used SC or IV at approximately 10% of intranasal dose. Adjust fluid intake to decrease risk of water intoxication and monitor serum sodium.

If switching stabilized patient from intranasal route to IV/SC route, use 10% of intranasal dose. Peak effects: 1–5 hr with intranasal route; 1.5–3 hr with IV route; and 2–7 hr with PO route.

DEXAMETHASONE

Decadron, Dexpak Taperpak, Maxidex, and generics; previously available as Hexadrol

Corticosteroid



Tabs (Decadron and other generics): 0.5, 0.75, 1, 1.5, 2, 4, 6 mg

Dexpak Taperpak, and generics: 1.5 mg [21 tabs (6 days), 35 tabs (10 days), 51 tabs (13 days)]

Injection (sodium phosphate salt): 4, 10 mg/mL (some preparations contain benzyl alcohol or methyl/propyl parabens)

Elixir: 0.5 mg/5 mL (237 mL); some preparations contain 5% alcohol

Oral solution: 0.1, 1 mg/mL; some preparations contain 30% alcohol

Ophthalmic solution: 0.1% (5 mL)

Ophthalmic suspension (Maxidex): 0.1% (5 mL)



Airway edema: 0.5–2 mg/kg/24 hr IV/IM ÷ Q6 hr (begin 24 hr before extubation and continue for 4–6 doses after extubation)

Asthma exacerbation: 0.6 mg/kg/dose (max. 16 mg/dose) PO/IV/IM Q24 hr ×1 or 2 doses; use beyond 2 days increases risk for metabolic adverse effects

Croup: 0.6 mg/kg/dose PO/IV/IM ×1

Antiemetic (chemotherapy induced):

Initial: 10 mg/m²/dose IV; **max. dose:** 20 mg

Subsequent: 5 mg/m²/dose Q6 hr IV

Anti-inflammatory:

Child: 0.08–0.3 mg/kg/24 hr PO, IV, IM ÷ Q6–12 hr

Adult: 0.75–9 mg/24 hr PO, IV, IM ÷ Q6–12 hr

Brain tumor associated cerebral edema:

Loading dose: 1–2 mg/kg/dose IV/IM ×1

Maintenance: 1–1.5 mg/kg/24 hr ÷ Q4–6 hr; **max. dose:** 16 mg/24 hr

Ophthalmic use (child and adult):

Solution: Instill 1–2 drops into the conjunctival sac(s) of the affected eye(s) Q1 hr during the day and Q2 hr during the night as initial therapy. When a favorable response is achieved, reduce dosage to Q3–4 hr. Further dose reduction to 1 drop TID–QID may be sufficient to control symptoms.

Suspension: Shake well before using. Instill 1–2 drops in the conjunctival sac(s) of the affected eye(s) up to 4–6 times/24 hr. For severe disease, drops may be used Q1 hr, being tapered to discontinuation as inflammation subsides. For mild disease, drops may be used ≤4–6 times/24 hr.

Not recommended for systemic therapy in the prevention or treatment of chronic lung disease in infants with very low birth weight because of increased risk for adverse events. Dexamethasone is a substrate of CYP P450 3A3/4 and P-glycoprotein, and a moderate inducer of CYP P450 3A4. Compared to prednisone, dexamethasone has no mineralocorticoid effects with greater glucocorticoid effects. Consider use of alternative low glucocorticoid systemic steroid for patients with hyperglycemia. **Contraindicated** in active untreated infections and fungal, viral, and mycobacterial ocular infections.



DEXAMETHASONE continued

Oral peak serum levels occur 1–2 hr and within 8 hr following IM administration. **For other uses, doses based on body surface area, and dose equivalence to other steroids, see Chapter 10.**

OPHTHALMIC USE: Use ophthalmic preparation only in consultation with an ophthalmologist. **Use with caution** in corneal/scleral thinning and glaucoma. Consider the possibility of persistent fungal infections of the cornea after prolonged use. Ophthalmic solution/suspension may be used in otitis externa.

DEXMEDETOMIDINE

Precedex and generics

Alpha-Adrenergic agonist, sedative

C

?

No

Yes

No

Injection (Precedex and generics): 200 mCg/2 mL (2 mL); preservative free

Multidose injection: 400 mCg/4 mL (4 mL); contains methyl- and propyl-parabens

Pre-mixed injection in NS (Precedex and generics): 80 mCg/20 mL (20 mL), 200 mCg/50 mL (50 mL), 400 mCg/100 mL (100 mL); preservative free

NOTE: Maintenance infusion rate dosing metric is mCg/kg/HR

**ICU sedation:**

Child (limited data): 0.5–1 mCg/kg/dose IV ×1 over 10 min followed by 0.2–1 mCg/kg/hr infusion titrated to effect. Children <1 yr of age may require higher dosages.

Adult: 1 mCg/kg/dose IV ×1 over 10 min, followed by 0.2–0.7 mCg/kg/hr infusion and titrated to effect.

Procedural sedation:**Child (limited data):**

IV: 2 mCg/kg/dose ×1 IV followed by 1.5 mCg/kg/hr was administered to children with autism/pervasive developmental disorders for sedation for electroencephalography (EEG).

IM: 1–4.5 mCg/kg/dose ×1 IM was administered to children for sedation for EEG. Extremely anxious, inconsolable, aggressive, and noncompliant children received doses >2.5 mCg/kg; and calm and relatively compliant children received doses ≤2.5 mCg/kg. A second lower repeat dose (~2 mCg/kg/dose IM) was administered adequate sedation was not achieved after 10 min of the first dose.

Intranasal route (limited data): 1–2 mCg/kg/dose ×1 for premedication 30–60 min prior to anesthesia induction.

Adult: 0.5–1 mCg/kg/dose IV ×1 over 10 min, followed by 0.6 mCg/kg/hr titrated to effect; dosage has ranged from 0.2–1 mCg/kg/hr.

**Use with caution** with other vasodilating or negative chronotropic agents (additive pharmacodynamic effects), hepatic impairment (decrease drug clearance; consider dose reduction), advanced heart block, hypovolemia, diabetes mellitus, chronic hypertension, and severe ventricular dysfunction. Prolonged use >24 hr may be associated with tolerance and tachyphylaxis and dose-related side effects (ARDS, respiratory failure and agitation).

Withdrawal symptoms within 24 hr after discontinuing dexmedetomidine have been reported in ~5% of adults receiving the medication up to 7 days regardless of dosage; no withdrawal symptoms were seen in adults after discontinuing therapy lasting <6 hr in duration.

Hypotension and bradycardia are common side effects; may be more pronounced in hypovolemia, diabetes or chronic hypertension. Transient hypertension has been observed during loading doses. QT prolongation, hypernatremia, sinus arrest, and polyuria have been reported. **Do not abruptly withdraw therapy, as withdrawal symptoms (nausea, vomiting, and agitation) are possible; taper the dose when discontinuing use.**

DEXMEDETOMIDINE continued

Use with anesthetics, sedatives, hypnotics, and opioids may lead to enhanced effects; consider dosage reduction of dexmedetomidine. Dexmedetomidine is a CYP 450 2A6 substrate and a weak inhibitor of CYP 450 1A2, 2C9, and 3A4.

Onset of action for procedural sedation: IV or IM: 15 min, intranasal: 15–30 min. Duration of action for procedural sedation: IM: 1 hr, intranasal: 1–1.5 hr.

This drug should be administered by individuals skilled in the management of patients in the ICU and OR. Concentrated IV solution (100 mCG/1 mL) must be diluted with NS to a concentration of 4 mCG/mL prior to administration. See [Chapter 6](#) for additional information.

DEXMETHYLPHENIDATE

Focalin, Focalin XR, and generics

CNS stimulant



C

3

No

No

No

Tab, immediate release (Focalin and generics): 2.5, 5, 10 mg

Extended release caps (Focalin XR and generics): 5, 10, 15, 20, 25, 30, 35, 40 mg

Attention deficit/hyperactivity disorder:

**METHYLPHENIDATE NAIVE:**

Age/Dosage Form	Initial Dose	Dosage Increase at Weekly Intervals, if Needed	Daily Maximum Dose
≥6 YR AND ADOLESCENT			
Immediate-Release Tabs ^a	2.5 mg PO BID	2.5–5 mg/24 hr	20 mg/24 hr (10 mg BID)
Extended-Release Caps ^b	5 mg PO once daily	5 mg/24 hr	30 mg/24 hr (some may require and able to tolerate up to 50 mg/24 hr)
ADULT			
Immediate-Release Tabs ^a	2.5 mg PO BID	2.5–5 mg/24 hr	20 mg/24 hr (10 mg BID)
Extended-Release Caps ^b	10 mg PO once daily	10 mg/24 hr	40 mg/24 hr

^aBID dosing (at least 4 hr apart).

^bOnce-daily dosing.

CONVERTING FROM METHYLPHENIDATE:

≥6 yr and adult: Start at 50% of the total daily dose of racemic methylphenidate with the following max. doses:

Immediate release tabs (BID dosing): 20 mg/24 hr; some may require and able to tolerate 50 mg/24 hr

Extended release caps (once daily dosing): 30 mg/24 hr for ≥6 yr–adolescents (some may require and able to tolerate 50 mg/24 hr); 40 mg/24 hr for adults.

COVERTING FROM IMMEDIATE RELEASE TABS (BID) TO EXTENDED RELEASE CAPS (once daily)

DEXMETHYLPHENIDATE: Use the equivalent mg dosage amount.

Dexmethylphenidate is the d-enantiomer of methylphenidate and accounts for the majority of clinical effects for methylphenidate. **Contraindicated** in glaucoma, anxiety disorders, motor tics, and Tourette syndrome. **Do not** use with monoamine oxidase (MAO) inhibitor; hypertensive crisis may occur if used within 14 days of discontinuance of MAO inhibitor. See methylphenidate for additional warnings and drug interactions.



Continued

DEXMETHYLPHENIDATE *continued*

Common side effects include abdominal pain, indigestion, appetite suppression, nausea, headache, insomnia, and anxiety. Peripheral vasculopathy, including Raynaud phenomenon, and priapism have been reported. Monitor for long-term growth suppression in children and assess for risk of abuse and dependence prior to prescribing.

Immediate-release tablets are dosed BID (minimum 4 hr between doses) and extended-release capsules are dosed once daily. Contents of the extended-release capsule may be sprinkled on a spoonful of applesauce and consumed immediately for those who are unable to swallow capsules.

DEXTROAMPHETAMINE ± AMPHETAMINE

Dexedrine, ProCentra, Zenzedi, Mydayis, and many generics

In combination with amphetamine: Adderall, Adderall XR, and generics

CNS stimulant, amphetamine

**Tabs, immediate release:**

Generics: 5, 10 mg

Zenzedi: 2.5, 5, 7.5, 10, 15, 20, and 30 mg

Sustained-release caps (Dexedrine and generics): 5, 10, 15 mg

Oral solution (ProCentra and generics): 1 mg/mL (473 mL)

In combination with amphetamine (Adderall): Available as 1:1:1:1 mixture of dextroamphetamine sulfate, dextroamphetamine saccharate, amphetamine aspartate, and amphetamine sulfate salts (e.g., 5 mg tablet contains 1.25 mg dextroamphetamine sulfate, 1.25 mg dextroamphetamine saccharate, 1.25 mg amphetamine aspartate, and 1.25 mg amphetamine sulfate; 5 mg of the mixture is equivalent to 3.1 mg amphetamine base):

Tabs (Adderall and generics): 5, 7.5, 10, 12.5, 15, 20, 30 mg

Caps, extended-release:

Adderal XR and generics: 5, 10, 15, 20, 25, 30 mg

Mydayis: 12.5, 25, 37.5, 50 mg

Oral suspension: 1 mg/mL

Dosages are in terms of mg of dextroamphetamine when using dextroamphetamine alone OR in terms of mg of the total dextroamphetamine and amphetamine salts when using Adderall.

Non-extended-release dosage forms are usually given BID–TID (first dose on awakening and subsequent doses at intervals of 4–6 hr later). Extended/sustained-released dosage forms are usually given PO once daily, sometimes BID (6–8 hr between doses).

Attention deficit/hyperactivity disorder:

3–5 yr: 2.5 mg/24 hr QAM; increase by 2.5 mg/24 hr at weekly intervals to a **max. dose** of 40 mg/24 hr ÷ once daily–BID (some may require TID dosing).

≥6 yr: 5 mg/24 hr QAM; increase by 5 mg/24 hr at weekly intervals to a **max. dose** of 40 mg/24 hr ÷ once daily–BID (some may require TID dosing). **Max. dose** of 60 mg/24 hr has been used patients >50 kg.

Narcolepsy (divide daily dosage once daily–TID for immediate release dosage form and once daily–BID for extended release dosage form):

6–12 yr: 5 mg/24 hr ÷ once daily–TID; increase by 5 mg/24 hr at weekly intervals to a **max. dose** of 60 mg/24 hr

>12 yr and adult: 10 mg/24 hr ÷ once daily–TID; increase by 10 mg/24 hr at weekly intervals to a **max. dose** of 60 mg/24 hr

DEXTROAMPHETAMINE ± AMPHETAMINE *continued*

Use with caution in presence of hypertension, cardiovascular disease, and renal or hepatic impairment (drug elimination may be decreased). **Avoid** use in known serious structural cardiac abnormalities, cardiomyopathy, serious heart rhythm abnormalities, coronary artery disease, or other serious cardiac problems that may increase risk of sympathomimetic effects of amphetamines (sudden death, stroke, and MI have been reported). **Do not** give with MAO inhibitors (also within 14 days of discontinuance) or general anesthetics. Use with proton pump inhibitors (PPIs) may reduce the effectiveness of either dextroamphetamine or the combination with amphetamine.

DEXTROAMPHETAMINE AND AMPHETAMINE: Serotonin syndrome may occur when used with serotonergic neurotransmitter medications such as MAO inhibitors, SSRIs, serotonin and norepinephrine reuptake inhibitors (SNRIs), triptans, and TCAs. CYP 450 2D6 inhibitors may increase the effects/toxicity of the combination medication.

Not recommended for <3 yr. Medication should generally **not** be used in children <5 yr old, as diagnosis of attention deficit and hyperactivity disorder (ADHD) in this age group is extremely difficult (use in consultation with a specialist). Interrupt administration occasionally to determine need for continued therapy. Many side effects, including insomnia (**avoid** dose administration within 6 hr of bedtime), restlessness/irritability, anorexia, psychosis, visual disturbances, headache, vomiting, abdominal cramps, dry mouth, and growth failure. Paranoia, mania, peripheral vasculopathy (including Raynaud phenomenon), priapism, bruxism, and auditory hallucination have been reported. Assess for risk of abuse and dependence prior to prescribing. Tolerance develops. Same guidelines as for methylphenidate apply. See Amphetamine for amphetamine-containing products.

DIAZEPAM

Valium, Diastat, Diastat AcuDial, and generics

Benzodiazepine; anxiolytic, anticonvulsant



D X Yes Yes No

Tabs: 2, 5, 10 mg

Oral solution: 1 mg/mL, 5 mg/mL; contains 19% alcohol

Injection: 5 mg/mL (2, 10 mL); contains 40% propylene glycol, 10% alcohol, 5% sodium benzoate, and 1.5% benzyl alcohol

Intramuscular auto-injector: 5 mg/mL (2 mL); contains 40% propylene glycol, 10% alcohol, 5% sodium benzoate, and 1.5% benzyl alcohol

Rectal gel:

Pediatric rectal gel (Diastat and generics): 2.5 mg (5 mg/mL concentration with 4.4 cm rectal tip delivery system; contains 10% alcohol, 1.5% benzyl alcohol, sodium benzoate, and propylene glycol); in twin packs.

Pediatric/Adult rectal gel (Diastat AcuDial and generics):

4.4 cm rectal tip delivery system (Pediatric/Adult): 10 mg (5 mg/mL, delivers set doses of either 5, 7.5, or 10 mg); contains 10% alcohol, 1.5% benzyl alcohol, sodium benzoate, and propylene glycol; in twin packs.

6 cm rectal tip delivery system (Adult): 20 mg (5 mg/mL, delivers set doses of either 12.5, 15, 17.5, 20 mg); contains 10% alcohol, 1.5% benzyl alcohol, sodium benzoate, and propylene glycol; in twin packs.

Sedative/muscle relaxant:

Child:

IM or IV: 0.04–0.2 mg/kg/dose Q2–6 hr; **max. dose:** 0.6 mg/kg within an 8-hr period.

PO: 0.12–0.8 mg/kg/24 hr ÷ Q6–8 hr



Continued

DIAZEPAM continued**Sedative/muscle relaxant (cont.):****Adult:****IM or IV:** 5–10 mg/dose Q3–4 hr PRN**PO:** 2–10 mg/dose Q6–8 hr PRN**Status epilepticus:****Neonate (use only after failed therapy of other agents; note the excipients of the IV dosage forms):** 0.1–0.3 mg/kg/dose IV Q15–30 min ×2–3 doses up to **max. total dose** of 2 mg.**Child >1 mo–<5 yr:** 0.2–0.5 mg/dose IV Q2–5 min up to **max. total dose** of 5 mg. May repeat dosing in 2–4 hr as needed.**Child ≥5 yr:** 1 mg/dose IV Q2–5 min up to **max. total dose** of 10 mg. May repeat dosing in 2–4 hr as needed.**Adult:** 5–10 mg/dose IV Q10–15 min; **max. total dose:** 30 mg in an 8-hr period. May repeat dosing in 2–4 hr as needed.**Rectal dose (using IV dosage form):** 0.5 mg/kg/dose followed by 0.25 mg/kg/dose in 10 min PRN; **max. dose:** 20 mg/dose.**Rectal gel:** all doses rounded to the nearest available dosage strength; repeat dose in 4–12 hr PRN.**Do not use** >5 times per month or > once every 5 days.**2–5 yr:** 0.5 mg/kg/dose**6–11 yr:** 0.3 mg/kg/dose**≥12 yr:** and adult: 0.2 mg/kg/dose**Max. dose** (all ages): 20 mg/dose

Contraindicated in myasthenia gravis, severe respiratory insufficiency, severe hepatic failure, and sleep apnea syndrome. Hypotension and respiratory depression may occur. **Use with caution** in hepatic and renal dysfunction, glaucoma, shock, and depression. **Do not** use in combination with protease inhibitors. Concurrent use with CNS depressants, cimetidine, erythromycin, itraconazole, and valproic acid may enhance the effects of diazepam. Use with opioids may result in profound sedation, respiratory depression, coma and mortality. Diazepam is a substrate for CYP 450 2B6, 2C8, 2C9, and 3A5-7, and minor substrate and inhibitor for CYP 450 2C19 and 3A3/4. The active desmethyldiazepam metabolite is a CYP 450 2C19 substrate.

Administer the conventional IV product undiluted no faster than 2 mg/min and **do not** mix with IV fluids.

In status epilepticus, diazepam must be followed by long-acting anticonvulsants. Onset of anticonvulsant effect: 1–3 min with IV route; 2–10 min with rectal route. **For management of status epilepticus, see Chapter 1.**

**DIAZOXIDE**

Proglycem

**Antihypoglycemic agent,
antihypertensive agent**

C



?



Yes



No



No

Oral suspension: 50 mg/mL (30 mL); contains 7.25% alcohol**Hyperinsulinemic hypoglycemia (due to insulin-producing tumors; start at the lowest dose;
see remarks):****Newborn and infant:** Start at 5 mg/kg/24 hr ÷ Q8–12 hr PO and gradually titrate if needed; usual range of 8–15 mg/kg/24 hr with reported range of 5–20 mg/kg/24 hr ÷ Q8–12 hr**Child and adolescent:** Start at 5 mg/kg/24 hr ÷ 8 hr PO and gradually titrate if needed; usual range: 3–8 mg/kg/24 hr ÷ Q8–12 hr PO

DIAZOXIDE *continued*

Hypoglycemia should be treated initially with IV glucose; diazoxide should be introduced only if refractory to glucose infusion. Should **not** be used in patients hypersensitive to thiazides unless benefit outweighs risk. Thiazides may enhance diazoxide's hyperglycemic effects.

Use with caution in renal impairment (clearance of drug is reduced); consider dosage reduction.

Sodium and fluid retention is common in young infants and adults and may precipitate congestive heart failure (CHF) in patients with compromised cardiac reserve (usually responsive to diuretics). Hirsutism (reversible), GI disturbances, transient loss of taste, tachycardia, ketoacidosis, palpitations, rash, headache, weakness, and hyperuricemia may occur. Pulmonary hypertension in newborns/infant treated for hypoglycemia has been reported as resolution/improvement of the condition was achieved after discontinuance of diazoxide. Monitor BP closely for hypotension.

Hyperglycemic effect with PO administration occurs within 1 hr, with a duration of 8 hr.

**DICLOXACILLIN SODIUM**

Generics; previously available as Dycill and Pathocil

Antibiotic, penicillin (penicillinase-resistant)



B

1

No

No

No

Caps: 250, 500 mg

Contains 0.6 mEq Na/250 mg drug



Child (<40 kg) (see remarks):

Mild/moderate infections: 12.5–25 mg/kg/24 hr PO ÷ Q6 hr; **max. dose:** 1 g/24 hr

Skin and soft tissue infection (MSSA): 25–50 mg/kg/24 hr PO ÷ Q6 hr; **max. dose:** 2 g/24 hr

Severe infections: 50–100 mg/kg/24 hr PO ÷ Q6 hr; **max. dose:** 2 g/24 hr

Child (≥40 kg) and adult: 125–500 mg/dose PO Q6 hr; **max. dose:** 2 g/24 hr

Contraindicated in patients with a history of penicillin allergy. **Use with caution** in cephalosporin hypersensitivity. May cause nausea, vomiting, and diarrhea. Immune hypersensitivity has been reported.

Limited experience in neonates and very young infants. Higher doses (50–100 mg/kg/24 hr) are indicated following IV therapy for osteomyelitis. CNS penetration is poor.

May decrease the effects of oral contraceptives and warfarin. Administer 1 hr before meals or 2 hr after meals.

**DIGOXIN**

Lanoxin, Lanoxin Pediatric, Digitek, and generics

Antiarrhythmic agent, inotrope



C

2

Yes

No

No

Tabs: 62.5, 125, 187.5, 250 mCg

Oral solution: 50 mCg/mL (60 mL); may contain 10% alcohol

Injection:

Lanoxin Pediatric: 100 mCg/mL (1 mL); may contain propylene glycol and alcohol

Lanoxin and generics: 250 mCg/mL (2 mL); may contain propylene glycol and alcohol

Continued

DIGOXIN continued

Digitalizing: Total digitalizing dose (TDD) and maintenance doses in mcg/kg/24 hr (see the table that follows). 

DIGOXIN DIGITALIZING AND MAINTENANCE DOSES

Age	TDD		Daily Maintenance	
	PO	IV/IM	PO	IV/IM
Premature neonate	20	15	5	3–4
Full term neonate	30	20	8–10	6–8
1 mo–<2 yr	40–50	30–40	10–12	7.5–9
2–10 yr	30–40	20–30	8–10	6–8
>10 yr and <100 kg	10–15	8–12	2.5–5	2–3

TDD, Total digitalizing dose.

Initial: 1/2 TDD, then 1/4 TDD Q8–18 hr ×2 doses; obtain electrocardiogram (ECG) 6 hr after dose to assess for toxicity

Maintenance:

<10 yr: Give maintenance dose ÷ BID

≥10 yr: Give maintenance dose once daily



Contraindicated in patients with ventricular dysrhythmias. Use should be **avoided** in patients with preserved left ventricular systolic function. Use with **caution** in renal failure, with calcium channel blockers (may result in heart block), and with adenosine (enhanced depressant effects on sinoatrial [SA] and atrioventricular [AV] nodes). May cause AV block or dysrhythmias. In patients treated with digoxin, cardioversion, or calcium infusion, may lead to ventricular fibrillation (pretreatment with lidocaine may prevent this). Patients with beri beri heart disease may not respond to digoxin if underlying thiamine deficiency is not treated concomitantly. Decreased serum potassium and magnesium, or increased magnesium and calcium may increase risk for digoxin toxicity. For signs and symptoms of toxicity, see [Chapter 3](#).

Excreted via the kidney; **adjust dose in renal failure** (see [Chapter 31](#)). Therapeutic concentration: 0.8–2 ng/mL. Higher doses may be required for supraventricular tachycardia. Neonates, pregnant women, and patients with renal, hepatic, or heart failure may have falsely elevated digoxin levels, due to the presence of digoxin-like substances.

Digoxin is a CYP450 3A4 and P-glycoprotein substrate. Calcium channel blockers, captopril, carvedilol, amiodarone, quinidine, cyclosporine, itraconazole, tetracycline, and macrolide antibiotics may increase digoxin levels. Use with β-blockers and ivabradine may increase risk for bradycardia. Succinylcholine may cause arrhythmias in digitalized patients.

T_{1/2}: Premature infants, 61–170 hr; full-term neonates, 35–45 hr; infants, 18–25 hr; and children, 35 hr.

Recommended serum sampling at steady state: Obtain a single level from 6 hr postdose to just before the next scheduled dose following 5–8 days of continuous dosing. Levels obtained prior to steady state may be useful in preventing toxicity.

DIGOXIN IMMUNE FAB (OVINE)

DigiFab

Antidigoxin antibody

C



?



Yes



No



No

Injection: 40 mg**Dosing based on known amounts of digoxin acutely ingested:****First determine total body digoxin load (TBL):**TBL (mg) = mg digoxin ingested $\times 0.8$ **Then, calculate digoxin immune Fab dose:****Dose in number of digoxin immune Fab vials (DigiFab):** # of vials = TBL $\div 0.5$ **Dosing based on steady-state serum digoxin levels:****Digitfab dose (mg) from steady-state digoxin levels**

Serum Digoxin Concentration (ng/mL)							
Patient Weight (kg)	1	2	4	8	12	16	20
1	0.4 mg ^a	1 mg ^a	1.5 mg ^a	3 mg ^a	5 mg	6.5 mg	8 mg
3	1 mg ^a	2.5 mg ^a	5 mg	10 mg	14 mg	19 mg	24 mg
5	2 mg ^a	4 mg	8 mg	16 mg	24 mg	32 mg	40 mg
10	4 mg	8 mg	16 mg	32 mg	48 mg	64 mg	80 mg
20	8 mg	16 mg	32 mg	64 mg	96 mg	128 mg	160 mg
40	20 mg	40 mg	80 mg	120 mg	200 mg	280 mg	320 mg
60	20 mg	40 mg	120 mg	200 mg	280 mg	400 mg	480 mg
70	40 mg	80 mg	120 mg	240 mg	360 mg	440 mg	560 mg
80	40 mg	80 mg	120 mg	280 mg	400 mg	520 mg	640 mg
100	40 mg	80 mg	160 mg	320 mg	480 mg	640 mg	800 mg

^aUse 1 mg/mL DigiFab concentration for dose accuracy**Dosage Administration:**

Reconstitute each vial with 4 mL NS for a 10 mg/mL concentration and infuse IV dose over 30 min.

If an infusion rate reaction occurs, stop infusion and restart at a slower rate. In situations of cardiac arrest, DigiFab can be administered as a bolus injection, but expect an increased risk for infusion-related reactions. For smaller doses, vials may be reconstituted with 36 mL NS for a 1 mg/mL concentration.

**Contraindicated** if hypersensitive to sheep products. **Use with caution** in renal or cardiac failure. May cause rapidly developing severe hypokalemia, decreased cardiac output (from withdrawal of digoxin's inotropic effects), rash, edema, and phlebitis. Digoxin therapy may be reinstated in 3–7 days, when toxicity has been corrected. Digoxin-immune FAB will interfere with digitalis immunoassay measurements to result in misleading concentrations.

DILTIAZEM

Cardizem, Cardizem CD, Cardizem LA, Cartia XT, Matzim LA, Taztia XT, Tiazac, and many others including generics

Calcium channel blocker, antihypertensive



C



1



Yes



Yes



No

Tabs: 30, 60, 90, 120 mg

Extended-release tabs (for Q24 hr dosing):

Various generics: 180, 240, 300, 360, 420 mg

Cardizem LA: 120, 180, 240, 300, 360, 420 mg

Matzim LA: 180, 240, 300, 360, 420 mg

Extended-release caps (for Q12 hr dosing): 60, 90, 120 mg

Extended-release caps (for Q24 hr dosing):

Various generics: 120, 180, 240, 300, 360, 420 mg

Cardizem CD, Taztia XT: 120, 180, 240, 300, 360 mg

Cartia XT: 120, 180, 240, 300 mg

Tiazac: 120, 180, 240, 300, 360, 420 mg

Oral liquid: 12 mg/mL

Injection: 5 mg/mL (5, 10, 25 mL)

Hypertension:

Child: 1.5–2 mg/kg/24 hr PO ÷ TID–QID; **max. dose:** 3.5 mg/kg/24 hr, alternative **max. dose** of 6 mg/kg/24 hr up to 360 mg/24 hr have been recommended



Adolescent and adult:

Immediate release: 30–120 mg/dose PO TID–QID; usual range 180–360 mg/24 hr

Extended release: 120–360 mg/24 hr PO ÷ once daily–BID (BID dosing with Q12 hr extended release generic capsule; once daily dosing with extended-release tabs, Cardizem CD, Cartia XT, Cardizem LA, Matzim LA, Taztia XT, Tiazac and Q24 hr generic extended release capsule or tab); **max. dose:** 540 mg/24 hr

Contraindicated in acute myocardial infarction (MI) with pulmonary congestion, second- or third-degree heart block, and sick sinus syndrome. **Use with caution** in CHF or renal and hepatic impairment. Dizziness, headache, edema, nausea, vomiting, heart block, and arrhythmias may occur. Acute hepatic injury and severe skin reactions have been reported.



Monitor heart rate with concurrent clonidine use (sinus bradycardia has been reported).

Diltiazem is a substrate and inhibitor of the CYP 450 3A4 enzyme system. May increase levels and effects/toxicity of buspirone, cyclosporine, carbamazepine, fentanyl, digoxin, ivabradine, quinidine, tacrolimus, benzodiazepines, and β -blockers. Cimetidine and statins may increase diltiazem serum levels. Rifampin may decrease diltiazem serum levels.

Maximal antihypertensive effect seen within 2 wk. Extended-release dosage forms should be swallowed whole and NOT crushed or chewed. Cardizem immediate-release tablets should be swallowed whole, as crushing or chewing them may alter their pharmacokinetics.

DIMENHYDRINATE

Dramamine, Driminate, and generics

Antiemetic, antihistamine



B



3



No



No



No

Tabs (OTC): 50 mg

Chewable tabs (OTC): 50 mg; contains 1.5 mg phenylalanine

Injection: 50 mg/mL; contains benzyl alcohol and propylene glycol

DIMENHYDRINATE continued

Child (<12 yr): 5 mg/kg/24 hr ÷ Q6 hr PO/IM/IV; alternative oral dosing by age:

2–5 yr: 12.5–25 mg/dose Q6–8 hr PRN PO with the max. dosage below

6–12 yr: 25–50 mg/dose Q6–8 hr PRN PO with the max. dosage below

≥12 yr and adult: 50–100 mg/dose Q4–6 hr PRN PO/IM/IV

MAX. PO DOSE:

2–5 yr: 75 mg/24 hr

6–12 yr: 150 mg/24 hr

≥12 yr and adult: 400 mg/24 hr

MAX. IM DOSE:

Child: 300 mg/24 hr



Causes drowsiness and anticholinergic side effects. May mask vestibular symptoms and cause CNS excitation in young children. **Caution** when taken with ototoxic agents or history of seizures. **Use should be limited to management of prolonged vomiting of known etiology. Not recommended** in children <2 yr. Toxicity resembles anticholinergic poisoning.

DIPHENHYDRAMINE

Benadryl, many other brand names, and generics

Antihistamine

B

3

Yes

No

No

Elixir (OTC): 12.5 mg/5 mL; may contain 5.6% alcohol

Oral liquid/solution (OTC): 12.5 mg/5 mL

Caps/Tabs (OTC): 25, 50 mg

Chewable tabs (OTC): 12.5 mg; contains aspartame, phenylalanine

Injection: 50 mg/mL

Topical cream (OTC): 1, 2% (30 g)

Topical gel (OTC): 2% (118 mL); contains parabens

Topical stick (OTC): 2% (14 mL); contains alcohol



Severe allergic reaction (anaphylaxis) and dystonic reactions (including phenothiazine toxicity) (PO/IM/IV):

Child: 1–2 mg/kg/dose Q6 hr; usual dose: 5 mg/kg/24 hr ÷ Q6 hr. **Max. dose:** 50 mg/dose and 300 mg/24 hr

Adult: 25–50 mg/dose Q4–8 hr; **max. dose:** 400 mg/24 hr

Sleep aid (PO/IM/IV): Administer dose 30 min before bedtime.

2–11 yr: 0.5–1 mg/kg/dose; **max. dose:** 50 mg/dose

≥12 yr: 50 mg

Topical (cream, gel, stick):

≥2 yr–adult: Apply 1% or 2% to affected area no more than TID–QID.



Contraindicated with concurrent MAO inhibitor use, acute attacks of asthma, GI or urinary obstruction. **Use with caution** in infants and young children, and **do not use** in neonates due to potential CNS effects. Side effects include sedation, nausea, vomiting, xerostoma, blurred vision, and other reactions common to antihistamines. CNS side effects more common than GI disturbances. May cause paradoxical excitement in children. False-positive test for urine phencyclidine (PCP) screen may occur. **Adjust dose in renal failure (see Chapter 31).**

TOPICAL USE: side effects include rash, urticaria, and photosensitivity.

DIVALPROEX SODIUM

Depakote, Depakote Sprinkles,
Depakote ER, and generics
Anticonvulsant



Delayed-release tabs: 125, 250, 500 mg

Extended-release tabs (Depakote ER and generics): 250, 500 mg

Sprinkle caps (Depakote Sprinkles and generics): 125 mg

Dose: see Valproic Acid



See Valproic Acid. Preferred over valproic acid for patients on ketogenic diet. **Contraindicated**

with known urea cycle disorders. Depakote ER is prescribed by a once-daily interval, whereas Depakote is typically prescribed BID. Depakote and Depakote ER are not bioequivalent; see package insert for dose conversion.



Efficacy was not established in separate randomized double-blinded, placebo-controlled trials for the treatment of pediatric bipolar disorder (10–17 yr old) and migraine prophylaxis (12–17 yr old).

Pregnancy category is “X” when used for migraine prophylaxis and is a “D” for all other indications.

DOBUTAMINE

Various generics; previously available as Dobutrex

Sympathomimetic agent



Injection: 12.5 mg/mL (20, 40 mL); contains sulfites

Prediluted injection in D₅W: 1 mg/mL (250 mL), 2 mg/mL (250 mL), 4 mg/mL (250 mL)



Continuous IV infusion (all ages): 2–20 mCg/kg/min

Max. dose: 40 mCg/kg/min

To prepare infusion: see IV infusions on page i

Contraindicated in idiopathic hypertrophic subaortic stenosis (IHSS). Tachycardia, arrhythmias (premature ventricular contractions [PVCs]), and hypertension may occasionally occur (especially at higher infusion rates). Correct hypovolemic states before use. Increases AV conduction, and may precipitate ventricular ectopic activity.



Dobutamine has been shown to increase cardiac output and systemic pressure in pediatric patients of every age group. However, in premature neonates, dobutamine is less effective than dopamine in raising systemic blood pressure without causing undue tachycardia, and dobutamine has not been shown to provide any added benefit when given to such infants already receiving optimal infusions of dopamine.

Monitor BP and vital signs. $T_{1/2}$: 2 min. Peak effects in 10–20 min. Use with linezolid may potentially increase blood pressure. Use with catechol-O-methyltransferase (COMT) inhibitors (e.g., entacapone) may increase heart rate, arrhythmias, and changes in blood pressure.

DOCUSATE

Colace, DocuSol Kids, DocuSol, Kao-Tin, Enemeez Mini, and many other brands

Stool softener, laxative



C



1



No



No



No

Available as docusate sodium:

Caps (OTC): 100, 250 mg; sodium content (100 mg cap: ~5 mg)

Tabs (OTC): 100 mg

Syrup (OTC): 20 mg/5 mL (473 mL); may contain alcohol

Oral liquid (OTC): 10 mg/mL (118, 473 mL); contains 1 mg/mL sodium

Rectal enema:

DocuSol Kids (OTC): 100 mg/5 mL (5 mL); contains polyethylene glycol

Enemeez Mini, and DocuSol (OTC): 283 mg/5 mL (5 mL); DocuSol Plus product contains benzocaine

Available as docusate calcium:

Caps (Kao-Tin and generics; OTC): 240 mg



PO (take with liquids; see remarks):

<3 yr: 10–40 mg/24 hr ÷ once daily–QID

3–6 yr: 20–60 mg/24 hr ÷ once daily–QID

6–12 yr: 40–150 mg/24 hr ÷ once daily–QID

>12 yr and adult: 50–400 mg/24 hr ÷ once daily–QID

Rectal (see remarks):

2–<12 yr: 100 mg/5 mL or 283 mg/5 mL PR once daily

≥12 yr and adult: 283 mg/5 mL PR once daily–TID. Alternatively, 50–100 mg of oral liquid (not syrup) mixed in enema fluid (saline or oil retention enemas) may be used.



Oral dosage effective only after 1–3 days of therapy, whereas the enema has an onset of action in 2–15 min. Reassess therapy if no response seen after 7 days of continuous use.

Incidence of side effects is exceedingly low. Rash, nausea, and throat irritation have been reported. Oral liquid is bitter; give with milk, fruit juice, or formula to mask taste.

A few drops of the 10 mg/mL oral liquid may be used in the ear as a cerumenolytic. Effect is usually seen within 15 min.

DOLASETRON

Anzemet

Antiemetic agent, 5-HT3 antagonist



B



?



Yes



Yes



No

Tabs: 50, 100 mg

Oral suspension: 10 mg/mL

Chemotherapy-induced nausea and vomiting prevention:

2 yr–adult: 1.8 mg/kg/dose PO up to a **max. dose** of 100 mg. Administer PO dose 60 min prior to chemotherapy. IV route of administration is considered contraindicated for this indication due to increased risk for QTc prolongation.

Postoperative nausea and vomiting prevention: Administer PO dose 2 hr prior to surgery and IV dose 15 min prior to cessation of anesthesia.

2–16 yr:

PO: 1.2 mg/kg/dose ×1 (**max. dose:** 100 mg) ×1

IV: 0.35 mg/kg/dose (**max. dose:** 12.5 mg) ×1

Adult:

IV: 12.5 mg/dose ×1



DOLASETRON *continued*

Postoperative nausea and vomiting treatment: Administer IV at onset of nausea and vomiting.

2–16 yr: 0.35 mg/kg/dose (**max. dose:** 12.5 mg) IV

>16 yr—adult: 12.5 mg/dose IV

May cause hypotension and prolongation of cardiac conduction intervals, particularly QTc interval (dose-dependent effect). Common side effects include dizziness, headache, sedation, blurred vision, fever, chills, and sleep disorders. Rare cases of sustained supraventricular and ventricular arrhythmias, fatal cardiac arrest, and MI have been reported in children and adolescents.

Avoid use in patients with congenital long QTc syndrome, hypomagnesemia, hypokalemia, or with concurrent use with other drugs that increase QTc interval (e.g., erythromycin, cisapride). Drug's active metabolite (hydrodolasetron) is a substrate for CYP 450 2D6 and 3A3/4 isoenzymes; concomitant use of enzyme inhibitors (e.g., cimetidine) may increase risk for side effects, and use of enzyme inducers (e.g., rifampin) may decrease dolasetron's efficacy. Serotonin syndrome has been associated with concurrent use of SSRIs (e.g., fluoxetine, sertraline), SNRIs (e.g., duloxetine, venlafaxine), MAO inhibitors, mirtazapine, fentanyl, lithium, tramadol, and IV methylene blue.

Although no dosage adjustments are necessary, hydrodolasetron's clearance decreases 42% with severe hepatic impairment and 44% with severe renal impairment.

ECG monitoring is recommended in patients with electrolyte abnormalities, CHF, bradyarrhythmias or renal impairment.

IV doses may be administered undiluted over 30 sec.

**DOPAMINE**

Various generics; previously available as Intropin

Sympathomimetic agent



C



?



No



No



No

Injection: 40 mg/mL (5, 10 mL)

Prediluted injection in D₅W: 0.8, 1.6, 3.2 mg/mL (250, 500 mL)

All ages:

Low dose: 2–5 mCg/kg/min IV; increases renal blood flow; minimal effect on heart rate and cardiac output



Intermediate dose: 5–15 mCg/kg/min IV; increases heart rate, cardiac contractility, cardiac output, and to a lesser extent, renal blood flow.

High dose: >15 mCg/kg/min IV; α adrenergic effects are prominent; decreases renal perfusion.

Max. dose recommended: 20–50 mCg/kg/min IV

To prepare infusion: see IV infusions on page i.

Do not use in pheochromocytoma, tachyarrhythmias, or hypovolemia. Monitor vital signs and blood pressure continuously. Correct hypovolemic states. Tachyarrhythmias, ectopic beats, hypertension, vasoconstriction, and vomiting may occur. **Use with caution** with phenytoin because hypotension and bradycardia may be exacerbated. Use with linezolid may potentially increase blood pressure.



Newborn infants may be more sensitive to the vasoconstrictive effects of dopamine. Children <2 yr of age clear dopamine faster, and high variability in neonates is exhibited.

Should be administered through a central line or large vein. Extravasation may cause tissue necrosis; treat with phentolamine. **Do not** administer into an umbilical arterial catheter.

DORNASE ALFA/DNASE

Pulmozyme

Inhaled mucolytic**Inhalation solution:** 1 mg/mL (2.5 mL; in boxes of 30s)**Cystic fibrosis:**

Child ≥5 yr and adult: 2.5 mg via nebulizer once daily. Some patients may benefit from 2.5 mg BID.



Contraindicated in patients with hypersensitivity to epoetin alfa. Voice alteration, pharyngitis, laryngitis may result. These are generally reversible without dose adjustment. Safety and efficacy have not been demonstrated in patients >1 yr of continuous use.



Do not mix with other nebulized drugs. An inhaled β-agonist may be useful before administration to enhance drug distribution. Chest physiotherapy should be incorporated into treatment regimen. The following nebulizer compressor systems have been recommended for use: Pulmo-Aide, Pari-Proneb, Mobilaire, Porta-Neb, or PariBaby. Use of the "Sidestream" nebulizer cup can significantly reduce the medication administration time.

DOXAPRAM HCL

Dopram

CNS stimulant**Injection:** 20 mg/mL (20 mL); contains 0.9% benzyl alcohol

Methylxanthine-refractory neonatal apnea (see remarks): Load with 2.5–3 mg/kg IV over 15 min, followed by a continuous IV infusion of 1 mg/kg/hr titrated to the lowest effective dose; **max. dose:** 2.5 mg/kg/hr

Contraindicated in seizures, proven or suspected pulmonary embolism, head injuries, cerebral vascular accident, cerebral edema, cardiovascular or coronary artery disease, severe hypertension, pheochromocytoma, hyperthyroidism, and in patients with mechanical disorders of ventilation. **Do not** use with general anesthetic agents that can sensitize the heart to catecholamines (e.g., halothane, cyclopropane, and enflurane) to reduce the risk of cardiac arrhythmias, including ventricular tachycardia and ventricular fibrillation. **Do not** initiate doxapram until the general anesthetic agent has been completely excreted.



Assess the benefit-risk of benzyl alcohol exposure to neonates. Hypertension occurs with higher doses (>1.5 mg/kg/hr). May also cause tachycardia, arrhythmias, seizure, hyperreflexia, hyperpyrexia, abdominal distension, bloody stools, and sweating. **Avoid** extravasation into tissues.

DOXYCYCLINE

Acticlate, Vibramycin, Doryx, Monodox,

Oracea, many others and generics

Antibiotic, tetracycline derivative**Caps:** 50, 75, 100, 150 mg**Tabs (Acticlate and generics):** 20, 50, 75, 100, 150 mg**Delayed release caps (Oracea and generics):** 40 mg**Delayed release tabs (Doryx and generics):** 50, 75, 100, 150, 200 mg**Syrup:** 50 mg/5 mL (473 mL); contains parabens and propylene glycol**Oral suspension:** 25 mg/5 mL (60 mL)**Injection:** 100 mg

DOXYCYCLINE *continued*

General Dosing, Lyme Disease, Rickettsial Disease, and Skin/Soft-Tissue Infection: (see remarks):

≤45 kg: 2.2 mg/kg/dose BID PO/IV; **max. dose:** 200 mg/24 hr

>45 kg: 100 mg/dose BID PO/IV

Max. dose: 200 mg/24 hr

**PID:**

Inpatient: 100 mg IV Q12 hr with cefotetan or cefoxitin, or ampicillin/sulbactam. Convert to oral therapy 24 hr after patient improves on IV to complete a 14-day total course (IV and PO).

Outpatient: 100 mg PO Q12 hr × 14 days with ceftriaxone, cefoxitin + probenecid, or other parenteral third-generation cephalosporin with or without metronidazole

Anthrax (inhalation/systemic/cutaneous; see remarks): Initiate therapy with IV route and convert to PO route when clinically appropriate. Duration of therapy is 60 days (IV and PO combined):

≤8 yr or ≤45 kg: 2.2 mg/kg/dose BID IV/PO; **max. dose:** 200 mg/24 hr

>8 yr and >45 kg: 100 mg/dose BID IV/PO

Malaria prophylaxis (start 1–2 days prior to exposure and continue for 4 wk after leaving endemic area):

>8 yr: 2.2 mg/kg/24 hr PO once daily; **max. dose:** 100 mg/24 hr and max. duration of 4 mo.

Adult: 100 mg PO once daily

Periodontitis:

Adult: 20 mg BID PO × ≤9 mo

Use with caution in hepatic and renal disease. Generally **not recommended** for use in children <8 yr due to risk for tooth enamel hypoplasia and discoloration. However, the AAP Redbook recommends doxycycline as the drug of choice for rickettsial disease regardless of age and the use in children <8 yr for short treatment courses (≤21 days). May cause GI symptoms, photosensitivity, hemolytic anemia, rash, and hypersensitivity reactions. Increased intracranial pressure (pseudotumor cerebri), TEN, DRESS, erythema multiforme, and Stevens-Johnson syndrome have been reported.

Doxycycline is approved for the treatment of anthrax (*Bacillus anthracis*) in combination with one or two other antimicrobials. If meningitis is suspected, consider using an alternative agent because of poor CNS penetration. Consider changing to high-dose amoxicillin (25–35 mg/kg/dose TID PO) for penicillin-susceptible strains. See www.bt.cdc.gov for the latest information.

Rifampin, barbiturates, phenytoin, and carbamazepine may increase clearance of doxycycline.

Doxycycline may enhance the hypoprothrombinemic effect of warfarin. See Tetracycline for additional drug/food interactions and remarks.

Infuse IV over 1–4 hr. **Avoid** prolonged exposure to direct sunlight.

For periodontitis, take tablets ≥1 hr prior or 2 hr after meals.

**DRONABINOL**

Marinol, Syndros, Tetrahydrocannabinol,

THC, and generics

Antiemetic



C



X



No



Yes



Yes

Caps (Marinol and generics): 2.5, 5, 10 mg; may contain sesame oil

Oral solution (Syndros): 5 mg/mL (30 mL); contains alcohol (50% w/w), parabens, and polyethylene glycol

Oral capsule and solution dosage forms are NOT bioequivalent and should not be used interchangeably.

**ORAL CAPSULES:**

Antiemetic:

Child and adult (PO capsules): 5 mg/m²/dose 1–3 hr prior to chemotherapy, then Q2–4 hr up to a **max. dose** of 4–6 doses/24 hr; doses may be gradually increased by 2.5 mg/m²/dose

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DRONABINOL *continued***Appetite stimulant:**

Adult (PO capsules): 2.5 mg BID 1 hr before lunch and dinner; if not tolerated, reduce dose to 2.5 mg once daily 1 hr before dinner or QHS. **Max dose:** 20 mg/24 hr (use **caution** when increasing doses because of increased risk of dose-related adverse reactions at higher dosages)

ORAL SOLUTION:**Antiemetic:**

Adult (PO oral solution): 4.2 mg/m²/dose 1–3 hr prior to chemotherapy, then Q2–4 hr up to a **max. dose** of 4–6 doses/24 hr; doses may be gradually increased by 2.1 mg/m²/dose increments up to a **max. dose** of 12.6 mg/m²/dose if needed and tolerated.

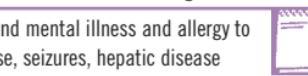
Appetite stimulant:

Adult (PO oral solution): 2.1 mg BID 1 hr before lunch and dinner; if not tolerated, reduce dose to 2.1 mg once daily 1 hr before dinner or QHS. Dose may be gradually increased, if needed and tolerated, by increasing the pre-dinner dose to 4.2 mg 1 hr before dinner. Further increase to 4.2 mg BID 1 hr before lunch and dinner if needed and tolerated. **Max. dose:** 16.8 mg/24 hr.

Contraindicated in patients with history of substance abuse and mental illness and allergy to sesame oil (capsules only). **Use with caution** in heart disease, seizures, hepatic disease (reduce dose if severe), and in patients who operate motor vehicles or dangerous machinery. Side effects: euphoria, dizziness, difficulty concentrating, anxiety, mood change, sedation, hallucinations, ataxia, paresthesia, hypotension, excessively increased appetite, and habit-forming potential. Exacerbation of mania, depression, schizophrenia, and seizures have been reported. **Avoid use** with other medications that can produce similar side effects.

Dronabinol is a substrate for CYP 450 2C9 and 3A4. Individuals with poor CYP 450 2C9 activity may have reduced clearance of dronabinol which may increase effects/toxicity.

Onset of action: 0.5–1 hr; duration of psychoactive effects 4–6 hr, appetite stimulation 24 hr.

**DROPERIDOL**

Generics; previously available as Inapsine

Sedative, antiemetic



C

3

Yes

Yes

No

Injection: 2.5 mg/mL (2 mL)

**Antiemetic/sedation:**

Child: 0.03–0.07 mg/kg/dose IM or IV over 2–5 min; if needed, may give 0.1–0.15 mg/kg/dose; **initial max. dose:** 0.1 mg/kg/dose and subsequent **max. dose:** 2.5 mg/dose.

Dosage interval:

Antiemetic: PRN Q4–6 hr

Sedation: Repeat dose in 15–30 min if necessary

Adult: 2.5–5 mg IM or IV over 2–5 min; **initial max. dose** is 2.5 mg.

Dosage interval:

Antiemetic: PRN Q3–4 hr

Sedation: Repeat dose in 15–30 min if necessary.

Use with caution in renal and hepatic impairment; 75% of metabolites are excreted renally, and drug is extensively metabolized in the liver. Side effects include hypotension, tachycardia, extrapyramidal side effects such as dystonia, feeling of motor restlessness, laryngospasm, bronchospasm. May lower seizure threshold. **Fatal arrhythmias and QT interval prolongation has been associated with use.**



Onset in 3–10 min. Peak effects within 10–30 min. Duration of 2–4 hr. Often given as adjunct to other agents.

ELEXACAFTOR/TEZACAFTOR/IVACAFTOR

Trikafta

Cystic Fibrosis Transmembrane Conductance Regulator Corrector and Potentiator

B

?

Yes

Yes

Yes

Tabs:**Morning dose (orange colored):** elexacaftor 100 mg + tezacaftor 50 mg + ivacaftor 75 mg**Evening dose (light blue colored):** ivacaftor 150 mg

Available as an 84-tablet carton containing 4 wallets for a 28-day supply; each wallet contains 14 morning-dose tablets and 7 evening-dose tablets for a 7-day supply

Child ≥12 yr and adult (PO, morning and evening dose should be taken ~12 hr apart with fat-containing food; see remarks):**Morning dose:** 2 morning-dose tablets (elexacaftor 100 mg + tezacaftor 50 mg + ivacaftor 75 mg each tablet) every morning**Evening dose:** 1 evening-dose tablet (150 mg ivacaftor) every evening**Dose Adjustment for Hepatic Impairment:**

	Mild (Child-Pugh Class A)	^a Moderate (Child-Pugh Class B)	Severe (Child-Pugh Class C)
Morning dose	Use regular dosage	Use regular dosage	Should not be used
Evening dose	Use regular dosage	No evening dosage	Should not be used

^aUse not recommended unless benefit exceeds risk.**Dose Adjustment for Moderate CYP 450 3A inhibitors (e.g., fluconazole, erythromycin):**

Administer doses in the morning only.

Day 1: 2 morning-dose tablets (elexacaftor 100 mg + tezacaftor 50 mg + ivacaftor 75 mg each tablet)**Day 2:** 1 evening-dose tablet (ivacaftor 150 mg) in the morning**Day 3:** 2 morning-dose tablets**Day 4:** 1 evening-dose tablet (ivacaftor 150 mg) in the morning, then continue with 2 morning-dose tablets and one evening-dose tablet (administered in the mornings) on alternate days**Dose Adjustment for Strong CYP 450 3A inhibitors (e.g., ketoconazole, itraconazole, posaconazole, voriconazole, telithromycin and clarithromycin):** Morning doses only.**Day 1:** 2 morning-dose tablets (elexacaftor 100 mg + tezacaftor 50 mg + ivacaftor 75 mg each tablet)**Days 2 and 3:** no dose**Day 4:** 2 morning-dose tablets, then continue with 2 morning-dose tablets twice a week (approximately 3–4 days apart)

Works on CFTR trafficking defects with two correctors (elexacaftor and tezacaftor) and a potentiator (ivacaftor). Indicated for individuals with at least one F508del CFTR mutation.



Common side effects include headache, URI, abdominal pain, diarrhea, rash, nasal congestion, rhinorrhea, rhinitis, influenza sinusitis, and increases in liver enzymes (ALT/AST, bilirubin) and serum creatine phosphokinase. Monitor baseline ALT/AST and bilirubin at baseline and repeat every 3 mo for the first year followed by annual assessments. Ocular exams should be obtained at baseline and annually as cataracts have been reported in children. May cause a false-positive urine drug screen for cannabinoids.

Do not use in severe hepatic impairment (Child-Pugh C) and use is not recommended, unless the benefit outweighs the risk, for moderate hepatic impairment (Child-Pugh B). **Use with caution** with D **plan** Knowledge Bank from ClinicalKey.com by

ELEXACAFTOR/TEZACAFTOR/IVACAFTOR *continued*

All three components of this medication are substrates of CYP 450 3A. **Avoid use** in combination with strong inducers of CYP 450 3A (e.g., rifampin, rifabutin, phenobarbital, carbamazepine, phenytoin, and St. John's wort). Use with moderate and strong CYP 3A inhibitors requires dose reductions; see dosing section. Elexacaftor/tezacaftor/ivacaftor may increase the effects/toxicity of digoxin, cyclosporine, everolimus, glimepiride, glipizide, glyburide, nateglinide, repaglinide, sirolimus, tacrolimus, and warfarin. Always evaluate the potential drug-drug interactions.

Avoid food or drink containing grapefruit or Seville oranges.

Administer all doses with high-fat foods to assure absorption. If a dose is missed within 6 hr of a scheduled dose, administer the respective morning or evening dose immediately and resume usual dosing. However, if the missed dose is >6 hr, the following is recommended:

Missed morning dose: take missed dose as soon as possible and do not take evening dose for that day; then resume usual dosing the next day.

Missed evening dose: do not take the missed dose; then resume usual dosing the next day.

Never take a double dose for a missed dose.

EMLA

See Lidocaine and Prilocaine

ENALAPRIL MALEATE (PO), ENALAPRILAT (IV)

Enalapril: Vasotec, Epaned, and generics

Enalaprilat: generics; previously available as Vasotec IV

Angiotensin converting enzyme inhibitor, antihypertensive



D



2



Yes



No



No

Enalapril:

Tabs (Vasotec and generics): 2.5, 5, 10, 20 mg (scored)

Oral solution (Epaned): 1 mg/mL (150 mL); contains sodium benzoate

Oral suspension: 0.1, 1 mg/mL

Enalaprilat:

Injection: 1.25 mg/mL (1, 2 mL); contains benzyl alcohol

Hypertension:**Infant and child:**

PO: 0.08 mg/kg/24 hr up to 5 mg/24 hr once daily; increase PRN over 2 wk.

Max. dose (higher doses have not been evaluated): 0.58 mg/kg/24 hr up to 40 mg/24 hr

IV: 0.005–0.01 mg/kg/dose Q8–24 hr; **max. dose:** 1.25 mg/dose

Adolescent and adult:

PO: 2.5–5 mg/24 hr once daily initially to **max. dose** of 40 mg/24 hr ÷ once daily–BID

IV: 0.625–1.25 mg/dose IV Q6 hr; doses as high as 5 mg Q6 hr is reported to be tolerated for up to 36 hr.

Contraindicated with hypersensitivity to ACE inhibitors and use in combination with a neprilysin inhibitor (e.g., sacubitril). **Use with caution** in bilateral renal artery stenosis. **Avoid use** in dialysis with high-flux membranes because anaphylactoid reactions have been reported. Side effects: nausea, diarrhea, headache, dizziness, hyperkalemia, hypoglycemia, hypotension, and hypersensitivity. Cough is a reported side effect of ACE inhibitors.



Risk for angioedema increases with enalapril and coadministration of rapamycin or sacubitril.

Enalapril (PO) is converted to its active form (Enalaprilat) by the liver. Administer IV over 5 min. **Adjust dose in renal impairment** (see Chapter 31).

EMLA continued

Nitritoid reactions have been seen in patients receiving concomitant IV gold therapy. Enalapril/enalaprilat should be discontinued as soon as possible when pregnancy is detected. If oliguria or hypotension occurs in a neonate with in utero exposure with enalapril/enalaprilat, exchange transfusions or dialysis may be needed to reverse hypotension and/or support renal function.

ENOXAPARIN

Lovenox and generics

Anticoagulant, low-molecular-weight heparin

B



1



Yes



Yes



No

Injection: 100 mg/mL (3 mL); contains pork proteins and 15 mg/mL benzyl alcohol

Injection (pre-filled syringes with 27-gauge × ½-inch needle): 30 mg/0.3 mL, 40 mg/0.4 mL, 60 mg/0.6 mL, 80 mg/0.8 mL, 100 mg/1 mL, 120 mg/0.8 mL, 150 mg/1 mL; preservative free and may contain pork proteins

Approximate anti-factor Xa activity: 100 IU per 1 mg

Initial empiric dosage; patient-specific dosage defined by therapeutic drug monitoring when indicated (see remarks).

**DVT treatment:**

<2 mo: 1.5 mg/kg/dose Q12 hr SC; higher doses of 1.7–2 mg/kg/dose Q12 hr SC have been recommended for neonates

≥2 mo—adult: 1 mg/kg/dose Q12 hr SC; alternatively, 1.5 mg/kg/dose Q24 hr SC can be used in adults.

Dosage adjustment for DVT treatment to achieve target anti-factor Xa low molecular weight heparin (LMWH) levels of 0.5–1 units/mL (see the following table).

Anti-factor Xa

Level LMWH (units/mL)	Hold Next Dose?	Dose Change	Repeat Anti-factor Xa Level LMWH?
<0.4	No	Increase by 25%	4 hr post next new AM dose
0.4	No	Increase by 10%	4 hr post next new AM dose
0.5	No	No	4 hr post next AM dose; if within therapeutic range recheck 1 wk later at 4 hr post dose
0.6–0.7	No	No	1 wk later at 4 hr post dose
0.8–1	No	No	4 hr post next AM dose; if within therapeutic range recheck 1 wk later at 4 hr post dose
1.1–1.5	No	Decrease by 20%	4 hr post next new AM dose
1.6–2	3 hr and measure trough level (goal <0.5 units/mL) prior to next new dose	Decrease by 30%	4 hr post next new AM dose
>2	Until anti-factor Xa LMWH reaches 0.5 units/mL (levels can be measured Q12 hr until it reaches ≤0.5 units/mL).	When anti-factor Xa LMWH reaches ≤0.5 units/mL, dose may be restarted at a dose 40% less than originally prescribed.	4 hr post next new AM dose

ENOXAPARIN *continued*

DVT prophylaxis:

Infant <2 mo: 0.75 mg/kg/dose Q12 hr SC

Infant ≥2 mo—child 18 yr: 0.5 mg/kg/dose Q12 hr SC; **max. dose:** 30 mg/dose

Patients with indwelling epidural catheters/neuraxial anesthesia (≥2 mo–child 18 yr): 1 mg/kg/dose Q24 hr SC; **max. dose:** 40 mg/dose. Twice-daily dosing is contraindicated for these patients.

See remarks.

Adjust dosage for DVT prophylaxis to achieve target anti-factor Xa levels of 0.1–0.3 units/mL for all children.

Adult:

Knee or hip replacement surgery: 30 mg BID SC ×7–14 days; initiate therapy 12–24 hr after surgery provided hemostasis is established. Alternatively, for hip replacement surgery, 40 mg once daily SC ×7–14 days initially up to 3 wk thereafter; initiate therapy 9–15 hr prior to surgery.

Inhibits thrombosis by inactivating factor Xa without significantly affecting bleeding time, platelet function, PT, or aPTT at recommended doses. Dosages of enoxaparin, heparin, or other LMWHs **CANNOT** be used interchangeably on a unit-for-unit (or mg-for-mg) basis because of differences in pharmacokinetics and activity. Peak anti-factor Xa LMWH activity is achieved 4 hr after a SC dose. **Anti-factor Xa LMWH is NOT THE SAME as unfractionated heparin anti-factor Xa level (used for monitoring heparin therapy).**



Contraindicated in major bleeding, drug-induced thrombocytopenia, and pork hypersensitivity.

Use with caution in uncontrolled arterial hypertension, bleeding diathesis, history of recurrent GI ulcers, diabetic retinopathy, and severe renal dysfunction (reduce dose by increasing the dosage interval from Q12 hr to Q24 hr if GFR <30 mL/min). Prophylactic use is not recommended in patients with prosthetic heart valves (especially in pregnant women) due to reports of fatalities in patients and fetuses. **Concurrent use with spinal or epidural anesthesia or spinal puncture has resulted in long-term or permanent paralysis; potential benefits must be weighed against the risks.** May cause fever, confusion, edema, nausea, hemorrhage, thrombocytopenia (including heparin-induced thrombocytopenia ± thrombosis [HIT/HITTS]), hypochromic anemia, and pain/erythema at injection site. Allergic reactions, headache, eosinophilia, alopecia, hepatocellular and cholestatic liver injury, and osteoporosis (long-term use) have been reported. **Protamine sulfate is the antidote;** 1 mg protamine sulfate neutralizes 1 mg enoxaparin.

DVT prophylaxis for patients with epidural catheters/neuraxial anesthesia: If placing needle, hold anticoagulation for 12 hr and restart dosing no sooner than 4 hr after needle insertion. If removing catheter, hold anticoagulation for 12 hr and restart dosing no sooner than 2 hr after catheter removal.

Recommended anti-factor Xa LMWH levels obtained 4 hr after subcutaneous dose after the third consecutive dose for children (anti-factor Xa LMWH response in children is highly variable compared to adults):

DVT treatment: 0.5–1 units/mL

DVT prophylaxis: 0.1–0.3 units/mL

Administer by deep SC injection by having the patient lie down. Alternate administration between the left and right anterolateral and left and right posterolateral abdominal wall. See package insert for detailed SC administration recommendations. To minimize bruising, do not rub the injection site. IM route of administration is not recommended.

For additional information, see *Chest* 2008;133:887–968 and *Regional Anesthesia and Pain Medicine* 2003;28(3):172–197.

EPINEPHRINE HCL

Adrenalin, EpiPen, Auvi-Q, Symjepi, Adrenaclick, Adyphren, Epinephrine SNAP, Primatene Mist, and generics

Sympathomimetic agent



C

2

No

No

No

Injection:

1:1000 (aqueous): 1 mg/mL (1, 30 mL); may contain chlorobutanol and metabisulfite

1:10,000 (aqueous): 0.1 mg/mL (10 mL pre-filled syringes with either 18-G 3.5 inch or 20-G 1.5-inch needles)

Autoinjector:

EpiPen and generics: Delivers a single 0.3 mg (0.3 mL) dose (2 pack; EpiPen and some generic products include a training device)

EpiPen Jr and generics: Delivers a single 0.15 mg (0.3 mL) dose (2 pack; EpiPen Jr and some generic products include a training device)

Auvi-Q: Delivers a single 0.1 mg (0.1 mL) dose, 0.15 mg (0.15 mL) dose, or 0.3 mg (0.3 mL) dose (2 pack with training device; each unit provides voice instructions when activated)

Symjepi: Delivers a single 0.15 mg (0.3 mL) dose or 0.3 mg (0.3 mL) dose (1 or 2 pack)

Adrenaclick: Delivers a single 0.15 mg (0.15 mL) dose, or 0.3 mg (0.3 mL) dose (2 pack)

Syringe Kit for Anaphylaxis (for specific weight-based dosages for any size patient):

Adyphren, EpinephrineSNAP: 1 mg/mL (1 mL single use vial in a box of 25 vials, 30 mL multi-use vial as a single vial or box of 10 vials)

Many preparations may contain sulfites.

Aerosol inhaler (HFA; Primatene Mist [OTC]): 0.125 mg per spray (160 sprays per inhaler) (11.7 g); contains 1% alcohol and polysorbate 80

CARDIAC USE:**Neonate:**

Asystole and bradycardia: 0.01–0.03 mg/kg of 1:10,000 solution (0.1–0.3 mL/kg)

IV/ET Q3–5 min PRN.

Infant and child:

Bradycardia/asystole and pulseless arrest: See page ii and PALS algorithms in the back of the book.

Bradycardia, asystole, and pulseless arrest (see remarks):

First dose: 0.01 mg/kg of 1:10,000 solution (0.1 mL/kg) IO/IV; **max. dose:** 1 mg (10 mL).

Subsequent doses Q3–5 min PRN should be the same. High-dose epinephrine after failure of standard dose has not been shown to be effective (see remarks). Must circulate drug with CPR. For ET route, see below.

All ET doses: 0.1 mg/kg of 1:1000 solution (0.1 mL/kg) ET Q3–5 min.

Adult:

Asystole: 1 mg IV or 2–2.5 mg ET Q3–5 min.

IV drip (all ages): 0.1–1 mCg/kg/min; titrate to effect; to prepare infusion, see inside front cover.

HYPERSensitivity/ANAPHYLACTIC REACTIONS (recommended IM administration via the anterolateral aspect of the thigh through clothing if necessary; see remarks for IV dosing):

Infant, child, and adolescent: 0.01 mg/kg/dose IM (**max. dose:** 0.3 mg/dose for prepubertal child, 0.5 mg/dose for adolescent) Q5–15 min PRN.

Auvi-Q (administer the following dosage IM ×1; an additional dose may be repeated in 5–15 min):

7.5 to <15 kg: 0.1 mg

15 to <30 kg: 0.15 mg

≥30 kg: 0.3 mg

EpiPen/EpiPen Jr, Adrenaclick, Symjepi, or equivalent generic autoinjector (administer the following dosage IM ×1; an additional dose may be repeated in 5–15 min):

15 to <30 kg: 0.15 mg

≥30 kg: 0.3 mg

EPINEPHRINE HCL continued

Adult: Start with 0.2–0.5 mg IM Q5–15 min PRN. If using EpiPen, Adrenaclick, Symjepi, or equivalent generic autoinjector, use 0.3 mg IM \times 1; an additional dose may be repeated in 5–15 min.

RESPIRATORY BRONCHODILATOR USE:

SC Injection (use 1:1000 or 1 mg/mL aqueous injection):

Infant and child: 0.01 mL/kg/dose SC (**max. single dose** 0.5 mL); repeat Q15 min \times 3–4 doses or Q4 hr PRN

Adult: 0.3–0.5 mg (0.3–0.5 mL)/dose SC Q20 min \times 3 doses.

Nebulization (alternative to racemic epinephrine): 0.5 mL/kg of 1:1000 solution diluted in 3 mL NS; **max. doses:** \leq 4 yr: 2.5 mL/dose; $>$ 4 yr: 5 mL/dose

Aerosol inhaler (Primatene Mist):

\geq 12 yr and adult: 1–2 inhalation(s) PO Q4 hr PRN; **max. dose:** 8 inhalations/24 hr



High-dose rescue therapy for in-hospital cardiac arrest in children after failure of an initial standard dose has been reported to be of no benefit compared to standard dose (*N Engl J Med* 2004;350:1722–1730).

May produce arrhythmias, tachycardia, hypertension, headaches, nervousness, nausea, vomiting, and rare cases of stress cardiomyopathy. Necrosis may occur at site of repeated local injection. Rare cases of serious skin and soft tissue infections, including necrotizing fasciitis and myonecrosis, have been reported with IM or deep SC injections.

Concomitant use of noncardiac selective β -blockers, MAO inhibitors, COMT inhibitors, clonidine, or tricyclic antidepressants may enhance epinephrine's pressor response. Chlorpromazine, diuretics, nitrates, or α -blockers may reverse the pressor response. **Do not** use products containing chlorobutanol for ophthalmic use, as it may be harmful to the corneal endothelium.

ETT doses should be diluted with NS to a volume of 3–5 mL before administration. Follow with several positive pressure ventilations.

Hypersensitivity reactions: For bronchial asthma and certain allergic manifestations (e.g., angioedema, urticaria, serum sickness, anaphylactic shock), use epinephrine SC. Patients with anaphylaxis may benefit from IM administration. The adult IV dose for hypersensitivity reactions or to relieve bronchospasm usually ranges from 0.1 to 0.25 mg injected slowly over 5–10 min Q5–15 min as needed. Neonates may be given a dose of 0.01 mg/kg body weight; for infants, 0.05 mg is an adequate initial dose, and this may be repeated at 20- to 30-min intervals in the management of asthma attacks.

Due to the inconsistent availability of autoinjector products, periodic reeducation of available device may be necessary. See respective autoinjector product for proper dose administration methods including methods to prevent injury and/or inadvertent dose administration to the individual administering the dose. Accidental injection into the digits, hand, or feet may result in the loss of blood flow to the affected area. **Do not** inject into the buttock area.

EPINEPHRINE, RACEMIC

Asthmanefrin, and S-2

Sympathomimetic agent



C

2

No

No

No

Solution for inhalation (OTC): 2.25% (1.25% epinephrine base) (0.5 mL) (30s)

Contains edetate disodium and may contain sulfites.

<4 yr:

Croup (using 2.25% solution): 0.05 mL/kg/dose up to a **max. dose** of 0.5 mL/dose diluted to 3 mL with NS. Given via nebulizer over 15 min PRN but **not** more frequently than Q1–2 hr.



\geq 4 yr: 0.5 mL/dose diluted to 3 mL with NS via nebulizer over 15 min Q3–4 hr PRN

Tachyarrhythmias, headache, nausea, palpitations have been reported. Rebound symptoms may occur. Cardiorespiratory monitoring should be considered if administered more frequently



EPOETIN ALFA

Epogen, Procrit, and Erythropoietin
Recombinant human erythropoietin



Injection (single-dose, preservative-free vials): 2000, 3000, 4000, 10,000, 40,000 U/mL (1 mL)

Injection (multi-dose vials): 10,000 U/mL (2 mL), 20,000 U/mL (1 mL); contains 1% benzyl alcohol

All dosage forms contain 2.5 mg albumin per 1 mL.

NOTE: Epoetin alfa-epbx (Retacrit) is a biosimilar product available as single-dose preservative-free vials at 2000, 3000, 4000, 10,000, 40,000 U/mL (1 mL) and contains phenylalanine.

Anemia in chronic renal failure (see remarks for dosage adjustment and withholding therapy): SC/IV (IV preferred for hemodialysis patients)

**Initial dose:**

Child and adolescent: Start at 50 U/kg/dose 3 times per week. Reported dosage range for children (3 mo–20 yr) not requiring dialysis, 50–250 U/kg/dose 3 times per week. Reported dosage range for children receiving hemodialysis, 50–450 U/kg/dose 2–3 times per week.

Adult: Start at 50–100 U/kg/dose 3 times per week

Maintenance dose: Dose is individualized to achieve and maintain the lowest Hgb level sufficient to avoid transfusions and **not to exceed** 11 g/dL.

Anemia in cancer (use until chemotherapy is completed; see remarks for dosage reduction and withholding therapy):

Initial dose:

Child (5–18 yr): Start at 600 U/kg (**max. dose:** 40,000 U) IV once weekly.

Adult: Start at 150 U/kg/dose SC 3 times per week or 40,000 U SC once every week.

Increasing doses (if needed):

Three-times-a-week dosing regimen (adult): If no increase in Hgb >1 g/dL and Hgb remains <10 g/dL after initial 4 wk of therapy, increase dosage to 300 U/kg/dose 3 times per week.

Weekly dosing regimen: If no increase in Hgb >1 g/dL and Hgb remains <10 g/dL after initial 4 wk of therapy:

Child: Increase dose to 900 U/kg/dose IV (**max. dose:** 60,000 U) once weekly.

Adult: 60,000 U SC once weekly.

For all ages, discontinue use after 8 wk of therapy if transfusions are still required or no hemoglobin response is observed.

AZT-treated HIV patients (Hgb should not exceed 12 g/dL): SC/IV

Child: Reported dosage range in children (≥3 mo–17 yr), 50–400 U/kg/dose 2–3 times per wk.

Adult (with serum erythropoietin ≤500 milliunits/mL and receiving ≤4200 mg AZT per week): Start at 100 U/kg/dose 3 times per wk ×8 wk. If response is NOT satisfactory in reducing transfusion requirements or increasing Hgb levels after 8 wk of therapy, dose may be increased by 50–100 U/kg/dose given 3 times per wk and reevaluated every 4–8 wk thereafter. Patients are unlikely to respond to doses >300 U/kg/dose 3 times per wk.

For all ages, withhold therapy if Hgb >12 g/dL and resume therapy by decreasing dosage by 25% once Hgb falls below 11 g/dL. For adults, discontinue therapy if Hgb does not increase after 8 wk of the 300 U/kg/dose 3 times per wk dosage.

Anemia of prematurity (many regimens exist):

250 U/kg/dose SC 3 times per wk ×10 doses; alternatively, 200–400 U/kg/dose IV/SC 3–5 times per wk for 2–6 wk (total dose per wk is 600–1400 U/kg). Administer with supplemental iron at 3–6 mg elemental iron/kg/24 hr.



Use the lowest dose to avoid transfusions.

Increased risk for death, serious cardiovascular events, and thrombosis/stroke have been reported in patients treated with chronic kidney disease and hemoglobin levels >11 g/dL.

Increased risk for death, shortened survival and/or shortened time to tumor progression/regression,

EPOETIN ALFA *continued*

serious cardiovascular events, and thrombosis in various cancer patients, especially with Hgb levels >12 g/dL, have been reported with epoetin alfa and other erythropoiesis-stimulating agents.

Evaluate serum iron, ferritin, TIBC before therapy. Iron supplementation recommended during therapy unless iron stores are already in excess. Monitor Hct, BP, clotting times, platelets, BUN, serum creatinine. Peak effect in 2–3 wk.

DOSAGE ADJUSTMENT FOR ANEMIA IN CHRONIC RENAL FAILURE:

Reduce dose by $\geq 25\%$: when Hgb increases >1 g/dL in any 2-wk period. Dose reductions can be made more frequently than once every 4 wk if needed.

Increase dose by 25%: when Hgb does not increase by 1 g/dL after 4 wk of therapy. Dosage increments should not be made more frequently than once every 4 wk.

Withholding therapy: when Hgb >11 g/dL; restart therapy at a 25% lower dose after Hgb decreases to target levels or <11 g/dL.

Inadequate response after a 12-week dose escalation: Use minimum effective dosage that will maintain hemoglobin levels to avoid the need for recurrent blood transfusions and evaluate other causes of anemia. Discontinue use if patient remains transfusion dependent.

DOSAGE REDUCTION ADJUSTMENT/WITHHOLDING THERAPY FOR ANEMIA IN CANCER:

If Hgb exceeds a level needed to avoid blood transfusion: Withhold dose and resume therapy at a reduced dosage by 25% when Hgb approaches a level where blood transfusions may be needed.

If Hgb increases >1 g/dL in any 2-wk period or Hgb reaches a level to avoid blood transfusion: Reduce dose by 25%.

May cause hypertension, seizure, hypersensitivity reactions, headache, edema, dizziness. SC route provides sustained serum levels compared to IV route. For IV administration, infuse over 1–3 min.

Do not use multi-dose vial preparation for breastfeeding mothers because of concerns for benzyl alcohol.

EPOPROSTENOL

Flolan, Veletri, and generic, PG_I₂, PGX, prostacyclin

Prostaglandin I₂, vasodilator



B



?



No



No



No

Injection: 0.5, 1.5 mg

Flolan: reconstitute with provided pH 12 sterile diluent for Flolan (50 mL)

Veletri (available only via designated specialty outpatient pharmacies): reconstitute with sterile water for injection or 0.9% sodium chloride

Generic: reconstitute with provided sterile diluent for epoprostenol sodium (50 mL)

Pulmonary Hypertension (limited data):

IV Infusion via central-line and 0.22-micron filter: Start at 1–2 nanograms/kg/min IV.

Increase by 0.5–2 nanograms/kg/min Q45 min as needed and tolerated. **Avoid** abrupt withdrawal, interruptions in delivery, or sudden large decreases in dosage.

Usual effective dose:

Neonate: 20–40 nanograms/kg/min

Infant, child, and adolescent: 40 to >150 nanograms/kg/min (average 80 nanograms/kg/min)

Down-titration of dosage is required in the presence of high-output state (hyperdynamic right ventricle).

Inhalation route (very limited data):

Neonate: 50 nanograms/kg/min via continuous nebulization at a rate of 8 mL/hr, OR 50 nanograms/kg/min diluted in 3 mL Q2 hr via intermittent nebulization has been reported.

Child: 20–50 nanograms/kg/min via continuous nebulization has been reported



EPOPROSTENOL *continued*

Contraindicated in heart failure caused by decreased left ventricular ejection fraction. **Use with caution** in bleeding disorders; inhibits platelet aggregation.

Dose-dependent side effects of nausea, diarrhea, jaw pain, bone pain, and headaches are common. Other common side effects include hypotension, flushing, diarrhea, loss of appetite, and chest and musculoskeletal pain. Reported complications include sepsis, local site infection, and catheter dislodgement resulting in severe sepsis or rebound pulmonary hypertension (**avoid** abrupt dose withdrawal and monitor for IV line interruptions). Hypoxia, flushing, and tachycardia may suggest an overdose.

Use with medications exhibiting antiplatelet effects (e.g., SSRI antidepressants, desvenlafaxine, venlafaxine, duloxetine, NSAIDs, and anticoagulants) may increase risk for bleeding. May increase digoxin levels.

Systemic $T_{1/2}$ is 2–5 min. Continuous IV infusion is administered via central venous catheter with a 0.22-micron filter. Medication temperature stability requirements and the use of icepacks are product specific; consult with a pharmacist.

**ERGOCALCIFEROL**

Calciferol, Calcidol, Drisdol, and generics
Vitamin D2



A/C



2



No



No



No

Caps:

Generics [OTC]: 2000 IU

Drisdol and generics: 50,000 IU (1.25 mg)

Tabs [OTC]: 400, 2000, 2400 IU

Drops: 8000 IU/mL (200 mCg/mL) (60 mL); contains propylene glycol

Conversion: 1 mg = 40,000 IU vitamin D activity

**Dietary supplementation (see Chapter 21 for additional information):**

Preterm: 200–400 IU/24 hr PO

Infant (<1 yr): 400 IU/24 hr PO

Child (≥1 yr) and adolescent: 400–600 IU/24 hr PO

Renal failure (CKD stages 2–5) and 25-OH vitamin D levels <30 ng/mL (monitor serum 25-OH vitamin D and corrected calcium/phosphorus 1 mo after initiation and Q 3 mo thereafter):

25-OH vitamin D <5 ng/mL:

Child: 8000 IU/24 hr × 4 wk followed by 4000 IU/24 hr × 2 mo; or 50,000 IU weekly × 4 wk followed by 50,000 IU twice monthly for 2 mo

25-OH vitamin D 5–15 ng/mL:

Child: 4000 IU/24 hr PO × 12 wk or 50,000 IU every other wk × 12 wk.

25-OH vitamin D 16–30 ng/mL:

Child: 2000 IU/24 hr PO × 3 mo or 50,000 IU every mo × 3 mo.

Vitamin D dependent rickets:

Child: 3000–5000 IU/24 hr PO; **max. dose:** 60,000 IU/24 hr

Nutritional rickets:

Child and adult with normal GI absorption: 2000–5000 IU/24 hr PO × 6–12 wk

Malabsorption:

Child: 10,000–25,000 IU/24 hr PO

Adult: 10,000–300,000 IU/24 hr PO

Vitamin D resistant rickets (with phosphate supplementation):

Child: initial dose 40,000–80,000 IU/24 hr PO; increase daily dose by 10,000–20,000 IU PO Q3–4 mo if needed.

Adult: 10,000–60,000 IU/24 hr PO

ERGOCALCIFEROL continued**Hypoparathyroidism (with calcium supplementation):****Child:** 50,000–200,000 IU/24 hr PO**Adult:** 25,000–200,000 IU/24 hr PO

Consider using cholecalciferol instead; cholecalciferol has shown to be more biologically potent with better absorption than ergocalciferol. Vitamin D₂ is activated by 25-hydroxylation in liver and 1-hydroxylation in kidney to the active form, calcitriol.

Monitor serum Ca⁽²⁺⁾, PO₄, 25-OH vitamin D (goal level for infant and child: ≥ 20 ng/mL), and alkaline phosphate. Serum Ca⁽²⁺⁾, PO₄ product should be < 70 mg/dL to avoid ectopic calcification. Titrate dosage to patient response. Watch for symptoms of hypercalcemia: weakness, diarrhea, polyuria, metastatic calcification, nephrocalcinosis.

Serum 25-OH vitamin D level of ≥ 35 ng/mL has been suggested in cystic fibrosis patients to decrease the risk of hyperparathyroidism and bone loss.

Pregnancy category changes to "C" if used in doses above the US RDA.

**ERGOTAMINE TARTRATE ± CAFFEINE****Ergomar**

In combination with caffeine: Cafergot, Migergot, and generics

Ergot alkaloid

X

X

Yes

Yes

No

Sublingual tabs (Ergomar): 2 mg

In combination with caffeine:

Tabs (Cafergot and generics): 1 mg and 100 mg caffeine

Suppository (Migergot): 2 mg and 100 mg caffeine (12s)

**ERGOTAMINE:****Adolescent and adult:**

SL: 2 mg at onset of migraine attack, then 2 mg Q30 min PRN up to **max. dose** of 6 mg/24 hr; **do not exceed** 10 mg/wk.

ERGOTAMINE PLUS CAFFEINE

Doses based on mg of ergotamine.

Oral tablet:

Adolescent and adult: 1 or 2 mg PO at onset of migraine attack, then 1 mg Q30 min up to 6 mg per attack, **not to exceed** 10 mg/wk.

Suppository:

Adolescent: 1 mg (0.5 suppository) at first sign of attack; follow with second 1 mg dose after 45 min if needed; **max. dose:** 2 mg per attack, 4 mg/24 hr, **not to exceed** 8 mg/wk.

Adult: 2 mg at first sign of attack; follow with second 2 mg dose after 1 hr if needed; **max. dose:** 4 mg per attack, not to exceed 10 mg/wk.



Use with caution in renal or hepatic disease. May cause paresthesias, GI disturbance, angina-like pain, rebound headache with abrupt withdrawal, or muscle cramps. **Contraindicated** in pregnancy and has **not been recommended** in breast feeding. Concurrent administration with protease inhibitors, clarithromycin, erythromycin, other CYP 450 3A4 inhibitors, and nitroglycerin are **contraindicated** owing to risk of ergotism (nausea, vomiting, vasospastic ischemia leading to cerebral and peripheral ischemia).

For sublingual administration, place tablet under the tongue and do not crush.

ERTAPENEM

Invanz and generics

Antibiotic, carbapenem**Injection:** 1 g

Contains ~6 mEq Na/g drug

≥1 mo–12 yr: 15 mg/kg/dose IV/IM Q12 hr; **max. dose:** 1 g/24 hr**Adolescent and adult:** 1 g IV/IM Q24 hr**Recommended duration of therapy (all ages):****Complicated intra-abdominal infection:** 5–14 days**Complicated skin/subcutaneous tissue infections:** 7–14 days**Diabetic foot infection without osteomyelitis:** 14–28 days**Community-acquired pneumonia, complicated UTI/pyelonephritis:** 10–14 days**Acute pelvic infection:** 3–10 days**Surgical prophylaxis:****Child and adolescent:** 15 mg/kg (**max. dose:** 1 g/dose) IV 1 hr before procedure**Adult (colorectal surgery):** 1 g IV 1 hr before procedureErtapenem has poor activity against *P. aeruginosa*, *Acinetobacter*, MRSA, and *Enterococcus*. **Do not use** in meningitis due to poor CSF penetration. **Use with caution** with CNS disordersincluding seizures. **Adjust dosage in renal impairment;** see **Chapter 31.**

Diarrhea, infusion complications, nausea, headache, vaginitis, phlebitis/thrombophlebitis, and vomiting are common. Seizures (primarily with renal insufficiency and/or CNS disorders such as brain lesions and seizures), decreased consciousness, muscle weakness, gait disturbance, abnormal coordination, teeth staining, and DRESS syndrome have been reported. Increased ALT, AST, and neutropenia have been reported in pediatric clinical trials. Decreases valproic acid levels. Probenecid may increase ertapenem levels.

IM route requires reconstitution with 1% lidocaine and **should not** be administered by IV. **Do not reconstitute or co-infuse with dextrose containing solutions.****ERYTHROMYCIN PREPARATIONS**

Erythromycin, EES, E-Mycin, EryPed, Ery-Tab, and generics

Ophthalmic ointment: Generics; previously available

as Ilopycin

Topical gel: Ery, Erygel, and generics

Antibiotic, macrolide

B 2 Yes Yes No

Erythromycin base:**Tabs:** 250, 500 mg**Delayed-release tabs (Ery-Tab and generics):** 250, 333, 500 mg**Delayed-release caps:** 250 mg**Topical gel (Erygel and generics):** 2% (30, 60 g); contains alcohol 92%**Topical solution:** 2% (60 mL); may contain 44%–66% alcohol**Topical pad/swab (Ery and generics):** 2% (60s); may contain propylene glycol and alcohol**Ophthalmic ointment:** 0.5% (1, 3.5 g)**Erythromycin ethyl succinate (EES):****Oral suspension (EES, EryPed, and generics):** 200 mg/5 mL (100, 200 mL), 400 mg/5 mL (100 mL)**Tabs (EES and generics):** 400 mg**Erythromycin stearate (Erythrocin):****Tabs:** 250 mg**Erythromycin lactobionate (Erythrocin):**

ERYTHROMYCIN PREPARATIONS *continued***Oral:****Neonate (use EES preparation):****<1.2 kg:** 20 mg/kg/24 hr ÷ Q12 hr PO**≥1.2 kg:****0–7 days:** 20 mg/kg/24 hr ÷ Q12 hr PO**>7 days:****1.2–2 kg:** 30 mg/kg/24 hr ÷ Q8 hr PO**≥2 kg:** 30–40 mg/kg/24 hr ÷ Q6–8 hr PO**Chlamydial conjunctivitis and pneumonia:** 50 mg/kg/24 hr ÷ Q6 hr PO × 14 days; **max. dose:** 2 g/24 hr.**Child (use base, EES, or stearate preparation):** 30–50 mg/kg/24 hr ÷ Q6–8 hr; **max. dose:** 4 g/24 hr**Pertussis:** 40–50 mg/kg/24 hr ÷ Q6 hr PO × 14 days (**max. dose:** 2 g/24 hr); use azithromycin for infants <1 mo old.**Adult:** 2 g/24 hr ÷ Q6 hr PO × 14 days**Parenteral:****Child and adult:** 15–20 mg/kg/24 hr ÷ Q6 hr IV; **max. dose:** 4 g/24 hr**Ophthalmic:****Neonatal gonococcal ophthalmia prophylaxis:** Apply 1-inch ribbon to both eyes × 1.**Conjunctivitis:****Infant, child, and adolescent:** Apply 1-inch ribbon to affected eye(s) several times a day up to 6 times daily.**Preoperative bowel prep:** 20 mg/kg/dose (**max. dose:** 1000 mg/dose) PO erythromycin base × 3 doses, with neomycin, 1 day before surgery**Prokinetic agent:****Infant and child:** 10–20 mg/kg/24 hr PO ÷ TID–QID (QAC or QAC and QHS)**Topical (administer doses after washing skin with warm water and soap and patting it dry):****Acne (≥7 yr–adolescent; typically not used as monotherapy):****Topical gel:** Apply to affected area once daily–BID; discontinue use after 8 wk if no improvement or worsening of condition.**Topical solution or pad:** Apply to affected area BID (morning and evening).

Avoid use in patients with known QT prolongation, proarrhythmic conditions (e.g., hypokalemia, hypomagnesemia, significant bradycardia), and receiving class IA or class III antiarrhythmic agents, HMG CoA reductase inhibitors metabolized by CYP 450 3A4 (e.g., lovastatin or simvastatin; increases risk for myopathy and rhabdomyolysis), cisapride, or pimozide. Hypertrophic pyloric stenosis in neonates receiving prophylactic therapy for pertussis; life-threatening episodes of ventricular tachycardia associated with prolonged QTc interval; and exacerbation of myasthenia gravis have been reported. May produce false-positive urinary catecholamines, 17-hydroxycorticosteroids, and 17-ketosteroids.

GI side effects common (nausea, vomiting, abdominal cramps). Cardiac dysrhythmia, anaphylaxis, interstitial nephritis, and hearing loss have been reported. Use with **caution** in liver disease. Estolate formulation may cause cholestatic jaundice, although hepatotoxicity is uncommon (2% of reported cases). Inhibits CYP 450 1A2, 3A3/4 isoenzymes. May produce elevated digoxin, theophylline, carbamazepine, clozapine, cyclosporine, and methylprednisolone levels. **Adjust dose in renal failure** (see Chapter 31). Use ideal body weight for obese patients when calculating doses.

Oral therapy should replace IV as soon as possible. Give oral doses after meals. Because of different absorption characteristics, higher oral doses of EES are needed to achieve therapeutic effects. **Avoid** IM route (pain, necrosis). For ophthalmic use, **avoid** contact of ointment tip with eye or skin.

ERYTHROPOIETIN

ESCITALOPRAM

Lexapro and generics

Antidepressant, selective serotonin reuptake inhibitor**Tabs:** 5, 10, 20 mg**Oral solution:** 1 mg/mL (240 mL); contains parabens and propylene glycol**Depression:**

<12 yr: Limited data, only one placebo-controlled RCT did not demonstrate efficacy.

≥12 yr and adolescent: Start with 10 mg PO once daily. If needed after 3 wk, dose may be increased to 20 mg once daily.

Adult: Start with 10 mg PO once daily. If needed after 1 wk, dose may be increased to 20 mg once daily.**Autism and Pervasive Developmental Disorders (PDD; limited data)**6–17 yr: A 10-wk open-label trial in which 28 subjects were given a weekly PRN increasing PO dosage regimen of 2.5, 5, 10, 15, and 20 mg/24 hr. Mean dosage of responders with significant improvement at 11.1 ± 6.5 mg/24 hr. 25% of subjects responded at doses <10 mg/24 hr and 36% responded at doses ≥ 10 mg/24 hr. Seven of the 17 (41%) responders and 25% of all treated subjects could not tolerate the 10-mg/24 hr dose.**Social Anxiety Disorder (limited data):**10–17 yr: A 12-wk open-label trial in which 20 subjects were given an initial PO dosage of 5 mg once daily × 7 days followed by 10 mg once daily. If needed and tolerated, increase by 5 mg/24 hr at weekly intervals up to a maximum of 20 mg/24 hr. Two subjects did not complete the trial due to lack of efficacy and tolerability. Sixty-five percent of the remaining subjects met the response criteria with a mean final dose of 13 ± 4.1 mg/24 hr. Common adverse events included somnolence (25%), insomnia (20%), flu symptoms (15%), increased appetite (15%), and decreased appetite (15%).

Increased risk for serotonin syndrome when used with MAO inhibitors (or within 14 days of discontinuance), linezolid, or methylene blue; concurrent use considered **contraindicated**. Do not use with pimozide because of risk for increased QTc interval. Use with caution with hepatic or severe renal impairment; dosage adjustment may be needed. Avoid abrupt discontinuation to prevent withdrawal symptoms.

Diaphoresis, GI discomfort, xerostomia, dizziness, headache, insomnia, somnolence, sexual dysfunction, and fatigue are common side effects. Abnormal bleeding, depression, QTc prolongation, and suicidal ideation have been reported.

Primarily metabolized by the CYP 450 2C19 and 3A4 enzymes and is a weak inhibitor for CYP 450 2D6 enzyme. Consider an alternative medication (not significantly metabolized by CYP 450 2C19) for individuals with ultrarapid CYP 450 2C19 activity. Poor CYP450 2C19 metabolizers can either initiate therapy at 50% the usual dose and titrate to response or consider alternative therapy.

Taking with other medications with QTc prolongation may further increase that risk. Omeprazole may increase the toxicity of escitalopram. Doses may be administered with or without food.

ESMOLOL HCL

Brevibloc and generics

β-1-selective adrenergic blocking agent, antihypertensive agent, class II antiarrhythmic**Injection:** 10 mg/mL (10 mL)**Injection, premixed infusion in iso-osmotic sodium chloride:** 2000 mg/100 mL (100 mL), 2500 mg/250 mL (250 mL)

ESMOLOL HCL *continued*

Postoperative hypertension: Titrate to response (limited information):

Loading dose: 500 mCg/kg IV over 1 min.

Maintenance dose: 50–250 mCg/kg/min IV as infusion. Titrate doses upward 50–100

mCg/kg/min Q 5–10 min as needed. Heart surgery patients may require higher doses (~700

mCg/kg/min). Dosages as high as 1000 mCg/kg/min have been administered to children 1–12 yr.

SVT: Titrate to response (limited information).

Loading dose: 100–500 mCg/kg IV over 1 min.

Maintenance dose: 25–100 mCg/kg/min IV as infusion. Titrate doses upward 50–100 mCg/kg/min

Q5–10 min as needed. Dosages as high as 1000 mCg/kg/min have been administered.

Contraindicated in sinus bradycardia, >first-degree heart block, and cardiogenic shock or heart failure. Short duration of action; $T_{1/2} = 2.9\text{--}4.7$ min for children and 9 min for adults. May cause bronchospasm, congestive heart failure, hypotension (at doses >200 mCg/kg/min), nausea, and vomiting. May increase digoxin (by 10%–20%) and theophylline levels. Morphine may increase esmolol level by 46%. Theophylline may decrease esmolol's effects.

Administer only in a monitored setting. Concentration for administration is typically ≤ 10 mg/mL, but 20 mg/mL has been administered in pediatric patients.



ESOMEPRAZOLE

Nexium, Nexium 24HR, and generics

Gastric acid proton pump inhibitor



B/C



2



Yes



Yes



No

Caps, delayed-released (Nexium and generics): 20, 40 mg; contains magnesium (some generic products may contain strontium instead)

Nexium 24 HR [OTC]: 20 mg

Tab, delayed-released (Nexium 24HR; [OTC]): 20 mg; contains magnesium

Powder for oral suspension (Nexium): 2.5, 5, 10, 20, 40 mg packets (30s); contains magnesium

Injection (Nexium and generics): 20, 40 mg; contains EDTA

Child (PO):

GERD:

1–11 yr: 10 mg once daily for up to 8 wk

≥12–17 yr: 20 mg once daily for 4 wk

Erosive esophagitis in GERD:

Infant (1 mo to <1 yr; use for up to 6 wk):

3–5 kg: 2.5 mg once daily

>5 to 7.5 kg: 5 mg once daily

>7.5 to 12 kg: 10 mg once daily

1–11 yr (use for 8 wk):

<20 kg: 10 mg once daily

≥20 kg: 10 or 20 mg once daily

12–17 yr: 20 or 40 mg once daily for 4–8 wk

Child (IV):

GERD with erosive esophagitis:

Infant: 0.5–1 mg/kg/dose once daily

Child 1–17 yr:

<55 kg: 10 mg once daily

≥55 kg: 20–40 mg once daily

Adult (PO/IV):

GERD: 20 mg once daily

GERD with erosive esophagitis: 20 or 40 mg once daily $\times 4\text{--}8$ wk.



ESOMEPRAZOLE *continued*

Prevention of NSAID-induced gastric ulcers: 20 or 40 mg once daily for up to 6 mo

Pathological hypersecretory conditions (e.g., Zollinger-Ellison syndrome): 40 mg BID; doses up to 240 mg/24 hr have been used.

Hepatic impairment: Patients with severe hepatic function impairment (Child-Pugh class C) should not exceed 20 mg/24 hr.

Cross-allergic reactions with other proton pump inhibitors (e.g., lansoprazole, pantoprazole, rabeprazole). **Use with caution** in liver impairment (see dosage adjustment recommendation in dosing section). GI disturbances and headache are common. Hypomagnesemia may occur with continuous use. Anaphylaxis, angioedema, bronchospasm, acute interstitial nephritis, erythema multiforme, urticaria, Stevens-Johnson syndrome, TEN, pancreatitis, and fractures of the hip, wrist, and spine (in adults >50 yr old receiving high doses or prolonged therapy >1 yr) have been reported. Fundic gland polyps have been associated with long-term use of >1 yr.



Drug is a substrate and inhibitor of CYP 450 2C19 and substrate of CYP 450 3A4. May decrease the absorption or effects of atazanavir, clopidogrel, ketoconazole, itraconazole, mycophenolate mofetil, and iron salts. May increase the effect/toxicity of diazepam, midazolam, digoxin, carbamazepine, and warfarin. Voriconazole may increase the effects of esomeprazole.

May be used in combination with clarithromycin and amoxicillin for *Helicobacter pylori* infections.

Pregnancy category is a "B" for the magnesium-containing product and a "C" for the strontium-containing product.

Administer all oral doses before meals and 30 min before sucralfate (if receiving). **Do not** crush or chew capsules. IV doses may be given as fast as 3 min or infused over 10–30 min.

ETANERCEPT

Enbrel, Enbrel SureClick, Enbrel Mini

Antirheumatic, immuno-modulatory agent, tumor necrosis factor receptor p75 Fc fusion protein



B

?

No

Yes

No

Pre-filled injection (single use): 25 mg (0.5 mL), 50 mg (1 mL); contains sucrose, L-arginine (preservative free) (carton of 4 pre-filled syringes)

Injection (powder; multi-dose vial): 25 mg with diluent (1 mL bacteriostatic water containing 0.9% benzyl alcohol); contains mannitol, sucrose, tromethamine

Auto-injector:

Enbrel SureClick (single use): 50 mg (1 mL); contains sucrose, L-arginine (preservative free) (carton of 4 auto-injectors)

Pre-filled injection cartridge to be used with Auto Touch reusable autoinjector device:

Enbrel Mini: 50 mg (1 mL); contains sucrose, L-arginine (preservative free) (carton of 4 cartridges)



Juvenile idiopathic arthritis:

Child 2–17 yr: 0.4 mg/kg/dose SC twice weekly administered 72–96 hr apart; **max. dose:** 25 mg. Alternative once weekly dose of 0.8 mg/kg/dose SC (**max. dose:** 50 mg/wk and **max. single injection site dose** of 25 mg) may be used.

Rheumatoid arthritis, psoriatic arthritis, ankylosing spondylitis:

Adult: 25 mg SC twice weekly administered 72–96 hr apart. Alternative once weekly dose of 50 mg SC (**max. single injection site dose** of 25 mg) may be used.

Plaque psoriasis:

Child and adolescent (4–17 yr): 0.8 mg/kg/dose (**max. dose:** 50 mg) SC once weekly.

Adult: Start with 50 mg SC twice weekly administered 72–96 hr apart × 3 mo, followed by a reduced maintenance dose of 50 mg SC per wk. Starting doses of 25 mg or 50 mg/wk have also been shown to be effective.

Max. single injection site dose: 25 mg.

ETANERCEPT *continued*

Contraindicated in serious infections, sepsis, or hypersensitivity to any of medication components.

Use with caution in patients with history of recurrent infections (including hepatitis B) or underlying conditions that may predispose them to infections (including concomitant immunosuppressive therapy), CNS demyelinating disorders, malignancies, immune-related diseases, and latex allergy. Common adverse effects in children include headache, abdominal pain, vomiting, and nausea. Injection site reactions (e.g., discomfort, itching, swelling), rhinitis, dizziness, rash, depression, infections (varicella, aseptic meningitis, rare cases of TB, and fatal/serious infections and sepsis), bone marrow suppression (e.g., aplastic anemia), sarcoidosis, vertigo, and CNS demyelinating disorder have also been reported. Malignancies (some fatal and ~50% were lymphomas) have been reported in children and adolescents.

Do not administer live vaccines concurrently with this drug. In JRA, it is recommended that before initiating therapy, the patient be brought up to date with all immunizations in agreement with current immunization guidelines.

Onset of action is 1–4 wk, with peak effects usually within 3 mo.

Patients must be properly instructed on preparing and administering the medication (see specific product information). For multi-dose vial, reconstitute vial by gently swirling its contents with the supplied diluent (**do not** shake or vigorously agitate), as some foaming will occur. Reconstituted solutions should be clear and colorless; unused portions must be stored in the refrigerator and used within 14 days. Do not store Auto Touch auto-injector device in the refrigerator.

Drug is administered subcutaneously by rotating injection sites (thigh, abdomen, or upper arm) with a **max. single injection site dose** of 25 mg. Administer new injections ≥1 inch from an old site and NEVER where the skin is tender, bruised, red, or hard.

ETHAMBUTOL HCL

Myambutol and generics

Antituberculosis drug



C

2

Yes

Yes

No

Tabs: 100, 400 mg; 400-mg tabs may be scored

Oral suspension: 50, 100 mg/mL

Tuberculosis (use in combination with other medications; see remarks):

Infant, child, adolescent, and adult:



<15 yr and < 40 kg: 15–25 mg/kg/dose (**max. dose:** 1 g/24 hr) PO once daily or 50 mg/kg/dose PO twice weekly (**max. dose:** 2.5 g/week)

<15 yr and ≥40 kg, or ≥15 yr:

40–55 kg: 800 mg PO once daily or 5 times weekly

56–75 kg: 1200 mg PO once daily or 5 times weekly

76–90 kg: 1600 mg PO once daily or 5 times weekly

Nontuberculous mycobacterial infection; and Mycobacterium avium complex in AIDS (recurrence prophylaxis or treatment; use in combination with other medications):

Infant, child, and adolescent: 15–25 mg/kg/24 hr PO once daily; **max. dose:** 2.5 g/24 hr



May cause reversible optic neuritis, especially with larger doses. Obtain baseline ophthalmologic studies before beginning therapy and then monthly. Follow visual acuity, visual fields, and (red-green) color vision. **Do not use** in optic neuritis and in children whose visual acuity cannot be assessed. **Discontinue** if any visual deterioration occurs. Monitor uric acid, liver function, heme status, and renal function. Hyperuricemia, GI disturbances, and mania are common.

Erythema multiforme and hepatotoxicity have been reported.

Dosing should be based on lean body weight. Coadministration with aluminum hydroxide can reduce ethambutol's absorption; space administration by 4 hr. Give with food. **Adjust dose with renal failure**

ETHOSUXIMIDE

Zarontin and generics

Anticonvulsant

D



2



Yes



Yes



No

Caps: 250 mg**Oral solution:** 250 mg/5 mL (473 mL); may contain sodium benzoate**Oral:** **≤ 6 yr:****Initial:** 15 mg/kg/24 hr \div BID; **max. dose:** 500 mg/24 hr; increase as needed Q4–7 days.**Usual maintenance dose:** 15–40 mg/kg/24 hr \div BID**>6 yr and adult:** 250 mg BID; increase by 250 mg/24 hr as needed Q4–7 days.**Usual maintenance dose:** 20–40 mg/kg/24 hr \div BID**Max. dose (all ages):** 1500 mg/24 hr

Drug of choice for absence seizures. **Use with caution** in hepatic and renal disease. Ataxia, anorexia, drowsiness, sleep disturbances, rashes, and blood dyscrasias are rare idiosyncratic reactions. May cause lupus-like syndrome; may increase frequency of grand mal seizures in patients with mixed-type seizures. Serious dermatological reactions (e.g., Stevens Johnson and DRESS) has been reported. May increase risk of suicidal thoughts/behavior. Cases of birth defects have been reported; ethosuximide crosses the placenta.



Carbamazepine, phenytoin, primidone, phenobarbital, valproic acid, nevirapine, and ritonavir may decrease ethosuximide levels.

Therapeutic levels: 40–100 mg/L. $T_{1/2} = 24\text{--}42$ hr. Recommended serum sampling time at steady state: obtain trough level within 30 min prior to the next scheduled dose after 5–10 days of continuous dosing.

To minimize GI distress, may administer with food or milk. Abrupt withdrawal of drug may precipitate absence status.

ETOMIDATE

Amide and generics

General anesthetic

C



2



Yes



No

**Injection:** 2 mg/mL (10, 20 mL); may contain propylene glycol**Rapid Sequence Intubation (infuse dose over 30–60 sec):****Normotensive patient:** 0.3 mg/kg/dose IV/IO $\times 1$; **max. dose:** 20 mg/dose**Hypotensive patient (see remarks):** 0.15 mg/kg/dose IV/IO $\times 1$; **max. dose:** 20 mg/dose

Not recommended for patients in septic shock due to transient adrenocortical suppression and increased risk for mortality. **Avoid use** with benznidazole and metronidazole due to the risk for disulfiram-like reaction. **Use with caution** in renal impairment (higher risk for toxicity) and in heart failure (may exacerbate condition).



Injection site pain, myoclonus (pretreatment with midazolam may reduce risk), nausea, and vomiting are reported common side effects for indications other than rapid-sequence intubation.

F

FAMCICLOVIRGenerics; previously available as Famvir
Antiviral**Tabs:** 125, 250, 500 mg**Adult:**

Herpes zoster: 500 mg Q8 hr PO × 7 days; initiate therapy promptly as soon as diagnosis is made (initiation within 48 hr after rash onset is ideal; currently no data for starting treatment >72 hr after rash onset).

Genital herpes (first episode): 250 mg Q8 hr PO × 7–10 days

Recurrent genital herpes:

Immunocompetent: 1000 mg Q12 hr PO × 1 day or 125 mg Q12 hr PO × 5 days; initiate therapy at first sign or symptom. Efficacy has not been established when treatment is initiated >6 hr after onset of symptoms or lesions.

Immunocompromised: 500 mg Q12 hr PO × 7 days

Suppression of recurrent genital herpes (immunocompetent): 250 mg Q12 hr PO up to 1 yr, then reassess for HSV infection recurrence

Recurrent herpes labialis:

Immunocompetent: 1500 mg PO × 1

Immunocompromised: 500 mg Q12 hr PO × 7 days

Recurrent mucocutaneous herpes in HIV: 500 mg Q12 hr PO × 7 days



Drug is converted to its active form (penciclovir). Hepatic impairment may impair/reduce the conversion of famciclovir to penciclovir. Better absorption than PO acyclovir.

May cause headache, diarrhea, nausea, and abdominal pain. Serious skin reactions (e.g., TEN and Stevens-Johnson), angioedema, hypersensitivity vasculitis, seizure, palpitations, cholestatic jaundice, and abnormal LFTs have been reported. Concomitant use with probenecid and other drugs eliminated by active tubular secretion may result in decreased penciclovir clearance.

Reduce dose in renal impairment (see Chapter 31).

Safety and efficacy in suppression of recurrent genital herpes have not been established beyond 1 yr.

No efficacy data is available for children 1–<12 yr to support its use for genital herpes, recurrent herpes labialis, and varicella. Furthermore, efficacy has not been established for recurrent herpes labialis for children 12–<18 yr. May be administered with or without food.

FAMOTIDINEPepcid, Pepcid AC [OTC], Pepcid AC Maximum Strength [OTC],
Pepcid Complete [OTC], and generics

Histamine-2-receptor antagonist



B 1 Yes No No

Injection: 10 mg/mL (2, 4, 20 mL); multidose vials contain 0.9% benzyl alcohol

Premixed injection: 20 mg/50 mL in iso-osmotic sodium chloride

Oral suspension: 40 mg/5 mL (50 mL); may contain parabens and sodium benzoate

Tabs: 10 (OTC), 20 (OTC), 40 mg

Chewable tabs:

Pepcid Complete (OTC): 10 mg famotidine with 800 mg calcium carbonate and 165 mg magnesium hydroxide (25s, 50s)

Continued

D

FAMOTIDINE *continued***Neonate and <3 mo:****IV:** 0.25–0.5 mg/kg/dose Q24 hr**PO:** 0.5–1 mg/kg/dose Q24 hr**≥3 mo–1 yr (GERD): 0.5 mg/kg/dose PO Q12 hr****Child (1–12 yr):****IV:** initial: 0.5–1 mg/kg/24 hr ÷ Q12 hr up to a **max.** of 40 mg/24 hr**PO:** initial: 1–1.2 mg/kg/24 hr ÷ Q12 hr up to a **max.** of 40 mg/24 hr**Peptic ulcer:** 0.5–1 mg/kg/24 hr PO QHS or ÷ Q12 hr up to a **max. dose** of 40 mg/24 hr**GERD:** 1–2 mg/kg/24 hr PO ÷ Q 12 hr up to a **max. dose** of 80 mg/24 hr**Adolescent and adult:****Duodenal ulcer:****PO:** 20 mg BID or 40 mg QHS × 4–8 wk, then maintenance therapy at 20 mg QHS**IV:** 20 mg BID**GERD:** 20 mg BID PO × 6 wk**Esophagitis:** 20–40 mg BID PO × 12 wk

A Q12-hr dosage interval is generally recommended; however, infants and young children may require a Q8-hr interval because of enhanced drug clearance. Headaches, dizziness, constipation, diarrhea, and drowsiness have occurred. **Dosage adjustment is required in severe renal failure** (see **Chapter 31**); prolonged QT interval has been reported very rarely in patients with renal impairment whose dosage had not been adjusted appropriately. Rhabdomyolysis has been reported.

Shake oral suspension well prior to each use. Oral doses may be administered with or without food.

**FELBAMATE**

Felbatol and generics

Anticonvulsant

C

3

Yes

Yes

No

Tabs: 400, 600 mg**Oral suspension:** 600 mg/5 mL (240, 473 mL)**Lennox-Gastaut for child 2–14 yr (adjunctive therapy):**

Start at 15 mg/kg/24 hr PO ÷ TID–QID; increase dosage by 15 mg/kg/24 hr increments at weekly intervals up to a **max. dose** of 45 mg/kg/24 hr or 3600 mg/24 hr (whichever is less). See remarks for adjusting concurrent anticonvulsants.

Child ≥14 yr–adult:

Adjunctive therapy: Start at 1200 mg/24 hr PO ÷ TID–QID; increase dosage by 1200 mg/24 hr at weekly intervals up to a **max. dose** of 3600 mg/day. See remarks for adjusting concurrent anticonvulsants.

Monotherapy (as initial therapy): Start at 1200 mg/24 hr PO ÷ TID–QID. Increase dose under close clinical supervision at 600 mg increments Q2 wk to 2400 mg/24 hr. **Max. dose:** 3600 mg/24 hr.

Conversion to monotherapy: Start at 1200 mg/24 hr ÷ PO TID–QID for 2 wk; then increase to 2400 mg/24 hr for 1 wk. At wk 3, increase to 3600 mg/24 hr. Reduce dose of other anticonvulsants by 33% at the initiation of felbamate, then an additional 33% of original dose at wk 2 and continue to reduce other anticonvulsants as clinically indicated at wk 3 and beyond.

Drug should be prescribed under strict supervision by a specialist. **Contraindicated** in blood dyscrasias or hepatic dysfunction (prior or current), and hypersensitivity to meprobamate. Aplastic anemia and hepatic failure leading to death have been associated with drug. May cause headache, fatigue, anxiety, GI disturbances, gingival hyperplasia, increased liver enzymes, and bone marrow suppression. Suicidal behavior or ideation have been reported.

D



FELBAMATE *continued*

Obtain serum levels of concurrent anticonvulsants. Monitor liver enzymes, bilirubin, CBC with differential, platelets at baseline, and every 1–2 wk. Doses should be decreased by 50% in renally impaired patients.

When initiating adjunctive therapy (all ages), doses of other antiepileptic drugs (AEDs) are reduced by 20% to control plasma levels of concurrent phenytoin, valproic acid, phenobarbital, and carbamazepine. Further reductions of concomitant AED dosage may be necessary to minimize side effects caused by drug interactions.

When converting to monotherapy, reduce other AEDs by one-third at the start of felbamate therapy. Then after 2 wk and at the start of increasing the felbamate dosage, reduce other AEDs by an additional one-third. At wk 3, continue to reduce other AEDs as clinically indicated.

Carbamazepine levels may be decreased; however, phenytoin and valproic acid levels may be increased. Phenytoin and carbamazepine may increase felbamate clearance; valproic acid may decrease its clearance. Doses can be administered with or without food.

FENTANYL

Sublimaze, Duragesic, Fentora, Actiq, and generics

Narcotic; analgesic, sedative

C/D

2

Yes

No

No

Injection: 50 mCg/mL (2, 5, 10, 20, 50 mL)**SR transdermal patch (Duragesic and generics):** 12.5, 25, 50, 75, 100 mCg/hr (5s)**Tabs for buccal administration:**

Fentora and generics: 100, 200, 400, 600, 800 mCg (28s)

Lozenge on a stick:

Actiq and generics: 200, 400, 600, 800, 1200, 1600 mCg (30s)

**Titrate dose to effect.****Neonate and younger infant:****Sedation/analgesia:** 1–4 mCg/kg/dose (**max. dose:** 100 mCg/dose) IV Q2–4 hr PRN**Continuous IV infusion:** 1–5 mCg/kg/hr; tolerance may develop**Older infant and child:****Sedation/analgesia:** 1–2 mCg/kg/dose (**max. dose:** 100 mCg/dose) IV/IM Q30–60 min PRN**Continuous IV infusion:** 1 mCg/kg/hr; titrate to effect; usual infusion range 1–3 mCg/kg/hr**To prepare infusion, use the following formula:**

$$50 \times \frac{\text{Desired dose (mCg/kg/hr)}}{\text{Desired infusion rate (mL/hr)}} \times \text{Wt (kg)} \frac{\text{mCg Fentanyl}}{50 \text{ mL fluid}}$$

Oral, breakthrough cancer pain for opioid-intolerant patients (see remarks):

Buccal tabs (≥18 yr NOT previously using Actiq): Start with 100 mCg by placing tablet in the buccal cavity (above a rear molar, between the upper cheek and gum) and letting the tablet dissolve for 15–25 min. A second 100 mCg dose, if needed, may be administered 30 min after the start of the first dose. If needed, increase dose initially in multiples of 100 mCg tablet when patients require >1 dose per breakthrough pain episode for several consecutive episodes. Must wait at least 4 hr before treating another episode with buccal tabs. If titration requires >400 mCg/dose, use 200 mCg tabs.

Lozenges (≥16 yr): Start with 200 mCg by placing lozenge in the mouth between the cheek and lower gum. If needed, may repeat dose 15 min after the completion of the first dose (30 min after start of prior dose). If therapy requires >1 lozenge per episode, consider increasing the dose to the next higher strength. **Do not** give more than 2 doses for each episode of breakthrough pain and reevaluate long-acting opioid therapy if patient requires >4 doses/24 hr. **Must wait at least 4 hr before treating another episode with lozenges.**

FENTANYL *continued*

Transdermal (see remarks): Safety has not been established in children <2 yr and should be administered in children ≥2 yr who are opioid tolerant. Use is **contraindicated** in acute or postoperative pain in opiate-naïve patients.

Opioid-tolerant child receiving at least 60 mg morphine equivalents/24 hr: Use 25 mCg/hr patch

Q72 hr. Patch titration should not occur before 3 days of administration of the initial dose or more frequently than every 6 days thereafter.

See [Chapter 6](#) for equianalgesic dosing and PCA dosing.

Intranasal route for acute and pre-procedure analgesia (use IV dosage form; see remarks):

≥1 yr—adolescent: 1–2 mCg/kg/dose intranasally via an automizer (**max. dose:** 100 mCg/dose)

Q1 hr PRN



Use with caution in bradycardia, respiratory depression, and increased intracranial pressure.

Adjust dose in renal failure (see Chapter 31). Fatalities and life-threatening respiratory depression have been reported with inappropriate use (overdoses, use in opioid-naïve patients, changing the patch too frequently, and exposing the patch to a heat source) of the transdermal route.

Highly lipophilic and may deposit into fat tissue. IV onset of action 1–2 min with peak effects in 10 min. IV duration of action 30–60 min. Give IV dose over 3–5 min. Rapid infusion may cause respiratory depression and chest wall rigidity. Respiratory depression may persist beyond the period of analgesia. Transdermal onset of action 6–8 hr with a 72-hr duration of action. See [Chapter 6](#) for pharmacodynamic information with transmucosal and transdermal routes.

Buccal tabs and oral lozenges are indicated only for the management of breakthrough cancer pain in patients who are already receiving and who are tolerant to opioid therapy. Buccal tabs (Fentora), transdermal patches (Duragesic), and lozenge (Actiq) dosage forms are available through a restricted distribution program (REMS) and are NOT bioequivalent (see package insert for conversion).

Intranasal route of administration for analgesia has an onset of action at 10–30 min. Pediatric studies have demonstrated that the intranasal fentanyl is equivalent to and better than morphine (PO/IV/IM) and equivalent to intravenous fentanyl for providing analgesia.

Fentanyl is a substrate for the CYP 450 3A4 enzyme. Be aware of medications that inhibit or induce this enzyme, for it may increase or decrease the effects of fentanyl, respectively.

Pregnancy category changes to “D” if drug is used for prolonged periods or in high doses at term.

FERRIC GLUCONATE

See Iron—Injectable Preparations

FERROUS SULFATE

See Iron—Oral Preparations

FEXOFENADINE ± PSEUDOEPHEDRINE

Allegra, Allegra ODT, Allegra-D 12 Hour, Allegra-D 24 Hour, and generics

Antihistamine, less-sedating ± decongestant



C 2 Yes No No

Tabs: 60 mg [OTC], 180 mg [OTC]

Tabs, orally disintegrating (Allegra Allergy Children's; ODT) [OTC]: 30 mg; contains phenylalanine

FEXOFENADINE ± PSEUDOEPHEDRINE continued***Extended-release tab in combination with pseudoephedrine (PE):******Allegra-D 12 Hour [OTC]:*** 60 mg fexofenadine + 120 mg pseudoephedrine***Allegra-D 24 Hour [OTC]:*** 180 mg fexofenadine + 240 mg pseudoephedrine***Fexofenadine:******6 mo—<2 yr:*** 15–30 mg PO BID***2–11 yr:*** 30 mg PO BID***≥12 yr—adult:*** 60 mg PO BID; 180 mg PO once daily may be used in seasonal rhinitis.***Extended-release tabs of fexofenadine and pseudoephedrine:******≥12 yr—adult:******Allegra-D 12 Hour:*** 1 tablet PO BID***Allegra-D 24 Hour:*** 1 tablet PO once daily

May cause drowsiness, fatigue, headache, dyspepsia, nausea, and dysmenorrhea. Has not been implicated in causing cardiac arrhythmias when used with other drugs that are metabolized by hepatic microsomal enzymes (e.g., ketoconazole, erythromycin). **Reduce dose to 15 mg PO once daily for child 6 mo—<2 yr, 30 mg PO once daily for child 6–11 yr old, and 60 mg PO once daily for ≥12 yr old for any degree of renal impairment.** For use of Allegra-D 12 Hour and decreased renal function ($\text{CrCl} < 80 \text{ mL/min}$), an initial dose of 1 tablet PO once daily is recommended. **Avoid use of Allegra-D 24 Hour in renal impairment.** See Pseudoephedrine for additional remarks if using the combination product.

Medication as the single agent may be administered with or without food. Do **not** administer antacids with or within 2 hr of fexofenadine dose. The extended-release combination product should be swallowed whole without food.

FILGRASTIM

Neupogen, G-CSF

Colony stimulating factor

C



2



Yes



No



No

Injection: 300 mCG/mL (1, 1.6 mL vials)**Injection, prefilled syringes with 27-gauge 1/2-inch needles:** 600 mCG/mL (300 mCG per 0.5 mL and 480 mCG per 0.8 mL) (10s)**All dosage forms contain polysorbate 80 and are preservative free.****NOTE:** the following biosimilar products are available (all contain polysorbate 80 and are preservative-free).**Single dose vials [Nivestym (filgrastim-aafi), Granix (tbo-filgrastim)]:** 300 mCG/1 mL and 480 mCG/1.6 mL (10s)**Prefilled syringes [Nivestym (filgrastim-aafi), Zarxio (filgrastim-sndz)]:** 300 mCG/0.5 mL and 480 mCG/0.8 mL (1 or 10s)***Individual protocols may direct dosing.******Myelosuppressive chemotherapy recipients with non-myeloid malignancies:*****IV/SC:** 5 mCG/kg/dose once daily \times 14 days or until ANC $> 10,000/\text{mm}^3$. Dosage may be increased by 5 mCG/kg/24 hr if desired effect is not achieved within 7 days.Discontinue therapy when ANC $> 10,000/\text{mm}^3$.

May cause bone pain, fever, and rash. Monitor CBC, uric acid, and LFTs. Aortitis, sickle cell crisis, serious allergic reactions, glomerulonephritis, and thrombocytopenia have been reported. Decreased bone density/osteoporosis has been reported in pediatric patients with severe chronic neutropenia. **Use with caution** in patients with malignancies with myeloid

Continued

D

FILGRASTIM continued

characteristics. **Contraindicated** for patients sensitive to *E. coli*-derived proteins. Avoid simultaneous administration with chemotherapy and radiation and do not administer 24 hr before or after administration of chemotherapy.

Safety and effectiveness have been established for nonmyeloid malignancies receiving myelospressive chemotherapy in children ≥ 1 mo– <17 yr old. The safety profile was similar to adults.

SC routes of administration are preferred because of prolonged serum levels over IV route. If used via IV route and G-CSF final concentration <15 mCg/mL, add 2 mg albumin/1 mL of IV fluid to prevent drug adsorption to the IV administration set.

FLECAINIDE ACETATE

Generics; previously available as Tambocor

Antiarrhythmic, class Ic



C



2



Yes



No

Tabs: 50, 100, 150 mg

Oral suspension: 20 mg/mL

Child: Initial: 1–3 mg/kg/24 hr \div Q8 hr PO; usual range: 3–6 mg/kg/24 hr \div Q8 hr PO, monitor serum levels to adjust dose if needed.



Adult:

Sustained VTach: 100 mg PO Q12 hr; may increase by 50 mg Q12 hr (100 mg/24 hr) every 4 days to **max. dose** of 400 mg/24 hr.

Paroxysmal SVT/paroxysmal AF: 50 mg PO Q12 hr; may increase dose by 50 mg Q12 hr every 4 days to **max. dose** of 300–400 mg/24 hr.



May aggravate LV failure, sinus bradycardia, preexisting ventricular arrhythmias. May cause AV block, dizziness, blurred vision, dyspnea, nausea, headache, and increased PR or QRS intervals. **Reserve for life-threatening cases. Use with caution** in renal and/or hepatic impairment.

Flecainide is a substrate for the CYP P-450 2D6 enzyme. Be aware of medications that inhibit (e.g., certain SSRIs) or induce this enzyme, for it may increase or decrease the effects of flecainide, respectively.

Therapeutic trough level: 0.2–1 mg/L. Recommended serum sampling time at steady state: Obtain trough level within 30 min prior to the next scheduled dose after 2–3 days of continuous dosing for children; after 3–5 days for adults. **Adjust dose in renal failure** (see Chapter 31).

FLUCONAZOLE

Diffucan and generics

Antifungal agent



C/D



2



Yes



No

Tabs: 50, 100, 150, 200 mg

Injection: 2 mg/mL (100, 200 mL); contains 9 mEq Na/2 mg drug

Oral suspension: 10 mg/mL (35 mL), 40 mg/mL (35 mL)



Neonate (IV/PO):

Loading dose: 12–25 mg/kg

Thrush: 6 mg/kg

Maintenance dose: 6–12 mg/kg with the following dosing intervals (see following table); use higher doses for severe infections of *Candida* strains with MICs >4 –8 mCg/mL.

Thrush: 3–6 mg/kg/dose with the following dosing intervals (see following table) for at least 2 wk

D

FLUCONAZOLE *continued*

Postconceptual Age (wk)	Postnatal Age (days)	Dosing Interval (hr) and Time (hr) to Start First Maintenance Dose After Load
≤ 29	0–14	48
	>14	24
≥ 30	0–7	48
	>7	24

Child ≥ 1 mo (IV/PO):

Indication	Loading Dose $\times 1$	Maintenance Dose (Q24 hr) to Begin 24 hr After Loading Dose
Oropharyngeal candidiasis	6 mg/kg (max. dose: 400 mg)	3 mg/kg (max. dose: 200 mg/dose)
Esophageal candidiasis	12 mg/kg (max. dose: 800 mg)	6 mg/kg (max. dose: 400 mg/dose)
Invasive systemic candidiasis and Cryptococcal meningitis	12 mg/kg (max. dose: 800 mg)	6–12 mg/kg (max. dose: 400–800 mg/dose)
Suppressive therapy for HIV infected with Cryptococcal meningitis	6 mg/kg (max. dose: 200 mg)	6 mg/kg (max. dose: 200 mg/dose)

Adult:

Oropharyngeal and esophageal candidiasis: Loading dose of 200 mg PO/IV followed by 100 mg Q24 hr (24 hr after load); doses up to **max. dose** of 400 mg/24 hr should be used for esophageal candidiasis

Systemic candidiasis and cryptococcal meningitis: Loading dose of 400 mg PO/IV, followed by 200–800 mg Q24 hr (24 hr after load)

Bone marrow transplant prophylaxis: 400 mg PO/IV Q24 hr

Suppressive therapy in for HIV infected with cryptococcal meningitis: 200 mg PO/IV Q24 hr

Vaginal candidiasis: 150 mg PO $\times 1$

Use with other medications known to prolong the QT interval and which are metabolized via the CYP 450 3A4 enzyme (e.g., erythromycin) are considered **contraindicated**. May cause nausea, headache, rash, vomiting, abdominal pain, hepatitis, cholestasis, and diarrhea. Neutropenia, agranulocytosis, thrombocytopenia, exfoliative skin disorders (e.g., SJS, TEN, DRESS), and adrenal insufficiency (reversible) have been reported. **Use with caution** in hepatic or renal dysfunction and in patients with hypokalemia, proarrhythmic conditions, or advanced cardiac failure.

Inhibits CYP 450 2C9/10 and CYP 450 3A3/4 (weak inhibitor). May increase effects, toxicity, or levels of cyclosporine, midazolam, phenytoin, rifabutin, tacrolimus, theophylline, warfarin, oral hypoglycemics, and AZT. Rifampin increases fluconazole metabolism.

Consider using higher doses in morbidly obese patients. **Adjust dose in renal failure (see Chapter 31).**

Pregnancy category is "C" for single 150 mg use for vaginal candidiasis, but a Danish study reports a higher risk for miscarriages for during weeks 7–22 of gestation. Pregnancy category "D" is for all other indications (high-dose use during first trimester of pregnancy may result in birth defects).

FLUCYTOSINE

Ancobon, 5-FC, 5-Fluorocytosine, and generics

Antifungal agent**Caps:** 250, 500 mg**Oral suspension:** 10, 50 mg/mL **Neonate (monitor serum concentrations):****<1 kg:****≤14 days old:** 75 mg/kg/24 hr ÷ Q8 hr PO**15–28 days old:** 75 mg/kg/24 hr ÷ Q6 hr PO**1–2 kg:****≤7 days old:** 75 mg/kg/24 hr ÷ Q8 hr PO**8–28 days old:** 75 mg/kg/24 hr ÷ Q6 hr PO**>2 kg and ≤60 days old:** 75 mg/kg/24 hr ÷ Q6 hr PO

Dosages of 75–100 mg/kg/24 hr have been used in neonates (preterm and term) for candidal meningitis.

Child and adult (monitor serum concentrations): 50–150 mg/kg/24 hr ÷ Q6 hr POMonitor CBC, BUN, serum creatinine, alkaline phosphatase, AST, and ALT. Common side effects: nausea, vomiting, diarrhea, rash, CNS disturbance, anemia, leukopenia, and thrombocytopenia. **Use with caution** in hepatic and renal impairment and in hematologic disorders. Use is **contraindicated** in the first trimester of pregnancy.**Therapeutic levels:** 25–100 mg/L. Recommended serum sampling time at steady state: Obtain peak level 2–4 hr after oral dose following 4 days of continuous dosing. Peak levels of 40–60 mg/L have been recommended for systemic candidiasis. Maintain trough levels above 25 mg/L. Prolonged levels above 100 mg/L can increase risk for bone marrow suppression. Bone marrow suppression in immunosuppressed patients can be irreversible and fatal.Flucytosine interferes with creatinine assay tests using the dry-slide enzymatic method (Kodak Ektachem analyzer). **Adjust dose in renal failure** (see [Chapter 31](#)).**FLUDROCORTISONE ACETATE**

Generics (previously available as Florigenf);

9-fluorohydrocortisone

Corticosteroid**Tabs:** 0.1 mg**Oral suspension:** 0.1 mg/mL **Infant and child:** 0.05–0.1 mg/24 hr once daily PO**Congenital adrenal hyperplasia:** 0.05–0.3 mg/24 hr once daily PO**Adult:** 0.05–0.2 mg/24 hr once daily PO**Contraindicated** in CHF and systemic fungal infections. Has primarily mineralocorticoid activity. **Use with caution** in hypertension, edema, or renal dysfunction. May cause hypertension, hypokalemia, acne, rash, bruising, headaches, GI ulcers, and growth suppression.Monitor BP and serum electrolytes. See [Chapter 10](#) for steroid potency comparison.**Drug interactions:** Drug's hypokalemic effects may induce digoxin toxicity; phenytoin and rifampin may increase fludrocortisone metabolism.

Doses 0.2–2 mg/24 hr has been used in the management of severe orthostatic hypotension in adults. Use a gradual dosage taper when discontinuing therapy.

FLUMAZENIL

Generics; previously available as Romazicon

Benzodiazepine antidote

C



?



No



Yes



No

Injection: 0.1 mg/mL (5, 10 mL); contains parabens**Benzodiazepine overdose (IV, see remarks):**

Child (limited data): 0.01 mg/kg (**max. dose:** 0.2 mg) Q1 min PRN to a **max. total cumulative dose** of 1 mg. As an alternative for repeat bolus doses, a continuous infusion of 0.005–0.01 mg/kg/hr have been used.

Adult: Initial dose: 0.2 mg over 30 sec, if needed, give 0.3 mg 30 sec later over 30 sec. Additional doses of 0.5 mg given over 30 sec Q1 min PRN up to a cumulative dose of 3 mg (usual cumulative dose: 1–3 mg). Patients with only partial response to 3 mg may require additional slow titration to a total of 5 mg.

Reversal of benzodiazepine sedation (IV):

Child: Initial dose: 0.01 mg/kg (**max dose:** 0.2 mg) given over 15 sec, if needed after 45 sec, 0.01 mg/kg (**max. dose:** 0.2 mg) Q1 min to a **max. total cumulative dose** of 0.05 mg/kg or 1 mg, whichever is lower. Usual total dose: 0.08–1 mg (average 0.65 mg).

Adult: Initial dose: 0.2 mg over 15 sec, if needed after 45 sec, give 0.2 mg Q1 min to a **max. total cumulative dose** of 1 mg. Doses may be repeated at 20 min interval (**max. dose** of 1 mg per 20 min interval) up to a **max. dose** of 3 mg in 1 hr.



Does not reverse narcotics. Onset of benzodiazepine reversal occurs in 1–3 min. Reversal effects of flumazenil ($T_{1/2}$ approximately 1 hr) may wear off sooner than benzodiazepine effects. If patient does not respond after cumulative 1–3 mg dose, suspect agent other than benzodiazepines.

May precipitate seizures, especially in patients taking benzodiazepines for seizure control or in patients with tricyclic antidepressant overdose. Fear and panic attacks in patients with history of panic disorders have been reported.

Use with caution in liver dysfunction; flumazenil's clearance is significantly reduced. Use normal dose for initial dose and decrease the dosage and frequency for subsequent doses.

See [Chapter 3](#) for complete management of suspected ingestions.

FLUNISOLIDE

Generics; previously available as Nasarel or Nasalide

Corticosteroid

C



1



No



No



No

Nasal solution: 25 mG/spray (200 sprays/bottle) (25 mL); contains propylene glycol and benzalkonium chloride

After symptoms are controlled, reduce to lowest effective maintenance dose (e.g., 1 spray each nostril once daily) to control symptoms.

Nasal solution:

Child (6–14 yr):

Initial: 1 spray per nostril TID or 2 sprays per nostril BID; **max. dose:** 4 sprays per nostril/24 hr.
≥15 yr and adult:

Initial: 2 sprays per nostril BID; if needed in 4–7 days, increase to 2 sprays per nostril TID; **max. dose:** 8 sprays per nostril/24 hr.



Nasal burning and stinging is common. Nasal congestion, sneezing, epistaxis, watery eyes, sore throat, nausea/vomiting, and headaches may also occur. May cause a reduction in growth velocity. Nasal septal perforations have been reported. Flunisolide is a minor substrate of CYP 450 3A4.

Do not use nasal passages before use.

ClinicalKey.com

FLUORIDE

Fluorabon, Fluor-A-Day, Fluoritab, many others, and generics
Mineral



B

2

No

No

No

Concentrations and strengths based on fluoride ion:

Oral drops: 0.125 mg/drop (30 mL), 0.25 mg/drop (24 mL)

Fluorabon: 0.42 mg/mL (60 mL)

Chewable tabs (Fluor-A-Day, Fluoritab, and generics): 0.25, 0.5, 1 mg

All doses/24 hr (see table below):

Recommendations from American Academy of Pediatrics and American Dental Association
for prevention of dental caries.

**Concentration of Fluoride in Drinking Water (ppm)**

Age	<0.3	0.3–0.6	>0.6
Birth–6 mo	0	0	0
6 mo–3 yr	0.25 mg	0	0
3–6 yr	0.5 mg	0.25 mg	0
6–16 yr	1 mg	0.5 mg	0

Contraindicated in areas where drinking water fluoridation is >0.7 ppm. **Acute overdose:** GI distress, salivation, CNS irritability, tetany, seizures, hypocalcemia, hypoglycemia, and cardiorespiratory failure. Chronic excess use may result in mottled teeth or bone changes.



Take with food, but **not** milk, to minimize GI upset. The doses have been decreased owing to concerns over dental fluorosis.

FLUOXETINE HYDROCHLORIDE

Prozac, Sarafem, and generics

Antidepressant, selective serotonin reuptake inhibitor



C

X

Yes

Yes

No

Oral solution: 20 mg/5 mL (120 mL); may contain alcohol

Caps: 10, 20, 40 mg

Delayed-released caps: 90 mg

Tabs: 10, 20, 60 mg

**Depression:**

Child, 8–18 yr: Start at 10–20 mg once daily PO. If started on 10 mg/24 hr, may increase dose to **max. dose** of 20 mg/24 hr after 1 wk. Use lower 10 mg/24 hr initial dose for lower-weight children; if needed, increase to 20 mg/24 hr after several weeks.

Adult: Start at 20 mg once daily PO. May increase after several weeks by 20 mg/24 hr increments to **max. dose** of 80 mg/24 hr. Doses >20 mg/24 hr should be divided BID.

Obsessive-compulsive disorder:

Child, 7–18 yr:

Lower weight child: Start at 10 mg once daily PO. May increase after several weeks. Usual dose range: 20–30 mg/24 hr. There is very minimal experience with doses >20 mg/24 hr and no experience with doses >60 mg/24 hr.

Higher weight child and adolescent: Start at 10 mg once daily PO and increase dose to 20 mg/24 hr after 2 wk. May further increase dose after several weeks. Usual dose range: 20–60 mg/24 hr.

FLUOXETINE HYDROCHLORIDE *continued***Bulimia:**

Adolescent (PO; limited data): 20 mg QAM × 3 days, then 40 mg QAM × 3 days, then 60 mg QAM.

Adult: 60 mg QAM PO; it is recommended to titrate up to this dose over several days.

Premenstrual dysphoric disorder:

Adult: Start at 20 mg PO once daily continuously or intermittently (starting 14 days prior to the anticipated onset of menstruation through the first full day of menses and repeating with each new cycle) using the Sarafem product. **Max. dose:** 80 mg/24 hr. Systematic evaluation has shown that efficacy is maintained for periods of 6 mo at a dose of 20 mg/day. Reassess patients periodically to determine the need for continued treatment.

Contraindicated in patients taking MAO inhibitors (e.g., linezolid) due to possibility of seizures, hyperpyrexia, and coma. **Use with caution** in patients with angle-closure glaucoma, receiving diuretics, or with liver (reduce dose with cirrhosis) or renal impairment. May increase the effects of tricyclic antidepressants. May cause headache, insomnia, nervousness, drowsiness, GI disturbance, and weight loss. Increased bleeding diathesis with unaltered prothrombin time may occur with warfarin. Hyponatremia has been reported. Monitor for clinical worsening of depression and suicidal ideation/behavior following the initiation of therapy or after dose changes.

May displace other highly protein-bound drugs. Inhibits CYP 450 2C19, 2D6, and 3A3/4 drug metabolism isoenzymes, which may increase the effects or toxicity of drugs metabolized by these enzymes. For example, use with pimozide or thioridazine may increase the risk for prolonged cardiac QTc interval and is considered **contraindicated**. Use with serotonergic drugs (e.g., triptans, methylene blue) and drugs that impair serotonin metabolism (MAOIs) may increase the risk for serotonin syndrome. Carefully review the patients' medication profile for potential interactions.

Delayed-release capsule is currently indicated for depression and is dosed at 90 mg Q7 days. It is unknown if weekly dosing provides the same protection from relapse as does daily dosing.

Breastfeeding is not recommended by the manufacturer, as adverse events to nursing infants have been reported. Fluoxetine and metabolite are variable and are higher when compared with other SSRIs. Maternal use of SSRIs during pregnancy and postpartum may result in more difficult breastfeeding. Infants exposed to SSRIs during pregnancy may also have an increased risk for persistent pulmonary hypertension of the newborn.

FLUTICASONE FUROATE + VILANTEROL

Breo Ellipta

Corticosteroid and long-acting β_2 -adrenergic agonist



C



2



No



Yes



No

Breath-activated aerosol powder for inhalation (Breo Ellipta; contains lactose):

100 mcg fluticasone furoate + 25 mcg vilanterol per actuation (28, 60 doses)

200 mcg fluticasone furoate + 25 mcg vilanterol per actuation (28, 60 doses)

For Fluticasone Furoate (Arnuity Ellipta) as a single agent, see Fluticasone Preparations.

Asthma:

Adult: one inhalation of 100 mcg fluticasone furoate + 25 mcg vilanterol OR 200 mcg fluticasone furoate + 25 mcg vilanterol once daily

Max. dose: one inhalation/24 hr for either dosage strength (25 mcg vilanterol/24 hr)



Contraindicated with hypersensitivity to milk proteins. See Fluticasone Preparations for remarks. Vilanterol is a long-acting β_2 -adrenergic agonist with a faster onset and longer duration of action compared to salmeterol.

Hypersensitivity reactions, hyperglycemia, muscle spasms, and tremor have been reported.

Titrate to the lowest effective strength after asthma is adequately controlled. This dosage form's breath-activated device requires a minimum inspiratory flow rate of 60 mL/min for proper dose activation. Proper patient education including dosage administration technique is essential; see



FLUTICASONE PREPARATIONS

Fluticasone propionate: Flonase, Cutivate, Beser, Flovent Diskus, Flovent HFA, ArmonAir RespiClick, and generics
 Fluticasone furoate: Flonase Sensimist, and Arnuity Ellipta
Corticosteroid

**FLUTICASONE PROPIONATE**

Nasal spray (Flonase and generics; OTC): 50 mCg/actuation (9.9 mL = 60 doses, 15.8 mL = 120 doses); contains benzalkonium chloride and polysorbate 80

Topical cream: 0.05% (15, 30, 60 g)

Topical ointment: 0.005% (15, 30, 60 g)

Topical lotion (Cutivate, Beser, and generics): 0.05% (60, 120 mL); contains parabens and propylene glycol

Aerosol inhaler (MDI) (Flovent HFA): 44 mCg/actuation (10.6 g), 110 mCg/actuation (12 g), 220 mCg/actuation (12 g); each inhaler provides 120 metered inhalations

Dry-powder inhalation (DPI) (Flovent Diskus): 50 mCg/dose, 100 mCg/dose, 250 mCg/dose; all strengths come in a package of 15 Rotadisks; each Rotadisk provides 4 doses for a total of 60 doses per package. Contains lactose.

Breath-activated aerosol powder inhaler (ArmonAir RespiClick): 55 mCg/inhalation, 113 mCg/inhalation, 232 mCg/inhalation; each inhaler contains 0.9 g of formulation and provides 60 doses.

FLUTICASONE FUROATE

Nasal spray (Flonase Sensimist [OTC]): 27.5 mCg/actuation (5.9 mL = 60 doses); contains benzalkonium chloride and polysorbate 80

Breath-activated aerosol powder inhaler (Arnuity Ellipta): 50 mCg/actuation, (30 doses), 100 mCg/actuation (14, 30 doses), 200 mCg/actuation dose (14, 30 doses)

Intranasal (allergic rhinitis):

Fluticasone propionate (Flonase and generics):

≥4 yr and adolescent: 1 spray (50 mCg) per nostril once daily. Dose may be increased to 2 sprays (100 mCg) per nostril once daily if inadequate response or severe symptoms. Reduce to 1 spray per nostril once daily when symptoms are controlled.

Adult: Initial 200 mCg/24 hr [2 sprays (100 mCg) per nostril once daily; OR 1 spray (50 mCg) per nostril BID]. Reduce to 1 spray per nostril once daily when symptoms are controlled.

Max. dose (4 yr–adult): 2 sprays (100 mCg) per nostril/24 hr

Fluticasone furoate (Veramyst):

2–11 yr: 1 spray (27.5 mCg) per nostril once daily. If needed, dose may be increased to 2 sprays each nostril once daily. Reduce to 1 spray per nostril once daily when symptoms are controlled.

≥11 yr and adult: 2 sprays (55 mCg) each nostril once daily. Reduce to 1 spray per nostril once daily when symptoms are controlled.

Max. dose (2 yr–adult): 2 sprays (55 mCg) per nostril/24 hr

Oral inhalation (asthma):

Fluticasone propionate (Flovent HFA and Diskus): Divide all 24 hr doses BID. If desired response is not seen after 2 wk of starting therapy, increase dosage. Then reduce to the lowest effective dose when asthma symptoms are controlled. Administration of MDI (HFA) with aerochamber enhances drug delivery.

FLUTICASONE PREPARATIONS *continued*

Recommended dosages for asthma (see following table).

Age	Previous Use of Bronchodilators Only: (Max. Dose)	Previous Use of Inhaled Corticosteroid: (Max. Dose)	Previous Use of Oral Corticosteroid: (Max. Dose)
Child (4–11 yr)	MDI: 88 mCg/24 hr (176 mCg/24 hr)	MDI: 88 mCg/24 hr (176 mCg/24 hr)	Dose not available
	DPI: 100 mCg/24 hr (200 mCg/24 hr)	DPI: 100 mCg/24 hr (200 mCg/24 hr)	
≥12 yr and adult	MDI: 176 mCg/24 hr (880 mCg/24 hr)	MDI: 176–440 mCg/24 hr (880 mCg/24 hr)	MDI: 880 mCg/24 hr (1760 mCg/24 hr)
	DPI: 200 mCg/24 hr (1000 mCg/24 hr)	DPI: 200–500 mCg/24 hr (1000 mCg/24 hr)	DPI: 1000–2000 mCg/24 hr (2000 mCg/24 hr)

DPI, Dry powder inhaler (breath activated); MDI, metered dose inhaler.

Breath-activated aerosol powder inhaler (ArmonAir RespiClick):

≥12 yr and adult:

No prior inhaled corticosteroids: Start with 55 mCg inhaled BID; **max. dose:** 232 mCg BID

Prior treatment with inhaled corticosteroids: Start with low (55 mCg), medium (113 mCg), or high (232 mCg) inhaled BID based on the strength of previous inhaled corticosteroid and disease severity; **max. dose:** 232 mCg BID

Fluticasone furoate (Arnuity Ellipta):

5–11 yr: Inhale 50 mCg once daily

≥12 yr and adult: Inhale 100–200 mCg once daily; **max. dose:** 200 mCg/24 hr.

Eosinophilic esophagitis (limited data; use oral fluticasone propionate HFA dosage form without spacer for PO administration as doses are swallowed):

Child (1–10 yr): 220 mCg QID × 4 wk, then 220 mCg TID × 3 wk, then 220 mCg BID × 3 wk, and 220 mCg once daily × 2 wk.

Child ≥11 yr and adolescent: 440 mCg QID × 4 wk, then 440 mCg TID × 3 wk, then 440 mCg BID × 3 wk, and 440 mCg once daily × 2 wk.

Topical (reassess diagnosis if no improvement in 2 wk):

Cream (see Chapter 8 for topical steroid comparisons):

≥3 mo and adult: Apply thin film to affected areas once daily—BID; then reduce to a less potent topical agent when symptoms are controlled.

Lotion (see remarks):

≥3 mo and adult: Apply thin film to affected areas once daily. Safety of use has not been evaluated longer than 4 wk.

Ointment:

Adult: Apply thin film to affected areas BID.

Fluticasone propionate and fluticasone furoate do not have equivalent potencies; follow specific dosing regimens for the respective products.

Concurrent administration with ritonavir and other CYP 450 3A4 inhibitors may increase fluticasone levels resulting in Cushing syndrome and adrenal suppression. **Use with caution** and monitor closely in hepatic impairment.

Intranasal: Clear nasal passages prior to use. May cause epistaxis and nasal irritation, which are usually transient. Taste and smell alterations, rare hypersensitivity reactions (angioedema, pruritis, urticaria, wheezing, dyspnea), and nasal septal perforation have been reported in postmarketing studies.



FLUTICASONE PREPARATIONS *continued*

Oral inhalation: Specific breath-activated dosage forms require the following minimum inspiratory flow rates for proper dose activation:

Arnuity Ellipta: 60 L/min

ArmonAir RespiClick: 30 L/min

Rinse mouth after each use. May cause dysphonia, oral thrush, and dermatitis. Esophageal candidiasis and hypersensitivity reactions have been reported. Compared to beclomethasone, has been shown to have less of an effect on suppressing linear growth in asthmatic children. Eosinophilic conditions may occur with the withdrawal or decrease of oral corticosteroids after the initiation of inhaled fluticasone.

FLUTICASONE PROPIONATE AND SALMETEROL

Advair Diskus, Advair HFA, AirDuo RespiClick, and generics

Corticosteroid and long acting β_2 -adrenergic agonist



C



2



No



Yes



No

Aerosol inhaler (MDI) (Advair HFA):

45 mCg fluticasone propionate + 21 mCg salmeterol per inhalation (8 g delivers 60 doses, 12 g delivers 120 doses)

115 mCg fluticasone propionate + 21 mCg salmeterol per inhalation (8 g delivers 60 doses, 12 g delivers 120 doses)

230 mCg fluticasone propionate + 21 mCg salmeterol per inhalation (8 g delivers 60 doses, 12 g delivers 120 doses)

Breath-activated DPI (Advair Diskus; contains lactose):

100 mCg fluticasone propionate + 50 mCg salmeterol per inhalation (14, 60 doses)

250 mCg fluticasone propionate + 50 mCg salmeterol per inhalation (14, 60 doses)

500 mCg fluticasone propionate + 50 mCg salmeterol per inhalation (14, 60 doses)

Breath-activated aerosol powder inhaler (AirDuo RespiClick; contains lactose):

55 mCg fluticasone propionate + 14 mCg salmeterol per inhalation (0.45 g delivers 60 doses)

113 mCg fluticasone propionate + 14 mCg salmeterol per inhalation (0.45 g delivers 60 doses)

232 mCg fluticasone propionate + 14 mCg salmeterol per inhalation (0.45 g delivers 60 doses)

Asthma:

Without prior inhaled steroid use:



Breath-activated (DPI; Advair Diskus):

4–11 yr: Start with one inhalation BID of 100 mCg fluticasone propionate + 50 mCg salmeterol.

≥12 yr and adult: Start with one inhalation BID of 100 mCg fluticasone propionate + 50 mCg salmeterol, OR 250 mCg fluticasone propionate + 50 mCg salmeterol; **max. dose:** one inhalation BID of 500 mCg fluticasone propionate + 50 mCg salmeterol.

Aerosol inhaler (MDI; Advair HFA):

≥12 yr and adult: Start with 2 inhalations BID of 45 mCg fluticasone + 21 mCg salmeterol,

OR 115 mCg fluticasone + 21 mCg salmeterol; **max. dose:** 2 inhalations BID of 230 mCg fluticasone + 21 mCg salmeterol.

Breath-activated aerosol powder inhaler (AirDuo RespiClick):

≥12 yr and adult: Start with 1 inhalation BID of 55 mCg fluticasone + 14 mCg salmeterol; **max. dose:** one inhalation BID of 232 mCg fluticasone propionate + 14 mCg salmeterol.

FLUTICASONE PROPIONATE AND SALMETEROL *continued*

With prior inhaled steroid use (conversion from other inhaled steroids; see following table and below):

Inhaled Corticosteroid	Current Daily Dose	Recommended Strength of Fluticasone Propionate + Salmeterol Diskus (DPI) (Advair Diskus)	Recommended Strength of Fluticasone Propionate + Salmeterol Aerosol Inhaler (MDI) (Advair HFA) Administered at Two Inhalations BID
		Administered at One Inhalation BID	
Beclomethasone dipropionate (Qvar Redihaler)	160 mCg	100 mCg + 50 mCg	45 mCg + 21 mCg
	320 mCg	250 mCg + 50 mCg	115 mCg + 21 mCg
	640 mCg	500 mCg + 50 mCg	230 mCg + 21 mCg
Budesonide	≤400 mCg	100 mCg + 50 mCg	45 mCg + 21 mCg
	800–1200 mCg	250 mCg + 50 mCg	115 mCg + 21 mCg
	1600 mCg	500 mCg + 50 mCg	230 mCg + 21 mCg
Flunisolide (Aerospan; HFA)	≤320 mCg	100 mCg + 50 mCg	45 mCg + 21 mCg
	640 mCg	250 mCg + 50 mCg	115 mCg + 21 mCg
Fluticasone propionate aerosol (HFA)	≤176 mCg	100 mCg + 50 mCg	45 mCg + 21 mCg
	440 mCg	250 mCg + 50 mCg	115 mCg + 21 mCg
	660–880 mCg	500 mCg + 50 mCg	230 mCg + 21 mCg
	≤200 mCg	100 mCg + 50 mCg	45 mCg + 21 mCg
Fluticasone propionate dry powder (DPI)	500 mCg	250 mCg + 50 mCg	115 mCg + 21 mCg
	1000 mCg	500 mCg + 50 mCg	230 mCg + 21 mCg
	220 mCg	100 mCg + 50 mCg	45 mCg + 21 mCg
Mometasone furoate	440 mCg	250 mCg + 50 mCg	115 mCg + 21 mCg
	880 mCg	500 mCg + 50 mCg	230 mCg + 21 mCg

DPI, Dry powder inhaler (breath activated); MDI, metered dose inhaler.

Breath-activated aerosol powder inhaler (AirDuo RespiClick): Select low (55 mCg fluticasone + 14 mCg salmeterol), medium (113 mCg fluticasone + 14 mCg salmeterol), or high (232 mCg fluticasone + 14 mCg salmeterol) dose strength based on the previous inhaled corticosteroid product or the strength of the inhaled corticosteroid from a combination product and disease severity. All dosage strengths are administered as one inhalation BID.

Max. doses:

Breath-activated (DPI; Advair Diskus): one inhalation BID of 500 mCg fluticasone propionate + 50 mCg salmeterol.

Aerosol inhaler (MDI; Advair HFA): two inhalations BID of 230 mCg fluticasone propionate + 21 mCg salmeterol.

Breath-activated aerosol powder inhaler (AirDuo RespiClick): one inhalation BID of 232 mCg fluticasone propionate + 14 mCg salmeterol.

Contraindicated with hypersensitivity to milk proteins. See Fluticasone Preparations and Salmeterol for remarks. Titrate to the lowest effective strength after asthma is adequately controlled.



FLUTICASONE PROPIONATE AND SALMETEROL *continued*

Specific breath-activated dosage forms require the following minimum inspiratory flow rates for proper dose activation:

Advair Diskus: 60 L/min

AirDuo RespiClick: 30 L/min

Proper patient education including dosage administration technique is essential; see patient package insert to specific dosage form for detailed instructions. Rinse mouth after each use.

FLUVOXAMINE

Generics; previously available as Luvox and Luvox CR

Antidepressant, selective serotonin reuptake inhibitor



C



2



No



Yes



Yes

Tabs: 25, 50, 100 mg

Extended-release capsules: 100, 150 mg

Obsessive compulsive disorder (use immediate-release tablets unless noted otherwise, see remarks):



8–17 yr: Start at 25 mg PO QHS. Dose may be increased by 25 mg/24 hr Q7–14 days (slower titration at Q2–4 wk may be used for minimizing behavioral side effects).

Total daily doses >50 mg/24 hr should be divided BID. Female patients may require lower dosages compared to males.

Max. dose: Child: 8–11 yr: 200 mg/24 hr; and child ≥12–17 yr: 300 mg/24 hr

Adult: Start at 50 mg PO QHS. Dose may be increased by 50 mg/24 hr Q4–7 days up to a **max. dose** of 300 mg/24 hr. Total daily doses >100 mg/24 hr should be divided BID with larger dose at bedtime.

Extended-release capsule (adult): Start at 100 mg PO QHS. Dose may be increased by 50 mg/24 hr Q7 days up to a **max. dose** of 300 mg/24 hr.

Contraindicated with coadministration of cisapride, pimozide, thioridazine, tizanidine, or MAO inhibitors. **Use with caution** in hepatic disease (dosage reduction may be necessary as drug is extensively metabolized by the liver) and in combination with serotonergic drugs (e.g., TCAs, triptans, fentanyl, lithium, tramadol, amphetamines, tryptophan, and St. John's Wort). Monitor for clinical worsening of depression and suicidal ideation/behavior following the initiation of therapy or after dose changes.



Major substrate for CYP 450 1A2 and 2D6. Poor metabolizers of CYP 450 2D6 should consider an initial dose reduction of 25%–50% and titrate to response or use an alternative medication not metabolized by this enzyme.

Inhibits CYP 450 1A2, 2C19, 2C9, 2D6, and 3A3/4, which may increase the effects or toxicity of drugs metabolized by these enzymes. Dose-related use of thioridazine with fluvoxamine may cause prolongation of QT interval and serious arrhythmias. May increase warfarin plasma levels by 98% and prolong PT. May increase toxicity and/or levels of theophylline, caffeine, and tricyclic antidepressants. Side effects include: headache, insomnia, somnolence, nausea, diarrhea, dyspepsia, and dry mouth.

Titrate to lowest effective dose. Use a gradual taper when discontinuing therapy to prevent withdrawal symptoms.

Consider the benefits to potential risk for maternal use in breastfeeding. Maternal use during pregnancy and postpartum may result in breastfeeding difficulties.

FOLIC ACID

FA-8 and many generics; previously available as Folvit
Water-soluble vitamin



Tabs [OTC]: 0.4, 0.8, 1 mg

Caps:

FA-8: 0.8 mg [OTC]

Generics: 5 mg, 20 mg

Oral solution: 0.05 mg/mL 1 mg/mL

Injection: 5 mg/mL (10 mL); contains 1.5% benzyl alcohol



For U.S. RDA, see **Chapter 21.**

Folic acid deficiency PO, IM, IV, SC:

Infant: 0.1 mg/24 hr once daily

Child <4 yr: 0.1–0.3 mg/24 hr once daily

Child ≥4 yr and adolescent: 0.1–0.4 mg/24 hr once daily

Adult: 0.4 mg/24 hr once daily

Pregnant and lactating women: 0.8 mg/24 hr once daily



Normal levels: see **Chapter 28.** May mask hematologic effects of vitamin B₁₂ deficiency, but will not prevent progression of neurologic abnormalities. High-dose folic acid may decrease the absorption of phenytoin.

Women of child-bearing age considering pregnancy should take at least 0.4 mg once daily before and during pregnancy to reduce risk of neural tube defects in the fetus. Pregnancy category changes to "C" if used in doses above the RDA.

FOMEPIZOLE

Antizol and generics

Antidote for ethylene glycol or methanol toxicity



Injection: 1 g/ mL (1.5 mL); preservative free



Child and adult not requiring hemodialysis (IV, all doses administered over 30 min):

Load: 15 mg/kg/dose × 1

Maintenance: 10 mg/kg/dose Q12 hr × 4 doses, then 15 mg/kg/dose Q12 hr until ethylene glycol or methanol level decreases to <20 mg/dL and the patient is asymptomatic with normal pH

Child and adult requiring hemodialysis (IV following the recommended doses at the intervals indicated here. Fomepizole is removed by dialysis. All doses administered IV over 30 min):

Dosing at the beginning of hemodialysis:

If <6 hr since last fomepizole dose: DO NOT administer dose.

If ≥6 hr since last fomepizole dose: Administer next scheduled dose.

Dosing during hemodialysis: Administer Q4 hr or, alternatively, 10–20 mg/kg loading dose, followed by a continuous infusion of 1–1.5 mg/kg/hr.

Dosing at the time hemodialysis is completed (based on the time between last dose and end of hemodialysis):

<1 hr: DO NOT administer dose at end of hemodialysis.

1–3 hr: Administer 1/2 of next scheduled dose.

>3 hr: Administer next scheduled dose.

Maintenance dose off hemodialysis: Give next scheduled dose 12 hr from last dose administered.

Continued

FOMEPIZOLE continued

Works by competitively inhibiting alcohol dehydrogenase. Safety and efficacy in pediatrics have not been established. **Contraindicated** in hypersensitivity to any components or other pyrazole compounds. Most frequent side effects include headache, nausea, and dizziness. Fomepizole is extensively eliminated by the kidneys (**use with caution** in renal failure) and removed by hemodialysis.

Drug product may solidify at temperatures $<25^{\circ}\text{C}$ (77°F); vial can be liquefied by running it under warm water (efficacy, safety, and stability are not affected). All doses must be diluted with at least 100 mL of D5W or NS to prevent vein irritation.

**FOSCARNET**

Foscavir and generics

Antiviral agent

C



3



Yes



No



No

Injection: 24 mg/mL (250 mL); preservative free

Contains 10 mEq Na/g drug

**HIV positive or exposed with the following infection (IV):****CMV disease:****Infant, child, and adolescent:**

Induction: 180 mg/kg/24 hr \div Q8–12 hr in combination with ganciclovir; continue until symptom improvement and convert to maintenance therapy

Maintenance: 90–120 mg/kg/dose Q24 hr

CMV retinitis (disseminated disease; IV):**Infant and child:**

Induction: 180 mg/kg/24 hr \div Q8–12 hr \times 14–21 days with or without ganciclovir

Maintenance: 90–120 mg/kg/24 hr once daily

Adolescent and adult:

Induction: 180 mg/kg/24 hr \div Q8–12 hr \times 14–21 days

Maintenance: 90–120 mg/kg/24 hr once daily

Acyclovir-resistant herpes simplex (limited data; IV):**Infant and child:** 40 mg/kg/dose Q8 hr or 60 mg/kg/dose Q12 hr for up to 3 wk or until lesions heal**Adolescent and adult:** 40 mg/kg/dose Q8–12 hr \times 14–21 days or until lesions heal**Varicella zoster unresponsive to acyclovir (IV):****Infant and child:** 40–60 mg/kg/dose Q8 hr \times 7–10 days**Adolescent:** 90 mg/kg/dose Q12 hr**Varicella zoster, progressive outer retinal necrosis (IV):****Infant and child:** 90 mg/kg/dose Q12 hr in combination with ganciclovir IV and intravitreal foscarnet with or without ganciclovir**Adolescent:** 90 mg/kg/dose every 12 hr in combination with IV ganciclovir and intravitreal foscarnet and/or ganciclovir**Intravitreal route for progressive outer retinal necrosis (HIV positive or exposed):****Child and adolescent:** 1.2 mg/0.05 mL or 2.4 mg/0.1 mL per dose 2–3 times weekly in combination with IV foscarnet and ganciclovir and/or intravitreal ganciclovir

Use with caution in patients with renal insufficiency and hypernatremia (large sodium content). **Discontinue** use in adults if serum Cr ≥ 2.9 mg/dL. **Adjust dose in renal failure** (see **Chapter 31**).



FOSCARNET continued

May cause peripheral neuropathy, seizures, neutropenia, esophageal ulceration, hallucinations, GI disturbance, increased LFTs, hypertension, chest pain, ECG abnormalities (QT interval prolongation has been reported), coughing, dyspnea, bronchospasm, and renal failure (adequate hydration and avoiding nephrotoxic medications may reduce risk). Hypocalcemia (increased risk if given with pentamidine), hypokalemia, and hypomagnesemia may also occur. Hypersensitivity reactions have been reported. Use with ciprofloxacin may increase risk for seizures.

Correction of dehydration and adequate hydration reduces the risk for nephrotoxicity. 10–20 mL/kg IV (**max. dose:** 1000 mL) of NS or D₅W should be administer prior to the first dose and concurrently with subsequent doses. For lower foscarnet dosage regimens of 40–60 mg/kg, use 50% of the aforementioned hydration recommendations. Actual hydration may need to be reduced when clinically indicated. Oral hydration methods may also be considered in patients who are able to tolerate.

For peripheral line IV administration, the concentration must be diluted to 12 mg/mL in NS or D₅W.

FOSPHENYTOIN

Cerebyx and generics

Anticonvulsant

D



3



Yes



Yes



Yes

Injection: 50 mg phenytoin equivalent (75 mg fosphenytoin)/1 mL (2, 10 mL)

1 mg phenytoin equivalent provides 0.0037 mmol phosphate

All doses are expressed as phenytoin sodium equivalents (PE) (see remarks for dose administration information):



Neonate, child, and adolescent: See Phenytoin and use the conversion of 1 mg phenytoin = 1 mg PE

Adult:**Loading dose:**

Status epilepticus: 20 mg PE/kg IV (**max. dose:** 1500 mg PE/dose)

Nonemergent loading: 10–20 mg PE/kg IV/IM

Nonemergent initial maintenance dose (initiated 12 hr after loading dose): 4–6 mg PE/kg/24 hr IV/IM ÷ Q12–24 hr

All doses should be prescribed and dispensed in terms of mg phenytoin sodium equivalents (PE) to avoid medication errors. Safety in pediatrics has not been fully established.



Contraindicated in patients with history of phenytoin or other hydantoin hypersensitivity. **Use with caution** in patients with renal or hepatic impairment and porphyria (consider amount of phosphate delivered by fosphenytoin in patients with phosphate restrictions). Drug is also metabolized to liberate small amounts of formaldehyde, which is considered clinically insignificant with short-term use (e.g., 1 wk). Side effects: hypokalemia (with rapid IV administration), slurred speech, dizziness, ataxia, rash, exfoliative dermatitis (e.g., TEN, SJS; increased risk with patients with HLA-B*1502 allele), nystagmus, diplopia, and tinnitus. Angioedema has been reported. Increased unbound phenytoin concentrations may occur in patients with renal disease or hypoalbuminemia; measure “free” or “unbound” phenytoin levels in these patients.

Abrupt withdrawal may cause status epilepticus. BP and ECG monitoring should be present during IV loading dose administration. **Max. IV infusion rate:** 2 mg PE/kg/min up to a **max.** of 150 mg PE/min. Administer IM via 1 or 2 injection sites and IM route is not recommended in status epilepticus.

Therapeutic levels: 10–20 mg/L (free and bound phenytoin) OR 1–2 mg/L (free only). Recommended peak serum sampling times: 4 hr following an IM dose or 2 hr following an IV dose.

See Phenytoin remarks for drug interactions and additional side effects. Drug is more safely administered via peripheral IV than phenytoin.

D

FUROSEMIDE
Lasix and generics
Loop diuretic



Tabs: 20, 40, 80 mg

Injection: 10 mg/mL (2, 4, 10 mL)

Oral solution: 10 mg/mL (60, 120 mL), 40 mg/5 mL (500 mL)

IM, IV:

Neonate (see remarks): 0.5–1 mg/kg/dose Q8–24 hr; **max. dose:** 2 mg/kg/dose

Infant and child: 1–2 mg/kg/dose Q6–12 hr; **max. dose:** 6 mg/kg/dose not to exceed 200 mg/dose

Adult: 20–40 mg/24 hr ÷ Q6–12 hr; **max. dose:** 200 mg/dose



PO:

Neonate: Bioavailability by this route is poor; doses of 1–3 mg/kg/dose once daily to BID have been used.

Infant and child: Start at 2 mg/kg/dose; may increase by 1–2 mg/kg/dose no sooner than 6–8 hr following the previous dose. **Max. dose:** 6 mg/kg/dose. Dosages have ranged from 1–6 mg/kg/dose Q12–24 hr.

Adult: 20–80 mg/dose Q6–12 hr; **max. dose:** 600 mg/24 hr

Continuous IV infusion:

Infant and child: 0.1 mg/kg IV bolus followed by 0.05–0.4 mg/kg/hr infusion and titrate to effect

Adult: 40–100 mg IV bolus followed by 10–40 mg/hr infusion and titrate to effect



Contraindicated in anuria and hepatic coma. **Use with caution** in hepatic disease (hepatic encephalopathy has been reported); cirrhotic patients may require higher than usual doses. Ototoxicity may occur in presence of renal disease (especially when used with aminoglycosides and other nephrotoxic drugs), with rapid IV injection (do not infuse >4 mg/min in adults), or with hypoproteinemia. May cause hypokalemia, alkalosis, dehydration, hyperuricemia, and increased calcium excretion. Rash with eosinophilia and systemic symptoms and acute generalized exanthematous pustulosis have been reported. Prolonged use in premature infants and in children <4 yr may result in nephrocalcinosis. May increase risk for PDA in premature infants during the first week of life.

Furosemide-resistant edema in pediatric patients may benefit with the addition of metolazone. Some of these patients may have an exaggerated response leading to hypovolemia, tachycardia, and orthostatic hypotension requiring fluid replacement. Severe hypokalemia has been reported with a tendency for diuresis persisting for up to 24 hr after discontinuing metolazone, prolonged use of laxatives, or concomitant use of corticosteroids, ACTH, and large amounts of licorice.

High doses of furosemide may inhibit binding of thyroid hormones to carrier proteins and result in transient increase in free thyroid hormones followed by an overall decrease in total thyroid hormone levels.

Max. rate of intermittent IV dose: 0.5 mg/kg/min. For patients receiving ECMO, **do not** administer IV doses directly into the ECMO circuit as the medication is absorbed in the circuit, which may result in diminished effects and the need for higher doses.

Pregnancy category changes to "D" if used in pregnancy-induced hypertension.

G**GABAPENTIN**

Neurontin, Gralise, Horizant and generics

Anticonvulsant**Caps:** 100, 300, 400 mg**Tabs:** 300, 600, 800 mg

Slow-release/extended-release tabs (these dosage forms are **not** interchangeable with other gabapentin products due to different pharmacokinetic profiles affecting the dosing interval; see specific product information for specific indications for use and dosage):

Gralise: 300, 600 mg

Horizant (Gabapentin Enacarbil): 300, 600 mg

Oral solution: 250 mg/5 mL (470 mL)

Seizures, adjunctive therapy (maximum time between doses should not exceed 12 hr):

3–<12 yr (PO, see remarks):

Day 1: 10–15 mg/kg/24 hr ÷ TID, then gradually titrate dose upward to the following dosages over a 3-day period:

3–4 yr: 40 mg/kg/24 hr ÷ TID

≥5–<12 yr: 25–35 mg/kg/24 hr ÷ TID

Dosages up to 50 mg/kg/24 hr have been well tolerated.

≥12 yr and adult (PO, see remarks): Start with 300 mg TID; if needed, increase dose up to 1800 mg/24 hr ÷ TID. Usual effective doses: 900–1800 mg/24 hr ÷ TID. Doses as high as 3.6 g/24 hr have been tolerated.

**Neuropathic pain:****Child (PO; limited data):**

Day 1: 5 mg/kg/dose (**max.** 300 mg/dose) at bedtime

Day 2: 5 mg/kg/dose (**max.** 300 mg/dose) BID

Day 3: 5 mg/kg/dose (**max.** 300 mg/dose) TID; then titrate dose to effect. Usual dosage range: 8–35 mg/kg/24 hr ÷ TID.

Maximum daily dose of 3600 mg/24 hr has been suggested but not formally evaluated.

Adult (PO):

Day 1: 300 mg at bedtime

Day 2: 300 mg BID

Day 3: 300 mg TID; then titrate dose to effect. Usual dosage range: 1800–2400 mg/24 hr; **max. dose:** 3600 mg/24 hr.

Post-herpetic neuralgia: the above dosage regimen may be titrated up PRN for pain relief to a daily dose of 1800 mg/24 hr ÷ TID (efficacy has been shown from 1800 to 3600 mg/24 hr, however no additional benefit has been shown for doses >1800 mg/24 hr). The Gralise dosage form is designed for once daily administration with the evening meals; whereas the Horizant dosage form is dosed once daily—BID. See specific product information for details.

Generally used as adjunctive therapy for partial and secondary generalized seizures, and neuropathic pain.

Somnolence, dizziness, ataxia, fatigue, and nystagmus were common when used for seizures (≥ 12 yr). Viral infections, fever, nausea and/or vomiting, somnolence, and hostility have been reported in patients 3–12 yr receiving other antiepileptics. Dizziness, somnolence, and peripheral edema are common side effects in adult with post-herpetic neuralgia. Suicidal behavior or ideation, agitation, and multi-organ hypersensitivity (e.g., anaphylaxis, angioedema, or drug reaction with eosinophilia and systemic symptoms [DRESS]) have been reported.

**D***Continued*

GABAPENTIN *continued*

Do not withdraw medication abruptly (gradually over a minimum of 1 wk). Drug is not metabolized by the liver and is primarily excreted in the urine unchanged. Higher doses may be required for children <5 yr because of faster clearance in this age group.

May be taken with or without food. In TID dosing schedule, **interval between doses should not exceed 12 hr. Adjust dose in renal impairment (see Chapter 31).**

GANCICLOVIR

Cytovene, Zirgan and generics

Antiviral agent



Injection (Cytovene and generics): 500 mg; contains 4 mEq Na per 1 g drug

Injection in solution: 500 mg/10 mL (10 mL)

Ophthalmic gel (drops):

Zirgan: 0.15% (5 g); contains benzalkonium chloride.

Cytomegalovirus (CMV) infections:

Neonate (congenital CMV): 12 mg/kg/24 hr ÷ Q12 hr IV × 6 wk or longer if HIV positive

Child >3 mo and adult:

Induction therapy (duration 14–21 days): 10 mg/kg/24 hr ÷ Q12 hr IV

IV maintenance therapy: 5 mg/kg/dose once daily IV for 7 days/wk or 6 mg/kg/dose once daily IV for 5 days/wk

**Prevention of CMV in transplant recipients:**

Child and adult:

Induction therapy (duration 7–14 days): 10 mg/kg/24 hr ÷ Q12 hr IV

IV maintenance therapy: 5 mg/kg/dose once daily IV for 7 days/wk or 6 mg/kg/dose once daily IV for 5 days/wk for 100–120 days post-transplant

Prevention of CMV in HIV-infected individuals (see www.aidsinfo.nih.gov for latest recommendations and guidelines for CMV treatment as well):**Recurrence prophylaxis:**

Infant, child, adolescent, and adult: 5 mg/kg/dose IV once daily. Consider valganciclovir as an oral alternative.

Herpetic keratitis (ophthalmic gel/drops):

≥2 yr and adult: Apply 1 drop onto affected eye(s) 5 times a day (~Q3 hr while awake) until corneal ulcer is healed, then 1 drop TID × 7 days.



Limited experience with use in children <12 yr old. **Contraindicated** in severe neutropenia

(ANC < 500/microliter) or severe thrombocytopenia (platelets < 25,000/microliter). **Use with extreme caution. Reduce dose in renal failure (see Chapter 31).** Has not been evaluated in hepatic impairment. For oral route of administration, see Valganciclovir.

Common side effects: neutropenia, thrombocytopenia, retinal detachment, and confusion. Drug reactions alleviated with dose reduction or temporary interruption. Ganciclovir may increase didanosine and zidovudine levels, whereas didanosine and zidovudine may decrease ganciclovir levels.

Immunosuppressive agents may increase hematologic toxicities. Amphotericin B, cyclosporine and tacrolimus increases risk for nephrotoxicity. Imipenem/cilastatin may increase risk for seizures.

May cause female and male infertility.

Minimum dilution is 10 mg/mL and should be infused IV over ≥1 hr. IM and SC administration are **contraindicated** because of high pH of 11.

GATIFLOXACINZymaxid and generics
Antibiotic, quinolone**Ophthalmic solution:** 0.5% (2.5 mL); may contain benzalkonium chloride

Previously available as a 0.3% ophthalmic solution (Zymar).

Conjunctivitis:**≥1 yr–adult:** Instill 1 drop to affected eye(s) Q2 hr while awake (up to 8 times/24 hr) for the first day, then 1 drop BID–QID while awake on days 2–7.

Worsening of conjunctivitis, decreased visual acuity, excessive tear production, and keratitis are common side effects. Conjunctival hemorrhage has been reported.

**Avoid** touching the applicator tip to eye, fingers, or other surfaces, and **do not** wear contact lenses during treatment of ocular infections. Apply pressure to the lacrimal sac during and for 1–2 min after dose administration to reduce risk of systemic absorption.**GCSF**

See Filgrastim

GENTAMICINGentak and generics; previously available as Garamycin
Antibiotic, aminoglycoside**Injection:** 10 mg/mL (2 mL, preservative free), 40 mg/mL (2, 20 mL); some products may contain sodium metabisulfite**Pre-mixed injection in NS:** 40 mg (50 mL), 60 mg (50 mL), 80 mg (50, 100 mL), 100 mg (50, 100 mL), 120 mg (100 mL)**Ophthalmic ointment (Gentak and generics):** 0.3% (3.5 g); may contain parabens**Ophthalmic drops:** 0.3% (5 mL)**Topical ointment:** 0.1% (15, 30 g)**Topical cream:** 0.1% (15, 30 g)**Initial empiric dosage; patient-specific dosage defined by therapeutic drug monitoring (see remarks).****Parenteral (IM or IV):****Neonate/Infant (see table below):**

Post-conceptional Age (wk)	Postnatal Age (days)	Dose (mg/kg/dose)	Interval (hr)
≤29 ^a	0–7	5	48
	8–28	4	36
	>28	4	24
30–34	0–7	4.5	36
	>7	4	24
≥35	ALL	4	24 ^b

^aOr significant asphyxia, patent ductus arteriosus (PDA), indomethacin use, poor cardiac output, reduced renal function.^bUse Q36 hr interval for hypoxic-ischemic encephalopathy (HIE) patients receiving whole-body therapeutic cooling.*Continued*

GENTAMICIN *continued***Child:** 7.5 mg/kg/24 hr ÷ Q8 hr**Adult:** 3–6 mg/kg/24 hr ÷ Q8 hr**Cystic Fibrosis:** 7.5–10.5 mg/kg/24 hr ÷ Q8 hr**Intrathecal/intraventricular (use preservative-free product only):****Newborn:** 1 mg once daily**>3 mo:** 1–2 mg once daily**Adult:** 4–8 mg once daily**Ophthalmic ointment:** Apply 0.5 inch ribbon to the conjunctival sac of the affected eye(s) Q8–12 hr**Ophthalmic drops:** Instill 1–2 drops to affected eye(s) Q2–4 hr**Topical cream or ointment:****>1 yr and adult:** Apply to affected area TID–QID

Use with caution in patients receiving anesthetics or neuromuscular blocking agents, and in patients with neuromuscular disorders. May cause nephrotoxicity and ototoxicity.



Ototoxicity may be potentiated with the use of loop diuretics. Eliminated more quickly in patients with cystic fibrosis, neutropenia, and burns. **Adjust dose in renal failure (see Chapter 31).** Monitor peak and trough levels.

Therapeutic peak levels are 6–10 mg/L in general, and 8–10 mg/L in pulmonary infections, cystic fibrosis, neutropenia, osteomyelitis, and severe sepsis.

To maximize bactericidal effects, an individualized peak concentration to target a peak/minimal inhibitory concentration (MIC) ratio of 8–10:1 may be applied.

Therapeutic trough levels: <2 mg/L. Recommended serum sampling time at steady state: trough within 30 min prior to the 3rd consecutive dose and peak 30–60 min after the administration of the 3rd consecutive dose.

For initial dosing in obese patients, use an adjusted body weight (ABW). ABW = Ideal Body Weight + 0.4 (Total Body Weight – Ideal Body Weight).

Pregnancy category is a “C” for ophthalmic use, a “D” with IV use, and not classified for topical use.

GLUCAGON HCL

Glucagen, Glucagon Emergency Kit, Baqsimi, and generics

Antihypoglycemic agent

B

1

No

No

No

Injection: 1 mg vial (requires reconstitution)**Nasal powder (Baqsimi):** 3 mg/dose (1 or 2 pack); contains betadex and dodecylphosphocholine
1 unit = 1 mg**Hypoglycemia (see remarks):****Injectable route (IM, IV, SC):****Neonate, infant, and child <20 kg:** 0.5 mg/dose (or 0.02–0.03 mg/kg/dose) Q20 min PRN**Child ≥20 kg and adult:** 1 mg/dose Q20 min PRN**Intranasal route (see remarks):****≥4 yr and adult:** Actuate 3 mg intranasally into one nostril × 1. If no response after 15 min, an additional 3 mg dose may be given.**β-blocker and calcium channel blocker overdose:** Load with 0.05–0.15 mg/kg IV (usually about 10 mg in adults) over 1 min followed by an IV infusion of 0.05–0.1 mg/kg/hr.

Alternatively, 5 mg IV bolus Q5–10 min PRN up to 4 doses. If patient is responsive at a particular bolus dose, initiate an hourly IV infusion at that same responsive dose. For example, if the patient responded at 10 mg, then start an infusion of 10 mg/hr.

GLUCAGON HCL *continued*

Contraindicated in insulinoma, pheochromocytoma, and history of hypersensitivity to glucagon and components. Drug product is genetically engineered and identical to human glucagon. High doses have a cardiac stimulatory effect and have been used with some success in β -blocker and calcium channel blocker overdose. May cause nausea, vomiting, urticaria, and respiratory distress. Necrolytic migratory erythema (NME) has been reported with continuous IV infusion; assess benefit/risk for continued use.

Do not delay glucose infusion; dose for hypoglycemia is 2–4 mL/kg of dextrose 25%.

Glucagon may increase the effects/toxicity of warfarin. Indomethacin use may decrease the effects of glucagon.

Sufficient hepatic glycogen is necessary for effect; patients in states of starvation, with adrenal or chronic hypoglycemia, may not have adequate levels of glycogen. Onset of action: IM: 8–10 min; IV: 1 min. Duration of action: IM: 12–27 min; IV: 9–17 min.

INTRANASAL USE: See product information for dose administration instructions. Dose does not need to be inhaled and can be administered if the patient has nasal congestion or the common cold. Common side effects include nausea, vomiting, headache, rhinorrhea, nasal discomfort/congestion, cough, epistaxis, and irritation to the eyes, nose, and throat. In type-1 pediatric diabetes trials, the time to increase glucose ≥ 20 mg/dL from nadir was 11–15 min and peak plasma levels were achieved in 15–20 min with a median $T_{1/2}$: of 21–31 min.

GLYCERIN

Pedia-Lax, Sani-Supp, Fleet Liquid Glycerin Supp, and others including generics

Osmotic Laxative



Rectal solution (Fleet Liquid Glycerin Supp and generics; OTC): each dose contains 7.5 mL to deliver 5.4 mL of glycerin on average (box of 4)

Suppository (OTC):

Infant/pediatric:

Pedia-Lax and generics: 1 g (12s, 25s)

Sani-Supp Pediatric and generics: 1.2 g (12s, 25s)

Adult:

Sani-Supp Adult and generics: 2 g (12s, 24s, 25s, 50s)

Constipation:

Neonate: 0.5 mL/kg/dose rectal solution PR as an enema once daily PRN or sliver/chip of infant/pediatric suppository PR once daily PRN

Child <6 yr: 2–5 mL rectal solution PR as an enema or 1 infant/pediatric suppository PR once daily PRN

>6 yr—adult: 5–15 mL rectal solution PR as an enema or 1 adult suppository PR once daily PRN

Onset of action: 15–30 min. May cause rectal irritation, abdominal pain, bloating, and dizziness. Insert suppository high into rectum and retain for 15 min.



GLYCOPYRRROLATE

Cuvposa and generics; previously available as Robinul
Anticholinergic agent



Tabs: 1, 1.5, 2 mg

Oral solution (Cuvposa): 1 mg/5 mL (473 mL); contains propylene glycol, and parabens

Injection: 0.2 mg/mL (1, 2, 5, 20 mL); some multidose vials contain 0.9% benzyl alcohol

Respiratory antisecretory:**IM/IV:**

Child: 0.004–0.01 mg/kg/dose TID–QID

Adult: 0.1–0.2 mg/dose TID–QID

Max. dose: 0.2 mg/dose or 0.8 mg/24 hr

Oral:

Child: 0.04–0.1 mg/kg/dose TID–QID

Alternative dosage for 3–16 yr old with chronic severe drooling secondary to neurological conditions:

Start with 0.02 mg/kg/dose PO TID and titrate in increments of 0.02 mg/kg/dose every 5–7 days as needed and tolerated up to a **max. dose** of 0.1 mg/kg/dose TID not exceed 1.5–3 mg/dose.

Adult: 1–2 mg/dose BID–TID

Reverse neuromuscular blockade:

Child and adult: 0.2 mg IV for every 1 mg neostigmine or 5 mg pyridostigmine



Use with caution in hepatic and renal disease, ulcerative colitis, asthma, glaucoma, ileus, or urinary retention. Atropine-like side effects: tachycardia, nausea, constipation, confusion, blurred vision, and dry mouth. These may be potentiated if given with other drugs with anticholinergic properties.

Onset of action: PO: within 1 hr; IM/SC: 15–30 min; IV: 1 min. Duration of antisialagogue effect: PO: 8–12 hr; IM/SC/IV: 7 hr. Oral doses should be administered 1 hr before and 2 hr after meals.

Pregnancy category is “B” for the injection and tablet dosage forms and “C” for the oral solution.

GRANISETRON

Sancuso, Sustol, and generics; previously available as Kytril
Antiemetic agent, 5-HT₃ antagonist



Injection: 1 mg/mL (1, 4 mL); 4 mL multi-dose vials contain benzyl alcohol

Prefilled syringe for subcutaneous extended-release injection (Sustol): 10 mg/0.4 mL (0.4 mL); contains propylene glycol

Tabs: 1 mg

Oral suspension: 0.2 mg/mL (50 mCg/mL)

Transdermal patch (Sancuso): 3.1 mg/24 hr

Chemotherapy-induced nausea and vomiting:**IV:**

Child ≥2 yr and adult: 10–20 mCg/kg/dose 15–60 min before chemotherapy; the same dose may be repeated 2–3 times at ≥10-min intervals following chemotherapy (within 24 hr after chemotherapy) as a treatment regimen. **Max. dose:** 3 mg/dose or 9 mg/24 hr. Alternatively, a single 40 mCg/kg/dose 15–60 min before chemotherapy has been used.

SC (Sustol):

Adult: 10 mg at least 30 min prior to first dose of moderately emetogenic chemotherapy used in combination with dexamethasone. **Do not** administer more frequently than Q7 days.

GRANISETRON *continued***PO:**

Infant, child, and adolescent: 40 mcg/kg/dose BID is recommended for moderately emetogenic chemotherapy; initiate first dose 1 hr prior to chemotherapy

Adult: 2 mg/24 hr ÷ once daily–BID; initiate first dose 1 hr prior to chemotherapy

Post-operative nausea and vomiting prevention (dosed prior to anesthesia or immediately before anesthesia reversal) and treatment (IV; see remarks):

Adult: 1 mg × 1

Radiation-induced nausea and vomiting prevention:

Adult: 2 mg once daily PO administered within 1 hr of radiation

Transdermal patch (see remarks):

Prophylaxis for chemotherapy-induced nausea and vomiting (adult): Apply 1 patch 24–48 hr prior to chemotherapy. Patch removal at a minimum of 24 hr after completion of chemotherapy. Patch may be worn up to 7 days, depending on the chemotherapy regimen duration.

Use with caution in liver disease and preexisting cardiac conduction disorders and arrhythmias. May cause hypertension, hypotension, arrhythmias, agitation, and insomnia.

Inducers or inhibitors of the CYP 450 3A3/4 drug metabolizing enzymes may increase or decrease, respectively, the drug's clearance. QT prolongation has been reported.

Safety and efficacy in pediatric patients for the prevention of postoperative nausea and vomiting has not been established due to lack of efficacy and QT prolongation in a prospective multicenter, randomized double blinded trial in 157 patients aged 2–16 yr.

Avoid external heat sources (e.g., heating pads) on and around the transdermal patch dosage form as heat may increase the rate of drug release. Application site reactions of pain, pruritus, rash, irritation, vesicles, and discoloration has been reported with transdermal patch use.

Onset of action: IV: 4–10 min. Duration of action: IV: ≤24 hr.

**GRISEOFULVIN**

Microsize: Generics; previously available as Grifulvin V,

Griseofulvin Microsize

Ultramicrosize: Generics; previously available as Gris-PEG

Antifungal agent



X



3



No



Yes



No

Microsize:

Tabs: 125, 250, 500 mg

Oral suspension: 125 mg/5 mL (120 mL); contains 0.2% alcohol, parabens and propylene glycol

Ultramicrosize:

Tabs: 125, 250 mg

250 mg ultramicrosize is approximately 500 mg microsize

**Microsize:**

Child >2 yr and adolescent: 20–25 mg/kg/24 hr PO ÷ once daily–BID; give with milk, eggs, fatty foods

Adult: 500–1000 mg/24 hr PO ÷ once daily–BID

Max. dose (all ages): 1 g/24 hr

Ultramicrosize:

Child >2 yr and adolescent: 10–15 mg/kg/24 hr PO ÷ once daily–BID

Adult: 375 mg/dose PO once daily or BID

Max. dose (all ages): 750 mg/24 hr

Continued

GRISEOFULVIN *continued*

Contraindicated in porphyria, pregnancy, and hepatic disease. Monitor hematologic, renal, and hepatic function. May cause leukopenia, rash, headache, paresthesias, and GI symptoms. Severe skin reactions (e.g., Stevens-Johnson, TEN), erythema multiforme, LFT elevations (AST, ALT, bilirubin), and jaundice have been reported. Possible cross-reactivity in penicillin-allergic patients. Usual treatment period is 8 wk for tinea capitis and 4–6 mo for tinea unguium. Photosensitivity reactions may occur. May reduce effectiveness or decrease level of oral contraceptives, warfarin, and cyclosporine. Induces CYP 450 1A2 isoenzyme. Phenobarbital may enhance clearance of griseofulvin. Coadministration with fatty meals will increase the drug's absorption.

**GUANFACINE**

Intuniv and generics

 α_2 -adrenergic agonist

B



3



Yes



Yes



No

Tabs: 1, 2 mg

Extended-release tabs: 1, 2, 3, 4 mg

**Attention-deficit hyperactivity disorder (see remarks):****Immediate-release tab:** **≥ 6 yr and adolescent:**

≥ 45 kg: Start at 0.5 mg QHS, if needed and tolerated, increase dose every 3–4 days at 0.5 mg/24 hr increments by increasing the dosing frequency to BID, TID, QID. **Max. dose:** 27–40.5 kg: 2 mg/24 hr and 40.5–45 kg: 3 mg/24 hr.

>45 kg: Start at 1 mg QHS, if needed and tolerated, increase dose every 3–4 days at 1 mg/24 hr increments by increasing the dosing frequency to BID, TID, QID. **Max. dose:** 4 mg/24 hr.

Extended-release tab:

6–17 yr: Start at 1 mg Q24 hr, if needed and tolerated, increase dose no more than 1 mg per week up to the **max. dose** of 4 mg/24 hr for 6–12 yr and 7 mg/24 hr for 13–17 yr.

Use with strong CYP 450 3A4 inhibitors or inducers:

CYP 450 3A4 Characteristic	Adding Guanfacine With Respective CYP 450 3A4 Inducer/Inhibitor Already on Board	Adding Respective CYP 450 3A4 Inducer/Inhibitor With Guanfacine Already on Board
Strong inducer (e.g., carbamazepine, phenytoin, rifampin, St. John's Wort)	Guanfacine may be titrated up to double the recommended target dose.	Consider increasing guanfacine dose up to double the recommended target dose over 1–2 wk as tolerated. If the strong inducer is discontinued, decrease guanfacine dose to target dose over 1–2 wk.
Strong inhibitor (e.g., clarithromycin, azole antifungals)	Decrease guanfacine dose to 50% of recommended target dose.	Decrease guanfacine dose to 50% of recommended target dose. If the strong inhibitor is discontinued, increase guanfacine dose to recommended target dose.

GUANFACINE *continued*

Use with caution in patients at risk for hypotension, bradycardia, heart block, and syncope. A dose-dependent hypotension and bradycardia may occur. Somnolence, fatigue, insomnia, dizziness, and abdominal pain are common side effects. Orthostatic hypotension, hallucinations, syncope, and erectile dysfunction have been reported.



Drug is a substrate for CYP 450 3A4. See dosing section for dosage adjustment with inhibitors and inducers.

Do not abruptly discontinue therapy (may cause rebound hypertension); taper of no more than 1 mg Q3–7 days has been recommended. Dose reductions may be required with clinically significant renal or hepatic impairment. When converting from an immediate-release tab to the extended-release tab, **do not** covert on a mg per mg basis (due to differences in pharmacokinetic profiles) but discontinue the immediate release and titrate with the extended-release product using the recommended dosing schedules.

H

HALOPERIDOL

Haldol, Haldol Decanoate, and generics

Antipsychotic agent



C



3



Yes



Yes



Yes

Injection (IM use only):

Lactate: 5 mg/mL (1, 10 mL); may contain parabens

Decanoate (long acting): 50, 100 mg/mL (1, 5 mL); in sesame oil with 1.2% benzyl alcohol

Tabs: 0.5, 1, 2, 5, 10, 20 mg

Oral solution: 2 mg/mL (15, 120 mL)

**Child 3–12 yr (see remarks):**

PO: Initial dose at 0.5 mg/24 hr ÷ BID–TID. If necessary, increase daily dosage by 0.25–0.5 mg/24 hr Q5–7 days PRN. Benefits are not to be expected for doses beyond 6 mg/24 hr. Usual maintenance doses for specific indications include the following:

Agitation: 0.01–0.03 mg/kg/24 hr once daily PO

Psychosis: 0.05–0.15 mg/kg/24 hr ÷ BID–TID PO

Tourette's syndrome: 0.05–0.075 mg/kg/24 hr ÷ BID–TID PO; may increase daily dose by 0.5 mg Q5–7 days

IM, as lactate, for 6–12 yr: 1–3 mg/dose Q4–8 hr; **max. dose:** 0.15 mg/kg/24 hr

>12 yr:

Acute agitation: 2–5 mg/dose IM as lactate or 1–15 mg/dose PO; repeat in 1 hr PRN

Psychosis: 2–5 mg/dose Q4–8 hr IM PRN or 1–15 mg/24 hr ÷ BID–TID PO

Tourette's syndrome: 0.5–2 mg/dose BID–TID PO; 3–5 mg/dose BID–TID PO may be used for severe symptoms



Contraindicated in severe toxic CNS depression, comas, Parkinson disease, and dementia Lewy bodies. **Use with caution** in patients with cardiac disease (risk of hypotension), renal or hepatic dysfunction, thyrotoxicosis, and in patients with epilepsy since the drug lowers the seizure threshold. Extrapyramidal symptoms, drowsiness, headache, tachycardia, ECG changes, nausea, and vomiting can occur. Higher than recommended doses are associated with a higher risk of QT-prolongation and torsades de pointes. Leukopenia/neutropenia, including agranulocytosis and rhabdomyolysis (IM route), and transient dyskinetic signs (following abrupt withdrawal from maintenance therapies) have been reported.

HALOPERIDOL *continued*

Drug is metabolized by CYP 450 1A2, 2D6, and 3A3/4 isoenzymes. May also inhibit CYP 450 2D6 and 3A3/4 isoenzymes. Serotonin-specific reuptake inhibitors (e.g., fluoxetine) may increase levels and effects of haloperidol. Carbamazepine and phenobarbital may decrease levels and effects of haloperidol. Monitor for encephalopathic syndrome when used in combination with lithium.

For poor metabolizers of CYP 450 2D6, consider a 50% reduction of initial dose and titrate to response, OR use an alternative medication not metabolized by this enzyme system.

Acutely aggravated patients may require doses as often as Q60 min. **Decanoate salt is given every 3–4 wk in doses that are 10–15 times the individual patient's stabilized oral dose.**

HEPARIN SODIUM

Various generics

Anticoagulant**Injection:**

Porcine intestinal mucosa: 1000, 5000, 10,000, 20,000 U/mL (some products may be preservative-free; multidosed vials contain benzyl alcohol)

Lock flush solution (porcine based): 10, 100 U/mL (some products may be preservative-free or contain benzyl alcohol)

Injection for IV infusion (porcine based):

D₅W: 40 U/mL (500 mL), 50 U/mL (250, 500 mL), 100 U/mL (100, 250 mL); contains bisulfite

NS (0.9% NaCl): 2 U/mL (500, 1000 mL)

0.45% NaCl: 50 U/mL (250, 500 mL), 100 U/mL (250 mL); contains EDTA

120 U = approximately 1 mg

**Anticoagulation empiric dosage:**

Continuous IV infusion (initial doses for goal unfractionated heparin (UFH) anti-Xa level of 0.3–0.7 units/mL):

Age	Loading Dose (IV) ^a	Initial IV infusion Rate (units/kg/hr)
Neonate and infant <1 yr	75 U/kg IV	28
Child age 1–16 yr	75 U/kg IV (max. dose: 8000 U)	20 (max. initial rate: 1650 U/hr)
>16 yr	70 U/kg IV (max. dose: 8000 U)	16 (max. initial rate: 1650 U/hr)

^aDo not give loading dose for patients with stroke or significant bleeding risk and obtain aPTT 4 hr after loading dose.

DVT or PE prophylaxis:

Adult: 5000 U/dose SC Q8–12 hr until ambulatory

Heparin flush (doses should be less than heparinizing dose):

Younger child: lower doses should be used to avoid systemic heparinization.

Older child and adult:

Peripheral IV: 1–2 mL of 10 U/mL solution Q4 hr

Central lines: 2–3 mL of 100 U/mL solution Q24 hr

TPN (central line) and arterial line: add heparin to make final concentration of 0.5–1 U/mL.

Contraindicated in active major bleeding, known or suspected HIT, and concurrent epidural therapy. **Use with caution** if platelets <50,000/mm³. **Avoid** IM injections and other medications affecting platelet function (e.g., NSAIDs and ASA). Toxicities include bleeding, allergy, alopecia, and thrombocytopenia.



Adjust dose with one of the following laboratory goals:

Unfractionated heparin (UFH) anti-Xa level: 0.3–0.7 units/mL

aPTT level (reagent specific to reflect anti-Xa level of 0.3–0.7 units/mL): 50–80 sec.

HEPARIN SODIUM *continued*

These laboratory measurements are best measured 4–6 hr after initiation or changes in infusion rate.

Do not collect blood levels from the heparinized line or same extremity as site of heparin infusion.

If unfractionated heparin anti-Xa or aPTT levels are not available, a ratio of aPTT 1.5–2.5 times control value has been used in the past. Unfractionated heparin anti-Xa level is NOT THE SAME as low molecular weight heparin anti-Xa (used for monitoring low molecular weight heparin products such as enoxaparin).

Use with IV nitroglycerin may decrease the partial thromboplastin time (PTT) with subsequent rebound upon discontinuation of nitroglycerin. Antithrombin III (human) and NSAIDs may increase heparin's anticoagulant effects and bleeding risk.

Use preservative-free heparin in neonates. **Note:** heparin flush doses may alter aPTT in small patients; consider using more dilute heparin in these cases.

Use actual body weight when dosing obese patients. Due to recent regulatory changes to the manufacturing process, heparin products may exhibit decreased potency.

Antidote: Protamine sulfate (1 mg per 100 U heparin in previous 4 hr). For low molecular weight heparin (LMWH), see Enoxaparin.

HYALURONIDASE

Amphadase, Hylenex, and Vitrase

Antidote, extravasation



Injection:

Amphadase: 150 U/mL (1 mL); bovine source; contains edetate disodium and thimerosal
Hylenex: 150 U/mL (1 mL); recombinant human source; contains 1 mg albumin, 1.5 mg L-methionine, and 0.2 mg polysorbate 80 per 150 U

Vitrase: 200 U/mL (1.2 mL); ovine source containing lactose, preservative-free

Pharmacy can make a 15 U/mL dilution.

Extravasation:

Infant and child: Give 1 mL (150 U) by injecting 5 separate injections of 0.2 mL (30 U) at borders of extravasation site SC or intradermal using a 25- or 26-gauge needle. Alternatively, a diluted 15 U/mL concentration has been used with the same dosing instructions.



Contraindicated in dopamine and alpha-agonist extravasation and hypersensitivity to the respective product sources (bovine or ovine). May cause urticaria. Patients receiving large amounts of salicylates, cortisone, ACTH, estrogens, or antihistamines may decrease the effects of hyaluronidase (larger doses may be necessary). Administer as early as possible (minutes to 1 hr) after IV extravasation.

Hylenex product is chemically incompatible with sodium metabisulfite, furosemide, benzodiazepines, and phenytoin.

HYDRALAZINE HYDROCHLORIDE

Generics; previously available as Apresoline

Antihypertensive, vasodilator



Tabs: 10, 25, 50, 100 mg

Injection: 20 mg/mL (1 mL)

Oral liquid: 4 mg/mL

Some dosage forms may contain tartrazines or sulfites.

HYDRALAZINE HYDROCHLORIDE *continued*

Hypertensive crisis (may result in severe and prolonged hypotension; see Chapter 1, Table 1.7 for alternatives):



Child: 0.1–0.2 mg/kg/dose IM or IV Q4–6 hr PRN; **max. dose:** 20 mg/dose. Usual IV/IM dosage range is 1.7–3.5 mg/kg/24 hr.

Adult: 10–20 mg IM or IV Q4–6 hr PRN; may increase to **max. dose** of 40 mg/dose if needed

Chronic hypertension:

Infant and child: Start at 0.75–1 mg/kg/24 hr PO ÷ Q6–12 hr (**max. initial dose:** 10 mg/dose). If necessary, increase dose over 3–4 wk up to a **max. dose** of 5 mg/kg/24 hr for infants and 7.5 mg/kg/24 hr for children; or 200 mg/24 hr.

Adult: 10–50 mg/dose PO QID; **max. dose:** 300 mg/24 hr

Use with caution in severe renal and cardiac disease. Slow acetylators, patients receiving high-dose chronic therapy, and those with renal insufficiency are at highest risk of lupus-like syndrome (generally reversible). May cause reflex tachycardia, palpitations, dizziness, headaches, and GI discomfort. MAO inhibitors and beta-blockers may increase hypotensive effects. Indomethacin may decrease hypotensive effects.



Drug undergoes first pass metabolism. Onset of action: PO: 20–30 min; IV: 5–20 min. Duration of action: PO: 2–4 hr; IV: 2–6 hr. **Adjust dose in renal failure** (see Chapter 31).

HYDROCHLOROTHIAZIDE

Generics; previously available as HydroDiuril and Microzide

Diuretic, thiazide

B/D



2



Yes



No



No

Tabs: 12.5, 25, 50 mg

Caps: 12.5 mg

Oral suspension: 5 mg/mL 10 mg/mL

Edema:

Neonate and infant <6 mo: 1–3 mg/kg/24 hr ÷ once daily—BID PO; **max. dose:** 37.5 mg/24 hr



≥6 mo, child and adolescent: 1–2 mg/kg/24 hr ÷ once daily—BID PO; **max. dose:**

<2 yr: 37.5 mg/24 hr, child 2–12 yr: 100 mg/24 hr, and adolescent: 200 mg/24 hr

Adult: 25–100 mg/24 hr ÷ once daily—BID PO; **max. dose:** 200 mg/24 hr

Hypertension:

Infant and child: Start at 0.5–1 mg/kg/24 hr once daily PO; dose may be increased to a **max. dose** of 3 mg/kg/24 hr up to 50 mg/24 hr.

Adult: 12.5–25 mg/dose once daily—BID PO; doses >50 mg/24 hr often results in hypokalemia



See Chlorothiazide. May cause fluid and electrolyte imbalances, and hyperuricemia. Drug may not be effective when creatinine clearance is less than 25–50 mL/min. Use with carbamazepine may result in symptomatic hyponatremia.

Hydrochlorothiazide is also available in combination with potassium-sparing diuretics (e.g., spironolactone), ACE inhibitors, angiotensin II receptor antagonists, hydralazine, methyldopa, reserpine, and beta-blockers.

Pregnancy category is “D” if used in pregnancy-induced hypertension.

HYDROCORTISONE

Systemic dosage forms: Solu-Cortef, Cortef, and generics
 Topical: Anusol HC, Cortifoam, Cocolcort, Cortenema, MiCort-HC, NuCort, Proctocort, and many others including generics

Corticosteroid**Hydrocortisone base:**

Tabs (Cortef and generics): 5, 10, 20 mg

Oral suspension: 2 mg/mL

Rectal cream: 1% (30 g)

Anusol HC and generics: 2.5% (30 g)

Rectal suspension as an enema (Colocort, Cortenema): 100 mg/60 mL; may contain parabens

Topical ointment: 0.5% [OTC], 1% [OTC], 2.5%

Topical cream: 0.5% [OTC], 1% [OTC], 2.5%

Topical lotion: 1% [OTC], 2%, 2.5%

Na Succinate (Solu-Cortef):

Injection: 100, 250, 500, 1000 mg/vial; contains benzyl alcohol

Acetate:

Topical cream: 1% [OTC]

MiCort-HC: 2.5% (4, 28.4 g); contains parabens

Topical lotion (NuCort): 2% (60 g); contains benzyl alcohol

Suppository:

Anusol HC and generics: 25 mg

Proctocort and generics: 30 mg

Rectal foam aerosol (Cortifoam): 10% (90 mg/dose) (15 g); may contain parabens

**Status asthmaticus:****Child:**

Load (optional): 4–8 mg/kg/dose IV; **max. dose:** 250 mg

Maintenance: 8 mg/kg/24 hr ÷ Q6 hr IV

Adult: 100–500 mg/dose Q6 hr IV

Physiologic replacement: see Chapter 10 for dosing**Anti-inflammatory/immunosuppressive:****Child:**

PO: 2.5–10 mg/kg/24 hr ÷ Q6–8 hr

IM/IV: 1–5 mg/kg/24 hr ÷ Q12–24 hr

Adolescent and adult:

PO/IM/IV: 15–240 mg/dose Q12 hr

Acute adrenal insufficiency: see Chapter 10 for dosing.**Topical use:**

Child and adult: Apply to affected areas BID–QID, depending on severity

Ulcerative colitis, induction for mild/moderate case:

Child, adolescent and adult: Insert 1 application of 100 mg rectal enema once daily–BID × 2–3 weeks.

Hemorrhoids:**Adult:**

Rectal cream: Apply sparingly up to BID with either 1% or 2.5% strength

Suppository: 25 or 30 mg PR BID × 2 weeks



Use with caution in immunocompromised patients, as they should avoid exposure to chicken pox or measles.

For potency comparisons of topical preparations, see Chapter 8. For doses based on body surface

HYDROMORPHONE HCL

Dilaudid and generics

Narcotic, analgesic**Tabs:** 2, 4, 8 mg**Extended-release tabs:** 8, 12, 16, 32 mg**Injection:** 1, 2, 4 mg/mL (1 mL), 10 mg/mL (1, 5, 10 mL); may be preservative free**Prefilled injectable syringes:** 10 mg/50 mL (50 mL), 15 mg/30 mL (30 mL)**Preservative-free:** 12 mg/60 mL (60 mL)**Powder for injection (Dilaudid-HP):** 250 mg**Suppository:** 3 mg (6s)**Oral solution:** 1 mg/mL; may contain parabens and metasulfite***Analgesia, initial doses with immediate-release dosage forms (titrate to effect):*****Child (<50 kg):****IV:** 0.015 mg/kg/dose Q3–6 hr PRN**PO:** 0.03–0.08 mg/kg/dose Q3–4 hr PRN; **max. dose:** 5 mg/dose***Child and adolescent (≥50 kg; NOTE: doses are NOT weight-based):*****IV:** 0.2–0.6 mg/dose Q2–4 hr PRN**IM, SC:** 0.8–1 mg/dose Q4–6 hr PRN**PO:** 1–2 mg/dose Q3–4 hr PRN**PR:** 3 mg Q4–8 hr PRN**Adult:****IV:** 0.2–1 mg/dose Q2–3 hr PRN**IM, SC:** 0.8–1 mg/dose Q3–4 hr PRN**PO:** 2–4 mg/dose Q4–6 hr PRN**PR:** 3 mg Q6–8 hr PRN**Refer to Chapter 6 for equianalgesic doses and for patient-controlled analgesia dosing.**

Less pruritus than morphine. Similar profile of side effects to other narcotics. **Use with caution** in infants and young children, and **do not use** in neonates due to potential CNS effects. Dose reduction recommended in renal insufficiency or severe hepatic impairment.



Pregnancy category changes to “D” if used for prolonged periods or in high doses at term. The FDA has assigned a Risk Evaluation and Mitigation Strategy (REMS) for this medication, which involves an education program for provision of safety information. See www.opioidanalgesicsrems.com.

HYDROXYCHLOROQUINE

Plaquenil and generics

Antimalarial, antirheumatic agent**Tabs:** 200 mg (155 mg base)**Oral suspension:** 25 mg/mL (19.375 mg/mL base) **All doses expressed in mg of hydroxychloroquine base.****Malaria prophylaxis (start 2 wk prior to exposure and continue for 4 wk after leaving endemic area):****Child:** 5 mg/kg/dose PO once weekly; **max. dose:** 310 mg**Adult:** 310 mg PO once weekly**Malaria treatment (acute uncomplicated cases):**

For treatment of malaria, consult with ID specialist or see the latest edition of the AAP Red Book.

Child: 10 mg/kg/dose (**max. dose:** 620 mg) PO \times 1 followed by 5 mg/kg/dose (**max. dose:** 310 mg) 6 hr later. Then 5 mg/kg/dose (**max. dose:** 310 mg) Q24 hr \times 2 doses starting 24 hr after the first dose.

Adult: 620 mg PO \times 1 followed by 310 mg 6 hr later. Then 310 mg Q24 hr \times 2 doses starting 24 hr

HYDROXYCHLOROQUINE *continued***Juvenile rheumatoid arthritis or systemic lupus erythematosus:**

Child: 2.325–3.875 mg/kg/24 hr (base) PO ÷ once daily–BID; **max. dose:** 310 mg/24 hr not to exceed 5.425 mg/kg/24 hr

Contraindicated in psoriasis, porphyria, retinal or visual field changes, and 4-aminoquinoline hypersensitivity. **Use with caution** in liver disease, G6PD deficiency, concomitant hepatic toxic drugs, renal impairment, metabolic acidosis, or hematologic disorders. Long-term use in children is **not recommended**. May cause headaches, myopathy, GI disturbances, skin and mucosal pigmentation, agranulocytosis, visual disturbances, and increased digoxin serum levels. Hypoglycemia, proximal myopathy/neuropathy, and suicidal behavior have been reported. Baseline ocular exam is recommended within the first year of initiating long-term therapy, as retinal damage has been reported.

Use with aurothioglucose may increase risk for blood dyscrasias. When used in combination with other immunosuppressive agents for SLE and JRA, lower doses of hydroxychloroquine can be used.

Pregnancy category has not been formally assigned by the FDA. The only situation where use is recommended during pregnancy is during the suppression or treatment of malaria, when the benefits outweigh the risks.

**HYDROXYZINE**

Vistaril and generics

Antihistamine, anxiolytic, antiemetic

C



3



No



Yes



No

Tabs (HCl salt): 10, 25, 50 mg**Caps (pamoate salt):** 25, 50, 100 mg**Oral syrup (HCl salt):** 10 mg/5 mL (120, 473 mL); may contain alcohol and sodium benzoate**Oral solution: (HCl salt):** 10 mg/5 mL (473 mL); may contain parabens, and propylene glycol**Injection for IM use (HCl salt):** 25 mg/mL (1 mL), 50 mg/mL (1, 2 mL); may contain benzyl alcohol**NOTE:** pamoate and HCl salts are equivalent in regards to mg of hydroxyzine.**Pruritus and anxiety:****Oral:****Child and adolescent:** 2 mg/kg/24 hr ÷ Q6–8 hr PRN, **max. single dose:** <6 yr: 12.5 mg,

6–12 yr: 25 mg, and >12 yr: 100 mg

Alternative dosing by age:

<6 yr: 50 mg/24 hr ÷ Q6–8 hr PRN

≥6 yr: 50–100 mg/24 hr ÷ Q6–8 hr PRN

Adult: 25 mg/dose TID–QID PRN; **max. dose:** 600 mg/24 hr**IM:****Child and adolescent:** 0.5–1 mg/kg/dose Q4–6 hr PRN; **max. single dose:** 100 mg**Adult:** 25–100 mg/dose Q4–6 hr PRN; **max. dose:** 600 mg/24 hr**Antiemetic (excluding use during pregnancy):****Child and adolescent:** 1.1 mg/kg/dose IM, **max. single dose:** 100 mg**Adult:** 25–100 mg IM

Contraindicated in prolonged QT interval. May potentiate barbiturates, meperidine, and other CNS depressants. **Use with caution** with concomitant use of other medications known to prolong the QT interval. May cause dry mouth, drowsiness, tremor, convulsions, blurred vision, and hypotension. May cause pain at injection site. Fixed drug eruptions has been reported with use of the oral dosage form.

Increase dosage interval to Q24 hr or longer in the presence of liver disease (e.g., Primary biliary cirrhosis).

action: 4–6 hr IV administration is **NOT recommended**.
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I

IBUPROFEN

PO: Motrin, Advil, Children's Advil, Children's Motrin, and generics

IV: NeoProfen, Caldolor

Nonsteroidal anti-inflammatory agent



C/D



1



Yes



Yes



No

Oral suspension [OTC]: 100 mg/5 mL (60, 120, 480 mL)

Oral drops [OTC]: 40 mg/mL (15, 30 mL)

Chewable tabs [OTC]: 100 mg

Caplets [OTC]: 100, 200 mg

Tabs: 200 [OTC], 400, 600, 800 mg

Capsules [OTC]: 200 mg

Injection:

NeoProfen and generic (lysine salt): 10 mg ibuprofen base/1 mL (2 mL)

Caldolor: 100 mg/mL (4, 8 mL); contains 78 mg/mL arginine

PO:

Infant and child (≥ 6 mo):

Analgesic/antipyretic: 5–10 mg/kg/dose Q6–8 hr PO; **max. dose:** 400 mg/dose or 40 mg/kg/24 hr

JRA (6 mo–12 yr): 30–50 mg/kg/24 hr \div Q6 hr PO; **max. dose:** 800 mg/dose or 2400 mg/24 hr

Adult:

Inflammatory disease: 400–800 mg/dose Q6–8 hr PO; **max. dose:** 800 mg/dose or 3.2 g/24 hr

Pain/fever/dysmenorrhea: 200–400 mg/dose Q4–6 hr PRN PO; **max. dose:** 3.2 g/24 hr



IV:

6 mo–<12 yr:

Analgesic and antipyretic: 10 mg/kg/dose up to 400 mg/dose Q4–6 hr PRN; **max. dose:** the lesser of 40 mg/kg/24 hr or 2400 mg/24 hr

12–17 yr:

Analgesic and antipyretic: 400 mg/dose Q4–6 hr PRN; **max. dose:** 2400 mg/24 hr

≥18 yr and adult:

Analgesic (see remarks): 400–800 mg/dose Q6 hr PRN; **max. dose:** 3200 mg/24 hr

Antipyretic (see remarks): 400 mg/dose Q4–6 hr or 100–200 mg/dose Q4 hr PRN; **max. dose:** 3200 mg/24 hr

Closure of ductus arteriosus:

<32 wk of gestation and 0.5–1.5 kg (use birth weight to calculate all doses and infuse all doses over 15 min; see remarks): 10 mg/kg/dose IV \times 1 followed by two doses of 5 mg/kg/dose each, 24 and 48 hr after the initial dose. Hold second or third dose if urinary output is <0.6 mL/kg/hr; dosing should resume when laboratory studies indicate the return of normal renal function. If the ductus arteriosus fails to close or reopens, a second course of ibuprofen, the use of IV indomethacin, or surgery may be necessary.

Contraindicated with active GI bleeding and ulcer disease. **Use caution** with aspirin

hypersensitivity, or hepatic/renal insufficiency, heart disease (risk for MI and stroke with prolonged use), dehydration, and in patients receiving anticoagulants. GI distress (lessened with milk), rashes, ocular problems, hypertension, granulocytopenia, and anemia may occur. Inhibits platelet aggregation. Consumption of more than three alcoholic beverages per day, use with corticosteroids or anticoagulants may increase risk for GI bleeding. False-positive test for urine cannabinoid and phencyclidine (PCP) screen may occur.



IBUPROFEN continued

May increase serum levels and effects of digoxin, methotrexate, and lithium. May decrease the effects of antihypertensives, aspirin (anti-platelet effects), furosemide, and thiazide diuretics. Pregnancy category changes to "D" if used in 3rd trimester or near delivery.

IV USE for analgesia/antipyretic: Hydrate patient well before use. Doses must be diluted to a concentration ≤ 4 mg/mL with NS, D5W, or LR and infused over ≥ 30 min for adults and ≥ 10 min for children. Most common reported side effects in clinical trials include nausea, flatulence, vomiting, and headache.

IV USE for PDA: Contraindicated in untreated infections, congenital heart diseases requiring a patent ductus arteriosus to facilitate satisfactory pulmonary and systemic blood flow, active intracranial or gastrointestinal bleeds, thrombocytopenia, coagulation defects, suspected/active NEC, and significant renal impairment. **Use with caution** in hyperbilirubinemia. Not indicated for IVH prophylaxis. Renal side effects are generally less frequent and severe when compared with IV indomethacin. NEC, GI perforation, and pulmonary hypertension have been reported. NeoProfen doses must be administered within 30 min of preparation and infused intravenously over 15 min.

ILOPROST

Ventavis, synthetic PG_{I₂}
Prostaglandin I₂, vasodilator



Inhalation solution: 10 mCg/mL (1 mL), 20 mCg/mL (1 mL); contains ethanol and tromethamine

Pulmonary arterial hypertension (limited data):

Intermittent inhalation via nebulization: Start at 2.5 mCg/dose (some recommend 1.25 mCg/dose for infant and small child). If tolerated, increase dose to 5 mCg/dose at intervals of 6 to 9 times daily (Q2–3 hr while awake; Q3–4 hr may be considered for patients with moderate/severe hepatic impairment).

Use with caution in bleeding disorders, respiratory diseases, and hypotension.

Headache, nausea, cough, flu-like symptoms, and flushing are common side effects.

Bronchospasm, hypotension, and AKI have been reported. May increase the effects/toxicity of anticoagulants, antiplatelet, antihypertensive, and vasodilating medications.

Administer by nebulization which may take 10–15 min. **Avoid** contact with skin or eyes and do not ingest by mouth.

**IMIPENEM AND CILASTATIN**

Primaxin IV and generics
Antibiotic, carbapenem



Injection: 250, 500 mg; each 1 mg drug contains 1 mg imipenem and 1 mg cilastatin

Contains 3.2 mEq Na/g drug



Dosages based on imipenem component.

Neonate (see remarks):

<1 kg:

≤14 days old: 40 mg/kg/24 hr \div Q12 hr IV

15–28 days old: 50 mg/kg/24 hr \div Q12 hr IV

1–2 kg:

≤7 days old: 40 mg/kg/24 hr \div Q12 hr IV

8–28 days old: 50 mg/kg/24 hr \div Q12 hr IV

IMIPENEM AND CILASTATIN *continued***Neonate (cont., see remarks):**

>2 kg:

≤7 days old: 50 mg/kg/24 hr ÷ Q12 hr IV**8–28 days old:** 75 mg/kg/24 hr ÷ Q8 hr IV**Child (4 wk–3 mo):** 100 mg/kg/24 hr ÷ Q6 hr IV**Child (>3 mo):** 60–100 mg/kg/24 hr ÷ 06 hr IV; **max. dose:** 4 g/24 hr**Cystic fibrosis:****Pulmonary exacerbation:** 100 mg/kg/24 hr ÷ Q6 hr IV; **max. dose:** 4 g/24 hr**Non-tuberculosis mycobacterium:** 30–40 mg/kg/24 hr ÷ Q12 hr IV; **max. dose:** 2 g/24 hr**Adult:** 0.5–1 g/dose Q6–8 hr IV; **max. dose:** 4 g/24 hr or 50 mg/kg/24 hr, whichever is less

For IV use, give slowly over 30–60 min at a concentration ≤5 mg/mL to reduce risk for nausea (lowering the rate may reduce severity). Adverse effects: thrombophlebitis, pruritus, urticaria, GI symptoms, seizures, dizziness, hypotension, elevated LFTs, blood dyscrasias, and penicillin allergy. Greater risk for seizures may occur with CNS infections, concomitant use with ganciclovir, higher doses, and renal impairment. CSF penetration is variable but best with inflamed meninges. Not recommended in CNS infections for neonates due to cilastatin accumulation and seizure risk.

Do not administer with probenecid (increases imipenem/cilastatin levels) and ganciclovir (increased risk for seizures). May significantly reduce valproic acid levels.

Adjust dose in renal insufficiency (see Chapter 31).

IMIPRAMINE Tofranil and generics <i>Antidepressant, tricyclic</i>					
	?	3	Yes	Yes	Yes

Tabs (HCl): 10, 25, 50 mg**Caps (pamoate):** 75, 100, 125, 150 mg; strengths are expressed as imipramine HCl equivalent**Antidepressant (see remarks):****Child (≥8 yr):****Initial:** 1.5 mg/kg/24 hr ÷ BID–TID PO; increase 1 mg/kg/24 hr Q3–4 days to a **max. dose** of 5 mg/kg/24 hr**Adolescent:****Initial:** 25–50 mg/24 hr ÷ once daily–TID PO; **max. dose:** 200 mg/24 hr. Dosages exceeding 100 mg/24 hr are generally not necessary.**Adult:****Initial:** 75–100 mg/24 hr ÷ TID PO**Maintenance:** 50–300 mg/24 hr QHS PO; **max. dose:** 300 mg/24 hr**Enuresis (≥6 yr):****Initial:** 10–25 mg QHS PO**Increment if needed:** 10–25 mg/dose at 1- to 2-wk intervals until **max. dose** for age or desired effect achieved. Continue × 2–3 mo, then taper slowly.**Max. dose:****6–12 yr:** the lesser of 2.5 mg/kg/24 hr or 50 mg/24 hr**≥12 yr:** 75 mg/24 hr**Augment analgesia for chronic pain:****Initial:** 0.2–0.4 mg/kg/dose QHS PO; increase 50% every 2–3 days PRN to a **max. dose** of 1–3 mg/kg/dose QHS PO

IMIPRAMINE *continued*

Contraindicated in narrow-angle glaucoma and patients who used MAO inhibitors within 14 days.

See **Chapter 3** for management of toxic ingestion. Monitor for clinical worsening of depression and suicidal ideation/behavior following the initiation of therapy or after dose changes. **Use with caution** in renal or hepatic impairment. Side effects include sedation, urinary retention, constipation, dry mouth, dizziness, drowsiness, and arrhythmia. QHS dosing during first weeks of therapy will reduce sedation. Monitor ECG, BP, CBC at start of therapy and with dose changes. Tricyclics may cause mania. False-positive test for urine PCP screen may occur.

Therapeutic reference range for depression (sum of imipramine and desipramine) =

150–250 ng/mL. Levels >1000 ng/mL are toxic; however, toxicity may occur at >300 ng/mL.

Recommended serum sampling times at steady-state: Obtain trough level within 30 min prior to the next scheduled dose after 5–7 days of continuous therapy.

Imipramine is a major substrate for CYP 450 2C19 and 2D6. See the remarks in amitriptyline for pharmacogenomic dosing considerations. Carbamazepine may reduce imipramine levels, and cimetidine, fluoxetine, fluvoxamine, labetalol, quinidine may increase imipramine levels.

Onset of antidepressant effects: 1–3 wk. **Do not discontinue** abruptly in patients receiving long-term high-dose therapy.

Pregnancy category has not been officially assigned by the FDA as congenital abnormalities have been reported in humans with the causal relationship not being established.

IMMUNE GLOBULIN**Immune globulins****IM preparations:**

GamaSTAN and GamaSTAN S/D: 150–180 mg/mL (2, 10 mL); GamaSTAN contains 0.16–0.26 M glycine and GamaSTAN contains 0.21–0.32 M glycine; both are preservative free

IV preparations in solution (preservative free):

Bivigam: 10% (100 mg/mL) (50, 100 mL); contains polysorbate 80 and 0.2–0.29 M glycine; sucrose free

Flabogamma D/F: 5% (50 mg/mL) (10, 50, 100, 200, 400 mL) 10% (100 mg/mL) (50, 100, 200 mL); contains 50 mg/mL sorbitol and ≤3 mg/mL polyethylene glycol; sucrose free

Gamunex-C: 10% (100 mg/mL) (10, 25, 50, 100, 200, 400 mL); contains 0.16–0.24 M glycine; sucrose free

Gammagard liquid: 10% (100 mg/mL) (10, 25, 50, 100, 200, 300 mL); contains 0.25 M glycine; sucrose free

Gammaked: 10% (100 mg/mL) (10, 25, 50, 100, 200 mL); contains 0.16–0.24 M glycine; sucrose free

Octagam: 5% (50 mg/mL) (20, 50, 100, 200, 500 mL), 10% (100 mg/mL) (20, 50, 100, 200, 300 mL); contains ~100 mg/mL maltose; sucrose free

Privigen 10% (100 mg/mL) (50, 100, 200, 400 mL); contains 210–290 mmol/L L-proline; sucrose free

Panziga 10%: (100 mg/mL) (10, 25, 50, 100, 200, 300 mL); sucrose free

IV preparations in powder for reconstitution:

Carimune NF: 6, 12 g (contains 1.67 g sucrose and <20 mg NaCl per 1 g Ig); dilute to 3%, 6%, 9%, or 12%

Gammagard S/D: 5, 10 g (when diluted at 5% or 50 mg/mL, contains <1 mCg/mL of IgA, 3 mg/mL albumin, 22.5 mg/mL glycine, 20 mg/mL glucose, 2 mg/mL polyethylene glycol, 1 mCg/mL tri-n-butyl phosphate, 1 mCg/mL octoxynol 9, and 100 mCg/mL polysorbate 80); may be diluted to 5% or 10%

Continued

IMMUNE GLOBULIN *continued***Subcutaneous (SC) preparations (sucrose and preservative free):**

Hizentra: 20% (200 mg/mL) (5, 10, 20, 50 mL); contains 210–290 mmol/L L-proline, 8–30 mg/L polysorbate 80, and ≤50 mCg/mL IgA

Cutaquig: 16.9% (169 mg/mL) (6, 10, 12, 20, 24, 48 mL); contains 30 mEq/L sodium and ≤0.6 mg/mL IgA

Cuvitru: 20% (200 mg/mL) (5, 10, 20, 40, 50 mL); contains 0.25 M glycine and ~80 mCg/mL IgA

**Intravenous (IV) preparations:**

Kawasaki disease (should be initiated within first 10 days of symptoms): 2 g/kg × 1 dose over 8–12 hr infusion. If signs and symptoms persist, consider a second 2 g/kg dose. Some recommend using a different drug brand or lot number for the second dose.

Immune thrombocytopenia (ITP) (see RH_d(D) immune globulin intravenous for Rh-positive patients):

Acute therapy: 400–1000 mg/kg/dose once daily for 2–5 days for a total cumulative dose 2000 mg/kg

Maintenance therapy: 400–1000 mg/kg/dose Q3–6 wk based on clinical response

Replacement therapy for antibody-deficient disorders: Start at 400–500 mg/kg/dose Q4 wk and adjust dose based on clinical response and to maintain a trough IgG level ≥500 mg/dL.

For severe hypogammaglobulinemia (<100 mg/dL), patients may benefit with a loading dose of 400 mg/kg/dose once daily × 2, followed by 400–500 mg/kg/dose Q4 wk.

Pediatric HIV with IgG <400 mg/dL: See replacement therapy for antibody-deficient disorder from above.

Bone marrow transplantation (may decrease risk for infection and death but not acute graft-versus-host disease): Start at 400–500 mg/kg/dose to maintain IgG levels ≥400 mg/dL resulting in dosage intervals ranging from once weekly to Q3–4 wk.

Measles, postexposure prophylaxis for individuals with primary humoral immunodeficiency or without evidence of measles immunity (6–16 yr): 400 mg/kg/dose as soon as possible and within 6 days after exposure.

General guidelines for administration (see package insert of specific products):

IV: Begin infusion at 0.01 mL/kg/min, double rate every 15–30 min, up to **max.** of 0.08 mL/kg/min. If adverse reactions occur, stop infusion until side effects subside and may restart at rate that was previously tolerated.

Subcutaneous (SC) preparations:

Converting to SC route from previous IV dosage for patients receiving IV immune globulin (IVIG) infusions at regular intervals for at least 3 mo (≥2 yr):

Initial weekly dose (start 1 wk after last IV dose):

SC Product	Dose Calculation (mg)	Dose Calculation (mL)
Hizentra	Dose (g) = 1.37 × Previous IVIG dose in grams (g) ÷ number of weeks between IVIG doses	mL = multiply dose (g) by 5
Cutaquig	Dose (g) = 1.40 × Previous IVIG dose in grams (g) ÷ number of weeks between IVIG doses	mL = multiply dose (g) by 6
Cuvitru	Dose (g) = 1.30 × Previous IVIG dose in grams (g) ÷ number of weeks between IVIG doses	mL = multiply dose (g) by 5

Adjust dose over time by clinical response and serum IgG trough levels. Obtain a previous trough level from IVIG therapy prior to SC conversion and repeat trough level 2–3 mo after initiating the SC route. A goal trough with the SC route of ~290 mg/dL higher than a trough with the IV route has been recommended.

Measles, postexposure prophylaxis for high-risk patients:

Hizentra: 0.2 g/kg/dose SC Q7 days × 2, or 0.4 g/kg/dose SC × 1

IMMUNE GLOBULIN *continued*

SC administration: Injection sites include the abdomen, thigh, upper arm, and/or lateral hip.

Doses may be administered into multiple sites (spaced ≥ 2 inches apart) simultaneously.

See following table.

SC Product	Max. Simultaneous Injection Sites	Max. Infusion Rate	Max. Infusion Volume
Hizentra	8	First infusion: 15 mL/hr per infusion site Subsequent infusions: 25 mL/hr per infusion site	First infusion: 15 mL per infusion site Subsequent infusions: 25 mL per infusion site
Cutaquig	6	First 6 infusions: 15–20 mL/hr per infusion site (max. rate for all sites combined: 30 mL/hr) Subsequent infusions: 25 mL/hr per infusion site (max. rate for all sites combined: gradually increase to 50 mL/hr, then 80 mL/hr and then if tolerated up to 100 mL/hr)	First 6 infusions: ≤ 25 mL per infusion site Subsequent infusions: gradual increase to 40 mL per infusion site
Cuvitru	4	First 2 infusions: 10–20 mL/hr per infusion site Subsequent infusions: ≤ 60 mL/hr per infusion site	First 2 infusions: <40 kg: ≤ 20 mL per infusion site ≥ 40 kg: ≤ 60 mL per infusion site Subsequent infusions (all weights): ≤ 60 mL per infusion site

Intramuscular (IM) preparations:

Measles, postexposure prophylaxis for high-risk patients: 0.5 mL/kg/dose (**max. dose:** 15 mL) IM $\times 1$ within 6 days of exposure.

IM administration: Administer in the anterolateral aspects of the upper thigh or deltoid muscle of the upper arm. **Avoid** gluteal region due to risk of injury to sciatic nerve. Consider splitting doses for multiple injection sites to address age specific maximum IM injection volumes.

Use with caution in patients with increased risk of thrombosis (e.g., hypercoagulable states, prolonged immobilization, in-dwelling catheters, estrogen use, thrombosis history, cardiovascular risks, and hyperviscosity) or hemolysis (e.g., non-O blood type, associated inflammatory conditions, and receiving high cumulative doses of immune globulins over several days).

May cause flushing, chills, fever, headache, and hypotension. Hypersensitivity reaction may occur when IV form is administered rapidly. Maltose-containing products may cause an osmotic diuresis.

May cause **anaphylaxis** in IgA-deficient patients due to varied amounts of IgA. Some products are IgA depleted; consult a pharmacist.

To decrease risk of renal dysfunction, including acute renal failure, IV preparations containing sucrose should not be infused at a rate such that the amount of sucrose exceeds 3 mg/kg/min.

SC route provides higher serum trough levels, lower rate of adverse reactions, and shorter administration time when compared with the IV route. Use of adjusted body weight [ABW = Ideal Body Weight + 0.5 (Actual Body Weight – Ideal Body Weight)] for dosing in obese patients has been recommended.

Delay immunizations after immune globulin administration (see latest AAP Red Book for details).



INDOMETHACIN

Indocin, Tivorbex, and generics

Nonsteroidal antiinflammatory agent

C/D



1



Yes



Yes



No

Caps: 25, 50 mg

Tivorbex: 20, 40 mg

Sustained-release caps: 75 mg**Oral suspension:** 25 mg/5 mL (237 mL); contains 1% alcohol**Suppositories:** 50 mg (30s)**Injection:** 1 mg***Anti-inflammatory/rheumatoid arthritis:*****Child (≥2 yr):** Start at 1–2 mg/kg/24 hr ÷ BID–QID PO; **max. dose:** the lesser of 4 mg/kg/24 hr or 200 mg/24 hr**Adult:** 50–150 mg/24 hr ÷ BID–QID PO; **max. dose:** 200 mg/24 hr

Tivorbex: 20 mg TID PO or 40 mg BID–TID PO

Closure of ductus arteriosus:**Infuse intravenously over 20–30 min:****Dose (mg/kg/dose Q12–24 hr)^a**

Postnatal Age at Time of 1st Dose	#1	#2	#3
<48 hr	0.2	0.1	0.1
2–7 days	0.2	0.2	0.2
>7 days	0.2	0.25	0.25

^aDo not administer if urine output is <0.6 mL/kg/hr or anuric.

For infants <1500 g, 0.1–0.2 mg/kg/dose IV Q24 hr may be given for an additional 3–5 days.

Intraventricular hemorrhage prophylaxis: 0.1 mg/kg/dose IV Q24 hr × 3 doses, initiated at 6–12 hr of age (give in consultation with a neonatologist).

Contraindicated in active bleeding, coagulation defects, necrotizing enterocolitis, and renal insufficiency (urine output <0.6 mL/kg/hr). **Use with caution** in cardiac dysfunction, hypertension, heart disease (risk for MI and stroke with prolonged use), and renal or hepatic impairment. May cause (especially in neonates) decreased urine output, thrombocytopenia, and decreased GI blood flow, and a reduction in the antihypertensive effects of β-blockers, hydralazine, and ACE inhibitors. **Fatal hepatitis reported in JRA treatment.** Pancreatitis has been reported. Thrombotic events have been observed in adults receiving high doses or prolonged duration of therapy. Monitor renal and hepatic function before and during use. False-positive test for urine cannabinoid screen may occur.

**Reduction in cerebral blood flow associated with rapid IV infusion;** infuse all IV doses over 20–30 min.

Sustained-release capsules are dosed once daily–BID. Pregnancy category changes to “D” if used for >48 hr or after 34 wk gestation or close to delivery.

INSULIN PREPARATIONS**Pancreatic hormone**

B



1



Yes



Yes



No

Many preparations, at concentrations of 100, 500 Units/mL. See **Chapter 10**, Table 10.3.

Diluted concentrations of 1 Units/mL or 10 Units/mL may be necessary for smaller doses in neonates and infants.

INSULIN PREPARATIONS *continued*

Hyperkalemia: See Resuscitation Medications Table in the front matter of the book.

DKA: See Chapter 10, Figure 10.1.



When using insulin drip with new IV tubing, fill the tubing with the insulin infusion solution and wait for 30 min (before connecting tubing to the patient). Then flush the line and connect the IV line to the patient to start the infusion. This will ensure proper drug delivery. **Adjust dose in renal failure (see Chapter 31).** Use with caution and monitor closely in hepatic impairment.

IODIDE

See Potassium Iodide

IODIXANOL

Visipaque

Radiopaque agent, contrast media



B



3



Yes



Yes



No

Injection: 270 mg/mL, 320 mg/mL (50, 100, 150, 200 mL); contains EDTA and tromethamine

Consult with your local radiologist for specific dosing and administration recommendations.



IV contrast for CT scans: Use Visipaque 320 mg/mL, check for contraindications, and all patients should be encouraged to drink extra fluids for 8 hrs after the exam as allowed.

eGFR ≥ 60 mL/min/1.73 m²: 2 mL/kg/dose

eGFR 30–60 mL/min/1.73 m²: Administered a reduced dose with IV fluids + acetylcysteine to reduce risk for nephropathy

eGFR <30 mL/min/1.73 m²: Avoid use unless life-threatening situation where benefits outweigh the risk

PO contrast for CT scans: see lohexol

Contraindicated in children with prolonged fasting and the administration of a laxative before use. Avoid use via intrathecal route (serious life-threatening reactions may occur) and previous hypersensitivity reactions with contrast agents. Use with caution in asthma, hay fever, food allergy, congestive heart failure, severe liver or renal impairment, diabetic nephropathy, multiple myeloma, pheochromocytoma, hyperthyroidism, and sickle cell disease.



Common side effects include general discomfort, sensations of warmth, and pain. Cardiac arrest, dysrhythmia, heart failure, shock, severe dermatological reactions (e.g., SJS, TEN), sickle cell crisis, thromboembolic disorder, acute kidney injury, and hypersensitivity reactions have been reported.

Children at higher risk for adverse events with contrast medium administration may include those having asthma, sensitivity to medication and/or allergens, congestive heart failure, serum creatinine >1.5 mg/dL, or those aged <12 mo.

Avoid use with metformin as lactic acidosis and acute renal failure may occur. Postpone IV administration in patients who have recently received an oral cholecystographic contrast agent as renal toxicity may occur.

Visipaque 320 mg/mL has an osmolality of 290 mOsmol/kg than Omnipaque 350 mg/mL (884 mOsmol/kg) for a lower risk of contrast nephropathy. See product information for intravenous and intra-arterial administration guidelines.

IOHESOL

Iohexol: Omnipaque 140, Omnipaque 180, Omnipaque 240, Omnipaque 300, Omnipaque 350, Omnipaque oral solution 9, Omnipaque oral solution 12, Oraltag



B

3

Yes

Yes

No

Iodixanol: Visipaque

Radiopaque agent, contrast media**Injection:**

Omnipaque 140: 302 mg iohexol equivalent to 140 mg iodine/mL (50 mL)

Omnipaque 180: 388 mg iohexol equivalent to 180 mg iodine/mL (10, 20 mL)

Omnipaque 240: 518 mg iohexol equivalent to 240 mg iodine/mL (10, 20, 50, 100, 150, 200 mL)

Omnipaque 300: 647 mg iohexol equivalent to 300 mg iodine/mL (10, 30, 50, 75, 100, 125, 150, 200, 500 mL)

Omnipaque 350: 755 mg iohexol equivalent to 350 mg iodine/mL (50, 75, 100, 125, 150, 200, 250, 500 mL)

Oral solution:

Omnipaque, Oraltag: 9 mg iodine/mL (19 mg/mL iohexol equivalent; 500 mL)

Omnipaque: 12 mg iodine/mL (26 mg iohexol equivalent; 500 mL)

All preparations contain tromethamine and edetate calcium disodium.

Consult with your local radiologist for specific dosing and administration recommendations.

Oral contrast for CT scans: Use oral Omnipaque 9 mg iodine/mL solution. If oral solution not available, mix 13 mL of the Omnipaque 350 injection with 500 mL of non-carbonated beverage to make an Omnipaque 9 mg iodine/mL solution. Administer dose all at once or over a period of up to 45 min. The more contrast the patient consumes, the better the CT study.

1–7 kg: 40–60 mL

8–11 kg: 110–160 mL

12–15 kg: 165–240 mL

16–42 kg: 250–360 mL

>42 kg: ≥480 mL

IV contrast for CT scans: see Iodixanol

Avoid use with history of severe cutaneous reactions to iohexol. Use with caution in dehydration, previous allergic reaction to a contrast medium, iodine sensitivity, asthma, hay fever, food allergy, congestive heart failure, severe liver or renal impairment, diabetic nephropathy, multiple myeloma, pheochromocytoma, hyperthyroidism, and sickle cell disease. Allergic reactions, arrhythmias, hypothyroidism, transient thyroid suppression, and nephrotoxicity have been reported.

Children at higher risk for adverse events with contrast medium administration may include those having asthma, sensitivity to medication and/or allergens, congestive heart failure, serum creatinine >1.5 mg/dL, or those aged <12 mo.

Use NOT recommended with drugs that lower seizure threshold (e.g., phenothiazines), amiodarone (increased risk of cardiotoxicity), and metformin (lactic acidosis and acute renal failure).

Many other uses exist, see package insert for additional information. Iohexol is particularly useful when barium sulfate is contraindicated in patients with suspected bowel perforation or those where aspiration of contrast medium is of concern. Oral dose is poorly absorbed from the normal GI tract (0.1%–0.5%); absorption increases with bowel perforation or bowel obstruction.

Concentrations 302–755 mg iohexol/mL have osmolalities from 1.1 to 3 times that of plasma (285 mOsm/kg) and CSF (301 mOsm/kg) and may be hypertonic.

IPRATROPIUM BROMIDE ± ALBUTEROL

Atrovent HFA and generics

In combination with albuterol: Combivent Respimat and generics; previously available as DuoNeb

Anticholinergic agent

B/C



1



No



No



No

Aerosol oral inhaler (Atrovent HFA): 17 mCg/dose (200 actuations per canister, 12.9 g); contains alcohol**Nebulized solution:** 0.02% (500 mCg/2.5 mL) (25s, 30s, 60s, 120s, 360s)**Nasal spray:** 0.03% (21 mCg per actuation, 30 mL provides 345 sprays); 0.06% (42 mCg per actuation, 15 mL provides 165 sprays)**In combination with albuterol:**

Nebulized solution (generic; previously available as DuoNeb): 0.5 mg ipratropium bromide and 2.5 mg albuterol in 3 mL (30s, 60s)

Inhalation spray (Combivent Respimat): 20 mCg ipratropium and 100 mCg albuterol per actuation (120 actuations per canister, 4 g); contains benzalkonium chloride

**Ipratropium:****Acute use in the ED or ICU:****Nebulizer treatments:**

<12 yr: 250–500 mCg/dose Q20 min × 3, then Q2–4 hr PRN

≥12 yr: 500 mCg/dose Q20 min × 3, then Q2–4 hr PRN

Inhaler:

<12 yr: 4–8 puffs Q20 min PRN up to 3 hr

≥12 yr: 8 puffs Q20 min PRN up to 3 hr

Non-acute use:**Inhaler:**<12 yr: 1–2 puffs Q6 hr; **max. dose:** 12 puffs/24 hr≥12 yr: 2–3 puffs Q6 hr; **max. dose:** 12 puffs/24 hr**Nebulized treatments:****Infant:** 125–250 mCg/dose Q8 hr**Child ≤12 yr:** 250–500 mCg/dose Q6–8 hr**>12 yr and adult:** 250–500 mCg/dose Q6 hr**Nasal spray:****0.03% strength (21 mCg/spray):****Allergic and non-allergic rhinitis (≥6 yr and adult):** 2 sprays (42 mCg) per nostril BID–TID**0.06% strength (42 mCg/spray):****Rhinitis associated with common cold (use up to a total of 4 days; safety and efficacy have not been evaluated >4 days):**2–<5 yr (**limited data**): 2 sprays (84 mCg) per nostril TID

5–11 yr: 2 sprays (84 mCg) per nostril TID

12 yr–adult: 2 sprays (84 mCg) per nostril TID–QID

Rhinitis associated with seasonal allergies:2–<5 yr (**limited data**): 1 spray (42 mCg) per nostril TID × 14 days**≥5 yr–adult:** 2 sprays (84 mCg) per nostril QID; use up to a total of 3 weeks (safety and efficacy have not been evaluated for >3 weeks)**Ipratropium in combination with albuterol:****Acute use in the ED or ICU:****Nebulizer treatments:**

<12 yr: 1.5 or 3 mL (0.25 mg ipratropium and 1.25 mg albuterol or 0.5 mg ipratropium and 2.5 mg albuterol) Q 20 min × 3 then Q2–4 hr PRN

≥12 yr: 3 mL (0.5 mg ipratropium and 2.5 mg albuterol) Q 20 min × 3 then Q2–4 hr PRN

Continued

IPRATROPIUM BROMIDE ± ALBUTEROL *continued***Inhalation spray (Combivent Respimat):****Ipratropium in combination with albuterol (Acute use in the ED or ICU; cont.):**

<12 yr: 4–8 sprays Q20 min × 3

≥12 yr: 8 sprays Q20 min × 3

Contraindicated in atropine hypersensitivity. **Use with caution** in narrow-angle glaucoma or bladder neck obstruction, though ipratropium has fewer anticholinergic systemic effects than atropine. May cause anxiety, dizziness, headache, GI discomfort, and cough with inhaler or nebulized use. Epistaxis, nasal congestion, and dry mouth/throat have been reported with the nasal spray. Reversible anisocoria may occur with unintentional aerosolization of drug to the eyes, particularly with mask nebulizers. Proven efficacy of nebulized solution in pediatrics is currently limited to reactive airway disease management in the emergency room and intensive care unit areas.

Current aerosol inhaler product does not contain soy products. Combination ipratropium and albuterol products are currently approved for use only in adults and has not been formally studied in children. See albuterol for additional remarks if using the combination product.

Bronchodilation onset of action is 1–3 min with peak effects within 1.5–2 hr and duration of action of 4–6 hr.

Shake inhaler well prior to use with spacer. Nebulized solution may be mixed with albuterol (or use the combination product).

Pregnancy category is "C" for Combivent Respimat. Breastfeeding safety **extrapolated** from safety of atropine.

**IRON DEXTRAN**

See Iron—Injectable Preparations

IRON SUCROSE

See Iron—Injectable Preparations

IRON—INJECTABLE PREPARATIONS

Ferric gluconate: Ferrlecit and generics

Iron dextran: INFeD

Iron sucrose: Venofer

Parenteral iron

B/C



2



No



No



No

Injection:

Ferric gluconate (Ferrlecit and generics): 62.5 mg/mL (12.5 mg elemental Fe/mL) (5 mL); contains 9 mg/mL benzyl alcohol and 20% sucrose

Iron dextran (INFeD): 50 mg/mL (50 mg elemental Fe/mL) (2 mL); products containing phenol 0.5% are only for IM administration; products containing sodium chloride 0.9% can be administered via the IM or IV route

Iron sucrose (Venofer): 20 mg/mL (20 mg elemental Fe/mL) (2.5, 5, 10 mL); contains 300 mg/mL sucrose; preservative free

IRON—NJECTABLE PREPARATIONS *continued*

FERRIC GLUCONATE (IV):

Iron deficiency anemia in patients undergoing chronic hemodialysis who are receiving supplemental erythropoietin therapy (most require 8 doses at 8 sequential dialysis treatments to achieve a favorable response):

Child ≥ 6 yr: 1.5 mg/kg elemental Fe (0.12 mL/kg) IV; **max. dose:** 125 mg elemental Fe/dose. Dilute dose in 25 mL NS and infuse over 1 hr.

Adult: 125 mg elemental Fe in 100 mL NS IV; infuse over 1 hr. Most require a minimum cumulative dose of 1 g elemental Fe administered over 8 sessions.

IRON DEXTRAN (IV or IM):

Iron deficiency anemia (≥ 4 mo, child, adolescent):

Test dose (IV over 5 min or IM; may initiate treatment dose 1 hr after test dose):

<10 kg: 10 mg

10–20 kg: 15 mg

≥ 20 kg: 25 mg

Total replacement dose of iron dextran (mL) = $0.0476 \times \text{lean body wt (kg)} \times (\text{desired Hb [g/dL]} - \text{measured Hb [g/dL]}) + 1 \text{ mL per } 5 \text{ kg lean body weight}$ (up to **max.** of 14 mL). Total replacement dose is divided into smaller daily doses if exceeds respective IV or IM daily **max. doses** (see below).

Acute blood loss: Total replacement dose of iron dextran (mL) = $0.02 \times \text{blood loss (mL)} \times \text{hematocrit expressed as decimal fraction}$. Assumes 1 mL of RBC = 1 mg elemental iron.

If no reaction to test dose, give remainder of replacement dose \div over 2–3 daily doses.

Max. daily IV dose: 100 mg

Max. daily IM dose:

<5 kg: 0.5 mL (25 mg)

5–10 kg: 1 mL (50 mg)

>10 kg: 2 mL (100 mg)

IM administration: use “Z-track” technique.

IV administration: Dilute in NS at a **max. concentration** of 50 mg/mL and infuse over 1–6 hr at a **max. rate** of 50 mg/min.

IRON SUCROSE (IV):

Test dose (optional): Infuse 25% of first day dose up to a **max.** of 25 mg undiluted over 30 min.

Iron deficiency anemia in patients with chronic kidney disease:

Child:

ESRD on hemodialysis: (limited data from 14 children): 1 mg/kg/dialysis was adequate for correcting ferritin levels and 0.3 mg/kg/dialysis was successful in maintaining ferritin levels between 193 and 250 mCG/L. Doses were administered during the last hr of each dialysis and are recommended at a frequency of 3 times a week. A 10 mg test dose was administered.

Non-renal iron deficiency, refractory to PO therapy (limited data): Calculate total iron replacement dose (mg) = $0.6 \times \text{wt (kg)} \times (100 - [\text{measured Hb} \div \text{desired Hb} \times 100])$. Replacement dose is administered by giving an initial dose of 5–7 mg/kg (**max. dose:** 100 mg/24 hr) followed by a maintenance dose of 5–7 mg/kg/dose (**max. dose:** 300 mg/24 hr) Q3–7 days until total iron replacement dose is achieved.

Adult:

Hemodialysis-dependent: 100 mg elemental Fe 1–3 times a wk during dialysis up to a total cumulative dose of 1000 mg. May continue to administer at lowest dose to maintain target Hb, Hct, and iron levels.

Nonhemodialysis-dependent: 200 mg elemental Fe on 5 different days over a 2 wk period (total cumulative dose: 1000 mg).

IV administration: May administer undiluted over 2–5 min. For an infusion, dilute each 100 mg with a **max.** of 100 mL NS and infuse over at least 15 min.

IRON—INJECTABLE PREPARATIONS *continued*

Oral therapy with iron salts is preferred, injectable routes are painful. Gluconate and sucrose salts may be better tolerated than iron dextran. Adverse effects include hypotension, GI disturbances, fever, rash, myalgia, arthralgias, cramps, and headaches. Hypersensitivity reactions have been reported for iron dextran and sucrose products; use of test dose prior to first therapeutic dose is recommended.



IM administration is only possible with iron dextran salt. Follow infusion recommendations for specific product. Monitor vital signs during IV infusion. TIBC levels may not be meaningful within 3 wk after dosing.

Efficacy and safety of iron sucrose for maintenance therapy has been evaluated in children 2 yr and older with CKD and receiving erythropoietin therapy. Common side effects include headache, respiratory tract viral infection, peritonitis, vomiting, pyrexia, dizziness, and cough.

Pregnancy category is "B" for ferric gluconate and iron sucrose, and "C" for iron dextran.

IRON—ORAL PREPARATIONS

Ferrous sulfate: Fer-In-Sol, Slow FE, Slow Iron, and many generics



A/?

2

No

No

No

Ferrous gluconate: Ferate and generics

Ferrous fumarate: Ferrets, Ferrimin 150, Hemocyte, and generics

Polysaccharide-iron complex: Ferrex 150, EZFE, Myferon 150, Poly-Iron 150, NovaFerrum, NovaFerrum Pediatric Drops, and many other brands; previously available as Niferex

Oral iron supplements**Ferrous sulfate (20% elemental Fe):**

Drops and oral solution (Fer-In-Sol and generics; OTC): 75 mg (15 mg Fe)/1 mL (50 mL); contains 0.2% alcohol and sodium bisulfite

Oral elixir and liquid (OTC): 220 mg (44 mg Fe)/5 mL; may contain 5% alcohol

Oral syrup (OTC): 300 mg (60 mg Fe)/5 mL

Tabs (OTC): 325 mg (65 mg Fe)

Extended-release tabs (Slow FE, Slow Iron, and generics, OTC): 142 mg (45 mg Fe), 160 mg (50 mg Fe), 324 mg (65 mg Fe), and 325 mg (65 mg Fe)

Ferrous gluconate (12% elemental Fe):

Tabs (Ferate and generics; OTC): 240 mg (27 mg Fe), 324 mg (37.5 mg Fe)

Ferrous fumarate (33% elemental Fe):

Tabs (all OTC):

Hemocyte and generics: 90 mg (29.5 mg Fe), 324 mg (106 mg Fe)

Ferrets: 325 mg (106 mg Fe)

Ferrimin 150: 456 mg (150 mg Fe)

Polysaccharide-iron complex and ferrous bis-glycinate chelate (expressed in mg elemental Fe):

Caps (OTC): 50 mg (NovaFerrum 50), 150 mg (Ferrex 150, Myferon 150, Poly-Iron 150, and others), 200 mg (EZFE); 150 mg strength may contain 50 mg vitamin C

Oral liquid (NovaFerrum 125; OTC): 125 mg/5 mL (180 mL); contains sodium benzoate and 100 units cholecalciferol/5 mL

Oral drops (NovaFerrum Pediatric Drops; OTC): 15 mg/mL (120 mL); contains sodium benzoate

Iron deficiency anemia:

Premature infant: 2–4 mg elemental Fe/kg/24 hr ÷ once daily—BID PO; **max. dose:** 15 mg elemental Fe/24 hr

Child: 3–6 mg elemental Fe/kg/24 hr ÷ BID—TID PO

Adult: 60–100 mg elemental Fe BID PO up to 60 mg elemental Fe QID

IRON—ORAL PREPARATIONS *continued*

Prophylaxis:

Child: Give dose below PO ÷ once daily—TID

Premature infant: 2 mg elemental Fe/kg/24 hr; **max. dose:** 15 mg elemental Fe/24 hr

Full-term infant: 1–2 mg elemental Fe/kg/24 hr; **max. dose:** 15 mg elemental Fe/24 hr

Child 2–12 yr: 2 mg elemental Fe/kg/24 hr; **max. dose:** 30 mg elemental Fe/24 hr

Adolescent and adult: 60 mg elemental Fe/24 hr PO once daily

Contraindicated in hemolytic anemia and hemochromatosis. **Avoid** use in GI tract inflammation. May produce constipation, dark stools (false positive guaiac is controversial), nausea, and epigastric pain. Iron and tetracycline inhibit each other's absorption. Antacids may decrease iron absorption.

Iron preparations are variably absorbed. Less GI irritation when given with or after meals. Vitamin C, 200 mg per 30 mg iron, may enhance absorption. Liquid iron preparations may stain teeth. Give with dropper or drink through straw.

Pregnancy category is "A" for ferrous sulfate and is unknown for the other salt forms.



ISONIAZID

Generics, INH; previously available as Nydrazid and Laniazid

In combination with rifampin: Rifamate and IsonaRif

In combination with rifampin and pyrazinamide: Rifater

Antituberculous agent



C

1

Yes

Yes

No

Tabs: 100, 300 mg

Syrup: 50 mg/5 mL (473 mL); contains parabens

Injection: 100 mg/mL (10 mL); contains 0.25% chlorobutanol

In combination with rifampin:

Caps (Rifamate, IsonaRif): 150 mg isoniazid + 300 mg rifampin

In combination with rifampin and pyrazinamide:

Caps (Rifater): 50 mg isoniazid + 120 mg rifampin + 300 mg pyrazinamide



See most recent edition of the AAP Red Book for details and length of therapy.

TB Treatment (see remarks):

Infant and child:

10–15 mg/kg (**max. dose:** 300 mg) PO once daily or 20–30 mg/kg (**max. dose:** 900 mg) per dose twice weekly with rifampin for uncomplicated pulmonary tuberculosis in compliant patients.

Additional drugs are necessary in complicated disease.

Adult:

5mg/kg (**max. dose:** 300 mg) PO once daily or 15 mg/kg (**max. dose:** 900 mg) per dose twice weekly with rifampin. Additional drugs are necessary in complicated disease.

For INH-resistant TB: Discuss with Health Department or consult ID specialist.



Should not be used alone for treatment. Contraindicated in acute liver disease and previous isoniazid-associated hepatitis. Peripheral neuropathy, optic neuritis, seizures, encephalopathy, psychosis, and hepatic side effects may occur with higher doses, especially in combination with rifampin. Severe liver injury has been reported in children and adults treated for latent TB. Follow LFTs monthly. Pancreatitis, toxic epidermal necrolysis, and DRESS have been reported. May cause false-positive urine glucose test.



Supplemental pyridoxine (1–2 mg/kg/24 hr) is recommended for prevention of neurological side effects.

ISONIAZID continued

Inhibits CYP 450 1A2, 2C9, 2C19, and 3A3/4 microsomal enzymes; decrease dose of carbamazepine, diazepam, phenytoin, and prednisone. Prednisone may decrease isoniazid's effects. Also a substrate and inducer of CYP 450 2E1 and may potentiate acetaminophen hepatotoxicity. **Avoid** daily alcohol use to reduce risk for isoniazid-induced hepatitis.

May be given IM (same as oral doses) when oral therapy is not possible. Administer oral doses 1 hr prior to and 2 hr after meals. Aluminum salts may decrease absorption. **Adjust dose in renal failure** (see Chapter 31).

ISOPROTERENOL

Isuprel and generics

Adrenergic agonist

Injection: 0.2 mg/mL (1, 5 mL); preparations may be preservative free or contain disodium EDTA

NOTE: The dosage units for adults are in mCg/min, compared to mCg/kg/min for children.

IV infusion:



Neonate–child: 0.05–2 mCg/kg/min; start at minimum dose and increase every 5–10 min by 0.1 mCg/kg/min until desired effect or onset of toxicity; **max. dose:** 2 mCg/kg/min.

Adult: 2–20 mCg/min; titrate to desired effect.



Use with caution in diabetes, hyperthyroidism, renal disease, CHF, ischemia, or aortic stenosis. May cause flushing, ventricular arrhythmias, profound hypotension, anxiety, and myocardial ischemia. Monitor heart rate, respiratory rate, and blood pressure. **Not** for treatment of asystole or for use in cardiac arrests, unless bradycardia is due to heart block.

Continuous infusion for bronchodilatation must be gradually tapered over a 24–48 hr period to prevent rebound bronchospasm. Tolerance may occur with prolonged use. Clinical deterioration, myocardial necrosis, congestive heart failure, and **death** have been reported with continuous infusion use in refractory asthmatic children.

ISOTRETINOIN

Absorica, Amnesteem, Claravis, Myorisan, Zenatane; previously available as Accutane

Retinoic acid, vitamin A derivative

Caps (all products contain soybean oil):

Absorica: 10, 20, 25, 30, 35, 40 mg

Amnesteem: 10, 20, 40 mg; contains EDTA

Claravis, Myorisan, Zenatane, and generics: 10, 20, 30, 40 mg; contains EDTA



Cystic acne/Severe Recalcitrant Nodular acne (see remarks):

Child (>12 yr) and adult: 0.5–2 mg/kg/24 hr ÷ BID PO × 15–20 wk or until the total cyst count decreases by 70%, whichever comes first. Dosages as low as 0.05 mg/kg/24 hr have been reported to be beneficial.

Contraindicated during pregnancy; known teratogen. Use with caution in females during childbearing years. May cause conjunctivitis, xerosis, pruritus, photosensitivity reactions (**avoid** exposure to sunlight and use sunscreen), epistaxis, anemia, hyperlipidemia, pseudotumor cerebri (especially in combination with tetracyclines; **avoid** this combination),



ISOTRETINOIN continued

cheilitis, bone pain, muscle aches, skeletal changes, lethargy, nausea, vomiting, elevated ESR, mental depression, aggressive/violent behavior, and psychosis. Serious skin reactions (e.g., Stevens Johnson syndrome, TEN) have been reported.

Elevation of liver enzymes may occur during treatment; a dosage reduction or continued treatment may result in normalization. Discontinue use if liver enzymes do not normalize or if hepatitis is suspected.

To avoid additive toxic effects, **do not** take vitamin A concomitantly. Increases clearance of carbamazepine. Hormonal birth control (oral, injectable, and implantable) failures have been reported with concurrent use. Monitor CBC, ESR, triglycerides, and LFTs.

Prescribers, site pharmacists, patients, and wholesalers must register with the iPLEDGE system (a risk minimization program) at www.ipledgeprogram.com or 1-866-495-0654 before doses are dispensed. Prescriptions may not be written for more than a 1-mo supply.

ITRACONAZOLE

Sporanox, Tolsura, and generics

Antifungal agent



C

3

Yes

Yes

No

Caps:

Sporanox and generics: 100 mg

Tolsura: 65 mg

Oral solution (Sporanox and generics): 10 mg/mL (150 mL); contains propylene glycol and saccharin



Neonate (limited data in full-term neonates treated for tinea capitis): 5 mg/kg/24 hr PO once daily × 6 wk

Child (limited data): 3–5 mg/kg/24 hr PO ÷ once daily–BID; dosages as high as 5–10 mg/kg/24 hr have been used for Aspergillus prophylaxis in chronic granulomatous disease. Population pharmacokinetic data in pediatric cystic fibrosis and bone marrow transplant patients suggest an oral liquid dosage of 10 mg/kg/24 hr PO ÷ BID or oral capsule dosage of 20 mg/kg/24 hr PO ÷ BID to be more reliable for achieving trough plasma levels between 500 and 2000 ng/mL.

Prophylaxis for recurrence of opportunistic disease in HIV:

Coccidioides spp.: 2–5 mg/kg/dose PO Q12 hr; **max. dose:** 400 mg/24 hr

Cryptococcus neoformans: 5 mg/kg/dose PO Q24 hr; **max. dose:** 200 mg/24 hr

Histoplasmosis: 5–10 mg/kg/dose PO once daily; **max. dose:** 200 mg/dose

Treatment of opportunistic disease in HIV:

Candidiasis: 5 mg/kg/24 hr PO ÷ Q12–24 hr; **max. dose:** 400 mg/24 hr

Coccidioides spp.: 2–5 mg/kg/dose (**max. dose:** 200 mg/dose) PO TID × 3 days, followed by 2–5 mg/kg/dose PO BID; **max. dose:** 400 mg/24 hr

Cryptococcus neoformans: 2.5–5 mg/kg/dose (**max. dose:** 200 mg/dose) PO TID × 3 days, followed by 5–10 mg/kg/24 hr (**max. dose:** 400 mg/24 hr) ÷ once to twice daily for a minimum of 8 wk

Histoplasmosis: 2–5 mg/kg/dose (**max. dose:** 200 mg/dose) PO TID × 3 days, followed by 2–5 mg/kg/dose (**max. dose:** 200 mg/dose) PO BID × 12 mo

Adult:

Blastomycosis and nonmeningeal histoplasmosis: 200 mg PO TID × 3 days, followed by 200 mg PO once daily or BID depending on severity

Aspergillosis and severe infections (use oral solution): 600 mg/24 hr PO ÷ TID × 3–4 days, followed by 200–400 mg/24 hr ÷ BID; **max. dose:** 600 mg/24 hr ÷ TID

Continued

ITRACONAZOLE *continued*

Oral solution and capsule dosage form should NOT be used interchangeably; oral solution is more bioavailable. Only the oral solution has been demonstrated effective for oral and/or esophageal candidiasis. **Contraindicated** in CHF and certain interacting drugs (see below).



Use with caution in hepatic and/or renal impairment, cardiac dysrhythmias, and azole hypersensitivity. May cause GI symptoms, headaches, rash, liver enzyme elevation, hepatitis, and hypokalemia. Double/blurred vision, dizziness, and tremor have been reported.

Like ketoconazole, it inhibits the activity of the CYP-450 3A4 drug metabolizing isoenzyme. Thus, the coadministration of cisapride, dofetilide, felodipine, methadone, nisoldipine, pimozide, quinidine, triazolam, lovastatin, simvastatin, ergot derivatives, and oral midazolam is contraindicated. May increase systemic hormone concentrations of oral contraceptives. See remarks in Ketoconazole for additional drug interaction information.

Steady-state serum concentrations of >0.25 mg/Litraconazole and >1 mg/L hydroxyitraconazole (metabolite) have been recommended. Recommended serum sampling time at steady state: any time after 2 wk after continuous dosing. Itraconazole has a 34–42-hour $T_{1/2}$.

Administer oral solution on an empty stomach but administer capsules with food. Oral capsule bioavailability has been shown to be reduced in immunocompromised patients. Achlorhydria reduces absorption of the drug. **Do not** use oral liquid dosage form in patients with GFR <30 mL/min because of hydroxypropyl- β -cyclodextrin excipient has reduced clearance with renal failure.

IVACAFTOR

Kalydeco

Cystic Fibrosis Transmembrane Conductance Regulator Potentiator



B

?

Yes

Yes

Yes

Oral granules: 50 mg (56 packets), 75 mg (56 packets)

Tabs: 150 mg (56 tabs)

**Cystic Fibrosis (see remarks):**

≥ 6 mo and child <6 yr (use oral granules):

$5-7$ kg: 25 mg PO Q12 hr

$7-14$ kg: 50 mg PO Q12 hr

≥ 14 kg: 75 mg PO Q12 hr

≥ 6 yr, adolescent and adult: 150 mg PO Q12 hr

Dosage modification with hepatic impairment:

Child-Pugh class B: Use above dosage with a once-daily dosage interval.

Child-Pugh class C: Studies have not been completed but exposure is expected to be higher than class B; use above dosage with caution once daily or with a less frequent dosage interval.

Dosage modification when used with CYP 450 3A inhibitors:

Age	Weight (kg)	Dosed With Strong CYP 450 3A Inhibitor (e.g., Ketoconazole, Itraconazole, Voriconazole, Posaconazole, Clarithromycin)	Dosed With Moderate CYP 450 3A Inhibitor (e.g., Erythromycin, Fluconazole)
≥ 6 mo and < 6 yr	5– <7 kg	25 mg PO twice weekly	25 mg PO once daily
	7– <14 kg	50 mg PO twice weekly	50 mg PO once daily
	≥ 14 kg	75 mg PO twice weekly	75 mg PO once daily
≥ 6 yr, adolescent, and adult	All	150 mg PO twice weekly	150 mg PO once daily

IVACAFTOR continued

Works as a CFTR potentiator on class 3 CFTR mutations. Originally indicated for G551D CFTR mutation but has since been approved for many other mutations; see product information for list of approved mutations.

Common side effects include rash, abdominal pain, diarrhea, nausea, dizziness, headache, nasal congestion, pharyngitis, and URIs. Increased liver enzymes and cataracts may occur; monitor baseline AST/ALT and ocular exam. Repeat AST/ALT every 3 months for the first year followed by annual assessments. Repeat ocular exams annually. May cause a false-positive urine drug screen test for cannabinoids. **Use with caution** in patients with CrCl \leq 30 mL/min; has not been studied.

Ivacaftor is CYP 450 3A substrate; see dose modification table in the dosing section. Use with strong CYP 450 3A inducers (e.g., rifampin, rifabutin, carbamazepine, St. John's wort) is not recommended. Always evaluate potential drug-drug interactions; see <https://www.kalydecohcp.com/drug-interactions>. Avoid food or drink containing grapefruit or Seville oranges.

Administer all doses with high-fat foods to assure absorption. Oral granules can be mixed with 5 mL of soft foods or liquids such as puréed fruits or vegetables, yogurt, applesauce, water, breast milk, infant formula, milk, or juice. Once mixed, it should be consumed within an hour. If a dose (all dosage forms) is missed within 6 hr of a scheduled dose, administer a dose immediately. However, if the missed dose is $>$ 6 hr, skip that dose and resume therapy at the next scheduled dose. Never take a double dose for a missed dose.

IVERMECTIN

Stromectol, Sklice, Soolantra, and generics

Anthelmintic



Tab (Stromectol and generics): 3 mg

Topical lotion (Sklice): 0.5% (117 g); contains parabens

Topical cream (Soolantra): 1% (30, 45, 60 g); contains cetyl alcohol, EDTA, parabens, and propylene glycol

Systemic use:

Cutaneous larva migrans or strongyloidiasis: 0.2 mg/kg/dose PO once daily \times 1–2 days for cutaneous larva migrans and \times 2 days for strongyloidiasis; dosing by body weight (see first table)

Scabies: 0.2 mg/kg/dose PO \times 1, may repeat dose in 7 or 10–14 days, dosing by body weight as follows:



Weight (kg)	Oral Dose
15–24	3 mg
25–35	6 mg
36–50	9 mg
51–65	12 mg
66–79	15 mg
\geq 80	0.2 mg/kg

Onchocerciasis: 0.15 mg/kg/dose PO \times 1, may repeat dose every 6–12 mo until asymptomatic; dosing by body weight as follows:

Weight (kg)	Single Oral Dose
15–25	3 mg
26–44	6 mg
45–64	9 mg
65–84	12 mg
\geq 85	0.15 mg/kg

IVERMECTIN *continued***Topical use:****Lotion:**

Head lice infestation (≥ 6 mo to adult): Apply lotion to dry hair in sufficient amounts (up to one full tube) to thoroughly coat the hair and scalp for 10 min. Then rinse off with water.

Cream:

Rosacea (Adult): Apply cream to each affected area once daily.

Systemic Use: Rare fatal encephalopathy may occur in onchocerciasis with a concurrent heavy Loa loa infection. Reactions experienced with strongyloidiasis include diarrhea, nausea, vomiting, pruritus, rash, dizziness, and drowsiness. Adverse reactions experienced in onchocerciasis include cutaneous or systemic allergic/inflammatory reactions of varying severity (Mazzotti reaction) and ophthalmologic reactions. Specific reactions may include arthralgia/synovitis, lymph node enlargement and tenderness, pruritus, edema, fever, orthostatic hypotension, and tachycardia. Therapy for postural hypotension may include oral hydration, recumbency, IV normal saline, and/or IV steroids. Antihistamines or aspirin, or both, have been used for most mild-to-moderate cases. Ivermectin may increase the effects/toxicity of warfarin. Administer oral doses on an empty stomach with water.



Topical Use: Safety and efficacy have not been established for children < 6 mo. Common side effects include conjunctivitis, ocular hyperemia, eye irritation, dandruff, dry skin, and skin-burning. Contact dermatitis has been reported. Not for oral, ophthalmic, or intravaginal use. Use of lotion for children should be supervised by an adult to prevent oral ingestion.

K**KALYDECO**

See Ivacaftor

KETAMINE

Ketalar and generics

General anesthetic

B



3



No



No



No

Injection: 10 mg/mL (20 mL), 50 mg/mL (10 mL), 100 mg/mL (5, 10 mL); contains benzethonium chloride

**Child (see remarks):****Sedation:**

PO: 5 mg/kg \times 1

IV: 0.5–1 mg/kg; **max. dose:** 150 mg/dose

IM: 2–5 mg/kg \times 1

Adult:**Analgesia with sedation:**

IV (see remarks): 0.2–1 mg/kg

IM: 0.5–4 mg/kg

Contraindicated in significant hypertension and known hypersensitivity to the drug. **Use with caution** in elevated ICP, aneurysms, thyrotoxicosis, CHF, angina, and psychotic disorders. May cause hypertension, hypotension, emergence reactions, tachycardia, laryngospasm,



KETAMINE *continued*

respiratory depression, and stimulation of salivary secretions. Cystitis has been reported with chronic use/abuse. Intravenous use may induce general anesthesia. Diplopia and nystagmus have been noted following IV administration. False-positive test for urine phencyclidine (PCP) screen may occur.

Coadministration of an anticholinergic agent may be added in situations of clinically significant hypersalivation in patients with impaired ability to mobilize secretions. Benzodiazepine may be used in the presence of a ketamine-associated recovery reaction (prophylaxis use in adults may be beneficial). Ondansetron prophylaxis can slightly reduce vomiting. See *Ann Emerg Med*. 2001;57:449–461 for additional use information in the emergency department.

Drug is a substrate for CYP 450 2B6, 2C9 and 3A4 isoenzymes. Consider potential drug interactions with respective enzyme inhibitors and inducers, especially with prolonged use.

Rate of IV infusion should **not** exceed 0.5 mg/kg/min and **should not** be administered in less than 60 sec. For additional information including onset and duration of action, see [Chapter 6](#).

KETOCONAZOLE

Nizoral, Nizoral A-D, Xolegel, Extina, Ketodan, and generics

Antifungal agent, imidazole



C



2



No



Yes



No

Tabs: 200 mg

Oral suspension: 100 mg/5 mL

Cream: 2% (15, 30, 60 g); contains sulfites

Gel: 2% [Xolegel] (45 g); contains 34% alcohol

Foam: 2% [Extina and generics] (50, 100 g); contains alcohol and propylene glycol

Shampoo: 1% [Nizoral A-D (OTC)] (125, 200 mL), 2% [Nizoral and generics] (120 mL)

Oral:

Child ≥2 yr and adolescent: 3.3–6.6 mg/kg/24 hr once daily

Adult: 200–400 mg/24 hr once daily

Max. dose (all ages): 400 mg/24 hr

Topical (≥12 yr; see remarks):

Cream: 1 application to affected area once daily × 2–6 wk. For seborrheic dermatitis, use BID × 4 wk.

Gel (Xolegel): 1 application to affected area once daily × 2 wk

Foam: 1 application to affected area BID × 4 wk

Shampoo:

1% (Dandruff): Apply to wet hair, generously lather, rinse thoroughly; use every 3–4 days for up to 8 wk PRN

2% (Tinea versicolor): Apply to wet hair and leave on for 5 minutes before rinsing × 1

The systemic dosage form should NOT be first-line treatment for any fungal infection due to concerns of hepatotoxicity and adrenal gland effects (per the FDA).

Monitor LFTs in long-term use and adrenal function for patients at risk. Drugs that decrease gastric acidity will decrease absorption. May cause nausea, vomiting, rash, headache, pruritus, and fever. Hepatotoxicity (including fatal cases) has been reported; use with hepatic impairment is **contraindicated**. High doses may decrease adrenocortical function and serum testosterone levels. Hypersensitivity reactions (including anaphylaxis), has been reported with all dosage forms.

Safety and efficacy with topical use in seborrheic dermatitis for patients >12 yr of age has been established. **Avoid** topical use on breast or nipples in nursing mothers.

Continued

KETAMINE *continued*

Inhibits CYP 450 3A4. **Contraindicated** when used with cisapride, disopyramide, methadone, mefloquine, quinidine, terfenadine, pimozide, or any drug that can prolong the QT interval (because of risk for cardiac arrhythmias), and HMG-CoA reductase inhibitors (e.g., simvastatin, and lovastatin). Excessive sedation and prolonged hypnotic effects with triazolam use (also **contraindicated**). May increase levels/effects of phenytoin, digoxin, cyclosporine, corticosteroids, nevirapine, protease inhibitors, and warfarin. Achlorhydria, phenobarbital, rifampin, isoniazid, H₂ blockers, antacids, and omeprazole can decrease levels of oral ketoconazole.

Administering oral doses with food or acidic beverages and 2 hr prior to antacids will increase absorption. For topical products, **avoid contact** with eyes and other mucous membranes.

To use shampoo, wet hair and scalp with water, apply sufficient amount to scalp and gently massage for about 1 min. Rinse hair thoroughly, reapply shampoo and leave on the scalp for an additional 3 min, and rinse.

KETOROLAC

Many generics (previously available as Toradol), Acular, Acular LS, Acuvail

Nonsteroidal anti-inflammatory agent



Injection: 15 mg/mL (1 mL), 30 mg/mL (1, 2 mL); contains 10% alcohol and tromethamine

Tabs: 10 mg; contains tromethamine

Ophthalmic solution (all containing tromethamine):

Acular and generic: 0.5% (3, 5, 10 mL); contains benzalkonium chloride and EDTA

Acular LS and generics: 0.4% (5 mL); contains benzalkonium chloride and EDTA

Acuvail: 0.45% (0.4 mL; 30s); preservative free

Systemic use is not to exceed 3–5 days, regardless of administration route (IM, IV, PO).



IM/IV:

Child: 0.5 mg/kg/dose IM/IV Q6–8 hr. **Max. dose:** 30 mg Q6 hr or 120 mg/24 hr.

Adult: 30 mg IM/IV Q6 hr. **Max. dose:** 120 mg/24 hr

PO:

Child >16 yr and adult: 10 mg PRN Q6 hr; max. dose: 40 mg/24 hr

Ophthalmic (see remarks):

Postoperative cataract surgery:

≥2 yr–adult (use 0.5%): 1 drop in each affected eye QID starting 24 hr after surgery × 2 wk

Postoperative corneal refractive surgery:

≥3 yr–adult (use 0.4%): 1 drop in each affected eye QID PRN for up to 4 days after surgery

Seasonal allergic conjunctivitis:

≥2 yr–adult (use 0.5%): 1 drop in each eye QID

May cause GI bleeding, nausea, dyspepsia, drowsiness, decreased platelet function, and interstitial nephritis. **Not recommended** in patients at increased risk of bleeding. **Do not use** in hepatic or renal failure. **Use with caution** in heart disease (risk for MI and stroke with prolonged use). False-positive test for urine cannabinoid screen may occur with systemic use.



Duration of therapy for ophthalmic use: 14 days after cataract surgery, and up to 4 days after corneal refractive surgery. Also indicated for ocular itching associated with seasonal allergic conjunctivitis. Bronchospasm or asthma exacerbations, corneal erosion/perforation/thinning/melt, and epithelial breakdown have been reported with ophthalmic use.

Pregnancy category changes to a “D” if used in the third trimester.

L

LABETALOL

Generics; previously available as Normodyne and Trandate
Adrenergic antagonist (α and β), antihypertensive



Tabs: 100, 200, 300 mg

Injection: 5 mg/mL (4, 20, 40 mL); contains parabens

Oral suspension: 10 mg/mL 40 mg/mL

Child (see remarks):

PO: Initial: 1–3 mg/kg/24 hr \div BID. May increase up to a **maximum** of 12 mg/kg/24 hr up to 1200 mg/24 hr.



IV: Hypertensive emergency (start at lowest dose and titrate to effect; see Chapter 4 for additional information):

Intermittent dose: 0.2–1 mg/kg/dose Q10 min PRN; **max. dose:** 40 mg/dose

Infusion (hypertensive emergencies): 0.4–1 mg/kg/hr, to a **max. dose** of 3 mg/kg/hr; may initiate with a 0.2–1 mg/kg bolus; **max. bolus:** 40 mg.

Adult (see remarks):

PO: 100 mg BID, increase by 100 mg/dose Q2–3 days PRN to a **max. dose** of 2.4 g/24 hr. Usual range: 200–800 mg/24hr \div BID

IV: Hypertensive emergency (start at lowest dose and titrate to effect with a **max. total dose** of 300 mg for both methods of administration):

Intermittent dose: 10–20 mg/dose Q10 min PRN; **max. dose:** 80 mg/dose

Infusion: 0.5–2 mg/min, increase to titrate to response.



Contraindicated in asthma, pulmonary edema, cardiogenic shock, and heart block. May cause orthostatic hypotension, edema, CHF, bradycardia, AV conduction disturbances, bronchospasm, urinary retention, and skin tingling. **Use with caution** in hepatic disease (dose reduction may be necessary), diabetes, liver function test elevation, hepatic necrosis, and hepatitis. Cholestatic jaundice has been reported. Use with digitalis glycosides may increase risk for bradycardia. False-positive test for urine amphetamine screen may occur. Patient should remain supine for up to 3 hr after IV administration. Pregnancy category changes to "D" if used in second or third trimesters.

Onset of action: PO: 1–4 hr; IV: 5–15 min.

LACOSAMIDE

Vimpat

Anticonvulsant



Oral solution: 10 mg/mL (200, 465 mL); contains aspartame, parabens, and propylene glycol

Tabs: 50, 100, 200 mg

Injection: 10 mg/mL (20 mL); preservative free

Continued

LACOSAMIDE *continued***Partial-onset seizures as monotherapy or adjunctive therapy (PO):****Child (≥4–<17 yr):**

Weight (kg)	Initial Dosage (PO)	Titration Regimen (PO)	Maintenance Dosage (PO)
11–<30	1 mg/kg/dose BID	Increase by 1 mg/kg/dose BID every 7 days	3–6 mg/kg/dose BID
30–<50	1 mg/kg/dose BID	Increase by 1 mg/kg/dose BID every 7 days	2–4 mg/kg/dose BID
≥50	50 mg BID	Increase by 50 mg BID every 7 days	Monotherapy: 150–200 mg BID Adjunctive therapy: 100–200 mg BID

17 yr and adult:

Initial Dosage (PO)	Titration Regimen (PO)	Maintenance Dosage (PO)
Monotherapy: 100 mg BID ^a Adjunctive therapy: 50 mg BID ^a	Increase by 50 mg BID every 7 days	Monotherapy: 150–200 mg BID Adjunctive therapy: 100–200 mg BID

^aAlternative initial dosage (under medical supervision due to increased risk for CNS side effects): 200 mg × 1 and start 12 hr later, 100 mg BID × 7 days then titrate to the respective monotherapy or adjunctive therapy goal.

Converting from other single antiepileptic drug (AED) to lacosamide monotherapy: administer lacosamide in combination with the established single AED for at least 3 days before tapering. Gradually withdrawing the concomitant AED over 6 wk is recommended.

IV use: Use same dose when converting from PO to IV and vice versa. IV use should be considered for short-term use and has not been studied in pediatrics.

Use with caution with known cardiac conduction problems (e.g., second-degree AV block), severe cardiac disease (e.g., MI or heart failure), concomitant use with drugs known to prolong PR interval, and renal (see [Chapter 31](#)) and hepatic impairment. Lacosamide undergoes 95% renal excretion; a reduction of 25% of the **maximum** dosage is recommended for adult and pediatric patients with severe renal impairment ($\text{CrCl} < 30 \text{ mL/min}$ and ESRD), or with mild/moderate hepatic impairment. Use is **not recommended** in severe hepatic impairment. Dose reduction may be also necessary with concurrent strong inhibitor of CYP 450 3A4 or 2C9 medication. Patients with mild/moderate hepatic impairment should be observed closely during dose titration. Oral bioavailability is approximately 100%.

Most common side effects in adults include diplopia, headache, dizziness, and nausea. Somnolence and irritability were frequently reported in pediatric studies. Patients should be advised of potential dizziness, ataxia, and syncope with use. Multiorgan hypersensitivity reactions (including DRESS, affecting the skin, kidney and liver), worsening of seizures, agranulocytosis, and euphoria (high doses) have been reported. As with other AEDs, monitor for suicidal behavior and ideation.

Oral doses may be administered with or without food. Swallow tablets whole; do not cut tablets. IV doses should be administered over 30–60 min. **Do not** abruptly withdraw therapy; gradually taper to prevent potential seizures.

LACTULOSE

Constulose, Enulose, Kristalose, and generics
Ammonium detoxicant, hyperosmotic laxative



B

?

No

No

No

Oral syrup: 10 g/15 mL (15, 30, 237, 473, 960, 1893 mL); contains galactose, lactose, and other sugars

Crystals for reconstitution (Kristalose): 10 g (30s), 20 g (30s)

**Constipation:**

Child: 1.5–3 mL/kg/24 hr PO ÷ BID; **max. dose:** 60 mL/24 hr

Adult: 15–30 mL/24 hr PO once daily to a **max. dose** of 60 mL/24 hr.

Portal systemic encephalopathy (adjust dose to produce 2–3 soft stools/day):

Infant: 2.5–10 mL/24 hr PO ÷ TID–QID

Child and adolescent: 40–90 mL/24 hr PO ÷ TID–QID

Adult: 30–45 mL/dose PO TID–QID; acute episodes 30–45 mL Q1–2 hr until 2–3 soft stools/day

Rectal (adult): 300 mL diluted in 700 mL water or NS in 30–60 min retention enema; may give Q4–6 hr.



Contraindicated in galactosemia. **Use with caution** in diabetes mellitus. GI discomfort and diarrhea may occur. For portal systemic encephalopathy, monitor serum ammonia, serum potassium, and fluid status.

Do not use with antacids. Dissolve crystal dosage form with 4 ounces of water or juice. All doses may be administered with juice, milk, or water.

LAMIVUDINE

Epivir, Epivir-HBV, 3TC, and generics
Antiviral agent, nucleoside analogue reverse transcriptase inhibitor



C

3

Yes

Yes

No

Tabs: 100 mg (Epivir-HBV and generics), 150, 300 mg (Epivir and generics)

Oral solution: 5 mg/mL (Epivir-HBV) (240 mL), 10 mg/mL (Epivir and generics) (240 mL); contains parabens



HIV: See www.aidsinfo.nih.gov/guidelines.

Prevention of maternal-fetal transmission to reduce nevirapine resistance (for infants

born to mothers with no antiretroviral therapy before or during labor, infants born to mothers with only intrapartum antiretroviral therapy, infants born to mothers with suboptimal viral suppression at delivery, or infants born to mothers with known antiretroviral drug resistance).

Neonate ≥32 wk gestation (use in combination with zidovudine and either raltegravir or nevirapine): 2 mg/kg/dose PO BID within 6–12 hr after birth. Increase dose to 4 mg/kg/dose PO BID at 4 wk of age.

Chronic hepatitis B (see remarks):

2–17 yr: 3 mg/kg/dose PO once daily up to a **max. dose** of 100 mg/dose

18 and adult: 100 mg/dose PO once daily



See aidsinfo.nih.gov/guidelines for remarks for use in HIV. Oral tablet dosage form is preferred over oral solution for children ≥14 kg treated for HIV because subjects in the ARROW clinical trial receiving oral solution had lower rates of HIV viral suppression, lower plasma lamivudine exposure, and developed viral resistance more frequently.

May cause headache, fatigue, GI disturbances, rash, and myalgia/arthritis. Lactic acidosis, severe hepatomegaly with steatosis, post-treatment exacerbations of hepatitis B and ALT elevations, pancreatitis, and emergence of resistant viral strains have been reported. Treatment should be suspended in any patient developing clinical or laboratory signs of lactic acidosis or hepatotoxicity.

LAMIVUDINE *continued*

Avoid use with sorbitol-containing medicines, as sorbitol reduces lamivudine exposure. Concomitant use with co-trimoxazole (TMP/SMX) may result in increased lamivudine levels.

Use Epivir-HBV product for chronic hepatitis B indication only. Safety and effectiveness beyond 1 yr have not been determined. If serum HBV DNA remains detectable after 24 wk of lamivudine monotherapy, consider switching to an alternative therapy. Patients with both HIV and hepatitis B should use the higher HIV doses along with an appropriate combination regimen.

May be administered with food. **Adjust dose in renal impairment** (see [Chapter 31](#)).

LAMOTRIGINE

Lamictal, Subvenite, Lamictal ODT, Lamictal XR, and generics

Anticonvulsant



Tabs (Lamictal, Subvenite, and generics): 25, 100, 150, 200 mg

Extended release tabs (Lamictal XR and generics): 25, 50, 100, 200, 250, 300 mg

Chewable tabs: 5, 25 mg

Orally disintegrated tabs (Lamictal ODT and generics): 25, 50, 100, 200 mg

Oral suspension: 1 mg/mL

Child 2–12 yr adjunctive seizure therapy (maintenance doses for patients <30 kg may need to be increased as much as 50%; see remarks):



WITH AEDs other than carbamazepine, phenytoin, phenobarbital, primidone, or valproic acid (use immediate-release dosage forms):

Wk 1 and 2: 0.3 mg/kg/24 hr PO ÷ once daily—BID; rounded down to the nearest whole tablet.

Wk 3 and 4: 0.6 mg/kg/24 hr PO ÷ BID; rounded down to the nearest whole tablet.

Usual maintenance dose: 4.5–7.5 mg/kg/24 hr PO ÷ BID titrate to effect. To achieve the usual maintenance dose, increase doses Q 1–2 wk by 0.6 mg/kg/24 hr (rounded down to the nearest whole tablet) as needed.

Max. dose: 300 mg/24 hr ÷ BID.

WITH enzyme-inducing AEDs WITHOUT valproic acid (use immediate-release dosage forms):

Wk 1 and 2: 0.6 mg/kg/24 hr PO ÷ BID; rounded down to the nearest whole tablet.

Wk 3 and 4: 1.2 mg/kg/24 hr PO ÷ BID; rounded down to the nearest whole tablet.

Usual maintenance dose: 5–15 mg/kg/24 hr PO ÷ BID titrate to effect. To achieve the usual maintenance dose, increase doses Q 1–2 wk by 1.2 mg/kg/24 hr (rounded down to the nearest whole tablet) as needed.

Max. dose: 400 mg/24 hr ÷ BID.

WITH AEDs WITH valproic acid (use immediate-release dosage forms):

Wk 1 and 2: 0.15 mg/kg/24 hr PO ÷ once daily—BID; rounded down to the nearest whole tablet (see following table)

Wk 3 and 4: 0.3 mg/kg/24 hr PO ÷ once daily—BID; rounded down to the nearest whole tablet (see following table)

Weight (kg)	Weeks 1 and 2	Weeks 3 and 4
6.7–14	2 mg every other day	2 mg once daily
14.1–27	2 mg once daily	4 mg/24 hr ÷ once daily—BID
27.1–34	4 mg/24 hr ÷ once daily—BID	8 mg/24 hr ÷ once daily—BID
34.1–40	5 mg once daily	10 mg/24 hr ÷ once daily—BID

LAMOTRIGINE *continued*

Usual maintenance dose: 1–5 mg/kg/24 hr PO ÷ once daily–BID, titrate to effect. To achieve the usual maintenance dose, increase doses Q 1–2 wk by 0.3 mg/kg/24 hr (rounded down to the nearest whole tablet) as needed. If adding lamotrigine with valproic acid alone, usual maintenance dose is 1–3 mg/kg/24 hr.

Max. dose: 200 mg/24 hr.

>12 yr and adult adjunctive therapy:

WITH AEDs other than carbamazepine, phenytoin, phenobarbital, primidone, or valproic acid (use immediate-release dosage forms):

Wk 1 and 2: 25 mg once daily PO

Wk 3 and 4: 50 mg once daily PO

Usual maintenance dose: 225–375 mg/24 hr ÷ BID PO, titrate to effect. To achieve the usual maintenance dose, increase doses Q 1–2 wk by 50 mg/24 hr as needed.

WITH enzyme-inducing AEDs WITHOUT valproic acid (use immediate-release dosage forms):

Wk 1 and 2: 50 mg once daily PO

Wk 3 and 4: 50 mg BID PO

Usual maintenance dose: 300–500 mg/24 hr ÷ BID PO, titrate to effect. To achieve the usual maintenance dose, increase doses Q 1–2 wk by 100 mg/24 hr as needed. Doses as high as 700 mg/24 hr ÷ BID have been used.

WITH AEDs WITH valproic acid: (use immediate-release dosage forms)

Wk 1 and 2: 25 mg every other day PO

Wk 3 and 4: 25 mg once daily PO

Usual maintenance dose: 100–400 mg/24 hr ÷ once daily–BID PO, titrate to effect. To achieve the usual maintenance dose, increase doses Q 1–2 wk by 25–50 mg/24 hr as needed. If adding lamotrigine to valproic acid alone, usual maintenance dose is 100–200 mg/24 hr.

Extended-release dosage form (Lamictal XR):

≥13 yr and adult adjunctive therapy (dose increases at wk 8 or later should not exceed

100 mg/24 hr at weekly intervals; see remarks):

	Weeks 1 and 2	Weeks 3 and 4	Week 5	Week 6	Week 7	Maintenance Dose
Patient NOT receiv- ing enzyme- inducing drugs (e.g., carbamazepine) OR valproic acid	25 mg once daily	50 mg once daily	100 mg once daily	150 mg once daily	200 mg once daily	300–400 mg once daily
Patients receiving enzyme- inducing drugs (e.g., carbamazepine) WITHOUT valproic acid	50 mg once daily	100 mg once daily	200 mg once daily	300 mg once daily	400 mg once daily	400–600 mg once daily
Patients receiving valproic acid	25 mg every other day	25 mg once daily	50 mg once daily	100 mg once daily	150 mg once daily	200–250 mg once daily

Continued

LAMOTRIGINE *continued**Converting Adjunctive Therapy to Lamotrigine Monotherapy:*

	Immediate-Release Lamotrigine Dosage Form Regimen (≥ 16 Yr and Adult)	Extended-Release Tabs (≥ 13 Yr and Adult)
Patient NOT receiving enzyme-inducing drugs (e.g., carbamazepine) OR valproic acid	No specific dosing guidelines provided	After achieving a maintenance dose of 250–300 mg/24 hr with the above recommendations, withdraw the concomitant AED by 20% decrements each week over a 4-wk period
Patients receiving enzyme-inducing drugs (e.g., carbamazepine) WITHOUT valproic acid	After achieving a maintenance dose of 500 mg/24 hr with the above recommendations, withdraw the concomitant enzyme-inducing AED by 20% decrements each week over a 4-wk period	After achieving a maintenance dose of 500 mg/24 hr with the above recommendations, withdraw the concomitant enzyme-inducing AED by 20% decrements each week over a 4-wk period. After 2 wks of the complete withdrawal of enzyme-inducing AED, lamotrigine may be decreased no faster than 100 mg/24 hr each week to the maintenance dose of 250–300 mg/24 hr.
Patients receiving valproic acid	<p><i>Step 1:</i> Achieve maintenance dose of 200 mg/24 hr with the above recommendations.</p> <p><i>Step 2:</i> Decrease valproic acid by decrements no greater than 500 mg/24 hr per week to reach 500 mg/24 hr and maintain for 1 wk</p> <p><i>Step 3:</i> Increase lamotrigine to 300 mg/24 hr and decrease valproic acid to 250 mg/24 hr; maintain both for 1 wk</p> <p><i>Step 4:</i> Increase lamotrigine by 100 mg/24 hr Q7 days until reaching maintenance dose of 500 mg/24 hr and discontinue valproic acid</p>	<p><i>Step 1:</i> Achieve maintenance dose of 150 mg/24 hr with the above recommendations.</p> <p><i>Step 2:</i> Decrease valproic acid by decrements no greater than 500 mg/24 hr per week to reach 500 mg/24 hr and maintain for 1 wk</p> <p><i>Step 3:</i> Increase lamotrigine to 200 mg/24 hr and decrease valproic acid to 250 mg/24 hr; maintain both for 1 wk</p> <p><i>Step 4:</i> Increase lamotrigine to 250–300 mg/24 hr and discontinue valproic acid</p>

Bipolar disease (use immediate-release dosage forms; see remarks): ≥ 18 yr and adult (PO; see table below):

	Weeks 1 and 2	Weeks 3 and 4	Week 5	Weeks 6 and Thereafter
Patient NOT receiving enzyme-inducing drugs (e.g., carbamazepine) OR valproic acid	25 mg/24 hr	50 mg/24 hr	100 mg/24 hr	200 mg/24 hr (target dose)

LAMOTRIGINE *continued*

	Weeks 1 and 2	Weeks 3 and 4	Week 5	Weeks 6 and Thereafter
Patients receiving enzyme-inducing drugs (e.g., carbamazepine) WITHOUT valproic acid	50 mg/24 hr	100 mg/24 hr ÷ once daily—BID	200 mg/24 hr ÷ once daily—BID	Week 6: 300 mg/24 hr ÷ once daily—BID Week 7 and thereafter: may increase to 400 mg/24 hr ÷ once daily—BID (target dose) ^a
Patients receiving valproic acid	25 mg every other day	25 mg/24 hr	50 mg/24 hr	100 mg/24 hr (target dose) ^b

^aIf carbamazepine or other enzyme-inducing drug is discontinued, maintain current lamotrigine dose for 1 wk, then decrease daily lamotrigine dose in 100 mg increments at weekly intervals until 200 mg/24 hr.

^bIf valproic acid is discontinued, increase by 50 mg at weekly intervals, up to 200 mg/24 hr.

Enzyme-inducing AEDs include carbamazepine, phenytoin, and phenobarbital. Stevens-Johnson syndrome, toxic epidermal necrolysis, and other potentially life-threatening rashes have been reported in children (0.3%–0.8%) and adults (0.08%–0.3%) for adjunctive therapy in seizures. Reported rates for adults treated for bipolar/mood disorders as monotherapy and adjunctive therapy are 0.08% and 0.13%, respectively. May cause fatigue, drowsiness, ataxia, rash (especially with valproic acid), headache, nausea, vomiting, and abdominal pain. Diplopia, nystagmus, aseptic meningitis, hemophagocytic lymphohistiocytosis, aggression, and alopecia have also been reported. False-positive test for urine phencyclidine (PCP) screen may occur.

Use during the first 3 mo of pregnancy may result in a higher chance for cleft lip or cleft palate in the newborn. Suicidal behavior or ideation have been reported.

If converting from immediate-release to extended-release dosage form, initial dose of extended-release should match the total daily dose of the immediate-release dosage and be administered once daily. Adjust dose as needed with the recommended dosage guidelines.

Reduce maintenance dose in renal failure. Reduce all doses (initial, escalation, and maintenance) in liver dysfunction defined by the Child-Pugh grading system as follows:

Grade B: moderate dysfunction, decrease dose by ~50%

Grade C: severe dysfunction, decrease dose by ~75%

Withdrawal symptoms may occur if discontinued suddenly. A stepwise dose reduction over ≥2 wk (~50% per week) is recommended unless safety concerns require a more rapid withdrawal.

Lamotrigine is metabolized by uridine 5'-diphospho-glucuronyl transferases (UGT). Strong and moderate inducers of CYP 450 3A4 are known to induce UGT to increase lamotrigine clearance. Acetaminophen, carbamazepine, oral contraceptives (ethinylestradiol), phenobarbital, primidone, phenytoin, and rifampin may decrease levels of lamotrigine. Valproic acid may increase levels. False positive urine drug screen for phencyclidine (PCP) has been reported.

Safety and efficacy for maintenance therapy for bipolar disorder in 10–17 yr olds were not established in a RCT in 301 subjects.

Continued

LANSOPRAZOLE

Prevacid, Prevacid SoluTab, First-Lansoprazole, and generics

Gastric acid pump inhibitor**Caps, delayed-release:** 15, 30 mg**Tabs, disintegrating delayed-release (Prevacid SoluTab):** 15, 30 mg; contains aspartame**Oral suspension (First-Lansoprazole):** 3 mg/mL (90, 150, 300 mL); contains benzyl alcohol**Neonate:** 0.5–1.5 mg/kg/24 hr PO ÷ once daily–BID**Short-term treatment of GERD and erosive esophagitis, for up to 12 wk (see remarks):****infant ≥ 3 mo:** 15 mg/24 hr ÷ once daily–BID**Child 1–11 yr (initial dose using fixed dosing):****≤ 30 kg:** 15 mg PO once daily**> 30 kg:** 30 mg PO once daily**Subsequent dosage increase (if needed):** may be increased up to 30 mg PO BID after ≥ 2 wk of therapy without response at initial dose level.**Alternative weight based dosing:****Infant:** 1–2 mg/kg/24 hr PO once daily**Child and adolescent:** 0.7–3 mg/kg/24 hr PO ÷ once daily–BID; **max. dose:** 30 mg/24 hr
12 yr–adult:**GERD:** 15 mg PO once daily for up to 8 wk**Erosive esophagitis:** 30 mg PO once daily × 8–16 wk; maintenance dose: 15 mg PO once daily**Duodenal ulcer:** 15 mg PO once daily × 4 wk; maintenance dose: 15 mg PO once daily**Gastric ulcer and NSAID induced ulcer:** 30 mg PO once daily for up to 8 wk**Hypersecretory conditions:** 60 mg PO once daily; dosage may be increased up to 90 mg PO BID, where doses >120 mg/24 hr are divided BID.

Common side effects include GI discomfort, headache, fatigue, rash, and taste perversion.

Hypersensitivity reactions may result in anaphylaxis, angioedema, bronchospasm, interstitial nephritis, and urticaria. Prolonged use may result in vitamin B₁₂ deficiency (≥ 2 yr) or hypomagnesemia (> 1 yr). Microscopic colitis resulting in watery diarrhea has been reported, and switching to an alternative proton-pump inhibitor may be beneficial in resolving diarrhea. Increased risk for fundic gland polyps has been associated with long-term use > 1 yr.Drug is a substrate for CYP 450 2C19 and 3A3/4. Ultrarapid metabolizers of CYP 450 2C19 may experience reduced efficacy and may require a 4-fold higher dosage. Lansoprazole may decrease levels of itraconazole, ketoconazole, iron salts, mycophenolate, nelfinavir, and ampicillin esters; and increase the levels/effects of methotrexate, tacrolimus and warfarin. Theophylline clearance may be enhanced. **Reduce dose in severe hepatic impairment.** May be used in combination with clarithromycin and amoxicillin for *H. pylori* infections.

A multicenter, double blind, parallel-group study in infants (1 mo–1 yr) with GERD was no more effective than placebo.

Administer all oral doses before meals and 30 min prior to sucralfate. **Do not crush or chew the granules (all dosage forms).** Capsule may be opened and intact granules may be administered in an acidic beverage or food (e.g., apple or cranberry juice, apple sauce). **Do not break or cut the orally disintegrating tablets.** Use of oral disintegrating tablets dissolved in water has been reported to clog and block oral syringes and feeding tubes (gastric and jejunostomy). For IV use, use a 1.2 micron in-line filter.

LEVALBUTEROL

Xopenex, Xopenex HFA, and generics
Beta-2 adrenergic agonist



Prediluted nebulized solution: 0.31 mg in 3 mL, 0.63 mg in 3 mL, 1.25 mg in 3 mL (30s)

Concentrated nebulized solution: 1.25 mg/0.5 mL (0.5 mL) (30s)

Aerosol inhaler (MDI; Xopenex HFA and generics): 45 mCg/actuation (15 g delivers 200 doses)

Nebulizer:

≤4 yr: Start at 0.31 mg inhaled Q4–6 hr PRN; dose may be increased up to 1.25 mg Q4–6 hr PRN

5–11 yr: Start at 0.31 mg inhaled Q8 hr PRN; dose may be increased to 0.63 mg Q8 hr PRN

≥12 yr and adult: Start at 0.63 mg inhaled Q6–8 hr PRN; dose may be increased to 1.25 mg inhaled Q8 hr PRN

Aerosol inhaler (MDI):

≥4 yr and adult: 2 puffs Q4–6 hr PRN.

For use in acute exacerbations, more aggressive dosing may be employed.

R-isomer of racemic albuterol. Side effects include tachycardia, palpitations, tremor, insomnia, nervousness, nausea, and headache.

Clinical data in children demonstrate levalbuterol is as effective as albuterol with fewer cardiac side effects at equipotent doses (0.31–0.63 mg levalbuterol ~2.5 mg albuterol).

However, when higher doses of levalbuterol (1.25 mg) were compared to 2.5 mg albuterol, changes in heart rate were similar.

More frequent dosing may be necessary in asthma exacerbation.

**LEVETIRACETAM**

Keprra, Keprra XR, Roweepra, Spritam, and generics
Anticonvulsant



Tabs: 250, 500, 750, 1000 mg

Extended release tabs (Keprra XR, Roweepra XR, and generics; see remarks): 500, 750 mg

Tabs, disintegrating (Spritam; see remarks): 250, 500, 750, 1000 mg

Oral solution: 100 mg/mL (480 mL); dye free and contains parabens

Injection: 100 mg/mL (5 mL); contains 45 mg sodium chloride and 8.2 mg sodium acetate trihydrate per 100 mg drug

Pre-mixed injection: 500 mg/100 mL in 0.82% sodium chloride, 1000 mg/100 mL in 0.75% sodium chloride, 1500 mg/100 mL in 0.54% sodium chloride

Partial seizures (adjunctive therapy; using immediate-release dosage forms and IV):

Infant (1–5 mo): Start at 7 mg/kg/dose PO/IV BID; increase by 7 mg/kg/dose BID every 2 wk as tolerated to the recommended dose of 21 mg/kg/dose BID. An average daily dose of 35 mg/kg/24 hr was reported in clinical trials.



Infant ≥6 mo–child 3 yr (>20 kg): Start at 10 mg/kg/dose PO/IV BID; increase by 10 mg/kg/dose BID every 2 wk as tolerated to the recommended dose of 25 mg/kg/dose BID. An average daily dose of 47 mg/kg/24 hr was reported in clinical trials.

Child 4–15 yr: Start at 10 mg/kg/dose PO/IV BID; increase by 10 mg/kg/dose BID every 2 wk as tolerated up to a **max. dose** of 30 mg/kg/dose BID or 3000 mg/24 hr. An average daily dose of 44 mg/kg/24 hr was reported in clinical trials.

Continued

LEVETIRACETAM continued

Partial seizures (adjunctive therapy; using immediate release dosage forms and IV, cont.):

Alternative dosing with oral tablets:

20–40 kg: Start at 250 mg PO BID; increase by 250 mg BID every 2 wk as tolerated up to a maximum of 750 mg BID.

>40 kg: Start at 500 mg PO BID; increase by 500 mg BID every 2 wk as tolerated up to a maximum of 1500 mg BID.

16 yr–adult: Start at 500 mg PO/IV BID; may increase by 500 mg/dose BID every 2 wk as tolerated up to a max. dose of 1500 mg BID.

Myoclonic seizure (adjunctive therapy; using immediate-release dosage forms and IV):

≥12 yr and adult: Start at 500 mg PO/IV BID; then increase dosage by 500 mg/dose BID every 2 wk as tolerated to reach the target dosage of 1500 mg BID.

Tonic-clonic seizure (primary generalized, adjunctive therapy; use immediate-release dosage forms and IV):

Child 6–15 yr: Start at 10 mg/kg/dose PO/IV BID; increase by 10 mg/kg/dose BID every 2 wk as tolerated to reach the target dosage of 30 mg/kg/dose BID.

Alternative fixed dosing with oral disintegrating tabs (Spritam):

20–40 kg: Start at 250 mg PO BID; increase by 250 mg BID every 2 wk as tolerated up to a maximum of 750 mg BID.

>40 kg: Start at 500 mg PO BID; increase by 500 mg BID every 2 wk as tolerated up to a maximum of 1500 mg BID.

16 yr–adult: Start at 500 mg PO/IV BID; then increase dosage by 500 mg/dose BID every 2 wk as tolerated to reach the target dosage of 1500 mg BID.

Refractory status epilepticus: (limited data):

Infant, child, and adolescent: 20 mg/kg (max. dose: 1500 mg/dose) IV over 15 min × 1, then start maintenance therapy based on clinical response and seizure type.

Do not abruptly withdraw therapy, to reduce risk for seizures. **Use with caution** in renal impairment (reduce dose; see Chapter 31), hemodialysis, and neuropsychiatric conditions.



May cause loss of appetite, vomiting, dizziness, headaches, somnolence, agitation, depression, and mood swings. Drowsiness, fatigue, nervousness, and aggressive behavior have been reported in children. Nonpsychotic behavioral symptoms reported in children are approximately 3 times greater than in adults (37.6% vs. 13.3%). Suicidal behavior or ideation, serious dermatological reactions (e.g., Stevens Johnson and TEN), hematologic abnormalities (e.g., anemia, leukopenia), hyponatremia, and hypertension have been reported. Levetiracetam may decrease carbamazepine's effects. Ginkgo may decrease levetiracetam's effects.

Drug has excellent PO absorption. For IV use, use similar immediate-release PO dosages only when the oral route of administration is not feasible. Extended-release tablet is designed for once-daily administration at similar daily dosage of the immediate-release forms (e.g., 1000 mg once daily of the extended release tablet is equivalent to 500 mg BID of the immediate release tablet).

Disintegrating tabs (Spritam) may be administered by allowing the tablet to disintegrate in the mouth when taken with a sip of liquid or made into a suspension (see package insert); **do not** swallow this dosage form whole.

LEVOCARNITINE

See Carnitine

LEVOFLOXACIN

Levaquin and generics

Antibiotic, quinolone

C



2



Yes



No



No

Tabs: 250, 500, 750 mg**Oral solution:** 25 mg/mL (100, 200, 480 mL)**Injection:** 25 mg/mL (20, 30 mL)**Pre-mixed injection in D₅W:** 250 mg/50 mL, 500 mg/100 mL, 750 mg/150 mL**Ophthalmic drops (genericis previously available as Quixin):** 0.5% (5 mL)**Child:****6 mo–<5 yr:** 10 mg/kg/dose IV/PO Q12 hr; **max. dose:** 500 mg/24 hr**≥5 yr:** 10 mg/kg/dose IV/PO Q24 hr; **max. dose:** 750 mg/24 hr**Recurrent or persistent acute otitis media (6 mo–<5 yr):** 10 mg/kg/dose PO Q12 hr × 10 days; **max. dose:** 500 mg/24 hr**Community acquired pneumonia (IDSA/Pediatric Infectious Disease Society):****6 mo–<5 yr:** 8–10 mg/kg/dose PO/IV Q12 hr; **max. dose:** 750 mg/24 hr**5–16 yr:** 8–10 mg/kg/dose PO/IV Q24 hr; **max. dose:** 750 mg/24 hr**Inhalational anthrax (postexposure) and plague:****≥6 mo and <50 kg:** 8 mg/kg/dose PO/IV Q12 hr; **max. dose:** 500 mg/24 hr**>50 kg:** 500 mg PO/IV once daily**Duration of therapy:****Inhalational anthrax (postexposure):** 60 days**Plague:** 10–14 days**Adult:****Community acquired pneumonia:** 500 mg PO/IV Q24 hr × 7–14 days; OR 750 mg PO/IV Q24 hr × 5 days**Complicated UTI/acute pyelonephritis:** 750 mg PO/IV Q24 hr × 5–7 days**Acute bacterial sinusitis:** 500 mg PO/IV Q24 hr × 10–14 days; OR 750 mg PO/IV Q24 hr × 5 days**Inhalational anthrax (post-exposure):** 750 mg PO/IV Q24 hr × 60 days**Plague:** 500 mg PO/IV Q24 hr × 10–14 days**Conjunctivitis:****≥1 yr and adult:** Instill 1–2 drops of the 0.5% solution to affected eye(s) Q2 hr up to 8 times/24 hr while awake for the first 2 days, then Q4 hr up to 4 times/24 hr while awake for the next 5 days.**Contraindicated** in hypersensitivity to other quinolones. **Avoid** in patients with history of QTc prolongation or taking QTc prolonging drugs, and excessive sunlight exposure.**Use with caution** in diabetes, seizures, myasthenia gravis, children <18 yr, and renal impairment (**adjust dose**, see Chapter 31). May cause GI disturbances, headache, and blurred vision with the ophthalmic solution. Musculoskeletal disorders (e.g., arthralgia, arthritis, tendinopathy, and gait abnormality) may occur. Peripheral neuropathy and uveitis have been reported. Safety in pediatric patients treated more than 14 days has not been evaluated. Like other quinolones, tendon rupture can occur during or after therapy (risk increases with concurrent corticosteroids). Psychiatric adverse events, increased intracranial pressure, seizures, and blood glucose disturbances have been reported. Use with NSAIDs may increase risk of CNS stimulation and seizures.Infuse IV over 1–1.5 hr; **avoid** IV push or rapid infusion because of risk of hypotension. **Do not** administer antacids or other divalent salts with or within 2 hr of oral levofloxacin dose; otherwise may be administer with or without food.

LEVOTHYROXINE (T₄)

Synthroid, Levoxyl, Tirosint, Tirosint-Sol, Unithroid,
Unithroid Direct, and generics
Thyroid product



A

1

No

No

No

Tabs: 25, 50, 75, 88, 100, 112, 125, 137, 150, 175, 200, 300 mCg

Caps (Tirosint): 13, 25, 50, 75, 88, 100, 112, 125, 137, 150, 175, 200 mCg

Injection: 100, 200, 500 mCg; preservative free

Oral solution (Tirosint-Sol): 13, 25, 50, 75, 88, 100, 112, 125, 137, 150, 175, 200 mCg/1 mL (30 ampules per box)

Oral suspension: 25 mCg/mL

Hypothyroidism:**Child PO dosing (see remarks):**

1–3 mo: 10–15 mCg/kg/dose once daily. If patient is at risk for developing cardiac failure start with lower dose of 25 mCg/24 hr; and if patient has very low T₄ (<5 mCg/dL) use higher 12–17 mCg/kg/24 hr dose.

3–6 mo: 8–10 mCg/kg/dose once daily

6–12 mo: 6–8 mCg/kg/dose once daily

1–5 yr: 5–6 mCg/kg/dose once daily

6–12 yr: 4–5 mCg/kg/dose once daily

>12 yr:

Incomplete growth and pre-puberty: 2–3 mCg/kg/dose once daily

Complete growth and puberty: 1.7 mCg/kg/dose once daily

Child IM/IV dose: 50%–75% of oral dose once daily

Adult:

PO: Start with 12.5–25 mCg/dose once daily. Increase by 25–50 mCg/24 hr at intervals of Q2–4 wk until euthyroid. Usual adult dose: 100–200 mCg/24 hr.

IM/IV dose: 50% of oral dose once daily

**Myxedema coma or stupor:**

Adult: 200–400 mCg IV × 1, then 50–100 mCg IV once daily; convert to oral therapy once patient is stabilized.

Contraindications include acute MI, thyrotoxicosis, and uncorrected adrenal insufficiency.

May cause hyperthyroidism, rash, growth disturbances, hypertension, worsening of diabetic control, decreased bone mineral density (primarily in post-menopausal females), arrhythmias, diarrhea, and weight loss. Pseudotumor cerebri and slipped capital femoral epiphysis have been reported in children. Overtreatment may cause craniostostosis in infants and premature closure of the epiphyses in children.

Total replacement dose may be used in children unless there is evidence of cardiac disease; in that case, begin with one-fourth of maintenance and increase weekly. Titrate dosage with clinical status and serum T₄ and TSH.

Increases the effects of warfarin. Phenytoin, rifampin, carbamazepine, iron and calcium supplements, antacids, grapefruit juice, and orlistat may decrease levothyroxine levels. Tricyclic antidepressants and SSRIs may enhance toxic effects. Use with ketamine may cause hypertension and tachycardia. High doses of propranolol or dexamethasone, and amiodarone may decrease the conversion of T₄ to T₃.

100 mCg levothyroxine = 65 mg thyroid USP. Administer oral doses on an empty stomach and tablets with a full glass of water. Iron and calcium supplements and antacids may decrease absorption; **do not** administer within 4 hr of these agents. Excreted in low levels in breast milk; preponderance of evidence suggests no clinically significant effect in infants.

LIDOCAINE

Xylocaine, L-M-X, Lidoderm, and generics
Anti-arrhythmic class Ib, local anesthetic



B 1 Yes Yes No

Injection: 0.5%, 1%, 1.5%, 2%, 4% (1% sol = 10 mg/mL)

IV infusion (in D₅W): 0.4% (4 mg/mL) (250, 500 mL); 0.8% (8 mg/mL) (250 mL)

Injection with epinephrine (some preparations may contain metasulfite and parabens or are preservative free):

Injection with 1:100,000 epinephrine: 1%, 2% lidocaine

Injection with 1:200,000 epinephrine: 0.5%, 1%, 1.5%, 2% lidocaine

Ointment: 5% (30, 50 g)

Cream, topical: 3% (30, 85 g), 4% (L-M-X-4 and generics)[OTC] (5, 15, 30, 45 g), 5% (L-M-X-5 and generics) (15, 30 g); may contain benzyl alcohol

Cream, rectal: 5% (L-M-X-5 and others; 15, 30 g); contains benzyl alcohol

Gel (external): 2% (5, 10, 20, 30 mL), 3% (10, 30 mL), 4% (10, 30, 113 g), 5% (10, 30, 113 g); may contain benzyl alcohol, EDTA

Lotion: 3% (118, 177 mL), 4% (88 mL)

Solution (external): 4% (50 mL); may contain parabens

Transdermal patch:

Lidocaine Pain Relief and generics [OTC]: 4% (5s, 10s); may contain menthol, capsaicin, and methyl salicylate

Lidoderm and generics: 5% (1s, 15s, 30s)

Oral solution (mouth/throat): 2% (15, 100 mL), 4% (4 mL)

Topical cream or gel 2.5% with 2.5% prilocaine: See Lidocaine and Prilocaine

Anesthetic:

Injection (local): Use <2% concentration. Dosage varies with procedure, degree and duration of analgesia, tissue vascularity, and patient condition.

Without epinephrine: max. dose of 4.5 mg/kg/dose (up to 300 mg); do not repeat within 2 hr.

With epinephrine: max. dose of 7 mg/kg/dose (up to 500 mg); do not repeat within 2 hr.

Topical:

Cream (child ≥ 2 yr and adult): Apply to affected intact skin areas BID–QID; max. dose: 4.5 mg/kg/dose up to 300 mg

Gel, lotion, or ointment (child ≥ 2 yr and adult): Apply to affected intact skin areas once daily–QID (BID–TID for lotion); max. dose: 4.5 mg/kg up to 300 mg

Patch:

4% (≥ 12 yr and adult): Apply patch to painful area and leave in place for up to 12 hr. Max. dose: one patch/24 hr.

5% (adult): Apply to most painful area with up to 3 patches at a time. Patch(es) may be left in place for up to 12 hr in any 24 hr period.

Antiarrhythmic (infant, child, adolescent):

Bolus: 1 mg/kg/dose (max. dose: 100 mg) slowly IV; may repeat in 10–15 min × 2; max. total dose 3–5 mg/kg within the first hr. ETT dose = 2–3 × IV dose.

Continuous infusion: 20–50 mCG/kg/min IV/IO (do not exceed 20 mCG/kg/min for patients with shock, CHF, hepatic disease, or cardiac arrest); see inside cover for infusion preparation. Administer a 1 mg/kg bolus when infusion is initiated if bolus has not been given within previous 15 min.

Oral use (viscous liquid):

Child (≥ 3 yr): up to the lesser of 4.5 mg/kg/dose or 300 mg/dose, swish and spit Q3 hr PRN up to a max. dose of 4 doses per 12 hr period

Adult: 15 mL, swish and spit Q3 hr PRN up to a max. dose of 8 doses/24 hr

LIDOCAINE *continued*

For cardiac arrest, amiodarone is the preferred agent over lidocaine; lidocaine may be used only when amiodarone is not available.



Contraindicated in Stokes-Adams or Wolff-Parkinson-White syndromes and SA, AV, or intraventricular heart block without a pacemaker. Solutions containing dextrose may be contraindicated in patients with known allergy to corn or corn products. Side effects include hypotension, asystole, seizures, and respiratory arrest. Anaphylactic reactions have been reported. Local anesthetic use has been associated with methemoglobinemia.

CYP 450 2D6 and 3A3/4 substrate. **Use with caution** in severe liver or renal disease. Decrease dose in hepatic failure or decreased cardiac output. **Do not use** topically for teething. Prolonged infusion may result in toxic accumulation of lidocaine, especially in infants. **Do not use** epinephrine-containing solutions for treatment of arrhythmias.

Therapeutic levels 1.5–5 mg/L. Toxicity occurs at >7 mg/L. Toxicity in neonates may occur at >5 mg/L due to reduced protein binding of drug. Elimination $T_{1/2}$: premature infant: 3.2 hr, adult: 1.5–2 hr.

When using the topical patch, **avoid** exposing the application site to external heat sources as this may increase the risk for toxicity.

LIDOCAINE AND PRILOCaine

Many brand names, Oraqix, Eutectic mixture of lidocaine and prilocaine; previously available as EMLA

**Topical analgesic**

Cream: Lidocaine 2.5% + prilocaine 2.5% (5, 30 g)

Peridental gel (Oraqix): Lidocaine 2.5% + prilocaine 2.5% (1.7 g in dental cartridges; 20s)



See Chapter 6, for general use information.

Neonate:

<37 wk gestation (*limited data*):

Painful procedures (e.g., IM injections): 0.5 g/site for 60 min.

≥37 wk gestation and <5 kg:

Painful procedures (e.g., IM injections): 1 g/site for 60 min. **Max. dose:** 1 g for all sites combined with a **max.** application area of 10 cm² and **max.** application time of 1 hr.

Circumcision: 1–2 g and cover with occlusive dressing for 60–90 min.

Infant and child: The following are the recommended **maximum doses** based on the child's age and weight.

Age and Weight	Maximum Total EMLA Dose (g)	Maximum Application Area (cm ²)	Maximum Application Time
Birth-<3 mo or <5 kg	1	10	1 hr
3–12 mo and >5 kg ^a	2	20	4 hr
1–6 yr and >10 kg	10	100	4 hr
7–12 yr and >20 kg	20	200	4 hr

^aIf patient is >3 mo and is not >5 kg, use the **maximum** total dose which corresponds to the patient's weight. EMLA, Eutectic mixture of local anesthetics.

Adolescent and adult:

Minor procedures: 2.5 g/site over 20–25 cm² of skin for at least 60 min.

Painful procedures: 2 g/10 cm² of skin for at least 2 hr.

LIDOCAINE AND PRILOCAINE *continued*

Should not be used in neonates <37 wk of gestation or in infants <12 mo old receiving treatment with methoglobin-inducing agents (e.g., sulfa drugs, acetaminophen, nitrofurantoin, nitroglycerin, nitroprusside, phenobarbital, phenytoin). **Use with caution** in patients with G6PD deficiency, patients treated with class I or III anti-arrhythmic drugs (additive or toxic cardiac effects), and in patients with renal and hepatic impairment. Prilocaine has been associated with methemoglobinemia. Long duration of application, large treatment area, small patients, or impaired elimination may result in high blood levels. Apply topically to intact skin and cover with occlusive dressing; **avoid** mucous membranes or the eyes. Wipe cream off before procedure.

**LINDANE**

Gamma benzene hexachloride, and various generics

Scabicidal agent, pediculocide

C

3

No

No

No

Shampoo: 1% (60 mL)**Lotion:** 1% (60 mL)**Child and adult (see remarks):**

Scabies: Apply thin layer of lotion from the neck to toes. Most patients will require 30 mL and larger patient may require the **maximum** dose of 60 mL. Bathe and rinse off medication in adults after 8–12 hr; children 6–8 hr. Do not re-treat.

Pediculosis capitis: Apply \leq 30 mL (amount depends on length and density of hair; **max. dose:** 60 mL) shampoo to dry hair without adding water. Work shampoo thoroughly into hair and allow to remain in place for 4 min. Then add small amounts of water to the hair until a good lather forms. Immediately rinse all the lather away and **avoid** contact of lather to other body surfaces. Towel dry and comb hair with fine-tooth comb to remove nits. Do not re-treat.

Pediculosis pubis: May use lotion or shampoo (applied locally) as for scabies and pediculosis capitis (see above).

Contraindicated in premature infants and seizure disorders. **Use with caution** with drugs that lower seizure threshold. Systemically absorbed. Risk of toxic effects is greater in young children; use other agents (permethrin) in infants, young children (<2 yr), and during pregnancy. Lindane is considered second-line therapy owing to side-effect risk and reports of resistance.



May cause a rash; rarely may cause seizures or aplastic anemia. For scabies, change clothing and bed sheets after starting treatment and treat family members. For pediculosis pubis, treat sexual contacts.

Avoid contact with face, urethral meatus, damaged skin, or mucous membranes. **Do not use** any covering that does not breathe (e.g., plastic lining or clothing) over the applied lindane.

LINEZOLID

Zyvox and generics

Antibiotic, oxazolidinone

C

2

No

No

No

Tabs: 600 mg; contains ~0.45 mEq Na per 200 mg drug**Oral suspension:** 100 mg/5 mL (150 mL); contains phenylalanine and sodium benzoate and 0.8 mEq Na per 200 mg drug**Injection, premixed:** 200 mg in 100 mL, 600 mg in 300 mL; contains 1.7 mEq Na per 200 mg drug*Continued*

D

LINEZOLID continued**Neonate:****<1 kg:****<14 days old:** 10 mg/kg/dose IV Q12 hr**≥14 days old:** 10 mg/kg/dose IV Q8 hr**≥1–2 kg:****<7 days old:** 10 mg/kg/dose IV/PO Q12 hr**≥7–28 days old:** 10 mg/kg/dose IV/PO Q8 hr**>2 kg:** 10 mg/kg/dose IV/PO Q8 hr**Alternate dosing by gestational age:****<34 wk gestation:****<7 days old:** 10 mg/kg/dose IV/PO Q12 hr**≥7–28 days old:** 10 mg/kg/dose IV/PO Q8 hr**≥34 wk gestation and 0–28 days old:** 10 mg/kg/dose IV/PO Q8 hr**Infant and child <12 yr old:**

Pneumonia, bacteremia, bone/joint infections, septic thrombosis (MRSA), complicated skin/skin structure infections, vancomycin-resistant E. faecium (VRE) infections (including endocarditis):

10 mg/kg/dose IV/PO Q8 hr.

Uncomplicated skin/skin structure infections:**<5 yr:** 10 mg/kg/dose IV/PO Q8 hr**5–11 yr:** 10 mg/kg/dose IV/PO Q12 hr**Max. dose for all indications <12 yr:** 600 mg/dose

≥12 yr and adult: 600 mg Q12 hr IV/PO; 400 mg Q12 hr IV/PO may be used for adults with uncomplicated infection.

Duration of therapy:**MRSA infections:** variable based on response**Pneumonia:** 10–14 days for non-MRSA and 7–21 days (per clinical response) for MRSA**Bacteremia:** 10–28 days**Bone/joint infections:** 3–6 wk**Skin/skin structure infections:** 10–14 days; longer for complicated cases**Septic thrombosis (MRSA):** 4–6 wk**VRE infections:** 14–28 days, minimum of 8 wk for endocarditis

Most common side effects include diarrhea, headache, and nausea. Anemia, leukopenia, pancytopenia, thrombocytopenia may occur in patients who are at risk for myelosuppression and who receive regimens >2 wk. Complete blood count monitoring is recommended in these individuals. Pseudomembranous colitis, neuropathy (peripheral and optic), and severe cutaneous adverse reactions (e.g., TEN and SJS) have also been reported. CSF penetration is variable in patients with VP shunts.

Do not use with SSRIs (e.g., fluoxetine, paroxetine), tricyclic antidepressants, venlafaxine, and trazodone; may cause serotonin syndrome. **Avoid** use with monoamine oxidase inhibitors (e.g., phenelzine); and in patients with uncontrolled hypertension, pheochromocytoma, thyrotoxicosis, and taking sympathomimetics or vasopressive agents (may elevate blood pressure). **Use caution** when consuming large amounts of foods and beverages containing tyramine; may increase blood pressure. Dosing information in severe hepatic failure and renal impairment with multi-doses have not been completed.

Protect all dosage forms from light and moisture. Oral suspension product must be gently mixed by inverting the bottle 3–5 times prior to each use (**do not shake**). All oral doses may be administered with or without food.



LISDEXAMFETAMINE

Vyvanse

CNS stimulant**Capsules:** 10, 20, 30, 40, 50, 60, 70 mg**Chewable tabs:** 10, 20, 30, 40, 50, 60 mg; contains mannitol and sucralose**Attention deficit hyperactivity disorder:**

Child ≥6 yr and adult: Start with 20–30 mg PO QAM (adult start at 30 mg). May increase dose by 10–20 mg/24 hr at weekly intervals if needed, up to a **max. dose** of 70 mg/24 hr.

Lower maximum dosages for renal insufficiency include the following:

GFR ≥30 mL/min/1.73 m²: 70 mg/24 hr**GFR 15–<30 mL/min/1.73 m²:** 50 mg/24 hr**GFR <15 mL/min/1.73 m² or ESRD on hemodialysis:** 30 mg/24 hr

Lisdexamfetamine is a pro-drug of dextroamphetamine which requires activation by intestinal/hepatic metabolism.



Contraindicated in amphetamine or sympathomimetic hypersensitivity, symptomatic cardiovascular disease, moderate/severe hypertension, hyperthyroidism, glaucoma, agitated states, drug/alcohol abuse history, and MAO inhibitors (concurrent or use within 14 days). As with other CNS stimulant medications, serious cardiovascular events, including **death**, have been reported in patients with preexisting structural cardiac abnormalities or other serious heart problems. **Use with caution** in patients with hypertension, psychiatric conditions, and epilepsy. May cause insomnia, irritability, rash, appetite suppression/weight loss, dizziness, xerostomia, and GI disturbances. Dermatillomania, bruxism, Stevens-Johnson syndrome, and TEN have been reported.

Urinary acidifying agents may reduce levels of amphetamines and urinary alkalinizing agent may increase levels. May increase the effects of TCAs; increase or decrease the effects of guanfacine and phenytoin, and phenobarbital; and decrease the effects of adrenergic blockers, antihistamines, and antihypertensives. Norepinephrine may increase the effects of amphetamines.

Chewable tablets must be completely chewed before swallowing. Chewable tablet and capsule dosage forms can be converted on an equal mg-per-mg basis.

See Dextroamphetamine ± Amphetamine for additional remarks.

LISINOPRIL

Prinivil, Qbrelis, ZestriL, and generics

Angiotensin converting enzyme inhibitor, antihypertensive**Tabs:** 2.5, 5, 10, 20, 30, 40 mg**Oral solution (Qbrelis):** 1 mg/mL (150 mL); contains sodium benzoate**Oral suspension:** 1 mg/mL 2 mg/mL **Hypertension (see remarks):****Child (<6 yr; limited data):** use 6–16 yr dosing below.

6–16 yr: Start with 0.07–0.1 mg/kg/dose PO once daily; **max. initial dose:** 5 mg/dose. If needed, titrate dose upward at 1–2 wk intervals to doses up to 0.61 mg/kg/24 hr or 40 mg/24 hr (higher doses have not been evaluated).

Adult: Start with 10 mg PO once daily (use 5 mg if using a diuretic). If needed, increase dose by 5–10 mg/24 hr at 1–2 wk intervals. Usual dosage range: 10–40 mg/24 hr. **Max. dose:** 80 mg/24 hr.

*Continued*

D

LISINOPRIL continued

Use lower initial dose (50% of recommended dose) if using with a diuretic or with the presence of hyponatremia, hypovolemia, severe CHF, or decreased renal function.

Contraindicated in hypersensitivity and history of angioedema with other ACE inhibitors, and in combination with a neprilysin inhibitor (e.g., sacubitril). **Do not use** with aliskiren in patients with diabetes. **Avoid** use with dialysis with high-flux membranes because anaphylactoid reactions have been reported. **Use with caution** in aortic or bilateral renal artery stenosis, and hepatic impairment. Side effects include cough, dizziness, headache, hyperkalemia, hypotension (especially with concurrent diuretic or antihypertensive agent use), rash, and GI disturbances. Mood alterations, including depressive symptoms, have been reported.

Dual blockade of the renin-angiotensin system with lisinopril and angiotensin receptor antagonists (e.g., losartan) or aliskiren is associated with increased risk for hypotension, syncope, hyperkalemia, and renal impairment. Diabetic patients on lisinopril treated with oral antidiabetic agents should be monitored for hypoglycemia, especially during the first month of use. NSAIDs (e.g., indomethacin) may decrease lisinopril's effects. Use with mTOR inhibitors (e.g., sirolimus, everolimus) may increase risk for angioedema. **Adjust dose in renal impairment** (see **Chapter 31**).

Onset of action: 1 hr with maximal effect in 6–8 hr. Long-term blood pressure monitoring is recommended at Q2–4 wk until good control is achieved, followed by Q3–4 mo.

Additional indications with limited data in children include proteinuria associated with mild IgA nephropathy, and renal protection for diabetes or renal parenchymal disease.

Lisinopril should be discontinued as soon as possible when pregnancy is detected.

LITHIUM

Lithobid and many generics; previously available as Eskalith

Antimanic agent

D



X



Yes



No



No

Carbonate salt:

300 mg carbonate = 8.12 mEq lithium

Caps: 150, 300, 600 mg

Tabs: 300 mg

Extended-release tabs: 300 mg (Lithobid and generics), 450 mg

Citrate salt:

Syrup: 8 mEq/5 mL (500 mL); 5 mL is equivalent to 300 mg lithium carbonate

Child (see remarks):

Initial (immediate release dosage forms): 15–60 mg/kg/24 hr ÷ TID–QID PO. Adjust as needed (weekly) to achieve therapeutic levels.

Adolescent: 600–1800 mg/24 hr ÷ TID–QID PO (divided BID–TID using extended-release tablets).

Adult:

Initial: 300 mg TID PO. Adjust as needed to achieve therapeutic levels. Usual dose is about 300 mg TID–QID with immediate release dosage form. For extended-release tablets, 900–1800 mg/24 hr PO ÷ BID–TID.

Contraindicated in severe cardiovascular disease (including Brugada syndrome) or renal disease. Decreased sodium intake or increased sodium wasting, significant renal or cardiovascular disease, may increase lithium levels, resulting in toxicity. May cause goiter, nephrogenic diabetes insipidus, hypothyroidism, arrhythmias, or sedation at therapeutic doses. Nephrotic syndrome has been reported.

Co-administration with diuretics, metronidazole, ACE inhibitors, angiotensin receptor antagonists (e.g., losartan), or NSAIDs may increase risk for lithium toxicity. Use with iodine may increase risk for hypothyroidism. If used in combination with haloperidol, closely monitor neurologic toxicities

by irreversible brain damage has been reported.

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LITHIUM *continued*

Safety and efficacy for monotherapy for acute mania or mixed episodes of bipolar I disorder and maintenance monotherapy of bipolar I disorder in children 7–17 yr have been established from a clinical trial. Common adverse effects observed in this study included nausea/vomiting, polyuria, thyroid abnormalities, tremor, polydipsia, dizziness, rash/dermatitis, ataxia/gait disturbance, anorexia, and blurry vision.

Therapeutic levels: 0.6–1.5 mEq/L. In either acute or chronic toxicity, confusion and somnolence may be seen at levels of 2–2.5 mEq/L. **Seizures or death** may occur at levels >2.5 mEq/L. Recommended serum sampling: trough level within 30 min prior to the next scheduled dose. Steady-state is achieved within 4–6 days of continuous dosing. **Adjust dose in renal failure** (see Chapter 31).

LODOXAMIDE

Alomide

Antiallergic agent, mast cell stabilizer

B



?



No



No



No

Ophthalmic solution: 0.1% (10 mL); contains benzalkonium chloride**≥2 yr and adult:** Instill 1–2 drops to affected eye(s) QID for up to 3 mo.

Transient burning, stinging or discomfort of the eye and headache are common side effects.

Itching/pruritus, blurred vision, dry eye, tearing, hyperemia, crystalline deposits, and foreign body sensation may also occur.

Do not wear soft contact lenses during treatment because medication contains benzalkonium chloride.**LOPERAMIDE**

Imodium, Imodium A–D, and generics

Antidiarrheal

C



1



No



No



No

Caps (OTC): 2 mg**Tabs (OTC):** 2 mg**Oral suspension (OTC):** 1 mg/7.5 mL (120 mL); each 30 mL contains 16 mg of sodium**Acute diarrhea (see remarks):****Child (initial doses within the first 24 hr):****2–5 yr (13–<21 kg):** 1 mg PO TID**6–8 yr (21–27 kg):** 2 mg PO BID**9–11 yr (>27–43 kg):** 2 mg PO TID**Max. single dose** 2 mg

Follow initial day's dose with 0.1 mg/kg/dose after each loose stool (not to exceed the aforementioned initial doses).

≥12 yr and adult: 4 mg/dose × 1, followed by 2 mg/dose after each stool up to **max. dose** of 8 mg/24 hr for 12–<18 yr and 16 mg/24 hr for adult.**Chronic diarrhea (see remarks):****Infant–child (limited data):** 0.08–0.24 mg/kg/24 hr PO ÷ BID–TID; **max. dose:** 2 mg/dose*Continued*

LOPERAMIDE *continued*

Contraindicated in acute dysentery; acute ulcerative colitis; bacterial enterocolitis caused by *Salmonella*, *Shigella*, *Campylobacter* and *Clostridium difficile*; and abdominal pain in the absence of diarrhea. **Avoid** use in children <2 yr due to reports of paralytic ileus associated with abdominal distention. Rare hypersensitivity reactions including anaphylactic shock have been reported. May cause nausea, rash, vomiting, constipation, cramps, dry mouth, and CNS depression. Use of higher than recommended dosages via abuse or misuse can cause serious cardiac events (e.g., Torsades de Pointes, arrhythmias, cardiac arrest, and QT prolongation).

Discontinue use if no clinical improvement is observed within 48 hr. Naloxone may be administered for CNS depression.

**LORATADINE ± PSEUDOEPHEDRINE**

Alavert, Claritin, Claritin Children's Allergy, Claritin RediTabs

In combination with pseudoephedrine:

Claritin-D 12 Hour, Claritin-D 24 Hour, Alavert Allergy and Sinus,

Loratadine-D 12 Hour, Loratadine-D 24 Hour, Allergy Relief-D, and generics

Antihistamine, less sedating ± decongestant



B



2



Yes



Yes



No

Tabs [OTC]: 10 mg

Chewable tabs (Claritin Children's Allergy) [OTC]: 5 mg; contains aspartame

Disintegrating tabs (Claritin RediTabs and others) [OTC]: 5, 10 mg; contains aspartame

Oral solution or syrup [OTC]: 1 mg/mL (120 mL); contains propylene glycol and sodium benzoate; some preparations may contain metasulfite

Time-release tabs in combination with pseudoephedrine (PE):

Claritin-D 12 Hour, Alavert Allergy and Sinus, Loratadine-D 12 Hour, and generics [OTC]: 5 mg loratadine + 120 mg PE

Claritin-D 24 Hour, Loratadine-D 24 Hour, Allergy Relief-D and generics [OTC]: 10 mg loratadine + 240 mg PE

**Loratadine:**

2–5 yr: 5 mg PO once daily

≥6 yr and adult: 10 mg PO once daily. Disintegrating tablet may be dosed at 5 mg PO BID or 10 mg PO once daily.

Time-release tabs of loratadine and pseudoephedrine:

≥12 yr and adult (see remarks):

Claritin-D 12 Hour and generics: 1 tablet PO BID

Claritin-D 24 Hour and generics: 1 tablet PO once daily



May cause drowsiness, fatigue, dry mouth, headache, bronchospasms, palpitations, dermatitis, and dizziness. Has not been implicated in causing cardiac arrhythmias when used with other drugs that are metabolized by hepatic microsomal enzymes (e.g., ketoconazole, erythromycin).

May be administered safely in patients who have allergic rhinitis and asthma.

In hepatic and renal function impairment (GFR <30 mL/min), prolong loratadine (single agent) dosage interval to every other day. **Adjust dose in renal failure (see Chapter 31).**

For time-release tablets of the combination product (loratadine and pseudoephedrine), prolong dosage interval in renal impairment (GFR <30 mL/min) as follows: Claritin-D 12 Hour: 1 tablet PO once daily; Claritin-D 24 Hour: 1 tablet PO every other day. **Do not use** the combination product in hepatic impairment because drugs cannot be individually titrated.

Administer doses on an empty stomach. For use of RediTabs, place tablet on tongue and allow it to disintegrate in the mouth with or without water. For Claritin-D products, also see remarks in Pseudoephedrine.

LORAZEPAM

Ativan and generics

Benzodiazepine anticonvulsant

D



2



Yes



Yes



No

Tabs: 0.5, 1, 2 mg**Injection:** 2, 4 mg/mL (1, 10 mL); each contains 2% benzyl alcohol and propylene glycol**Oral solution:** 2 mg/mL (30 mL); some dosage forms may be alcohol and dye free**Status epilepticus (IV route is preferred but may use IM route if IV is not available):****Neonate, infant, child, and adolescent:** 0.05–0.1 mg/kg/dose IV over 2–5 min.May repeat dose in 10–15 min. **Max. dose:** 4 mg/dose. If IV access not available, 0.1 mg/kg/dose (**max.** 4 mg/dose) may be administered intranasally.**Adult:** 4 mg/dose IV given slowly over 2–5 min. May repeat in 10–15 min. Usual total **max. dose** in 12-hr period is 8 mg.**Antiemetic adjunct therapy:****Child:** 0.02–0.05 mg/kg/dose IV Q6 hr PRN; **max. single dose:** 2 mg.**Anxiolytic/sedation:****Infant and child:** 0.05 mg/kg/dose Q4–8 hr PO/IV; **max. dose:** 2 mg/dose

May also give IM for preprocedure sedation.

Adult: 1–10 mg/24 hr PO ÷ BID–TID

Contraindicated in narrow-angle glaucoma and severe hypotension. **Use with caution** in renal insufficiency (glucuronide metabolite clearance is reduced), hepatic insufficiency (may worsen hepatic encephalopathy; decrease dose with severe hepatic impairment), compromised pulmonary function, and use of CNS depressant medications. May cause respiratory depression, especially in combination with opioids and other sedatives. May also cause sedation, dizziness, mild ataxia, mood changes, rash, and GI symptoms.

Paradoxical excitation has been reported in children (10%–30% of patients <8 yr old).

When compared to diazepam for status epilepticus (3 mo–17 yr), lorazepam was found to be more sedating with a longer time to return to baseline mental status.

Significant respiratory depression and/or hypotension has been reported when used in combination with loxapine. Probenecid and valproic acid may increase the effects/toxicity of lorazepam and oral contraceptive steroids may decrease lorazepam's effects.

Injectable product may be given rectally. Benzyl alcohol and propylene glycol may be toxic to newborns at higher doses.

Onset of action for sedation: PO, 20–30 min; IM, 30–60 min; IV, 1–5 min. Duration of action: 6–8 hr.**Flumazenil is the antidote.****LOSARTAN**

Cozaar and generics

Angiotensin II receptor antagonist

C/D



?



Yes



Yes



No

Tabs: 25, 50, 100 mg**Oral suspension:** 2.5 mg/mL

Contains 2.12 mg potassium per 25 mg drug

Hypertension (see remarks):**6–16 yr:** Start with 0.7 mg/kg/dose (**max. dose:** 50 mg/dose) PO once daily. Adjust dose todesired blood pressure response. **Max. dose** (higher doses have not been evaluated): 1.4 mg/kg/24 hr or 100 mg/24 hr.

LOSARTAN *continued*

Hypertension (see remarks; cont.):

≥17 yr and adult: Start with 50 mg PO once daily (use lower initial dose of 25 mg PO once daily if patient receiving diuretics, experiencing intravascular volume depletion, or has hepatic impairment). Usual maintenance dose is 25–100 mg/24 hr PO ÷ once daily—BID

Use with caution in angioedema (current or past), excessive hypotension (volume depletion), hepatic (use lower starting dose) or renal (contains potassium) impairment, hyperkalemia (including use with medications that can cause hyperkalemia), renal artery stenosis and severe CHF. Not recommended in patients <6 yr or in children with GFR <30 mL/min/1.73 m², owing to lack of data.

Discontinue use as soon as possible when pregnancy is detected because injury and death to developing fetus may occur. Pregnancy category is “C” during the first trimester but changes to “D” for the second and third trimesters.

Diarrhea, asthenia, dizziness, fatigue, and hypotension are common. Thrombocytopenia, rhabdomyolysis, hallucinations, and angioedema have been rarely reported.

Losartan is a substrate for CYP 450 2C9 (major) and 3A4. Fluconazole and cimetidine may increase losartan effects/toxicity. Rifampin, phenobarbital, and indomethacin may decrease its effects.

Losartan may increase the risk of lithium toxicity. **Do not use** with aliskiren in patients with diabetes or with renal impairment (GFR <60 mL/min). Dual blockade of the renin-angiotensin system with losartan and ACE inhibitors (e.g., captopril) or aliskiren is associated with increased risk for hypotension, syncope, hyperkalemia, and renal impairment.



LOW MOLECULAR WEIGHT HEPARIN

See Enoxaparin

LUCINACTANT

See Surfactant, pulmonary

LUMACAFTOR AND IVACAFTOR

Orkambi

Cystic Fibrosis Transmembrane Conductance Regulator Corrector and Potentiator



B

?

Yes

Yes

Yes

Oral granules (Lumacaftor: Ivacaftor): 100 mg:125 mg (56 packets), 150 mg: 188 mg (56 packets)

Tabs (Lumacaftor:Ivacaftor): 100 mg:125 mg (112 tabs), 200 mg:125 mg (112 tabs)

Child ≥2–5 yr:

<14 kg: one lumacaftor 100 mg/ivacaftor 125 mg granule packet PO Q12 hr

≥14 kg: one lumacaftor 150 mg/ivacaftor 188 mg granule packet PO Q12 hr



Child ≥6–11 yr: two lumacaftor 100 mg/ivacaftor 125 mg tablets PO Q12 hr

Child ≥12, adolescent and adult: two lumacaftor 200 mg/ivacaftor 125 mg tablets PO Q12 hr

LUMACAFTOR AND IVACAFTOR *continued***Dosage modification for hepatic impairment:**

Level of Hepatic Impairment (Child-Pugh Class)	Age Group	Morning Dose	Evening Dose
A: Mild	2–5 yr	No dose adjustment; use usual dose	No dose adjustment; use usual dose
	≥6 yr	No dose adjustment; use usual dose	No dose adjustment; use usual dose
B: Moderate	2–5 yr	1 packet of granules	1 packet of granules every other day
	≥6 yr	2 tablets	1 tablet
C: Severe	2–5 yr	1 packet of granules ^a	No dose
	≥6 yr	1 tablet ^a	1 tablet ^a

^aor less frequently as studies have not been conducted in severe hepatic impairment.

Dosage modification when used with CYP 450 3A inhibitors:

Already taking Orkambi and initiating a strong CYP 450 3A inhibitor (e.g., itraconazole): no dosage adjustment

Already taking a strong CYP 450 3A inhibitor and initiating Orkambi: Reduce Orkambi dosage to 1 tablet or 1 packet of granules every other day × the first week followed by the recommended daily dose. If Orkambi is interrupted for >1 wk and re-initiated while taking strong CYP 450 3A inhibitors, Orkambi should be reintroduced with the reduced dosage of 1 tablet or 1 packet of granules every other day × 1 wk followed by the recommended daily dose.

Works on CFTR trafficking defect by acting as a CFTR corrector (lumecaftor) and in combination with a CFTR potentiator (ivacaftor). Indicated for individuals with homozygous F508del CFTR mutation.

Respiratory events, such as chest discomfort, dyspnea and abnormal respiration, may occur during the initiation of therapy and may vary from transient to severe (requiring discontinuation). Common side effects include rash, diarrhea, nausea, flatulence, fatigue, nasal discharge, and URIs. Increased liver enzymes and cataracts may occur; monitor AST/ALT and ocular exam at baseline. Repeat AST/ALT every 3 mo for the first year followed by annual assessments. Repeat ocular exams annually. Hypertension has been reported. May cause a false positive urine drug screen for cannabinoids.

Use with **caution** with CrCl ≤30 mL/min and ESRD. Reduce dose with moderate/severe hepatic impairment (see dosage section) or when initiating therapy while taking a strong CYP 450 3A4 inhibitor.

Lumecaftor is a strong inducer of CYP 450 3A and ivacaftor is a CYP 450 3A substrate; see dose modification table in the dosing section. Use with strong CYP 450 3A inducers (e.g., rifampin, rifabutin, carbamazepine, St. John's wort) are not recommended. Lumecaftor/ivacaftor may reduce the efficacy of hormonal contraceptives and increase the incidence of menstruation-associated side effects (e.g., amenorrhea, dysmenorrhea, and irregular menses). Always evaluate potential drug-drug interactions; see <https://www.orkambihcp.com/drug-interactionsddi-tool>. Avoid food or drink containing grapefruit or Seville oranges.

Administer all doses with high-fat foods to assure absorption. Oral granules can be mixed with 5 mL of soft foods or liquids such as puréed fruits or vegetables, yogurt, applesauce, water, breast milk, infant formula, milk, or juice. Once mixed, it should be consumed within an hour. If a dose (all dosage forms) is missed within 6 hr of a scheduled dose, administer a dose immediately. However, if the missed dose is >6 hr, skip that dose and resume therapy at the next scheduled dose. Never take a double dose for a missed dose.

MAGNESIUM CITRATE

Various generics

16.17% Elemental Magnesium

Laxative/cathartic

C



1



Yes



No



No

Oral solution (OTC): 1.75 g/30 mL (300 mL); 5 mL = 3.9–4.7 mEq Mg**Tabs:** 100 mg**Cathartic:****2–<6 yr:** 2–4 mL/kg/24 hr PO ÷ once daily–BID; **OR** 60–90 mL/24 hr PO ÷ once daily–BID**6–12 yr:** 100–150 mL/24 hr PO ÷ once daily–BID**>12 yr and adult:** 150–300 mL/24 hr PO ÷ once daily–BID**Bowel prep:****Child >6 yr and adolescent:** 4–6 mL/kg/24 hr (max. 300 mL/24 hr) PO ×1 as a single or divided dose the day prior to surgery.

Use with caution in renal insufficiency (monitor magnesium level) and patients receiving digoxin. May cause hypermagnesemia, diarrhea, muscle weakness, hypotension, and respiratory depression. Up to approximately 30% of dose is absorbed. May decrease absorption of H₂ antagonists, phenytoin, iron salts, tetracyclines, steroids, benzodiazepines, and quinolone antibiotics.

**MAGNESIUM HYDROXIDE**

Milk of Magnesia, Pedia-Lax, and various generics

41.69% Elemental Magnesium

Antacid, laxative

?



1



Yes



No



No

Oral liquid (OTC): 400 Mg/5 mL (Milk of Magnesia and others) (355, 473 mL)**Concentrated oral liquid (OTC):** 2400 mg/10 mL (Milk of Magnesia concentrate) (100, 400 mL)**Chewable tabs (Pedia-Lax, see remarks [OTC]):** 400 mg

400 mg magnesium hydroxide is equivalent to 166.76 mg elemental magnesium

Combination product with aluminum hydroxide: See Aluminum Hydroxide.**Laxative (all liquid mL doses based on 400 mg/5 mL magnesium hydroxide, unless noted otherwise):**

Dose/24 hr ÷ once daily–QID PO

<2 yr: 0.5 mL/kg**2–5 yr:** 5–15 mL **OR** 400–1200 mg (1–3 chewable tabs)**6–11 yr:** 15–30 mL **OR** 1200–2400 mg (3–6 chewable tabs)**≥12 yr and adult:** 30–60 mL **OR** 2400–4800 mg (6–12 chewable tabs)**Antacid:****Child:****Liquid:** 2.5–5 mL/dose once daily–QID PO**Tabs:** 400 mg once daily–QID PO**Adult:****Liquid:** 5–15 mL/dose once daily–QID PO**Concentrated liquid (800 mg/5 mL):** 2.5–7.5 mL/dose once daily–QID PO**Tabs:** 400–1200 mg/dose once daily–QID PO

MAGNESIUM HYDROXIDE *continued*

See Magnesium Citrate. **Use with caution** in renal insufficiency (monitor magnesium level) and patients receiving digoxin. Drink a full 8 oz. of liquid with each dose of the chewable tablets. Pedia-Lax chewable tablet is magnesium hydroxide. However, other dosage forms bearing the Pedia-Lax name in other dosage forms (e.g., oral liquid, suppository, and enema) contains different active ingredients.



MAGNESIUM OXIDE

Mag-200, Mag-Ox 400, Uro-Mag, and other generics

60.32% Elemental Magnesium

Oral magnesium salt



A/? 1 Yes No No

Tabs (OTC): 200, 400, 420, 500 mg

Caps (Uro-Mag; OTC): 140 mg

400 mg magnesium oxide is equivalent to 241.3 mg elemental Mg or 20 mEq Mg



Doses expressed in magnesium oxide salt.

Magnesium supplementation:

Child: 5–10 mg/kg/24 hr ÷ TID–QID PO

Adult: 400–800 mg/24 hr ÷ BID–QID PO

Hypomagnesemia:

Child: 65–130 mg/kg/24 hr ÷ QID PO

Adult: 2000 mg/24 hr ÷ QID PO

See Magnesium Citrate. **Use with caution** in renal insufficiency (monitor magnesium level) and patients receiving digoxin. **For dietary recommended intake (U.S. recommended daily allowance [RDA]) for magnesium, see Chapter 21.**



Pregnancy category is an "A" for doses up to 400 mg/24 hr.

MAGNESIUM SULFATE

Epsom salts, many others, and generics

9.9% Elemental Magnesium

Magnesium salt



D 2 Yes No No

Injection: 500 mg/mL (4 mEq/mL) (2, 10, 20, 50 mL)

Injection, prediluted in sterile water for injection; ready to use: 40 mg/mL (0.325 mEq/mL) (50, 100, 500, 1000 mL); 80 mg/mL (0.65 mEq/mL) (50 mL)

Injection, prediluted in D₅W; ready to use: 10 mg/mL (0.081 mEq/mL) (100 mL)

Granules (Epsom salts and generics): Approx. 40 mEq Mg per 5 g (454, 1810 g)

500 mg magnesium sulfate is equivalent to 49.3 mg elemental Mg or 4.1 mEq Mg



All doses expressed in magnesium sulfate salt.

Cathartic:

Child: 0.25 g/kg/dose PO Q4–6 hr

Adult: 10–30 g/dose PO Q4–6 hr

Hypomagnesemia or hypocalcemia:

IV/IM: 25–50 mg/kg/dose Q4–6 hr × 3–4 doses; repeat PRN. **Max. single dose:** 2 g

PO: 100–200 mg/kg/dose QID PO

Daily maintenance for parenteral nutrition:

30–60 mg/kg/24 hr or 0.25–0.5 mEq/kg/24 hr IV; max. dose: 1 g/24 hr

MAGNESIUM SULFATE *continued*

Adjunctive therapy for moderate to severe reactive airway disease exacerbation (bronchodilation); some recommend an IV saline bolus prior to magnesium administration to prevent hypotension:

Child: 25–75 mg/kg/dose (**max. dose:** 2 g) × 1 IV over 20 min.

Adult: 2 g/dose × 1 IV over 20 min.

When given IV, **beware** of hypotension, bradycardia, respiratory depression, complete heart block, and/or hypermagnesemia. Calcium gluconate (IV) should be available as **antidote**.

Use with caution in patients with renal insufficiency (monitor magnesium levels) and with patients on digoxin. **Serum level dependent toxicity** includes the following: >3 mg/dL: CNS depression; >5 mg/dL: decreased deep tendon reflexes, flushing, somnolence; and >12 mg/dL: respiratory paralysis, heart block.

Max. IV intermittent infusion rate: 1 mEq/kg/hr or 125 mg MgSO₄ salt/kg/hr.

Pregnancy category is “D” because hypocalcemia, osteopenia, and fractures in the developing baby or fetus have been reported in pregnant women receiving magnesium >5–7 days for preterm labor.

**MANNITOL**

Osmotrol, Resectisol, and generics

Osmotic diuretic

C

?

Yes

No

No

Injection: 50, 100, 150, 200, 250 mg/mL (5%, 10%, 15%, 20%, 25%, respectively)

Irrigation solution (Resectisol): 50 mg/mL (5%) (2000 mL)



Oliguria (Child and adult):

Test dose to assess renal function: 0.2 g/kg/dose (**max. dose:** 12.5 g) IV over 3–5 min.

If there is no diuresis within 2 hr, discontinue mannitol.

Initial: 0.5–1 g/kg/dose IV over 2–6 hr

Maintenance: 0.25–2 g/kg/dose Q4–6 hr IV over 2–6 hr

Intracranial pressure reduction (see remarks): 0.25–1 g/kg/dose IV/IO over 20–30 min; may repeat dose if needed



Contraindicated in severe renal disease, active intracranial bleed, dehydration (especially severe hypovolemia), prior hypersensitivity to mannitol, and pulmonary edema. May cause circulatory overload and electrolyte disturbances. For hyperosmolar therapy, keep serum osmolality at 310–320 mOsm/kg. **Do not use** with aminoglycosides as this may enhance nephrotoxicity risk.

Larger doses may require fluid bolus to prevent hypotension. May cause hypovolemia, headache, acute kidney injury, and polydipsia. Reduction in ICP occurs in 15 min and lasts 3–6 hr.

Caution: drug may crystallize at low temperatures with concentrations ≥15%; redissolve crystals by warming solution up to 70°C with agitation. Use an in-line filter (≤5 micron).

MEBENDAZOLE

Emverm; previously available as Vermox

Anthelmintic

C

1

No

Yes

No

Chewable tabs: 100 mg (may be swallowed whole or chewed) (boxes of 12s)



Child (>2 yr) and adult:

Pinworms (Enterobius): 100 mg PO ×1, repeat in 2 wk if not cured.

Hookworms, roundworms (Ascaris), and whipworm (Trichuris): 100 mg PO BID ×3 days.

Repeat in 3–4 wk if not cured. Alternatively, may administer 500 mg PO ×1 and repeat in 3–4 wk if not cured.

D

MEBENDAZOLE *continued*

Capillariasis: 200 mg PO BID \times 20–30 days

Visceral larva migrans (Toxocariasis): 100–200 mg PO BID \times 5 days

Trichinellosis (Trichinella spiralis): 200–400 mg PO TID \times 3 days, then 400–500 mg PO TID \times 10 days; use with steroids for severe symptoms

Ancylostoma caninum (Eosinophilic enterocolitis): 100 mg PO BID \times 3 days.

See latest edition of the AAP Red Book for additional information.

Experience in children <2 yr and pregnancy is limited. May cause rash, headache, diarrhea, and abdominal cramping in cases of massive infection. Liver function test elevations and hepatitis have been reported with prolonged courses; monitor hepatic function with prolonged therapy.

Family may need to be treated as a group. Therapeutic effect may be decreased if administered to patients receiving aminoquinolones, carbamazepine, or phenytoin. Cimetidine may increase the effects/toxicity of mebendazole. Administer with food. Tablets may be crushed and mixed with food, swallowed whole, or chewed.

**MEDROXYPROGESTERONE**

Depo-Provera, Provera, Depo-Sub Q Provera 104, and generics

Contraceptive, progestin



X

2

No

Yes

No

Tabs (Provera and generics): 2.5, 5, 10 mg

Injection, suspension as acetate:

Depo-Provera and generics, for IM use only: 150 mg/mL (1 mL and 1 mL prefilled syringe), 400 mg/mL (2.5 mL); may contain parabens and polyethylene glycol

Injection, prefilled syringe as acetate:

Depo-Sub Q Provera 104, for SC use only: 104 mg (0.65 mL of 160 mg/mL); contains parabens and polyethylene glycol



Adolescent and adult:

Contraception: Initiate therapy during the first 5 days after onset of a normal menstrual period; within 5 days postpartum if not breastfeeding; or if breastfeeding, at 6 wk postpartum. When converting contraceptive method to Depo-Sub Q Provera, dose should be administered within 7 days after the last day of using the previous method (pill, ring, patch).

IM (Depo-Provera and generics): 150 mg Q3 mo (every 13 wk)

SC (Depo-Sub Q Provera 104): 104 mg Q3 mo (every 12–14 wk)

Amenorrhea: 5–10 mg PO once daily \times 5–10 days

Abnormal uterine bleeding: 5–10 mg PO once daily \times 5–10 days initiated on the 16th or 21st day of the menstrual cycle.

Endometriosis-associated pain (Depo-Sub Q Provera 104): 104 mg SC Q 3 mo. Do not use longer than 2 yr due to impact on bone mineral density.

Consider patient's risk for osteoporosis because of the potential for decrease in bone mineral density with long-term use. **Contraindicated** in pregnancy, breast or genital cancer, liver disease, missed abortion, thrombophlebitis, thromboembolic disorders, cerebral vascular disease, and undiagnosed vaginal bleeding. **Use with caution** in patients with family history of breast cancer, depression, diabetes, and fluid retention. May cause dizziness, headache, insomnia, fatigue, nausea, weight increase, appetite changes, amenorrhea, and breakthrough bleeding. Cholestatic jaundice, adrenal suppression, anaphylaxis, and increased intracranial pressure have been reported. Injection site reactions may include pain/tenderness, persistent atrophy/indentation/dimpling, lipodystrophy, sterile abscess, skin color change, and node/lump.



MEDROXYPROGESTERONE *continued*

Drug is a substrate to CYP 450 3A4 isoenzyme. Aminoglutethimide may decrease medroxyprogesterone levels. May alter thyroid and liver function tests, prothrombin time, factors VII, VIII, IX, and X, and metyrapone test.

Do not inject IM or SC product intravenously. Shake IM injection vial well before use, and administer in the upper arm or buttock. Administer SC injection product into the anterior thigh or abdomen. Administer oral doses with food.

MEFLOQUINE HCl

Generics; previously available as Lariam

Antimalarial



B

2

No

Yes

No

Tabs: 250 mg (228 mg base)

Doses expressed in mg mefloquine HCl salt

Malaria prophylaxis (start 2 wk prior to exposure and continue for 4 wk after leaving endemic area; see remarks):



Child (PO, administered Q7 days):

<10 kg: 5 mg/kg

10–19 kg: 62.5 mg (1/4 tablet)

20–30 kg: 125 mg (1/2 tablet)

31–45 kg: 187.5 mg (3/4 tablet)

>45 kg: 250 mg (1 tablet)

Adult: 250 mg PO Q7 days

Malaria treatment (uncomplicated/mild infection, chloroquine-resistant Plasmodium vivax):

Child ≥6 mo and >5 kg: 15 mg/kg (**max. dose:** 750 mg) ×1 PO followed by 10 mg/kg (**max. dose:** 500 mg) ×1 PO 6–12 hr later

Adult: 750 mg ×1 PO followed by 500 mg ×1 PO 6–12 hr later

See latest edition of the Red Book for additional information.

Contraindicated in active or recent history of depression, anxiety disorders, psychosis or schizophrenia, seizures, or hypersensitivity to quinine or quinidine. **Use with caution** in cardiac dysrhythmias and neurologic disease. May cause dizziness, ringing of the ears, headache, syncope, psychiatric symptoms (e.g., anxiety, paranoia, depression, hallucinations, and psychotic behavior), seizures, ocular abnormalities, GI symptoms, leukopenia, and thrombocytopenia. If neurologic or psychiatric side effects occur, discontinue therapy and use an alternative medication. Most adverse events occur within 3 doses with prophylaxis use. Monitor liver enzymes and ocular exams for therapies >1 yr.



Mefloquine is a substrate and inhibitor of P-glycoprotein and may reduce valproic acid levels.

ECG abnormalities may occur when used in combination with quinine, quinidine, chloroquine, halofantrine, and β-blockers. If any of the aforementioned antimalarial drugs is used in the initial treatment of severe malaria, initiate mefloquine at least 12 hr after the last dose of any of these drugs. **Do not** initiate halofantrine or ketoconazole within 15 days of the last dose of mefloquine. Use with chloroquine may increase risk for seizures. Rifampin may decrease mefloquine levels.

Do not take on an empty stomach. Administer with at least 240 mL (8 oz) water. Treatment failures in children may be related to vomiting of administered dose. If vomiting occurs less than 30 min after the dose, administer a second full dose. If vomiting occurs 30–60 min after the dose, administer an additional half-dose. If vomiting continues, monitor patient closely and consider alternative therapy.

MEROPENEM

Merrem and generics

Carbapenem antibiotic**Injection:** 0.5, 1 g

Contains 3.92 mEq Na/g drug

Neonate and infant <3 mo (IV):**Non-CNS general dosing (meropenem MIC <4):****≤2 kg:****<14 days old:** 20 mg/kg/dose Q12 hr**15–28 days old:** 20 mg/kg/dose Q8 hr**29–60 days old:** 30 mg/kg/dose Q8 hr**>2 kg:****<14 days old:** 20 mg/kg/dose Q8 hr**15–60 days old:** 30 mg/kg/dose Q8 hr**Non-CNS infection with moderately resistant meropenem isolate (MIC 4–8 mCg/mL; from a single-dose PK simulation study):****>30 wk gestation and >7 days old:** 40 mg/kg/dose IV Q8 hr**Intra-abdominal infection (meropenem MIC <4 mCg/mL):****<32-wk gestation:****<14 days old:** 20 mg/kg/dose Q12 hr**≥14 days old:** 20 mg/kg/dose Q8 hr**≥32-wk gestation:****<14 days old:** 20 mg/kg/dose Q8 hr**≥14 days old:** 30 mg/kg/dose Q8 hr**Meningitis (1–3 mo, IV; recommendation from 2004 IDSA meningitis practice guidelines):** 40 mg/kg/dose Q8 hr**Infant (≥3 mo), child and adolescent (IV):****Meningitis, severe infections, cystic fibrosis pulmonary exacerbations:** 40 mg/kg/dose (**max.** 2 g/dose) Q8 hr**Complicated skin and skin structure infection:** 10 mg/kg/dose (**max. dose:** 500 mg/dose) Q8 hr. For severe or necrotizing infections or *Pseudomonas aeruginosa* infection (suspected or confirmed), use 20 mg/kg/dose (**max. dose:** 1 g/dose) Q8 hr.**Intra-abdominal and mild/moderate infections, and fever/neutropenia empiric therapy:** 20 mg/kg/dose (**max. dose:** 1 g/dose) Q8 hr**Adult (IV):****Skin and subcutaneous tissue infections:** 500 mg Q8 hr; use 1 g Q8 hr for suspected or confirmed *Pseudomonas aeruginosa***Intra-abdominal and mild/moderate infections; and fever/neutropenia empiric therapy:** 1 g Q8 hr
Meningitis and severe infections: 2 g Q8 hr**Contraindicated** in patients sensitive to carbapenems, or with a history of anaphylaxis to β-lactam antibiotics. **Use with caution** in meningitis and CNS disorders (may cause seizures) and renal impairment (**adjust dose;** see Chapter 31). Drug penetrates well into the CSF.

May cause diarrhea, rash, nausea, vomiting, oral moniliasis, glossitis, pain and irritation at the IV injection site, and headache. Hepatic enzyme and bilirubin elevation, dermatologic reactions (including Stevens-Johnson, DRESS, and TEN), leukopenia, thrombocytopenia (in renal dysfunction), and neutropenia have been reported. Probenecid may increase serum meropenem levels. May reduce valproic acid levels.

Lengthening the IV drug administration time to 4 hr will improve the meropenem concentration time above the MIC and may be useful in situations of resistant organisms.

MESALAMINE

Apriso, Asacol, Asacol HD, Canasa, Delzicol, Lialda, Pentasa, Rowasa, SfRowasa, and generics; 5-aminosalicylic acid, 5-ASA

Salicylate, GI antiinflammatory agent



B

2

Yes

Yes

No

Caps, controlled release:

Pentasa: 250, 500 mg

Delzicol and generics: 400 mg

Apriso (for Q24 hr dosing): 375 mg; contains aspartame

Tabs, delayed release:

Asacol: 400 mg

Asacol HD and generics: 800 mg

Lialda and generics: 1200 mg

Suppository (Canasa and generics): 1000 mg (30s, 42s)

Rectal suspension enema (Rowasa, SfRowasa, and generics): 4 g/60 mL; contains sulfites (SfRowasa is sulfite free) and sodium benzoate

Child and adolescent (ulcerative colitis):

Caps (controlled release) and tabs (delayed release): 50–100 mg/kg/24 hr ÷ Q6–12 hr PO; max. dose: 1 g/dose



Delzicol (mild/moderate ulcerative colitis; ≥5–18 yr; see remarks):

17–32 kg: 800 mg QAM and 400 mg Q afternoon PO

33–53 kg: 1200 mg QAM and 800 mg Q afternoon PO

54–90 kg: 1200 mg QAM and Q afternoon PO

Older child and adolescent (ulcerative colitis):

Enema (Rowasa): 4 g QHS

Suppository (Canasa): 500 mg QHS–BID

Adult (ulcerative colitis):

Caps, controlled release:

Initial therapy: 1 g QID PO ×3–8 wk

Maintenance therapy for remission:

Apriso: 1.5 g QAM PO

Pentasa: 1 g QID PO

Tabs, delayed release:

Initial therapy:

Asacol: 800 mg TID PO ×6 wk

Asacol HD: 1.6 g TID PO ×6 wk

Delzicol: 800 mg TID PO/6 wk

Lialda: 2.4–4.8 g once daily PO up to 8 wk

Maintenance therapy for remission:

Asacol: 1.6 g/24 hr PO in divided doses

Delzicol: 1.6 g/24 hr PO divided BID–QID

Lialda: 2.4 g PO once daily

Suppository: 1000 mg QHS PR ×3–6 wk; retain each dose in the rectum for 1–3 hr or longer, if possible.

Rectal suspension: 60 mL (4 g) QHS ×3–6 wk, retaining each dose for about 8 hr; lie on left side during administration to improve delivery to the sigmoid colon.

Generally **not recommended** in children <16 yr with chicken pox or flu-like symptoms (risk of Reye syndrome). **Contraindicated** in active peptic ulcer disease, severe renal failure, and salicylate hypersensitivity. Rectal suspension should not be used in patients with history of

MESALAMINE *continued*

renal function, pyloric stenosis, and concurrent thrombolytics. May cause headache, GI discomfort, pancreatitis, pericarditis, and rash. Angioedema, Stevens-Johnson syndrome, DRESS, fatal infections (e.g., sepsis and pneumonia; discontinue use), and photosensitivity have been reported. May cause a false-positive urinary normetanephrine test.

Safety and efficacy of Asacol in children 5–17 yr for mild/moderate acute ulcerative colitis have been established over a 6 wk period. However, efficacy for maintenance of remission was not established in a 26 wk RCT (potential factors affecting outcome included improper dosage used and premature termination of trial). Safety and efficacy of Canasa suppositories have not been demonstrated for mild/moderate active ulcerative proctitis in a 6-wk open-label study in 49 patients 5–17 yr old.

Do not administer with lactulose or other medications that can lower intestinal pH. Use with myelosuppressive drugs (e.g., azathioprine, 6-mercaptopurine) may increase risk for blood disorders, bone marrow failure and associated complications.

Two Delzicol 400-mg capsules have not been shown to be interchangeable or substitutable with one mesalamine 800-mg delayed-release tablet. Oral capsules are designed to release medication throughout the GI tract and oral tablets release medication at the terminal ileus and beyond. 400 mg PO mesalamine is equivalent to 1 g sulfasalazine PO. Tablets should be swallowed whole.

METFORMIN

Glucophage, Glucophage XR, Glumetza, Fortamet, Riomet, and generics

Antidiabetic, biguanide



B

2

Yes

Yes

No

Tabs: 500, 850, 1000 mg

Tabs, extended release:

Glucophage XR and generics: 500, 750 mg

Fortamet, Glumetza, and generics: 500, 1000 mg

Oral suspension (Riomet and generics): 100 mg/mL (120, 480 mL); may contain saccharin and propylene glycol

Type 2 Diabetes: Administer all doses with meals (e.g., BID: morning and evening meals).



Child (10–16 yr; PO) (see remarks):

Immediate-release dosage forms: Start with 500 mg BID; may increase dose every 1–2 wk as tolerated by 500 mg/24 hr in 2 divided doses up to a **max. dose** of 2000 mg/24 hr.

Extended-release tabs: Start with 500–1000 mg once daily \times 7–14 days; may increase dose every 1–2 wk as tolerated by 500–1000 mg/24 hr as once daily or divided doses up to a **max. dose** of 2000 mg/24 hr.

Child \geq 17 yr and adult (see remarks):

500-mg tabs: Start with 500 mg PO BID; may increase dose weekly by 500 mg/24 hr in 2 divided doses up to a **max. dose** of 2500 mg/24 hr. Administer 2500 mg/24 hr doses by dividing daily dose TID with meals.

850-mg tabs: Start with 850 mg PO once daily with morning meal; may increase by 850 mg every 2 wk up to a **max. dose** of 2550 mg/24 hr (first dosage increment: 850 mg PO BID; second dosage increment: 850 mg PO TID).

Extended-release tabs: Start with 500 mg PO once daily with evening meal; may increase by 500 mg every week up to a **max. dose** of 2000 mg/24 hr (if glycemic control is not achieved at **max. dose**, divide dose to 1000 mg PO BID). If using Fortamet, **max. dose** is 2500 mg/24 hr. If a dose $>$ 2000 mg is needed, consider switching to non-extended-release tablets in divided doses and increase dose to a **max. dose** of 2550 mg/24 hr.

Continued

METFORMIN continued

Assess patient's eGFR prior to initiating therapy. **Contraindicated** in severe renal impairment (<30 mL/min/1.73 m²), hepatic impairment (increased risk for lactic acidosis), CHF, and metabolic acidosis and during radiology studies using iodinated contrast media. **Use with caution** when transferring patients from chlorpropamide therapy (potential hypoglycemia risk), excessive alcohol intake, hypoxemia, dehydration, surgical procedures, mild/moderate renal impairment, hepatic disease, anemia, and thyroid disease.



Fatal lactic acidosis (diarrhea; severe muscle pain, cramping; shallow and fast breathing; unusual weakness and sleepiness) and decrease in vitamin B₁₂ levels have been reported. May cause GI discomfort (~50% incidence), anorexia, and vomiting. Transient abdominal discomfort or diarrhea have been reported in 40% of pediatric patients. Organic cationic transporter-2 (OCT2) and multidrug and toxin extrusion (MATE) inhibitors (e.g., cimetidine), furosemide, and nifedipine may increase the effects/toxicity of metformin. In addition to monitoring serum glucose and glycosylated hemoglobin, monitor renal function and hematologic parameters (baseline and annual).

Adult patients initiated on 500 mg PO BID may also have their dose increased to 850 mg PO BID after 2 wk.

COMBINATION THERAPY WITH SULFONYLUREAS: If patient has not responded to 4 wk of **maximum** doses of metformin monotherapy, consider gradual addition of an oral sulfonylurea with continued **maximum** metformin dosing (even if failure with sulfonylurea has occurred). Attempt to identify the minimum effective dosage for each drug (metformin and sulfonylurea) because the combination can increase risk for sulfonylurea-induced hypoglycemia. If patient does not respond to 1–3 mo of combination therapy with maximum metformin doses, consider discontinuing combination therapy and initiating insulin therapy.

Administer all doses with food.

METHADONE HCl

Dolophine, Methadose, and generics

Narcotic, analgesic



C

2

Yes

Yes

No

Tabs: 5, 10 mg

Tabs (dispersible): 40 mg

Oral solution: 5 mg/5 mL, 10 mg/5 mL; contains 8% alcohol

Concentrated solution: 10 mg/mL

Injection: 10 mg/mL (20 mL), contains 0.5% chlorobutanol

Analgesia (see remarks):

Child: 0.7 mg/kg/24 hr ÷ Q4–6 hr PO, SC, IM, or IV PRN pain; **max. dose:** 10 mg/dose.



Adult: 2.5–10 mg/dose Q3–4 hr PO, SC, IM, or IV PRN pain.

Detoxification or maintenance: See package insert.

Unintentional overdoses have resulted in fatalities and severe adverse events such as respiratory depression and cardiac arrhythmias. **Use with caution** in hepatic (**avoid** in severe cases) and biliary tract impairment. May cause respiratory depression, sedation, increased intracranial pressure, hypotension, and bradycardia. Cardiac QT interval prolongation and serious arrhythmias have occurred mostly with higher doses; **avoid use** with other medications which may prolong QT interval.



Average T_{1/2}: children 19 hr, and adults 35 hr. Duration of action PO is 6–8 hr initially and 22–48 hr after repeated doses. Respiratory effects last longer than analgesia. Accumulation may occur with continuous use making it necessary to adjust dose.

METHADONE HCL continued

Nevirapine may decrease serum levels of methadone. Fatalities have been reported with abuse in combination with benzodiazepines. Serotonin syndrome has been reported with use with selective serotonin reuptake inhibitors (SSRIs), serotonin norepinephrine reuptake inhibitor (SNRIs), TCAs, 5-HT3 antagonists, MAO inhibitors, and drugs that affect the serotonergic neurotransmitter system (e.g., trazodone, tramadol). Methadone is a substrate for CYP 450 3A3/4, 2D6, and 1A2 and inhibitor of 2D6.

See Chapter 6 for equianalgesic dosing and onset of action. **Adjust dose in renal failure (see Chapter 31).**

A Risk Evaluation and Mitigation Strategy (REMS) is required for healthcare providers to ensure the benefits outweigh the risks of addiction, abuse, and misuse. See www.fda.gov/OpioidAnalgesicREMSBlueprint or call 1-800-503-0784.

METHIMAZOLE

Tapazole and generics

Antithyroid agent**Tabs:** 5, 10 mg**Hyperthyroidism:****Child:**

Initial: 0.4–0.7 mg/kg/24 hr or 15–20 mg/m²/24 hr PO ÷ Q8 hr

Maintenance: 1/3–2/3 of initial dose PO ÷ Q8 hr

Max. dose: 30 mg/24 hr

Adult:

Initial: 15–60 mg/24 hr PO ÷ once daily or BID (for doses >30 mg)

Maintenance: 5–15 mg/24 hr PO once daily

Readily crosses placental membranes and distributes into breast milk (maternal doses ≤20 mg/24 hr is considered safe but there is insufficient data to support safe use with maternal doses >20 mg/24 hr). Blood dyscrasias, dermatitis, hepatitis, arthralgia, CNS reactions, pruritis, nephritis, hypoprothrombinemia, agranulocytosis, headache, fever, and hypothyroidism may occur.



May increase the effects of oral anticoagulants. When correcting hyperthyroidism, existing β-blocker, digoxin, and theophylline doses may need to be reduced to avoid potential toxicities. Switch to maintenance dose when patient is euthyroid. Administer all doses with food.

METHYLDOPA

Generics

Central α-adrenergic blocker, antihypertensive**Tabs:** 250, 500 mg**Oral suspension:** 50 mg/mL **Hypertension:**

Child: 10 mg/kg/24 hr ÷ Q6–12 hr PO; increase PRN Q2 days. **Max. dose:** 65 mg/kg/24 hr or 3 g/24 hr, whichever is less.

Adult: 250 mg/dose BID–TID PO. Increase PRN Q2 days to **max. dose** of 3 g/24 hr.

Continued

METHYLDOPA *continued*

Contraindicated in pheochromocytoma and active liver disease. **Use with caution** if patient is receiving haloperidol, propranolol, lithium, or sympathomimetics. Positive Coombs test rarely associated with hemolytic anemia. Fever, leukopenia, sedation, memory impairment, hepatitis, GI disturbances, orthostatic hypotension, black tongue, and gynecomastia may occur. May interfere with lab tests for creatinine, urinary catecholamines, uric acid, and AST. May increase the AV blocking effects of β -blockers and antihypertensive effects of other antihypertensives. α_2 -antagonist antidepressants, serotonin/norepinephrine reuptake inhibitors and methylphenidate may reduce the antihypertensive effects of methyldopa. **Do not use** in combination with MAO inhibitors (may enhance adverse effects of methyldopa). **Do not coadminister** oral doses with iron; decreases methyldopa absorption. **Adjust dose in renal failure** (see Chapter 31).

**METHYLENE BLUE**

ProvayBlue and generics

Antidote, drug-induced methemoglobinemia, and cyanide toxicity

X ? Yes No No

Injection: 10 mg/mL (1%) (1, 10 mL)**Intravenous solution (ProvayBlue):** 50 mg/10 mL (10 mL)**Methemoglobinemia:****Child and adult:** 1–2 mg/kg/dose or 25–50 mg/m²/dose IV over 5 min. May repeat in 30–60 min if needed.

At high doses, may cause methemoglobinemia. **Avoid** subcutaneous or intrathecal routes of administration. **Use with caution** in G6PD deficiency or renal insufficiency. May cause nausea, vomiting, dizziness, headache, diaphoresis, stained skin, and abdominal pain. Causes blue-green discoloration of urine and feces.



Serotonin syndrome has been reported with the co-administration of SSRI, SNRI, or clomipramine. Use with bupropion, paroxetine, sertraline, duloxetine, vilazodone, venlafaxine, fluoxetine, or desipramine is considered **contraindicated**.

METHYLPHENIDATE HCL

Ritalin, Adhansia XR, Aptensio XR, Jornay PM, Methylin, Metadate CD, Metadate ER, Methylin ER, Concerta, Relexxii, QuilliChew ER, Quillivant XR, Ritalin LA, Cotempla XR-ODT, Daytrana, and generics

CNS stimulant

C 3 No Yes No

Tabs (Ritalin and generics): 5, 10, 20 mg**Chewable tabs (Methylin and generics):** 2.5, 5, 10 mg; contains phenylalanine**Extended-release chewable tabs (dosed once daily in the morning):**

QuilliChew ER: 20, 30, 40 mg; contains phenylalanine

Oral solution (Methylin and generics): 1 mg/mL, 2 mg/mL; may contain propylene glycol**Oral suspension, extended release (dosed once daily in the morning):**

Quillivant XR: 25 mg/5 mL (60, 120, 150, 180 mL); contains sodium benzoate

Extended-release tabs:**8-hr duration (Metadate ER):** 20 mg; dosed BID–TID**24-hr duration:****Concerta and generics:** 18, 27, 36, 54 mg

METHYLPHENIDATE HCL continued**Extended-release oral disintegrating tabs:****Cotempla XR-ODT (dosed once daily in the morning):** 8.6, 17.3, 25.9 mg; contains polyethylene glycol**Extended-release caps****24-hr duration:****Ritalin LA, Medatate CD, and generics:** 10, 20, 30, 40, 50, 60 mg**Adhansia XR:** 25, 35, 45, 55, 70, 85 mg**Aptensio XR:** 10, 15, 20, 30, 40, 50, 60 mg**Jornay PM:** 20, 40, 60, 80, 100 mg (dosed only in the evening)**Transdermal patch (Daytrana):** 10 mg/9 hr (each 12.5 cm² patch contains 27.5 mg), 15 mg/9 hr (each 18.75 cm² patch contains 41.3 mg), 20 mg/9 hr (each 25 cm² patch contains 55 mg), 30 mg/9 hr (each 37.5 cm² patch contains 82.5 mg) (30s)**Attention-deficit/hyperactivity disorder (ADHD):****Immediate-release oral-dosage forms (Methylin, Ritalin; ≥6 yr):**

Initial: 0.3 mg/kg/dose (or 2.5–5 mg/dose) given before breakfast and lunch. May increase by 0.1 mg/kg/dose PO (or 5–10 mg/24 hr) weekly until maintenance dose achieved. May give extra afternoon dose if needed.

Maintenance dose range: 0.3–1 mg/kg/24 hr**Max. dose:** 2 mg/kg/24 hr or 60 mg/24 hr for those weighing ≤50 kg and 100 mg/24 hr >50 kg.**Extended-release once-daily oral-dosage form (Concerta; ≥6 yr):**

Methylphenidate naive patients: Start with 18 mg PO QAM for children and adolescents and 18–36 mg PO QAM for adults; dosage may be increased at weekly intervals at 18 mg increments up to the following **max. dose**:

6–12 yr: 54 mg/24 hr**13–17 yr:** 72 mg/24 hr **not to exceed** 2 mg/kg/24 hr**Patients weighing >50 kg:** higher **max. dose** of 108 mg/24 hr may be used.**Patients currently receiving methylphenidate:** See following table.**RECOMMENDED DOSE CONVERSION FROM METHYLPHENIDATE REGIMENS TO CONCERTA**

Previous Methylphenidate Daily Dose	Recommended Concerta Dose
5 mg PO BID–TID or 20 mg SR PO once daily	18 mg PO QAM
10 mg PO BID–TID or 40 mg SR PO once daily	36 mg PO QAM
15 mg PO BID–TID or 60 mg SR PO once daily	54 mg PO QAM
20 mg PO BID–TID	72 mg PO QAM

After a week of receiving the above-recommended Concerta dose, dose may be increased in 18 mg increments at weekly intervals PRN up to a **maximum** of 54 mg/24 hr for 6–12 yr and 72 mg/24 hr (not to exceed 2 mg/kg/24 hr) for 13–17 yr.

Other extended-release oral-dosage forms (see specific product information if converting from another product or dosage form):

Product (Dosage Form)	Initial Dose (≥6 yr) ^a	Dosage Adjustment	Max. Dose
Adhansia XR (extended-release caps)	25 mg PO once daily in the AM	Increase at 10–15 mg increments at intervals ≥5 days PRN	85 mg/24 hr but doses ≥70 mg/24 hr were associated with higher rate of side effects in children
Aptensio XR (extended-release caps)	10 mg PO once daily in the AM	Increase at 10 mg increments Q7 days PRN	60 mg/24 hr

METHYLPHENIDATE HCL *continued*

Product (Dosage Form)	Initial Dose (≥ 6 yr) ^a	Dosage Adjustment	Max. Dose
Cotempia XR-ODT (extended-release oral disintegrating tabs) ^b	17.3 mg PO once daily in the AM	Increase at 8.6 or 17.3 mg increments Q7 days PRN	51.8 mg/24 hr
Jornay PM (extended- release caps)	20 mg PO QHS (between 6:30 and 9:30 PM; 8:00 PM was the most optimal time for 6–12 yr in clin- ical trials)	Increase at 20 mg incre- ments Q7 days PRN; administered QHS	100 mg/24 hr
Metadata CD (extended-release caps)	20 mg PO once daily	Increase at 10–20 mg increments Q7 days PRN	≤ 50 kg: 60 mg/24 hr >50 kg: 100 mg/24 hr
Quillivant XR (extended-release oral suspension) ^a	20 mg PO once daily	Increase at 10–20 mg increments Q7 days PRN	60 mg/24 hr
QuilliChew (extended- release chewable tabs)	20 mg PO once daily	Increase by 10, 15, or 20 mg Q7 days PRN	Doses >60 mg/24 hr have not been studied
Ritalin LA (extended- release caps)	20 mg PO once daily	Increase at 10 mg incre- ments Q7 days PRN	≤ 50 kg: 60 mg/24 hr >50 kg: 100 mg/24 hr

^aQuillivant XR dosing recommendations for children 6–12 yr.

^bCotempia XR ODT dosing recommendations for children 6–17 yr.

Metadata ER (8-hr duration of action): Convert immediate-release tabs when the 8-hr dosage corresponds to the available extended-release tablet size. Usual **max. dose:** 60 mg/24 hr for children but some patients >50 kg may tolerate doses up to 100 mg/24 hr with increased monitoring.

Transdermal patch (Daytrana; see remarks): Apply to the hip 2 hr before the effect is needed and remove 9 hr later. Patch may be removed before 9 hr if shorter duration of effect is desired or if late day adverse effects appear.

6–17 yr: Start with 10 mg/9 hr patch once daily. Increase dose PRN Q7 days by increasing to the next dosage strength. Higher starting doses have been reported in patients converting from oral-dosage forms >20 mg/24 hr.

Contraindicated in glaucoma, anxiety disorders, motor tics, and Tourette syndrome. Medication should generally not be used in children <5 yr old; diagnosis of ADHD in this age group is extremely difficult and should be only done in consultation with a specialist. Sudden death (children, adolescents, and adults), stroke (adults), and MI (adults) have been reported in patients with preexisting structural cardiac abnormalities or other serious heart problems.

Use with caution in patients with hypertension, psychiatric conditions, and epilepsy.

Insomnia, weight loss, anorexia, rash, nausea, emesis, abdominal pain, hypertension or hypotension, tachycardia, arrhythmias, palpitations, restlessness, headaches, fever, tremor, visual disturbances, and thrombocytopenia may occur. Abnormal liver function (ranging from transaminase elevation to severe hepatic injury), cerebral arteritis and/or occlusion, peripheral vasculopathy (including Raynaud phenomenon), leukopenia and/or anemia, hypersensitivity reactions, transient depressed mood, paranoia, mania, auditory hallucination, priapism, and scalp hair loss have been reported. Skin irritation, chemical leukoderma, and contact dermatitis have been reported with transdermal route. High doses

METHYLPHENIDATE HCL continued

May increase serum concentrations/effects of tricyclic antidepressants, dopamine agonists (e.g., haloperidol), phenytoin, phenobarbital, and warfarin. May decrease the effects of antihypertensive drugs. Effect of methylphenidate may be potentiated by MAO inhibitors; hypertensive crisis may also occur if used within 14 days of discontinuance of the MAO inhibitor.

Extended/sustained-release dosage forms have either an 8- or 24-hr dosage interval (as stipulated previously). Concerta dosage form delivers 22.2% of its dose as an immediate-release product with the remaining amounts as an extended-release product (e.g., 18-mg strength: 4 mg as immediate release and 14 mg as extended release). Jornay PM is dosed only in the evening and should **NOT** be taken in the morning. **Do not** consume alcohol with Ritalin LA dosage form, because it may result in a more rapid release of the drug. **Do not** expose transdermal application site to external heat sources (e.g., electric blankets, heating pads); this may increase drug release.

METHYLPREDNISOLONE

Medrol, Medrol Dosepack, Solu-Medrol, Depo-Medrol, and generics

Corticosteroid



Tabs: 2, 4, 8, 16, 32 mg

Tabs, dose pack (Medrol Dosepack and generics): 4 mg (21s)

Injection, Na succinate (Solu-Medrol and generics): 40, 125, 500, 1000 mg (IV or IM use); may contain benzyl alcohol

Injection, Acetate (Depo-Medrol and generics): 20, 40, 80 mg/mL (IM repository); may contain polyethylene glycol (1, 5 mL)

Antiinflammatory/immunosuppressive:

PO/IM/IV (use succinate salt for IM/IV): 0.5–1.7 mg/kg/24 hr ÷ Q6–12 hr.



Asthma exacerbations (2007 National Heart, Lung, and Blood Institute Guideline

Recommendations; dose until peak expiratory flow reaches 70% of predicted or personal best):

Child ≤12 yr (IV/IM/PO; use succinate salt for IV/IM): 1–2 mg/kg/24 hr ÷ Q12 hr (**max. dose:** 60 mg/24 hr). Higher alternative regimen of 1 mg/kg/dose Q6 hr × 48 hr followed by 1–2 mg/kg/24 hr (**max. dose:** 60 mg/24 hr) ÷ Q12 hr has been suggested.

Child >12 yr and adult (IV/IM/PO; use succinate salt for IV/IM): 40–80 mg/24 hr ÷ Q12–24 hr.

Outpatient asthma exacerbation burst therapy (longer durations may be necessary):

PO:

Child ≤12 yr: 1–2 mg/kg/24 hr ÷ Q12–24 hr (**max. dose:** 60 mg/24 hr) × 3–10 days.

Child >12 yr and adult: 40–60 mg/24 hr ÷ Q12–24 hr × 3–10 days.

IM (use methylprednisolone acetate product) for patients vomiting or with adherence issues:

Child ≤4 yr: 7.5 mg/kg (**max. dose:** 240 mg) IM × 1

Child >4 yr, adolescent, and adult: 240 mg IM × 1.

Acute spinal cord injury:

30 mg/kg IV over 15 min followed in 45 min by a continuous infusion of 5.4 mg/kg/hr × 23 hr.

See **Chapter 10** for relative steroid potencies. Acetate form may also be used for intra-articular and intralosomal injection and has longer times to max. effect and duration of action; it should **NOT** be given IV. **Use with caution** with systemic sclerosis. Like all steroids, may cause hypertension, leukocytosis, pseudotumor cerebri, acne, Cushing syndrome, adrenal axis suppression, GI bleeding, hyperglycemia, and osteoporosis.

Barbiturates, phenytoin, and rifampin may enhance methylprednisolone clearance. Erythromycin, itraconazole, and ketoconazole may increase methylprednisolone levels. Methylprednisolone may increase cyclosporine and tacrolimus levels.

D

METOCLOPRAMIDE

Reglan and generics

Antiemetic, prokinetic agent

B

2

Yes

No

No

Tabs: 5, 10 mg**Tabs, orally disintegrating (ODT):** 5, 10 mg**Injection:** 5 mg/mL (2 mL)**Oral solution:** 5 mg/5 mL (473 mL)**Gastroesophageal reflux (GER) or GI dysmotility:**

Infant and child: 0.1–0.2 mg/kg/dose up to QID IV/IM/PO; **max. dose:** 0.8 mg/kg/24 hr or 10 mg/dose

**Adult:** 10 mg/dose QAC and QHS IV/IM/PO**Antiemetic (child and adolescent):** Premedicate with diphenhydramine to reduce extrapyramidal symptoms (EPS)

1–2 mg/kg/dose Q2–6 hr IV/IM/PO up to 5 doses/24 hr

Postoperative nausea and vomiting:**Child:** 0.1–0.2 mg/kg/dose Q6–8 hr PRN IV; **max. dose:** 10 mg/dose**>14 yr and adult:** 10 mg Q6–8 hr PRN IV

Contraindicated in GI obstruction, seizure disorder, tardive dyskinesia, pheochromocytoma, or in patients receiving drugs likely to cause EPS. May cause EPS, especially at higher doses. Sedation, headache, anxiety, depression, leukopenia, and diarrhea may occur. Neuroleptic malignant syndrome and tardive dyskinesia (increase risk with prolong duration of therapy; **avoid use** >12 wk) have been reported.

Metoclopramide is a substrate for CYP 450 2D6; inhibitors to this enzyme may increase risk metoclopramide toxicity. G6PD deficiency may increase risk for methemoglobinemia; **DO NOT** use methylene blue as it may cause a fatal hemolytic anemia.

For GER, give 30 min before meals and at bedtime. **Reduce dose in renal impairment** (see [Chapter 31](#)).

METOLAZONE

Generics; previously available as Zaroxolyn

Diuretic, thiazide-like

B

2

Yes

Yes

No

Tabs: 2.5, 5, 10 mg**Oral suspension:** 0.25 mg/mL 1 mg/mL **Dosage based on Zaroxolyn (for oral suspension, see remarks):****Child:****Edema:** 0.2–0.4 mg/kg/24 hr ÷ once daily–BID PO**Adult:****Hypertension:** 2.5–5 mg once daily PO**Edema:** 2.5–20 mg once daily PO

Contraindicated in patients with anuria, hepatic coma, or hypersensitivity to sulfonamides or thiazides. **Use with caution** in severe renal disease, impaired hepatic function, gout, lupus erythematosus, diabetes mellitus, and elevated cholesterol and triglycerides. Electrolyte imbalance, GI disturbance, hyperglycemia, marrow suppression, chills, hyperuricemia, chest pain, hepatitis, and rash may occur.

Oral suspensions have increased bioavailability; therefore lower doses may be necessary when using these dosage forms. More effective than thiazide diuretics in impaired renal function; may be effective in GFRs as low as 20 mL/min. Furosemide-resistant edema in pediatric patients may

METOPROLOL

Lopressor, Toprol-XL, Kapspargo Sprinkle, and generics
Adrenergic blocking agent (β_1 selective), class II antiarrhythmic



Tabs: 25, 37.5, 50, 75, 100 mg

Extended-release tabs (Toprol-XL and generics): 25, 50, 100, 200 mg

Extended-release caps as sprinkles (Kapspargo Sprinkle): 25, 50, 100, 200 mg; contains corn starch

Oral liquid: 10 mg/mL

Injection: 1 mg/mL (5 mL)

Hypertension:

Child ≥ 1 yr and adolescent



Non-extended-release oral-dosage forms: Start at 1–2 mg/kg/24 hr PO \div BID (max. initial dose: 25 mg/dose); if needed, adjust dose up to a **max. dose** of 6 mg/kg/24 hr **up to** 200 mg/24 hr.

Extended-release tabs (≥ 6 yr and adolescent): Start at 1 mg/kg/dose (**max. dose:** 50 mg) PO once daily; if needed, adjust dose **up to a max. dose** of 2 mg/kg/24 hr or 200 mg/24 hr once daily (higher doses have not been evaluated).

Adult:

Non-extended-release tabs: Start at 50–100 mg/24 hr PO \div once daily–BID; if needed, increase dosage at weekly intervals to desired blood pressure. Usual effective dosage range is 100–200 mg/24 hr. Doses >450 mg/24 hr have not been studied. Patients with bronchospastic diseases should receive the lowest possible daily dose divided TID.

Extended-release tabs: Start at 25–100 mg/24 hr PO once daily; if needed, increase dosage at weekly intervals to desired blood pressure. Usual dosage range is 50–200 mg/24 hr. Doses >400 mg/24 hr have not been studied.

Contraindicated in sinus bradycardia, heart block >1 st degree, sick sinus syndrome (except with functioning pacemaker), cardiogenic shock, and uncompensated CHF. **Use with caution** in hepatic dysfunction, peripheral vascular disease, history of severe anaphylactic hypersensitivity drug reactions, pheochromocytoma, and concurrent use with verapamil, diltiazem, or anesthetic agents that may decrease myocardial function. Should not be used with bronchospastic diseases. Reserpine and other drugs that deplete catecholamines (e.g., MAO inhibitors) may increase the effects of metoprolol. Metoprolol is a CYP 450 2D6 substrate. Poor metabolizers and extensive metabolizers who concomitantly use CYP 2D6 inhibitors will have significant increases in metoprolol blood levels to decrease its cardioselectivity.



Avoid abrupt cessation of therapy in ischemic heart disease; angina, ventricular arrhythmias, and MI have occurred. Common side effects include bradycardia, heart block, heart failure, pruritus, rash, GI disturbances, dizziness, fatigue, and depression. Bronchospasm, dyspnea, and elevations in transaminase, alkaline phosphatase, and LDH have all been reported.

METRONIDAZOLE

Flagyl, First-Metronidazole, MetroGel, MetroLotion, MetroCream, Rosadan, Noritate, Vandazole, Nuvessa, and generics

Antibiotic, antiprotozoal



Tabs: 250, 500 mg

Caps: 375 mg

Oral suspension: 50 mg/mL

First-Metronidazole: 50 mg/mL (150 mL), 100 mg/mL (150 mL); contains sodium benzoate and saccharin

METRONIDAZOLE *continued*

Ready-to-use injection: 5 mg/mL (100 mL); contains 28 mEq Na/g drug
Gel, topical:

Rosadan and generics: 0.75% (45 g)

MetroGel and generics: 1% (55, 60 g)

Lotion (MetroLotion and generics): 0.75% (59 mL); contains benzyl alcohol

Cream, topical:

MetroCream, Rosadan and generics: 0.75% (45 g); contains benzyl alcohol

Noritate: 1% (60 g); contains parabens

Gel, vaginal:

Vandazole, and generics: 0.75% (each applicator delivers ~5 g of gel containing ~37.5 mg metronidazole); contains parabens (70 g with 5 applicators)

Nuvessa: 1.3%: (each applicator delivers ~5 g containing ~65 mg metronidazole); contains parabens and benzyl alcohol (1 prefilled applicator)

Amebiasis:

Child: 35–50 mg/kg/24 hr PO ÷ Q8 hr × 10 days; **max. dose:** 750 mg/dose

Adult: 500–750 mg/dose PO Q8 hr × 10 days



Anaerobic infection (see remarks):

Neonate: PO/IV:

Loading dose (all ages): 15 mg/kg × 1

Maintenance dose based on postmenstrual age (PMA):

PMA 24–25 wk: 7.5 mg/kg/dose Q24 hr

PMA 26–27 wk: 10 mg/kg/dose Q24 hr

PMA 28–33 wk: 7.5 mg/kg/dose Q12 hr

PMA 34–40 wk: 7.5 mg/kg/dose Q8 hr

PMA >40 wk: 7.5 mg/kg/dose Q6 hr

Infant/child/adolescent:

PO: 30–50 mg/kg/24 hr ÷ Q8 hr; **max. dose:** 2250 mg/24 hr

IV: 22.5–40 mg/kg/24 hr ÷ Q6–8 hr; **max. dose:** 4 g/24 hr

Adult:

PO/IV: 30 mg/kg/24 hr ÷ Q6–8 hr; **max. dose:** 4 g/24 hr. A 15 mg/kg/dose IV loading dose over 1 hr is administered 6 hr prior to the aforementioned maintenance dose for IV route.

Bacterial vaginosis:

Adolescent and adult:

PO:

Immediate-release tabs: 500 mg BID × 7 days

Vaginal:

Vaginal gel 0.75% (Adolescent and adult): ~37.5 mg (1 applicator full) QHS × 5 days

Vaginal gel 1.3% (≥12 yr and adult): ~65 mg (1 applicator full) at bedtime × 1

Giardiasis:

Child: 15–30 mg/kg/24 hr PO ÷ TID × 5–7 days; **max. dose:** 750 mg/24 hr

Adult: 250 mg PO TID × 5 days

Trichomoniasis: Treat sexual contacts.

Child <45 kg: 45 mg/kg/24 hr PO ÷ TID × 7 days; **max. dose:** 2000 mg/24 hr

Child ≥45 kg, adolescent/adult: 2 g PO × 1, or 500 mg PO BID × 7 days.

Clostridium difficile infection (IV may be less efficacious):

Child: 30 mg/kg/24 hr ÷ Q6 hr PO/IV × 10–14 days; **max. dose:** 2000 mg/24 hr

Severe fulminant infection (with oral or rectal vancomycin): 30 mg/kg/24 hr ÷ Q8 hr IV × 10 days

Adult: 500 mg TID PO/IV × 10–14 days

Severe fulminant infection (with oral or rectal vancomycin): 500 mg IV Q8 hr.

METRONIDAZOLE continued

Helicobacter pylori infection (use in combination with amoxicillin and acid-suppressing agent with/without clarithromycin):

Child: 20 mg/kg/24 hr (**max. dose:** 1000 mg/24 hr) ÷ BID PO × 10–14 days

Adult: 250–500 mg TID–QID (QAC and QHS) PO × 10–14 days

Topical use: Apply and rub a thin film to affected areas at the following frequencies specific to product concentration.

0.75% cream: BID

1% cream: once daily

Avoid use in first-trimester pregnancy. **Use with caution** in patients with CNS disease, blood dyscrasias, severe liver (reduce dose by 50% with Child-Pugh C), or **renal disease (GFR <10 mL/min; see Chapter 31)**. If using single 2-g dose in a breast-feeding mother, discontinue breastfeeding for 12–24 hr to allow excretion of the drug.



Nausea, diarrhea, urticaria, dry mouth, leukopenia, vertigo, metallic taste, and peripheral neuropathy may occur. Candidiasis may worsen. May discolor urine. Patients **should not** ingest alcohol for 24–48 hr after dose (disulfiram-type reaction). Fatal hepatotoxicity has been reported with individuals with Cockayne syndrome.

Single-dose oral regimen no longer recommended in bacterial vaginosis due to poor efficacy. May increase levels or toxicity of phenytoin, lithium, and warfarin. Phenobarbital and rifampin may increase metronidazole metabolism.

IV infusion must be given slowly over 1 hr. For intravenous use in all ages, some references recommend a 15-mg/kg loading dose.

MICAFUNGIN SODIUM

Mycamine

Antifungal, echinocandin



C

?

Yes

Yes

No

Injection: 50, 100 mg; contains lactose

Invasive candidiasis (see remarks):



Neonate and infant (based on a multidose pharmacokinetic and safety trial in 13 neonates/infants >48 hr and <120 days old with suspected or invasive candidiasis; minimum of 4–5 days of therapy):

<1 kg: 10 mg/kg/dose IV once daily; additional data from another multidose trial in 12 preterm neonates (median birth weight: 775 g, 27 wk gestation) suggest 15 mg/kg/dose IV once daily will provide similar AUC drug exposure of approximately 5 mg/kg/dose in adults.

≥1 kg: 7–10 mg/kg/dose IV once daily; 10–12 mg/kg/dose IV once daily may be needed for HIV-exposed/infected neonates.

Child and adolescent: 3–4 mg/kg/dose IV once daily; **max. dose:** 100 mg/dose

Adult: 100–150 mg IV once daily

Esophageal candidiasis, invasive aspergillosis, candidal endocarditis (see remarks):

Infant (≥1 mo), child and adult: 4 mg/kg/dose IV once daily; **max. dose:** 150 mg/24 hr

Adult: 150 mg IV once daily

Candida prophylaxis in hematopoietic stem cell transplant:

Infant (1 mo), child and adult: 1 mg/kg/dose IV once daily; **max. dose:** 50 mg/dose

Prior hypersensitivity to other echinocandins (anidulafungin, caspofungin) increases risk; anaphylaxis with shock has been reported. **Use with caution** in hepatic and renal impairment.



Continued

MICAFUNGIN SODIUM *continued*

No dosing adjustments are required based on race or gender, or in patients with severe renal dysfunction or mild to moderate hepatic function impairment. Effect of severe hepatic function impairment on micafungin pharmacokinetics has not been evaluated. Higher dosage requirements in premature and young infants may be attributed to the faster drug clearance due to lower protein binding. Higher treatment doses in infants and children have been reported at 8.6–12 mg/kg/dose IV once daily.

May cause GI disturbances, phlebitis, rash, hyperbilirubinemia, liver function test elevation, headache, fever, and rigor. Anemia, leukopenia, neutropenia, thrombocytopenia, TEN, Stevens-Johnson syndrome, and hemolysis have been reported. Micafungin is CYP450 3A isoenzyme substrate and weak inhibitor. May increase the effects/toxicity of nifedipine and sirolimus.

Safety and efficacy in children ≥ 4 mo have been demonstrated based on well-controlled studies and pharmacokinetic/safety studies.

MICONAZOLE

Topical products: Micatin, Desenex, Lotrimin AF, and other brands including generics

Vaginal products: Miconazole 7, Miconazole 3, Monistat, Vagistat-3, and other brands including generics

Antifungal agent

Cream (OTC): 2% (15, 30, 57, 118, 141 g); may contain benzoic acid

Ointment (OTC): 2% (43, 71, 85, 90 g)

Solution (OTC): 2% with alcohol (29.57 mL)

Topical solution (OTC): 2% with alcohol (30 mL)

Powder (OTC): 2% (43, 71, 85, 90 g)

Spray, liquid (OTC): 2% (150 g); contains alcohol

Spray, powder (OTC): 2% (85, 113, 133, 150 g); contains alcohol

Vaginal cream (OTC): 2% (45 g); contains benzoic acid

Vaginal suppository (OTC): 100 mg (7s), 200 mg (3s)

Vaginal combination packs:

Monistat 1 Combination Pack (OTC): 1200 mg suppository (1) and 2% cream (9 g)

Miconazole 3 Combo Pack, Monistat 3 Combo Pack, Vagistat-3 (OTC): 200 mg suppository (3s) and 2% cream (9 g)

Monistat 7 Combo Pack (OTC): 100 mg suppository (7s) and 2% cream (9 g)

Topical (≥ 2 yr and adolescent): Apply BID $\times 2$ –4 wk

Vaginal (≥ 12 yr and adult):



7-day regimen: 1 applicator full of 2% cream or 100 mg suppository QHS $\times 7$ days

3-day regimen: 1 applicator full of 4% cream or 200 mg suppository QHS $\times 3$ days

1-day regimen (Monistat 1): 1200 mg suppository $\times 1$ at bedtime or during the day.

Use with caution in hypersensitivity to other imidazole antifungal agents (e.g., clotrimazole, ketoconazole). Side effects include pruritis, rash, burning, phlebitis, headaches, and pelvic cramps.



Drug is a substrate and inhibitor of the CYP 450 3A3/4 isoenzymes. Vaginal use with concomitant warfarin use has also been reported to increase warfarin's effect. Vegetable oil base in vaginal suppositories may interact with latex products (e.g., condoms and diaphragms); consider switching to the vaginal cream.

Avoid contact with eyes.

MIDAZOLAM

Nayzilam and various generics; previously available as Versed
Benzodiazepine



Injection: 1 mg/mL (2, 5, 10 mL), 5 mg/mL (1, 2, 5, 10 mL); some preparations may contain 1% benzyl alcohol

Oral syrup: 2 mg/mL (118 mL); contains sodium benzoate

Nasal solution (Nayzilam): 5 mg per 0.1 mL (2s); contains propylene glycol



Titrate to effect under controlled conditions (see remarks).

See Chapter 6 for additional routes of administration.

Sedation for procedures:**Infant, child, and adolescent:**

IM: 0.1–0.15 mg/kg/dose 30–60 min prior to procedure. Higher dose of 0.5 mg/kg/dose has been used for anxious patients. **Max. dose:** 10 mg.

IV:

6 mo–5 yr: 0.05–0.1 mg/kg/dose over 2–3 min. May repeat dose PRN in 2–3 min intervals up to a **max. total dose** of 6 mg. A total dose up to 0.6 mg/kg may be necessary for desired effect.

6–12 yr: 0.025–0.05 mg/kg/dose over 2–3 min. May repeat dose PRN in 2–3 min intervals up to a **max. total dose** of 10 mg. A total dose up to 0.4 mg/kg may be necessary for desired effect.

>12–16 yr: Use adult dose; up to **max. total dose** of 10 mg.

Po:

≥6 mo, child, and adolescent <16 yr: 0.25–0.5 mg/kg/dose ×1; **max. dose:** 20 mg. Younger patients (6 mo–5 yr) may require higher doses of 1 mg/kg/dose, whereas older patients (6–15 yr) may require only 0.25 mg/kg/dose. Use 0.25 mg/kg/dose for patients with cardiac or respiratory compromise, concurrent CNS depressive drug, or high-risk surgery.

Intranasal (limited data; using IV dosage form):

Infant, child, and adolescent: 0.2–0.3 mg/kg/dose (**max.** 10 mg/dose) intranasally via an atomizer ×1. Higher doses of 0.4–0.5 mg/kg/dose (**max.** 10 mg/dose) have also been reported.

Adult:

IM: 0.07–0.08 mg/kg/dose 30–60 min prior to procedure; usual dose is 5 mg.

IV: 0.5–2 mg/dose over 2 min. May repeat PRN in 2–3 min intervals until desired effect. Usual total dose: 2.5–5 mg. **Max. total dose:** 10 mg.

Sedation with mechanical ventilation:**Intermittent:**

Infant and child: 0.05–0.15 mg/kg/dose IV Q1–2 hr PRN

Continuous IV infusion (initial doses, titrate to effect):**Neonate:**

<32-wk gestation: 0.5 mCg/kg/min

≥32-wk gestation: 1 mCg/kg/min

Infant and child: 1–2 mCg/kg/min

Refractory status epilepticus:

≥2 mo and child: Load with 0.15 mg/kg IV ×1 followed by a continuous infusion of 1 mCg/kg/min; titrate dose upward Q5 min to effect (mean dose of 2.3 mCg/kg/min with a range of 1–18 mCg/kg/min has been reported).

Acute treatment of intermittent, stereotypic episodes of frequent seizure activity (i.e., seizure clusters, acute repetitive seizures) that are distinct from a patient's usual seizure pattern in patients with epilepsy:

≥12 yr and adult (Nayzilam intranasal; see remarks): Administer one spray (5 mg) intranasally into one nostril. If no response in 10 min, administer an additional 5 mg spray into the alternative nostril. **Do not** administer the second dose if patient has trouble breathing or if there is excessive

Continued

MIDAZOLAM continued

sedation that is uncharacteristic of the patient during a seizure episode. **Max. dose:** 10 mg/dose per episode; **not to exceed** one episode every 3 days and 5 episodes per month.

Contraindicated in patients with narrow-angle glaucoma and shock. **Use with caution** in CHF, renal impairment (**adjust dose**; see [Chapter 31](#)), pulmonary disease, hepatic dysfunction, and neonates. Causes respiratory depression, hypotension, and bradycardia. Cardiovascular monitoring is recommended. Use lower doses or reduce dose when given in combination with narcotics or in patients with respiratory compromise.

Higher recommended dosage for younger patients (6 mo–5 yr) is attributed to the water-soluble properties of midazolam and the higher percent body water for younger patients.

Drug is a substrate for CYP 450 3A4. Serum concentrations may be increased by cimetidine, clarithromycin, diltiazem, erythromycin, itraconazole, ketoconazole, ranitidine, and protease inhibitors (**use contraindicated**). Sedative effects may be antagonized by theophylline. **Effects can be reversed by flumazenil.** For pharmacodynamic information, see [Chapter 6](#).

Do not prime Nayzilam intranasal dosage form, because this will promote drug loss.

**MILRINONE**

Generics; previously available as Primacor
Inotrope, phosphodiesterase inhibitor



C

?

Yes

No

No

Injection: 1 mg/mL (10, 20, 50 mL)

Premixed injection in D₅W: 200 mCg/mL (100, 200 mL)



Child (limited data): 50 mCg/kg IV bolus over 15 min, followed by a continuous infusion of 0.25–0.75 mCg/kg/min and titrate to effect.

Adult: 50 mCg/kg IV bolus over 10 min, followed by a continuous infusion of 0.375–0.75 mCg/kg/min and titrate to effect. **Max. dose:** 1.13 mg/kg/24 hr.

Contraindicated in severe aortic stenosis, severe pulmonic stenosis, and acute MI. May cause headache, dysrhythmias, hypotension, hypokalemia, nausea, vomiting, anorexia, abdominal pain, hepatotoxicity, and thrombocytopenia. Pediatric patients may require higher mCg/kg/min doses because of a faster elimination T_½ and larger volume of distribution, when compared with adults. Hemodynamic effects can last up to 3–5 hr after discontinuation of infusion in children. **Reduce dose in renal impairment.**

**MINERAL OIL**

GoodSense Mineral Oil, Kondremul, Fleet Mineral Oil, and generics

Laxative, lubricant



C

2

No

No

No

Liquid, oral (GoodSense Mineral Oil and generics; OTC): 30, 472, 500, 1000 mL

Emulsion, oral (Kondremul; OTC): 480 mL; each 5 mL Kondremul contains 2.5 mL mineral oil

Rectal liquid (Fleet Mineral Oil and generics; OTC): 133 mL bottle delivers approximately 120 mL



Constipation:

Child 6–11 yr (see remarks):

Oral liquid: 5–15 mL/24 hr ÷ once daily—TID PO

Oral emulsion (Kondremul): 10–30 mL/24 hr ÷ once daily—TID PO

Rectal (2–11 yr): 66.5 mL as single dose

Child ≥12 yr and adult (see remarks):

MINERAL OIL *continued*

Oral emulsion (Kondremul): 30–90 mL/24 hr ÷ once daily–TID PO

Rectal:

2–<12 yr: ~60 mL (half-bottle) as a single dose

≥12 yr and adult: ~120 mL as single dose

May cause diarrhea, cramps, and lipid pneumonitis via aspiration. Use as a laxative **should not exceed** >1 wk. Onset of action is approximately 6–8 hr. Higher doses may be necessary to achieve desired effect. **DO NOT** give QHS dose and use with **caution** in children <5 yr to minimize risk of aspiration. May impair the absorption of fat-soluble vitamins, calcium, phosphorus, oral contraceptives, and warfarin. Emulsified preparations are more palatable and are dosed differently than the oral liquid preparation.

For disimpaction, doses up to 1 ounce (30 mL) per year of age (**max. dose** of 240 mL) BID can be given.

**MINOCYCLINE**

Minocin, Solodyn, Minolira, Ximino, Amzeeq, and generics

Antibiotic, tetracycline derivative



D

X

Yes

Yes

No

Tabs: 50, 75, 100 mg

Caps: 50, 75, 100 mg

Extended-release tabs (Q24 hr dosing):

Solodyn and generics: 55, 65, 80, 105, 115 mg

Minolira: 105, 135 mg

Other generics: 45, 90, 135 mg

Extended-release caps (Q24 hr dosing):

Ximino: 45, 90, 135 mg

Injection (Minocin): 100 mg; may contain 2.2 mEq magnesium/100 mg drug

Topical foam (Amzeeq): 4% (30 g); contains alcohols and dispensed in a pressurized container with butane, isobutane, and propane propellants



General infections:

Child (8–12 yr): 4 mg/kg/dose (**max. dose:** 200 mg/dose) ×1 IV/PO, then 2 mg/kg/dose

Q12 hr IV/PO; **max. dose:** 200 mg/24 hr

Adolescent and adult: 200 mg/dose ×1 IV/PO, then 100 mg Q12 hr IV/PO

Chlamydia trachomatis/Ureaplasma urealyticum:

Adolescent and adult: 100 mg IV/PO Q12 hr ×7 days

Acne (≥12 yr–adult):

Immediate-release dosage forms: 50–100 mg PO once daily–BID

Extended-release tabs:

Solodyn and generics:

45–49 kg: 45 mg PO once daily

50–59 kg: 55 mg PO once daily

60–71 kg: 65 mg PO once daily

72–84 kg: 80 mg PO once daily

85–96 kg: 90 mg PO once daily

97–110 kg: 105 mg PO once daily

111–125 kg: 115 mg PO once daily

126–136 kg: 135 mg PO once daily

Continued

MINOCYCLINE *continued***Acne (≥ 12 yr–adult, cont.):****Minolira:**

- 45–59 kg:** 52.5 mg (half of 105 mg tab)
60–89 kg: 67.5 mg (half of 135 mg tab) PO once daily
90–125 kg: 105 mg PO once daily
126–136 kg: 135 mg PO once daily

Extended-release caps:**Ximino:**

- 45–59 kg:** 45 mg PO once daily
60–90 kg: 90 mg PO once daily
91–136 kg: 135 mg PO once daily

Topical foam (Amzeeq; moderate-to-severe acne vulgaris):

≥ 9 yr and adult (see remarks): Apply to affected areas QHS until all areas are treated

Not recommended for children <8 yr and during the last half of pregnancy due to risk of permanent tooth discoloration. **Use with caution** in renal failure, lower dosage may be necessary. High incidence of vestibular dysfunction (30%–90%). Nausea, vomiting, allergy, increased intracranial pressure (e.g., pseudotumor cerebri), photophobia, and injury to developing teeth may occur. Hepatitis, including autoimmune hepatitis, liver failure, hypersensitivity reactions (e.g., anaphylaxis, Stevens Johnson syndrome, erythema multiforme), serum sickness-like and lupus-like syndrome have been reported.



May increase effects/toxicity of warfarin and decrease the efficacy of live attenuated oral typhoid vaccine. May be administered with food but **NOT** with milk or dairy products. See Tetracycline for additional drug/food interactions and comments.

TOPICAL USE: Dosage form is flammable; **avoid** smoking during and immediately after application. Not for oral, ophthalmic, or intravaginal use. Headache is the most common side effect. Hyperpigmentation, erythema, dryness, itching, and headache have also been reported.

MINOXIDIL

Tabs: Generics; previously available as Loniten
 Topical: Rogaine Men's/Women's, Minoxidil for Men/Women, Hair Regrowth Treatment Men, Men's Rogaine Extra Strength

Antihypertensive agent, hair growth stimulant



C

2

Yes

Yes

No

Tabs: 2.5, 10 mg

Topical solution:

Minoxidil for Men, Minoxidil for Women, Rogaine, and generics (OTC): 2% (60 mL)
Hair Regrowth Treatment for Men, Men's Rogaine Extra Strength, Minoxidil Extra Strength for Men, and generics (OTC): 5% (60, 120 mL); contains 30% alcohol

Topical foam:

Rogaine Men's, Rogaine Women's, Rogaine Extra Strength (OTC): 5% (60 g); contains cetyl alcohol

Hypertension:

Child <12 yr: Start with 0.1–0.2 mg/kg/24 hr PO once daily; **max. dose:** 5 mg/24 hr. Dose may be increased in increments of 0.1–0.2 mg/kg/24 hr at 3-day intervals. Usual effective range: 0.25–1 mg/kg/24 hr PO \div once daily–TID; **max. dose:** 50 mg/24 hr.



≥ 12 yr and adult: Start with 5 mg PO once daily. Dose may be gradually increased at 3-day intervals. Usual effective range: 10–40 mg/24 hr \div once daily–TID; **max. dose:** 100 mg/24 hr.

MINOXIDIL continued**Topical (alopecia; see remarks):****Adult:**

Solution (2% or 5%): Apply 1 mL to affected areas of the scalp BID (QAM and QHS)

Foam:

Female: Apply ½ capful to affected areas of the scalp once daily

Male: Apply ½ capful to affected areas of the scalp BID

Contraindicated in acute MI, dissecting aortic aneurysm, and pheochromocytoma. Concurrent use with a β-blocker and diuretic is recommended to prevent reflex tachycardia and reduce water retention, respectively. Use with **caution** in hepatic impairment as decrease in drug clearance has been reported in mild cirrhosis for adults. May cause drowsiness, dizziness, CHF, pulmonary edema, pericardial effusion, pericarditis, thrombocytopenia, leukopenia, Stevens-Johnson syndrome, TEN, and hypertrichosis (reversible) with systemic use. Neonatal hypertrichosis has been reported following use during pregnancy.



Concurrent use of guanethidine may cause profound orthostatic hypotension; use with other antihypertensive agents may cause additive hypotension. Patients with renal failure or receiving dialysis may require a dosage reduction. Antihypertensive onset of action within 30 min and peak effects within 2–8 hr.

TOPICAL USE: Local irritation, contact dermatitis may occur. **Do not use** in conjunction with other topical agents including topical corticosteroids, retinoids or petrolatum, or agents that are known to enhance cutaneous drug absorption. Onset of hair growth is 4 mo. Wash hands thoroughly after each application. The 5% solution is flammable.

MOMETASONE FUROATE ± FOMOTEROL FUMARATE

Asmanex, Nasonex, Elocon, and other generic nasal and topical products

In combination with fomoterol: Dulera

Corticosteroid



C

2

No

Yes

No

Nasal spray (Nasonex and generics): 0.05%, 50 mCg per actuation (17 g, provides 120 doses)

Aerosol for inhalation (Asmanex HFA): 50 mCg per actuation (13 g, provides 120 actuations), 100 mCg per actuation (13 g, provides 120 actuations), 200 mCg per actuation (13 g; provides 120 actuations)

Powder for inhalation, breath activated (Asmanex Twisthaler; see remarks): 110 mCg per actuation (7, 30 doses), 220 mCg per actuation (14, 60, 120 doses); contains lactose and milk proteins

Topical cream and ointment (Elocon and generics): 0.1% (15, 45 g)

Topical lotion (Elocon and generics): 0.1% (30, 60 mL); contains isopropyl alcohol

In combination with fomoterol:

Aerosol inhaler (Dulera):

50 mCg mometasone furoate + 5 mCg fomoterol fumarate dihydrate per inhalation (13 g delivers 120 inhalations)

100 mCg mometasone furoate + 5 mCg fomoterol fumarate dihydrate per inhalation (8.8 g delivers 60 inhalations, 13 g delivers 120 inhalations)

200 mCg mometasone furoate + 5 mCg fomoterol fumarate dihydrate per inhalation (8.8 g delivers 60 inhalations, 13 g delivers 120 inhalations)

Continued

MOMETASONE FUROATE ± FOMOTEROL FUMARATE *continued***MOMETASONE FUROATE:**

Intranasal (allergic rhinitis): Patients with known seasonal allergic rhinitis should initiate therapy 2–4 wk prior to anticipated pollen season.

Child 2–11 yr: 50 mCg (1 spray) each nostril once daily (100 mCg/24 hr)

Child ≥12 yr and adult: 100 mCg (2 sprays) each nostril once daily (200 mCg/24 hr).

Oral inhalation:**Asmanex HFA (aerosol for inhalation):**

Child 5–<12 yr: 2 inhalations (100 mCg) BID of 50 mCg inhaler (200 mCg/24 hr)

Child ≥12 yr and adult: Max. effects may not be achieved until 2 wk. Titrate doses to lowest effective dose once asthma stabilized.

Previously treated with bronchodilators alone or medium-dose inhaled corticosteroids: 2 inhalations (200 mCg) BID of 100 mCg inhaler (400 mCg/24 hr)

Previously receiving high-dose inhaled or chronic oral corticosteroids: 2 inhalations (400 mCg) BID of 200 mCg inhaler (800 mCg/24 hr).

Max. dose (all ages): 800 mCg/24 hr.

Asmanex Twisthaler (breath activated powder for inhalation):

Child 4–11 yr: Start with 110 mCg (1 inhalation) QHS of the 110-mCg inhaler regardless of prior therapy. **Max. dose:** 110 mCg/24 hr.

Child ≥12 yr and adult: Max. effects may not be achieved until 1–2 wk or longer. Titrate doses to the lowest effective dose once asthma stabilized.

Previously treated with bronchodilators alone or with inhaled corticosteroids: Start with 220 mCg (1 inhalation) QHS. Dose may be increased up to a **max. dose** of 440 mCg/24 hr ÷ QHS or BID.

Previously treated with oral corticosteroids: Start with 440 mCg BID; **max. dose:** 880 mCg/24 hr.

Topical (see Chapter 8 for topical steroid comparisons):**Cream and ointment:**

≥2 yr and adult: Apply a thin film to affected area once daily. Safety and efficacy for >3 wk has not been established for pediatric patients.

Lotion:

≥12 yr and adult: Apply a few drops to affected area and massage lightly into skin once daily until it disappears.

MOMETASONE FUROATE + FOMOTEROL FUMARATE (Dulera):

Child 5–<12 yr: Two inhalations BID of 50 mCg mometasone + 5 mCg fomoterol; **max. dose:** 2 inhalations BID

Child ≥12 yr and adult: Two inhalations BID of either 100 mCg mometasone + 5 mCg formoterol or 200 mCg mometasone + 5 mCg formoterol based on prior asthma therapy (see the following table). If using the lower strength (100 mCg mometasone + 5 mCg formoterol), allow for 2 wk of therapy before increasing to the higher strength if no adequate response. **Max. dose:** Two inhalations BID of 200 mCg mometasone + 5 mCg formoterol.

Previous Therapy	Recommended Starting Dose	Recommended Maximum Daily Dose
Medium-dose inhaled corticosteroids	100 mCg mometasone + 5 mCg formoterol: 2 inhalations BID	400 mCg mometasone + 20 mCg formoterol
High-dose inhaled corticosteroids	200 mCg mometasone + 5 mCg formoterol: 2 inhalations BID	800 mCg mometasone + 20 mCg formoterol

MOMETASONE FUROATE ± FOMOTEROL FUMARATE *continued*

Mometasone is a CYP 450 3A4 substrate; concurrent administration with ketoconazole and other CYP 450 3A4 inhibitors (e.g., protease inhibitors) may increase mometasone levels, resulting in Cushing syndrome and adrenal suppression. Blurred vision, cataracts, and glaucoma have been reported. Use with **caution** with hepatic impairment; increased drug exposure is possible.

INTRANASAL: Clear nasal passages and shake nasal spray well before each use. Onset of action for nasal symptoms of allergic rhinitis has been shown to occur within 11 hr after the first dose. Nasal burning and irritation may occur. Nasal septal perforation and taste and smell disturbances have been rarely reported. A clinical trial in children 6–17 yr old was not able to demonstrate effectiveness for treating nasal polyps.

ORAL INHALATION (all forms): Rinse mouth after each use. Fever, allergic rhinitis, URI, UTI, GI discomfort, and sore throat have been reported in children. Musculoskeletal pain, oral candidiasis, arthralgia, and fatigue may occur. May potentially worsen tuberculosis, fungal, bacterial, viral or parasitic infection, or ocular herpes simplex. **Do not use** Asmanex Twisthaler if allergic to milk proteins. The Twisthaler dosage form requires a minimum 30–60 L/min inspiratory flow rate to assure proper dose delivery. Breast-feeding information is currently unknown, but most experts consider use of inhaled corticosteroids acceptable.

MOMETASONE + FOMOTEROL (Dulera): Common side effects include nasopharyngitis, sinusitis, and headache. Angioedema, anaphylaxis, and arrhythmias have been reported. See Formoterol for additional remarks.

TOPICAL USE: HPA axis suppression and skin atrophy have been reported with cream and ointment use in infants 6–23 mo. **Avoid** application/contact to face, eyes, underarms, groin, and mucous membranes. Occlusive dressings and use in diaper dermatitis are not recommended.

MONTELUKAST

Singulair and generics

Antiasthmatic, antiallergy, leukotriene receptor antagonist

B

1

No

Yes

No

Chewable tabs: 4, 5 mg; contains phenylalanine**Tabs:** 10 mg**Oral granules:** 4 mg per packet (30s)**Asthma and allergic rhinitis:**

Child (6 mo–5 yr): 4 mg (oral granules or chewable tablet) PO QHS; minimum age for use in asthma (per product label) is 12 mo.



Child (6–14 yr): 5 mg (chewable tablet) PO QHS

≥15 yr and adult: 10 mg PO QHS

Prevention of exercise-induced bronchospasm (administer dose at least 2 hr prior to exercise; additional doses should not be administered within 24 hr):

Child (6–14 yr): 5 mg (chewable tablet) PO

≥15 yr and adult: 10 mg PO

Chewable tablet dosage form is **contraindicated** in phenylketonuric patients. Side effects include: headache, abdominal pain, dyspepsia, fatigue, dizziness, cough, and elevated liver enzymes. Diarrhea, enuresis, epistaxis, pulmonary eosinophilia, thrombocytopenia, hypersensitivity reactions (including Stevens-Johnson and TEN), pharyngitis, nausea, otitis, sinusitis, and viral infections have been reported in children. Neuropsychiatric events, including aggression, anxiety, dream abnormalities, obsessive-compulsive symptoms, hallucinations, depression, suicidal behavior, and insomnia, have been reported.



Drug is a substrate for CYP 450 3A4 and 2C9. Phenobarbital and rifampin may induce hepatic metabolism to increase the clearance of montelukast.

Doses may be administered with or without food.

D

MORPHINE SULFATE

Roxanol, MS Contin, Avinza, Kadian, Arymo ER,
MorphaBond ER, and many generics

Narcotic, analgesic



C/D

2

Yes

Yes

No

Oral solution: 10 mg/5 mL, 20 mg/5 mL

Concentrated oral solution: 100 mg/5 mL

Tabs: 15, 30 mg

Controlled-release tabs:

MS Contin and generics: 15, 30, 60, 100, 200 mg

Extended-release tabs:

MorphaBond ER: 15, 30, 60, 100 mg

Arymo ER: 15, 30, 60 mg

Extended-release caps:

Avinza (10% of dose as immediate release): 30, 60, 90, 120 mg

Kadian: 10, 20, 30, 40, 50, 60, 80, 100, 200 mg

Generics: 10, 20, 30, 40, 45, 50, 60, 75, 80, 90, 100, 120 mg

Rectal suppository: 5, 10, 20, 30 mg (12s)

Injection: 0.5, 1, 2, 4, 5, 8, 10, 15, 25, 50 mg/mL

Titrate to effect.

Neonate:



Analgesia/tetralogy (cyanotic) spells: 0.05–0.2 mg/kg/dose IM, slow IV, SC Q4 hr

Opiate withdrawal: 0.08–0.2 mg/kg/dose PO Q3–4 hr PRN

Infant 1–6 mo:

Analgesia:

PO: 0.08–0.1 mg/kg/dose Q3–4 hr PRN

IV: 0.025–0.03 mg/kg/dose Q2–4 hr PRN

Infant >6 mo and child:

Analgesia:

PO: 0.2–0.5 mg/kg/dose (**initial max. dose:** 15–20 mg/dose) Q4–6 hr PRN (immediate release) or 0.3–0.6 mg/kg/dose Q12 hr PRN (controlled release)

IM/IV/SC: 0.1–0.2 mg/kg/dose Q2–4 hr PRN; **max. initial dose:** infant: 2 mg/dose, 1–6 yr: 4 mg/dose, 7–12 yr: 8 mg/dose, and adolescent: 10 mg/dose.

Adult (analgesia):

PO: 10–30 mg Q4 hr PRN (immediate release) or 15–30 mg Q8–12 hr PRN (controlled release)

IM/IV/SC: 2–15 mg/dose Q2–6 hr PRN

Continuous IV infusion and SC infusion: Dosing ranges, titrate to effect.

Neonate (IV route only): 0.01–0.02 mg/kg/hr

Infant and child:

Postoperative pain: 0.01–0.04 mg/kg/hr

Sickle cell and cancer: 0.04–0.07 mg/kg/hr

Adult: 0.8–10 mg/hr

To prepare infusion for neonates, infants, and children, use the following formula:

$$50 \times \frac{\text{Desired dose (mg/kg/hr)}}{\text{Desired infusion rate (mL/hr)}} \times \text{Wt (kg)} = \frac{\text{mg morphine}}{50 \text{ mL fluid}}$$

Dependence, CNS and respiratory depression, nausea, vomiting, urinary retention, constipation, hypotension, bradycardia, increased ICP, miosis, biliary spasm, and allergy may occur. Be aware of concomitant medications with similar side effect profiles.



MORPHINE SULFATE *continued*

Naloxone may be used to reverse effects, especially respiratory depression. Causes histamine release resulting in itching and possible bronchospasm. Low-dose naloxone infusion may be used for itching. Inflammatory masses (e.g., granulomas) have been reported with continuous infusions via indwelling intrathecal catheters.

Dosage reduction may be necessary with liver cirrhosis. See Chapter 6 for equianalgesic dosing.

Pregnancy category changes to "D" if used for prolonged periods or in higher doses at term.

Rectal dosing is same as oral dosing but is not recommended due to poor absorption. Controlled/sustained-release oral tablets must be administered whole. Controlled-release oral capsules may be opened and the entire contents sprinkled on applesauce immediately prior to ingestion. **Be aware** of the various oral solution concentrations; the concentrated oral solution (100 mg/5 mL) has been associated with accidental overdoses. **Adjust dose in renal failure** (see Chapter 31).

The FDA has assigned a REMS for Opioid Analgesia; see www.fda.gov/OpioidAnalgesicREMSPCG. The REMS strongly encourages the (1) completion of a REMS-compliant education program; (2) counsel patients/caregivers on prescription safe use, risks, storage, and disposal; (3) emphasize the importance of reading the Medication Guide provided by pharmacists at all times; and (4) consider other methods for improving patient, household, and community safety.

MUPIROCIN

Bactroban, Centany, Centany AT, Bactroban Nasal, and generics

Topical antibiotic



B



2



No



No



No

Ointment: 2% (15, 22, 30 g); contains propylene glycol

Cream: 2% (15, 30 g); may contain benzyl alcohol

Nasal ointment (Bactroban Nasal): 2% (1 g), as calcium salt

Topical (see remarks):

≥3 mo–adult: Apply small amount TID to affected area ×5–10 days. Topical ointment may be used in infants ≥2 mo for impetigo.



Intranasal for elimination of nasal colonization of Staphylococcus aureus, including MRSA:

Infant and child: Apply small amount intranasally BID ×5–10 days.

Child ≥12 yr and adult: Apply 500 mg (half of 1 g nasal ointment) intranasally BID ×5–10 days.

Avoid contact with the eyes. Topical cream is not intended for use in lesions >10 cm in length or 100 cm² in surface area. **Do not use** topical ointment preparation on open wounds because of concerns about systemic absorption of polyethylene glycol. May cause minor local irritation and dry skin. Intranasal route may cause nasal stinging, taste disorder, headache, rhinitis, and pharyngitis. Severe allergic reactions (e.g., anaphylaxis, urticaria, angioedema and rash) have been reported.



If clinical response is not apparent in 3–5 days with topical use, reevaluate infection.

MYCOPHENOLATE

Mycophenolate mofetil: CellCept and generics

Mycophenolic acid: Myfortic and generics

Immunosuppressant agent



D



3



Yes



No



Yes

Mycophenolate mofetil:

Caps: 250 mg

Tabs: 500 mg

MYCOPHENOLATE continued**Mycophenolate mofetil (cont.):**

Oral suspension: 200 mg/mL (160 mL); contains phenylalanine (0.56 mg/mL) and methylparabens

Injection: 500 mg; may contain polysorbate 80

Mycophenolic acid:

Delayed-release tabs (Myfortic and generics): 180, 360 mg

**Infant ≥3 mo, child, and adolescent (see remarks):****Renal transplant:**

Caps, tabs, or suspension: 600 mg/m²/dose PO/IV BID up to a **max. dose** of 2000 mg/24 hr;

alternatively, patients with body surface areas (BSAs) ≥1.25 m² may be dosed as follows:

1.25–1.5 m²: 750 mg PO BID

>1.5 m²: 1000 mg PO BID

Delayed-release tabs (Myfortic; ≥5 yr): 400 mg/m²/dose PO BID; **max. dose:** 720 mg BID; this dosage form not recommended in patients with BSAs <1.19 m². Alternatively, patients with BSAs ≥1.19 m² may be dosed as follows:

1.19–1.58 m²: 540 mg PO BID

>1.58 m²: 720 mg PO BID

Nephrotic syndrome:

Frequently relapsing: 12.5–18 mg/kg/dose or 600 mg/m²/dose PO BID up to a **max. dose** of 2000 mg/24 hr for 1–2 yr and taper prednisone regimen.

Steroid dependent: 12–18 mg/kg/dose or 600 mg/m²/dose PO BID up to a **max. dose** of 2000 mg/24 hr for at least 12 mo.

Adult (in combination with corticosteroids and cyclosporine; check specific transplantation protocol for specific dosage):

IV: 2000–3000 mg/24 hr ÷ BID

Oral:

Caps, tabs, or suspension: 2000–3000 mg/24 hr PO ÷ BID

Delayed-release tabs (Myfortic): 720–1080 mg PO BID



Check specific transplantation protocol for specific dosage. Mycophenolate mofetil is a prodrug for mycophenolic acid. Owing to differences in absorption, the delayed-release tablets should **not** be interchanged with other oral-dosage forms on an equivalent milligram-to-milligram basis. Increases risk of first trimester pregnancy loss and increased risk of congenital malformations (especially external ear and facial abnormalities including cleft lip and palate, and anomalies of the distal limbs, heart, and esophagus).

Common side effects may include headache, hypertension, diarrhea, vomiting, bone marrow suppression, anemia, fever, opportunistic infections, and sepsis. May cause drowsiness and increase the risk for bacterial, fungal, protozoal, and viral infections, and lymphomas or other malignancies. GI bleeds and increased risk for rejection in heart transplant patients switched from calcineurin inhibitors (e.g., cyclosporine and tacrolimus) and CellCept to sirolimus and CellCept have been reported. Cases of progressive multifocal leukoencephalopathy (PML), pure red cell aplasia (PRCA), posttransplant lymphoproliferative disorder (PTLD), and hypogammaglobulinemia have also been reported.

Use of mycophenolic acid (Myfortic) should be **avoided** in patients with hypoxanthine-guanine phosphoribosyltransferase (HPRT) deficiency (e.g., Lesch-Nyhan and Kelley-Seegmiller syndrome) because it may exacerbate disease symptoms characterized by increased uric acid leading to acute arthritis, tophi, nephrolithiasis/urolithiasis, and renal failure.

Use with caution in patients with active GI disease or renal impairment (GFR <25 mL/min/1.73 m²) outside of the immediate posttransplant period. In adults with renal impairment, **avoid** doses >2 g/24 hr and observe carefully. Dose should be interrupted or reduced in the presence of neutropenia (ANC <1.3 × 10³/microliter). No dose adjustment is needed for patients experiencing delayed graft function postoperatively.

MYCOPHENOLATE *continued*

Drug interactions: (1) Displacement of phenytoin or theophylline from protein-binding sites will decrease total serum levels and increase free serum levels of these drugs. Salicylates displace mycophenolate to increase free levels of mycophenolate. (2) Competition for renal tubular secretion results in increased serum levels of acyclovir, ganciclovir, probenecid, and mycophenolate (when any of these are used together). (3) **Avoid** live and live attenuated vaccines (including influenza); decreases vaccine effectiveness. (4) Proton pump inhibitors, antacids, cholestyramine, cyclosporine, and telmisartan may reduce mycophenolate levels.

Administer oral doses on an empty stomach. Infuse intravenous doses over 2 hr. Oral suspension may be administered via NG tube with a minimum size of 8 Fr.

N

NAFCILLIN

Generics; previously available as Nallpen

Antibiotic, penicillin (*penicillinase resistant*)



Injection: 1, 2, 10 g; contains 2.9 mEq Na/g drug

Injection, premixed in iso-osmotic dextrose: 1 g in 50 mL, 2 g in 100 mL

Neonate (IM/IV):

<1 kg:

≤14 days old: 50 mg/kg/24 hr ÷ Q12 hr
15–28 days old: 75 mg/kg/24 hr ÷ Q8 hr



1–2 kg:

≤7 days old: 50 mg/kg/24 hr ÷ Q12 hr
8–28 days old: 75 mg/kg/24 hr ÷ Q8 hr

>2 kg:

≤7 days old: 75 mg/kg/24 hr ÷ Q8 hr
8–28 days old: 100 mg/kg/24 hr ÷ Q6 hr

Infant and child (IM/IV):

Mild to moderate infections: 100–150 mg/kg/24 hr ÷ Q6 hr

Severe infections: 150–200 mg/kg/24 hr ÷ Q4–6 hr; give 200 mg/kg/24 hr ÷ Q4–6 hr for Staphylococcal endocarditis or meningitis.

Max. dose: 12 g/24 hr

Adult:

IV: 1000–2000 mg Q4–6 hr

IM: 500–1000 mg Q4–6 hr

Max. dose: 12 g/24 hr

Allergic cross-sensitivity with penicillin. Solutions containing dextrose may be

contraindicated in patients with known allergy to corn or corn products. High incidence of phlebitis with IV dosing. May cause rash, bone marrow suppression, and false-positive urinary and serum proteins. Hypokalemia has been reported. Acute interstitial nephritis is rare.



Cerebrospinal fluid (CSF) penetration is poor unless meninges are inflamed. **Use with caution** in patients with combined renal and hepatic impairment (reduce dose by 33%–50%). Nafcillin may increase elimination of cyclosporine and warfarin.

NALOXONE

Narcan, Evzio, and generics

Narcotic antagonist**Injection:** 0.4 mg/mL (1, 10 mL); some preparations may contain parabens**Injection, in syringe:** 2 mg/2 mL (2 mL)**Auto-injector (Evzio):** 2 mg/0.4 mL (2 each with trainer device)**Nasal liquid (Narcan):** 2 mg/0.1 mL (4 each), 4 mg/0.1 mL (2 each); contains benzalkonium chloride**Opiate intoxication (full reversal, IM/IV/SC, use 2–10 times IV dose for ETT route; see remarks):****Neonate, infant, child ≤20 kg or ≤5 yr:** 0.1 mg/kg/dose. May repeat PRN Q2–3 min.**Child >20 kg or >5 yr:** 2 mg/dose. May repeat PRN Q2–3 min.**Continuous infusion (child and adult):** 0.005 mg/kg loading dose followed by infusion of 0.0025 mg/kg/hr has been recommended. A range of 0.0025–0.16 mg/kg/hr has been reported. Taper gradually to avoid relapse.**Adult:** 0.4–2 mg/dose. May repeat PRN Q2–3 min. Use 0.1- to 0.2-mg increments in opiate-dependent patients.**Intranasal route for opiate intoxication (full reversal):****All ages:** 4 mg (0.1 mL) of nasal liquid (Narcan) into one nostril Q2–3 min PRN in alternating nostrils.**Opioid-dependent patient at risk for opioid withdrawal:** Use lower 2 mg (0.1 mL) nasal liquid (Narcan) into one nostril Q2–3 min PRN in alternating nostrils. Alternatively, the 2 mg/2 mL intravenous (IV) syringe dosage form with nasal adapter may be used by administering 1 mg (1 mL) per nostril.**Opiate-induced pruritus (limited data):** 0.25–2 mCg/kg/hr IV; a dose-finding study in 59 children suggests a minimal dose of 1 mCg/kg/hr when used as prophylactic therapy. Doses ≥3 mCg/kg/hr increases the risk for reduced pain control.Short duration of action may necessitate multiple doses. For severe intoxication, doses of 0.2 mg/kg may be required. If no response is achieved after a cumulative dose of 10 mg, reevaluate diagnosis. **In the nonarrest situation, use the lowest dose effective (may start at 0.001 mg/kg/dose).** See **Chapter 6** for additional information.Will produce narcotic withdrawal syndrome in patients with chronic dependence. Use with **caution** in patients with chronic cardiac disease. Abrupt reversal of narcotic depression may result in nausea, vomiting, diaphoresis, tachycardia, hypertension, and tremulousness. Aggressive behavior has been reported in abrupt reversal of an opioid overdose. False-positive test for urine opiates screen may occur.

IV administration is preferred. Onset of action may be delayed with other routes of administration.

NAPROXEN/NAPROXEN SODIUM

Naprosyn, EC-Naprosyn, Naprosyn DR, Naprelan, Aleve [OTC], and many others including generics

Nonsteroidal anti-inflammatory agent**Naproxen:****Tabs:** 250, 375, 500 mg**Delayed release tabs (EC-Naprosyn, Naprosyn DR):** 375, 500 mg**Oral suspension (Naprosyn and generics):** 125 mg/5 mL; contains 0.34 mEq Na/1 mL and parabens

NAPROXEN/NAPROXEN SODIUM *continued***Naproxen Sodium:****Tabs:****Alieve and generics (over the counter [OTC]):** 220 mg (200 mg base); contains 0.87 mEq Na**Generics:** 275 mg (250 mg base), 550 mg (500 mg base); contains, 1 mEq, 2 mEq Na, respectively**Controlled-release tabs (Naprelan and generics):** 412.5 mg (375 mg base), 550 mg (500 mg base), 825 mg (750 mg base)**All doses based on naproxen base.****Child >2 yr:****Analgesia:** 5–10 mg/kg/dose Q12 hr PO**JRA:** 10–20 mg/kg/24 hr ÷ Q12 hr PO**Usual max. dose:** 1000 mg/24 hr**Adolescent and adult:****Analgesia:****Over-the-counter dosage forms:** 200 mg Q8–12 hr PRN PO (400 mg initial dose may be needed).**Max. dose:** 600 mg/24 hr.**Prescription-strength dosage forms:** 250 mg Q8–12 hr PRN (500 mg initial dose may be needed) or 500 mg Q12 hr PRN PO. **Max. dose:** 1250 mg/24 hr for first day then 1000 mg/24 hr.**Rheumatoid arthritis, ankylosing spondylitis:****Immediate release forms:** 250–500 mg BID PO**Delayed release tabs (EC-Naprosyn, Naprosyn DR):** 375–500 mg BID PO**Controlled-release tabs (Naprelan):** 750–1000 mg once daily PO. For patients converting from immediate and delayed release forms, calculate daily dose and administer Naprelan as a single daily dose.**Max. dose (all dosage forms):** 1000–1500 mg/24 hr.**Dysmenorrhea:**500 mg × 1, then 250 mg Q6–8 hr PRN PO or 500 mg Q12 hr PRN PO; **max. dose:** 1250 mg/24 hr for first day then 1000 mg/24 hr.**Contraindicated** in treating perioperative pain for coronary artery bypass graft surgery. May cause GI bleeding, thrombocytopenia, heartburn, headache, drowsiness, vertigo, and tinnitus. **Use with caution** in patients with GI disease, cardiac disease (risk for thrombotic events, myocardial infarction [MI], stroke), renal or hepatic impairment, and those receiving anticoagulants. False-positive test for urine cannabinoid screen may occur.Use is **NOT** recommended for moderate/severe renal impairment ($\text{CrCl} < 30 \text{ mL/min}$). See ibuprofen for other side effects.

Pregnancy category changes to D if used in the third trimester or near delivery. Administer doses with food or milk to reduce GI discomfort.

**NEO-POLYMYCIN OPHTHALMIC OINTMENT**

See neomycin/polymyxin B ophthalmic products.

**NEOSPORIN OPHTHALMIC SOLUTION**

See neomycin/polymyxin B ophthalmic products.

**NEO-POLYCIN HC**

NEOMYCIN SULFATE

Generics

Antibiotic, aminoglycoside; ammonium detoxicant**Tabs:** 500 mg**Oral solution:** 25 mg/mL contains parabens.

125 mg neomycin sulfate is equivalent to 87.5 mg neomycin base.

Enteric bacterial eradication:**Preterm (>1.2 kg) and newborn:** 50 mg/kg/24 hr ÷ Q6 hr PO for up to 2 wk **Hepatic encephalopathy (limited data):****Infant and child:** 50–100 mg/kg/24 hr ÷ Q6–8 hr PO × 5–6 days. **Max. dose:** 12 g/24 hr**Adult:** 4–12 g/24 hr ÷ Q4–6 hr PO × 5–6 days**Bowel prep (in combination with erythromycin base; many other regimens exist):****Child:** 90 mg/kg/24 hr PO ÷ Q4 hr × 2–3 days**Adult:** 1 g Q1 hr PO × 4 doses, then 1 g Q4 hr PO × 5 doses

Contraindicated in ulcerative bowel disease, intestinal obstruction, or aminoglycoside hypersensitivity. Monitor for nephrotoxicity and ototoxicity. Oral absorption is limited, but levels may accumulate. Consider dosage reduction in the presence of renal failure. May cause itching, redness, edema, colitis, candidiasis, or poor wound healing if applied topically. Prevalence of neomycin hypersensitivity has increased. May decrease absorption of penicillin V, vitamin B₁₂, digoxin, and methotrexate. May potentiate oral anticoagulants and the adverse effects of other neurotoxic, ototoxic, or nephrotoxic drugs.

NEOMYCIN/POLYMYXIN B OPHTHALMIC PRODUCTS**Neomycin/Polymyxin B + Bacitracin:**

Neo-Polyclin and generics

Neomycin/Polymyxin B + Dexamethasone:

Maxitrol and generics

Neomycin/Polymyxin B + Gramicidin:

Generics

Neomycin/Polymyxin B + Hydrocortisone:

Generics

Neomycin/Polymyxin B + Bacitracin + Hydrocortisone:

Neo-Polyclin HC and generics

Ophthalmic antibiotic ± corticosteroid**Neomycin/Polymyxin B + Bacitracin:****Ophthalmic ointment (Neo-Polyclin Ophthalmic Ointment and generics):** 3.5 g neomycin, 10,000 U polymyxin B, and 400 U bacitracin per g ointment (3.5 g)**Neomycin/Polymyxin B + Dexamethasone:****Ophthalmic ointment (Maxitrol and generics):** 3.5 mg neomycin, 10,000 U polymyxin B, and 1 mg dexamethasone per 1 g (3.5 g);**Ophthalmic suspension (Maxitrol and generics):** 3.5 mg neomycin, 10,000 U polymyxin B, and 1 mg dexamethasone per 1 mL (5 mL); contains benzalkonium chloride**Neomycin/Polymyxin B + Gramicidin:****Ophthalmic solution:** 1.75 neomycin, 10,000 U polymyxin B, and 0.025 mg gramicidin per 1 mL (10 mL); contains propylene glycol, alcohol, and trimersosal

NEOMYCIN/POLYMYXIN B OPHTHALMIC PRODUCTS *continued*

Neomycin/Polymyxin B + Hydrocortisone:

Ophthalmic suspension: 3.5 mg neomycin, 10,000 U polymyxin B, and 10 mg hydrocortisone per 1 mL (7.5 mL)

Neomycin/Polymyxin B + Bacitracin + Hydrocortisone:

Ophthalmic ointment (Neo-Polycin HC and generics): 3.5 mg neomycin, 10,000 U polymyxin B, 400 U bacitracin, and 10 mg hydrocortisone per 1 g (3.5 g)

Neomycin/Polymyxin B + Bacitracin:

Child and adult: Apply 0.5-inch ribbon to affected eye(s) Q3–4 hr for acute infections or

BID–TID for mild/moderate infections × 7–10 days.



Neomycin/Polymyxin B + Dexamethasone:

Child (≥2 yr)–adult:

Ophthalmic suspension: Instill 1–2 drops into the conjunctival sac of the affected eye(s) 4–6 times per day for mild/moderate infections. For severe infections, administered Q1 hr and taper to discontinuation as inflammation subsides. No more than 20 mL should be prescribed initially.

Ophthalmic ointment: Apply ~0.5-inch ribbon into the conjunctival sac of the affected eye(s) TID–QID. Reevaluate diagnosis if signs and symptoms do not improve in 48 hr. Do not dispense >8 g.

Neomycin/Polymyxin B + Gramicidin:

Child and adult: Instill 1–2 drops to affected eye(s) Q4 hr or 2 drops every hour for severe infections × 7–10 days.

Neomycin/Polymyxin B + Hydrocortisone:

Child and adult: Instill 1–2 drops to affected eye(s) Q3–4 hr. More frequent dosing has been used for severe infection in adults.

Neomycin/Polymyxin B + Bacitracin + Hydrocortisone:

Child and adult (limited data): Apply ointment sparingly to inside of lower lid of affected eye(s) Q3–4 hr. Reevaluate diagnosis if signs and symptoms do not improve in 48 hr. Monitor intraocular pressure if use is equal to or greater than 10 days.



Contraindicated if patient is hypersensitive to specific medications (e.g., neomycin, polymyxin B, gramicidin, bacitracin, or hydrocortisone) of respective product. **Use with caution** in glaucoma.

Blurred vision, burning and stinging may occur. Increased intraocular pressure and mycosis may occur with prolonged use. **Avoid** prolonged use with products containing corticosteroids.

Ophthalmic solution/suspension: Shake well before use and **avoid** contamination of tip of eye dropper. Apply finger pressure to lacrimal sac during and 1–2 min after dose application.

Ophthalmic ointment: Do not touch tube tip to eyelids or other surfaces to prevent contamination.



NEOMYCIN/POLYMYXIN B/BACITRACIN

Neosporin, Neo to Go, Neo-Polycin, Triple Antibiotic, and generics

Topical antibiotic

Ointment, topical (OTC): 3.5 mg neomycin sulfate, 400 U bacitracin, 5000 U polymyxin B/g (1, 15, 30, 454 g)

For ophthalmic products, see Neomycin/Polymyxin B ophthalmic products

Child and adult: Apply to minor wounds and burns once daily–TID



Do not use for extended periods. May cause superinfection, delayed healing. See neomycin for additional remarks. Prevalence of neomycin hypersensitivity has increased.



NEOSTIGMINE

Bioxiverz and generics

Anticholinesterase (cholinergic) agent

Injection (Bioxiverz and generics): 0.5, 1 mg/mL (10 mL) (as methylsulfate); may contain parabens or phenol.

Prefilled syringe injection: 1 mg/mL (3 mL); contains phenol.

Myasthenia gravis diagnosis: Use with atropine (see remarks)



Child: 0.025–0.04 mg/kg IM × 1

Adult: 0.02 mg/kg IM × 1

Treatment:

Child: 0.01–0.04 mg/kg/dose IM/IV/SC Q2–4 hr PRN

Adult: 0.5–2.5 mg/dose IM/IV/SC Q1–3 hr PRN up to **max. dose** of 10 mg/24 hr

Reversal of nondepolarizing neuromuscular blocking agents: Administer with atropine or glycopyrrolate.

Neonate: 0.025–0.07 mg/kg/dose IV

Infant: 0.025–0.1 mg/kg/dose IV

Child: 0.025–0.08 mg/kg/dose IV

Adult: 0.5–2 mg/dose IV

Max. dose (all ages): 5 mg/dose

Contraindicated in GI and urinary obstruction. **Caution** in asthmatics. May cause cholinergic crisis, bronchospasm, salivation, nausea, vomiting, diarrhea, miosis, diaphoresis, lacrimation, bradycardia, hypotension, fatigue, confusion, respiratory depression, and seizures. Titrate for each patient, but **avoid** excessive cholinergic effects.



For reversal of neuromuscular blockade, infants and small children may be at greater risk of complications from incomplete reversal of neuromuscular blockade due to decreased respiratory reserve.

For diagnosis of myasthenia gravis (MG), administer atropine 0.011 mg/kg/dose IV immediately before or IM (0.011 mg/kg/dose) 30 min before neostigmine. For treatment of MG, patients may need higher doses of neostigmine at times of greatest fatigue.

Antidote: Atropine 0.01–0.04 mg/kg/dose. Atropine and epinephrine should be available in the event of a hypersensitivity reaction.

Adjust dose in renal failure (see [Chapter 31](#)).

NEVIRAPINE

Viramune, Viramune XR, NVP, and generics

Antiviral, nonnucleoside reverse transcriptase inhibitor

Tabs: 200 mg

Extended-release tabs:

Generics: 100, 400 mg

Viramune XR: 400 mg

Oral suspension: 10 mg/mL (240 mL); contains parabens

HIV: See www.aidsinfo.nih.gov/guidelines



Prevention of vertical transmission during high-risk situations (women who received no antepartum antiretroviral prophylaxis, women with suboptimal viral suppression at delivery, or women with known antiretroviral drug-resistant virus) and in combination with other antiretroviral medications (see [Chapter 17](#) for additional information):

Newborn: 3 doses (based on birth weight) in the first week of life; dose 1: within 48 hr of birth; dose 2: 48 hr after dose 1; dose 3: 96 hr after dose 2

D

NEVIRAPINE continued***Birth weight:*** 1.5–2 kg: 8 mg/dose PO***Birth weight:*** >2 kg: 12 mg/dose POSee www.aidsinfo.nih.gov/guidelines for additional remarks.

Use with caution in patients with hepatic or renal dysfunction. **Contraindicated** in moderate/severe hepatic impairment (Child-Pugh Class B or C) and postexposure (occupational or nonoccupational) prophylactic regimens. Most frequent side effects with continuous therapy include skin rash (may be life-threatening, including Stevens-Johnson syndrome and DRESS; permanently discontinue and never restart), fever, abnormal liver function tests, headache, and nausea. **Discontinue therapy** if any of the following occurs: severe rash; rash with fever, blistering, oral lesions, conjunctivitis or muscle aches. Permanently discontinue and do not restart therapy if symptomatic hepatitis, severe transaminase elevations or hypersensitivity reactions occur.

Life-threatening hepatotoxicity has been reported primarily during the first 12 wk of continuous therapy. Patients with increased serum transaminase or a history of hepatitis B or C infection prior to nevirapine are at greater risk for hepatotoxicity. Women, including pregnant women, with CD₄ cell counts >250/mm³ or men with CD₄ cell counts >400/mm³ are at risk for hepatotoxicity. Monitor liver function tests (obtain transaminases immediately after development of hepatitis signs/symptoms, hypersensitivity reactions, or rash) and complete blood counts. Hypophosphatemia has been reported. Nevirapine induces the CYP 450 3A4 drug metabolizing isoenzyme to cause an autoinduction of its own metabolism within the first 2–4 wk of therapy and has the potential to interact with many drugs. **Carefully review the patient's drug profile for other drug interactions each time nevirapine is initiated or when a new drug is added to a regimen containing nevirapine.**

Doses can be administered with food and concurrently with didanosine.

NIACIN/VITAMIN B3Niacor, Niaspan, Slo-Niacin, Nicotinic acid, Vitamin B₃, and many generics**Vitamin, water soluble**

A/C



2



Yes



Yes



No

Tabs (OTC): 50, 100, 250, 500 mg**Timed or extended-release tabs:** 250 (OTC), 500, 750, 1000 mg**Caps (OTC):** 500, 1000 mg**Timed- or extended-release caps (OTC):** 250, 500 mg**Powder (OTC):** 500 g**US recommended dietary allowance (RDA):** See Chapter 21.**Pellagra (P0):** Usual treatment duration is 3–4 wk**Child:** 50–100 mg/dose TID**Adult:** 50–100 mg/dose TID–QID**Max. dose:** 500 mg/24 hr

Contraindicated in hepatic dysfunction, active peptic ulcer, and severe hypotension. **Use with caution** in unstable angina, acute MI (especially if patient is receiving vasoactive drugs), renal dysfunction, and in patients with history of jaundice, hepatobiliary disease, or peptic ulcer. Adverse reactions of flushing, pruritus, or GI distress may occur with oral administration. May cause hyperglycemia, hyperuricemia, blurred vision, abnormal liver function tests, dizziness, and headaches. Burning sensation of the skin, skin discoloration, hepatitis, and elevated creatine kinase have been reported. May cause false-positive urine catecholamines (fluorometric methods) and urine glucose (Benedict reagent).

Pregnancy category changes to C if used in doses above the RDA or for typical doses used for lipid disorders. See Chapter 21 for multivitamin preparations.



NICARDIPINE

Cardene IV, Cardene SR, and generics

Calcium channel blocker, antihypertensive**Caps (immediate release):** 20, 30 mg**Sustained-release caps (Cardene SR):** 30, 45, 60 mg**Injection:**

Cardene IV: 0.1 mg/mL (200 mL; premixed in isotonic dextrose or saline), 0.2 mg/mL (200 mL; premixed in isotonic saline)

Generic: 2.5 mg/mL (10 mL); contains sorbitol

Child (see remarks):**Hypertension:**

Continuous IV infusion for severe hypertension: Start at 0.5–1 mCg/kg/min, dose may be increased as needed every 15–30 min up to a **max.** of 4–5 mCg/kg/min.

Adult (see remarks):**Hypertension:****Oral:**

Immediate release: 20 mg PO TID, dose may be increased after 3 days to 40 mg PO TID if needed.

Sustained release: 30 mg PO BID, dose may be increased after 3 days to 60 mg PO BID if needed.

Continuous IV infusion: Start at 5 mg/hr, increase dose as needed by 2.5 mg/hr Q5–15 min up to a **max. dose** of 15 mg/hr. Following attainment of desired BP, decrease infusion to 3 mg/hr and adjust rate as needed to maintain desired response.

Reported use in children has been limited to a small number of preterm infants, infants, and children.



Contraindicated in advanced aortic stenosis. **Avoid** systemic hypotension in patients following an acute cerebral infarct or hemorrhage. Use with **caution** in hepatic or renal dysfunction by carefully titrating dose. The drug undergoes significant first-pass metabolism through the liver and is excreted in the urine (60%). Use **caution** when converting to another dosage form; they are NOT equivalent on a milligram-per-milligram basis.

May cause headache, dizziness, asthenia, peripheral edema, and GI symptoms. Nicardipine is a substrate for CYP 450 3A and inhibitor of CYP 450 2 C9/19. Cimetidine increases the effects/toxicity of nicardipine. Nicardipine may increase effect/toxicity of cyclosporine and tacrolimus. See **Nifedipine** for additional drug and food interactions.

Onset of action for orally administered drug is 20 min with peak effects in 0.5 to 2 hr. Onset of action of intravenously administered drug is 1 min. Duration of action following a single IV or PO dose is 3 hr. To reduce the risk for venous thrombosis, phlebitis, and vascular impairment with IV administration, do not use small veins (e.g., dorsum of hand or wrist). **Avoid** intra-arterial administration or extravasation. For additional information, see **Chapter 4**.

NIFEDIPINE

Procardia, Adalat CC, Nifedical XL, Procardia XL, and many generics

Calcium channel blocker, antihypertensive

C, 2, No, Yes, No

Caps: (Procardia and generics): 10 mg (0.34 mL), 20 mg (0.45 mL)**Sustained-release tabs:** (Adalat CC, Nifedical XL, Procardia XL and generics): 30, 60, 90 mg**Oral suspension:** 4 mg/mL

NICARDIPINE continued**Child (see remarks for precautions):****Chronic hypertension:**

Sustained release tabs: Start with 0.25–0.5 mg/kg/24 hr (initial **max. dose**: 30–60 mg/24 hr) ÷ Q12–24 hr. May increase to **max. dose**: 3 mg/kg/24 hr up to 120 mg/24 hr.

Adult:**Chronic hypertension or angina:**

Sustained-release tabs: Start with 30 or 60 mg PO once daily. May increase to **max. dose** of 90 mg/24 hr for Adalat CC, Afeditab CR, and Nifediac CC, and 120 mg/24 hr for Procardia XL.



Use of immediate-release dosage form in children is controversial and has been abandoned by many. **Use with caution** in children with acute CNS injury due to increased risk for stroke, seizure, hepatic impairment, and altered level of consciousness. To prevent rapid decrease in blood pressure in children, an initial dose of ≤ 0.25 mg/kg is recommended.

Use with caution in patients with congestive heart failure (CHF), aortic stenosis, GI obstruction/narrowing (bezoar formation), and cirrhosis (reduced drug clearance). May cause severe hypotension, peripheral edema, flushing, tachycardia, headaches, dizziness, nausea, palpitations, and syncope. Acute generalized exanthematous pustulosis has been reported.

Although overall use in adults has been abandoned, the immediate-release dosage form is **contraindicated** in adults with severe obstructive coronary artery disease or recent MI and in hypertensive emergencies.

Nifedipine is a substrate for CYP 450 3A3/4, and 3A5-7. **Do not administer** with grapefruit juice; may increase bioavailability and effects. Itraconazole and ketoconazole may increase nifedipine levels and/or effects. CYP 3A inducers (e.g., rifampin, rifabutin, phenobarbital, phenytoin, carbamazepine) may reduce nifedipine's effects. Nifedipine may increase phenytoin, cyclosporine, and digoxin levels. For hypertensive emergencies, see **Chapter 4**.

For sublingual (SL) administration, capsule must be punctured and liquid expressed into the patient's mouth. A small amount is absorbed via the SL route. Most effects are due to swallowing and oral absorption. **Do not** crush or chew sustained-release tablet dosage form.

NITROFURANTOIN

Furadantin, Macrodantin, Macrobid, and generics

Antibiotic

B/X



2



Yes



Yes



No

Caps (macrocrystals; Macrodantin and generics): 25, 50, 100 mg

Caps (dual release; Macrobid and generics): 100 mg (25 mg macrocrystal/75 mg monohydrate)

Oral suspension (Furadantin and generics): 25 mg/5 mL (230 mL); contains parabens and saccharin

**Child (>1 mo; oral suspension or macrocrystals):**

Treatment: 5–7 mg/kg/24 hr ÷ Q6 hr PO; **max. dose:** 400 mg/24 hr

UTI prophylaxis: 1–2 mg/kg/dose QHS PO; **max. dose:** 100 mg/24 hr

≥12 yr and adult:

Treatment:

Macrocrystals: 50–100 mg/dose Q6 hr PO

Dual-release (Macrobid): 100 mg/dose Q12 hr PO

UTI prophylaxis (macrocrystals): 50–100 mg/dose PO QHS

Continued

NITROFURANTOIN *continued*

Contraindicated in severe renal disease, infants below 1 mo of age, glomerular filtration rate (GFR) below 60 mL/min (reduced drug distribution the urine), active/previous cholestatic jaundice/hepatitis dysfunction, and pregnant women at term. **Use with caution** in G6PD deficiency, anemia, lung disease, and peripheral neuropathy. May cause nausea, hypersensitivity reactions (including vasculitis), vomiting, cholestatic jaundice, headache, hepatotoxicity, polyneuropathy, and hemolytic anemia.



Anticholinergic drugs and high-dose probenecid may increase nitrofurantoin toxicity. Magnesium salts may decrease nitrofurantoin absorption. Causes false-positive urine glucose with Clinitest. Administer doses with food or milk.

Pregnancy category changes to X at term (38–42 wk gestation). Breastfeeding in mothers receiving nitrofurantoin is not recommended for infants below 1 mo and those with G6PD deficiency; use in infants 1 mo and without G6PD deficiency is compatible.

NITROGLYCERIN

Nitro-Bid, Nitrostat, Nitro-Time, Nitro-Dur, Nitrolingual, Nitromist, Minitran, Rectiv, and generics

Vasodilator, antihypertensive



C

?

Yes

Yes

No

Injection: 5 mg/mL (10 mL); contains alcohol or propylene glycol

Prediluted injection in D5W: 100 mCg/mL (250 mL), 200 mCg/mL (250 mL), 400 mCg/mL (250 mL); contains alcohol and propylene glycol

Sublingual tabs (Nitrostat and generics): 0.3, 0.4, 0.6 mg

Sustained-release caps (Nitro-Time and generics): 2.5, 6.5, 9 mg

Ointment, topical (Nitro-Bid): 2% (1, 30, 60 g)

Ointment, rectal (Rectiv): 0.4% (30 g); contains propylene glycol

Patch (Nitro-Dur, Minitran, and generics): 2.5 mg/24 hr (0.1 mg/hr), 5 mg/24 hr (0.2 mg/hr), 7.5 mg/24 hr (0.3 mg/hr), 10 mg/24 hr (0.4 mg/hr), 15 mg/24 hr (0.6 mg/hr), 20 mg/24 hr (0.8 mg/hr) (30s, 100s)

Spray, translingual (Nitrolingual and generics): 0.4 mg per metered spray (4.9, 12 g; delivers 60 and 200 doses, respectively); contains 20% alcohol (flammable)

Aerosol spray, translingual (Nitromist): 0.4 g per spray (4.1, 8.5 g; delivers 90 and 230 doses, respectively); contains peppermint oil and menthol



NOTE: The IV dosage units for children are in mCg/kg/min, compared with mCg/min for adults.

Infant/child:

Continuous IV infusion: Begin with 0.25–0.5 mCg/kg/min; may increase by 0.5–1 mCg/kg/min Q3–5 min PRN. Usual dose: 1–5 mCg/kg/min. **Max. dose:** 20 mCg/kg/min.

Adult:

Continuous IV infusion: 5 mCg/min IV, then increase Q3–5 min PRN by 5 mCg/min up to 20 mCg/min. If no response, increase by 10 mCg/min Q3–5 min PRN up to a **max.** of 400 mCg/min.

Sublingual: 0.3–0.4 mg Q5 min. **Max.** of three doses in 15 min.

Oral: 2.5–6.5 mg TID–QID; up to 26 mg QID

Ointment: Apply 1/2 inch upon rising in the morning and another 1/2 inch 6 hr later if needed, double the dose to 1 in with the same dosing schedule the next day and subsequently to 2 in if needed. Max. recommended dose: 2 doses/24 hr. Provide 10–12 hr/day of nitrate-free to minimize tolerance.

NITROGLYCERIN *continued*

Patch: 0.2–0.4 mg/hr initially, then titrate to 0.4–0.8 mg/hr; apply new patch daily (tolerance is minimized by removing patch for 10–12 hr/24 hr)

Contraindicated in glaucoma, with increased ICP, cerebral hemorrhage, traumatic brain injury, shock, severe anemia, concurrent phosphodiesterase-5 inhibitor (e.g., sildenafil), and concurrent guanylate cyclase stimulator (e.g., riociguat). In small doses (1–2 mCg/kg/min) acts mainly on systemic veins and decreases preload. At 3–5 mCg/kg/min acts on systemic arterioles to decrease resistance. May cause headache, flushing, hypersensitivity reactions, hypotension, GI upset, blurred vision, and methemoglobinemia. **Use with caution** in severe renal impairment, and hepatic failure. IV nitroglycerin may antagonize anticoagulant effect of heparin.

Decrease dose gradually in patients receiving drug for prolonged periods to avoid withdrawal reaction. Must use polypropylene infusion sets to avoid adsorption of drug to plastic tubing. Use in heparized patients may result in a decrease of PTT with subsequent rebound effect on discontinuation of nitroglycerin.

Onset (duration) of action: IV: 1–2 min (3–5 min); sublingual: 1–3 min (30–60 min); PO sustained release: 40 min (4–8 hr); topical ointment: 20–60 min (2–12 hr); and transdermal patch: 40–60 min (18–24 hr).



NITROPRUSSIDE

Nitropress, Nipride RTU, and generics

Vasodilator, antihypertensive



Injection:

Nitropress and generics: 25 mg/mL (2 mL)

Prediluted injection in 0.9% sodium chloride:

Nipride RTU: 0.2 mg/mL (100 mL), 0.5 mg/mL (100 mL)



Child, adolescent, and adult:

Dose: Start at 0.3–0.5 mCg/kg/min, titrate to effect. Usual dose is 3–4 mCg/kg/min.

Max. dose: 10 mCg/kg/min.

Contraindicated in patients with decreased cerebral perfusion and in situations of compensatory hypertension (increased ICP). Monitor for hypotension and acidosis. Dilute with D₅W and protect from light.



Pediatric efficacy is supported by a dose-ranging trial, an open-label trial, and adult trials. No novel safety issues were found in the aforementioned pediatric trials.

Nitroprusside is nonenzymatically converted to cyanide, which is converted to thiocyanate. Cyanide may produce metabolic acidosis and methemoglobinemia; thiocyanate may produce psychosis and seizures. Monitor thiocyanate levels if used for more than 48 hr or in a dose equal to or greater than 4 mCg/kg/min. **Thiocyanate levels should be less than 50 mg/L. Monitor cyanide levels (toxic levels >2 mCg/mL)** in patients with hepatic dysfunction and thiocyanate levels in patients with renal dysfunction.

Onset of action is 2 min with a 1- to 10-min duration of effect.



NOREPINEPHRINE BITARTRATE

Levodopa and generics

Adrenergic agonist**Injection:** 1 mg/mL as norepinephrine base (4 mL); may contain sulfites**NOTE:** The dosage units for children are in mCg/kg/min compared with mCg/min for adults.**Child:** Continuous IV infusion doses as norepinephrine base. Start at 0.05–0.1 mCg/kg/min.Titrate to effect. **Max. dose:** 2.5 mCg/kg/min.**Adult:** Continuous IV infusion doses as norepinephrine base. Start at 8–12 mCg/min and titrate to effect. Usual maintenance dosage range: 2–4 mCg/min.

May cause cardiac arrhythmias, hypertension, hypersensitivity, headaches, vomiting, uterine contractions, and organ ischemia. May cause decreased renal blood flow and urine output.

**Avoid** extravasation into tissues; may cause severe tissue necrosis. If this occurs, treat locally with phentolamine.**NORTRIPTYLINE HYDROCHLORIDE**

Pamelor and generics

Antidepressant, tricyclic**Caps:** 10, 25, 50, 75 mg; may contain benzyl alcohol, EDTA**Oral solution:** 10 mg/5 mL (473 mL); contains up to 4% alcohol, benzoic acid, and sorbitol**Depression (see remarks):****Child 6–12 yr:** 1–3 mg/kg/24 hr ÷ TID–QID PO or 10–20 mg/24 hr ÷ TID–QID PO**Adolescent:** 1–3 mg/kg/24 hr ÷ TID–QID PO or 30–50 mg/24 hr ÷ TID–QID PO**Adult:** 75–100 mg/24 hr ÷ TID–QID PO**Max. dose** (all ages): 150 mg/24 hr**Nocturnal enuresis (see remarks):****6–7 yr (20–25 kg):** 10 mg PO QHS**8–11 yr (26–35 kg):** 10–20 mg PO QHS**>11 yr (36–54 kg):** 25–35 mg PO QHSSee imipramine for contraindications and common side effects. Also **contraindicated** with linezolid or IV methylene blue due to increased risk for serotonin syndrome. **Avoid** use in patients with Brugada syndrome. Fewer CNS and anticholinergic side effects than with amitriptyline. May cause mild pupillary dilation, which can lead to narrow angle glaucoma.Lower doses and slower dose titration are recommended in hepatic impairment. Therapeutic antidepressant effects occur in 7–21 days. Monitor for clinical worsening of depression and suicidal ideation/behavior following the initiation of therapy or after dose changes. **Do not** discontinue abruptly. Nortriptyline is a substrate for the CYP 450 1A2 and 2D6 drug-metabolizing enzymes. Use and dosing considerations have been recommended based on the following CYP 450 2D6 phenotypes:**Ultrarapid metabolizer:** Use of alternative drug not metabolized by CYP 2D6. If use warranted, titrate to the highest target dose and monitor serum levels.**Intermediate metabolizer:** Reduce recommended initial dose by 25% and monitor serum levels.**Poor metabolizer:** **Avoid use** to prevent potential side effect and use alternative drug not metabolized by CYP 2D6. If use is warranted, reduce recommended initial dose by 50% and monitor serum levels.

Rifampin may increase the metabolism of nortriptyline.

Therapeutic nortriptyline levels for depression: 50–150 ng/mL. Recommended serum sampling time: obtain a single level 8 or more hours after an oral dose (following 4 days of continuous dosing for children and after 9–10 days for adults).

NYSTATIN

Bio-Statin, Nyamyc, Nystop, and generics; previously available as Mycostatin and Nilstat

Antifungal agent



Tabs: 500,000 U

Oral suspension: 100,000 U/mL (5, 60, 480 mL)

Topical cream and ointment: 100,000 U/g (15, 30 g)

Topical powder (Nyamyc, Nystop, and generics): 100,000 U/g (15, 30, 60 g)

**Oropharyngeal candidiasis:**

Preterm infant: 0.5 mL (50,000 U) to each side of mouth QID

Term infant: 1–4 mL (100,000–400,000 U) to each side of mouth QID

Child, adolescent, and adult: 4–6 mL (400,000–600,000 U) swish and swallow QID

Non-esophageal mucous membrane GI Candidiasis:

Adult (oral tabs): 500,000–1,000,000 U PO Q8 hr until 48 hr after clinical cure

**Topical (all topical dosage forms):**

All ages: Apply to affected areas BID-QID.

May produce diarrhea and GI side effects. Local irritation, contact dermatitis, and Stevens-Johnson syndrome have been reported. Treat until 48–72 hr after resolution of symptoms.

Drug is poorly absorbed through the GI tract. Oral suspension should be swished about the mouth and retained in the mouth as long as possible before swallowing.

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OCTREOTIDE ACETATE

Sandostatin, Sandostatin LAR Depot, and generics

Somatostatin analog, antisecretory agent



B ? Yes No No



Injection (amps): 0.05, 0.1, 0.5 mg/mL (1 mL)

Injection (multidose vials): 0.2, 1 mg/mL (5 mL); contains phenol

Injection, microspheres for suspension (Sandostatin LAR Depot; see remarks): 10, 20, 30 mg (in kits with 2 mL diluent and 1.5-inch 20-gauge needles)

Infant and child (limited data):**Intractable diarrhea:**

IV/SC: 1–10 mCg/kg/24 hr ÷ Q12–24 hr. Dose may be increased within the recommended range by 0.3 mCg/kg/dose every 3 days as needed. **Max. dose:** 1500 mCg/24 hr.

IV continuous infusion: bolus of 1 mCg/kg/dose followed by 1 mCg/kg/hr; this has been used in diarrhea associated with graft-versus-host disease.

Cholelithiasis, hyperglycemia, hypoglycemia, hypothyroidism, nausea, diarrhea, abdominal discomfort, headache, dizziness, and pain at injection site may occur. Growth hormone suppression may occur with long-term use. Bradycardia, thrombocytopenia, and increased risk for pregnancy in patients with acromegaly and pancreatitis have been reported.

Cyclosporine levels may be reduced in patients receiving this drug. May increase the effects/toxicity of bromocriptine.

Patients with severe renal failure requiring dialysis may require dosage adjustments due to an increase in half-life. Effects of hepatic dysfunction on octreotide have not been evaluated.

Sandostatin LAR Depot is administered once every 4 wk **only** by the IM route and is currently indicated

IV/SC therapy. See package insert for details.
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OFLOXACIN (OTIC AND OPHTHALMIC)

Floxin Otic, Ocuflax, and generics; previously available as Floxin

Antibiotic, quinolone

C

2

No

No

No

Otic solution (Floxin Otic and generics): 0.3% (5, 10 mL); may contain benzalkonium chloride**Ophthalmic solution (Ocuflax and generics):** 0.3% (5, 10 mL); may contain benzalkonium chloride**Otic use:****Otitis externa:**

6 mo–12 yr: 5 drops to affected ear(s) once daily × 7 days

≥13 yr–adult: 10 drops to affected ear(s) once daily × 7 days

Chronic suppurative otitis media:

≥12 yr–adult: 10 drops to affected ear(s) BID × 14 days

Acute otitis media with tympanostomy tubes:

1–12 yr: 5 drops to affected ear(s) BID × 10 days

Ophthalmic use (>1 yr–adult):**Conjunctivitis:** 1–2 drops to affected eye(s) 2–4 hr while awake × 2 days, then QID × 5 additional days**Corneal ulcer:** 1–2 drops to affected eye(s) Q30 min while awake and Q4–6 hr while asleep at

night × 2 days, followed by Q1 hr while awake × 5 days, and then QID until treatment has been completed.



Pruritus, local irritation, taste perversion, dizziness, earache have been reported with otic use. Ocular burning/discomfort is frequent with ophthalmic use. Consult with ophthalmology in corneal ulcers.

When otic solution is being used, the solution should be warmed by holding the bottle in the hand for 1–2 min. The use of cold solutions may result in dizziness. For otitis externa, the patient should lie with the affected ear upward before instillation and remain in the same position after dose administration for 5 min to enhance drug delivery. For acute otitis media with tympanostomy tubes, the patient should lie in the same position prior to instillation and the tragus should be pumped 4 times after the dose to assist in drug delivery to the middle ear.

Systemic use of ofloxacin is typically replaced by levofloxacin, its S-isomer, which has a more favorable side effect profile than ofloxacin. See **levofloxacin**.**OLANZAPINE**

Zyprexa, Zyprexa Zydis, Zyprexa Relprevv, and generics

Antipsychotic, atypical second generation

C

2

No

Yes

No

Tabs: 2.5, 5, 7.5, 10, 15, 20 mg**Orally disintegrating tabs (Zyprexa Zydis and generics):** 5, 10, 15, 20 mg; contains phenylalanine
IM injection:**Short-acting:** 10 mg; contains tartaric acid**Long-acting pamoate salt (Zyprexa Relprevv):****Every 2 week dosing:** 210, 300 mg; contains mannitol, polysorbate 80**Every 4 week dosing:** 405 mg; contains mannitol, polysorbate 80**PO DOSING:****Bipolar I disorder (manic or mixed episodes):****Child 4–6 yr of age (limited data, based on an open-label trial in 15 subjects):** Start at

1.25 mg PO once daily × 7 days, then increase dose Q7 days PRN as tolerated to a target dose of 10 mg once daily.

Child 6–12 yr of age (limited data): Start at 2.5 mg PO once daily × 7 days, then increase dose in 2.5 or 5 mg increments Q7 days to a target dose of 10 mg once daily. Suggested **max. dose:** 20 mg/24 hr.

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OLANZAPINE *continued*

Adolescent (see remarks): Start at 2.5 or 5 mg PO once daily \times 7 days, then increase dose in 2.5 or 5 mg increments Q7 days to a target dose of 10 mg once daily. Suggested **max. dose:** 20 mg/24 hr (doses >20 mg/24 hr have not been evaluated).

Adult: Start at 10 or 15 mg PO once daily (use 10 mg if used with lithium or valproate). If needed, increase or decrease dose by 5 mg daily at intervals not <24 hr. Maintenance dosage range: 5–20 mg/24 hr. Suggested **max. dose:** 20 mg/24 hr (doses >20 mg/24 hr have not been evaluated).

Schizophrenia:

Child \geq 8 yr of age and adolescent (see remarks): Start with 2.5 or 5 mg PO once daily, increase dose in 2.5 or 5 mg increments Q7 days to the target dose of 10 mg once daily (doses >20 mg/24 hr have not been evaluated).

Adult: Start with 5 or 10 mg PO once daily (use 5 mg for individuals who are debilitated, predisposed to hypotension, pharmacodynamically sensitive to olanzapine, or nonsmoking females \geq 65 yr old) with a target dose of 10 mg once daily within 5–7 days. If needed, increase or decrease dose by 5 mg daily at weekly intervals. Usual dosage range: 10–15 mg once daily. Additional clinical assessment is recommended for doses >10 mg/24 hr (doses >20 mg/24 hr have not been evaluated).

IM DOSING:

Short acting for acute agitation associated with bipolar I or schizophrenia:

Child and adolescent (limited retrospective data in 15 children and 35 adolescents): \leq 12 yr: 5 mg and adolescent (13–17 yr): 10 mg. Dosing frequencies and max. doses were not reported.

Adult: 10 mg (5 mg for geriatric patients and 2.5 mg for individuals who are debilitated, predisposed to hypotension, or pharmacodynamically sensitive to olanzapine). If needed, additional doses \times 2 may be given; second dose 2 hr after the first dose and third dose 4 hr after the second dose. Recommended **max. dose** is 30 mg/24 hr (10 mg \times 3 given 2–4 hr apart); safety of doses >30 mg /24 hr has not been evaluated.

Long-acting pamoate salt (Zyprexa Relprevv) for schizophrenia (adult): see remarks and package insert for specific dosage based on established oral dosage.

Use with caution in cardiovascular or cerebrovascular disease, hypotensive conditions, diabetes/hyperglycemia, elevated serum lipids and cholesterol, paralytic ileus, hepatic impairment, seizure disorders, narrow angle glaucoma, and prostatic hypertrophy. Medication exhibits anticholinergic effects.



Common side effects include orthostatic hypotension, peripheral edema, hypercholesterolemia, hyperprolactinemia, appetite stimulation, weight gain (greater in adolescents than adults; monitoring is recommended), hypertriglyceridemia, constipation, xerostomia, akathisia, asthenia, dizziness, somnolence, tremor, and personality disorder. Neuroleptic malignant syndrome, dystonia, cognitive and motor impairment, tardive dyskinesia (irreversible with cumulative high doses), neutropenia, leukopenia, agranulocytosis, suicidal intent, acute pancreatitis, pulmonary embolism, increases in liver function tests (ALT, AST, GGT), DRESS, and hyperthermia have been reported.

Olanzapine is a major substrate for CYP 450 1A2 and minor substrate for 2D6. It also is a weak inhibitor to CYP 450 1A2, 2C9/19. Do not use in combination with alcohol, benzodiazepines, or opiates due to increased risk for sedation and cardiopulmonary depression. Caution is also indicated with anticholinergic agents (e.g., azelastine, glycopyrrolate), as olanzapine may enhance the anticholinergic effects. Use with QTc-prolonging medications may further increase the risk for QTc prolongation. Metoclopramide may enhance neurological side effects of olanzapine. Do not use oral disintegrating tablets in phenylketonuria.

T_½: 37 hr for children and 21–54 hr for adults via PO route. Short-acting IM T_½ in adults is similar to PO route but long-acting IM T_½ is \sim 30 days in adults.

Maintenance treatment for bipolar I disorder and schizophrenia has not been systematically evaluated in adolescents. Therefore it is recommended to utilize the lowest dose to maintain efficacy and to reassess the need for maintenance treatment periodically for this age group.

OLANZAPINE *continued*

All oral dosages may be taken either with or without food. For orally disintegrating tabs, tablet must be placed in patient's mouth immediately after removing it from the foil pack (by peeling off the foil, not by pushing the tablet through the foil) and allowed to dissolve in saliva; then swallowed with or without liquids.

Zyprexa Relprev (long-acting IM injection): post injection delirium and sedation syndrome have been reported with this dosage form. Patients must be observed by a health care provider at a health care facility for at least 3 hr after administration. The FDA REMS program requires prescribers, healthcare facilities, and pharmacies to register with the Zyprexa Relprev Patient Care Program at 1-877-772-9390 for use of this product.

OLOPATADINE

Patanol, Pataday, Pazeo, Patanase, and generics

Antihistamine**Ophthalmic solution (products may contain benzalkonium chloride):**

Patanol and generics: 0.1% (5 mL)

Pataday and generics: 0.2% (2.5 mL)

Pazeo: 0.7% (2.5 mL)

Nasal spray (Patanase and generics): 0.6% (30.5 g provides 240 metered spray doses); contains benzalkonium chloride.

**Ophthalmic use for allergic conjunctivitis:****0.1% solution (Patanol and generics):**

Patients ≥ 3 yr old and adults: 1 drop in affected eye(s) BID (spaced 6–8 hr apart).

0.2% solution (Pataday) or 0.7% (Pazeo):

Patients ≥ 2 yr old and adults: 1 drop in affected eye(s) once daily

Intranasal use of allergic rhinitis:

Patients 6–11 yr old: Inhale 1 spray into each nostril BID

Patients ≥ 12 yr old and adults: Inhale 2 sprays into each nostril BID.



Ocular use: DO NOT use while wearing contact lenses; wait at least 10 min after instilling drops before inserting lenses. Ocular side effects include burning or stinging, dry eye, foreign body sensation, hyperemia, keratitis, lid edema, and pruritus. May also cause headaches, asthenia, pharyngitis, rhinitis, and taste perversion.

Nasal use: Common side effects include bitter taste and headaches. Nasal ulceration, epistaxis, nasal septal perforation, throat pain and postnasal drip have been reported.

To reduce the risk of drug being systemically absorbed with ophthalmic use, place pressure on the tear duct by the corner of the eye for ≥1 min, then remove the excess solution with an absorbent tissue.

OMEPRAZOLE

Prilosec, Prilosec OTC, First-Omeprazole, Omeprazole and Syrpred SF Alka, and generics

In combination with sodium bicarbonate: Zegerid, Zegerid OTC, and generics

Gastric acid pump inhibitor

Caps, sustained release: 10, 20, 40 mg; may contain magnesium

Tabs, delayed release (Prilosec OTC and generics; OTC): 20 mg; may contain magnesium

OMEПRAZOLE continued**Oral suspension:**

First-Omeprazole: 2 mg/mL (90, 150, 300 mL); contains benzyl alcohol.

Omeprazole and Syrpend SF Alka: 2 mg/mL (100 mL); sugar free and preservative free.

Compounded formulation: 2 mg/mL; contains ~0.5 mEq sodium bicarbonate per 1 mg drug.

Granules for oral suspension (Prilosec): 2.5 and 10 mg packets (30s); contains magnesium.

In combination with sodium bicarbonate:

Powder for oral suspension (Zegerid and generics): 20, 40 mg packets (30s); each packet (regardless of strength) contains 1680 mg (20 mEq) sodium bicarbonate.

Caps, immediate-release (Zegerid, Zegerid OTC, and generics): 20 (OTC), 40 mg; each capsule (regardless of strength) contains 1100 mg (13.1 mEq) sodium bicarbonate.

Chewable tabs (Zegerid): 20 and 40 mg; each tab (regardless of strength) contains 600 mg (7.1 mEq) sodium bicarbonate and 700 mg magnesium hydroxide.

Infant and child:

Esophagitis, GERD, or ulcers: Start at 1 mg/kg/24 hr PO ÷ once daily–BID (**max. dose:**

20 mg/24 hr). Reported effective range: 0.2–3.5 mg/kg/24 hr. Children 1–6 yr may require higher doses due to enhanced drug clearance. Alternative dosing by weight category:

3–<5 kg: 2.5 mg PO once daily

5–<10 kg: 5 mg PO once daily

10–<20 kg: 10 mg PO once daily

20 kg and above: 20 mg PO once daily

**Adult:**

Duodenal ulcer or GERD: 20 mg/dose PO once daily × 4–8 wk; may give up to 12 wk for erosive esophagitis

Gastric ulcer: 40 mg/24 hr PO ÷ once daily–BID × 4–8 wk

Pathologic hypersecretory conditions: Start with 60 mg/24 hr PO once daily. If needed, dose may be increased up to 120 mg/24 hr PO ÷ TID. Daily doses >80 mg should be administered in divided doses.



Common side effects: headache, diarrhea, nausea, and vomiting. Allergic reactions including anaphylaxis, acute interstitial nephritis, and vitamin B₁₂ deficiency (with prolonged use) have been reported. Fundic gland polyps has been associated with long-term use of PPIs. Has been associated with increased risk for *Clostridium difficile*–associated diarrhea.

Drug induces CYP 450 1A2 (decreases theophylline levels) and is also a substrate and inhibitor of CYP 2C19. Recommended dosage modification for ultrarapid metabolizers of CYP 2C19 is to increase the usual dose by threefold. Increases T_{1/2} of citalopram, diazepam, phenytoin, and warfarin. May decrease the effects of itraconazole, ketoconazole, clopidogrel, iron salts, and ampicillin esters. St. John's wort and rifampin may decrease omeprazole effects. May be used in combination with clarithromycin and amoxicillin for *Helicobacter pylori* infections. Omeprazole may interfere with serum chromogranin A (CgA) diagnostic test for neuroendocrine tumors; discontinue use at least 14 days prior to testing. Bioavailability may be increased with hepatic dysfunction or in patients of Asian descent. Safety and efficacy for GERD in children <1 mo have not been established.

Administer all doses before meals. Administer 30 min prior to sucralfate. Capsules contain enteric-coated granules to ensure bioavailability. Do not chew or crush capsule. For doses unable to be divided by 10 mg, capsule may be opened and intact pellets may be administered in an acidic beverage (e.g., apple juice, cranberry juice) or applesauce. The extemporaneously compounded oral suspension product may be less bioavailable due to the loss of the enteric coating.

OMNIPAQUE

See iohexol

ONDANSETRON

Zofran, Zofran ODT, Zuplenz, and generics

Antiemetic agent, 5-HT3 antagonist**Injection:** 2 mg/mL (2, 20 mL); may contain parabens and some preparations are preservative free**Tabs:** 4, 8, 24 mg**Tabs, orally disintegrating (ODT):** 4, 8 mg; contains aspartame**Oral solution:** 4 mg/5 mL (50 mL); contains sodium benzoate**Oral film (Zuplenz):** 4, 8 mg (30s)***Preventing nausea and vomiting associated with chemotherapy:*****Oral (give initial dose 30 min before chemotherapy):****Child (≥ 2 yr of age and adolescent), dose based on body surface area:**

- <0.3 m²: 1 mg TID PRN nausea
- 0.3–0.6 m²: 2 mg TID PRN nausea
- 0.6–1 m²: 3 mg TID PRN nausea
- >1 m²: 4–8 mg TID PRN nausea

Dose based on age:

- <4 yr of age: Use dose based on body surface area from preceding dosages.
- 4–11 yr of age: 4 mg TID PRN nausea
- >11 yr of age and adult: 8 mg TID or 24 mg once daily PRN nausea

IV (child and adult):

Moderately emetogenic drugs: 0.15 mg/kg/dose (**max. dose:** 8 mg/dose for child and 16 mg/dose adult) at 30 min before and 4 and 8 hr after emetogenic drugs. Then same dose Q4 hr PRN.

Highly emetogenic drugs: 0.15 mg/kg/dose (**max. dose:** 16 mg/dose) 30 min before 4 and 8 hr after emetogenic drugs. Then 0.15 mg/kg/dose (**max. dose:** 16 mg/dose) Q4 hr PRN.

Preventing nausea and vomiting associated with surgery (additional doses for controlling nausea and vomiting may not provide any benefits):**IV/IM (administered prior to anesthesia over 2–5 min):****Child (1 mo–12 yr of age):**

- <40 kg: 0.1 mg/kg/dose × 1
- ≥40 kg: 4 mg × 1

Adult: 4 mg × 1**Oral:**

Adult: 16 mg × 1, 1 hr prior to induction of anesthesia

Preventing nausea and vomiting associated with radiation therapy:

Child: use above dosage for preventing nausea and vomiting associated with chemotherapy and give initial dose 1–2 hr prior to radiation.

Adult:

Total body irradiation: 8 mg PO 1–2 hr prior to radiation once daily-BID

Single high-dose fraction radiation to abdomen: 8 mg PO 1–2 hr prior to radiation with subsequent doses Q8 hr after first dose × 1–2 days after completion of radiation.

Daily fractionated radiation to abdomen: 8 mg PO 1–2 hr prior to radiation with subsequent doses Q8 hr after first dose for each day radiation is given.

Vomiting in acute gastroenteritis (oral route is preferred, use IV route when oral administration is not possible):**Oral (child 6 mo–10 yr old and weighing ≥8 kg; use oral disintegrating tablet):**

- 8–15 kg: 2 mg × 1
- >15 and ≤30 kg: 4 mg × 1
- >30 kg: 8 mg × 1

IV (≥1 mo): 0.15–0.3 mg/kg/dose × 1; **max. dose:** 4 mg/dose

ONDANSETRON continued

Avoid use in congenital long-QTc syndrome. Bronchospasm, tachycardia, hypokalemia, seizures, headaches, lightheadedness, constipation, diarrhea and transient increases in AST, ALT, and bilirubin may occur. Transient blindness (resolution within a few min up to 48 hr), arthralgia, Stevens-Johnson syndrome, TEN, hepatic dysfunction, and rare/transient ECG changes (including QTc-interval prolongation) have been reported. Data limited for use in children below 3 yr of age.

ECG monitoring is recommended in patients with electrolyte abnormalities, CHF, or bradycardia. Drug clearance is higher for surgical and cancer patients <18 yr as compared with adults. Clearance is slower for children 1–4 mo old compared with children >4–24 mo old.

Ondansetron is a substrate for CYP 450 1A2, 2D6, 2E1, and 3A3/4 drug metabolizing enzymes. It is likely that the inhibition/loss of one of the previously listed enzymes will be compensated by others and may result in insignificant changes to the elimination of ondansetron, which may be affected by CYP 450 enzyme inducers. Ultrarapid metabolizers of CYP 450 2D6 is associated with decreased response and use of an alternative drug not predominantly metabolized by CYP 2D6 (e.g., granisetron) is recommended. Follow theophylline, phenytoin, or warfarin levels closely, if used in combination. Use with apomorphine may result in profound hypotension and loss of consciousness and is **contraindicated**.

To administer the oral film dosage form (Zuplenz), film must be placed on top of patient's tongue, allowed to dissolve completely in 4–20 sec, and swallowed with or without liquid.

OSELTAMIVIR PHOSPHATE

Tamiflu and generics

Antiviral, neuraminidase inhibitor**Caps:** 30, 45, 75 mg**Oral suspension:** 6 mg/mL (60 mL); may contain saccharin and sodium benzoate

May also be extemporaneously compounded from capsules (6 mg/mL)

Treatment of influenza (initiate therapy within 2 days of onset of symptoms):**Preterm neonate (limited data):** Usual duration of therapy for 5 days.**Post-menstrual age (PMA) neonate <38 wk:** 1 mg/kg/dose PO BID**PMA 38–40 wk:** 1.5 mg/kg/dose PO BID**Full-term neonate (PMA >40 wk):** 3 mg/kg/dose PO BID × 5 days**Child <1 yr:** see following table.

Age (mo)	Dosage for 5 days	Volume of Oral Suspension (6 mg/mL)
<3	12 mg PO BID	2 mL
3–5	20 mg PO BID	3.33 mL
6–11	25 mg PO BID	4.2 mL

Child ≥1–12 yr: see following table.

Weight (kg)	Dosage for 5 days	Volume of Oral Suspension (6 mg/mL)
≤15	30 mg PO BID	5 mL
>15–23	45 mg PO BID	7.5 mL
>23–40	60 mg PO BID	10 mL
>40	75 mg PO BID	12.5 mL

≥13 yr old and adult: 75 mg PO BID × 5 days.

D

Continued

OSELTAMIVIR PHOSPHATE *continued*

Prophylaxis of influenza (initiate therapy within 2 days of exposure; see remarks):

Child 3 mo–<1 yr: 3 mg/kg/dose PO once daily; alternative dosage based on age:

3–5 mo: 20 mg PO once daily

6–11 mo: 25 mg PO once daily

Child 1–12 yr:

≤15 kg: 30 mg PO once daily

16–23 kg: 45 mg PO once daily

24–40 kg: 60 mg PO once daily

>40 kg: 75 mg PO once daily

≥13 yr old and adult: 75 mg PO once daily for a minimum of 7 days and up to 6 wk; initiate therapy within 2 days of exposure.

Currently indicated for the treatment of influenza A and B strains. Use in children <1 yr of age has not been recommended due to concerns of excessive CNS penetration and fatalities in 7-day-old rats.



Nausea and vomiting generally occur within the first 2 days and are the most common adverse effects. Insomnia, vertigo, seizures, hypothermia, neuropsychiatric events (may result in fatal outcomes), arrhythmias, rash, and toxic epidermal necrolysis have also been reported. If the glomerular filtration rate (GFR) is 10–30 mL/min, reduce treatment dose to 75 mg PO once daily × 5 days for adults. (See Chapter 31.)

PROPHYLACTIC USE: Oseltamivir is not a substitute for annual flu vaccination. Safety and efficacy have been demonstrated for ≤6 wk of therapy; duration of protection lasts for as long as dosing is continued. Adjust prophylaxis dose if GFR is 10–30 mL/min by extending the dosage interval to once every other day.

Probenecid increases oseltamivir levels. Oseltamivir decreases the efficacy of the nasal influenza vaccine (live attenuated influenza vaccine, FluMist); avoid administration of vaccine within 2 wk before or 48 hr after oseltamivir administration unless medically indicated.

Dosage adjustments in hepatic impairment, severe renal disease, and dialysis have not been established for either treatment or prophylactic use. The safety and efficacy of repeated treatment or prophylaxis courses have not been evaluated. Doses may be administered with or without food.

OXACILLIN

Various generics

Antibiotic, penicillin (penicillinase resistant)



B



2



Yes



Yes



No

Injection: 1, 2, 10 g

Injection, premixed in iso-osmotic dextrose: 1 g/50 mL, 2 g/50 mL

Injectable products contain 2.8–3.1 mEq Na per 1 g drug



Neonate (IM/IV):

≤7 days old:

<2 kg: 50 mg/kg/24 hr ÷ Q12 hr

≥2 kg: 75 mg/kg/24 hr ÷ Q8 hr

8–28 days old:

<1 kg:

8–14 days old: 50 mg/kg/24 hr ÷ Q12 hr

15–28 days old: 75 mg/kg/24 hr ÷ Q8 hr

1–2 kg: 75 mg/kg/24 hr ÷ Q8 hr

≥2 kg: 100 mg/kg/24 hr ÷ Q6 hr

OXACILLIN continued***Meningitis (IV):***

≤7 days old: 75 mg/kg/24 hr ÷ Q8–12 hr

8–28 days old: 150–200 mg/kg/24 hr ÷ Q6–8 hr

Infant and child (IM/IV): 100–200 mg/kg/24 hr ÷ Q4–6 hr (**max. dose:** 12 g/24 hr); use 200 mg/kg/24 hr for endocarditis and severe infections.

Adult (IM/IV): 250–2000 mg/dose Q4–6 hr; use higher dosage range for endocarditis or severe infections

Max. dose (all ages): 12 g/24 hr.

Rash and GI disturbances are common. Leukopenia, reversible hepatotoxicity, and acute interstitial nephritis has been reported. Hematuria and azotemia have occurred in neonates and infants with high doses. May cause false-positive urinary and serum proteins.

Probenecid increases serum oxacillin levels. Tetracyclines may antagonize the bactericidal effects of oxacillin.

CSF penetration is poor unless meninges are inflamed. Use the lower end of the usual dosage range for patients with creatinine clearances <10 mL/min. **Adjust dose in renal failure** (see Chapter 31).

**OXCARBAZEPINE**

Trileptal, Oxtellar XR, and generics

Anticonvulsant



C



2



Yes



Yes



Yes

Tabs: 150, 300, 600 mg

Extended release tabs (Oxtellar XR): 150, 300, 600 mg

Oral suspension: 300 mg/5 mL (250 mL); contains saccharin, ethanol, and propylene glycol

**IMMEDIATE RELEASE PRODUCT:**

Child (2–<4 yr old):

Adjunctive therapy for partial-onset seizures: Start with 8–10 mg/kg/24 hr PO ÷ BID up to a **max. dose** of 600 mg/24 hr. For children <20 kg, may consider using a starting dose of 16–20 mg/kg/24 hr PO ÷ BID; gradually increase the dose over a 2–4 wk period and do not exceed 60 mg/kg/24 hr ÷ BID.

Child (4–16 yr old, see remarks):

Adjunctive therapy for partial-onset seizures: Start with 8–10 mg/kg/24 hr PO ÷ BID up to a **max. dose** of 600 mg/24 hr. Then gradually increase the dose over a 2-wk period to the following maintenance doses:

20–29 kg: 900 mg/24 hr PO ÷ BID

29.1–39 kg: 1200 mg/24 hr PO ÷ BID

>39 kg: 1800 mg/24 hr PO ÷ BID

Conversion to monotherapy for partial-onset seizures: Start with 8–10 mg/kg/24 hr PO ÷ BID and simultaneously initiate dosage reduction of concomitant AEDs and withdrawal completely over 3–6 wk. Dose may be increased at weekly intervals, as clinically indicated, by a **maximum** of 10 mg/kg/24 hr to achieve the recommended monotherapy maintenance dose as described in the following table.

Initiation of monotherapy for partial-onset seizures (with no concomitant AEDs): Start with 8–10 mg/kg/24 hr PO ÷ BID. Then increase by 5 mg/kg/24 hr Q3 days up to the recommended monotherapy maintenance dose as described in the following table:

Continued

OXCARBAZEPINE *continued***IMMEDIATE-RELEASE PRODUCT:***Child (4–16 yr, see remarks, cont.)***RECOMMENDED MONOTHERAPY MAINTENANCE DOSES FOR CHILDREN BY WEIGHT**

Weight (kg)	Daily Oral Maintenance Dose (mg/24 hr) Divided BID
20–<25	600–900
25–<35	900–1200
35–<45	900–1500
45–<50	1200–1500
50–<60	1200–1800
60–<70	1200–2100
≥70	1500–2100

Adult:

Adjunctive therapy for partial-onset seizures: Start with 600 mg/24 hr PO ÷ BID. Dose may be increased at weekly intervals, as clinically indicated, by a **maximum** of 600 mg/24 hr. Usual maintenance dose is 1200 mg/24 hr PO ÷ BID. Doses ≥2400 mg/24 hr are generally not well tolerated due to CNS side effects.

Conversion to monotherapy for partial-onset seizures: Start with 600 mg/24 hr PO ÷ BID and simultaneously initiate dosage reduction of concomitant AEDs. Dose may be increased at weekly intervals as clinically indicated, by a **max** of 600 mg/24 hr to achieve a dose of 2400 mg/24 hr PO ÷ BID. Concomitant AEDs should be terminated gradually over approximately 3–6 wk.

Initiation of monotherapy for partial-onset seizures: Start with 600 mg/24 hr PO ÷ BID. Then increase by 300 mg/24 hr every 3 days up to 1200 mg/24 hr PO ÷ BID.

EXTENDED RELEASE TABS (Oxtellar XR; see remarks):**Child 6–17 yr of age:**

Adjunctive therapy for partial-onset seizures: Start with 8–10 mg/kg/24 hr PO once daily up to a **max. dose** of 600 mg/24 hr. Then gradually increase at weekly intervals in increments of 8–10 mg/kg/24 hr (**max. dosage increment**: 600 mg) to the following maintenance doses:

20–29 kg: 900 mg PO once daily

29.1–39 kg: 1200 mg PO once daily

≥39.1 kg: 1800 mg PO once daily

Adult:

Adjunctive therapy for partial-onset seizures: Start with 600 mg PO once daily (consider using 900 mg if patient is receiving concomitant enzyme-inducing AEDs). Then gradually increase at weekly intervals in 600 mg/24 hr increments to the maintenance dose of 1200–2400 mg once daily.

Clinically significant hyponatremia may occur; generally seen within the first 3 mo of therapy. May also cause headache, dizziness, drowsiness, ataxia, fatigue, nystagmus, urticaria, diplopia, abnormal gait, and GI discomfort. About 25%–30% of patients with carbamazepine hypersensitivity will experience a cross reaction with oxcarbazepine. Serious dermatologic reactions (Stevens-Johnson syndrome [SJS] and TEN), multiorgan hypersensitivity reactions (e.g., DRESS), bone marrow depression, osteoporosis, pancreatitis, folic acid deficiency, hypothyroidism, rare cases of anaphylaxis and angioedema, and suicidal behavior or ideation have been reported. Increased risk for severe dermatologic reactions (e.g., SJS and TEN) has been associated with the HLA-B*1502 (prevalent among persons of Asian descent) alleles.



OXCARBAZEPINE continued

Inhibits CYP 450 2C19 and induces CYP 450 3A4/5 drug metabolizing enzymes. Carbamazepine, cyclosporine, phenobarital, phenytoin, rifampin, valproic acid and verapamil may decrease oxcarbazepine levels. Oxcarbazepine may increase phenobarital and phenytoin levels. Oxcarbazepine can decrease the effects of oral contraceptives, cyclosporine, felodipine, and lamotrigine.

If GFR <30 mL/min, adjust dosage by administering 50% of the normal starting dose (max. dose: 300 mg/24 hr) followed by a slower than normal increase in dose if necessary (see Chapter 31). No dosage adjustment is required in mild/moderate hepatic impairment. Use is **not recommended** in severe hepatic impairment due to lack of information.

Extended release and immediate release products are not bioequivalent, as higher doses of the extended release product may be necessary. Doses may be administered with or without food.

OXYBUTYNIN CHLORIDE

Ditropan XL, Oxytrol, Oxtrol for Women, and generics;
 previously available as Ditropan

Anticholinergic agent, antispasmodic



Tabs: 5 mg

Tabs, extended-release (Ditropan XL and generics): 5, 10, 15 mg

Syrup: 1 mg/mL (473 mL); contains parabens

Transdermal system (Oxytrol, Oxytrol for Women): delivers 3.9 mg/24 hr (1, 8s); contains 36 mg per system

Child ≤5 yr:

Immediate release: 0.2 mg/kg/dose BID–TID PO; **max. dose:** 15 mg/24 hr



Child >5 yr:

Immediate release: 5 mg/dose BID–TID PO; **max. dose:** 20 mg/24 hr

Extended release (≥6 yr): Start with 5 mg/dose once daily PO; if needed, increase as tolerated by 5-mg increments up to a **maximum** of 20 mg/24 hr.

Adult:

Immediate release: 5 mg/dose BID–TID PO; **max. dose:** 5 mg QID

Extended release (Ditropan XL): 5–10 mg/dose once daily PO, adjust in 5-mg weekly increments if needed, up to a **max. dose** of 30 mg/dose once daily PO

Transdermal system:

Female: 1 patch (3.9 mg/24 hr) every 4 days

Male: 1 patch (3.9 mg/24 hr) every 3–4 days (twice weekly)



Use with caution in hepatic or renal disease, hyperthyroidism, GE reflux, IBD, concurrent use of bisphosphonates, or cardiovascular disease. Anticholinergic side effects may occur, including drowsiness, confusion, and hallucinations. **Contraindicated** in glaucoma, GI obstruction, megacolon, myasthenia gravis, severe colitis, hypovolemia, and GU obstruction. Memory impairment, angioedema, and QT-interval prolongation have been reported. Oxybutynin is a CYP 450 3A4 substrate; inhibitors and inducers of CYP 450 3A4 may increase and decrease the effects of oxybutynin, respectively. May antagonize the effects of metoclopramide.

Dosage adjustments for the extended-release dosage form are at weekly intervals. The extended-release tablets **should not** be crushed, chewed, or divided. Apply transdermal system on dry intact skin on the abdomen, hip, or buttock; rotate the site and avoiding same-site application within 7 days.

OXYCODONE

OxyContin, Roxicodone, Xtampza ER, and many others including generics

Narcotic, analgesic



Expressed as hydrochloride salt unless indicated otherwise.

Oral solution: 1 mg/mL (5, 15, 473 mL); contains alcohol

Concentrated oral solution: 20 mg/mL (30 mL); may contain saccharin

Tabs: 5, 10, 15, 20, 30 mg

Controlled-release tabs (OxyContin and generics): 10, 15, 20, 30, 40, 60, 80 mg (80 mg strength for opioid-tolerant patients only)

Caps: 5 mg

Extended-release caps (Xtampza ER): 9, 13.5, 18, 27, 36 mg oxycodone base; equivalent to 10, 15, 20, 30, and 40 mg oxycodone hydrochloride salt, respectively

Opioid naïve doses based upon oxycodone hydrochloride salt:

Child: 0.05–0.15 mg/kg/dose Q4–6 hr PRN up to 5 mg/dose PO

Adolescent (≥ 50 kg) and adult: 5–10 mg Q4–6 hr PRN PO; see remarks for use of controlled-release tablets.



There is a potential for abuse; CNS and respiratory depression, increased ICP, histamine release, constipation, and GI distress may occur. **Use with caution** in severe renal impairment (increases $T_{1/2}$) and mild/moderate hepatic dysfunction (use of one-third to one-half of usual dose has been recommended). **Naloxone is the antidote.** See Chapter 6 for equianalgesic dosing. Check dosages of acetaminophen or aspirin when using combination products (e.g., Percocet, Percodan). Oxycodone is metabolized by the CYP 450 3A4 (major) and 2D6 (minor) isoenzyme.

When controlled-released tablets (e.g., Oxycontin) are being used, determine patient's total 24-hr requirement should be determined and divided by 2 to administer on a Q12 hr dosing interval. Oxycontin 80-mg tablet is **USED ONLY** for opioid-tolerant patients; this strength can cause fatal respiratory depression in opioid-naïve patients. Controlled-release dosage form should not be used as a PRN analgesic and must be swallowed whole.

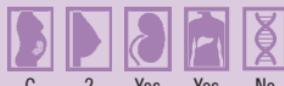
Pregnancy category changes to D if used for prolonged periods or in high doses at term.

The FDA has assigned a Risk Evaluation and Mitigation Strategy (REMS) for opioid analgesia; see www.fda.gov/OpioidAnalgesicREMSPCG. The REMS strongly encourages the (1) completion of a REMS-compliant education program; (2) counsel patients/caregivers on prescription safe use, risks, storage, and disposal; (3) emphasize the importance of reading the medication guide provided by pharmacists at all times; and (4) consider other methods for improving patient, household, and community safety.

OXYCODONE AND ACETAMINOPHEN

Endocet, Percocet, Roxicet, and many others including generics

Combination analgesic with a narcotic



C 2 Yes Yes No

Tabs (Percocet, Endocet, and others including generics):

Most common strength: oxycodone HCl 5 mg + acetaminophen 325 mg

Other strengths:

Oxycodone HCl 2.5 mg + acetaminophen 325 mg

Oxycodone HCl 7.5 mg + acetaminophen 325 mg

Oxycodone HCl 10 mg + acetaminophen 325 mg

D

OXYCODONE AND ACETAMINOPHEN continued

Oral solution: Oxycondone HCl 5 mg + acetaminophen 325 mg/5 mL (500 mL); may contain 0.4% alcohol and saccharin

Dose based on amount of oxycodone and acetaminophen. Do not exceed 4 g/24 hr of acetaminophen.

See oxycodone and acetaminophen. Check dosages of acetaminophen and oxycodone when using these combination products.

The FDA has assigned a Risk Evaluation and Mitigation Strategy (REMS) for Opioid Analgesia; see www.fda.gov/OpioidAnalgesicREMSPCG. The REMS strongly encourages the (1) completion of a REMS-compliant education program; (2) counsel patients/caregivers on prescription safe use, risks, storage and disposal; (3) emphasize the importance of reading the Medication Guide provided by pharmacists at all times; and (4) consider other methods for improving patient, household and community safety.

OXYCODONE AND ASPIRIN

Various generics; previously available as Percodan and Endodan,

Combination analgesic (narcotic and salicylate)



Tabs: Oxycodone 4.8355 mg and aspirin 325 mg

Dose based on amount of oxycodone and aspirin. Do not exceed 4 g/24 hr of aspirin.

See oxycodone and aspirin. **Must not be used** in children <16 yr of age because of risk for Reye syndrome. Check dosages of aspirin and oxycodone when using these combination products.

The FDA has assigned a Risk Evaluation and Mitigation Strategy (REMS) for Opioid Analgesia; see www.fda.gov/OpioidAnalgesicREMSPCG. The REMS strongly encourages the (1) completion of a REMS-compliant education program; (2) counsel patients/caregivers on prescription safe use, risks, storage and disposal; (3) emphasize the importance of reading the Medication Guide provided by pharmacists at all times; and (4) consider other methods for improving patient, household and community safety.

OXYMETAZOLINE

Afrin 12 Hour, Neo-Synephrine 12-Hour Nasal, nostrilla and many others including generics

Nasal decongestant, vasoconstrictor



Nasal spray (OTC): 0.05% (15, 30 mL); may contain benzalkonium chloride and propylene glycol

Nasal decongestant (not to exceed 3 days in duration):

≥6 yr of age to adult: 2–3 sprays or 2–3 drops in each nostril BID. **Do not exceed** 2 doses/24 hr.

Contraindicated in patients on MAO inhibitor therapy. Rebound nasal congestion may occur with excessive use (>3 days) via the nasal route. Systemic absorption may occur.

Headache, insomnia, hypertension, transient burning, stinging, dryness, nasal mucosal ulceration, and sneezing have occurred.

Accidental ingestion in children <5 yr of age has been reported and required hospitalization for adverse events (nausea, vomiting, lethargy, tachycardia, respiratory depression, bradycardia, hypotension, hypertension, sedation, mydriasis, stupor, hypothermia, drooling and coma).

P**PALIVIZUMAB**

Synagis

Monoclonal antibody

Injection, solution: 100 mg/mL (0.5, 1 mL; single use); contains glycine and histidine.

RSV prophylaxis during RSV season for the following age and clinical criteria (see latest edition of Red Book for most recent indications).



Following recommendations are from *Pediatrics* 2014;134(2):415–420.

Candidates for recommended use:

<12 mo of age (one of the following):

Born at ≤28-wk gestation; OR

With chronic lung disease (CLD) of prematurity (<32-wk gestation requiring >21% oxygen for at least 28 days after birth); OR

With hemodynamically significant congenital heart disease

<24 mo of age:

Born at ≤32-wk gestation with CLD requiring medical therapy (e.g., ≥28 days of supplemental oxygen, bronchodilator, diuretics, or chronic steroids) within 6 mo prior to start of RSV season.

Candidates for consideration:

<12 mo of age (one of the following):

With congenital airway abnormalities or neuromuscular disorders that decrease ability to manage airway secretions; OR

With cystic fibrosis with clinical evidence of CLD and/or nutritional compromise

≤24 mo of age (one of the following):

With cystic fibrosis with severe lung disease (previous pulmonary exacerbation in first year of life or abnormal chest x-ray) or weight for length less than the 10th percentile; OR

Profoundly immunocompromised; OR

Undergoing cardiac transplantation during RSV season

DOSE:

≤24 mo old: 15 mg/kg/dose IM Q monthly just prior to and during the RSV season. **Maximum** of five doses per RSV season is recommended by the AAP. Therapy should be discontinued if child experiences breakthrough RSV hospitalization.

RSV season typically November through April in the northern hemisphere but may begin earlier or persist later in certain communities. **IM** is currently the only route of administration, so **use with caution** in patients with thrombocytopenia or any coagulation disorder. The following adverse effects have been reported at slightly higher incidences when compared with placebo: rhinitis, rash, pain, increased liver enzymes, pharyngitis, cough, wheeze, diarrhea, vomiting, conjunctivitis, and anemia. Rare acute hypersensitivity reactions have been reported (first or subsequent doses).



Does not interfere with the response to routine childhood vaccines. May interfere with immunologic-based RSV diagnostic tests (some antigen detection-based assays and viral culture assays) but not with reverse transcriptase-polymerase chain reaction (PCR)-based assays.

Palivizumab is currently indicated for RSV prophylaxis in high-risk infants only. Efficacy and safety have not been demonstrated for treatment of RSV.

Cardiopulmonary bypass and ECMO will significantly reduce serum concentrations; administer a dose immediately after the bypass procedure or ECMO even if it is <1 mo from the previous dose.

Each dose should be administered IM in the anterolateral aspect of the thigh. It is recommended to divide doses with total injection volumes >1 mL. **Avoid** injection in the gluteal muscle because of risk for damage to the sciatic nerve.

PANCRELIPASE/PANCREATIC ENZYMES

Creon, Pancreaze, Pertzye, Ultresa, Viokace, and Zenpep

Pancreatic enzyme

Delayed-release enterically coated beads, microspheres, or minitabs in capsules (porcine derived):

Product	Lipase (USP) Units	Amylase (USP) Units	Protease (USP) Units
Creon^a			
3	3,000	15,000	9,500
6	6,000	30,000	19,000
12	12,000	60,000	38,000
24	24,000	120,000	76,000
36	36,000	180,000	114,000
Pancreaze^b			
MT 2	2,600	10,850	6,200
MT 4	4,200	24,600	14,200
MT 10	10,500	61,500	35,500
MT 16	16,800	98,400	56,800
MT 20	21,000	83,900	54,700
Pertzye^{a,c}			
4	4,000	15,125	14,375
8	8,000	30,250	28,750
16	16,000	60,500	57,500
24	24,000	90,750	86,250
Ultresa^b			
4	4,000	8,000	8,000
13	13,800	27,600	27,600
20	20,700	41,400	41,400
23	23,000	46,000	46,000
Zenpep^d			
3	3,000	14,000	10,000
5	5,000	24,000	17,000
10	10,000	42,000	32,000
15	15,000	63,000	47,000
20	20,000	84,000	63,000
25	25,000	105,000	79,000
40	40,000	168,000	126,000

^aEnteric coated microspheres.^bEnteric coated minitabs.^cContains bicarbonate.^dEnteric coated beads.**Tabs (porcine derived):**

Product	Lipase (USP) Units	Amylase (USP) Units	Protease (USP) Units
Viokace			
10	10,440	39,150	39,150
20	20,880	78,300	78,300

PANCRELIPASE/PANCREATIC ENZYMES *continued***Initial doses (actual requirements are patient specific):****Enteric coated microspheres and microtabs:****Infant:** 2000–4000 U lipase per 120 mL (formula or breast milk)**Child <4 yr:** 1000 U lipase/kg/meal**Child ≥4 yr and adult:** 500 U lipase/kg/meal**Max. dose (child–adult):** 2500 U lipase/kg/meal, or 10,000 U lipase/kg/24 hr, or 4000 U lipase/g fat/24 hr.

Total daily dose should include approximately three meals and two to three snacks per day. Snack doses are approximately half of meal doses, depending on the amount of fat and food consumed.

May cause occult GI bleeding, allergic reactions to porcine proteins, hyperuricemia, and hyperuricosuria with high doses. Dose should be titrated to eliminate diarrhea and to minimize steatorrhea. **Do not** chew microspheres or microtabs. Concurrent administration with H₂ antagonists or gastric acid pump inhibitors may enhance enzyme efficacy. Doses higher than 6000 U lipase/kg/meal have been associated with colonic strictures in children <12 yr. Nonenteric coated dosage forms (e.g., powder and tablet) are not preferred, owing to potential GI mucosal ulceration. Patients who are unable to swallow capsules intact may mix the contents with small amount of acidic soft foods (pH ≤4.5; such as applesauce) and swallow immediately after mixing.



Avoid use of generic pancreatic enzyme products because they been associated with treatment failures. Products not approved by the FDA are no longer allowed to be distributed in the United States. Patients requiring enzyme supplementation who receive enteral feeding via a feeding tube may alternatively use a digestive enzyme cartridge (RELIORB).

PANCURONIUM BROMIDE

Generics

Nondepolarizing neuromuscular blocking agent

C

?

Yes

Yes

No

Injection: 1 mg/mL (10 mL); contains benzyl alcohol**Intermittent dosing (see remarks):****Neonate:****Initial:** 0.02 mg/kg/dose IV**Maintenance:** 0.05–0.1 mg/kg/dose IV Q0.5–4 hr PRN**1 mo–adult:****Initial:** 0.04–0.1 mg/kg/dose IV**Maintenance:** 0.015–0.1 mg/kg/dose IV Q30–60 min**Continuous IV infusion (see remarks):****Neonate:** 0.02–0.04 mg/kg/hr**Child:** 0.03–1 mg/kg/hr**Adolescent and adult:** 0.02–0.04 mg/kg/hr

Onset of action is 1–2 min. May cause tachycardia, salivation, and wheezing. Severe anaphylactic reactions have been reported; cross reactivity between neuromuscular blocking agents has been reported.



Drug effects may be accentuated by hypothermia, acidosis, neonatal age, decreased renal function, halothane, succinylcholine, hypokalemia, hyponatremia, hypocalcemia, clindamycin, tetracycline, and aminoglycoside antibiotics. Drug effects may be antagonized by alkalosis, hypercalcemia, peripheral neuropathies, diabetes mellitus, demyelinating lesions, carbamazepine, phenytoin,

PANCURONIUM BROMIDE *continued*

theophylline, anticholinesterases (e.g., neostigmine, pyridostigmine), and azathioprine. For obese patients, use of lean body weight for dose calculation has been recommended to prevent intense block of long duration and possible overdose.

Antidote is neostigmine (with atropine or glycopyrrolate). **Avoid** use in severe renal impairment (<10 mL/min). Patients with cirrhosis may require a high initial dose to achieve adequate relaxation, but muscle paralysis will be prolonged.

PANTOPRAZOLE

Protonix and generics

Gastric acid pump inhibitor

C 2 Yes Yes Yes

Tab, delayed release: 20, 40 mg**Injection:** 40 mg; contains edetate sodium**Oral suspension:** 2 mg/mL; contains 0.25 mEq sodium bicarbonate per 1 mg drug**Enterically coated granules for delayed-release oral suspension (Protonix):** 40 mg packets (30s); contains polysorbate 80**Child (see remarks):****GERD (limited data):**

Infant and <5 yr: 1.2 mg/kg/24 hr PO once daily. **Note:** Pantoprazole did not significantly improve GERD symptoms scores in an open-label trial in 128 infants (1–11 mo) receiving 1.2 mg/kg/24 hr PO once daily \times 4 wk, followed by a 4 wk double blinded placebo-controlled withdrawal phase.

≥ 5 yr and adolescent: 20 or 40 mg PO once daily

GERD with erosive esophagitis:

1–5 yr (limited data): 0.3, 0.6, or 1.2 mg/kg/24 hr PO once daily all improved GERD symptoms in an 8-wk multicenter, randomized placebo control trial for 60 subjects with GERD and histologic/erosive esophagitis.

 ≥ 5 yr (up to 8 wk of therapy):

15–<40 kg: 20 mg PO once daily

≥ 40 kg: 40 mg PO once daily

IV (data limited to pharmacokinetic trials): Some doses ranging from 0.32–1.88 mg/kg/dose have been reported from three separate trials (total $N = 31$; 0.01–16.4 yr). Patients with systemic inflammatory response syndrome (SIRS) cleared the drug more slowly, resulting in higher T_{1/2} and AUC, than patients without. Despite limited data, 1–2 mg/kg/24 hr \div Q12–24 hr have been used. Additional studies are needed.

Adult:**GERD with erosive esophagitis:**

PO: 40 mg once daily \times 8–16 wk

IV: 40 mg once daily \times 7–10 days

Peptic ulcer: 40–80 mg PO once daily \times 4–8 wk

Hypersecretory conditions:

PO: 40 mg BID; dose may be increased as needed up to a **max. dose** of 240 mg/24 hr.

IV: 80 mg Q12 hr; dose may be increased as needed to Q8 hr (**max. dose:** 240 mg/24 hr). Therapy $>$ 7 days at 240 mg/24 hr has not been evaluated.

Convert from IV to PO therapy as soon as patient is able to tolerate PO. Common side effects include diarrhea and headache. May cause transient elevation in LFTs. Like other PPIs, may increase risk for *Clostridium difficile*-associated diarrhea. Hypomagnesemia has been reported with long-term use. Hypersensitivity reactions (e.g., anaphylaxis, shock,

*Continued*

PANTOPRAZOLE *continued*

angioedema, bronchospasm, acute interstitial nephritis, and urticaria), agranulocytosis, pancytopenia, and taste disorders have been reported. Fundic gland polyps have been associated with long term use of PPIs.

May interfere with serum chromogranin A (CgA) diagnostic test for neuroendocrine tumors; discontinue use at least 14 days prior to testing. False-positive test for urine cannabinoid screen may occur.

Drug is a substrate for CYP 450 2C19 (major), 2D6 (minor), and 3A3/4 (minor) isoenzymes. Recommended dosage modification for ultrarapid metabolizers of CYP 2C19 is to increase the usual dose by fivefold. May decrease the absorption of itraconazole, ketoconazole, iron salts, and ampicillin esters. May increase the effect/toxicity of methotrexate.

Children 1–2 yr of age have demonstrated more rapid clearance of pantoprazole in pharmacokinetic studies; this age group may require higher doses. All oral doses may be taken with or without food.

Do not crush or chew tablets. The extemporaneously compounded oral suspension may be less bioavailable owing to the loss of the enteric coating. Granules for delayed-release oral suspension product may be mixed with 5 mL apple juice (administer immediately followed by rinsing container with more apple juice), or sprinkled on 1 teaspoonful of apple sauce (administer within 10 min); see package insert for NG administration.

For IV infusion, doses may be administered over 15 min at a concentration of 0.4–0.8 mg/mL or over 2 min at a concentration of 4 mg/mL. Midazolam and zinc are **not compatible** with the IV dosage form. Parenteral routes other than IV are **not recommended**.

PAROMOMYCIN SULFATE

Generics; previously available as Humatin
Amebicide, antibiotic (aminoglycoside)



Caps: 250 mg

Intestinal amebiasis (Entamoeba histolytica), Dientamoeba fragilis, and Giardia lamblia infection:

Child and adult: 25–35 mg/kg/24 hr PO ÷ Q8 hr × 7 days



Tapeworm (Taenia saginata, Taenia solium, Diphyllobothrium latum, and Dipylidium caninum):

Child: 11 mg/kg/dose PO Q15 min × 4 doses

Adult: 1 g PO Q15 min × 4 doses

Tapeworm (Hymenolepis nana):

Child and adult: 45 mg/kg/dose PO once daily × 5–7 days

Cryptosporidial diarrhea:

Adult: 1.5–2.25 g/24 hr PO ÷ 3–6× daily. Duration varies from 10–14 days to 4–8 wk. Maintenance therapy has also been used. Alternatively, 1 g PO BID × 12 wk in conjunction with azithromycin 600 mg PO once daily × 4 wk has been used in patients with AIDS.

Contraindicated in intestinal obstruction. **Use with caution** in ulcerative bowel lesions to avoid renal toxicity via systemic absorption. Drug is generally poorly absorbed and therefore not indicated for sole treatment of extraintestinal amebiasis. Side effects include GI disturbance, hematuria, rash, ototoxicity, and hypcholesterolemia. Bacterial overgrowth of nonsusceptible organisms, including fungi, may occur. May decrease the effects of digoxin.



PAROXETINE

Paxil, Pexeva, Paxil CR, Brisdelle, and generics

Antidepressant, selective serotonin reuptake inhibitor

B

2

Yes

Yes

Yes

Tabs (Paxil, Pexeva, and generics): 10, 20, 30, 40 mg**Caps (Bridelle and generics):** 7.5 mg**Controlled-release tabs (Paxil CR and generics):** 12.5, 25, 37.5 mg**Oral suspension (Paxil):** 10 mg/5 mL (250 mL); contains saccharin and parabens**Child:****Depression:** Well-controlled clinical trials have failed to demonstrate efficacy in children.

The FDA recommends paroxetine not to be used for this indication.

Obsessive compulsive disorder (limited data, based on a 10-wk randomized controlled trial in 207 children 7–17 yr; mean age 11.1 + 3.03 yr): Start with 10 mg PO once daily. If needed, adjust upwards by increasing dose no more than 10 mg/24 hr no more frequently than Q7 days up to a **max. dose** of 50 mg/24 hr. Mean doses of 20.3 mg/24 hr (children) and 26.8 mg/24 hr (adolescents) were used.**Social anxiety disorder (limited data; 8–17 yr):** Start with 10 mg PO once daily. If needed, increase dose by 10 mg/24 hr no more frequently than Q7 days up to a **max. dose** of 50 mg/24 hr.**Adult:****Depression:****Immediate release dosage forms:** Start with 20 mg PO QAM ×4 wk. If no clinical improvement, increase dose by 10 mg/24 hr Q7 days PRN up to a **max. dose** of 50 mg/24 hr.**Controlled-release tabs (Paxil CR and generics):** Start with 25 mg PO QAM ×4 wk. If no improvement, increase dose by 12.5 mg/24 hr Q7 days PRN up to a **max. dose** of 62.5 mg/24 hr.**Obsessive compulsive disorder (immediate release):** Start with 20 mg PO once daily; increase dose by 10 mg/24 hr Q7 days PRN up to a **max. dose** of 60 mg/24 hr. Usual dose is 40 mg PO once daily.**Panic disorder:****Immediate release dosage forms:** Start with 10 mg PO QAM; increase dose by 10 mg/24 hr Q7 days PRN up to a **max. dose** of 60 mg/24 hr.**Paxil CR:** Start with 12.5 mg PO QAM; increase dose by 12.5 mg/24 hr Q7 days PRN up to a **max. dose** of 75 mg/24 hr.**Contraindicated** in patients taking MAO inhibitors (within 14 days of discontinuing MAO inhibitors), linezolid, methylene blue, pimozide, or thioridazine. **Use with caution** in patients with history of seizures, renal or hepatic impairment, cardiac disease, suicidal concerns, mania/hypomania, concurrent use with other serotonergic drugs (e.g., triptans, fentanyl, lithium, tramadol, amphetamines, or St. John's Wort), and diuretic use. Patients with severe renal or hepatic impairment should initiate therapy at 10 mg/24 hr and increase dose as needed up to a **max.** of 40 mg/24 hr.

Common side effects include anxiety, nausea, anorexia, and decreased appetite. Monitor for clinical worsening of depression and suicidal ideation/behavior following the initiation of therapy or after dose changes. Stevens-Johnson syndrome has been reported.

Paroxetine is an inhibitor and substrate for CYP 450 2D6. Ultrametabolizers of CYP 2D6 should avoid use of paroxetine and use an alternative medication not metabolized by this enzyme system. A 50% initial dose reduction for poor CYP 2D6 metabolizers has been recommended. May increase the effects/toxicity of tricyclic antidepressants, theophylline, and warfarin. May decrease the effects of tamoxifen. Cimetidine, ritonavir, MAO inhibitors (fatal serotonin syndrome), dextromethorphan, phenothiazines, and type 1C antiarrhythmics may increase the effect/toxicity of paroxetine.

Weakness, hyperreflexia, and poor coordination have been reported when taken with sumatriptan.

Do not discontinue therapy abruptly; may cause sweating, dizziness, confusion, and tremor. May be taken with or without food.

PENICILLIN G PREPARATIONS—AQUEOUS POTASSIUM AND SODIUM

Pfizerpen and generics

Antibiotic, aqueous penicillin**Injection (K^+):** 5, 20 million units (contains 1.7 mEq K and 0.3 mEq Na/1 million units penicillin G)**Premixed frozen injection (K^+):** 1 million units in 50 mL dextrose 4%; 2 million units in 50 mL dextrose 2.3%; 3 million units in 50 mL dextrose 0.7% (contains 1.7 mEq K and 0.3 mEq Na/1 million units penicillin G)**Injection (Na^+):** 5 million units (contains 2 mEq Na/1 million units penicillin G)**Conversion:** 250 mg = 400,000 units**Neonate (IM/IV; use higher end of dosage range for meningitis and severe infections):** **≤ 7 days old:** 50,000–100,000 units/kg/24 hr \div Q12 hr**8–28 days old:****<1 kg:****8– ≤ 14 days old:** 50,000–100,000 units/kg/24 hr \div Q12 hr**15–28 days old:** 75,000–150,000 units/kg/24 hr \div Q8 hr **≥ 1 kg:** 75,000–150,000 units/kg/24 hr \div Q8 hr**Group B streptococcal meningitis:** **≤ 7 days:** 250,000–450,000 units/kg/24 hr \div Q8 hr**8–28 days:** 450,000–500,000 units/kg/24 hr \div Q4–6 hr**Congenital syphilis (total of 10 days of therapy; if >1 day of therapy is missed, restart the entire course):** **≤ 7 days:** 100,000 units/kg/24 hr \div Q12 hr IV; increase to the following dosage at day 8 of life.**8–28 days:** 150,000 units/kg/24 hr \div Q8 hr IV**Infant, child, and adolescent:****IM/IV (use higher end of dosage range and Q4 hr interval for meningitis and severe infections):**100,000–400,000 units/kg/24 hr \div Q4–6 hr; **max. dose:** 24 million units/24 hr**Neurosyphilis:****Infant and child:** 200,000–300,000 units/kg/24 hr \div Q4–6 hr IV \times 10–14 days;
max. dose: 24 million units/24 hr**Adolescent:** 3–4 million units Q4 hr IV \times 10–14 days; **max. dose:** 24 million units/24 hr**Adult:****IM/IV:** 12–24 million units/24 hr \div Q4–6 hr**Neurosyphilis:** 18–24 million units/24 hr \div Q4–6 hr IV \times 10–14 days.

Use penicillin V potassium for oral use. Side effects: anaphylaxis, urticaria, hemolytic anemia, interstitial nephritis, Jarisch-Herxheimer reaction (syphilis). Preparations containing potassium and/or sodium salts may alter serum electrolytes. $T_{1/2} = 30$ min; may be prolonged by concurrent use of probenecid. For meningitis, use higher daily dose at shorter dosing intervals. For the treatment of anthrax (*Bacillus anthracis*), see www.bt.cdc.gov for additional information. **Adjust dose in renal impairment (see Chapter 31).**

Tetracyclines, chloramphenicol, and erythromycin may antagonize penicillin's activity.

Probenecid increases penicillin levels. May cause false-positive or false-negative urinary glucose (Clintest method), false-positive direct Coombs test, and false-positive urinary and/or serum proteins.

PENICILLIN G PREPARATIONS—BENZATHINE

Bicillin L-A

Antibiotic, penicillin (very-long-acting IM)**Injection:** 600,000 units/mL (1, 2, 4 mL); contains parabens and povidone**Injection should be IM only.****Group A streptococci:****Infant and child:** 25,000–50,000 units/kg/dose IM ×1. **Max. dose:** 1.2 million units/dose **OR:****>1 mo and <27 kg:** 600,000 units/dose IM ×1**≥27 kg and adult:** 1.2 million units/dose IM ×1**Rheumatic fever prophylaxis (Q3 wk administration is recommended for high-risk situations):****Infant and child (>1 mo and <27 kg):** 600,000 units/dose IM Q3–4 wk.**Child ≥27 kg and adult:** 1.2 million units/dose IM Q3–4 wk**Congenital Syphilis:****Neonate:** 50,000 units/kg/dose IM ×1**Syphilis (if >1 day of therapy is missed, restart the entire course; divided total dose into two injection sites):****Infant and child:****Primary, secondary, and early latent syphilis (<1-yr duration):** 50,000 units/kg/dose ×1**Late latent syphilis or latent syphilis of unknown duration:** 50,000 units/kg/dose Q7 days ×3 doses.**Max. dose:** 2.4 million units/dose**Adult:****Primary, secondary, and early latent syphilis:** 2.4 million units/dose IM ×1**Late latent syphilis or latent syphilis of unknown duration:** 2.4 million units/dose IM Q7 days ×3 doses.**Provides sustained levels for 2–4 wk. Use with caution in renal failure, asthma, G6PD deficiency (risk for methemoglobinemia), and cephalosporin hypersensitivity. Side effects and drug interactions same as for Penicillin G Preparations—Aqueous Potassium and Sodium. Injection site reactions are common.****Deep IM administration only. Do not administer intravenously** (cardiac arrest and death may occur), and **do not inject** into or near an artery or nerve (may result in permanent neurologic damage).**PENICILLIN G PREPARATIONS—PENICILLIN G BENZATHINE****AND PENICILLIN G PROCAINE**

Bicillin C-R, Bicillin C-R 900/300

Antibiotic, penicillin (very-long-acting IM)**Bicillin CR:** 300,000 units penicillin G procaine + 300,000 units penicillin G benzathine/mL to provide 600,000 units penicillin per 1 mL (2 mL Tubex syringe)**Bicillin CR (900/300):** 150,000 units penicillin G procaine + 450,000 units penicillin G benzathine/mL (2 mL Tubex syringe)

All preparations contain parabens and povidone.

Injection should be for IM use only.**Dosage based on total amount of penicillin.****Group A streptococci (see remarks):****Infant and child (Bicillin CR):****<14 kg:** 600,000 units/dose IM ×1**14–27 kg:** 900,000–1,200,000 units/dose IM ×1

PENICILLIN G PREPARATIONS—PENICILLIN G BENZATHINE AND PENICILLIN G PROCAINE *continued*

Dosage based on total amount of penicillin.

Group A streptococci (see remarks; cont.):

Child >27 kg and adult

Bicillin C-R: 2,400,000 units/dose IM ×1

Bicillin C-R 900/300: 1,200,000 units/dose IM ×1

Pneumococcal infection (non-CNS): dosed Q2–3 days until afebrile for 48 hr (see remarks)

Child (Bicillin C-R): 600,000 units/dose IM

Adult (Bicillin C-R or Bicillin C-R 900/300): 1,200,000 units/dose IM

This preparation provides early peak levels in addition to prolonged levels of penicillin in the blood.

Do not use this product to treat syphilis; treatment failure can occur. Use with caution in renal failure, asthma, significant allergies, G6PD deficiency (risk for methemoglobinemia), and cephalosporin hypersensitivity. The addition of procaine penicillin has not been shown to be more efficacious than benzathine alone. However, it may reduce injection discomfort.

Deep IM administration only. Do not administer intravenously (cardiac arrest and death may occur), and **do not inject into or near an artery or nerve** (may result in permanent neurologic damage).

Side effects and drug interactions same as for Penicillin G Preparations—Aqueous Potassium and Sodium. Immune hypersensitivity reaction has been reported.



PENICILLIN G PREPARATIONS—PROCAINE

Generics; previously available as Wycillin

Antibiotic, penicillin (long-acting IM)



B



2



Yes



No



No

Injection: 600,000 units/mL (1, 2 mL); may contain parabens, phenol, povidone, and formaldehyde) Contains 120 mg procaine per 300,000 units penicillin.

Injection should be for IM use only.



Newborn (see remarks): 50,000 units/kg/24 hr IM once daily

Infant and child: 25,000–50,000 units/kg/24 hr ÷ Q12–24 hr IM. **Max. dose:** 4.8 million units/24 hr

Adult: 0.6–4.8 million units/24 hr ÷ Q12–24 hr IM

Congenital syphilis, syphilis (if >1 day of therapy is missed, restart the entire course; see remarks):

Neonate, infant, child: 50,000 units/kg/dose once daily IM ×10 days.

Neurosyphilis (see remarks):

Adolescent and adult: 2.4 million units IM once daily and probenecid 500 mg Q6 hr PO ×10–14 days (both medications).

Inhaled anthrax: Postexposure prophylaxis (total duration of therapy with all forms of therapy is 60 days; switch to an alternative form of therapy after 2 wk of procaine penicillin because of the risk for adverse effects; see remarks):

Child and adolescent: 25,000 units/kg/dose (**max. dose:** 1.2 million units/dose) IM Q12 hr

Adult: 1.2 million units IM Q12 hr

Provides sustained levels for 2–4 days. **Use with caution** in renal failure, asthma, significant allergies, cephalosporin hypersensitivity, G6PD deficiency (risk for methemoglobinemia), and neonates (higher incidence of sterile abscess at injection site and risk of procaine toxicity). Side effects and drug interactions similar to Penicillin G Preparations—Aqueous Potassium and Sodium. In addition, may cause CNS stimulation and seizures. Immune hypersensitivity reaction has been reported.

Deep IM administration only. Do not administer intravenously (cardiac arrest and death may occur), and **do not inject** into or near an artery or nerve (may result in permanent neurologic damage).

Large doses may be administered in two injection sites. No longer recommended for empiric treat-



PENICILLIN V POTASSIUM

Generics; previously available as Veetids

Antibiotic, penicillin

B



2



Yes



No



No

Tabs: 250, 500 mg**Oral solution:** 125 mg/5 mL, 250 mg/5 mL (100, 200 mL); may contain saccharin

Contains 0.7 mEq potassium/ 250 mg drug

Conversion: 250 mg = 400,000 units**Infant and child:** 25–75 mg/kg/24 hr ÷ Q6–8 hr PO; **max. dose:** 2 g/24 hr**Adolescent and adult:** 125–500 mg/dose PO Q6–8 hr**Acute group A streptococcal pharyngitis (use BID dosing regimen ONLY if good compliance is expected):****Child <27 kg:** 250 mg PO BID–TID ×10 days**Child ≥27 kg, adolescent and adult:** 500 mg PO BID–TID ×10 days**Rheumatic fever prophylaxis, and pneumococcal prophylaxis for sickle cell disease and functional or anatomic asplenia (regardless of immunization status):****2 mo – <3 yr:** 125 mg PO BID**3–5 yr:** 250 mg PO BID; for sickle cell and asplenia, use may be discontinued after 5 yr of age if child received recommended pneumococcal immunizations and did not experience invasive pneumococcal infection.**Recurrent rheumatic fever prophylaxis:****Child and adult:** 250 mg PO BIDSee Penicillin G Preparations—Aqueous Potassium and Sodium for side effects and drug interactions. GI absorption is better than penicillin G. **Note:** Must be taken 1 hr before or 2 hr after meals. Penicillin will prevent rheumatic fever if started within 9 days of the acute illness. **Adjust dose in renal failure (see Chapter 31).****PENTAMIDINE ISETHIONATE**

Pentam 300, NebuPent, and generics

Antibiotic, antiprotozoal

C



3



Yes



No



No

Injection (Pentam 300 and generics): 300 mg**Inhalation (NebuPent):** 300 mg**Treatment (child and adult):*****Pneumocystis jiroveci (carinii):*** 4 mg/kg/24 hr IM/IV once daily ×14–21 days
(IV is the preferred route)***Trypanosomiasis (Trypanosoma gambiense, Trypanosoma rhodesiense without CNS involvement):***

4 mg/kg/24 hr IM/IV once daily ×7–10 days

Visceral leishmaniasis (Leishmania donovani, L. infantum, L. chagasi): 4 mg/kg/dose IM/IV once daily, or once every other day ×15–30 doses***Cutaneous leishmaniasis (Leishmania [Viannia] panamensis]:*** 2–4 mg/kg/dose IM/IV once or twice a week until lesions healed**Prophylaxis (child and adult):*****P. jiroveci (carinii):***IM/IV: 4 mg/kg/dose Q4 wk (Q2–4 wk for hematopoietic stem cell transplant); **max. single dose:** 300 mg***Inhalation (use with Respigard II nebulizer):***<5 yr: 9 mg/kg (**max. dose:** 300 mg/dose) Q month

≥5 yr: 300 mg Q month

PENTAMIDINE ISETHIONATE *continued*

Use with caution in ventricular tachycardia, Stevens-Johnson syndrome, and daily doses >21 days.

May cause hypoglycemia, hyperglycemia, hypotension (both IV and IM administration), nausea, vomiting, fever, mild hepatotoxicity, pancreatitis, megaloblastic anemia, nephrotoxicity, hypocalcemia, and granulocytopenia. Additive nephrotoxicity with aminoglycosides, amphotericin B, cisplatin, and vancomycin may occur. Aerosol administration may also cause bronchospasm, cough, oxygen desaturation, dyspnea, and loss of appetite. Infuse IV over 1–2 hr to reduce the risk of hypotension. Sterile abscess may occur at IM injection site.

Adjust dose in renal impairment (see Chapter 31) with systemic use.

**PENTOBARBITAL**

Nembutal and generics

Barbiturate

D



3



No



Yes



No

Injection: 50 mg/mL (20, 50 mL); contains propylene glycol and 10% alcohol

**Hypnotic****Child:**

IM: 2–6 mg/kg/dose. **Max. dose:** 100 mg

Adult:

IM: 150–200 mg

Reduction in Elevated ICP (adjunct therapy; patient must be intubated): Barbiturate coma may be used if needed.

Child and adolescent:

IV/IO: 1–3 mg/kg/dose

IM/PR: 2–6 mg/kg/dose

Max. dose: 100 mg/dose

Barbiturate coma**Child and adult:**

IV: loading dose: 10–15 mg/kg given slowly over 1–2 hr

Maintenance: Begin at 1 mg/kg/hr. Dose range: 1–3 mg/kg/hr as needed.



Contraindicated in liver failure and history of porphyria. Use in preprocedure sedation has been replaced by other agents. **Use with caution** in hypovolemic shock, CHF, hypotension, and hepatic impairment. No advantage over phenobarbital for control of seizures. May cause drug-related isoelectric EEG. **Do not administer** for >2 wk in treatment of insomnia. May cause hypotension, arrhythmias, hypothermia, respiratory depression, and dependence.

Onset of action: IM: 10–15 min; IV: 1 min. Duration of action: IV: 15 min.

Administer IV at a rate of <50 mg/min.

Therapeutic serum levels: sedation: 1–5 mg/L; hypnosis: 5–15 mg/L; coma: 20–40 mg/L (steady state is achieved after 4–5 days of continuous IV dosing).

PERMETHRIN

Elimite, Nix, and generics

Scabicidal agent

B



2



No



No



No

Cream (Elimite and generics): 5% (60 g); contains 0.1% formaldehyde

Liquid cream/rinse/lotion (Nix Lice Killing Crème Rinse-OTC and generics) [OTC]: 1% (59 mL with comb); may contain 20% isopropyl alcohol

PERMETHRIN continued

Additional OTC permethrin products for use on bedding, furniture, and garments include the following:

Liquid spray (Nix Lice Control Spray): 0.25% (150 mL)

Spray (Rid Home Lice Bedbug and Dust Mite Spray): 0.5% (141.8 g)

Pediculus humanus capitis, Phthirus pubis (> 2 mo, child, and adolescent):

Head lice: Saturate hair and scalp with 1% cream rinse/lotion after shampooing, rinsing, and towel drying hair. Leave on for 10 min, then rinse. May repeat in 7 days. May be used for lice in other areas of the body (e.g., pubic lice) in same fashion. If the 1% cream rinse is resistant, the 5% cream may be used after shampooing, rinsing, and towel drying hair. Leave on for 8–14 hr overnight under a shower cap; then rinse off. May repeat in 7 days.

Scabies: Apply 5% cream from neck to toe (head to toe for infants and toddlers) wash off with water in 8–14 hr. May repeat in 14 days if mites appear. Use in full-term infants <1 mo is safe and effective when applied for a 6 hr period.

Ovicidal activity generally makes single-dose regimen adequate. However, resistance to permethrin has been reported. May cause pruritus, hypersensitivity, burning, stinging, erythema, and rash. For either lice or scabies, instruct patient to launder bedding and clothing. For lice, treat symptomatic contacts only. For scabies, treat all contacts even if asymptomatic.

Avoid contact with eyes during application. Shake well before using. Do not use near eyes, inside of nose, mouth, or vagina, or for lice in eyebrows/eyelashes. Topical cream dosage form contains formaldehyde. Dispense 60 g per one adult or two small children.

**PHENAZOPYRIDINE HCL**

Pyridium, Azo-Urinary Pain Relief [OTC], Azo-Urinary Pain Relief Maximum Strength [OTC], and generics
Urinary analgesic



Tabs: 95 mg [OTC] (12s, 30s), 97.5 mg [OTC] (12s, 24s), 99.7 mg [OTC] (6s, 12s, 48s), 100 mg, 200 mg

Oral suspension: 10 mg/mL

**UTI (use with an appropriate antibacterial agent):**

Child 6–<12 yr: 12 mg/kg/24 hr ÷ TID PO until symptoms of lower urinary tract irritation are controlled or for 2 days. **Max. dose:** 200 mg/dose.

≥12 yr and adult: 190–200 mg TID PO until symptoms are controlled or for 2 days.



May cause pruritus, rash, GI distress, vertigo, and headache. Anaphylactoid-like reaction, methemoglobinemia, hemolytic anemia, and renal and hepatic toxicity have been reported, usually at overdosage levels. Colors urine orange; stains clothing. May also stain contact lenses and interfere with urinalysis tests based on spectrometry or color reactions. Give doses with or after meals.

Avoid use in moderate/severe renal impairment; adjust dose in mild renal impairment (see Chapter 31).

PHENOBARBITAL

Generics; previously available as Luminal
Barbiturate



Tabs: 15, 16.2, 30, 32.4, 60, 64.8, 97.2, 100 mg

Elixir or oral solution: 20 mg/5 mL (473 mL); may contain alcohol

Injection: 65, 130 mg/mL (1 mL); may contain 10% alcohol and propylene glycol

Status epilepticus:

Loading dose, IV:



Neonate, infant, and child: 15–20 mg/kg/dose (max. loading dose: 1000 mg) in a single or divided dose. May give additional 5 mg/kg doses Q15–30 min to a **max. total** of 40 mg/kg.

Seizures maintenance therapy (PO/IV): Monitor levels.

Neonate: 3–5 mg/kg/24 hr ÷ once daily—BID

Infant: 5–6 mg/kg/24 hr ÷ once daily—BID

Child 1–5 yr: 6–8 mg/kg/24 hr ÷ once daily—BID

Child 6–12 yr: 4–6 mg/kg/24 hr ÷ once daily—BID

>12 yr: 1–3 mg/kg/24 hr ÷ once daily—BID

Hyperbilirubinemia (limited data; <12 yr): 3–8 mg/kg/24 hr PO ÷ BID–TID. Doses up to 12 mg/kg/24 hr have been used. Not recommended for biliary cirrhosis.

Preoperative sedation (child): 1–3 mg/kg/dose IM/IV/PO × 1. Give 60–90 min before procedure.

Contraindicated in porphyria, severe respiratory disease with dyspnea, or obstruction.



Use with caution in hepatic or renal disease (reduce dose). IV administration may cause respiratory arrest or hypotension. Side effects include drowsiness, cognitive impairment, ataxia, hypotension, hepatitis, rash, respiratory depression, apnea, megaloblastic anemia, and anticonvulsant hypersensitivity syndrome. Paradoxical reaction in children (not dose related) may cause hyperactivity, irritability, or insomnia. Induces several liver enzymes (CYP 450 1A2, 2A6, 2B6, 2C8/9, 3A4), P-glycoprotein, and glucuronidation (UGT1A1), thus decreases blood levels of many drugs (e.g., anticonvulsants). **IV push not to exceed 1 mg/kg/min.**

T_½ is variable with age: neonates, 45–100 hr; infants, 20–133 hr; children, 37–73 hr. Owing to long half-life, consider other agents for sedation for procedures.

Therapeutic levels: 15–40 mg/L. Recommended serum sampling time at steady state: trough level obtained within 30 min prior to the next scheduled dose after 10–14 days of continuous dosing.

Adjust dose in renal failure (see [Chapter 31](#)).

PHENTOLAMINE MESYLATE

OraVerse and generics; previously available as Regitine
Adrenergic blocking agent (α); antidote, extravasation



Injection: 5 mg vial; may contain mannitol

Injection in solution for submucosal use:

OraVerse: 0.4 mg/1.7 mL (1.7 mL in dental cartridges) (10s); contains edetate disodium



Treatment of α -adrenergic drug extravasation (most effective within 12 hr of extravasation):

All doses are five doses administered SC around the site of extravasation within 12 hr of extravasation. Monitor for hypotension (BP) Q15 min × 4 then Q1 hr × 2. See the following table for weight-based dosing and recommended drug concentration.

PHENTOLAMINE MESYLATE *continued*

Patient Weight	Drug Concentration (Diluted with Preservative-Free NS)	Dose for each syringe ×5 syringes	Total Dose from All 5 Syringes
<1 kg	0.2 mg/mL	0.05 mL	0.05 mg
1–<2.5 kg	0.2 mg/mL	0.1 mL	0.1 mg
2.5–<5 kg	1 mg/mL	0.05 mL	0.25 mg
5–<10 kg	1 mg/mL	0.1 mL	0.5 mg
10–<20 kg	1 mg/mL	0.2 mL	1 mg
20–<30 kg	1 mg/mL	0.4 mL	2 mg
30–<40 kg	1 mg/mL	0.6 mL	3 mg
40–<50 kg	1 mg/mL	0.8 mL	4 mg
≥50 kg	1 mg/mL	1 mL	5 mg

Max. total dose:**Neonate:** 2.5 mg**Infant, child, adolescent, and adult:** 0.1–0.2 mg/kg/dose or 5 mg**Diagnosis of pheochromocytoma, IM/IV:****Child:** 0.05–0.1 mg/kg/dose up to a **max. dose** of 5 mg.**Adult:** 5 mg/dose**Hypertension, prior to surgery for pheochromocytoma, IM/IV:****Child:** 0.05–0.1 mg/kg/dose up to a **max. dose** of 5 mg 1–2 hr **before** to surgery, repeat Q2–4 hr PRN.**Adult:** 5 mg/dose 1–2 hr **before** to surgery, repeat Q2–4 hr PRN.

Contraindicated in MI, coronary insufficiency and angina. **Use with caution** in hypotension, arrhythmias, and cerebral vascular spasm/occlusion.

For diagnosis of pheochromocytoma, patient should be resting in a supine position. A blood pressure reduction of more than 35 mm Hg systolic and 24 mm Hg diastolic is considered a positive test for pheochromocytoma. For treatment of extravasation, use 27- to 30-gauge needle with multiple small injections, and monitor site closely because repeat doses may be necessary.

**PHENYLEPHRINE HCL**

Vazculep, Neo-Synephrine, Biorphen, many others, and generics

Adrenergic agonist**Injection:****Vazculep and generics:** 10 mg/mL (1%) (1, 5, 10 mL); may contain metasulfites**Ready to use injection:****Biorphen:** 0.1 mg/mL (5 mL)**Nasal spray/drops [OTC; may contain benzalkonium chloride]:**

0.125% (Little Remedies Decongestant Nose Drops): 0.125% (15 mL)

0.25% (Neo-Synephrine Mild Strength, Rhinall): 0.25% (15, 30, 40 mL)

0.5% (Neo-Synephrine Regular Strength): 0.5% (15 mL)

1% (4-Way, Nasal Four, Neo-Synephrine Extra Strength): 1% (15, 30 mL)

NOTE: For Neo-Synephrine 12-hr Nasal, see Oxymetazoline**Ophthalmic drops (Altafrin and generics):** 2.5% (2, 15 mL), 10% (5 mL); contains benzalkonium chloride**Tabs (Sudafed PE and others) [OTC]:** 10 mg**Oral solution (Sudafed PE Children's; OTC):** 2.5 mg/5 mL (118 mL)*Continued*

PHENYLEPHRINE HCL *continued***Hypotension:**

NOTE: the IV drip dosage units for children are in mCg/kg/min, compared with mCg/min for adults. To prepare infusion: See inside front cover.

Child:

IV bolus: 5–20 mCg/kg/dose (initial **max. dose:** 500 mCg/dose, subsequent max. dose: 1000 mCg/dose) Q10–15 min PRN

IV drip: 0.1–0.5 mCg/kg/min; titrate to effect

IM/SC: 0.1 mg/kg/dose Q1–2 hr PRN; **max. dose:** 5 mg

Adult:

IV bolus: 0.1–0.5 mg/dose Q10–15 min PRN; max. initial dose: 0.5 mg/dose

IV drip: Initial rate at 100–180 mCg/min; titrate to effect. Usual maintenance dose: 40–60 mCg/min.

Pupillary dilation (see remarks):

<1 yr: 2.5% solution; 1 drop in each eye 15–30 min before exam.

Child (≥1 yr) and adult: 2.5% or 10% solution; 1 drop in each eye 10–60 min before exam.

Nasal decongestant (in each nostril; give up to 3 days):

Child 2–<6 yr: 1–3 drops to each nostril of 0.125% solution Q4 hr PRN

Child 6–12 yr: 1–3 sprays/drops to each nostril of 0.25% solution Q4 hr PRN

>12 yr–adult: 1–3 sprays/drops to each nostril of 0.25%, 0.5% or 1% solution Q4 hr PRN

Oral decongestant (see remarks):

4–<6 yr: 2.5 mg (5 mL) PO Q4 hr PRN, up to 15 mg (30 mL)/24 hr

≥6–<12 yr: 5 mg (10 mL) PO Q4 hr PRN up to 30 mg (60 mL)/24 hr

≥12 yr and adult: 10 mg PO Q4 hr PRN up to 60 mg/24 hr

Use with **caution** in presence of arrhythmias, hyperthyroidism, or hyperglycemia. May cause tremor, insomnia, or palpitations. Metabolized by MAO. **Contraindicated** in pheochromocytoma and severe hypertension. Injectable product may contain sulfites.

Nasal decongestants may cause rebound congestion with excessive use (>3 days). The 1% nasal spray can be used in adults with extreme congestion.

Oral phenylephrine is found in a variety of combination cough and cold products and has replaced pseudoephedrine and phenylpropanolamine. Over-the-counter (OTC or nonprescription) use of this product is **not recommended** for children younger than age 6; reports of serious adverse effects (cardiac and respiratory distress, convulsions, and hallucinations) and fatalities (from unintentional overdosages, including combined use of other OTC products containing the same active ingredients) have been made.

Ophthalmic use: Apply pressure to the lacrimal sac during and 2 min after administering drops to minimize systemic absorption.

PHENYTOIN

Dilantin, Dilantin Infatab, Phenytoin Infatab, Phenytek, and generics

Anticonvulsant, class Ib antiarrhythmic



D



2



Yes



Yes



Yes

Chewable tabs (Dilantin Infatab and generics): 50 mg

Extended-release caps:

Dilantin: 30, 100 mg

Phenytek: 200, 300 mg

Generics: 100, 200, 300 mg

Oral suspension (Dilantin and generics): 125 mg/5 mL (240 mL); contains ≤0.6% alcohol

Injection: 50 mg/mL (2, 5 mL); contains alcohol and sodium benzoate

D

PHENYTOIN continued

Status epilepticus: See [Chapter 1](#) and remarks.

Loading dose (all ages): 20 mg/kg IV; **max. dose:** 1500 mg/24 hr

Maintenance for seizure disorders (initiate 12 hr after administration of loading dose):

Neonate: start with 5 mg/kg/24 hr PO/IV ÷ Q12 hr; usual range 4–8 mg/kg/24 hr PO/IV ÷ Q8–12 hr.

Infant/child: start with 5 mg/kg/24 hr ÷ BID–TID PO/IV; usual dose range (doses divided BID–TID):

6 mo–3 yr: 8–10 mg/kg/24 hr

4–6 yr: 7.5–9 mg/kg/24 hr

7–9 yr: 7–8 mg/kg/24 hr

10–16 yr: 6–7 mg/kg/24 hr

Note: Use once daily–BID dosing with extended release caps.

Adult: Start with 100 mg/dose Q8 hr IV/PO and carefully titrate (if needed) by 100 mg increments Q2–4 wk to 300–600 mg/24 hr (or 6–7 mg/kg/24 hr) ÷ Q8–24 hr IV/PO.

Contraindicated in patients with heart block or sinus bradycardia; those who are receiving delavirdine (decrease virologic response); and history of hydantoin hypersensitivity. **Use with caution** in patients with pacemakers or cardiac dysrhythmias because of its class IB antiarrhythmic properties. IM administration is **not recommended** because of erratic absorption and pain at injection site; consider fosphenytoin. Side effects include gingival hyperplasia, hirsutism, dermatitis, blood dyscrasias, ataxia, lupus-like and Stevens-Johnson syndromes, lymphadenopathy, liver damage, and nystagmus. Suicidal behavior or ideation, bradycardia, cardiac arrest, and multiorgan hypersensitivity (DRESS) have been reported.

An increased risk for serious skin reactions (e.g., TEN and Stevens-Johnson) may occur in patients with the HLA-B*1502 allele; do not use this medication in individuals who carry this genotype.

Many drug interactions: levels may be increased by cimetidine, chloramphenicol, INH, sulfonamides, trimethoprim, etc. Levels may be decreased by some antineoplastic agents. Phenytoin induces hepatic microsomal enzymes (CYP 450 1A2, 2C8/9/19, and 3A3/4), leading to decreased effectiveness of oral contraceptives, fosamprenavir (used without ritonavir), quinidine, valproic acid, theophylline, and other substrates to the previously listed CYP 450 hepatic enzymes. May increase levels of amprenavir when administered with fosamprenavir and ritonavir. May cause resistance to neuromuscular blocking action of nondepolarizing neuromuscular blocking agents (e.g., pancuronium, vecuronium, rocuronium, and cisatracurium) and decrease concentrations of T₄ and T₃ (typically without clinical hypothyroidism).

The following initial maintenance dose modifications for HLA-B*1502 allele noncarriers and CYP 450 2C9 phenotypes have been recommended:

CYP 2C9 intermediate metabolizer: 25% reduction with therapeutic drug monitoring

CYP 2C9 poor metabolizer: 50% reduction with therapeutic drug monitoring

Ideal body weight should be used for calculating dosages. Suggested dosing intervals for specific oral dosage forms: extended release caps (once daily–BID); chewable tablets, and oral suspension (TID). Oral absorption reduced in neonates. T_{1/2} is variable (7–42 hr) and dose dependent. Drug is highly protein bound; free fraction of drug will be increased in patients with hypoalbuminemia.

For seizure disorders, therapeutic levels: 10–20 mg/L (free and bound phenytoin) **OR** 1–2 mg/L (free only). Monitor free phenytoin levels in hypoalbuminemia or renal insufficiency. Recommended serum sampling times: trough level (PO/IV) within 30 min prior to the next scheduled dose; peak or postload level (IV) 1 hr after the end of IV infusion. Steady state is usually achieved after 5–10 days of continuous dosing. For routine monitoring, measure trough.

IV push/infusion rate: **Not to exceed** 0.5 mg/kg/min in neonates, or 1 mg/kg/min infants, children, and adults with **maximum** of 50 mg/min; may cause cardiovascular collapse. Consider fosphenytoin in situations of tenuous IV access and risk for extravasation.

PHOSPHORUS SUPPLEMENTS

K-PHOS Neutral, Av-Phos 250 Neutral, Phospho-Trin 250 Neutral, Phospha 250 Neutral, Virt-Phos 250 Neutral, PHOS-NaK, Sodium Phosphate, Potassium Phosphate, and many generics for injections

***Electrolyte supplement*****Oral:****Na and K phosphate:**

PHOS-NaK and generics; powder: 250 mg (8 mM) P, 6.96 mEq (160 mg) Na, 7.16 mEq (280 mg) K per packet of powder (100s); reconstitute with 75 mL water or juice per packet

K-PHOS Neutral, Av-Phos 250 Neutral, Phospho-Trin 250 Neutral, Phospha 250 Neutral, Virt-Phos 250 Neutral, and generics; tabs: 250 mg P (8 mM), 13 mEq Na, 1.1 mEq K; administer each dose with a full glass of water

K-PHOS No. 2; tabs: 250 mg P (8 mM), 5.8 mEq Na, 2.3 mEq K; administer each dose with a full glass of water

K phosphate:

K-Phos Original; tabs: 500 mg potassium acid phosphate (114 mg phosphorus and 3.7 mEq K); dissolve each tab in 3–4 oz water

Injection:

Na phosphate: 3 mM (93 mg) P, 4 mEq Na/mL (5 mL)

K phosphate: 3mM (93 mg) P, 4.4 mEq K/mL (5 mL)

Conversion: 31 mg P = 1 mM P



Acute hypophosphatemia: 0.16–0.32 mM/kg/dose (or 5–10 mg/kg/dose) IV over 6 hr

Maintenance/replacement:**Child:**

IV: 0.5–1.5 mM/kg (or 15–45 mg/kg) over 24 hr

PO: 30–90 mg/kg/24 hr (or 1–3 mM/kg/24 hr) ÷ TID–QID

Adult:

IV: 50–65 mM (or 1.5–2 g) over 24 hr

PO: 3–4.5 g/24 hr (or 100–150 mM/24 hr) ÷ TID–QID

Recommended IV infusion rate: ≤0.1 mM/kg/hr (or 3.1 mg/kg/hr) of phosphate. When potassium salt is used, the rate will be limited by the **max.** potassium infusion rate. **Do not** co-infuse with calcium containing products.



May cause tetany, hyperphosphatemia, hyperkalemia, or hypocalcemia. **Use with caution** in patients with renal impairment. Be aware of sodium and/or potassium load when supplementing phosphate. IV administration may cause hypotension and renal failure, or arrhythmias, heart block, cardiac arrest with potassium salt. PO dosing may cause nausea, vomiting, abdominal pain, or diarrhea. See Chapter 21 for daily requirements and Chapter 11 for additional information on hypophosphatemia and hyperphosphatemia.

PHYSOSTIGMINE SALICYLATE

Generics; previously available as Antilirium

Cholinergic agent

Injection: 1 mg/mL (2 mL); contains 2% benzyl alcohol and 0.1% sodium bisulfite

**Reversal of toxic anticholinergic effects from antihistamine or anticholinergic agents:**

Child: 0.02 mg/kg/dose IM or IV (administered no >0.5 mg/min), dose may be repeated every 5–10 min if no response or return of anticholinergic symptoms up to a **max. total** of 2 mg

D

PHYSOSTIGMINE SALICYLATE continued

Adult: 0.5–2 mg IM or IV (administered no >1 mg/min), if needed repeat dose every 10–30 min until response is seen or when adverse effects occurs.

Physostigmine antidote: Atropine always should be available. **Contraindicated** in asthma, gangrene, diabetes, cardiovascular disease, GI or GU tract obstruction, any vagotonic state, and patients receiving choline esters or depolarizing neuromuscular blocking agents (e.g., decamethonium, succinylcholine). May cause seizures, arrhythmias, bradycardia, GI symptoms, and other cholinergic effects. Rapid IV administration can cause bradycardia and hypersalivation leading to respiratory distress and seizures.

PHYTONADIONE/VITAMIN K₁

Mephyton and generics

Vitamin, fat soluble

C



2



No



No



No

Tabs (Mephyton and generics): 5 mg**Oral suspension:** 1 mg/mL**Injection, emulsion (contains no more than 110 mCg/L aluminum):**

2 mg/mL (0.5 mL); preservative free but contains propylene glycol

10 mg/mL (1 mL); contains 0.9% benzyl alcohol

**Vitamin K deficiency bleeding (Neonatal hemorrhagic disease): Preservative free dosage form is preferred.****Prophylaxis (IM, administered 1 hr within 1 hr after birth):**

<1 kg: 0.5 mg/kg/dose ×1

1–1.5 kg: 0.5 mg ×1

>1.5 kg: 1 mg ×1

Treatment: 1–2 mg/24 hr IM/SC/IV**Oral anticoagulant (warfarin) overdose (see remarks):****No significant bleeding:****INR 4–4.5:** Consider PO vitamin K at dosage indicated for INR >4.5–<10 below and monitor INR Q24 hr. Lower or hold warfarin dose.**INR >4.5–<10:** Hold warfarin dose and monitor INR Q24 hr until INR <4. Give vitamin K for patients with high bleeding risk:

<40 kg: 0.03 mg/kg PO ×1

≥40 kg: 1–2.5 mg PO ×1

INR ≥10: Hold warfarin dose and monitor INR Q12 hr and give vitamin K (dose may be repeated Q12–24 hr PRN):

<40 kg: 0.06 mg/kg PO ×1

≥40 kg: 5–10 mg PO ×1

Minor bleeding (any elevated INR): Hold warfarin and monitor INR Q12–24 hr, repeat vitamin K dose in 24 hr if full correction not achieved and bleeding persists.**PO:**

<40 kg: 0.03 mg/kg ×1

≥40 kg: 1–2.5 mg ×1

IV: 0.5–2.5 mg ×1**Significant or Life-threatening bleeding (any elevated INR):** Hold warfarin and give vitamin K 5–10 mg IV ×1 in combination with FFP (10–15 mL/kg) or prothrombin complex concentrate (KCentra).

Monitor INR Q4–6 hr, repeat vitamin K dose if full correction not achieved at 12–24 hr and bleeding persists.

PHYTONADIONE/VITAMIN K₁ *continued***Vitamin K deficiency:****Infant and child:****PO:** 2.5–5 mg/24 hr**IM/SC/IV:** 1–2 mg/dose ×1**Adolescent and adult:****PO:** 2.5–25 mg/24 hr**IM/SC/IV:** 2.5–25 mg/dose ×1

IV or IM doses may cause flushing, dizziness, cardiac/respiratory arrest, hypotension, and anaphylaxis. IV or IM administration is indicated only when other routes of administration are not feasible (or in emergency situations).



Monitor PT/PTT. Large doses (10–20 mg) in newborns may cause hyperbilirubinemia and severe hemolytic anemia. Blood coagulation factors increase within 6–12 hr after oral doses and within 1–2 hr following parenteral administration. Use of higher doses for warfarin overdose may cause warfarin resistance for ≥1 wk. Concurrent administration of oral mineral oil may decrease GI absorption of oral vitamin K.

IV injection rate **not to exceed** 3 mg/m²/min or 1 mg/min. Protect product from light. See **Chapter 21** for multivitamin preparations.

PILOCARPINE HCL

Isotopto Carpine, Salagen, and generics

Cholinergic agent

C

3

No

Yes

No

Ophthalmic solution (Isotopto Carpine and generics): 1% (15 mL), 2% (15 mL), 4% (15 mL); may contain benzalkonium chloride

Tab (Salagen and generics): 5, 7.5 mg

**For elevated intraocular pressure:**

Infant and child <2 yr: Instill 1 drop of the 1% solution into each affected eye(s) TID

Child ≥2 yr, adolescent, and adult: Instill 1–2 drop(s) in each affected eye up to 4 times a day; concentration and dosage frequency is dependent on the degree of elevated pressure and miotic response.

Xerostomia:

Adult: 5 mg/dose PO TID, dose may be titrated to 10 mg/dose PO TID in patients who do not respond to lower dose and who are able to tolerate the drug. 5 mg/dose PO QID has been used in Sjögren syndrome.

OPHTHALMIC USE: **Contraindicated** in acute iritis or anterior chamber inflammation and uncontrolled asthma. May cause stinging, burning, lacrimation, headache, and retinal detachment. **Use with caution** in patients with corneal abrasion or significant cardiovascular disease. Use with topical NSAIDs (e.g., ketorolac) may decrease topical pilocarpine effects.



ORAL USE: Sweating, nausea, rhinitis, chills, flushing, urinary frequency, dizziness, asthenia, and headaches have also been reported. Reduce oral dosing in the presence of mild hepatic insufficiency (Child-Pugh score of 5–6); **avoid use** in severe hepatic insufficiency.

PIMECROLIMUS

Elidel and generics

Topical immunosuppressant, calcineurin inhibitor**Cream:** 1% (30, 60, 100 g); contains benzyl alcohol and propylene glycol**Atopic dermatitis (second line therapy):**

Child ≥2 yr, adolescent, and adult (see remarks): Apply a thin layer to affected area BID and rub in gently and completely. Reevaluate patient in 6 wk if lesions are not healed.



Do not use in children <2 yr (higher rate of upper respiratory infections), in immunocompromised patients, or with occlusive dressings (promotes systemic absorption). **Avoid use** on malignant or premalignant skin conditions as rare cases of lymphoma and skin malignancy have been reported with topical calcineurin inhibitors. Approved as a second line therapy for atopic dermatitis for patients who fail to respond, or do not tolerate, other approved therapies. Use medication for short periods of time by using the minimum amounts to control symptoms; long-term safety is unknown. **Avoid** contact with eyes, nose, mouth, and cut, infected, or scraped skin. Minimize and **avoid** exposure to natural and artificial sunlight, respectively.

Most common side effects include burning at the application site, headache, viral infections, and pyrexia. Skin discoloration, skin flushing associated with alcohol use, anaphylactic reactions, ocular irritation after application to the eye lids or near the eyes, angioneurotic edema, and facial edema have been reported. Drug is a CYP 450 3A3/4 substrate.

PIPERACILLIN WITH TAZOBACTAM

Zosyn and generics

Antibiotic, penicillin (extended spectrum with β-lactamase inhibitor)**8:1 ratio of piperacillin to tazobactam:**

Injection, powder: 2 g piperacillin and 0.25 g tazobactam; 3 g piperacillin and 0.375 g tazobactam; 4 g piperacillin and 0.5 g tazobactam; 12 g piperacillin and 1.5 g tazobactam; 36 g piperacillin and 4.5 g tazobactam

Injection, premixed in iso-osmotic dextrose: 2 g piperacillin and 0.25 g tazobactam in 50 mL; 3 g piperacillin and 0.375 g tazobactam in 50 mL; 4 g piperacillin and 0.5 g tazobactam in 100 mL
Contains 2.84 mEq Na/g piperacillin

**All doses based on piperacillin component.****Neonate and infant (IV):****≤2 kg:****≤7 days old:** 100 mg/kg/dose Q8 hr**8–28 days old:****≤30 wk post menstrual age:** 100 mg/kg/dose Q8 hr**>30 wk post menstrual age:** 80 mg/kg/dose Q6 hr**29–60 days old:** 80 mg/kg/dose Q6 hr**>2 kg:****≤60 days old:** 80 mg/kg/dose Q6 hr

NOTE: For patients with a post menstrual age of >35 wk, a pharmacokinetic study suggests using 80 mg/kg/dose IV Q4 hr to achieve targeted drug concentration time above the MIC.

Continued

PIPERACILLIN WITH TAZOBACTAM continued

All doses based on piperacillin component.

Child and adolescent (IV): Severe infections (shortening the dosing interval to Q6 hr and lengthening the dose administration time to 4 hr (see remarks) may enhance the pharmacodynamic properties):

2–9 mo: 80 mg/kg/dose Q6–8 hr

>9 mo, child, and adolescent: 100 mg/kg/dose Q6–8 hr

Max. dose (all ages): 16 g/24 hr

Appendicitis or peritonitis (IV route for 7–10 days; dosing interval may be shortened to Q6 hr to enhance pharmacodynamic properties):

2–9 mo: 80 mg/kg/dose Q6–8 hr

>9 mo–adolescent:

≤40 kg: 100 mg/kg/dose (max. 3000 mg/dose) Q6–8 hr

>40 kg: 3 g/dose Q6 hr

Max. dose (all ages): 16 g/24 hr.

Adult:

Intra-abdominal or soft tissue infections: 3 g IV Q6 hr

Nosocomial pneumonia: 4 g IV Q6 hr

Cystic fibrosis (antipseudomonal; see remarks):

All ages: 350–600 mg/kg/24 hr IV ÷ Q4–6 hr; **max. dose:** 24 g/24 hr.

Tazobactam is a β -lactamase inhibitor, thus extending the spectrum of piperacillin. Like other penicillins, CSF penetration occurs only with inflamed meninges. GI disturbances, pruritus, rash, and headaches are common. Abnormal platelet aggregation and prolonged bleeding, serious skin reactions (e.g., Stevens-Johnson, DRESS, acute generalized exanthematous pustulosis, and TEN) have been reported. Cystic fibrosis patients have an increased risk for fever and rash. Increases in renal failure risk (in critically ill adults) and incidence of acute kidney injury (in combination with IV vancomycin) have been reported.

Coagulation parameters should be tested more frequently and monitored regularly with high doses of heparin, warfarin, or other drugs affecting blood coagulation or thrombocyte function. May falsely decrease amnoglycoside serum levels if the drugs are infused close to one another; allow a minimum of 2 hr between infusions to prevent this interaction. May prolong the neuromuscular blockade effects of vecuronium.

Prolonging the dose administration time to 4 hr will maximize the pharmacokinetic/pharmacodynamic properties by prolonging the time of drug concentration above the MIC; especially for pathogens with piperacillin MICs of 8–16 mCg/mL. **Adjust dose in renal impairment, (see Chapter 31).**

POLYCITRA

See Citrate Mixtures

POLYETHYLENE GLYCOL—ELECTROLYTE SOLUTION

Bowel cleansing products: GoLYTELY, CoLyte, NuLYTELY, TriLyte, and many others including generics

Laxative products: MiraLax, GaviLAX, GlycoLax, HealthyLax, PEGylax, and many others including generics

Bowel evacuant, osmotic laxative



C



?



No



No



No

Powder for oral solution:

Bowel cleansing products:

GoLYTELY and others: Polyethylene glycol 3350 236 g; contains Na sulfate 22.74 g, Na bicarbonate 6.74 g, NaCl 5.86 g, KCl 2.97 g (mixed with water to 4 L). Contents vary somewhat. See

D Knowledge Bank from ClinicalKey.com by

POLYETHYLENE GLYCOL—ELECTROLYTE SOLUTION *continued***Laxative products:**

MiraLax [OTC], GaviLAX [OTC], Glycolax [OTC], HealtyLax [OTC], PegyLax [Rx], and generics [OTC and Rx]: Polyethylene glycol 3350 (17, 119, 238, 255, 510, 527, 765, 850 g)



Bowel cleansing (using products containing supplemental electrolytes for bowel cleansing such as GoLYTELY, CoLyte, NuLYTELY, TriLyte and others; and patients should be NPO 3–4 hr prior to dosing):

Child:

Oral/nasogastric: 25–40 mL/kg/hr until rectal effluent is clear (usually in 4–10 hr)

Adult:

Oral: 240 mL PO Q10 min up to 4 L or until rectal effluent is clear

Nasogastric: 20–30 mL/min (1.2–1.8 L/hr) up to 4 L or until rectal effluent is clear.

Bowel cleansing (using Miralax or equivalent products):

≥2 yr and adolescent: 1.5 g/kg/24 hr (**max. dose:** 100 g/24 hr) × 4 days.

Constipation (MiraLax and others):

Child (limited data in 20 children with chronic constipation, 18 mo–11 yr; see remarks): a mean effective dose of 0.84 g/kg/24 hr PO ÷ BID for 8 wk (range: 0.25–1.42 g/kg/24 hr) was used to yield 2 soft stools per day. Do not exceed 17 g/24 hr. If patient >20 kg, use adult dose.

Adult: 17 g (one heaping tablespoonful) mixed in 240 mL of water, juice, soda, coffee, or tea PO once daily

Fecal impaction:**GoLYTELY and others:**

≥2 yr (PO/NG tube): 20 mL/kg/hr up to a **maximum** of 1 L/hr × 4 hr per 24 hr for 2 days.

Miralax and others:

>3 yr: 1–1.5 g/kg/24 hr (**max. dose:** 100 g/24 hr) PO × 3–6 days. Following disimpaction, give a maintenance dose of 0.4 g/24 hr for ≥2 mo.



Contraindicated in polyethylene glycol hypersensitivity. Monitor electrolytes, BUN, serum glucose, and urine osmolality with prolonged administration. Seizures resulting from electrolyte abnormalities have been reported.

BOWEL CLEANSING: Contraindicated in toxic megacolon, gastric retention, colitis, and bowel perforation. Use with caution in patients prone to aspiration or with impaired gag reflex. Effect should occur within 1–2 hr. Solution generally more palatable if chilled.

CONSTIPATION (MiraLax and others): Contraindicated in bowel obstruction.

Child: Dilute powder using the ratio of 17 g powder to 240 mL of water, juice, or milk. An onset of action within 1 wk in 12 of 20 patients, with the remaining 8 patients reporting improvement during the second week of therapy. Side effects reported in this trial included diarrhea, flatulence, and mild abdominal pain. (See *J Pediatr* 2001;139[3]:428–432 for additional information.)

Adult: 2–4 days may be required to produce a bowel movement. Most common side effects include nausea, abdominal bloating, cramping, and flatulence. Use beyond 2 wk has not been studied.

POLYMYXIN B SULFATE AND BACITRACIN

See Bacitracin ± Polymyxin B

POLYMYXIN B SULFATE AND TRIMETHOPRIM SULFATE

Polytrim Ophthalmic Solution and generics

Topical antibiotic (ophthalmic preparations listed)

Ophthalmic solution: Polymyxin B sulfate 10,000 U/mL, and trimethoprim sulfate 1 mg/mL (10 mL); some preparations may contain 0.04 mg/mL benzalkonium chloride

≥2 mo, child, adolescent, and adult: Instill 1 drop in the affected eye(s) Q3 hr (**max.** of 6 doses/24 hr) $\times 7\text{--}10$ days.



Active against susceptible strains of *Staphylococcus aureus*, *Staphylococcus epidermidis*, *Streptococcus pneumoniae*, *Streptococcus viridans*, *Haemophilus influenzae*, and *Pseudomonas aeruginosa*. **Not indicated** for the prophylaxis or treatment of ophthalmia neonatorum. Local irritation consisting of redness, burning, stinging, and/or itching is common. Hypersensitivity reactions consisting of lid edema, itching, increased redness, tearing, and/or circumocular rash have been reported.



Apply finger pressure to lacrimal sac during and for 1–2 min after dose application.

**POLYMYXIN B SULFATE, NEOMYCIN SULFATE,
HYDROCORTISONE OTIC**

Generics; previously available as Cortisporin Otic

Topical otic antibiotic

Otic solution or suspension: Polymyxin B sulfate 10,000 U/mL, neomycin sulfate 5 mg/mL (3.5 mg/mL neomycin base), hydrocortisone 10 mg/mL (10 mL); some preparations may contain thimerosal and metabisulfite.

For ophthalmic suspension, see **NEOMYCIN/POLYMYXIN B OPHTHALMIC PRODUCTS**

**Otitis externa:**

≥2 yr, child, and adolescent: 3 drops TID–QID $\times 7\text{--}10$ days. If preferred, a cotton wick may be saturated and inserted into ear canal. Moisten wick with antibiotic every 4 hr. Change wick Q24 hr.

Adult: 4 drops TID–QID $\times 7\text{--}10$ days.

Contraindicated in patients with active varicella and herpes simplex and in cases with perforated eardrum (possible ototoxicity). **Use with caution** in chronic otitis media and when the integrity of the tympanic membrane is in question. Metabisulfite-containing products may cause allergic reactions to susceptible individuals. Hypersensitivity (itching, skin rash, redness, swelling, or other sign of irritation in or around the ear) may occur. Neomycin may cause sensitization. Prolonged treatment may result in overgrowth of nonsusceptible organisms and fungi. May cause cutaneous sensitization.



Shake suspension well before use. Warm the medication to body temperature prior to use.

POLYSPORINSee Bacitracin \pm Polymyxin B**POLYTRIM OPHTHALMIC SOLUTION**

See Polymyxin B Sulfate and Trimethoprim Sulfate

POSACONAZOLE

Noxafil

Antifungal agent**Delayed release tabs:** 100 mg**Injection:** 300 mg/16.7 mL (16.7 mL); contains EDTA and sulfobutyl ether- β -cyclodextrin (SBECD)**Oral suspension:** 40 mg/mL (105 mL); contains polysorbate 80 and sodium benzoate**Child ≤ 12 yr (see remarks):****Oral suspension:**

Antifungal prophylaxis for hematopoietic stem cell transplant recipients: 4 mg/kg/dose PO TID initiated 2–4 days prior to discharge. Duration of therapy: the longer of 100 days posttransplant or when CD₃ T cells is $\geq 200/\text{mm}^3$ and CD⁴ is $\geq 100/\text{mm}^3$.

IV: Clinical trials with IV dosage form currently limited to a phase I study compared with the oral suspension dosage form; results pending.

Adolescent (≥ 13 yr) and adult (see remarks):

Prophylaxis for invasive Aspergillus and Candida: Duration based on neutropenia or immunosuppression recovery.

IV (≥ 18 yr) or delayed-release tablets: 300 mg Q12 hr IV/PO tab $\times 2$ doses followed by 300 mg Q24 hr IV/PO tab the next day.

Oral suspension: 200 mg PO TID

Oropharyngeal Candidiasis:

Oral suspension: 100 mg PO Q12 hr $\times 2$ doses followed by 100 mg PO Q24 hr $\times 13$ days.

Refractory Oropharyngeal Candidiasis (to itraconazole/fluconazole): Duration based on severity and clinical response.

Oral suspension: 400 mg PO Q12 hr



Contraindicated with use of ergot alkaloids (e.g., ergotamine); major substrates for CYP 450 3A4 (e.g., atorvastatin, lovastatin, simvastatin, sirolimus); or CYP 450 3A4 medications that prolong the QTc interval (e.g., pimozide and quinidine). **Use with caution** electrolyte imbalances (correct prior to use), cardiac arrhythmias, and hepatic or renal impairment. Use of IV dosage form is not recommended for eGFR $<50 \text{ mL/min}$ due to the risk for accumulation of SBECD excipient.

Hypokalemia, diarrhea, nausea, vomiting, headache, and fever are common side effects. Serious reactions include hypersensitivity reactions, arrhythmias, QTc prolongation, and hepatotoxicity (consider discontinuing therapy). Pseudoaldosteronism and pancreatitis have been reported.

Posaconazole is a substrate of UDP-glucuronosyltransferase 1–4 (UGT1A4) and P-gp efflux and strong inhibitor of CYP 450 3A4 (see earlier for contraindicated substrates for concurrent use). Use with vincristine has been associated with neurotoxicity, seizures, peripheral neuropathy, SIADH, and paralytic ileus.

Oral suspension and tablets are **NOT** bioequivalent/interchangeable and their respective uses are indication specific. Administer delayed-release tablets with food to enhance absorption. **Do not** crush or chew delayed-release tablets. IV dosage information currently limited in adults.

PORACTANT ALFA

See Surfactant, pulmonary

POTASSIUM IODIDE

Iosat, SSKI, ThyroShield, ThyroSafe, and others

Antithyroid agent**Tabs:**

Iosat [OTC]: 65 mg (50 mg iodine), 130 mg

ThyroSafe [OTC]: 65 mg

Oral solution:

ThyroShield [OTC]: 65 mg/mL (30 mL); contains parabens and saccharin

Saturated solution (SSKI): 1000 mg/mL (30, 240 mL); 10 drops = 500 mg potassium iodide

Potassium content is 6 mEq (234 mg) K⁺/g potassium iodide**Neonatal Graves disease:** 50–100 mg (about 1–2 drops of SSKI) PO once daily**Thyrotoxicosis:**

Child: 50–250 mg (about 1–5 drops of SSKI) PO TID

Adult: 50–500 mg (1–10 drops of SSKI) PO TID

Cutaneous or lymphocutaneous sporotrichosis (treat for 4–6 wk after lesions have completely healed; increase dose until either max. dose is achieved or signs of intolerance appear):**Child and adolescent (limited data):** 50 mg PO TID. Dose may be gradually increased as tolerated to the **max. dose** of the lesser of 50 mg/kg/dose or 2000–2500 mg PO TID.**Adult:** Start with 250 mg PO TID. Doses may be gradually increased as tolerated to the **max. dose** of 2000–2500 mg PO TID.**Contraindicated** in pregnancy, hyperkalemia, iodine-induced goiter, and hypothyroidism. **Use with caution** in cardiac disease and renal failure. GI disturbance, metallic taste, rash, salivary gland inflammation, headache, lacrimation, and rhinitis are symptoms of iodism.

Give with milk or water after meals. Monitor thyroid function tests. Onset of antithyroid effects: 1–2 days.

Lithium carbonate and iodide-containing medications may have synergistic hypothyroid activity.

Potassium-containing medications, potassium-sparing diuretics, and ACE inhibitors may increase serum potassium levels.

For use as a thyroid blocking agent in nuclear or radiation emergencies, see <https://www.fda.gov/drugs/bioterrorism-and-drug-preparedness/radiation-emergencies>**POTASSIUM SUPPLEMENTS**

Many brand names and generics

Electrolyte**Potassium chloride (40 mEq K = 3 g KCl):**

Sustained-release caps: 8, 10 mEq

Sustained-release tabs: 8, 10, 15, 20 mEq

Powder: 20 mEq/packet (30s, 100s)

Oral solution/liquid: 10% (6.7 mEq/5 mL), 20% (13.3 mEq/5 mL) (473 mL)

Concentrated injection: 2 mEq/mL

Potassium gluconate (40 mEq K = 9.4 g K gluconate):

Tabs: 465 mg (2 mEq), 581 mg (2.5 mEq)

Caps [OTC as K-99]: 595 mg (2.56 mEq)

Potassium acetate (40 mEq K = 3.9 g K acetate):

Concentrated injection: 2 mEq/mL

Potassium bicarbonate/citric acid (10 mEq K = 1 g K bicarbonate):

Effervescent tab for oral solution (Effer-K): 10, 20, 25 mEq; each 10 mEq K contains 0.84 g citric acid

POTASSIUM SUPPLEMENTS *continued*

Potassium phosphate:

See Phosphorus Supplements

Normal daily requirements: See [Chapter 21](#).



Replacement: Determine based on maintenance requirements, deficit and ongoing losses.

See [Chapter 11](#).

Hypokalemia:

Oral:

Child: 1–4 mEq/kg/24 hr ÷ BID–QID. Monitor serum potassium.

Adult: 40–100 mEq/24 hr ÷ BID–QID; limit single doses by 20–25 mEq to minimize GI side effects

IV: MONITOR SERUM K CLOSELY.

Child: 0.5–1 mEq/kg/dose given as an infusion of 0.5 mEq/kg/hr × 1–2 hr.

Max. IV infusion rate: 1 mEq/kg/hr. This may be used in critical situations (i.e., hypokalemia with arrhythmia).

Adult:

Serum K ≥ 2.5 mEq/L: Replete at rates up to 10 mEq/hr. **Total dosage not to exceed 200 mEq/24 hr.**

Serum K < 2.5 mEq/L: Replete at rates up to 40 mEq/hr. **Total dosage not to exceed 400 mEq/24 hr.**

Max. peripheral IV solution concentration: 40 mEq/L

Max. concentration for central line administration: 150–200 mEq/L

PO administration may cause GI disturbance and ulceration. Oral liquid supplements should be diluted in water or fruit juice prior to administration. Sustained-release tablets must be swallowed whole, and **NOT** dissolved in the mouth or chewed.



Do not administer IV potassium undiluted. IV administration may cause irritation, pain, and phlebitis at the infusion site. **Rapid or central IV infusion may cause cardiac arrhythmias.** Patients receiving infusion >0.5 mEq/kg/hr (>20 mEq/hr for adults) should be placed on an ECG monitor.

PRALIDOXIME CHLORIDE

Protopam, 2-PAM, and generics

In combination with atropine: Duodote, ATNAA

Antidote, organophosphate poisoning



C

?

Yes

No

No

Injection (Protopam): 1000 mg

Injection for intramuscular injection, in autoinjector device: 600 mg/2 mL (2 mL); dispenses 600 mg; contains benzyl alcohol

In combination with atropine (Duodote, ATNNA):

Injection for intramuscular injection in autoinjector device: 600 mg/2 mL of pralidoxime and 2.1 mg/0.7 mL of atropine; contains benzyl alcohol. Duodote or ATNNA must be administered by emergency medical services personnel who have had adequate training in the recognition and treatment of nerve agent or insecticide intoxication.

Organophosphate poisoning (use with atropine):



Child:

IV intermittent: 20–50 mg/kg/dose (**max. dose:** 2000 mg) × 1 IV. May repeat in 1–2 hr if muscle weakness is not relieved, then at Q10–12 hr PRN if cholinergic signs reappear.

IV continuous infusion: loading dose of 20–50 mg/kg/dose (**max. dose:** 2000 mg) IV over 15–30 min followed by 10–20 mg/kg/hr.

Continued

PRALIDOXIME CHLORIDE *continued****Organophosphate poisoning (use with atropine):******Child (cont.):******IM:***

<40 kg: 15 mg/kg/dose \times 1 IM. May repeat Q15 min PRN up to a **maximum total dose** of 45 mg/kg for mild symptoms; may repeat twice in rapid succession for severe symptoms (**maximum total dose** of 45 mg/kg). For persistent symptoms, may repeat another maximum 45 mg/kg series (in 3 divided doses) approximately 1 hr after the last injection.

$\geq 40 \text{ kg}:$ 600 mg \times 1 IM. May repeat Q15 min PRN up to a **max. total dose** of 1800 mg for mild symptoms; may repeat twice in rapid succession for severe symptoms (**max. total dose** of 1800 mg). For persistent symptoms, may repeat another **max.** 1800 mg series (in 3 divided doses) approximately 1 hr after the last injection.

Adult:

IV intermittent: 1–2 g/dose \times 1 IV. May repeat in 1–2 hr if muscle weakness is not relieved, then at Q10–12 hr PRN if cholinergic signs reappear.

IM: Use aforementioned $\geq 40\text{-kg}$ child IM dosage.

In combination with atropine (Duodote, ATNNA; see remarks for description of symptoms):***Child and adult >41 kg:***

Mild Symptoms of Nerve Agent or Insecticide Exposure: Inject one prefilled syringe IM \times 1 and wait 10–15 min for effect. If severe symptoms emerge at any time after the first dose, inject 2 additional prefilled syringes IM in rapid succession.

Severe Symptoms of Nerve Agent or Insecticide Exposure: Inject three prefilled syringes IM in rapid succession.

Contraindicated in poisonings due to phosphorus, inorganic phosphates, or organic phosphates without anticholinesterase activity. **Do not use** as an antidote for carbamate classes of pesticides. Removal of secretions and maintaining a patent airway is critical. May cause muscle rigidity, laryngospasm, and tachycardia after rapid IV infusion. Drug is generally ineffective if administered 36–48 hr after exposure. Additional doses may be necessary.

For IV administration, dilute to 50 mg/mL or less and infuse over 15–30 min (**not to exceed** 200 mg/min). Reduce dosage in renal impairment since 80%–90% of the drug is excreted unchanged in the urine 12 hr after administration.

Pralidoxime and atropine combination (Duodote): Safety and efficacy data are only available for children and adults $>41 \text{ kg}$ (90 lbs). Duodote product information description of mild and severe symptoms:

Mild symptoms: increased airway secretions, blurred vision, bradycardia, breathing difficulties, chest tightness, drooling, miosis, nausea, vomiting, runny nose, salivation, stomach cramps (acute onset), tachycardia, teary eyes, tremors/muscular twitching, wheezing/coughing.

Severe symptoms: breathing difficulties (severe), confused/strange behavior, convulsions, copious secretions from lung or airways, involuntary urination/defecation, muscular twitching/generalized weakness (severe), unconsciousness.

IM injection is via the midlateral thigh.

**PREDNISOLONE**

Oral products:

Oraped ODT, Pediapred, Millipred, Veripred 20, and generics; previously available as Prelone

Ophthalmic products:

Pred Forte, Pred Mild, Omnipred, Econopred, and generics

Corticosteroid

2

No

No

No

Tabs: 5 mg

PREDNISOLONE continued

Tablets, orally disintegrating (as Na phosphate) (Orapred ODT and generics): 10, 15, 30 mg

Oral solution/syrup (as Na phosphate):

Pediapred and generics: 5 mg/5 mL (120 mL); alcohol and dye free

Generics: 10 mg/5 mL (237 mL), 15 mg/5 mL (237 mL), 20 mg/5 mL (237 mL), 25 mg/5 mL (237 mL); may contain parabens, alcohol and some preparations may be dye free

Ophthalmic suspension (as acetate; both strengths contain benzalkonium chloride and may contain bisulfites):

Pred Mild: 0.12% (5, 10 mL)

Econopred: 0.125% (5, 10 mL)

Omnipred, PredForte, Econopred Plus and generics: 1% (5, 10, 15 mL)

Ophthalmic solution (as Na phosphate): 1% (10 mL); may contain benzalkonium chloride



See Prednisone for systemic oral dosing (equivalent dosing).

Ophthalmic (consult ophthalmologist before use; see remarks):

Ophthalmic suspension:

Child (limited data) and adult: 1–2 drops to the conjunctival sac of the affected eye(s) BID–QID (dosage frequency may be increased during initial 24–48 hr if needed). Reevaluate patient if signs and symptoms do not improve after 2 days.

Ophthalmic solution:

Child and adult: Start with 1–2 drops Q1 hr during the day and Q2 hr during the night until favorable response, then reduce dose to 1 drop Q4 hr. Dose may be further reduced to 1 drop TID–QID.

See Prednisone for remarks. See Chapter 10 for relative steroid potencies. Pregnancy category changes to "D" if used in the first trimester.



OPHTHALMIC USE: Contraindicated in viral (e.g., herpes simplex, vaccinia, and varicella), fungal, and mycobacterial infections of the cornea and conjunctiva. Increase in intraocular pressure, cataract formation, eye pain, and delayed wound healing may occur.

PREDNISONE

Deltasone, Rayos, and generics

Corticosteroid



C/D



2



No



Yes



No

Tabs (Deltasone and generics): 1, 2.5, 5, 10, 20, 50 mg

Delayed release tabs (Rayos): 1, 2, 5 mg

Oral solution: 1 mg/mL (120, 500 mL); may contain 5% alcohol and saccharin

Concentrated solution (Prednisone Intensol): 5 mg/mL (30 mL); contains 30% alcohol



Antiinflammatory/immunosuppressive:

Child: 0.5–2 mg/kg/24 hr PO ÷ once daily–BID

Acute asthma:

Child: 2 mg/kg/24 hr PO ÷ once daily–BID × 5–7 days; **max. dose:** 80 mg/24 hr. Patients may benefit from tapering if therapy exceeds 5–7 days.

Asthma exacerbations (2007 National Heart, Lung, and Blood Institute [NHLBI] Guideline)

Recommendations; dose until peak expiratory flow reaches 70% of predicted or personal best:

Child ≤ 12 yr: 1–2 mg/kg/24 hr PO ÷ Q12 hr (**max. dose:** 60 mg/24 hr).

>12 yr and adult: 40–80 mg/24 hr PO ÷ Q12–24 hr.

Outpatient asthma exacerbation burst therapy (2007 NHLBI guidelines; longer durations may be necessary):

Child ≤ 12 yr: 1–2 mg/kg/24 hr PO ÷ Q12–24 hr (**max. dose:** 60 mg/24 hr) × 3–10 days.

Child >12 yr and adult: 40–60 mg/24 hr PO ÷ Q12–24 hr × 3–10 days

Continued

PREDNISONE *continued***Nephrotic syndrome:**

Child (use ideal body weight for obese patients): Starting dose of 2 mg/kg/24 hr PO (**max. dose:** 60 mg/24 hr) ÷ once daily–TID is recommended. Further treatment plans are individualized. Consult a nephrologist.

See Chapter 10 for physiologic replacement, relative steroid potencies, and doses based on body surface area. Methylprednisolone is preferable in hepatic disease because prednisone must be converted to methylprednisolone in the liver.



Side effects may include: mood changes, seizures, hyperglycemia, diarrhea, nausea, abdominal distension, GI bleeding, HPA axis suppression, osteopenia, cushingoid effects, and cataracts with prolonged use. Prednisone is a CYP 450 3A3/4 substrate and inducer. Barbiturates, carbamazepine, phenytoin, rifampin, and isoniazid may reduce the effects of prednisone, whereas estrogens may enhance the effects. Pregnancy category changes to “D” if used in the first trimester.

PRIMAQUINE PHOSPHATE

Various generics

Antimalarial

C

?

No

No

No

Tabs: 26.3 mg (15 mg base)**Oral suspension:** 10.52 mg (6 mg base)/5 mL**Doses expressed in mg of primaquine base:****Malaria:**

Prevention of relapses for Plasmodium vivax or Plasmodium ovale only (initiate therapy during the last 2 wk of, or following a course of, suppression with chloroquine or comparable drug):

Child: 0.5 mg/kg/dose (**max. dose:** 30 mg/dose) PO once daily ×14 days

Adult: 30 mg PO once daily ×14 days

Prevention of chloroquine-resistant strains (initiate 1 day prior to departure and continued until 3–7 days after leaving endemic area):

Child: 0.5 mg/kg/dose PO once daily; **max. dose:** 30 mg/24 hr.

Adult: 30 mg PO once daily

P. jiroveci (carinii) pneumonia (in combination with clindamycin):

Child: 0.3 mg/kg/dose (**max. dose:** 30 mg/dose) PO once daily ×21 days.

Adult: 30 mg PO once daily ×21 days

Contraindicated in granulocytopenia (e.g., rheumatoid arthritis, lupus erythematosus) and bone marrow suppression. **Avoid use** with quinacrine and with other drugs that have a potential for causing hemolysis or bone marrow suppression. **Use with caution** in G6PD and NADH methemoglobin-reductase deficient patients due to increased risk for hemolytic anemia and leukopenia, respectively. Monitor ECG for QTc prolongation in patients with cardiac disease, history of arrhythmias, uncorrected hypokalemia and/or hypomagnesemia, bradycardia, and receiving concomitant QTc prolonging medications. Use in pregnancy is **not recommended** by the AAP Red Book. Cross sensitivity with iodoquinol.



May cause headache, visual disturbances, nausea, vomiting, and abdominal cramps. Hemolytic anemia, leukopenia, cardiac arrhythmia, QTc interval prolongation, and methemoglobinemia have been reported. Administer all doses with food to mask bitter taste.

PRIMIDONE

Mysoline and generics

Anticonvulsant, barbiturate**Tabs:** 50, 250 mg

Neonate: 12–20 mg/kg/24 hr PO ÷ BID–QID; initiate therapy at the lower dosage range and titrate upwards.

**Child, adolescent, and adult:**

Day of Therapy	<8 Yr	≥8 Yr and Adult
Days 1–3	50 mg PO QHS	100–125 mg PO QHS
Days 4–6	50 mg PO BID	100–125 mg PO BID
Days 7–9	100 mg PO BID	100–125 mg PO TID
Day 10 and thereafter	125–250 mg PO TID or 10–25 mg/kg/ 24 hr ÷ TID—QID	250 mg PO TID–QID; max. dose: 2 g/24 hr

Use with caution in renal or hepatic disease and pulmonary insufficiency. Primidone is metabolized to phenobarbital and has the same drug interactions and toxicities (see Phenobarbital). In addition, primidone may cause vertigo, nausea, leukopenia, malignant lymphoma-like syndrome, diplopia, nystagmus, and systemic lupus-like syndrome. Monitor for suicidal behavior or ideation. Acetazolamide may decrease primidone absorption. **Adjust dose in renal failure** (see Chapter 31).



Monitor both primidone and phenobarbital levels. Therapeutic levels: 5–12 mg/L of primidone and 15–40 mg/L of phenobarbital. Recommended serum sampling time at steady state: trough level obtained within 30 min prior to the next scheduled dose after 1–4 days of continuous dosing.

PROBENECID

Various generics

Penicillin therapy adjuvant, uric acid–lowering agent**Tabs:** 500 mg**To prolong penicillin levels.**

Child (2–14 yr): 25 mg/kg PO ×1, then 40 mg/kg/24 hr ÷ QID; **max. single dose:** 500 mg/dose.

Use adult dose if >50 kg.

**Adult:** 500 mg PO QID**Hyperuricemia with gout:**

Adult: 250 mg PO BID ×1 wk, then 500 mg PO BID; may increase by 500 mg increments Q4 wk PRN up to a **max. dose** of 2–3 g/24 hr ÷ BID.

Gonorrhea, antibiotic adjunct (administer just prior to antibiotic):

≤45 kg: 23 mg/kg/dose PO ×1

>45 kg: 1 g PO ×1

Prevention of nephrotoxicity from cidofovir: see Cidofovir.

Use with caution in patients with peptic ulcer disease. **Contraindicated** in children <2 yr and patients with renal insufficiency. **Do not use** if GFR <30 mL/min.



Increases uric acid excretion. Inhibits renal tubular secretion of acyclovir, ganciclovir, ciprofloxacin, levofloxacin, nalidixic acid, moxifloxacin, organic acids, penicillins, cephalosporins, AZT, dapsone, methotrexate, nonsteroidal antiinflammatory agents, and benzodiazepines. Salicylates may decrease probenecid's activity. Alkalizes urine in patients with gout. May cause headache, GI

False positive glucosuria with Clinitest may occur.

PROCAINAMIDE

Generics

Antiarrhythmic, class Ia**Injection:** 100 mg/mL (10 mL), 500 mg/mL (2 mL); may contain methylparabens and bisulfites**NOTE:** The IV infusion dosage units for adults are in mg/min; compared to mCg/kg/min for children.**Child (limited data):****IV:** Load with 15 mg/kg/dose IV or IO $\times 1$ over 30–60 min. Then followed by maintenance continuous IV infusion of 20–80 mCg/kg/min; **max. dose:** 2 g/24 hr.**IM:** 20–30 mg/kg/24 hr \div Q4–6 hr; **max. dose:** 4 g/24 hr (peak effect in 1 hr).**Adult:****IV: Load:** 50–100 mg/dose; repeat dose Q5 min PRN to a **max. total dose** of 1000–1500 mg.**Maintenance:** 1–6 mg/min by continuous infusion**IM:** 50 mg/kg/24 hr \div Q3–6 hr

Contraindicated in myasthenia gravis, complete heart block, SLE, and torsade de pointes. Use with caution in asymptomatic premature ventricular contractions, digitalis intoxication, CHF, renal or hepatic dysfunction. Adjust dose in renal failure (see Chapter 31).

May cause lupus-like syndrome, positive Coombs' test, thrombocytopenia, arrhythmias, GI complaints, and confusion. Increased LFTs and liver failure have been reported. Monitor BP and ECG when using IV. QRS widening by >0.02 sec suggests toxicity.Do not use with desipramine and other TCAs. Cimetidine, ranitidine, amiodarone, β -blockers, and trimethoprim may increase procainamide levels. Procainamide may enhance the effects of skeletal muscle relaxants and anticholinergic agents. Therapeutic levels: 4–10 mg/L of procainamide or 10–30 mg/L of procainamide and NAPA levels combined.**Recommended serum sampling times:****IM intermittent dosing:** Trough level within 30 min prior to the next scheduled dose after 2 days of continuous dosing (steady state).**IV continuous infusion:** 2 and 12 hr after start of infusion and at 24-hr intervals thereafter.**PROCHLORPERAZINE**

Compro and generics; previously available as Compazine

Antiemetic, phenothiazine derivative**Tabs (as maleate):** 5, 10 mg**Suppository (Compro and generics):** 25 mg (12s)**Injection (as edisylate):** 5 mg/mL (2 mL); may contain benzyl alcohol**Antiemetic doses:****Child (≥ 2 yr and ≥ 9 kg):****PO or PR:** 0.4 mg/kg/24 hr \div TID–QID (**max. dose:** 10 mg/dose) or alternative dosing by weight:**9–13 kg:** 2.5 mg once daily–BID; **max. dose:** 7.5 mg/24 hr**>13–18 kg:** 2.5 mg BID–TID; **max. dose:** 10 mg/24 hr**>18–39 kg:** 2.5 mg TID or 5 mg BID; **max. dose:** 15 mg/24 hr**>39 kg:** Use adult dose**IM:** 0.1–0.15 mg/kg/dose BID–TID; **max. dose:** 10 mg/single dose or 40 mg/24 hr**Adult:****PO:** 5–10 mg/dose TID–QID; **max. dose:** 40 mg/24 hr**PR:** 25 mg/dose BID

PROCHLORPERAZINE continued**IM:** 5–10 mg/dose Q3–4 hr**IV:** 2.5–10 mg/dose; may repeat Q3–4 hr PRN**Max. IM/IV dose:** 40 mg/24 hr**Psychoses:****Child 2–12 yr and >9 kg:****PO:** Start with 2.5 mg BID–TID with a **max. first day dose** of 10 mg/24 hr. Dose may be increased as needed to 20 mg/24 hr for children 2–5 yr and 25 mg/24 hr for 6–12 yr.**IM:** 0.13 mg/kg/dose $\times 1$ and convert to PO immediately.**Adult:****PO:** 5–10 mg TID–QID; may be increased as needed to a **max. dose** of 150 mg/24 hr**IM:** 10–20 mg Q2–4 hr PRN convert to PO immediately.**Intractable migraines:****Child (5–18 yr, limited data):** 0.15 mg/kg/dose (**max. dose:** 10 mg/dose) IV over 10 min was effective in migraine headaches presenting in the emergency departments (see *Ann Emerg Med*. 2004;43:256–262).

Toxicity as for other phenothiazines (see Chlorpromazine). Extrapyramidal reactions (reversed by diphenhydramine) or orthostatic hypotension may occur. May mask signs and symptoms of overdosage of other drugs and may obscure the diagnosis and treatment of conditions such as intestinal obstruction, brain tumor, and Reye syndrome. May cause false-positive test for phenylketonuria, urinary amylase, uroporphyrins, and urobilinogen. **Do not use IV route in children.** Use only in management of prolonged vomiting of known etiology.

**PROMETHAZINE**

Phenergan, Phenadoz, Promethegan, and generics

Antihistamine, antiemetic, phenothiazine derivative

C



3



No



No



No

Tabs: 12.5, 25, 50 mg**Oral solution/syrup:** 6.25 mg/5 mL (118, 473 mL); contains alcohol and may contain parabens, sodium benzoate, or phenol (many formulations exist)**Suppository (Phenadoz, Promethegan and generics):** 12.5, 25, 50 mg (12s)**Injection:** 25, 50 mg/mL (1 mL); may contain edetate disodium, sulfites, and phenol**Antihistaminic:****Child ≥ 2 yr:** 0.1 mg/kg/dose (**max. dose:** 12.5 mg/dose) Q6 hr PO during the day hours and 0.5 mg/kg/dose (**max. dose:** 25 mg/dose) QHS PO PRN**Adult:** 6.25–12.5 mg PO/PR TID and 25 mg QHS**Nausea and vomiting PO/IM/IV/PR (see remarks):****Child ≥ 2 yr:** 0.25–1 mg/kg/dose Q4–6 hr PRN; **max. dose:** 25 mg/dose**Adult:** 12.5–25 mg Q4–6 hr PRN**Motion sickness:** (1st dose 0.5–1 hr before departure):**Child ≥ 2 yr:** 0.5 mg/kg/dose Q12 hr PO/PR PRN; **max. dose:** 25 mg/dose**Adult:** 25 mg PO Q8–12 hr PRN

Avoid use in children <2 yr because of risk for fatal respiratory depression. Toxicity similar to other phenothiazines (see Chlorpromazine). **Do not** administer SC or intra-arterially because of severe local reactions. IV route of administration is **not recommended** (IM preferred) due to severe tissue injury (tissue necrosis and gangrene). If using IV route, dilute 25 mg/mL strength product with 10–20 mL NS and administer over 10–15 min, consider lower initial doses, administer through a large-bore vein and check patency of line before administering, administer through an IV line at the port farthest from the

PROMETHAZINE *continued*

patient's vein, and monitor for burning or pain during or after injection. Administer oral doses with meals to decrease GI irritation.

May cause profound sedation, blurred vision, respiratory depression (use lowest effective dose in children and **avoid** concomitant use of respiratory depressants), and dystonic reactions (reversed by diphenhydramine). Cholestatic jaundice and neuroleptic malignant syndrome has been reported. May interfere with pregnancy tests (immunologic reactions between hCG and anti-hCG). **For nausea and vomiting, use only in management of prolonged vomiting of known etiology.**

PROPRANOLOL

Inderal, Inderal LA, Hemangeol, and generics

Adrenergic blocking agent (β), class II antiarrhythmic



C/D

1

Yes

Yes

No

Tabs: 10, 20, 40, 60, 80 mg

Extended-release caps (Inderal LA and others including generics): 60, 80, 120, 160 mg

Oral solution: 20 mg/5 mL, 40 mg/5 mL; contains parabens and saccharin

Hemangeol: 4.28 mg/mL (120 mL); alcohol, sugar and parabens free; contains saccharin

Injection: 1 mg/mL (1 mL)

**Arrhythmias:****Child:**

IV: 0.01–0.1 mg/kg/dose IV push over 10 min, repeat Q6–8 hr PRN; **max. dose:** 1 mg/dose for infant; 3 mg/dose for child

PO: Start at 0.5–1 mg/kg/24 hr \div Q6–8 hr; increase dosage Q3–5 days PRN. Usual dosage range: 2–4 mg/kg/24 hr \div Q6–8 hr; **max. dose:** 60 mg/24 hr or 16 mg/kg/24 hr

Adult:

IV: 1 mg/dose Q5 min up to total 5 mg

PO: 10–30 mg/dose TID–QID; increase PRN. Usual range 30–160 mg/24 hr \div TID–QID.

Hypertension (as alternative therapy):**Child:**

PO: Initial: 0.5–1 mg/kg/24 hr \div Q6–12 hr. May increase dose Q5–7 days PRN; **max. dose:** 8 mg/kg/24 hr

Adult:

PO: 40 mg/dose PO BID or 60–80 mg/dose (sustained-release capsule) PO once daily. May increase 10–20 mg/dose Q3–7 days; **max. dose:** 640 mg/24 hr.

Migraine prophylaxis:**Child:**

<35 kg: Start with 10 mg PO once daily and increase dose PRN weekly intervals at 10 mg increments. Usual dosage range: 10–20 mg PO TID.

≥ 35 kg: 20–40 mg PO TID

Adult: 80 mg/24 hr \div Q6–8 hr PO; increase dose by 20–40 mg/dose Q3–4 wk PRN. Usual effective dose range: 160–240 mg/24 hr.

Tetralogy spells:

IV: 0.15–0.25 mg/kg/dose slow IV push. May repeat in 15 min $\times 1$. See also [Chapter 7](#).

PO: Start at 2–4 mg/kg/24 hr \div Q6 hr PRN. Usual dose range: 4–8 mg/kg/24 hr \div Q6 hr PRN. Doses as high as 15 mg/kg/24 hr have been used with careful monitoring.

Thyrotoxicosis:

Neonate: 2 mg/kg/24 hr PO \div Q6–12 hr

Adolescent and adult:

IV: 1–3 mg/dose over 10 min. May repeat in 4–6 hr.

PROPRANOLOL *continued***Infantile hemangioma (see remarks):**

Infant (5 wk–5 mo and ≥2 kg; labeled dosing information for Hemangeol product): 0.6 mg/kg/dose BID PO (at least 9 hr apart) ×7 days, then increase to 1.1 mg/kg/dose BID PO ×14 days, followed by 1.7 mg/kg/dose BID PO ×6 mo.

Alternative dosing: Start at 1 mg/kg/24 hr ÷ Q8 hr PO. If tolerated after 1 day, increase dose to 2 mg/kg/24 hr ÷ Q8 hr PO

Contraindicated in asthma, Raynaud syndrome, heart failure, and heart block. **Not indicated** for the treatment of hypertensive emergencies. **Use with caution** in presence of obstructive lung disease, diabetes mellitus, or renal or hepatic disease. May cause hypoglycemia, hypotension, nausea, vomiting, depression, weakness, impotence, bronchospasm, and heart block. Cutaneous reactions, including Stevens-Johnson, TEN, exfoliative dermatitis, erythema multiforme, and urticaria have been reported. Acute hypertension has occurred after insulin-induced hypoglycemia in patients on propranolol.

Therapeutic levels for beta-blockade: 50–100 ng/mL; ventricular arrhythmia: 40–85 ng/mL. Drug is metabolized by CYP 450 1A2, 2C18, 2C19 and 2D6 isoenzymes. Concurrent administration with barbiturates, indomethacin, or rifampin may cause decreased activity of propranolol. Concurrent administration with cimetidine, hydralazine, flecainide, quinidine, chlorpromazine, or verapamil may lead to increased activity of propranolol. **Avoid** IV use of propranolol with calcium channel blockers; may increase effect of calcium channel blocker. Use with amiodarone may increase negative chronotropic effects.

For infantile hemangioma, monitor BP and HR 2 hr after initiating therapy and after dose increases. To reduce risk of hypoglycemia, administer doses during or right after a feeding; hold doses if child is not eating or is vomiting. Infants <6 mo must be fed every 4 hr. Common adverse effects (>10%) reported in clinical trials with Hemangeol include sleep disorders, aggravated respiratory tract infections (e.g., bronchitis and bronchiolitis) associated with cough/fever, diarrhea, and vomiting. Readjust dose periodically with changes (increases) in child's body weight.

Successful use in infantile hepatic hemangiomas has also been reported.

Pregnancy category changes to "D" if used in second or third trimesters.

PROPYLTHIOURACIL

PTU and generics

Antithyroid agent



D



2



Yes



Yes



No

Tabs: 50 mg

Oral suspension: 5 mg/mL

100 mg PTU = 10 mg methimazole

Dosages should be adjusted as required to achieve and maintain T₄, TSH levels in normal ranges.



Neonate: 5–10 mg/kg/24 hr ÷ Q8 hr PO

Child:

Initial: 5–7 mg/kg/24 hr ÷ Q8 hr PO, OR by age:

6–10 yr: 50–150 mg/24 hr ÷ Q8 hr PO

>10 yr: 150–300 mg/24 hr ÷ Q8 hr PO

Maintenance: Generally begins after 2 mo. Usually 1/3–2/3 the initial dose in divided doses (Q8–12 hr) when the patient is euthyroid.

Adult:

Initial: 300–400 mg/24 hr ÷ Q6–8 hr PO; some may require larger doses of 600–900 mg/24 hr

Maintenance: 100–150 mg/24 hr ÷ Q8 hr PO

D

Continued

PROPYLTHIOURACIL *continued*

Generally reserved for patients who are unable to tolerate methimazole and whom radioactive iodine or surgery are not appropriate. May be the antithyroid treatment of choice during or just prior to the first trimester of pregnancy because of risk of fetal abnormalities associated with methimazole.

May cause blood dyscrasias, fever, liver disease, dermatitis, urticaria, malaise, CNS stimulation or depression, and arthralgias. Glomerulonephritis, severe liver injury/failure, agranulocytosis, severe vasculitis, interstitial pneumonitis, exfoliative dermatitis, and erythema nodosum have also been reported. May decrease the effectiveness of warfarin. Monitor thyroid function. A dose reduction of β -blocker may be necessary when the hyperthyroid patient becomes euthyroid.

For neonates, crush tablets, weigh appropriate dose, and mix in formula/breast milk. **Adjust dose in renal failure (see Chapter 31).**

PROSTAGLANDIN E₁

See Alprostadil

PROTAMINE SULFATE

Various generics

Antidote, heparin



C

?

No

No

No

Injection: 10 mg/mL (5, 25 mL); preservative free



Heparin antidote, IV:

1 mg protamine will neutralize 115 U porcine intestinal heparin, or 100 U (1 mg) low-molecular-weight heparin.

Consider time since last heparin dose:

If <0.5 hr: give 100% of specified dose

If within 0.5–1 hr: give 50%–75% of aforementioned dose

If within 1–2 hr: give 37.5%–50% of aforementioned dose

If ≥2 hr: give 25%–37.5% of aforementioned dose

Max. dose: 50 mg/dose IV

Max. infusion rate: 5 mg/min

Max. IV concentration: 10 mg/mL

If heparin was administered by deep SC injection, give 1–1.5 mg protamine per 100 U heparin as follows:

Load with 25–50 mg via slow IV infusion followed by the rest of the calculated dose via continuous infusion over 8–16 hr or the expected duration of SC heparin absorption.

Enoxaparin overdosage, IV (see remarks): Approximately 1 mg protamine will neutralize 1 mg enoxaparin.

Consider time since last enoxaparin dose:

If <8 hr: give 100% of aforementioned dose.

If within 8–12 hr: Give 50% of aforementioned dose

If >12 hr: Protamine not required but if serious bleeding is present, give 50% of aforementioned dose.

If aPTT remains prolonged 2–4 hr after the first protamine dose or if bleeding continues, a second infusion of 0.5 mg protamine per 1 mg enoxaparin may be given.

Max. dose: 50 mg/dose. See aforementioned heparin antidote IV dosage for max. administration concentration and rate.

PROTAMINE SULFATE *continued*

Risk factors for protamine hypersensitivity include known hypersensitivity to fish and exposure to protamine-containing insulin or prior protamine therapy.

May cause hypotension, bradycardia, dyspnea, and anaphylaxis. Monitor aPTT or ACT. Heparin rebound with bleeding has been reported to occur 8–18 hr later.

Use in enoxaparin overdose may not be complete despite using multiple doses of protamine.

**PSEUDOEPHEDRINE**

Sudafed, Sudafed 12 Hour, Sudafed 24 Hour, and generics

Sympathomimetic, nasal decongestant



C



2



Yes



No



No

Tabs (OTC): 30, 60 mg

Extended-release tab (OTC):

Sudafed 12 Hour and generics: 120 mg

Sudafed 24 Hour: 240 mg

Oral liquid (OTC): 15 mg/5 mL, 30 mg/5 mL (120 mL); may contain sodium benzoate

Purchases of OTC products are limited to behind the pharmacy counter sales with monthly sale limits due to the methamphetamine epidemic.



Child <12 yr: 4 mg/kg/24 hr ÷ Q6 hr PO or by age:

<4 yr: 4 mg/kg/24 hr ÷ Q6 hr PO; **max. dose:** 60 mg/24 hr

4–5 yr: 15 mg/dose Q4–6 hr PO; **max. dose:** 60 mg/24 hr

6–12 yr: 30 mg/dose Q4–6 hr PO; **max. dose:** 120 mg/24 hr

Child ≥12 yr and adult:

Immediate release: 60 mg/dose Q4–6 hr PO; **max. dose:** 240 mg/24 hr

Sustained release:

Sudafed 12 Hour and generics: 120 mg PO Q12 hr

Sudafed 24 Hour: 240 mg PO Q24 hr



Contraindicated with MAO inhibitor drugs and in severe hypertension and severe coronary artery disease. **Use with caution** in mild/moderate hypertension, hyperglycemia, hyperthyroidism, and cardiac disease. May cause dizziness, nervousness, restlessness, insomnia, and arrhythmias. Pseudoephedrine is a common component of OTC cough and cold preparations and is combined with several antihistamines; these products are not recommended for children <6 yr. Since drug and active metabolite are primarily excreted renally, **doses should be adjusted in renal impairment**. May cause false-positive test for amphetamines (EMIT assay).

PSYLLIUM

Metamucil, Geri-Mucil, Konsyl, Reguloid, and many others including some generics

Bulk-forming laxative



B



1



No



No



No

Check specific product label for amount of psyllium per unit of measurement.

Granules [OTC]:

Konsyl: 4.3 g psyllium per rounded teaspoon or 6 g of granules (300 g); contains maltodextrin and 35 mg potassium for each 6 g dose; sugar and gluten free

Continued

D

PSYLLIUM *continued***Powder [OTC]:**

Metamucil: 3.4 g psyllium per rounded teaspoon; contains 5 mg sodium, 30 mg potassium, and 25 mg phenylalanine for each teaspoon. Other products may contain sucrose or maltodextrin instead of phenylalanine.

Caps [OTC]:

Reguloid and generics: 0.52 g; may contain potassium sorbate and polysorbate 80 and may be gluten and milk free; Reguloid is a fish derivative

3.4 g psyllium hydrophilic mucilloid is equivalent to 2 g soluble fiber



Constipation (granules or powder must be mixed with a full glass [240 mL] of water or juice):

<6 yr: 1.25–2.5 g/dose PO once daily–TID; **max. dose:** 7.5 g/24 hr

6–11 yr: 2.5–3.75 g/dose PO once daily–TID; **max. dose:** 15 g/24 hr

≥12 yr and adult: 2.5–7.5 g/dose PO once daily–TID; **max. dose:** 30 g/24 hr



Contraindicated in cases of fecal impaction or GI obstruction. **Use with caution** in patients with esophageal strictures and rectal bleeding. Phenylketonurics should be aware that certain preparations may contain aspartame. Should be taken or mixed with a full glass (240 mL) of liquid. Onset of action: 12–72 hr.

PYRANTEL PAMOATE

Reese's Pinworm Medicine and many other generics

Anthelmintic



C

2

No

Yes

No

Oral suspension (OTC): 50 mg/mL pyrantel base (144 mg/mL pyrantel pamoate) (30, 473 mL); may contain sodium benzoate, parabens, and saccharin

Tabs (OTC): 62.5 mg pyrantel base (180 mg pyrantel pamoate); scored tablet



All doses expressed in terms of pyrantel base.

Child (≥2 yr), adolescent, and adult:

Ascaris (roundworm) and Trichostrongylus: 11 mg/kg/dose PO ×1

Enterobius (pinworm): 11 mg/kg/dose PO ×1. Repeat same dose 2 wk later.

Hookworm or eosinophilic enterocolitis: 11 mg/kg/dose PO once daily ×3 days

Moniliformis: 11 mg/kg/dose PO Q2 wk ×3 doses.

Max. dose (all indications): 1 g/dose

Use with caution in liver dysfunction. **Do not use** in combination with piperazine because of antagonism. May cause nausea, vomiting, anorexia, transient AST elevations, headaches, rash, and muscle weakness. Limited experience in children <2 yr. May increase theophylline levels. Drug may be mixed with milk or fruit juice and may be taken with food.

**PYRAZINAMIDE**

Pyrazinoic acid amide, and generics

Antituberculous agent



C

2

Yes

Yes

No

Tab: 500 mg

Oral suspension: 100 mg/mL

In combination with isoniazid and rifampin (Rifater):

Tab: 300 mg with 50 mg isoniazid and 120 mg rifampin; contains povidone and propylene glycol

PYRAZINAMIDE *continued*

Tuberculosis: Use as part of a multidrug regimen for tuberculosis. See latest edition of the AAP Red Book for recommended treatment for tuberculosis.

Child:

Daily dose regimen: 30–40 mg/kg/24 hr PO once daily; **max. dose:** 2 g/24 hr

Twice-weekly dose regimen: 50 mg/kg/dose PO 2× per week; **max. dose:** 2 g/dose

Adult:

Daily dose regimen:

40–55 kg: 1000 mg PO once daily

56–75 kg: 1500 mg PO once daily

76–90 kg: 2000 mg PO once daily

Twice-weekly dose regimen:

40–55 kg: 2000 mg PO 2× per week

56–75 kg: 3000 mg PO 2× per week

76–90 kg: 4000 mg PO 2× per week

See latest edition of the AAP Red Book for recommended treatment for tuberculosis.



Contraindicated in severe hepatic damage and acute gout. The CDC and ATS **do not recommend** the combination of pyrazinamide and rifampin for latent TB infections. **Use with caution** in patients with renal failure (dosage reduction has been recommended), gout or diabetes mellitus. Monitor liver function tests (baseline and periodic) and serum uric acid.

Hepatotoxicity is most common dose-related side effect; doses ≤30 mg/kg/24 hr minimizes effect.

Hyperuricemia, maculopapular rash, arthralgia, fever, acne, porphyria, dysuria, and photosensitivity may occur. Severe hepatic toxicity may occur with rifampin use. May decrease isoniazid levels.

PYRETHRINS WITH PIPERONYL BUTOXIDE

A-200, Pronto Plus, RID, LiceMD, Licide, and many others

Pediculicide

C

2

No

No

No

All products are available OTC without a prescription.

Gel (LiceMD): 0.3% pyrethrins and 4% piperonyl butoxide (118 mL)

Shampoo (RID, Pronto Plus, Licide, A-200): 0.33% pyrethrins and 4% piperonyl butoxide (60, 120, 240 mL); may contain alcohol



Pediculosis (≥2 yr and adult): Apply to dry hair or affected body area for 10 min, then wash thoroughly and comb with fine-tooth comb or nit-removing comb; repeat in 7–10 days.

Contraindicated in ragweed hypersensitivity; drug is derived from the chrysanthemum flowers. For topical use only. **Avoid** use in and around the eyes, mouth, nose, or vagina.

Avoid repeat applications in <24 hr. Low ovicidal activity requires repeat treatment.

Dead nits require mechanical removal. Wash bedding and clothing to eradicate infestation.

Local irritation including erythema, pruritis, urticaria, edema, and eczema may occur.



PYRIDOSTIGMINE BROMIDE

Mestinon, Regonol, and generics
Cholinergic agent



Oral syrup (Mestinon): 60 mg/5 mL (473 mL); contains 5% alcohol and sodium benzoate

Tabs (Mestinon and generics): 30, 60 mg

Sustained-release tab (Mestinon and generics): 180 mg; scored tablet

Injection (Regonol): 5 mg/mL (2 mL); may contain 1% benzyl alcohol

Myasthenia gravis:***Neonate:***

PO: 1 mg/kg/dose Q4 hr; **max.** dose: 7 mg/kg/24 hr

IM/IV: 0.05–0.15 mg/kg/dose Q4–6 hr; **max.** single IM/IV dose: 10 mg

***Child:***

PO: 7 mg/kg/24 hr in 5–6 divided doses

IM/IV: 0.05–0.15 mg/kg/dose Q4–6 hr; **max.** single IM/IV dose: 10 mg

Adult:

PO (immediate release): 60 mg TID; increase Q48 hr PRN. Usual effective dose: 60–1500 mg/24 hr.

PO (sustained release): 180–540 mg once daily–BID

IM/IV (use when PO therapy is not practical): Give 1/30 of the usual PO

Contraindicated in mechanical intestinal or urinary obstruction. **Use with caution** in patients with epilepsy, asthma, bradycardia, hyperthyroidism, arrhythmias, or peptic ulcer. May cause nausea, vomiting, diarrhea, rash, headache, and muscle cramps. Pyridostigmine is mainly excreted unchanged by the kidney. Therefore lower doses titrated to effect in renal disease may be necessary.



Changes in oral dosages may take several days to show results. **Atropine is the antidote.**

PYRIDOXINE

Vitamin B₆, and various names including generics
Vitamin, water soluble



Tabs (HCl) [OTC]: 25, 50, 100, 250, 500 mg

Oral solution (HCl): 1 mg/mL

Injection (HCl): 100 mg/mL (1 mL); some products may contain aluminum and 0.5% chlorobutanol

***Deficiency, IM/IV/PO (PO preferred):***

Child: 5–25 mg/24 hr × 3 wk, followed by 2.5–5 mg/24 hr as maintenance therapy

(via multivitamin preparation)

Adolescent and adult: 10–20 mg/24 hr × 3 wk, followed by 2–5 mg/24 hr as maintenance therapy
(via multivitamin preparation)

Drug-induced neuritis (PO):***Prophylaxis:***

Child: 1 mg/kg/24 hr or 10–50 mg/24 hr

Adolescent and adult: 25–50 mg/24 hr

Treatment (optimal dose not established):

Child: 50–200 mg/24 hr

Adolescent and adult: 50–300 mg/24 hr

PYRIDOXINE continued***Pyridoxine-dependent seizures:*****Neonate and infant:****Initial:** 50–100 mg/dose IM or rapid IV ×1**Maintenance:** 50–100 mg/24 hr PO**Recommended daily allowance:** See *Chapter 21*.

Use caution with concurrent levodopa therapy. Chronic administration has been associated with sensory neuropathy. Nausea, headache, increased AST, decreased serum folic acid level, and allergic reaction may occur. May lower phenobarbital and phenytoin levels. See *Chapter 20* for management of neonatal seizures.

Pregnancy category changes to "C" if dosage exceeds U.S. RDA recommendation.

**PYRIMETHAMINE**

Daraprim and generics

Antiparasitic agent**Tabs:** 25 mg; scored tablet (see remarks for outpatient prescription process)**Oral suspension:** 2 mg/mL***Congenital toxoplasmosis (administer with sulfadiazine and leucovorin; see remarks):*****Load:** 2 mg/kg/24 hr PO ÷ Q12 hr ×2 days**Maintenance:** 1 mg/kg/24 hr PO once daily ×2–6 mo, then 1 mg/kg/24 hr 3× per wk to complete total 12 mo of therapy***Toxoplasmosis (administer with sulfadiazine or trisulfapyrimidines, and leucovorin):*****Child:****Load:** 2 mg/kg/24 hr PO ÷ BID (**max. dose:** 100 mg/24 hr) with the following duration:**Non-HIV exposed/positive:** 2 days**HIV exposed/positive:** 3 days**Maintenance:****Non-HIV exposed/positive:** 1 mg/kg/24 hr PO once daily (**max. dose:** 25 mg/24 hr)×6 mo, followed by 1 mg/kg/dose (**max. dose:** 25 mg/24 hr) 3 times per week to complete a total 12 mo therapy**HIV exposed/positive:** 1 mg/kg/24 hr PO once daily (**max. dose:** 25 mg/24 hr) ≥6 wk**Adult:****Non-HIV exposed/positive:** 50–75 mg/24 hr PO ×1–3 wk. Depending on tolerance and response, additional therapy at a 50% reduced dosage is continued ×4–5 wk.**HIV exposed/positive:** 200 mg PO ×1 followed by 50–75 mg/24 hr once daily ×≥6 wk.

Pyrimethamine is a folate antagonist. Supplementation with folinic acid leucovorin at 5–15 mg/24 hr is recommended. **Contraindicated** in megaloblastic anemia secondary to folate deficiency. **Use with caution** in G6PD deficiency, malabsorption syndromes, alcoholism, pregnancy, and renal or hepatic impairment. Pyrimethamine can cause glossitis, bone marrow suppression, seizures, rash, and photosensitivity. For congenital toxoplasmosis, see *Clin Infect Dis* 1994;18:38–72. Zidovudine and methotrexate may increase risk for bone marrow suppression. Aurothioglucose, trimethoprim, and sulfamethoxazole may increase risk for blood dyscrasias. Administer doses with meals. Most cases of acquired toxoplasmosis do not require specific antimicrobial therapy.

Outpatient prescriptions may need to be processed through a specialty pharmacy program via the manufacturer; see <http://www.daraprimdirect.com/healthcare-providers>.

QUETIAPINE

Seroquel, Seroquel XR, and generics
Antipsychotic, second generation



C

2

No

Yes

No

Tabs: 25, 50, 100, 200, 300, 400 mg

Extended release tabs (Seroquel XR and generics): 50, 150, 200, 300, 400 mg

Oral suspension: 40 mg/ml

Bipolar Mania (continue therapy at lowest dose to maintain efficacy and periodically assess maintenance treatment needs; PO):

Immediate release dosage forms:



Age	Dose Titration	Recommended Dose	Maximum Dose
Child ≥10 yr and adolescent	Day 1: 25 mg BID Day 2: 50 mg BID Day 3: 100 mg BID Day 4: 150 mg BID Day 5: 200 mg BID ≥Day 6: If needed, additional increases should be ≤100 mg/24 hr up to 600 mg/24 hr. Total daily doses may be divided TID based on response and tolerability.	400–600 mg/24 hr	600 mg/24 hr
Adult	Day 1: 50 mg BID Day 2: 100 mg BID Day 3: 150 mg BID Day 4: 200 mg BID ≥Day 5: If needed, additional increases ≤200 mg/24 hr up to 800 mg/24 hr by day 6.	400–800 mg/24 hr	800 mg/24 hr

Extended-release tabs (see remarks):

Age	Dose Titration	Recommended Dose	Maximum Dose
Child ≥10 yr and adolescent	Day 1: 50 mg once daily Day 2: 100 mg once daily Day 3–5: increase by 100 mg/24 hr increments each day until 400 mg once daily is achieved on day 5.	400–600 mg once daily	600 mg/24 hr
Adult	Day 1: 300 mg once daily Day 2: 600 mg once daily Day 3: Adjust dose to 400–800 mg once daily based on efficacy and tolerance	400–800 mg once daily	800 mg/24 hr (some may require 1200 mg/24 hr)

QUETIAPINE continued

Schizophrenia (continue therapy at lowest dose to maintain efficacy and periodically assess maintenance treatment needs; PO):

Immediate release dosage forms:

Age	Dose Titration	Recommended Dose	Maximum Dose
Adolescent (13–17 yr)	Day 1: 25 mg BID Day 2: 50 mg BID Day 3: 100 mg BID Day 4: 150 mg BID Day 5: 200 mg BID ≥Day 6: If needed, additional increases should be ≤100 mg/24 hr up to 800 mg/24 hr. Total daily doses may be divided TID based on response and tolerability.	400–800 mg/24 hr	800 mg/24 hr
Adult	Day 1: 25 mg BID Day 2 and 3: increase in increments of 25–50 mg divided 2–3 doses daily to 300–400 mg/24 hr divided BID–TID by day 4. If needed, increase dose by 50–100 mg/24 hr at intervals of at least 2 days.	150–750 mg/24 hr	800 mg/24 hr

Extended release tabs (see remarks):

Age	Dose Titration	Recommended Dose	Maximum Dose
Adolescent (13–17 yr)	Day 1: 50 mg once daily Day 2: 100 mg once daily Day 3: 200 mg once daily Day 4: 300 mg once daily Day 5: 400 mg once daily	400–800 mg once daily	800 mg/24 hr
Adult	Day 1: 300 mg once daily If needed, increase dose in increments of up to 300 mg/24 hr	400–800 mg once daily	800 mg/24 hr

Avoid use in patients with history of cardiac arrhythmias or prolonged QTc syndrome, concurrent medications that can prolong the QTc interval, and alcohol use. **Use with caution** in hypovolemia and diabetes mellitus.

Suicidal ideation/behavior or worsening depression may occur especially in children and young adults during the first few months of therapy or during dosage changes.

Common side effects in children include hypertension, hyperglycemia, hyperprolactinemia, and significant weight gain. Other common side effects include orthostatic hypotension, tachycardia, hypercholesterolemia, hypertriglyceridemia, abdominal pain, GI disturbances, increase appetite, xerostomia, increase serum transaminases, EPS, headache, dizziness, agitation, and fatigue. Anaphylactic reactions, DRESS, SJS, TEN, SIADH, cardiomyopathy, priapism, DKA, pancreatitis, eosinophilia, agranulocytosis, leukopenia, neutropenia, cataracts, hypothyroidism, neuroleptic malignant syndrome, and seizures have been reported. Anticholinergic side effects (e.g., constipation, urinary retention) may occur due to norquetiapine, its active metabolite.



For explanation of icons, see p. 667

Continued

QUETIAPINE continued

Do not abruptly discontinue medication as acute withdrawal symptoms occur. Dosage adjustment in hepatic impairment may be necessary as it is primarily hepatically metabolized. Quetiapine is a major substrate for CYP 450 3A4 and minor substrate for 2D6. Opioids and other CNS depressants may enhance CNS depressant effects. Carbamazepine may decrease the effects of quetiapine. Quetiapine may decrease dopamine agonist effects (e.g., anti-parkinson agents) but may enhance the anticholinergic and QTc prolongation effects to those medications processing these risks.

Always check for drug interactions as effects can be mild to severe.

Non-extended release dosage forms may be administered with or without food. Extended-release tabs must be swallowed whole and administered preferably in the evening without food (a light meal of ≤ 300 calories is allowed). May convert patients from immediate-release to extended-release tablets at the equivalent total daily dose and administer once daily; individual dosage adjustments may be necessary.

QUINIDINE

Various generics

Class Ia antiarrhythmic, antimalarial agent



C

2

Yes

Yes

No

As gluconate (62% quinidine):

Slow-release tabs: 324 mg

As sulfate (83% quinidine):

Tabs: 200, 300 mg

Oral suspension: 10 mg/mL

Equivalents: 200 mg sulfate = 267 mg gluconate

NOTE: The intravenous dosage form is no longer available in the United States. Contact the CDC

Malaria Hotline at (770) 488-7788 or (855) 856-4713 for an alternative therapy.

All doses are expressed as salt forms.



Antiarrhythmic (not first line):

Child (as sulfate): 15–60 mg/kg/24 hr 24 hr PO \div Q 6 hr; **max. dose:** 2400 mg/24 hr.

Adult:

As sulfate: 100–600 mg/dose PO Q 4–6 hr. Begin at 200 mg/dose and titrate to desired effect.

As gluconate: 324–972 mg PO Q 8–12 hr.

Malaria:

Child and adult (give intravenously as gluconate; see remarks):

Loading dose: 10 mg/kg/dose IV (**max. dose:** 600 mg) over 1–2 hr followed by maintenance dose.

Omit or decrease load if patient has received quinine or mefloquine.

Maintenance dose: 0.02 mg/kg/min IV as continuous infusion until oral therapy can be initiated. If more than 48 hr of intravenous therapy is required, reduce dose by 30%–50%.



Test dose is given to assess for idiosyncratic reaction to quinidine. Toxicity indicated by increase of QRS interval by ≥ 0.02 sec (skip dose or stop drug). May cause gastrointestinal (GI) symptoms, hypotension, tinnitus, TTP, rash, heart block and blood dyscrasias. When used alone, may cause 1:1 conduction in atrial flutter leading to ventricular fibrillation. Patients may develop idiosyncratic ventricular tachycardia with low levels, especially when therapy is being initiated.

QUINIDINE *continued*

Quinidine is a substrate of CYP 450 3A3/4 and 3A5–7 enzymes, and an inhibitor of CYP 450 2D6 and 3A3/4 enzymes. Can cause increase in digoxin levels. Quinidine potentiates the effect of neuromuscular blocking agents, beta blockers, anticholinergics, and warfarin. Amiodarone, antacids, delavirdine, diltiazem, grapefruit juice, saquinavir, ritonavir, verapamil, or cimetidine may enhance the drug's effect. Barbiturates, phenytoin, cholinergic drugs, nifedipine, sucralfate, or rifampin may reduce quinidine's effect. **Use with caution** in renal insufficiency (15%–25% of drug is eliminated unchanged in the urine), myocardial depression, sick sinus syndrome, G6PD deficiency, and hepatic dysfunction.

Therapeutic levels (antiarrhythmic): 3–7 mg/L. Recommended serum sampling times at steady state: trough level obtained within 30 min prior to the next scheduled dose after 1–2 days of continuous dosing (steady state).

Malaria use: Continuous monitoring of electrocardiogram, blood pressure, and serum glucose is recommended, especially in pregnant women and young children.

QUINUPRISTIN AND DALFOPRISTIN

Synercid

Antibiotic, streptogramin



B



?



No



Yes



No

Injection: 500 mg (150 mg quinupristin and 350 mg dalfopristin)

Doses expressed in mg of combined quinupristin and dalfopristin.

Vancomycin-resistant Enterococcus faecium (VREF):



Child < 16 yr (limited data), ≥16 yr and adult: 7.5 mg/kg/dose IV Q 8 hr

Complicated skin infections:

Child < 16 yr (limited data), ≥16 yr and adult: 7.5 mg/kg/dose IV Q 12 hr for at least 7 days

VREF endocarditis:

Child and adult: 7.5 mg/kg/dose IV Q 8 hr for at least 8 weeks



Not active against *Enterococcus faecalis*. Use with caution in hepatic impairment; dosage reduction may be necessary. Most common side effects include pain, burning, inflammation and edema at the intravenous infusion site, thrombophlebitis, and thrombosis, GI disturbances, rash, arthralgia, myalgia, increased liver enzymes, hyperbilirubinemia, and headache. Dose frequency reductions (Q 8 hr–Q 12 hr) or discontinuation can improve severe cases of arthralgia and myalgia. Use total body weight for obese patients when calculating dosages.

Drug is an inhibitor to the CYP 450 3A4 isoenzyme. **Avoid use** with CYP 450 3A4 substrates, which can prolong QTc interval. May increase the effects/toxicity of cyclosporine, tacrolimus, sirolimus, delavirdine, nevirapine, indinavir, ritonavir, diazepam, midazolam, carbamazepine, methylprednisolone, vinca alkaloids, docetaxel, paclitaxel, quinidine and some calcium channel blockers.

Pediatric (<16 yr old) pharmacokinetic studies are incomplete. Reduce dose for patients with hepatic cirrhosis (Child-Pugh A or B).

Drug is compatible with D₅W and incompatible with saline and heparin. Infuse each dose over 1 hr using the following **max. IV concentrations:** peripheral line: 2 mg/mL, central line: 5 mg/mL. If injection site reaction occurs, dilute infusion to <1 mg/mL.

R**RANITIDINE HCL**

Zantac, Zantac 75 [OTC], Zantac 150 Maximum Strength [OTC], and generics

Histamine-2-antagonist



Tabs: 75 [OTC], 150 [OTC and Rx], 300 mg

Caps: 150, 300 mg

Oral syrup: 15 mg/mL (480 mL); may contain 7.5% alcohol and parabens

Injection: 25 mg/mL (2, 6, 40 mL); may contain 0.5% phenol

Neonate:

PO: 6 mg/kg/24 hr ÷ Q 8 hr



IV:

Pre-term: 1–3 mg/kg/24 hr ÷ Q 12 hr

Term: 1.5–4.5 mg/kg/24 hr ÷ Q 8 hr

ECMO: 2 mg/kg/dose IV Q 12–24 hr

Child ≥1 mo–16 yr:

Duodenal/gastric ulcer (see remarks):

PO:

Treatment: 4–8 mg/kg/24 hr ÷ Q 12 hr; **max. dose:** 300 mg/24 hr

Maintenance: 2–4 mg/kg/24 hr ÷ Q 12 hr; **max. dose:** 150 mg/24 hr

IV/IM: 2–4 mg/kg/24 hr ÷ Q 6–8 hr; **max. dose:** 200 mg/24 hr

Gastroesophageal reflux disease (GERD)/eruptive esophagitis:

PO: 5–10 mg/kg/24 hr ÷ Q 8–12 hr; **max. dose:** 300 mg/24 hr

IV/IM: 2–4 mg/kg/24 hr ÷ Q 6–8 hr; **max. dose:** 50 mg per dose

Adolescent and adult:

PO: 150 mg/dose BID or 300 mg/dose QHS; doses as high as 6 g/24 hr have been used in patients with severe disease (e.g., Zollinger-Ellison syndrome).

IM/IV: 50 mg/dose Q 6–8 hr; **max. dose:** 400 mg/24 hr

Continuous infusion, all ages: Administer daily intravenous dosage over 24 hr (may be added to parenteral nutrition solutions). An initial loading dose (using the respective age-appropriate intermittent dose) may be administered.

May cause headache and gastrointestinal (GI) disturbance, malaise, insomnia, sedation, arthralgia, and hepatotoxicity. Acute interstitial nephritis has been reported. May increase levels of nifedipine and midazolam. May decrease levels of ketoconazole, itraconazole and delavirdine. May cause false-positive urine protein test (Multistix).



Duodenal/gastric ulcer doses for ≥1 mo–16 yr are extrapolated from clinical adult trials and pharmacokinetic data in children. Extemporaneously compounded carbohydrate-free oral solution dosage form is useful for patients receiving the ketogenic diet. The syrup dosage form has a peppermint flavor and may not be tolerated. **Adjust dose in renal failure (see Chapter 31).**

RASBURICASE

Elitek

Antihyperuricemic agent

C



?



No



No



Yes

Injection: 1.5, 7.5 mg; contains mannitol and L-alanine**Hyperuricemia (all ages):** 0.1–0.2 mg/kg/dose (rounded down to the nearest whole 1.5 mg multiple) IV over 30 min × 1. Patients generally respond to one dose but if needed dose may be repeated Q 24 hr for up to four additional doses.**Contraindicated** in G6PD deficiency (risk for acute hemolytic anemia) or history of hypersensitivity, hemolytic reactions, or methemoglobinemia with rasburicase. **Use with caution** in asthma, allergies, hypersensitivity with other medications, and children <2 yr of age (decreased efficacy and increased risk for rash, vomiting, diarrhea, and fever).

Common side effects include nausea, vomiting, abdominal pain, discomfort, diarrhea, constipation, mucositis, fever, and rash. Serious and fatal hypersensitivity reactions have been reported in <1% of patients, including anaphylaxis, and can occur at any time; discontinue use immediately and permanently.

During therapy, uric acid blood samples must be sent to the laboratory immediately. Blood should be collected in prechilled tubes containing heparin, and placed in an ice-water bath to avoid potential falsely low uric acid levels (degradation of plasma uric acid occurs in the presence of rasburicase at room temperature). Centrifugation in a precooled centrifuge (4°C) is indicated. Plasma samples must be assayed within 4 hr of sample collection.

RH₀ (D) IMMUNE GLOBULIN INTRAVENOUS (HUMAN)

WinRho-SDF, Rhophylac

Immune Globulin

C

1

Yes

No

No

Injection (WinRho-SDF): 1500 IU (1.3 mL), 2500 IU (2.2 mL), 5000 IU (4.4 mL), 15,000 IU (13 mL); may contain polysorbate 80**Prefilled injection (Rhophylac):** 1500 IU (2 mL)**Conversion:** 1 mCg = 5 IU**IM route and IM dosage forms:** indicated for prevention of Rh hemolytic disease of newborn by administering to Rh₀(D) negative mother or prevention of isoimmunization in Rh₀(D)-negative individuals who have been transfused with Rh₀(D)-positive blood/cell components.**All doses based on international units (IU)****Immune thrombocytopenic purpura (nonsplenectomized Rh₀(D)-positive patients):****WinRho-SDF (child, adolescent, and adult; see remarks):****Initial dose (may be given in two divided doses on separate days or as a single dose):****Hemoglobin ≥ 10 mg/dL:** 250 IU/kg/dose IV × 1**Hemoglobin 8–<10 mg/dL:** 125–200 IU/kg/dose IV × 1**Hemoglobin <8 mg/dL:** Use alternative therapy.**Subsequent doses (actual dose and frequency of administration is determined by the patient's clinical response and subsequent hemoglobin level):****Hemoglobin <8 g/dL:** Use alternative therapy.**Hemoglobin 8–10 g/dL:** 125–200 IU/kg/dose IV × 1**Hemoglobin > 10 g/dL:** 250–300 IU/kg/dose IV × 1**Rhophylac (child, adolescent, and adult; see remarks):** 250 IU/kg/dose IV × 1

Continued

RH_O (D) IMMUNE GLOBULIN INTRAVENOUS (HUMAN) *continued*

Contraindicated in IgA deficiency. **Use with caution** with history of atherosclerosis, known/suspected hyperviscosity, coagulation disorders, and other thrombotic risks. Adverse events associated with ITP indication include headache, chills, fever and reduction in hemoglobin (due to the destruction of Rh_O[D] antigen-positive red cells). Intravascular hemolysis resulting in anemia and renal insufficiency has been reported. May interfere with immune response to live virus vaccines (e.g., MMR, varicella).



Clinical response for ITP therapy requires monitoring of platelet counts, RBC, Hgb, and reticulocyte count. Rh_O(D)-positive patients should be monitored for signs and symptoms of intravascular hemolysis, anemia, and renal insufficiency.

Recommended IV administration rate:

WinRho-SDF: over 3–5 min

Rhophylac: each 1500 IU (2 mL) per 15–60 sec

RIBAVIRIN

Oral: Rebetol and generics

Inhalation: Virazole and generics

Antiviral agent



X

3

Yes

Yes

No

Oral solution (Rebetol): 200 mg/5 mL (100 mL); contains sodium benzoate and propylene glycol

Oral caps (Rebetol and generics): 200 mg

Tabs: 200, 400, 500, 600 mg

Aerosol (Virazole and generics): 6 g



Hepatitis C (PO, see remarks): Hepatitis C combination therapy is dependent on HCV genotype and treatment status. Specific treatment recommendations are dynamic with newer therapies; see the most recent American Association for the Study of Liver Diseases/Infectious Disease Society of America (AASLD/IDSA) treatment recommendations at www.hcvguidelines.org

Child: In combination with sofosbuvir for patients with genotypes 2 or 3 with/without cirrhosis:

Child <12 yr and ≥35 kg, child ≥12 yr and adolescent (see remarks):

<47 kg: 15 mg/kg/24 hr PO ÷ BID

47–49 kg: 300 mg PO BID

50–65 kg: 400 mg PO BID

66–80 kg: 500 mg PO BID

>80 kg: 600 mg PO BID

Duration of therapy:

Genotype 2: 12 weeks

Genotype 3: 24 weeks

Adult (see remarks):

Oral capsules or solution as part of a recommended combination therapy:

<75 kg: 500 mg PO BID

≥75 kg: 600 mg PO BID

Inhalation (see remarks):

Continuous: Administer 6 g by aerosol over 12–18 hr once daily for 3–7 days. The 6-g ribavirin vial is diluted in 300 mL preservative-free sterile water to a final concentration of 20 mg/mL. Must be administered with Viretek Small Particle Aerosol Generator (SPAG-2).

Intermittent (for nonventilated patients): Administer 2 g by aerosol over 2 hr TID for 3–7 days. The 6 g ribavirin vial is diluted in 100 mL preservative-free sterile water to a final concentration of 60 mg/mL. The intermittent use is not recommended in patients with endotracheal tubes.

RIBAVIRIN continued

ORAL RIBAVIRIN: **Contraindicated** in pregnancy, significant or unstable cardiac disease, autoimmune hepatitis, hepatic decompensation (Child-Pugh score >6; class B or C), hemoglobinopathies, and creatinine clearance <50 mL/min. **Use with caution** in preexisting cardiac disease, pulmonary disease and sarcoidosis. Anemia (most common), insomnia, depression, irritability, and suicidal behavior (higher in adolescent and pediatric patients) have been reported with the oral route.

Combination therapy with peginterferon for Hep C is no longer recommended due to poor efficacy.

Tinnitus, hearing loss, vertigo, severe hypertriglyceridemia, and homicidal ideation have been reported in combination with interferon. Pancytopenia has been reported in combination with interferon and azathioprine. Increased risk for hepatic decompensation with cirrhotic chronic hepatitis C patients treated with α interferons or with HIV coinfection receiving HAART and interferon alfa-2a. Growth inhibition (delays in weight and height increases) was observed in children (5–17 years old) receiving combination therapy for up to 48 weeks.

May decrease the effects of zidovudine, stavudine; and increase risk for lactic acidosis with nucleoside analogues. **Reduce or discontinue dosage for toxicity as follows:**

Patient with no cardiac disease:

Hgb < 10 g/dL and ≥ 8.5 g/dL:

Child: 12 mg/kg/dose PO once daily; may further reduce to 8 mg/kg/dose PO once daily

Adult: 600 mg PO once daily (capsules or solution) or 200 mg PO QAM and 400 mg PO QPM (tablets)

Hgb < 8.5 g/dL: Discontinue therapy permanently.

Patient with cardiac disease:

≥ 2 mg/dL decrease in Hgb during any 4-week period during therapy:

Child: 12 mg/kg/dose PO once daily; may further reduce to 8 mg/kg/dose PO once daily (monitor weekly)

Adult: 600 mg PO once daily (capsules or solution) or 200 mg PO QAM and 400 mg PO QPM (tablets)

Hgb < 12 g/dL after 4 weeks of reduced dose: Discontinue therapy permanently

INHALED RIBAVIRIN: Use of ribavirin for RSV is controversial and not routinely indicated. Aerosol therapy may be considered for selected infants and young children at high risk for serious RSV disease (see most recent edition of the AAP Redbook). Most effective if begun early in course of RSV infection; generally in the first 3 days. May cause worsening respiratory distress, rash, conjunctivitis, mild bronchospasm, hypotension, anemia and cardiac arrest. **Avoid** unnecessary occupational exposure to ribavirin due to its teratogenic effects. Drug can precipitate in the respiratory equipment.

RIBOFLAVIN

Vitamin B₂ and various brands and generics

Water-soluble vitamin



A/C



1



No



No



No

Tabs [OTC]: 25, 50, 100 mg

Caps [OTC]: 50, 400 mg

Riboflavin deficiency:

Child: 2.5–10 mg/24 hr \div once daily–BID PO

Adult: 5–30 mg/24 hr \div once daily–BID PO

U.S. RDA requirements: see **Chapter 21.**



Continued

RIBOFLAVIN *continued***Migraine prophylaxis (limited data):****Child ≥8 yr and adolescent:** 200–400 mg PO once dailyHypersensitivity may occur. Administer with food. Causes yellow to orange discoloration of urine. For multivitamin information, see [Chapter 21](#).

Pregnancy category changes to C if used in doses above the RDA.

**RIFABUTIN**

Mycobutin and generics

Antituberculous agent

B



3



Yes



Yes



No

Caps: 150 mg**Oral suspension:** 20 mg/mL **MAC primary prophylaxis for first episode of opportunistic disease in HIV (see remarks for interactions and www.aidsinfo.nih.gov/guidelines):****Child >5 yr, adolescent, and adult:** 300 mg PO once daily; doses may be administered as 150 mg PO BID if gastrointestinal (GI) upset occurs.**MAC secondary prophylaxis for recurrence of opportunistic disease in HIV (in combination with ethambutol and a macrolide antibiotic [clarithromycin or azithromycin]):****Infant and child:** 5 mg/kg/24 hr PO once daily; **max. dose:** 300 mg/24 hr**Adolescent and adult:** 300 mg PO once daily; doses may be administered 150 mg PO BID if GI upset occurs
MAC treatment:**Child:** 10–20 mg/kg/24 hr PO once daily; **max. dose:** 300 mg/24 hr as part of a multidrug regimen for severe disease.**Adult:** 300 mg PO once daily; may be used in combination with azithromycin and ethambutol.**Use in combination with HIV antiretroviral agents:** see product information for dosage recommendations.**Should not be used** for MAC prophylaxis with active TB. May cause GI distress, discoloration of skin and body fluids (brown-orange color) and marrow suppression. Rash, eosinophilia, and bronchospasm have been reported. **Use with caution** in renal and liver impairment.**Adjust dose in renal impairment (see Chapter 31).** May permanently stain contact lenses.

Uveitis can occur when using high doses (>300 mg/24 hr in adults) in combination with macrolide antibiotics.

Rifabutin is an inducer of CYP 450 3A enzyme and is structurally similar to rifampin (similar drug interactions, see Rifampin). Clarithromycin, fluconazole, itraconazole, nevirapine and protease inhibitors increase rifabutin levels. Efavirenz may decrease rifabutin levels. May decrease effectiveness of dapsone, delavirdine, nevirapine, amprenavir, indinavir, nelfinavir, saquinavir, itraconazole, warfarin, oral contraceptives, digoxin, cyclosporine, ketoconazole and narcotics.

Doses may be administered with food if patient experiences GI intolerance.

RIFAMPIN

Rifadin and generics

Antibiotic, antituberculous agent, rifamycin

C



2



Yes



Yes



No

Caps (Rifadin and generics): 150, 300 mg**Oral suspension:** 10, 15, 25 mg/mL **Injection (Rifadin and generics):** 600 mg

RIFAMPIN continued

Staphylococcus aureus infections (as part of synergistic therapy with other antistaphylococcal agents):

Neonate, infant, child, and adolescent: 10–20 mg/kg/24 hr ÷ Q 12 hr IV/PO; **max. dose:**

600 mg/24 hr

Prosthetic valve endocarditis:

Early infection (≤ 1 yr surgery): 20 mg/kg/24 hr ÷ Q 8 hr IV/PO; **max. dose:** 900 mg/24 hr

Late infection (> 1 yr surgery): 15–20 mg/kg/24 hr ÷ Q 12 hr IV/PO; **max. dose:** 600 mg/24 hr

Adult: 600 mg once daily, or 300–450 mg Q 12 hr IV/PO

Prosthetic valve endocarditis: 300 mg Q 8 hr IV/PO for a minimum of 6 weeks in combination with antistaphylococcal penicillin with or without gentamicin for first 2 weeks.

Tuberculosis (see latest edition of the AAP Red Book for duration of therapy and combination therapy): Twice-weekly therapy may be used after 1–2 months of daily therapy.

Infant, child and adolescent:

Daily therapy: 15–20 mg/kg/24 hr ÷ Q 12–24 hr IV/PO; higher dose of 20–30 mg/kg/24 hr ÷ Q 12–24 hr has been recommended for infants and toddlers and for central nervous system (CNS) and disseminated disease.

Twice-weekly therapy: 15–20 mg/kg/24 hr PO twice weekly; higher dose of 20–30 mg/kg/24 hr twice weekly has been recommended for infants and toddlers and for CNS and disseminated disease.

Max. daily dose: 600 mg/24 hr

Adult:

Daily therapy: 10 mg/kg/24 hr PO once daily

Twice-weekly therapy: 10 mg/kg/24 hr once daily twice weekly

Max. daily dose: 600 mg/24 hr

Prophylaxis for Neisseria meningitidis (see latest edition of the AAP Red Book for additional information):

0–<1 mo: 10 mg/kg/24 hr ÷ Q12 hr PO × 2 days

≥1 mo: 15–20 mg/kg/24 hr ÷ Q12 hr PO × 2 days

Adult: 600 mg PO Q12 hr × 2 days

Max. dose (all ages): 1200 mg/24 hr.

Never use as monotherapy except when used for prophylaxis. Patients with latent tuberculosis infection should NOT be treated with rifampin and pyrazinamide because of the risk of severe liver injury. Use is **NOT recommended** in porphyria. Use with **caution** in diabetes.

May cause GI irritation, allergy, headache, fatigue, ataxia, muscle weakness, confusion, fever, hepatitis, transient LFT abnormalities, blood dyscrasias, interstitial nephritis, and elevated BUN and uric acid. Causes red discoloration of body secretions such as urine, saliva and tears (which can permanently stain contact lenses). Bleeding and vitamin K-dependent coagulation disorders have been reported.

Induces several hepatic enzymes and transporters (CYP 450 2C9, 2C19, and 3A4; UGT1A1, P-glycoprotein, and OATP1B1/1B3), which may decrease plasma concentration of digoxin, corticosteroids, buspirone, benzodiazepines, fentanyl, calcium channel blockers, β blockers, cyclosporine, tacrolimus, itraconazole, ketoconazole, oral anticoagulants, barbiturates, and theophylline. May reduce the effectiveness of oral contraceptives and anti-retroviral agents (protease inhibitors and nonnucleoside reverse transcriptase inhibitors). Use is **contraindicated** with praziquantel due to decreased praziquantel levels; rifampin should be discontinued 4 weeks prior to initiating praziquantel and rifampin can be restarted one day after completion of praziquantel. Hepatotoxicity is a concern when used in combination with pyrazinamide and ritonavir-boosted saquinavir (use is **contraindicated**).

Adjust dose in renal failure (see Chapter 31). Reduce dose in hepatic impairment. Give oral doses 1 hr before or 2 hr after meals.

For *Haemophilus influenzae* type b prophylaxis, see latest edition of the *Red Book*.

RIFAXIMIN

Xifaxan

Antibiotic, rifamycin derivative**Tabs:** 200, 550 mg; may contain edetate disodium**Oral suspension:** 20 mg/mL ***Small intestinal bacterial overgrowth (SIBO; limited data):*****Child ≥3 yr and adolescent:** 200–550 mg PO TID × 7 days **Adult:** 550 mg PO TID × 14 days***Irritable bowel syndrome with diarrhea:*****Child ≥8 yr and adolescent (limited data):** 10–30 mg/kg/24 hr PO ÷ TID; **max. dose:** 1200 mg/24 hr**Adult:** 550 mg PO TID × 14 days; may repeat up to two times with the same dosage regimen***Travelers' diarrhea (caused by noninvasive strains of Escherichia coli):*****Child ≥3–11 yr (limited data):** 100 mg PO QID for up to 5 days**Child ≥12 yr and adult:** 200 mg PO TID × 3 days***Recurrent or subsequent Clostridium difficile diarrhea:*****Child ≥12 yr and adult:** 400 mg PO TID × 20 days initiated after a 10-day course of oral vancomycin **Contraindicated** with rifamycin hypersensitivity. **Avoid use** in diarrhea complicated by fever or blood in the stool. **Use with caution** in severe hepatic impairment (Child-Pugh class C).

Common side effects include peripheral edema, abdominal pain, nausea, ascites, dizziness, headache, and fatigue. Anaphylaxis, angioedema, and exfoliative dermatitis have been reported.

Substrate and inhibitor of OATP1A2/SLCOA2 transporter and substrate of P-glycoprotein ABCB1 and OATP1B1/1B3. May decrease the effects of warfarin and immunological effects of cholera and BCG vaccines. P-glycoprotein inhibitors (e.g., cyclosporine) may increase the effects/toxicity of rifaximin.

Doses may be administered with or without food.

RIMANTADINE

Flumadine and generics

Antiviral agent**Tabs:** 100 mg**Oral suspension:** 10 mg/1 mL ***Influenza A prophylaxis (for at least 10 days after known exposure; usually for 6–8 weeks during influenza A season or local outbreak):*** **Child:****1–9 yr:** 5 mg/kg/24 hr PO once daily—BID; **max. dose:** 150 mg/24 hr**≥10 yr:****<40 kg:** 5 mg/kg/24 hr PO ÷ BID; **max. dose:** 150 mg/24 hr**≥40 kg:** 100 mg per dose PO BID**Adult:** 100 mg PO BID***Influenza A treatment (within 48 hr of illness onset):***

Use the aforementioned prophylaxis dosage × 5–7 days.

Resistance to influenza A and recommendations against the use for treatment and prophylaxis have been reported by the Centers for Disease Control (CDC). Check with local microbiology laboratories and the CDC for seasonal susceptibility/resistance.

RIMANTADINE *continued*

Preferred over amantadine for influenza due to lower incidence of adverse events. Individuals immunized with live attenuated influenza vaccine (e.g., FluMist) should not receive rimantadine prophylaxis for 14 days after the vaccine. Chemoprophylaxis does not interfere with immune response to inactivated influenza vaccine.

May cause GI disturbance, xerostoma, dizziness, headache and urinary retention. CNS disturbances are less than with amantadine. **Contraindicated** in amantadine hypersensitivity. **Use with caution** in renal or hepatic insufficiency; dosage reduction may be necessary. A dosage reduction of 50% has been recommended in severe hepatic or renal impairment. Subjects with severe renal impairment have been reported to have an 81% increase in systemic exposure.

RISPERIDONE

Risperdal, Risperdal Consta, and generics
Atypical antipsychotic, serotonin (5-HT₂) and dopamine (D₂) antagonist



C

3

Yes

Yes

No

Tabs: 0.25, 0.5, 1, 2, 3, 4 mg

Oral solution: 1 mg/mL (30 mL); may contain benzoic acid

Orally disintegrating tabs: 0.25, 0.5, 1, 2, 3, 4 mg; contains phenylalanine

IM Injection (Risperdal Consta): 12.5, 25, 37.5, 50 mg (prefilled syringe with 2 mL diluent; includes one 21-gauge 1-in needle for deltoid administration and one 20-gauge 2-in needle for gluteal administration); for IM administration only

Irritability associated with autistic disorder:

5–16 yr (PO daily doses may be administered once daily—BID; patients experiencing somnolence may benefit from QHS or BID dosing or dose reduction):

**Initial dose:**

<20 kg: 0.25 mg/24 hr PO for a minimum of 4 days; use with caution if <15 kg as dosing recommendation is not established.

≥20 kg: 0.5 mg/24 hr PO for a minimum of 4 days

Dose increment (if needed) after 4 days of initial dose:

<20 kg: 0.5 mg/24 hr PO for a minimum of 14 days, if additional increments needed, increase dose by 0.25 mg/24 hr at intervals of at least 14 days.

≥20 kg: 1 mg/24 hr PO for a minimum of 14 days, if additional increments needed, increase dose by 0.5 mg/24 hr at intervals of at least 14 days.

Max. daily dose for plateau of therapeutic effect (from one pivotal clinical trial):

<20 kg: 1 mg/24 hr

≥20–45 kg: 2.5 mg/24 hr

>45 kg: 3 mg/24 hr

Bipolar mania: Oral doses may be administered once or twice daily; patients experiencing somnolence may benefit from QHS or BID dosing or dose reduction. Long-term use beyond 3 weeks and doses (all ages) >6 mg/24 hr have not been evaluated.

Child (10–17 yr): Start with 0.5 mg/24 hr PO once daily (QAM or QHS). If needed, increase dose at intervals ≥24 hr in increments of 0.5 or 1 mg/24 hr, as tolerated, up to a recommended dose of 2.5 mg/24 hr. Although efficacy has been demonstrated between 0.5–6 mg/24 hr, no additional benefit was seen above 2.5 mg/24 hr. Higher doses were associated with more adverse effects.

Adult: Start with 2–3 mg PO once. Dosage increases or decreases of 1 mg/24 hr can be made at 24-hr intervals. Dosage range: 1–6 mg/24 hr.

Continued

D

RISPERIDONE *continued*

Schizophrenia: Oral doses be administered once daily--BID and patients experiencing somnolence may benefit from BID dosing (see remarks).

Adolescent (13–17 yr): No data are available to support long-term use of >8 wk.

PO: Start with 0.5 mg once daily (QAM or QHS). If needed, increase dose at intervals ≥24 hr in increments of 0.5 to 1 mg/24 hr, as tolerated, to a recommended dose of 3 mg/24 hr. Although efficacy has been demonstrated between 1–6 mg/24 hr, no additional benefit and greater side effects were seen above 3 mg/24 hr. Doses >6 mg/24 hr have not been studied.

Adult:

PO: Start with 1 mg BID on day 1; if tolerated, increase to 2 mg BID on day 2 and to 3 mg BID thereafter. Dosage increases or decreases of 1–2 mg can be made on a weekly basis if needed. Usual effective dose: 2–8 mg/24 hr. Doses above 16 mg/24 hr have not been evaluated.

IM: Start with 25 mg Q 2 wk; if no response, dose may be increased to 37.5 mg or 50 mg at 4-week intervals. **Max. IM dose:** 50 mg Q 2 wk. PO risperidone should also be administered with the initial IM dose and continued × 3 weeks and discontinued to provide adequate plasma concentrations during the initial IM dosing period.

Use with caution in cardiovascular disorders, diabetes, renal or hepatic impairment (dose reduction necessary), hypothermia or hyperthermia, seizures, breast cancer or other prolactin dependent tumors, and dysphagia. Common side effects include abdominal pain and other GI disturbances, arthralgia, anxiety, dizziness, headache, insomnia, somnolence (use QHS dosing), EPS, cough, fever, pharyngitis, rash, rhinitis, sexual dysfunction, tachycardia, and weight gain. Weight gain, somnolence, and fatigue were common side effects reported in the autism studies. Priapism, QTc prolongation, hypothermia, sleep apnea syndrome, sleep walking, ileus, urinary retention, diabetes mellitus, and hypoglycemia have been reported in post marketing reports. Very rare cases of anaphylaxis have been reported with use of the IM dosage form in patients who have previously tolerated the oral dosage form.



In the presence of severe renal or hepatic impairment or risk for hypotension, the following adult dosing has been recommended: Start with 0.5 mg PO BID. Increase dose, if needed and tolerated, in increments no more than 0.5 mg BID. Increases to doses >1.5 mg BID should occur at intervals of at least 1 week; slower titration may be required in some patients.

Limited studies in pediatric related Tourette syndrome, schizophrenia, and aggressive behavior in psychiatric disorders are reported. Autistic disorder safety and efficacy in children <5 years of age have not been established. If therapy has been discontinued for a period of time, therapy should be reinitiated with the same initial titration regimen.

Drug is a CYP 450 2D6 and 3A4 isoenzyme substrate. Concurrent use of isoenzyme inhibitors (e.g., fluoxetine, paroxetine, sertraline, cimetidine) and inducers (e.g., carbamazepine, rifampin, phenobarbital, phenytoin) may increase and decrease the effects of risperidone, respectively. Alcohol, CNS depressants, and St. John's wort may potentiate the drug's side effect. Risperidone may enhance the hypotensive effects of levodopa and dopamine agonists.

Oral dosage forms may be administered with or without food. Oral solution can be mixed in water, coffee, orange juice, or low-fat milk but is incompatible with cola or tea. **Do not** split or chew the orally disintegrating tablet. Use IM suspension preparation within 6 hr after reconstitution.

RIZATRIPTAN BENZOATE

Maxalt, Maxalt-MLT, and generics

Antimigraine agent, selective serotonin agonist



C

3

Yes

Yes

No

Tabs:

Maxalt and generics: 5, 10 mg (12s, 18s, 30s)

Orally disintegrating tabs (ODT):

RIZATRIPTAN BENZOATE *continued***Treatment of acute migraines with or without aura (tabs and ODT):****Child 6–17 yr (efficacy and safety with >1 dose within 24 hr has not been established):**

<40 kg: 5 mg PO × 1

≥40 kg: 10 mg PO × 1

≥18 yr and adult (safety of an average of >4 headaches in a 30 day period has not been established; see remarks): 5–10 mg PO × 1. If needed in 2 hr, a second dose may be administered.

Max. daily dose: 30 mg/24 hr.

Dosage adjustment if receiving propranolol:**Child 6–17 yr:**

<40 kg: DO NOT USE

≥40 kg: 5 mg PO × 1; max. dose: 5 mg/24 hr period

≥18 yr and adult: 5 mg PO up to a maximum of three doses at 2-hr intervals; max. dose: 15 mg/24 hr period.**Contraindicated** in hemiplegic or basilar migraine, coronary artery vasospasm, uncontrolled hypertension, ischemic bowel or coronary artery disease, peripheral vascular disease, history of stroke or transient ischemic attack (TIA), and current or recent use (within 2 weeks) of a MAO inhibitor.**Do not** administer with any ergotamine-containing medication ergot-type medication, any other 5-HT1 agonist (e.g., triptans), methylene blue, or linezolid.Use with **caution** in renal and hepatic impairment as a 44% increase in AUC for patients receiving hemodialysis and a 30% increase plasma concentration for patients with moderate hepatic dysfunction were reported.

Common adverse effects include nausea, asthenia, dizziness, somnolence, and fatigue. Serious adverse effects include chest pain, coronary artery spasm, hypertension, myocardial infarction (MI), peripheral ischemia, ventricular arrhythmia, ischemic colitis, anaphylaxis, angioedema, cerebrovascular accident, and serotonin syndrome. Transient and permanent vision loss have been reported.

When the ODT is being used, place the whole tablet on the tongue, allow the tablet to dissolve, and swallow with saliva. Administration with liquids is optional. Do not break the ODT tablet.

ROCURONIUM

Generics; previously available as Zemuron

Nondepolarizing neuromuscular blocking agent

C

?

No

Yes

No

Injection: 10 mg/mL (5, 10 mL)**Use of a peripheral nerve stimulator to monitor drug effect is recommended.****Infant:**

IV: 0.5 mg/kg/dose; may repeat Q 20–30 min PRN

Child (3 mo–14 yr):

IV: 0.6 mg/kg/dose × 1; if needed, give maintenance doses of 0.075–0.125 mg/kg/dose Q20–30 min PRN when neuromuscular blockade returns to 25% of control. Alternatively, a maintenance continuous intravenous infusion may be used starting at 7–12 mCg/kg/min when neuromuscular blockade returns to 10% of control.

Adolescent and adult:

IV: Start with 0.6–1.2 mg/kg/dose × 1; if needed, maintenance doses at 0.1–0.2 mg/kg/dose Q 20–30 min PRN. Alternatively, a maintenance continuous intravenous infusion may be used starting at 10–12 mCg/kg/min (range: 4–16 mCg/kg/min).

ROCURONIUM *continued*

Use with caution in hepatic impairment and history of anaphylaxis with other neuromuscular blocking agents. Hypertension, hypotension, arrhythmia, tachycardia, nausea, vomiting, bronchospasm, wheezing, hiccups, rash, and edema at the injection site may occur. Myopathy after long-term use in an intensive care unit (ICU) and QT interval prolongation in pediatric patients receiving general anesthetic agents have been reported. Severe anaphylactic reactions and malignant hypothermia have been reported. Increased neuromuscular blockade may occur with concomitant use of aminoglycosides, clindamycin, tetracycline, magnesium sulfate, quinine, quinidine, succinylcholine and inhalation anesthetics (for continuous infusion, reduce infusion by 30%–50% at 45–60 min after intubating dose).

Caffeine, calcium, carbamazepine, phenytoin, phenylephrine, azathioprine, and theophylline may reduce neuromuscular blocking effects.

Use must be accompanied by adequate anesthesia or sedation. Peak effects occur in 0.5–1 min for children and in 1–3.7 min for adults. Duration of action: 30–40 min in children and 20–94 min in adults (longer in geriatrics). Recovery time in children 3 months to 1 year of age is similar to that in adults. To prevent residual paralysis, extubate patient **only** after the patient has sufficiently recovered from neuromuscular blockade. In obese patients, use actual body weight for dosage calculation.

RUFINAMIDE

Banzel

Anticonvulsant, triazole derivative

Tabs: 200, 400 mg

Oral suspension: 40 mg/mL (460 mL); contains parabens and propylene glycol

Lennox-Gastaut Syndrome (it is not known if doses lower than the targeted dosages are effective; see remarks):

Child 1–17 yr (see remarks): Start at 10 mg/kg/24 hr PO ÷ BID, then increase dose by ~10 mg/kg/24 hr every other day up to the **maximum** targeted dose of 45 mg/kg/24 hr ÷ BID **not to exceed** 3200 mg/24 hr.

Child ≥17 yr and adult: Start at 400–800 mg/24 hr PO ÷ BID, then increase dose by 400–800 mg/24 hr every other day up to the **maximum** targeted dose of 3200 mg/24 hr ÷ BID.

Use with concurrent valproate therapy: Use lower initial dosages; <10 mg/kg/24 hr for child 1–17 yr and <400 mg/24 hr for ≥17 yr and adult.

Contraindicated in Familial short-QT syndrome. Use is **not recommended** in severe hepatic impairment (Child-Pugh 10–15). Use with **caution** when taking other medications that can shorten the QT interval, performing tasks requiring mental alertness, and in mild/moderate hepatic impairment (Child-Pugh 5–9).

Common side effects include fatigue, blurred vision, diplopia, ataxia, dizziness, headache, somnolence, nausea, vomiting and shortening of cardiac QT interval. Serious side effects of leukopenia, severe dermatologic reactions (e.g., Stevens-Johnson syndrome), multiorgan hypersensitivity reactions (e.g., DRESS), and suicidal ideation have been reported.

Rufinamide is a weak inhibitor of CYP 450 2E1 and weak inducer of 3A4. May decrease levels/effects of nifedipine, nimodipine, piperaquine, calcifediol, clozapine, carbamazepine, lamotrigine, triazolam, orlistat, and hormonal contraceptives. May increase the levels/effects of phenytoin and phenobarbital. Primidone, phenobarbital, phenytoin, and carbamazepine may decrease the levels/effects of rufinamide. Whereas valproic acid may increase the levels/effects of rufinamide.

The effectiveness data for 1- to 4-year-old children is based on bridging pharmacokinetic (PK) and safety data as their PK and safety data are similar to children ≥4 years old and adults.

Consider dose adjustment for drug loss in patients receiving hemodialysis (rufinamide is dialyzable). For therapy discontinuation, reduce dose by ~25% every 2 days. Tablets may be crushed and all

S

SALMETEROL

Serevent Diskus

β-2-adrenergic agonist (long acting)

C



2



No



Yes



No

Dry powder inhalation (DPI; Diskus): 50 mCG/inhalation (28, 60 inhalations); contains lactose**In combination with fluticasone:** see Fluticasone Propionate and Salmeterol**Persistent asthma (see remarks):****≥4 yr and adult:** 1 inhalation (50 mCG) Q 12 hr**Prevention of exercise-induced bronchospasm:****≥4 yr and adult:** 1 inhalation 30 to 60 min before exercise. Additional doses should not be used for another 12 hr. Patients who are already using 12-hr dosing for persistent asthma should not use additional salmeterol doses for this indication and use alternative therapy (e.g., albuterol) prior to exercise.

For long-term asthma control, should be used in combination with inhaled corticosteroids.

Should not be used to relieve symptoms of acute asthma. It is long acting and has its onset of action in 10 to 20 min with a peak effect at 3 hr. May be used at QHS (1 inhalation of the dry powder inhaler [DPI]) for nocturnal symptoms. Salmeterol is a chronic medication and is not used in similar fashion to short-acting β agonists (e.g., albuterol). Patients already receiving salmeterol every 12 hr should not use additional doses for prevention of exercise-induced bronchospasm; consider alternative therapy. Asthma exacerbations or hospitalizations were reported to be lower when this medication was used with an inhaled corticosteroid.



WARNING: Long-acting β-2-agonists as monotherapy increase the risks of asthma-related death and asthma-related hospitalizations. Monotherapy without concomitant use of an inhaled corticosteroid is **contraindicated** in asthma. Use salmeterol only as additional therapy for patients not adequately controlled on other asthma-controller medications (e.g., low- to medium-dose inhaled corticosteroids) or whose disease severity clearly requires initiation of treatment with two maintenance therapies. **Contraindicated** in milk allergies; contains milk proteins.

Should not be used in conjunction with an inhaled, long-acting β-2 agonist and is not a substitute for inhaled or systemic corticosteroid. Use with strong CYP450 3A4 inhibitors (e.g., ketoconazole, HIV protease inhibitors, clarithromycin, itraconazole, nefazodone, and telithromycin) is **not recommended** due to risk for cardiovascular adverse events (e.g., QTc prolongation, tachycardia). Salmeterol is a CYP450 3A4 substrate.

Proper patient education is essential. Use with caution in hepatic impairment. Side effects are similar to those of albuterol. Hypertension and arrhythmias have been reported. See [Chapter 24](#) for recommendations for asthma controller therapy.

SCOPOLAMINE HYDROBROMIDE

Transderm Scop and generics

Anticholinergic agent

C



2



Yes



Yes



No

Transdermal (Transderm Scop and generics): 1.5 mg/patch (4s, 10s, and 24s);

delivers ~1 mg over 3 days

**Transdermal (≥12 yr and adult; see remarks):****Motion sickness:** Apply patch behind the ear at least 4 hr prior to exposure to motion; remove after 72 hr.

SCOPOLAMINE HYDROBROMIDE *continued*

Transdermal (≥ 12 yr and adult; see remarks):

Antiemetic prior to surgery: Apply patch behind the ear the evening before prior to surgery. Remove patch 24 hr after surgery.

Antiemetic prior to cesarean section: Apply patch behind the ear 1 hr prior surgery to minimize infant exposure. Remove patch 24 hr after surgery.

Toxicities similar to those of atropine. **Contraindicated** in closed-angle glaucoma and hypersensitivity to belladonna alkaloids. **Use with caution** in hepatic or renal dysfunction, GI and urinary disorders (discontinue use if there is difficulty in urination), cardiac disease, seizures, or psychosis. May cause dry mouth, drowsiness, and blurred vision. Generalized rash and erythema may indicate hypersensitivity to the medication or other ingredients in the formulation.

Transdermal route should **NOT** be used in children under 12 yr of age. Drug withdrawal symptoms (nausea, vomiting, headache, and vertigo) have been reported following removal of transdermal patch in patients using the patch for more than 3 days. For perioperative use, the patch should be kept in place for 24 hr following surgery.

Concurrent use with medications with known CNS adverse reactions or have anticholinergic properties may potentiate scopolamine's CNS effects. Use of this medication may delay the rate of orally administered drugs and will interfere with the gastric secretion test (discontinue use 10 days prior to testing).

REMOVE transdermal patch before undergoing an MRI; patch contains aluminum.

**SELENIUM SULFIDE**

Selsun Blue Max Strength, SelRx, and generics

Topical antiseborrheic agent



C



2



No



No



No

Shampoo:

1% (Selsun Blue Max Strength and others; OTC): 207, 325, 400, 420 mL; some products are available with conditioner. Be aware of different active ingredients in the Selsun Blue product line.

2.25%: 180 mL; may contain parabens and propylene glycol

2.3% (SelRx and generics): 180 mL; may contain parabens and propylene glycol

Topical lotion: 2.5% (120 mL)

 **≥ 2 yr and adult:**

Seborrhea/Dandruff: Massage 5 to 10 mL of shampoo into wet scalp and leave on scalp for 2 to 3 min. Rinse thoroughly and repeat. Shampoo twice weekly for 2 weeks. Use maintenance application once every 1 to 4 wk.

Pityriasis (Tinea) versicolor: Apply 2.5% lotion to affected areas of skin. Allow to remain on skin for 10 min. Rinse thoroughly. Repeat once daily for 7 days. Follow with weekly or monthly applications for 3 mo to prevent recurrences.

Rinse hands and body well after treatment. May cause local irritation, hair loss, and hair discoloration. **Avoid** eyes, genital areas, and skin folds. Shampoo may be used for tinea capitis to reduce risk of transmission to others (does not eradicate tinea infection).

For tinea versicolor, 15% to 25% sodium hyposulfite or thiosulfate (Tinver lotion) applied to affected areas twice daily for 2 to 4 wk is an alternative. Topical antifungals (e.g., clotrimazole, miconazole) may be used for small focal infections. **Do not use** for tinea versicolor during pregnancy.



SENNA/SENNOSIDES

Senokot, Senna-Lax, Ex-Lax, and many others

Laxative, stimulant

C



1



No



No



No

Based on mg of senna (all products are OTC):**Oral powder:** 284 g**Oral syrup:** 176 mg/5 mL, 218 mg/5 mL (60 mL, 240 mL); may contain parabens and propylene glycol**Tabs:** 187, 217, 374 mg

187 mg senna extract is approximately 8.6 mg sennosides.

Based on mg of sennosides (all products are OTC):**Oral syrup:** 8.8 mg/5 mL (40, 237 mL); may contain parabens and propylene glycol**Tabs:** 8.6, 15, 17.2, 25 mg**Chewable tabs:** 15 mg

8.6 mg sennosides is approximately 187 mg senna extract.

Constipation:**Dosing based on mg senna:****Child:****Oral:** 10–20 mg/kg/dose PO QHS (**max. dose:** as shown below) or dosage by age:**1 mo–1 yr:** 55–109 mg PO QHS to **max. dose:** 218 mg/24 hr**1–5 yr:** 109–218 mg PO QHS to **max. dose:** 436 mg/24 hr**5–15 yr:** 218–436 mg PO QHS to **max. dose:** 872 mg/24 hr**Adult:****Oral powder:** 1/2 to 1 tsp PO once or twice daily**Syrup:** 436–654 mg PO at bedtime; **max. dose:** 654 mg (15 mL) BID**Tabs:** 374 mg PO at bedtime; **max. dose:** 748 mg BID**Dosing based on mg sennosides:****Child:****Syrup:****1 mo–2 yr:** 2.2–4.4 mg (1.25–2.5 mL) PO QHS to **max. dose:** 8.8 mg/24 hr**2–5 yr:** 4.4–6.6 mg (2.5–3.75 mL) PO QHS to **max. dose:** 6.6 mg BID**6–12 yr:** 8.8–13.2 mg (5–7.5 mL) PO QHS to **max. dose:** 13.2 mg BID**Tabs:****2–5 yr:** 4.3 mg PO QHS to **max. dose:** 8.6 mg BID**6–12 yr:** 8.6 mg PO QHS to **max. dose:** 17.2 mg BID**>12 yr and adult:****Granules:** 15 mg PO QHS to **max. dose:** 30 mg BID**Syrup:** 17.6–26.4 mg (10–15 mL) PO QHS to **max. dose:** 26.4 mg BID**Tabs:** 17.2 mg PO QHS to **max. dose:** 34.4 mg BID

Effects occur within 6 to 24 hr after oral administration. Prolonged use (>1 wk) should be avoided as it may lead to dependency. May cause nausea, vomiting, diarrhea, and abdominal cramps. Active metabolite stimulates the Auerbach plexus. Syrup may be administered with juice, milk, or mixed with ice cream.

**SERTRALINE HCL**

Zoloft and generics

Antidepressant (selective serotonin reuptake inhibitor)

C



2



Yes



Yes



Yes

Tabs: 25, 50, 100 mg**Oral concentrate solution:** 20 mg/mL (60 mL); may contain 12% alcohol and propylene glycol

SERTRALINE HCL *continued***Depression (see remarks):**

Child ≥6–12 yr (data limited in this age group): Start at 12.5–25 mg PO once daily.

May increase dosage by 25 mg at weekly intervals up to a **max. dose** of 200 mg/24 hr.

Child ≥13 yr and adult: Start at 25–50 mg PO once daily. May increase dosage by 50 mg at weekly intervals up to a **max. dose** of 200 mg/24 hr.

**Obsessive-compulsive disorder (see remarks):**

Child ≥6–12 yr: Start at 25 mg PO once daily. May increase dosage by 25 mg at 3- to 4-day intervals or by 50 mg at 7-day intervals up to a **max. dose** of 200 mg/24 hr.

Child ≥13 yr and adult: Start at 50 mg PO once daily. May increase dosage by 50 mg at weekly intervals up to **max. dose** of 200 mg/24 hr.



Drug is **contraindicated** in combination (or within 14 days of discontinuing use) with a monoamine oxidase (MAO) inhibitor (e.g., linezolid or intravenous methylene blue) or pimozide (increases adverse/toxic effects of pimozide). **Use with caution** in patients with abnormal bleeding, syndrome of inappropriate diuretic hormone (SIADH) secretion, and hepatic or renal impairment. Adverse effects include nausea, diarrhea, tremor, and increased sweating. Hyponatremia, diabetes mellitus, rhabdomyolysis, trismus, and platelet dysfunction have been reported. A positive correlation with length of QTc interval and serum sertraline and N-desmethylsertraline levels has been reported.

Monitor for clinical worsening of depression and suicidal ideation/behavior following the initiation of therapy or after dose changes. Use during the late third trimester of pregnancy may increase risk for withdrawal symptoms and persistent pulmonary hypertension in the newborn.

Use with drugs that interfere with hemostasis (e.g., NSAIDs, aspirin, warfarin) may increase risk for GI bleeds. Use with warfarin may increase PT. Inhibits the CYP 450 2D6 drug metabolizing enzyme. Serotonin syndrome may occur when taken with selective serotonin reuptake inhibitors (e.g., amitriptyline, amphetamines, buspirone, dihydroergotamine, sumatriptan, sympathomimetics).

Sertraline is a substrate for CYP 450 2B6, 2C9, 2C19, 2D6, and 3A4. Poor metabolizers of CYP 450 2C19 should initiate therapy at 50% of the recommended dosage and titrate to desired effect *or* consider using an alternative medication not predominantly metabolized by this enzyme. Ultrarapid 2C19 metabolizers should initiate therapy at the recommended starting dose and titrate to the recommended maintenance dosage *or* consider using a drug not predominantly metabolized by this enzyme.

Do not abruptly discontinue use; gradually taper dose (4–6 wk has been recommended) to reduce risk for withdrawal symptoms.

Mix oral concentrate solution with 4 oz of water, ginger ale, lemon/lime soda, lemonade, or orange juice. After mixing, a slight haze may appear; this is normal. This dosage form should be **used cautiously** in patients with latex allergy because the dropper contains dry natural rubber.

SILDENAFIL

Revatio, Viagra, and generics

Phosphodiesterase type-5 (PDE5) inhibitor



B

?

Yes

Yes

No

Tabs:

Revatio and generics: 20 mg

Viagra and generics: 25, 50, 100 mg

Oral suspension: 2.5 mg/mL

Revatio and generics: 10 mg/mL (112 mL); may contain sodium benzoate

Injection:

Revatio and generics: 0.8 mg/mL (12.5mL)

SILDENAFIL *continued*



Pulmonary hypertension:

Neonate (limited data from case reports and small clinical trials):

PO: Several dosages have been reported and have ranged from 0.5 to 3 mg/kg/dose

Q 6–12 hr PO. A single dose of ~0.3 mg/kg PO has been used in select patients to facilitate weaning from inhaled nitric oxide.

IV (case report from 4 neonates >34 wk gestation and <72 hr old): Start with 0.4 mg/kg/dose

IV over 3 hr followed by a continuous infusion of 1.6 mg/kg/24 hr (0.067 mg/kg/hr) for up to 7 days.

Infant and child (limited data):

PO: Start at 0.25 mg/kg/dose Q 6 hr or 0.5 mg/kg/dose Q 8 hr; if needed, titrate dose up to

1–2 mg/kg/dose Q 6–8 hr. A single dose of ~0.4mg/kg PO has been used in select patients to facilitate weaning from inhaled nitric oxide.

Child 1–17 yr (higher doses and long-term use are associated with increased risk for mortality; see remarks).

PO:

≥8–20 kg: 10 mg TID

>20–45 kg: 20 mg TID

>45 kg: 40 mg TID

Pulmonary arterial hypertension:

Adult:

PO: 20 mg TID (take at least 4–6 hr apart)

IV: 10 mg TID



Contraindicated with concurrent use of nitrates (e.g., nitroglycerin) and other nitric oxide donors; potentiates hypotensive effects. **Use with caution** in sepsis (high levels of cGMP may potentiate hypotension), hypotension, sickle cell anemia (use not established) and with concurrent CYP 450 3A4 inhibiting medications (see discussion that follows) and anti-hypertensive medications. Hepatic insufficiency or severe renal impairment (glomerular filtration rate [GFR] <30 mL/min) significantly reduces sildenafil clearance.

Findings from the dose-ranging study in 1- to 17-yr-olds with pulmonary arterial hypertension found an association of increased mortality risk with long-term use (>2 yr). Headache, pyrexia, upper respiratory tract infections (URTI), vomiting, and diarrhea were the most frequently reported side effect in this study. Optimal dosing based on age and body weight still needs to be determined. Hazard ratios for mortality were 3.95 (95% CI: 1.46–10.65) for high versus low doses and 1.92 (95% CI: 0.65–5.65) for medium versus low doses in follow-up study for those receiving therapy for ≥3 yr. A subsequent extension open-label study on the same population for an additional 16 weeks reported a greater hazard ratio for mortality with high- versus low-dose therapy ($P = 0.007$).

In adults, a transient impairment of color discrimination may occur; this effect could increase risk of severe retinopathy of prematurity in neonates. Common side effects reported in adults have included flushing, rash, diarrhea, indigestion, headache, abnormal vision, and nasal congestion. Hearing loss has been reported.

Sildenafil is substrate for CYP 450 3A4 (major) and 2C8/9 (minor). Azole antifungals, cimetidine, ciprofloxacin, clarithromycin, erythromycin, nicardipine, propofol, protease inhibitors, quinidine, verapamil, and grapefruit juice may increase the effects/toxicity of sildenafil. Bosentan, efavirenz, carbamazepine, phenobarbital, phenytoin, rifampin, St. John's wort, and high-fat meals may decrease sildenafil effects.

SILVER SULFADIAZINE

Silvadene, Thermazene, SSD Cream, and generics

Topical antibiotic**Cream:** 1% (20, 25, 50, 85, 400, 1000 g); contains methylparabens and propylene glycol**Child (≥ 2 mo) and adult:** Cover affected areas completely once or twice daily. Apply cream to a thickness of 1/16 inch using sterile technique.

Contraindicated in premature infants and infants up to 2 mo of age due to concerns of kernicterus; also contraindicated in pregnancy (approaching term). **Use with caution** in G6PD and renal and hepatic impairment. Discard product if cream has darkened. Significant systemic absorption may occur in severe burns. Adverse effects include pruritus, rash, bone marrow suppression, hemolytic anemia, hepatitis, interstitial nephritis, and life-threatening cutaneous reactions (e.g., Stevens-Johnson syndrome/toxic epidermal necrolysis [TEN] and exfoliative dermatitis). **Avoid** contact with the eye. Dressing may be used but is not necessary. See [Chapter 4](#) for more information.

**SIMETHICONE**Mylicon, Children's Mylicon, Phazyme,
Mylanta Gas, Gas-X and generics*Antiflatulent*

All dosage forms available OTC

Oral drops and suspension: 40 mg/0.6 mL (15, 30 mL); may contain sodium benzoate**Caps (Phazyme, Gas-X, and generics):** 125, 180, 250 mg**Chewable tabs:** 80, 125 mg**Children's Mylicon:** 40 mg; contains 400 mg calcium carbonate**Strip, orally disintegrating (Gas-X):** 40 mg (16s), 62.5 mg (18s); may contain alcohol**Infant and child (<2 yr):** 20 mg PO QID PRN; **max. dose:** 240 mg/24 hr**2–12 yr:** 40 mg PO QID PRN**>12 yr and adult:** 40–125 mg PO QPC and QHS PRN; **max. dose:** 500 mg/24 hr

Efficacy has not been demonstrated for treating infant colic. **Avoid** carbonated beverages and gas-forming foods. Oral liquid may be mixed with water, infant formula, or other suitable liquids for ease of oral administration.

**SIROLIMUS**

Rapamune and generics

Immunosuppressant agent**Tabs:** 0.5, 1, 2 mg**Oral solution:** 1 mg/mL (60 mL); contains 1.5%–2.5% ethanol**Child (≥ 13 yr (see remarks):**

<40 kg: 3 mg/m²/dose PO given once immediately after transplantation, followed by 1 mg/m²/24 hr PO \div Q 12–24 hr on the next day. Adjust dose to achieve desired trough blood levels.

 **≥ 40 kg:** use adult (low/moderate immunologic risk) ≥ 40 kg dosage below.

SIROLIMUS *continued*

Adult (see remarks):

Patients at low/moderate immunologic risk:

In combination with cyclosporine (adjust dose to achieve desired trough blood levels):

<40 kg: 3 mg/m²/dose PO given once immediately after transplantation followed by 1 mg/m²/dose PO once on the next day

≥40 kg: 6 mg PO once immediately after transplantation, followed by 2 mg PO once on the next day

Patients at high immunologic risk:

In combination with cyclosporine (withdrawal of cyclosporine is not recommended): 15 mg PO once immediately after transplantation, followed by 5 mg PO once on the next day. Adjust dose to achieve desired trough blood levels.

Increased susceptibility to infection and development of lymphoma may result from immunosuppression. **Fatal** bronchial anastomotic dehiscence has been reported in lung transplantation. Excess mortality, graft loss, and hepatic artery thrombosis have been reported in liver transplantation when used with tacrolimus. Patients with the greatest amount of urinary protein excretion prior to sirolimus conversion were those whose protein excretion increased the most after conversion. Increase risk of BK virus associated nephropathies have been reported. The following adverse effects have been reported when converting from a calcineurin inhibitor-based regimen to maintenance sirolimus:

Stable liver transplant: increased mortality

Kidney transplant: pneumonia, proteinuria, acute rejection, graft loss and death.

Monitor whole-blood trough levels (just prior to a dose at steady state); especially with pediatric patients; hepatic impairment; concurrent use of CYP 450 3A4 and/or P-gp inducers and inhibitors; and/or if cyclosporine dosage is markedly changed or discontinued. Steady-state is generally achieved after 5 to 7 days of continuous dosing. **Interpretation will vary based on specific treatment protocol and assay methodology (HPLC vs immunoassay vs LC/MS/MS).** Younger children may exhibit faster sirolimus clearance compared with adolescents.

Sirolimus is a substrate for CYP 450 3A4 and P-gp. Cyclosporine, diltiazem, protease inhibitors, erythromycin, grapefruit juice and other inhibitors of CYP 3A4 may increase the toxicity of sirolimus. Phenobarbital, carbamazepine, phenytoin, and St John's wort may decrease the effects of sirolimus. Strong inhibitors (e.g., azole antifungals and clarithromycin) and strong inducers (e.g., rifamycins) are **not recommended**.

Hypertension, peripheral edema, increase serum creatinine, dyspnea, epistaxis, headache, anemia, thrombocytopenia, hyperlipidemia, hypercholesterolemia, and arthralgia may occur. Progressive multifocal leukoencephalopathy (PML), diabetes mellitus, posterior reversible encephalopathy syndrome, ovarian cysts and menstrual disorders have been reported. Urinary tract infections have been reported in pediatric renal transplant patients with high immunologic risk.

Two milligrams of the oral solution have been demonstrated to be clinically equivalent to the 2-mg tablets. However, it is not known whether they are still therapeutically equivalent at higher doses. Reduce maintenance dosage by one-third in the presence of hepatic function impairment. Administer doses consistently with or without food. When administered with cyclosporine, give dose 4 hr after cyclosporine. **Do not** crush or split tablets. Measure the oral liquid dosage form with an amber oral syringe and dilute in a cup with 60 mL of water or orange juice only. Take dose immediately after mixing, add/mix additional 120 mL diluent into the cup, and drink immediately after mixing.

SODIUM BICARBONATE

Neut and generics

Alkalinating agent, electrolyte

Injection: 4% (Neut) (0.48 mEq/mL) (5 mL), 4.2% (0.5 mEq/mL) (5, 10 mL), 7.5% (0.89 mEq/mL) (50 mL), 8.4% (1 mEq/mL) (10, 50 mL)

Tabs: 325 mg (3.8 mEq), 650 mg (7.6 mEq)

Powder: 1, 120, 500 g; contains 30 mEq Na⁺ per 1/2 teaspoon

Each 1 mEq bicarbonate provides 1 mEq Na⁺.

Cardiac arrest: See inside front cover.

Correction of metabolic acidosis: Calculate patient's dose with the following formulas.



Neonate, infant and child:

$\text{HCO}_3^- \text{ (mEq)} = 0.3 \times \text{weight (kg)} \times \text{base deficit (mEq/L)}$, **OR**

$\text{HCO}_3^- \text{ (mEq)} = 0.5 \times \text{weight (kg)} \times [24 - \text{serum HCO}_3^- \text{ (mEq/L)}]$

Adult:

$\text{HCO}_3^- \text{ (mEq)} = 0.2 \times \text{weight (kg)} \times \text{base deficit (mEq/L)}$, **OR**

$\text{HCO}_3^- \text{ (mEq)} = 0.5 \times \text{weight (kg)} \times [24 - \text{serum HCO}_3^- \text{ (mEq/L)}]$

Urinary alkalization (titrate dose accordingly to urine pH):

Child: 84–840 mg (1–10 mEq)/kg/24 hr PO ÷ QID

Adult: 4 g (48 mEq) × 1 followed by 1–2 g (12–24 mEq) PO Q4 hr. Doses up to 16 g (192 mEq)/24 hr have been used.



Contraindicated in respiratory alkalosis, hypochloremia, and inadequate ventilation during cardiac arrest. **Use with caution** in congestive heart failure (CHF), renal impairment, cirrhosis, hypocalcemia, hypertension, and concurrent corticosteroids. Maintain high urine output. Monitor acid-base balance and serum electrolytes. May cause hypernatremia (contains sodium), hypokalemia, hypomagnesemia, hypocalcemia, hyperreflexia, edema, and tissue necrosis (extravasation). Oral route of administration may cause GI discomfort and gastric rupture from gas production.

For direct intravenous administration (cardiac arrest) in neonates and infants, use the 0.5 mEq/mL (4.2 %) concentration or dilute the 1 mEq/mL (8.4 %) concentration 1:1 with sterile water for injection and infuse at a rate **no greater than** 10 mEq/min. The 1 mEq/mL (8.4 %) concentration may be used in children and adults for direct intravenous administration.

For intravenous infusions (for all ages), dilute to a **max. concentration** of 0.5 mEq/mL in dextrose or sterile water for injection and infuse over 2 hr using a **max. rate** of 1 mEq/kg per hr.

Sodium bicarbonate should not be mixed with or be in contact with calcium, norepinephrine or dobutamine.

SODIUM CHLORIDE—INHALED PREPARATIONS

Hypersal, Nebusal, PulmoSal, Simply Saline, Ocean, Ayr Saline, Ayr Nasal Mist Allergy/Sinus, Rhinaris, many other brands, and generics

Electrolyte, inhalation

Nebulized solution (generics): 0.9% (3, 5, 15 mL), 3% (4, 15 mL), 7% (4 mL), 10% (4, 15 mL)

Hypersal (preservative-free): 3.5% (4 mL), 7% (4 mL)

Nebusal: 3% (4 mL), 6% (4 mL)

PulmoSal: 7% (4 mL)

Nasal solution spray/drops/mist (OTC): 0.2% (30 mL), 0.65% (15, 30, 45 mL), 0.9% (45, 90 mL), 2.65% (50 mL), 3% (100 mL); may contain benzalkonium chloride

SODIUM CHLORIDE—INHALED PREPARATIONS *continued*

Intranasal as moisturizer:



Child and adult:

Spray/Mist: 2–6 sprays into each nostril Q 2 hr PRN

Drops: 2–6 drops into each nostril Q 2 hr PRN

Cystic Fibrosis (Pre-treatment with albuterol is recommended to prevent bronchospasms; see remarks):

≥6 yr and adult: Nebulize 4 mL of 7% solution once or twice daily. If patient is unable to tolerate the 7% strength, lower strengths of 3%, 3.5% or 5% may be used.

Acute viral bronchiolitis (for hospitalized patients only; pretreatment with albuterol is recommended to prevent bronchospasms; see remarks):

Infant (>34 weeks' gestation up to 18 mo old): Nebulize 4 mL of 3% solution Q 2 hr for three doses followed by Q 4 hr for five doses followed by Q-6-hr dosing until discharge.

INTRANASAL USE: May be used as a nasal wash for sinuses, to restore moisture, to thin nasal secretions, or to relieve dry, crusted, and inflamed nasal membranes from colds, low humidity, allergies, nasal decongestant overuse, minor nose bleeds, and other irritations.



Nasal administration instructions:

Nasal drops: tilt head back and hold bottle upside down.

Nasal spray: hold head in upright position and give short, firm squeezes into each nostril. Sniff deeply.

NEBULIZATION: Hypertonic solutions lowers sputum viscosity and enhances mucociliary clearance.

Cystic Fibrosis: Improves FEV₁ and reduces pulmonary exacerbation frequency. May cause bronchospasm, cough, pharyngitis, hemoptysis, and acute decline in pulmonary function (administer first dose in a medical facility). It is recommended to withhold therapy in the presence of massive hemoptysis.

Acute viral bronchiolitis: Reduces length of hospitalization when compared to normal saline. May cause acute bronchospasm and local irritation.

SODIUM PHENYLACETATE AND SODIUM BENZOATE

Ammonul and generics

Ammonium detoxificant, Urea Cycle Disorder Treatment Agent



C

?

Yes

Yes

Yes

Injection: 100 mg sodium phenylacetate and 100 mg sodium benzoate per 1 mL (50 mL)



IV via central line (administered with IV arginine, continue infusion until ammonia levels are in the normal range): See Chapter 13 for dosing information.

Indicated for hyperammonemia due to enzyme deficiencies of the urea cycle (e.g., carbamoyl phosphate synthetase [CPS] and ornithine transcarbamylase deficiency). **Use with caution** in renal and hepatic impairment. Significant amounts of sodium may be administered with prolonged durations of therapy. Ammonia clearance is most efficient with hemodialysis.



Side effects include hypotension, hypokalemia, hyperglycemia, injection site reaction, nausea/vomiting, altered mental status, fever, metabolic acidosis, cerebral edema, seizures, anemia, and disseminated intravascular coagulation. CNS side effects are more frequent with ornithine transcarbamylase (OTC) and CPS. Blood and lymphatic system disorders and hypotension are common in patients 30 days old or younger, whereas nausea, vomiting, and diarrhea are common in patients more than 30 days old.

Although no formal drug interaction studies have been completed, penicillin antibiotics and probenecid may increase serum concentrations of sodium phenylacetate and sodium benzoate by competing for renal tubular secretion. Use of valproic acid or corticosteroids may increase plasma ammonia levels.

Must be diluted and administered IV via central line; peripheral line administration may result in burning.

SODIUM PHOSPHATE

Fleet Enema, Fleet Pedia-Lax, Fleet Enema Extra,
Fleet Phospho-Soda, OsmoPrep, and generics
Laxative, enema/oral



C

2

Yes

No

No

Enema [OTC]:

7 g dibasic sodium phosphate and 19 g monobasic sodium phosphate/118 mL; contains 4.4 g sodium per 118 mL

Pediatric size (Fleet Pedia-Lax): 66 mL

Adult size (Fleet Enema and generics): 133 mL

7 g dibasic sodium phosphate and 19 g monobasic sodium phosphate/197 mL; contains 4.4 g sodium per 197 mL

Fleet Enema Extra: 230 mL

Oral solution (Fleet Phospho-Soda and generics) [OTC]: 2.4 g monobasic sodium phosphate and 0.9 g dibasic sodium phosphate/5 mL (45 mL); contains 96.4 mEq Na per 20 mL and 62.25 mEq phosphate/5 mL

Oral tablets (OsmoPrep): 1.5 g (1.102 g monobasic sodium and 0.398 g per tablet)

Injection: see Phosphorus Supplements

Not to be used for phosphorus supplementation (see Phosphorus Supplements).

**Enema (see remarks):**

2–4 yr: 33 mL enema (half of Fleet Pedia-Lax) ×1

5–11 yr: 66 mL enema (Fleet Pedia-Lax) ×1

≥12 yr and adult: 133 mL enema (Fleet Enema or generics) **OR** 230 mL enema
(Fleet enema Extra) ×1

Oral laxative (Fleet Phospho-Soda or generic); mix with a full glass of water:

5–9 yr: 7.5 mL PO ×1

10–11 yr: 15 mL PO ×1

≥12 yr and adult: 15–45 mL PO ×1

Bowel prep prior to colonoscopy:

Adult (PO):

Evening prior to colonoscopy: 4 tabs (OsmoPrep) with 8 ounces of clear liquids Q 15 min up to a total of 5 doses (20 tabs with 40 oz of clear liquids)

Day of colonoscopy, 3 to 5 hr prior to procedure: 4 tabs (OsmoPrep) with 8 oz of clear liquids Q 15 min up to a total of three doses (12 tabs with 24 oz of clear liquids)



Contraindicated in patients with severe renal failure, megacolon, bowel obstruction, and CHF. May cause hyperphosphatemia, hypernatremia, hypocalcemia, hypotension, dehydration, and acidosis. **Avoid** retention of enema solution and **do not exceed** recommended doses, as this may lead to severe electrolyte disturbances due to enhanced systemic absorption. **Use with caution** in cardiac arrhythmias. Colonic mucosal aphthous ulceration should be considered when interpreting colonoscopy findings with use in patients with known or suspected irritable bowel disease (IBD).

A rare but serious form of kidney failure (acute phosphate nephropathy) has been reported with the use of bowel cleansing preparations such as Fleet Phospho-Soda.

Correct electrolyte abnormalities prior to use to minimize electrolyte side effects.

Onset of action: PO, 3–6 hr; PR, 2–5 min.

SODIUM POLYSTYRENE SULFONATE

SPS, Kionex, and generics; previously available as Kayexalate

Potassium-removing resin**Powder:** 454 g**Oral suspension:** 15 g/60 mL (60, 120, 500 mL); contains 21.5 mL sorbitol per 60 mL and 0.1%–0.3% alcohol**Rectal suspension:** 30 g/120 mL (120 mL), 50 g/200 mL (200 mL)

Contains 4.1 mEq Na+/g drug.

Note: Suspension may be given PO or PR. Practical exchange ratio is 1 mEq K per 1 g resin. May calculate dose according to desired exchange (see remarks).

**Infant and child:****PO:** 1 g/kg per dose (**max. dose:** 15 g per dose) Q 6 hr**PR:** 1 g/kg per dose Q 2–6 hr; **max. dose:** 30–50 g per dose. Dosing by practical exchange (1 mEq K per 1 g resin) has been recommended for infants and smaller children.**Adult:****PO:** 15 g once daily-QID**PR:** 30–50 g Q 6 hr

Contraindicated in obstructive bowel disease, neonates with reduced gut motility, and oral administration in neonates. **Use cautiously** in presence of renal failure, CHF, hypertension or severe edema. May cause hypokalemia, hypernatremia, hypomagnesemia, and hypocalcemia. Cases of colonic necrosis, GI bleeding, ischemic colitis, and perforation have been reported with the concomitant use of sorbitol in patients with GI risk factors (prematurity, history of intestinal disease or surgery hypovolemia, and renal insufficiency/failure). Use in neonates generally **not recommended** due to complication concerns for hypernatremia and NEC.

1 mEq Na delivered for each mEq K removed. **Do not administer** with antacids or laxatives containing Mg²⁺ or Al³⁺. Systemic alkalosis may result. May reduce absorption of other orally administered medication; administer other oral medications at least 3 hr before or 3 hr after sodium polystyrene sulfonate (patients with gastroparesis may require a 6-hr separation). Enema should be retained in the colon for at least 30–60 min.

SPIRONOLACTONE

Aldactone, CaroSpir, and generics

Diuretic, potassium sparing

C/D 2 Yes Yes No

Tabs: 25, 50, 100 mg**Oral suspension:** 1, 5, 25 mg/mL**CaroSpir:** 25 mg/5 mL (118, 473 mL); contains saccharin**Diuretic:****Neonate:** 1–3 mg/kg/24 hr ÷ once or twice daily PO**Child:** 1–3 mg/kg/24 hr ÷ BID–QID PO; **max. dose by indication:****Hypertension:** the lesser of 3.3 mg/kg/24 hr or 100 mg/24 hr**Edema:** the lesser of 4–6 mg/kg/24 hr or 400 mg/24 hr**Adult:** 25–200 mg/24 hr ÷ once daily–BID PO (see remarks); **max. dose:** 200 mg/24 hr**Diagnosis of primary aldosteronism:****Child:** 125–375 mg/m²/24 hr ÷ once or twice daily PO**Adult:** 400 mg once daily PO × 4 days (short test) or 3–4 wk (long test), then 100–400 mg once or twice daily maintenance.

SPIRONOLACTONE *continued***Hirsutism in women:**

Adult: 50–200 mg/24 hr ÷ once or twice daily PO

Contraindicated in Addison disease, hyperkalemia, use with eplerenone, or severe renal failure (see Chapter 31). **Use with caution** in dehydration, hyponatremia, and renal or hepatic dysfunction. Precipitation of impaired neurologic function, worsening hepatic encephalopathy, and coma may occur with hepatic disease with cirrhosis and ascites. May cause hyperkalemia (especially with severe heart failure), GI distress, rash, lethargy, dizziness, and gynecomastia. May potentiate ganglionic blocking agents and other antihypertensives. Monitor potassium levels and be aware of other K⁺ sources, K⁺-sparing diuretics and angiotensin-converting enzyme inhibitors [ACEIs] (all of which can increase K⁺).



Do not use with other medications known to cause hyperkalemia (e.g., ACEIs, angiotensin II antagonists, aldosterone blockers, and other potassium-sparing diuretics). Hyperkalemic metabolic acidosis has been reported with concurrent cholestyramine use. May cause false elevation in serum digoxin levels measured by radioimmunoassay.

Although TID–QID regimens have been recommended, data suggest once- or twice-daily dosing to be adequate. Pregnancy category changes to D if used in pregnancy-induced hypertension.

STREPTOMYCIN SULFATE

Generics

Antibiotic, aminoglycoside; antituberculous agent



D



2



Yes



No



No

Powder for injection: 1 g



MDR tuberculosis: Use as part of multidrug regimen (see latest edition of *AAP Red Book*). IM route is preferred. Monitor levels.

Infant, child, and adolescent (<15 yr or ≤40 kg):

Daily therapy: 20–40 mg/kg/24 hr IM/IV once daily

Max. daily dose: 1 g/24 hr

Twice weekly therapy (under direct observation): 25–30 mg/kg/dose IM/IV twice weekly

Max. daily dose: 1 g/24 hr

Child, adolescent and adult (≥15 yr or >40 kg):

Daily therapy: 15 mg/kg/24 hr IM/IV once daily; **max. daily dose:** 1 g/24 hr

Twice weekly therapy (under direct observation): 15 mg/kg/dose IM/IV twice weekly; **max. daily dose:** 1 g/24 hr

Brucellosis, tularemia, plague and rat bite fever (See latest edition of the *Red Book*).

Contraindicated with aminoglycoside and sulfite hypersensitivity. **Use with caution** in preexisting vertigo, tinnitus, hearing loss and neuromuscular disorders. Drug is administered via deep IM injection **only**. Follow auditory status. May cause CNS depression, other neurologic problems, myocarditis, serum sickness, nephrotoxicity, and ototoxicity. Concomitant neurotoxic, ototoxic, or nephrotoxic drugs and dehydration may increase risk for toxicity.



Therapeutic levels: peak 15–40 mg/L; trough: <5 mg/L. Recommended serum sampling time at steady state: trough within 30 min prior to the third consecutive dose and peak at 30–60 min (60 min for IM) after the administration of the third consecutive dose. Therapeutic levels are not achieved in cerebrospinal fluid (CSF).

Adjust dose in renal failure (see Chapter 31).

SUCCIMER

Chemet, DMSA [dimercaptosuccinic acid]

Chelating agent**Cap:** 100 mg**Lead chelation, child:**

10 mg/kg/dose (or 350 mg/m²/dose) PO Q 8 hr × 5 days, then 10 mg/kg/dose (or 350 mg/m²/dose) PO Q 12 hr × 14 days. **Max. dose:** 500 mg per dose.



Manufacturer recommendation (see following table):

Weight (kg)	Dose (mg) Q 8 hr × 5 Days Followed by Same Dose Q 12 hr × 14 Days
8–15	100
16–23	200
24–34	300
35–44	400
≥45	500

Use caution in patients with compromised renal or hepatic function. Repeated courses may be necessary. Follow serum lead levels. Allow a minimum of 2 wk between courses unless blood levels require more aggressive management. Side effects: GI symptoms, increased negative liver function tests (LFTs) (10%), rash, headaches, and dizziness. Allergic reactions, such as urticaria and angioedema, and neutropenia have been reported. May cause false-positive urinary ketone readings with nitroprusside reagent tests such as Ketostix and can falsely lower measured serum uric acid and creatine phosphokinase (CPK). **Coadministration with other chelating agents is not recommended.**



Serum transaminases should be monitored at baseline and weekly during therapy. Treatment of iron deficiency is recommended as well as environmental remediation. Contents of capsule may be sprinkled on food for those who are unable to swallow a capsule.

SUCCINYLCHOLINE

Anectine, Quelicin

Neuromuscular blocking agent**Injection:**

Anectine, Quelicin: 20 mg/mL (10 mL); contains parabens

**Paralysis for intubation (see remarks):****Infant, child, and adolescent:****Initial:****IV:****Infant:** 2–3 mg/kg/dose × 1**Child:** 1–2 mg/kg/dose × 1**Adolescent:** 1–1.5 mg/kg/dose × 1**IM:****Infant <6 mo:** 4–5 mg/kg/dose × 1**Infant ≥6 mo and child:** 4 mg/kg/dose × 1; **max. dose:** 150 mg per dose**Adolescent:** 3–4 mg/kg/dose × 1; **max. dose:** 150 mg per dose*Continued*

SUCCINYLCHOLINE *continued***Paralysis for intubation (see remarks, cont.):****Adult:****Initial:****IV:** 0.3–1.1 mg/kg/dose × 1**IM:** 3–4 mg/kg/dose × 1; **max. dose:** 150 mg/dose**Maintenance for long surgical procedures:** 0.04–0.07 mg/kg/dose IV Q 5–10 min PRN.

Continuous infusion not recommended.

Contraindicated after the acute phase of an injury following major burns, multiple trauma, extensive denervation of skeletal muscle, or upper motor neuron injury because severe hyperkalemia and subsequent **cardiac arrest** may occur. Individuals carrying the *RYR1* or *CACNA1S* gene have an increased risk for developing malignant hyperthermia with succinylcholine or halogenated volatile anesthetics; use in these individuals is **contraindicated**. Succinylcholine should be **avoided** in patients who are susceptible to malignant hyperthermia.

Pretreatment with atropine is recommended to reduce incidence of bradycardia. For rapid sequence intubation, see [Chapter 1](#).

Cardiac arrest has been reported in children and adolescents primarily with skeletal muscle myopathies (e.g., Duchenne muscular dystrophy). Identify developmental delays suggestive of a myopathy prior to use. Predose creatine kinase may be useful for identifying patients at risk. Monitoring of the electrocardiogram (ECG) for peaked T waves may be useful in detecting early signs of this adverse effect.

May cause malignant hyperthermia (use dantrolene to treat), bradycardia, hypotension, arrhythmia, and hyperkalemia. Severe anaphylactic reactions have been reported; **use caution** if previous anaphylactic reaction to other neuromuscular blocking agents. **Use with caution** in patients with severe burns, paraplegia, or crush injuries and in patients with preexisting hyperkalemia. Beware of prolonged depression in patients with liver disease, malnutrition, pseudocholinesterase deficiency, hypothermia and those receiving aminoglycosides, phenothiazines, quinidine, β blockers, amphotericin B, cyclophosphamide, diuretics, lithium, acetylcholine, and anticholinesterases. Diazepam may decrease neuromuscular blocking effects. Prior use of succinylcholine may enhance the neuromuscular blocking effect of vecuronium and its duration of action.

Duration of action 4–6 min IV, 10–30 min IM. Must be prepared to intubate within 1 min.

**SUCRALFATE**

Carafate and generics

Oral antiulcer agent**Tabs:** 1 g**Oral suspension:** 100 mg/mL (420 mL); contains sorbitol and parabens**Child:****Duodenal or gastric ulcer:** 40–80 mg/kg/24 hr ÷ Q6 hr PO; **max. dose:** 1000 mg/dose**Stomatitis:** 5–10 mL (500–1000 mg of suspension), swish and spit or swish and swallow QID**Adult:****Duodenal ulcer:****Treatment:** 1 g PO QID (1 hr before meals and QHS) or 2 g PO BID × 4–8 wk**Maintenance/prophylaxis:** 1 g PO BID**Stress ulcer:****Prophylaxis:** 1 g PO QID**Stomatitis:** 10 mL (1000 mg of suspension), swish and spit or swish and swallow QID**Proctitis (use oral suspension as rectal enema):** 20 mL (2 g) PR once or twice daily

SUCRALFATE *continued*

May cause vertigo, constipation, and dry mouth. Hypersensitivity, including anaphylactic reactions, and hyperglycemia in diabetic patients have been reported. Aluminum may accumulate in patients with renal failure. This may be augmented by the use of aluminum-containing antacids. **Use with caution** in patients with dysphagia or other conditions that may alter gag or cough reflexes or diminish oropharyngeal coordination/motility who are receiving the oral tablet dosage form; cases of tablet aspiration with respiratory complications have been reported.

Decreases absorption of phenytoin, digoxin, theophylline, cimetidine, fat-soluble vitamins, ketoconazole, omeprazole, quinolones, and oral anticoagulants. Administer these drugs at least 2 hr before or after sucralfate doses.

Drug requires an acidic environment to form a protective polymer coating for damaged GI tract mucosa. Administer oral doses on an empty stomach (1 hr before meals and QHS).

SUGAMMADEX

Bridion

Neuromuscular blockade reversal agent

B

1

Yes

Yes

No

Injection: 100 mg/1 mL (2, 5 mL)

Infant, child, and adolescent (limited data):

Routine reversal of rocuronium-induced moderate blockade (see remarks):

2 mg/kg/dose IV once over 10 sec; some suggest administering over slow intravenous push to reduce risk for bradycardia or asystole.



Adult (use actual body weight):

Reversal rocuronium or vecuronium-induced neuromuscular blockade:

Deep block (spontaneous recovery of twitch response reaching 1 to 2 post-tetanic counts with no twitch responses to train-of-four stimulation): 4 mg/kg/dose IV ×1

Moderate block (spontaneous recovery of reappearance of the second twitch in response of train-of-four stimulation): 2 mg/kg/dose IV ×1

Reversal of neuromuscular blockade 3 min after rocuronium 1.2 mg/kg: 16 mg/kg/dose IV ×1. The recovery to T₁ of 10% baseline (relative to the time of administration of rocuronium or succinylcholine) was faster with rocuronium/sugammadex than with succinylcholine alone. This dose has not been evaluated for vecuronium-induced neuromuscular blockade.

Sugammadex is a modified gamma cyclodextrin that binds to rocuronium and vecuronium for reduced neuromuscular blockade.

Use is **not recommended** for GFR <30 mL/min or on dialysis. **Use with caution** in hepatic impairment, especially in the presence of coagulopathy or severe edema.



Common side effects include nausea, vomiting, and headache. Serious effects include bradycardia, prolonged QTc interval, hypersensitivity reactions/anaphylaxis, increase creatine kinase, and bronchospasms. Sugammadex may increase the effects/toxicity of anticoagulants, and decrease the effects of hormonal contraceptives. Fusidic acid and toremifene may decrease sugammadex activity.

Limited data in children (especially <2 yr) and dosing in a multicenter, randomized, parallel-group, dose-finding study in 63 children (28 days to 17 yr of age) and 28 adult surgical patients.

Doses were well tolerated across all ages with dose-response relationship for those 2 yr of age or older. All had a median recovery time of 1.1 to 1.2 min after a 2 mg/kg dose (*Anesthesiology*. 2009;110:284–294).

SULFACETAMIDE SODIUM OPHTHALMIC

Bleph-10 and generics

Ophthalmic antibiotic, sulfonamide derivative

C

?

No

No

No

Ophthalmic solution (Bleph 10 and generics): 10% (5, 15 mL); may contain thimerosal or benzalkonium chloride

Ophthalmic ointment: 10% (3.5 g)



Conjunctivitis (usual duration of therapy for ophthalmic use is 7–10 days):

>2 mo and adult:

Ointment: Apply 0.5-in ribbon into conjunctival sac Q 3–4 hr and QHS initially, and reduce the dosing frequency with adequate response.

Drops: 1–2 drops to affected eye(s) Q 2–3 hr initially and reduce the dosing frequency with adequate response.



Hypersensitivity reactions between different sulfonamides can occur regardless of route of administration. May cause local irritation, stinging, burning, conjunctival hyperemia, excessive tear production, and eye pain. Rare toxic epidermal necrolysis and Stevens-Johnson syndrome have been reported. Sulfacetamide preparations are incompatible with silver preparations.

To reduce risk of systemic absorption with ophthalmic solution, apply finger pressure to lacrimal sac during and 1–2 min after instillation.

SULFADIAZINE

Various generics

Antibiotic, sulfonamide derivative

C/D

3

Yes

Yes

Yes

Tabs: 500 mg

Oral suspension: 100, 200 mg/mL



Infant ≥2 mo, child and adolescent: 75 mg/kg/dose or 2000 mg/m²/dose PO ×1, followed by

150 mg/kg/24 hr or 4000 mg/m²/24 hr ÷ Q 4–6 hr (**max. dose:** 6000 mg/24 hr).

Adult: 2–4 g/dose ×1, followed by 2–4 g/24 hr PO ÷ Q 4–8 hr

Congenital toxoplasmosis (administer with pyrimethamine and folinic acid; see pyrimethamine for dosage information):

Infant: 100 mg/kg/24 hr PO ÷ BID × 12 mo

Acquired toxoplasmosis (administer with pyrimethamine and folinic acid; see Pyrimethamine for dosage information):

Infant ≥2 mo and child: 100–200 mg/kg/24 hr ÷ Q 6 hr PO for at least 4–6 wk; **max. dose:** 6000 mg/24 hr

Adult: 4–6 g/24 hr PO ÷ Q6 hr for at least 4–6 wk

Rheumatic fever prophylaxis:

≤27 kg: 500 mg PO once daily

>27 kg: 1000 mg PO once daily



Most cases of acquired toxoplasmosis do not require specific antimicrobial therapy. **Contraindicated** in porphyria and hypersensitivity to sulfonamides. **Use with caution** in premature infants and infants below 2 mo of age, because of risk of hyperbilirubinemia, and in hepatic or renal dysfunction (30%–44% eliminated in urine). Maintain hydration. May cause fever, rash, hepatitis, systemic lupus erythematosus (SLE)-like syndrome, vasculitis, bone marrow suppression, and hemolysis in patients with G6PD deficiency, and Stevens-Johnson syndrome.

SULFADIAZINE *continued*

May cause increased effects of warfarin, methotrexate, thiazide diuretics, uricosuric agents, and sulfonylureas due to drug displacement from protein binding sites. Large quantities of vitamin C or acidifying agents (e.g., cranberry juice) may cause crystalluria. Pregnancy category changes from C to D if administered near term. Administer on an empty stomach with plenty of water.

SULFAMETHOXAZOLE AND TRIMETHOPRIM

Trimethoprim-sulfamethoxazole, Co-Trimoxazole, TMP-SMX; Bactrim, Bactrin DS, Sulfatrim, and generics; previously available as Septra

Antibiotic, sulfonamide derivative



Tabs:

Reg. strength (Bactrim and generics): 80 mg TMP/400 mg SMX

Double strength (Bactrim DS and generics): 160 mg TMP/800 mg SMX

Oral suspension (Sulfatrim and generics): 40 mg TMP/200 mg SMX per 5 mL (100, 480 mL)

Injection: 16 mg TMP/mL and 80 mg SMX/mL (5, 10, 30 mL); some preparations may contain propylene glycol and benzyl alcohol

Doses based on TMP component.

Minor/moderate infections (PO or IV):



Child: 8–12 mg/kg/24 hr ÷ BID; **max. dose** 160 mg/dose

Adult (>40 kg): 160 mg/dose BID

Severe infections (PO or IV):

Child and adult: 20 mg/kg/24 hr ÷ Q6–8 hr

UTI prophylaxis:

Child: 2–4 mg/kg/24 hr PO once daily

Pneumocystis jiroveci (carinii) pneumonia (PCP):

Treatment (≥2 mo and adult, PO or IV): 15–20 mg/kg/24 hr ÷ Q 6–8 hr × 21 days

Prophylaxis (PO or IV):

≥1 mo and child: 150 mg/m²/24 hr ÷ BID for 3 consecutive days per wk; **max. dose:** 320 mg/24 hr; see Chapter 17 for use criteria for perinatal HIV PCP prophylaxis.

Adolescent and adult: 80 or 160 mg once daily or 160 mg 3 days per wk.

Not recommended for use in infants below 2 mo of age (excluding PCP prophylaxis).



Contraindicated in patients with sulfonamide or trimethoprim hypersensitivity and megaloblastic anemia due to folate deficiency. May cause kernicterus in newborns; may cause blood dyscrasias, crystalluria, glossitis, renal or hepatic injury, GI irritation, rash, Stevens-Johnson syndrome, or hemolysis in patients with G6PD deficiency. Severe hyponatremia may occur during treatment of Pneumocystic jiroveci pneumonia. Hyperkalemia may appear in HIV/AIDS patients.

Use with caution in renal and hepatic impairment and in G6PD deficiency. QT prolongation resulting in ventricular tachycardia has been reported. Slow acetylators may be prone to idiosyncratic reactions to sulfonamides. Intravenous dosage form contains propylene glycol and benzyl alcohol, which may result in adverse toxic effects when used at higher dosages, especially in neonates. Use of an adjusted body weight ([ABW] ABW = ideal body weight + 0.4 × [total body weight – ideal body weight]) has been recommended for determining doses for obese patients.

Epidemiologic studies suggest that use during pregnancy may be associated with increase risk of congenital malformations (particularly neural tube defects), cardiovascular malformations, urinary tract defects, oral clefts, and club foot.

Sulfamethoxazole is a CYP 450 2C9 substrate and inhibitor. Trimethoprim is a CYP 450 2C9, 3A4 substrate and 2C8/9 inhibitor. **Reduce dose in renal impairment** (see Chapter 31).

D

SULFASALAZINE

Azulfidine, Azulfidine EN-tabs, Salicylazosulfapyridine, and generics

Anti-inflammatory agent



B/D



2



Yes



Yes



Yes

Tabs: 500 mg

Delayed-release tabs (Azulfidine EN-tabs and generics): 500 mg

Oral suspension: 100 mg/ml



Inflammatory bowel disease:

Child ≥ 6 yr:

Initial dosing:

Mild: 40–50 mg/kg/24 hr \div Q 6 hr PO

Moderate/severe: 50–75 mg/kg/24 hr \div Q 4–6 hr PO

Max. initial dose: 4 g/24 hr

Maintenance: 30–70 mg/kg/24 hr \div Q 4–8 hr PO; **max. dose:** 4 g/24 hr

Adult:

Initial: 3–4 g/24 hr \div Q 4–8 hr PO

Maintenance: 2 g/24 hr \div Q 6 hr PO

Max. dose: 6 g/24 hr

Juvenile idiopathic arthritis:

Child 6–16 yr: Start with 10 mg/kg/24 hr \div BID PO and increase by 10 mg/kg/24 hr Q7 days until planned maintenance dose is achieved. Usual maintenance dose is 30–50 mg/kg/24 hr \div BID PO up to a **max.** of 2 g/24 hr.



Contraindicated in sulfa or salicylate hypersensitivity, porphyria and GI or genitourinary (GU) obstruction. Discontinue use if a serious infection develops. **Use with caution** in renal impairment, blood dyscrasias, or asthma. Maintain hydration. May cause orange-yellow discoloration of urine and skin. May permanently stain contact lenses. May cause photosensitivity, hypersensitivity (which may result in hepatitis and nephritis), blood dyscrasias, CNS changes, nausea, vomiting, anorexia, diarrhea and renal damage. Hepatotoxicity/hepatic failure, anaphylaxis, angioedema, severe drug rash with eosinophilia and systemic symptoms (DRESS), and interstitial lung disease have been reported. May cause hemolysis in patients with G6PD deficiency. Pseudomononucleosis, myocarditis, folate deficiency (decreases folic acid absorption), nephrolithiasis and oropharyngeal pain have been reported.

Reduces serum digoxin and cyclosporine levels. Slow acetylators may require lower dosage due to accumulation of active sulfapyridine metabolite. May cause false-positive test for urinary normetanephrine if using liquid chromatography methods.

Pregnancy category changes to D if drug is administered near term. Bloody stools or diarrhea have been reported in breastfed infants of mothers receiving sulfasalazine.

SUMATRIPTAN SUCCINATE

Imitrex, Imitrex STAT dose, Sumavel Dose Pro, Zembrace SymTouch, Tosymra, and generics

In combination with naproxen:

Treximet

Antimigraine agent, selective serotonin agonist



C



2



Yes



Yes



No

Injection, for subcutaneous use:

Zembrace SymTouch: 3 mg/0.5 mL (0.5 mL)

Imitrex, Imitrex STAT dose, Sumavel DosePro, and generics: 4 mg/0.5 mL (0.5 mL), 6 mg/0.5 mL (0.5 mL)

D

SUMATRIPTAN SUCCINATE *continued*

Tabs: 25, 50, 100 mg

Oral suspension: 5 mg/mL

Nasal spray (as a unit-dose spray device):

Imitrex and generics: 5 mg dose in 100 microliters (six units per pack); 20 mg dose in 100 microliters (six units per pack)

Tosymra: 10 mg dose in 100 microliters (six units per pack)

Nasal powder (Onzetta): 11 mg capsule with nasal inhalation nosepiece (two each per pouch; box of eight pouches)

In combination with naproxen:

Tab (TrexiMet and generics): 85 mg sumatriptan and 500 mg naproxen sodium (nine tabs)

Adolescent ≥18 yr and adult (see remarks):

PO: 25, 50, or 100 mg as soon as possible after onset of headache. If no relief in 2 hr, give 25–100 mg Q 2 hr up to a daily **max.** of 200 mg. Safety of treating more than four headaches in a 30-day period has not been established.

Max. single dose: 100 mg/dose.

Max. daily dose: 200 mg/24 hr (with exclusive PO dosing or with an initial SC dose and subsequent PO dosing).

SC: 3, 4, or 6 mg ×1 as soon as possible after onset of headache. If no response, may give an additional dose 1 hr later; **max. daily dose:** 12 mg/24 hr. Use lower subsequent dose if side effects occur.

Nasal (safety of treating more than four headaches in a 30-day period has not been established):

Nasal spray (Imitrex, Tosymra, and generics): 5, 10, or 20 mg per dose into one nostril or divided into each nostril after onset of headache. Dose may be repeated in 2 hr up to a **max.** of 40 mg/24 hr.

Nasal powder (Onzetta): Inhale 22 mg (11 mg per nostril) after onset of headache. Dose may be repeated in 2 hr up to a **max.** of 44 mg/24 hr. If using a combination of different dosage forms, the **max. dose** is one dose of Onzetta (22 mg) and one dose of another sumatriptan product.

In combination with naproxen sodium:

TrexiMet and generics:

Child 12–17 yr: 1 tablet (85 mg sumatriptan + 500 mg naproxen sodium) after the onset of headache ×1; **max. dose:** 1 tab/24 hr. Safety of treating more than two headaches in a 30-day period has not been established.

Adult: 1 tablet (85 mg sumatriptan + 500 mg naproxen sodium) after the onset of headache ×1, if response is unsatisfactory in 2 hr, a second dose may be administered. **Max. dose:** 2 tabs/24 hr. Safety of treating more than five headaches in a 30-day period has not been established.

Contraindicated with concomitant administration of ergotamine derivatives, MAO inhibitors (and use within the past 2 wk), or other vasoconstrictive drugs. **Not** for migraine prophylaxis. **Use with caution** in renal or hepatic impairment. A **max. single** PO dose of 50 mg has been recommended in adults with hepatic dysfunction. Acts as selective agonist for serotonin receptor. Induration and swelling at the injection site; flushing; dizziness; as well as chest, jaw, and neck tightness may occur with SC administration. Weakness, hyperreflexia, incoordination, and serotonin syndrome (may be life-threatening) have been reported with use in combination with selective serotonin reuptake inhibitors (e.g., fluoxetine, fluvoxamine, paroxetine, sertraline).

May cause coronary vasospasm if administered intravenously. **Use injectable form SC only!** Onset of action is 10–120 min SC, 60–90 min PO, and 15–120 min intranasal.

PO and SC efficacy studies were not conclusive in clinical trials for children. Some do not recommend use in patients less than 18 yr of age owing to poor efficacy and reports of serious adverse events (e.g., stroke, visual loss, and death) in both children and adults with all dosage forms.

To minimize infant exposure to sumatriptan, **avoid** breastfeeding for 12 hr after treatment. See naproxen remarks if using the combination sumatriptan and naproxen dosage form.

SURFACTANT, PULMONARY/BERACTANT

Survanta

Bovine lung surfactant

?

?

No

No

No

Suspension for inhalation: 25 mg/mL phospholipids (4, 8 mL); contains 0.5–1.75 mg triglycerides, 1.4–3.5 mg free fatty acids and <1 mg protein per 1 mL drug

Prophylactic therapy: 4 mL/kg/dose intratracheally as soon as possible; up to four doses may be given at intervals no shorter than Q 6 hr during the first 48 hr of life.



Rescue therapy (treatment): 4 mL/kg/dose intratracheally immediately following the diagnosis of respiratory distress syndrome (RDS). May repeat dose as needed Q 6 hr to max. of four doses total.

Method of administration for previously listed therapies (see remarks): Suction infant prior to administration. Each dose is divided into four aliquots of 1 mL/kg each; administer 1 mL/kg in each of four different positions (slight downward inclination with head turned to the right, head turned to the left; slight upward inclination with the head turned to the right, head turned to the left).



Transient bradycardia, O₂ desaturation, pallor, vasoconstriction, hypotension, endotracheal tube blockage, hypercarbia, hypercapnea, apnea, and hypertension may occur during the administration process. Other side effects may include pulmonary interstitial emphysema, pulmonary air leak, and posttreatment nosocomial sepsis. Monitor heart rate and transcutaneous O₂ saturation during dose administration and arterial blood gases for postdose hyperoxia and hypocarbia after administration.

All doses are administered intratracheally via a 5-french feeding catheter. If the suspension settles during storage, gently swirl the contents; **do not shake**. Drug is stored in the refrigerator, protected from light, and must be warmed by standing at room temperature for at least 20 min or warmed in the hand for at least 8 min. Artificial warming methods should **NOT** be used.

SURFACTANT, PULMONARY/CALFACTANT

Infasurf

Bovine lung surfactant

?

?

No

No

No

Intratracheal suspension: 35 mg/mL phospholipids (3, 6 mL); contains 26 mg phosphatidylcholine, 0.7 mg protein, and 0.26 mg surfactant protein B per 1 mL



Prophylactic therapy: 3 mL/kg/dose intratracheally as soon as possible; up to a total of three doses may be given Q 12 hr.

Rescue therapy (treatment; see remarks): 3 mL/kg/dose intratracheally immediately after the diagnosis of RDS. May repeat dose as needed Q12 hr to max. of 3 doses total.

Method of administration for previously listed therapies (see remarks): Suction infant prior to administration. Manufacturer recommends administration through a side-port adapter into the endotracheal tube with two attendants (one to instill drug and another to monitor and position patient). Each dose is divided into two aliquots of 1.5-mL/kg each; administer 1.5 mL/kg in each of two different positions (infant positioned with either the right or left side dependent). Drug is administered while ventilation is continued over 20 to 30 breaths for each aliquot, with small bursts timed only during the inspiratory cycles. A pause followed by evaluation of respiratory status and repositioning should separate the two aliquots. The drug has also been administered by divided dose into four equal aliquots and administered with repositioning in the prone, supine, right, and left lateral positions.

SURFACTANT, PULMONARY/CALFACTANT *continued*

Common adverse effects include cyanosis, airway obstruction, bradycardia, reflux of surfactant into the endotracheal (ET) tube, requirement for manual ventilation, and reintubation. Monitor O₂ saturation and lung compliance after each dose such that oxygen therapy and ventilator pressure are adjusted as necessary.

All doses administered intratracheally via a 5-french feeding catheter. If suspension settles during storage, gently swirl the contents; **do not shake**. Drug is stored in the refrigerator, protected from light, and does not need to be warmed before administration. Unopened vials that have been warmed to room temperature (once only) may be refrigerated within 24 hr and stored for future use.

For rescue therapy, repeat doses may be administered as early as 6 hr after the previous dose for a total of up to four doses if the infant is still intubated and requires at least 30% inspired oxygen to maintain a PaO₂ ≥ 80 torr.

SURFACTANT, PULMONARY/PORACTANT ALFA

Curosurf

Porcine lung surfactant



?

?

No

No

No

Intratracheal suspension: 80 mg/mL (1.5, 3 mL): contains 76 mg phospholipids, 1 mg protein (0.45 mg surfactant protein B, and 0.59 mg surfactant protein C) per 1 mL drug

Rescue therapy (treatment): 2.5 mL/kg/dose × 1 intratracheally, immediately following the diagnosis of RDS. May administer 1.25 mL/kg/dose Q 12 hr × 2 doses as needed up to a **max. total dose** of 5 mL/kg.



Method of administration (see remarks): Suction infant prior to administration. Each dose is divided into two aliquots, with each aliquot administered into one of the two main bronchi by positioning the infant with either the right or left side dependent. After the first aliquot is administered, remove the catheter from the ET tube and manually ventilate the infant with 100% oxygen at a rate of 40–60 breaths/min for 1 min. When the infant is stable, reposition the infant and administer the second dose with the same procedures. Then remove the catheter without flushing.

Currently approved by the US Food and Drug Administration (FDA) for the treatment (rescue therapy) of RDS. Transient episodes of bradycardia, decreased oxygen saturation, reflux of surfactant into the ET tube, and airway obstruction have occurred during dose administration. Monitor O₂ saturation and lung compliance after each dose and adjust oxygen therapy and ventilator pressure as necessary. Pulmonary hemorrhage has been reported.



All doses administered intratracheally via a 5-french feeding catheter. Suction infant prior to administration and 1 hr after surfactant instillation (unless signs of significant airway obstruction).

Drug is stored in the refrigerator and protected from light. Each vial of drug should be slowly warmed to room temperature and gently turned upside down for uniform suspension (**do not shake**) before administration. Unopened vials that have been warmed to room temperature (once only) may be refrigerated within 24 hr and stored for future use.

SYMDEKO

See Tezacaftor and Ivacaftor

T

TACROLIMUS

Prograf, Astagraf XL, Envarsus XR, Protopic, FK506, and generics

Immunosuppressant

C 2 Yes Yes Yes

Caps (Prograf and generics): 0.5, 1, 5 mg

Extended release caps (Astagraf XL): 0.5, 1, 5 mg (Q24 hr dosing; see remarks)

Extended release tabs (Envarsus XR): 0.75, 1, 4 mg (Q24 hr dosing; see remarks)

Oral suspension: 0.5, 1 mg/mL

Injection (Prograf): 5 mg/mL (1 mL); contains alcohol and polyoxyl 60 hydrogenated castor oil (cremophor)

Topical ointment (Protopic and generics): 0.03%, 0.1% (30, 60, 100 g)

SYSTEMIC USE:

Infant, child, and adolescent (initial immediate release doses; titrate to therapeutic levels and convert IV to PO as soon as possible; see remarks):

Liver transplantation:

IV: 0.03–0.05 mg/kg/24 hr by continuous infusion

PO: 0.15–0.2 mg/kg/24 hr ÷ Q12 hr

Renal transplantation:

IV: 0.06 mg/kg/24 hr by continuous infusion

PO: 0.2–0.3 mg/kg/24 hr ÷ Q12 hr

Astagraf XL (in combination with other immunosuppressants): 0.3 mg/kg/24 hr PO Q24 hr, initiated within 24 hr following reperfusion.

Cardiac transplantation:

IV: 0.01–0.03 mg/kg/24 hr by continuous infusion

PO: 0.1–0.3 mg/kg/24 hr ÷ Q12 hr

Adult (initial immediate release doses; titrate to therapeutic levels):

IV: 0.01–0.05 mg/kg/24 hr by continuous infusion

PO: 0.075–0.2 mg/kg/24 hr ÷ Q12 hr

Liver transplantation: 0.1–0.15 mg/kg/24 hr PO ÷ Q12 hr

Kidney transplantation: 0.1–0.2 mg/kg/24 hr PO ÷ Q12 hr

Cardiac transplantation: 0.075 mg/kg/24 hr PO ÷ Q12 hr

TOPICAL USE:

Atopic dermatitis (continue treatment for 1 wk after clearing of signs and symptoms; see remarks):

Child ≥2 to 15 yr old: Apply a thin layer of the 0.03% ointment to the affected skin areas BID and rub in gently and completely.

Adolescent ≥16 yr and adult: Apply a thin layer of the 0.03% or 0.1% ointment to the affected skin areas BID and rub in gently and completely.

Avoid use in patients with prolonged cardiac QT intervals. IV dosage form **contraindicated** in patients allergic to polyoxyl 60 hydrogenated castor oil (cremophor). Experience in pediatric kidney transplantation is limited. Pediatric patients may require higher mg/kg doses than adults. For BMT use (beginning 1 day before BMT), dose and therapeutic levels similar to those in liver transplantation have been used.

Major adverse events include tremor, headache, insomnia, diarrhea, constipation, hypertension, nausea, and renal dysfunction. Hypokalemia, hypomagnesemia, hyperglycemia, confusion, depression, infections, lymphoma, liver enzyme elevation, optic neuropathy, and coagulation disorders may also occur. GI perforation, agranulocytosis, and hemolytic anemia have been reported.

TACROLIMUS *continued*

Tacrolimus is a substrate of the CYP 450 3A4 drug metabolizing enzyme and Pgp transporter. A 1.5–2-fold higher initial standard dose up to a max. dose of 0.3 mg/kg/24 hr has been recommended for intermediate or extensive metabolizers for CYP 450 3A5. Calcium channel blockers, imidazole antifungals (ketoconazole, itraconazole, fluconazole, clotrimazole, posaconazole), macrolide antibiotics (erythromycin, clarithromycin, troleandomycin), cisapride, cimetidine, cyclosporine, danazol, herbal products containing schisandra sphenanthera extracts, methylprednisolone, grapefruit juice, seville oranges, and severe diarrhea can increase tacrolimus serum levels. In contrast, carbamazepine, caspofungin, phenobarbital, phenytoin, rifampin, rifabutin, and sirolimus may decrease levels. Use with sirolimus may increase risk for hepatic artery thrombosis. **Avoid use of live attenuated vaccines.** Use with other CYP 450 3A inhibitors and substrates has the potential to prolong the cardiac QT interval. Reduce dose in renal or hepatic insufficiency.

Monitor trough levels (just prior to a dose at steady state). Steady state is generally achieved after 2–5 days of continuous dosing. Interpretation will vary based on treatment protocol and assay methodology (whole blood ELISA vs. MEIA vs. HPLC). Whole blood trough concentrations of 5–20 ng/mL have been recommended in liver transplantation at 1–12 mo. Trough levels of 7–20 ng/mL (whole blood) for the first 3 mo and 5–15 ng/mL after 3 mo have been recommended in renal transplantation. African Americans may need to be titrated to higher dosages.

Tacrolimus therapy generally should be initiated 6 hr or more after transplantation. PO is the preferred route of administration and all PO dosage forms should be administered on an empty stomach (1 hr before and 2 hr after meals).

Astagraf XL (extended release capsule): Safety and efficacy has been established for de novo and stable (receiving immediate-release dosage form) pediatric kidney transplant patients. A mg per mg conversion from immediate release dosage form to Astagraf XL has been recommended.

Envarsus XR (extended release tablet): Currently labeled for use in adult kidney transplant patients (de novo and stable on immediate-release tacrolimus). When converting to Envarsus XR from immediate-release dosage form, initiate at 80% of the established immediate-release dosage form.

All extended-release formulations are NOT interchangeable. IV infusions should be administered at concentrations between 0.004 and 0.02 mg/mL diluted with NS or D₅W.

TOPICAL USE: Not recommended for use in patients with skin conditions with a skin barrier defect with the potential for systemic absorption. **Do not use** in children <2 yr, immunocompromised patients, or with occlusive dressings (promotes systemic absorption). Approved as a second-line therapy for short-term and intermittent treatment of atopic dermatitis for patients who fail to respond, or do not tolerate, other approved therapies. Long-term safety is unknown. Skin burn sensation, pruritus, flu-like symptoms, allergic reaction, skin erythema, headache, and skin infection are the most common side effects. Application site edema has been reported. Although the risk is uncertain, the FDA has issued an alert about the potential cancer risk with the use of this product. See www.fda.gov/medwatch for the latest information.

TAZAROTENE

Avage, Fabior, Tazorac, and generics

Topical retinoid acid prodrug, keratolytic agent for acne or psoriasis



X

3

No

No

No

Topical Cream:

Tazorac: 0.05%, 0.1% (30, 60 g); contains benzyl alcohol

Avage: 0.1% (30 g); contains benzyl alcohol

Generics: 0.05% (30 g), 0.1% (30, 60 g); may contain benzyl alcohol

TAZAROTENE continued**Topical Foam:****Fabior:** 0.1% (50, 100 g)**Topical Gel:****Tazorac:** 0.05%, 0.1% (30, 100 g); contains benzyl alcohol**Acne:****≥12 yr and adult:** Apply a small amount of 0.1% strength dosage forms to affected areas QHS.Use thin film (2 mg/cm²) for cream or gel dosage form and small amount for foam dosage form.**Psoriasis:****≥12 yr and adult:** Apply a small amount of 0.05% gel (2 mg/cm²) to affected areas QHS initially.

If needed and tolerated, increase to 0.1% gel QHS. The cream dosage form may also be used the same way as the gel but it is currently labeled for use in adults (≥18 yr).



Contraindicated in pregnancy. Pregnancy testing 2 wk prior to use and initiate use during menstrual period has been recommended. **Avoid** use in abraded or eczematous skin, with other medications or cosmetics with drying effects, or medications that can cause photosensitivity.

Tazarotene is a retinoid prodrug which is converted to its active form, the cognate carboxylic acid of tazarotene (AGN 190299), by rapid deesterification in animals and man.

Common side effects include erythema, dry skin, skin irritation/pain (including blistering and skin desquamation), pruritus, and worsening of psoriasis.

Avoid contact with mucous membranes. The foam dosage form is flammable; **avoid** fire, flame, or smoking during or immediately after use.

TERBINAFINE

Previously available as Lamisil, Lamisil AT, and generics

Antifungal

B



2



Yes



Yes



No

Tabs: 250 mg**Oral suspension:** 25 mg/mL **Topical cream:****Lamisil AT and generics [OTC]:** 1% (12, 15, 30 g); contains benzyl alcohol**Topical spray:****Lamisil AT [OTC]:** 1% (30, 125 mL); contains alcohol and propylene glycol**Tinea capitidis:**

Child: 4–6 mg/kg/dose (**max. dose:** 250 mg) PO once daily, OR by the following once daily dosage by weight category:

10–20 kg: 62.5 mg**20–40 kg:** 125 mg**>40 kg:** 250 mg**Duration of therapy:** T. tonsurans: 2–6 wk; M canis: 8–12 wk**Adult:** 250 mg PO once daily × 4–6 wk**Onychomycosis:****Child and adolescent (limited data):** PO once daily by weight category:**10–20 kg:** 62.5 mg**20–40 kg:** 125 mg**>40 kg:** 250 mg**Adult:** 250 mg PO once daily

TERBINAFINE *continued*

Duration of therapy:

Fingernail infection: 6 wk

Toenail infection: 12 wk

Topical Use for dermal mycosis:

≥ 12 yr:

Tinea pedis: Apply topically (cream or spray) interdigitally BID \times 1 wk; if needed, apply the cream to the bottom or sides of the foot BID \times 2 wk

Tinea cruris/Tinea corporis: Apply topically (cream or spray) to affected area once daily \times 1 wk

Pityriasis (tinea) versicolor: Apply spray to affected area once daily \times 1 wk

SYSTEMIC USE: Contraindicated in chronic or acute liver disease. Common side effects include headache, fever, cough, diarrhea, taste disorder, increased LFTs, GI disturbances, and rash. Severe dermatological reactions (e.g., SJS, TEN), hearing loss, neutropenia, thrombotic microangiopathy, and liver failure (some fatal) have been reported. Monitor AST/ALT at baseline and repeat with CBC if therapy is >6 wk. Signs and symptoms of liver disease may include persistent nausea, anorexia, fatigue, vomiting, right upper abdominal pain, or jaundice. Discontinue use immediately if biochemical or clinical evidence of liver injury develops.

Use with caution in renal impairment as terbinafine's clearance has been shown to decrease by ~50% in adults with CrCl ≤ 50 mL/min. Terbinafine inhibits CYP 450 2D6, thus increasing the effects/toxicity of 2D6 substrates such as amphetamines, risperidone, and fluoxetine.

Doses may be administered with or without food.

TOPICAL USE: Do not use on/in the eyes, mouth, nails, scalp, or vaginal areas. Local irritation, skin rash, xeroderma, pruritus, and contact dermatitis may occur. Apply to clean and dry affected area, and wash hands after each use. If using topical spray, hold spray 4–6 inches from the affected area during dose administration.

TERBUTALINE

Various generics; previously available as Brethine

β_2 -adrenergic agonist



C



2



Yes



No



No

Tabs: 2.5, 5 mg

Oral suspension: 1 mg/mL 

Injection: 1 mg/mL (1 mL)

Acute asthma exacerbation:

SC injection:

≤ 12 yr: 0.005–0.01 mg/kg/dose (**max. dose:** 0.4 mg/dose) Q15–20 min \times 3; if needed, Q2–6 hr PRN.

>12 yr and adult: 0.25 mg/dose Q20 min PRN \times 3; **max. total dose:** 0.75 mg.

Continuous infusion, IV: 2–10 mCg/kg loading dose followed by infusion of 0.1–0.4 mCg/kg/min.

May titrate in increments of 0.1–0.2 mCg/kg/min Q30 min depending on clinical response. Doses as high as 10 mCg/kg/min have been used. To prepare infusion: See IV infusions on page i.

Nebulization (use IV dosage form):

<2 yr: 0.5 mg in 2.5 mL NS Q4–6 hr PRN

2–9 yr: 1 mg in 2.5 mL NS Q4–6 hr PRN

>9 yr: 1.5–2.5 mg in 2.5 mL NS Q4–6 hr PRN



Continued

TERBUTALINE *continued*

Prevention and reversal of bronchospasms with asthma:

Oral:

≤12 yr: Initial: 0.05 mg/kg/dose Q8 hr, increase as required. **Max. dose:** 0.15 mg/kg/dose Q8 hr or total of 5 mg/24 hr.

>12 yr and adult: 2.5–5 mg/dose PO Q6–8 hr

Max. dose:

12–15 yr: 7.5 mg/24 hr

>15 yr: 15 mg/24 hr

Use of the IV and PO route should not be used for the prevention or prolonged treatment of preterm labor because of the potential for serious maternal cardiac events and even death. Nervousness, tremor, headache, nausea, tachycardia, arrhythmias and palpitations may occur. Paradoxical bronchoconstriction may occur with excessive use; if it occurs, discontinue drug immediately. Injectable product may be used for nebulization. For acute asthma, nebulizations may be given more frequently than Q4–6 hr.

Monitor heart rate, blood pressure, respiratory rate, and serum potassium when using the continuous IV infusion route of administration. **Adjust dose in renal failure (see Chapter 31).**

**TETRACYCLINE HCL**

Various generics; previously available as Sumycin

Antibiotic



D



2



Yes



Yes



No

Caps: 250, 500 mg

Oral suspension: 25 mg/mL



Do not use in children <8 yr.

Child ≥8 yr: 25–50 mg/kg/24 hr PO ÷ Q6 hr; **max. dose:** 3 g/24 hr

Acne: 500 mg PO BID

Adult: 250–500 mg PO Q6–12 hr

Not recommended in patients <8 yr owing to tooth staining and decreased bone growth.

Also **not recommended** for use in pregnancy because these side effects may occur in the fetus. The risk for these adverse effects is highest with long-term use. May cause nausea, GI upset, hepatotoxicity, stomatitis, rash, fever, and superinfection. Photosensitivity reaction may occur. **Avoid** prolonged exposure to sunlight.



Never use outdated tetracyclines because they may cause Fanconi-like syndrome. **Do not give** with dairy products or with any divalent cations (i.e., Fe²⁺, Ca²⁺, Mg²⁺). Give 1 hr before or 2 hr after meals. May decrease the effectiveness of oral contraceptives, increase serum digoxin levels, and increase effects of warfarin. Use with methoxyflurane increases risk for nephrotoxicity and use with isotretinoin is associated with pseudotumor cerebri. **Adjust dose in renal failure (see Chapter 31).**

Short-term maternal use is not likely to cause harm to breast-feeding infants.

TEZACAFTOR AND IVACAFTOR

Symdeko

Cystic Fibrosis Transmembrane Conductance Regulator Corrector and Potentiator



B



?



Yes



Yes



Yes

Tabs (4-week supply in 4 weekly blister packs):

Tezacaftor 50 mg and Ivacaftor 75 mg (white tabs; 28 tabs) and Ivacaftor 75 mg (light blue tabs; 28 tabs)

Tezacaftor 100 mg and Ivacaftor 150 mg (yellow tabs; 28 tabs) and Ivacaftor 150 mg (light blue

TEZACAFTOR AND IVACAFTOR *continued***Child 6 to <12 yr:**

<30 kg: one tezacaftor 50 mg/75 mg ivacaftor PO QAM and one ivacaftor 75 mg PO every evening administered ~12 hr apart

≥30 kg: one tezacaftor 100 mg/150 mg ivacaftor PO QAM and one ivacaftor 150 mg PO every evening administered ~12 hr apart

Child ≥12 yr–adult: one tezacaftor 100 mg/150 mg ivacaftor PO QAM and one ivacaftor 150 mg PO every evening administered ~12 hr apart

Dosage Modification with Hepatic Impairment:

Child-Pugh Class	Morning Dose	Evening Dose
	Age 6 to <12 yr and <30 kg: Age 6 to <12 yr and ≥30 kg, and ≥12 yr—adult:	All Patients
Class A	No adjustment	No adjustment
Class B	One tablet of tezacaftor 50 mg/ivacaftor 75 mg PO QAM	One tablet of tezacaftor 100 mg/ivacaftor 150 mg PO QAM
Class C	One tablet of tezacaftor 50 mg/ivacaftor 75 mg PO QAM or less frequently	One tablet of tezacaftor 100 mg/ivacaftor 150 mg PO QAM or less frequently

Dosage Modification with CYP 450 3A4 inhibitors:

Moderate inhibitors (e.g., fluconazole, erythromycin): Do not administer any evening doses.

Child 6 to <12 yr and <30 kg: Administer the following tablet PO on the following days only in the morning:

Tablet	Day 1	Day 2	Day 3	Day 4 ^a
Tezacaftor 50 mg/ivacaftor 75 mg tab	One tablet		One tablet	
Ivacaftor 75 mg tab		One tablet		One tablet

^aContinue dosing with tezacaftor 50 mg/ivacaftor 75 mg or ivacaftor 75 mg on alternate days.

Child 6 to <12 yr and ≥30 kg, and ≥12 yr–adult: Administer the following tablet PO on the following days only in the morning:

Tablet	Day 1	Day 2	Day 3	Day 4 ^a
Tezacaftor 100 mg/ivacaftor 150 mg tab	One tablet		One tablet	
Ivacaftor 150 mg tab		One tablet		One tablet

^aContinue dosing with tezacaftor 100 mg/ivacaftor 150 mg or ivacaftor 150 mg on alternate days.

Strong inhibitors (e.g., ketoconazole, itraconazole, posaconazole, voriconazole, telithromycin, and clarithromycin): Do not administer any evening doses.

Child 6 to <12 yr and <30 kg: One tezacaftor 50 mg/ivacaftor 75 mg PO in the morning on days 1 and 4, then continue with the same one tablet twice weekly (administered 3–4 days apart).

Child 6 to <12 yr and ≥30 kg, and ≥12 yr–adult: One tezacaftor 100 mg/ivacaftor 150 mg PO in the morning on days 1 and 4, then continue with the same one tablet twice weekly (administered 3–4 days apart).

Works on CFTR trafficking defect by acting as a CFTR corrector (tezacaftor) and in combination with a CFTR potentiator (ivacaftor). Indicated for individuals with homozygous F508del CFTR mutation or who have at least one CFTR mutation that is responsive to this drug based on in vitro data and/or clinical evidence.

Continued

TEZACAFTOR AND IVACAFTOR *continued*

Common side effects include headache, nausea, sinus congestion, and dizziness. Increased liver enzymes and cataracts may occur; monitor baseline AST/ALT and ocular exam at baseline. Repeat AST/ALT every 3 months for the first year followed by annual assessments. Repeat ocular exams annually. May cause a false positive urine drug screen for cannabinoids.

Use with caution with CrCl \leq 30 mL/min and ESRD. Reduce dose with moderate/severe hepatic impairment or when initiating therapy while taking a CYP 450 3A4 inhibitor (see dosing section).

Tezacaftor and ivacaftor are substrates for CYP 450 3A4/3A5. Use with strong CYP 450 3A inducers (e.g., rifampin, rifabutin, carbamazepine, phenobarbital, phenytoin, St. John's wort) is not recommended. Tezacaftor and ivacaftor may increase the effects/toxicity of cyclosporine, digoxin, everolimus, sirolimus, tacrolimus, and warfarin. Always evaluate potential drug-drug interactions; see <https://www.symdekohcp.com/drug-interactions>. Avoid food or drink containing grapefruit or Seville oranges.

Administer all doses with high-fat foods to assure absorption. If a dose (all dosage forms) is missed within 6 hrs of a scheduled dose, administer a dose immediately. However, if the missed dose is $>$ 6 hr, skip that dose and resume therapy at the next scheduled dose. Never take a double dose for a missed dose.

THEOPHYLLINE

Theo-24, Elixophyllin, and generics
Bronchodilator, methylxanthine



Other dosage forms may exist.

Immediate release:

Oral elixir/solution (Elixophyllin and generics): 80 mg/15 mL (473 mL); may contain up to 20% alcohol (alcohol-free preparations may be available).

Sustained/extended release (see remarks):

Tabs:

Q12 hr dosing (generics): 100, 200, 300, 450 mg

Q24 hr dosing (generics): 400, 600 mg

Caps (Q24 hr dosing): Theo-24 and generics: 100, 200, 300, 400 mg

Sustained-release forms should **not** be chewed or crushed. Capsules may be opened and contents may be sprinkled on food.

Dosing intervals are for immediate-release preparations.

For sustained-release preparations, divide daily dose $>$ Q8–24 hr based on product.



Neonatal apnea:

Loading dose: 5 mg/kg/dose PO \times 1

Maintenance: 3–6 mg/kg/24 hr PO \div Q6–8 hr

Bronchospasm; PO:

Loading dose: 1 mg/kg/dose for each 2 mg/L desired increase in serum theophylline level.

Maintenance, infant (<1 yr):

Preterm:

<24 days old (postnatal): 1 mg/kg/dose PO Q12 hr

\geq 24 days old (postnatal): 1.5 mg/kg/dose PO Q12 hr

Full-term up to 1 yr old: Total daily dose (mg) = [(0.2 \times age in weeks) + 5] \times (kg body weight)

\leq 6 mo: Divide daily dose Q8 hr

$>$ 6 mo: Divide daily dose Q6 hr

THEOPHYLLINE *continued*

Maintenance, child >1 yr and adult without risk factors for altered clearance (see remarks):

<**45 kg:** Begin therapy at $12\text{--}14 \text{ mg/kg}/24 \text{ hr} \div Q4\text{--}6 \text{ hr}$ up to **max. dose** of $300 \text{ mg}/24 \text{ hr}$. If needed based on serum levels, gradually increase to $16\text{--}20 \text{ mg/kg}/24 \text{ hr} \div Q4\text{--}6 \text{ hr}$. **Max. dose:** $600 \text{ mg}/24 \text{ hr}$.

≥45 kg: Begin therapy with $300 \text{ mg}/24 \text{ hr} \div Q6\text{--}8 \text{ hr}$. If needed based on serum levels, gradually increase to $400\text{--}600 \text{ mg}/24 \text{ hr} \div Q6\text{--}8 \text{ hr}$.

Drug metabolism varies widely with age, drug formulation, and route of administration. Most common side effects and toxicities are nausea, vomiting, anorexia, abdominal pain, gastroesophageal reflux, nervousness, tachycardia, seizures, and arrhythmias.

Serum levels should be monitored. Therapeutic levels: bronchospasm: $10\text{--}20 \text{ mg/L}$; apnea: $7\text{--}13 \text{ mg/L}$. Half-life is age-dependent: 30 hr (newborns); 6.9 hr (infants); 3.4 hr (children); 8.1 hr (adults). See Aminophylline for guidelines for serum level determinations. Liver impairment, cardiac failure, and sustained high fever may increase theophylline levels. Theophylline is a substrate for CYP 450 1A2. Levels are increased with allopurinol, alcohol, ciprofloxacin, cimetidine, clarithromycin, disulfiram, erythromycin, estrogen, isoniazid, propranolol, thiabendazole, and verapamil. Levels are decreased with carbamazepine, isoproterenol, phenobarbital, phenytoin, and rifampin. May cause increased skeletal muscle activity, agitation, and hyperactivity when used with doxapram, and increase quinine levels/toxicity.

Use ideal body weight in obese patients when calculating dosage because of poor distribution into body fat. Risk factors for increased clearance include: smoking, cystic fibrosis, hyperthyroidism, and high-protein diet. Factors for decreased clearance include CHF, correction of hyperthyroidism, fever, viral illness, sepsis, and high carbohydrate diet.

Suggested dosage intervals for sustained-released products (see following table):

THEOPHYLLINE SUSTAINED-RELEASE PRODUCTS

Trade Name	Available Strengths	Dosage Interval
CAPSULES:		
Theo-24	100, 200, 300, 400 mg	Q24 hr
TABLETS:		
Theochron and generics	100, 200, 300, 450 mg	Q12 hr
Generics	400, 600 mg	Q24 hr

THIAMINE

VITAMIN B1, many generic products

Water-soluble vitamin



Tabs (OTC): 50, 100, 250 mg

Caps (OTC): 50 mg

Oral suspension: 25, 100 mg/mL

Injection: 100 mg/mL (2 mL); may contain benzyl alcohol

For US RDA, see Chapter 21.

Beriberi (thiamine deficiency):

Child: 10–25 mg/dose IM/IV once daily (if critically ill) or 10–50 mg/dose PO once daily $\times 2$ wk, followed by 5–10 mg/dose once daily $\times 1$ mo.

Adult: 5–30 mg/dose IM/IV TID (if critically ill) $\times 2$ wk, followed by 5–30 mg/24 hr PO \div once daily or TID $\times 1$ mo.



Continued

THIAMINE *continued****Wernicke's encephalopathy syndrome:***

Adult: 100 mg IV \times 1, then 50–100 mg IM/IV once daily until patient resumes a normal diet.
(Administer thiamine before starting glucose infusion.)

Multivitamin preparations contain amounts meeting RDA requirements. Allergic reactions and anaphylaxis may occur, primarily with IV administration. Therapeutic range: 1.6–4 mg/dL. High carbohydrate diets or IV dextrose solutions may increase thiamine requirements. Large doses may interfere with serum theophylline assay. Pregnancy category changes to "C" if used in doses above the RDA.

**THIORIDAZINE**

Various generics, previously available as Mellaril

Antipsychotic, phenothiazine derivative



C



?



No



Yes



No

Tabs: 10, 25, 50, 100 mg

**Schizophrenia:**

Child \geq 6 yr–adolescent: Start with 0.5 mg/kg/24 hr PO \div BID–TID (**initial max.:** 50 mg/dose); dosage range: 0.5–3 mg/kg/24 hr PO \div BID–TID. **Max. dose:** 3 mg/kg/24 hr.

Adult: Start with 75–300 mg/24 hr PO \div TID. Then gradually increase PRN to **max. dose** 800 mg/24 hr \div BID–QID.



Indicated for schizophrenia unresponsive to standard therapy. **Contraindicated** in severe CNS depression, brain damage, narrow-angle glaucoma, blood dyscrasias, and severe liver or cardiovascular disease. **DO NOT** co-administer with drugs which may inhibit the CYP 450 2D6 isoenzymes (e.g., SSRIs such as fluoxetine, fluvoxamine, paroxetine; and beta-blockers such as propranolol and pindolol); drugs which may widen the QTc interval (e.g., disopyramide, procainamide, quinidine); and in patients with known reduced activity of CYP 450 2D6.

May cause drowsiness, extrapyramidal reactions, autonomic symptoms, ECG changes (QTc prolongation in a dose-dependent manner), arrhythmias, paradoxical reactions, and endocrine disturbances. Long-term use may cause tardive dyskinesia. Pigmentary retinopathy may occur with higher doses; a periodic eye exam is recommended. More autonomic symptoms and less extra-pyramidal effects than chlorpromazine. Concurrent use with epinephrine can cause hypotension. Increased cardiac arrhythmias may occur with tricyclic antidepressants.

In an overdose situation, monitor ECG and avoid drugs that can widen QTc interval.

TIAGABINE

Gabitril and generics

Anticonvulsant



C



?



No



Yes



No

Tabs: 2, 4, 12, 16 mg



Oral suspension: 1 mg/mL

Adjunctive therapy for refractory seizures (see remarks):

Child \geq 2 yr (limited data from a safety and tolerability study in 52 children 2–17 yr,

mean 9.3 + 4.1): Initial dose of 0.25 mg/kg/24 hr PO \div TID \times 4 wk. Dosage was increased at 4-wk intervals to 0.5, 1, and 1.5 mg/kg/24 hr until an effective and well-tolerated dose was established. Criteria for dose increase required tolerance of the current dosage level and <50% reduction in seizures. Patients receiving enzyme-inducing antiepileptic drugs (AEDs) received a **max. daily dose** of 0.73 + 0.44 mg/kg/24 hr and patients receiving non-enzyme inducing AEDs received a **max.** of 0.61 + 0.32 mg/kg/24 hr.

D

TIAGABINE *continued***Adjunctive therapy for partial seizures (dosage based on use with enzyme-inducing AEDs; see remarks).**

NOTE: Patients receiving non-enzyme-inducing AEDs had tiagabine blood levels about two times higher than patients receiving enzyme-inducing AEDs.

≥12 yr and adult: Start at 4 mg PO once daily \times 7 days. If needed, increase dose to 8 mg/24 hr PO

÷ BID. Dosage may be increased further by 4–8 mg/24 hr at weekly intervals (daily doses may be divided BID–QID) until a clinical response is achieved or up to specified **max. dose**.

Max. dose:

12–18 yr: 32 mg/24 hr

Adult: 56 mg/24 hr

Use with caution in hepatic insufficiency (may need to reduce dose and/or increase dosing interval). Most common side effects include dizziness, somnolence, depression, confusion, and asthenia. Nervousness, tremor, nausea, abdominal pain, confusion, and difficulty in concentrating may also occur. Cognitive/neuropsychiatric symptoms resulting in nonconvulsive status epilepticus requiring subsequent dose reduction or drug discontinuation have been reported. Suicidal behavior or ideation, bullous dermatitis, and blurred vision have been reported. **Off-label use in patients WITHOUT epilepsy is discouraged** due to reports of seizures in these patients.

Tiagabine's clearance is increased by concurrent hepatic enzyme-inducing antiepileptic drugs (e.g., phenytoin, carbamazepine, and barbiturates), and St. John's Wort. Lower doses or a slower titration for clinical response may be necessary for patients receiving non-enzyme-inducing drugs (e.g., valproate, gabapentin, and lamotrigine). **Avoid** abrupt discontinuation of drug.

TID dosing schedule may be preferred since BID schedule may not be well tolerated. Doses should be administered with food.

TIOTROPIUM

Spiriva HandiHaler, Spiriva Respimat

Anticholinergic agent, long-acting



C



2



Yes



No



No

Aerosol inhaler:**Spiriva Respimat:**

For asthma: 1.25 mCg/actuation (each cartridge weighs 4 g and provides either 28 or 60 actuations/inhaler); contains benzalkonium chloride and disodium EDTA

For COPD: 2.5 mCg/puff (each cartridge weighs 4 g and provides either 10, 28, or 60 actuations/inhaler); contains benzalkonium chloride and disodium EDTA

Inhalational capsules:

Spiriva HandiHaler: 18 mCg (boxes of 5s, 30s, or 90s with one HandiHaler device); contains milk protein

Asthma (maintenance therapy, see remarks):

Child ≥6 yr, adolescent, and adult:



Spiriva Respimat: Inhale two 1.25 mCg actuations once daily.

Contraindicated in patients with ipratropium hypersensitivity reactions (e.g., angioedema, itching, or rash). Common side effects include headache, constipation, xerostomia, UTI, bronchitis, cough, pharyngitis, sinusitis, and URI. Bowel obstruction, angle-closure glaucoma, urinary retention, and bronchospasm have been reported. The pediatric adverse reaction profile is similar to adults.

Use as an add-on maintenance therapy for asthma along with inhaled corticosteroid. Maximum benefits may take up to 4–8 wk of continuous use. Doses >2.5 mCg/24 hr were not associated with greater efficacy in FEV₁ for asthmatic adults.

TIOTROPIUM *continued*

Monitor for anticholinergic side effects in patients with moderate/severe renal impairment (eGFR <60 mL/min).

Administration of Spiriva Respimat 1.25 mCg × 2 delivered with the AeroChamber Plus Flow-Vu holding chamber with/without facemask by an in vitro study utilizing inspiratory flow rates for children 6–12 mo, 2–5 yr, and >5 yr has been shown to deliver a comparable adult dose on a mCg per body weight basis. Despite a report of similar adverse reaction profile to adolescents and adults from a 12-wk placebo control trial (2.5 mCg/24 hr) in children 1–5 yr, the clinical efficacy and safety have not been fully established for children <6 years of age with asthma.

TOBRAMYCIN

Tobrex, TOBI, TOBI Podhaler, Bethkis, Kitabis Pak, and generics; previously available as Nebcin

Antibiotic, aminoglycoside



B/D



2



Yes



No



No

Injection: 10 mg/mL (2 mL), 40 mg/mL (2, 30, 50 mL); may contain phenol and bisulfites

Powder for injection: 1.2 g; preservative free

Ophthalmic ointment (Tobrex) 0.3% (3.5 g)

In combination with dexamethasone (TobraDex): 0.3% tobramycin with 0.1% dexamethasone (3.5 g); contains 0.5% chlorbutanol

Ophthalmic solution (Tobrex and generics): 0.3% (5 mL)

In combination with dexamethasone as an ophthalmic suspension (both products contain 0.01% benzalkonium chloride and EDTA):

TobraDex and generics: 0.3% tobramycin with 0.1% dexamethasone (2.5, 5, 10 mL)

TobraDex ST: 0.3% tobramycin with 0.05% dexamethasone (5 mL)

Nebulizer solution:

Bethkis: 300 mg/4 mL (56s); preservative free

TOBI, Kitabis Pak, and generics: 300 mg/5 mL (56s); preservative free

170 mg/3.4 mL (mixed in 0.45% NS, preservative free, use with eFlow/Trio nebulizer)

Powder for inhalation:

TOBI Podhaler: 28 mg capsules (224 capsules in 4 weekly packs with 2 Podhaler inhalation devices)

Initial empiric dosage; patient-specific dosage defined by therapeutic drug monitoring (see remarks).

Neonate/Infant, IM/IV (see following table):

Post-conceptional age (wk)	Postnatal age (days)	Dose (mg/kg/dose)	Interval (hr)
≤29 ^a	0–7	5	48
	8–28	4	36
	>28	4	24
30–34	0–7	4.5	36
	>7	4	24
≥35	ALL	4	24 ^b

^aOr significant asphyxia, PDA, indomethacin use, poor cardiac output, reduced renal function.

^bUse Q36 hr interval for HIE patients receiving whole-body therapeutic cooling.

Child: 7.5 mg/kg/24 hr ÷ Q8 hr IV/IM

Cystic fibrosis (if available, use patient's previous therapeutic mg/kg dosage):

Conventional Q8 hr dosing: 7.5–10.5 mg/kg/24 hr ÷ Q8 hr IV

High dose extended interval (once daily) dosing: 10–12 mg/kg/dose Q24 hr IV

TOBRAMYCIN *continued*

Adult:

Conventional Q8 hr dosing: 3–6 mg/kg/24 hr ÷ Q8 hr IV/IM

High dose extended interval: 4–7 mg/kg/dose Q24 hr IV/IM

Ophthalmic:

Tobramycin:

Child and adult:

Ophthalmic ointment: Apply 0.5-inch ribbon into conjunctival sac(s) BID–TID; for severe infections, apply Q3–4 hr initially then reduce dose frequency

Ophthalmic drop: Instill 1–2 drops of solution to affected eye(s) Q4 hr; for severe infections, instill 2 drops Q30–60 min initially, then reduce dosing frequency.

Tobramycin with dexamethasone:

≥2 yr and adult:

Ophthalmic ointment: Apply 0.5-inch ribbon of ointment into conjunctival sac(s) TID–QID

Ophthalmic drop: Instill 1–2 drops of solution to affected eye(s) Q2 hr × 24–48 hr, then 1–2 drops Q4–6 hr.

Inhalation:

Cystic fibrosis prophylaxis therapy:

≥6 yr and adult:

TOBI, Bethkis, Kitabis Pak, and generic nebs: 300 mg Q12 hr administered in repeated cycles of 28 days on drug followed by 28 days off drug.

Use with eFlow/Trio nebulizer: 170 mg Q12 hr administered in repeated cycles of 28 days on drug followed by 28 days off drug.

TOBI Podhaler: Inhale four 28-mg capsules (112 mg) Q12 hr administered in repeated cycles of 28 days on drug followed by 28 days off drug.

Use with caution in combination with neurotoxic, ototoxic, or nephrotoxic drugs; anesthetics or neuromuscular blocking agents; pre-existing renal, vestibular, or auditory impairment; and in patients with neuromuscular disorders. May cause ototoxicity, nephrotoxicity, and neuromuscular blockade. Serious allergic reactions including anaphylaxis and dermatologic reactions including exfoliative dermatitis, toxic epidermal necrolysis, erythema multiforme, and Stevens-Johnson syndrome have been reported rarely. **Ototoxic effects synergistic with furosemide.**



Higher doses are recommended in patients with cystic fibrosis, neutropenia, or burns. **Adjust dose in renal failure (see Chapter 31).** Monitor peak and trough levels.

Therapeutic peak levels with conventional Q8 hr dosing:

6–10 mg/L in general

8–10 mg/L in pulmonary infections, neutropenia, osteomyelitis, and severe sepsis

Therapeutic trough levels with conventional Q8 hr dosing: <2 mg/L. Recommended serum sampling time at steady state: trough within 30 min prior to the third consecutive dose and peak 30–60 min after the administration of the third consecutive dose.

Therapeutic peak and trough goals for high-dose extended-interval dosing for cystic fibrosis:

Peak: 20–40 mg/L; recommended serum sampling time at 30–60 min after the administration of the first dose.

Trough: <1 mg/L; recommended serum sampling time within 30 min before the second dose.

Serum levels should be rechecked with changing renal function, poor clinical response, and at a minimum of once weekly for prolonged therapies.

To maximize bactericidal effects, an individualized peak concentration to target a peak/MIC ratio of 8–10:1 may be applied.

For initial dosing in obese patients, use an adjusted body weight (ABW). ABW = Ideal Body Weight + 0.4 (Total Body Weight – Ideal Body Weight).

TOBRAMYCIN *continued*

INHALATIONAL USE: Transient voice alteration, bronchospasm, dyspnea, pharyngitis, and increased cough may occur. Transient tinnitus, decreased appetite, and hearing loss have been reported with nebulized dosage forms. Aphony, discolored sputum, and malaise have been reported with the powder for inhalation. Use is not recommended with nephrotoxic, neurotoxic, or ototoxic medications, or when intravenous antibiotic therapy is prescribed. When used with other inhaled medications in cystic fibrosis, use the following order of administration: bronchodilator first, chest physiotherapy, other inhaled medications (if indicated), and tobramycin last. For TOBI Podhaler, inhale the entire contents of each capsule. To improve adherence with prophylactic inhalation therapy, initiate each 28-day inhalation cycle on the first day of an odd or even numbered month. Pregnancy category is a "D" for injection and inhalation routes of administration and a "B" for the ophthalmic route.

TOLNAFTATE

Tinactin, many other brands and generics

Antifungal agent**Topical aerosol liquid [OTC]:** 1% (150 g); may contain 29% vol/vol or 41% wt/wt alcohol**Aerosol powder [OTC]:** 1% (133 g); contains 11% vol/vol alcohol and talc**Cream [OTC]:** 1% (15, 30, 114 g)**Topical powder [OTC]:** 1% (45 g)**Topical solution [OTC]:** 1% (10, 15, 30 mL); may contain propylene glycol and/or parabens**Child (≥ 2 yr), adolescent, and adult:****Topical for Tinea pedis, Tinea corporis, and Tinea cruris:** apply 1–3 drops of solution, or small amount of liquid, cream, or powder to affected areas BID for 2–4 wk.May cause mild irritation and sensitivity. Contact dermatitis has been reported. **Avoid** eye contact. **Do not use** for nail or scalp infections. Discontinue use if sensitization develops.

Pregnancy category not formally assigned by FDA.

TOPIRAMATE

Topamax, Topamax Sprinkle, Trokendi XR, Qudexy XR, and generics

Anticonvulsant**Caps, sprinkle:****Topamax Sprinkle and generics:** 15, 25 mg**Tabs:****Topamax and generics:** 25, 50, 100, 200 mg**Extended-release caps, sprinkle (Q24 hr dosing; see remarks):****Qudexy XR and generics:** 25, 50, 100, 150, 200 mg**Extended-release caps (Q24 hr dosing; see remarks):****Trokendi XR:** 25, 50, 100, 200 mg**Oral suspension:** 6, 14, 20 mg/mL**Adjunctive therapy for partial onset seizures or Lennox-Gastaut syndrome:****Child 2–16 yr:** Start with 1–3 mg/kg/dose (**max. dose:** 25 mg/dose) PO QHS \times 7 days, then increase by 1–3 mg/kg/24-hr increments at 1- to 2-wk intervals (divided daily dose BID) to response. Usual maintenance dose is 5–9 mg/kg/24 hr PO \div BID

D

TOPIRAMATE *continued*

≥17 yr and adult: Start with 25–50 mg PO QHS × 7 days, then increase by 25–50 mg/24 hr increments at 1-wk intervals until adequate response. Doses >50 mg should be divided BID. Usual maintenance dose: 100–200 mg/24 hr. Doses above 1600 mg/24 hr have not been studied.

Adjunctive therapy for primary generalized tonic clonic seizures:

Child 2–16 yr: Use above initial dose and slower titration rate by reaching 6 mg/kg/24 hr by the end of 8 weeks

≥17 yr and adult: Use above initial dose and slower titration rate by reaching 200 mg BID by the end of 8 weeks; **max. dose:** 1600 mg/24 hr.

Monotherapy for partial onset seizures or primary generalized tonic clonic seizures:

Child 2 to <10 yr: Start with 25 mg PO QHS × 7 days, if needed and tolerated, may increase dose to 25 mg PO BID. May further increase by 25–50 mg/24 hr at weekly intervals over 5–7 weeks up to the lower end of the following daily target maintenance dosing range (if needed and tolerated, increase to higher end of dosing range by increasing by 25–50 mg/24 hr at weekly intervals):

≤11 kg: 150–250 mg/24 hr ÷ BID

12–22 kg: 200–300 mg/24 hr ÷ BID

23–31 kg: 200–350 mg/24 hr ÷ BID

32–38 kg: 250–350 mg/24 hr ÷ BID

>38 kg: 250–400 mg/24 hr ÷ BID

Child ≥10 yr and adult: Start with 25 mg PO BID × 7 days, then increase by 50 mg/24 hr increments at 1-wk intervals up to a **max. dose** of 100 mg PO BID at wk 4. If needed, dose may be further increased at weekly intervals by 100 mg/24 hr up to a recommended **max. dose** of 200 mg PO BID.

Migraine prophylaxis:

Child 6 to <12 yr and ≥20 kg (limited data): Start with 15 mg PO once daily × 7 days, then increase to 25 mg PO BID × 7 days, then gradually increase dose to effect up to a target dose of 2–3 mg/kg/24 hr ÷ BID (**max. dose:** 200 mg/24 hr).

Child ≥12 yr and adult: titrate dosage to 50 mg PO BID with the following schedule:

	Morning PO Dose	Evening PO Dose
Week 1	None	25 mg
Week 2	25 mg	25 mg
Week 3	25 mg	50 mg
Week 4 and beyond	50 mg	50 mg

Use clinical outcome to guide dose and titration. Longer intervals between dose adjustments can be used.

Use with caution in renal and hepatic dysfunction (decreased clearance) and sulfa hypersensitivity. **Reduce dose by 50%** when creatinine clearance is <70 mL/min.

Common side effects (incidence lower in children) include ataxia, cognitive dysfunction, dizziness, nystagmus, paresthesia, sedation, visual disturbances, nausea, dyspepsia, and kidney stones (incidence higher in children). Secondary angle closure glaucoma characterized by ocular pain, acute myopia, and increased intraocular pressure has been reported and may lead to blindness if left untreated. Patients should be instructed to seek immediate medical attention if they experience blurred vision or periorbital pain.

Oligohidrosis and hyperthermia has been reported primarily in children and should be monitored especially during hot weather and with use of drugs that predispose patients to heat-related disorders (e.g., carbonic anhydrase inhibitors and anticholinergics). Low serum bicarbonate levels have been reported in pediatric and adult clinical trials.

Hyperchloremic, non-anion gap metabolic acidosis, hyperammonemia (with or without encephalopathy), suicidal behavior or ideation, and false-positive sweat chloride test for cystic fibrosis have been reported.



TOPIRAMATE *continued*

Drug is metabolized by and inhibits the CYP 450 2C19 isoenzyme. Phenytoin, valproic acid, and carbamazepine may decrease topiramate levels. Topiramate may decrease valproic acid, digoxin, warfarin, and ethinyl estradiol (to decrease oral contraceptive efficacy) but may increase phenytoin levels/effects. Alcohol and CNS depressants may increase CNS side effects. Carbonic anhydrase inhibitors (e.g., acetazolamide) may increase risk of metabolic acidosis, nephrolithiasis, or paresthesia. Use with valproic acid may result in the development of hyperammonemia.

Safety and efficacy in migraine prophylaxis in pediatrics have not been established; an increase in serum creatinine has been reported in a clinical trial.

Qudexy XR and Trokendi XR are not bioequivalent and should not be interchanged. Doses may be administered with or without food. Capsule may be opened and sprinkled on small amount of food (e.g., 1 teaspoonful of applesauce) and swallowed whole (do not chew). Maintain adequate hydration to prevent kidney stone formation. If discontinuing therapy, gradually taper dosage.

TRAZODONE

Generics, previously available as Desyrel

Antidepressant, serotonin reuptake inhibitor/antagonist, triazoloypyridine-derivative



Tabs: 50, 100, 150, 300 mg

Oral suspension: 10 mg/mL

Insomnia with comorbid psychiatric disorders (limited data):

18 mo to <3 yr: Start at 25 mg PO QHS. If needed, increase by 25 mg Q2 week up to a **max.** of 100 mg/24 hr.



3–5 yr: Start at 50 mg PO QHS, if needed, increase by 25 mg Q2 week up to a **max.** of 150 mg/24 hr.

5 yr–adolescent: 25–50 mg PO QHS, if needed, increase by 25–50 mg Q2 week up to a **max.** of 200 mg/24 hr. Daily dose may be divided BID–TID when used for palliative care.

Use with caution in pre-existing cardiac disease, initial recovery phase of MI, in patients receiving antihypertensive medications, renal and hepatic impairment (has not been evaluated), and electroconvulsive therapy. Common side effects include dizziness, drowsiness, dry mouth, and diarrhea. May cause angle-closure glaucoma in patients with anatomically narrow angles who do not have an iridectomy. Seizures, tardive dyskinesia, EPS, arrhythmias, priapism, blurred vision, neuromuscular weakness, anemia, orthostatic hypotension, and rash have been reported. Monitor for clinical worsening of depression and suicidal ideation/behavior following the initiation of therapy or after dose changes.



Trazodone is CYP 450 3A4 isoenzyme substrate (may interact with inhibitors and inducers) and may increase digoxin levels and increase CNS effects of alcohol, barbiturates, and other CNS depressants. **Max.** antidepressant effect is seen at 2–6 wk.

TREPROSTINIL

Remodulin, Tyvaso, Orenitram

Prostaglandin I₂ analogue, vasodilator

**Injection:**

Remodulin: 1 mg/mL (20 mL), 2.5 mg/mL (20 mL), 5 mg/mL (20 mL), 10 mg/mL (20 mL); contains metacresol

Inhalation solution:

Tyvaso: 0.6 mg/mL (2.9 mL; 4s and 28s); use with Tyvaso inhalation system

Extended release tab:

TREPROSTINIL *continued*

Pulmonary arterial hypertension (PAH):



IV/SC infusion:

Child (limited data): Initial dose of 2 nanogram/kg/min has been recommended with careful titration. Stable doses have been reported at 50–80 nanogram/kg/min with an unknown maximum dosage. Dosages as high as 350 and 170 nanogram/kg/min have been reported with the SC and IV routes, respectively.

Adult: Start at 1.25 nanogram/kg/min. If not tolerated, reduce to 0.625 nanogram/kg/min. If needed, increase dose at increments of 1.25 nanogram/kg/min per week for the first 4 wk followed by 2.5 nanogram/kg/min per week thereafter. Limited experience with doses >40 nanogram/kg/min.

Inhalation:

Child (limited data): 1–9 (6–54 mCg) patient-activated breaths Q6 hr. A retrospective report of 29 children with PAH receiving background therapy initially received 3 breaths (18 mCg) via oral inhalation QID and titrated doses weekly as tolerated to a **maximum** of 9 breaths (54 mCg) QID for ≥6 wk. 19 of 29 children had WHO functional class improvement (significant improvements in exercise tolerance and peak oxygen consumption). Four children had to discontinue therapy for reasons of O₂ desaturation (1), progression of PAH (1), and chest tightness with bronchospasms (2).

Adult: Start at 3 breaths (18 mCg) via oral inhalation Q4 hr four times a day during waking hours.

Reduce dose to 1 or 2 breaths if not tolerated and subsequently increase to 3 breaths. If tolerated, increase dose by 3 additional inhalations at ~1–2 wk intervals to the target and **maximum** maintenance dose of 9 breaths (54 mCg) QID.



Use with caution in liver or renal impairment by titrating doses slowly. **Avoid use** with the oral dosage form in Child-Pugh class B and C. Treprostinil is primarily metabolized by the liver via CYP 450 2C8 and its metabolites are excreted primarily via the urinary route. Inhibitors (e.g., gemfibrozil) and inducers (e.g., rifampin) may increase and decrease treprostinil effects, respectfully.

Flushing, muscle pain (especially with SC route), headaches, and diarrhea are common side effects with injectable routes. Central line gram-negative catheter infections have been reported with the IV route. Recommendations for reducing this risk include using watertight seals in the drug delivery system and closed-hub systems, replacing the diluent with the diluent used for epoprostenol, and using the SC route. Thrombocytopenia has been reported with SC administration. Worsening of reactive airway symptoms, cough, dizziness, bone pain, headache, syncope, and flushing may occur with the inhaled route. Headache, diarrhea, nausea, and flushing are common side effects with the oral dosage form in clinical trials.

Treprostinil has a longer T_{1/2} than epoprostenol with better room temperature stability (depending on specific diluent used).

Do not abruptly withdrawal therapy and have a backup plan for interruptions with IV/SC continuous therapies (e.g., backup pumps and medications).

TRETINOIN—TOPICAL PREPARATIONS

Retin-A, Retin-A Micro, Altreno, Atralin, Avita, Renova, Refissa, and many others

In combination with clindamycin: Veltin, Ziana, and generics

Retinoic acid derivative, topical acne product



C 2 No No No

Cream (all strengths may contain parabens, benzyl alcohol, and edetate disodium):

0.02% (20, 40, 60 g): Renova

0.025% (20, 45 g): Avita, Retin-A, and generics

0.05% (20, 40, 45 g): Refissa and generics

0.1% (20, 45 g): generics

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TRETINOIN—TOPICAL PREPARATIONS *continued*

Topical gel (all strengths may contain 90% alcohol, benzyl alcohol, propylene glycol, and trolamine):

0.01% (15, 45 g): Retin-A and generics

0.025% (15, 45 g): Avita and generics

0.04% (20, 45, 50 g): Retin-A Micro and generics

0.05% (45 g): Atralin and generics

0.06% and 0.08% (50 g): Retin-A Micro

0.1% (20, 45, 50 g): Retin-A Micro and generics

Lotion (Altreno):

0.05% (20, 45 g), contains benzyl alcohol, parabens, and trolamine

In combination with clindamycin:

Topical gel: 0.025% tretinoin and 1.2% clindamycin (30, 60 g); may contain parabens, tromethamine, and propylene glycol

Topical:

Child ≥ 12 yr and adult (may be used as young as 8 yr as reported in the literature and specific product labeling; see remarks):

Gently wash face with a mild soap, pat the skin dry, and wait 20 to 30 min before use. Initiate therapy with lower strengths (0.02% or 0.025% cream, or 0.01% gel) and apply a small pea-size amount to the affected areas of the face QHS or on alternate days. See remarks.



In combination with clindamycin:

Child ≥ 12 yr and adult: Gently wash face with a mild soap, pat the skin dry, and wait 20 to 30 min before use. Apply a pea-size amount to entire face QHS.



Contraindicated in sunburns. **Avoid** excessive sun exposure. If stinging or irritation occurs, decrease frequency of administration to every other day. **Avoid** contact with eyes, ears, nostrils, mouth, or open wounds. Local adverse effects include irritation, erythema, excessive dryness, blistering, crusting, hyperpigmentation or hypopigmentation, and acne flare-ups. Concomitant use of other topical acne products may lead to significant skin irritation. Onset of therapeutic benefits may be experienced within 2–3 wk with optimal effects in 6 wk. The gel dosage form is flammable and should not be exposed to heat or temperatures >120°F.

Lower minimum age (<12 yr) for use by specific product labeling:

Atralin gel: ≥10 yr

Altreno lotion: ≥9 yr

In combination with clindamycin (additional remarks from above): **Contraindicated** in regional enteritis, ulcerative colitis, or history of antibiotic-associated colitis. Prolonged use may result in fungal and bacterial superinfection, including *C. difficile* associated diarrhea.



TRIAMCINOLONE

Nasal preparations: Nasacort Allergy 24HR Children,

Nasacort Allergy 24HR, Nasal Allergy 24 Hour, and generics

Topical preparations: Triderm, Kenalog, Oralone, Trianex, and generics

Injection preparations: Kenalog-10, Kenalog-40, Kenalog-80, generics, and others in kits

Corticosteroid



C/D

2

Yes

Yes

No

Nasal spray:

Nasacort Allergy 24HR, Nasal Allergy 24 Hour, and generics [OTC]: 55 mCg/actuation (60 actuations per 10.8 mL, 120 actuations per 16.9 mL); contains benzalkonium chloride, polysorbate 80, and EDTA.

Nasacort Allergy 24 HR Children [OTC]: 55 mCg/actuation (60 actuations per 10.8 mL); contains

TRIAMCINOLONE *continued*

Cream:

Triderm and generics: 0.1% (15, 28.4, 30, 85.2, 454 g); contains propylene glycol
Generics: 0.025% (15, 80, 454 g), 0.5% (15 g)

Ointment:

Generics: 0.025%, 0.1% (15, 80, 454 g)
Trianex and generics, 0.5% (15, 430 g)

Lotion:

Topical aerosol:

Kenalog and generics: 0.2 mg/2 second spray, each g of spray contains 0.147 mg triamcinolone acetate (63, 100 g); contains 10.3% alcohol

Dental paste:

Oralone and generics: 0.1% (5 g)

See Chapter 10 for potency rankings and sizes of topical preparations.

Injection as acetonide: 10 mg/mL (Kenalog-10 and generics) (5 mL), 40 mg/mL (Kenalog-40 and generics) (1, 5, 10 mL), 80 mg/mL (Kenalog-80) (1, 5 mL); contains benzyl alcohol and polysorbate 80

Kits (all contain benzyl alcohol and polysorbate 80):

P-Care K40, Pod-Care 100K: 40 mg/mL (1 × 1 mL)
P-Care K80, Pro-C-Dure 5: 40 mg/mL (2 × 1 mL)
Pro-C-Dure 6: 40 mg/mL (3 × 1 mL)



Intranasal (titrate to lowest effective dose after symptoms are controlled; discontinue use if no relief of symptoms occurs after 3 weeks of use):

Child 2–5 yr: 1 spray in each nostril once daily (110 mCG/24 hr; starting and **max. dose**).

Child 6–11 yr: Start with 1 spray in each nostril once daily (110 mCG/24 hr). If no benefit in 1 wk, dose may be increased to the **max. dose** of 2 sprays in each nostril once daily (220 mCG/24 hr). Decrease dose back to 1 spray each nostril when symptoms are controlled.

≥12 yr and adult: 2 sprays in each nostril once daily (220 mCG/24 hr; starting and **max. dose**). Decrease dose to 1 spray each nostril when symptoms are controlled.

Topical cream or ointment:

Infant, child, and adult: Apply a thin film to affected areas BID–TID for topical concentrations of 0.1% or 0.5% and BID–QID for 0.025% or 0.05%.

Topical spray or lotion:

Infant, child, and adult: Spray or apply to affected area TID–QID

SYSTEMIC USE (see remarks):

Anti-inflammatory and allergic condition:

Child and adolescent (use 40 or 80 mg/mL strength, deep IM into gluteal muscle):

0.11–1.6 mg/kg/24 hr IM ÷ TID–QID

Intralesional for dermatosis:

≥12 yr and adult (use 10 mg/mL strength): Inject up to 1 mg/site × 1 and may be repeated × 1 or more times weekly. May give separate doses in sites ≥1 cm apart, **not to exceed** 30 mg.



NASAL USE: Rare reports of bone mineral density loss and osteoporosis have been reported with prolonged use of inhaled dosage form. Nasal preparations may cause epistaxis, cough, fever, nausea, throat irritation, dyspepsia, and fungal infections (rarely). Shake intranasal dosage forms before each use.

TOPICAL USE: Topical preparations may cause dermal atrophy, telangiectasias, and hypopigmentation. HPA axis suppression, Cushing syndrome, and intracranial hypertension have been reported in children with topical use. Topical steroids should be used with caution on the face and in intertriginous areas. See Chapter 8. **Avoid** spraying the eye or inhaling the topical aerosol dosage form. Aerosol dosage form is flammable.

TRIAMCINOLONE *continued*

INJECTABLE USE: Anaphylaxis has been reported with use of the injectable dosage form. Dosage adjustment for hepatic failure with systemic use may be necessary. Triamcinolone is a substrate of the CYP 450 3A4 enzyme; inhibitors of this enzyme may increase risk for side effects. **Use with caution** in thyroid dysfunction, respiratory TB, ocular herpes simplex, peptic ulcer disease, osteoporosis, hypertension, CHF, myasthenia gravis, ulcerative colitis, and renal dysfunction. With systemic use, pregnancy category changes to "D" if used in the first trimester. **Avoid** IV administration with injectable dosage forms. Injectable forms contain benzyl alcohol.

TRIAMTERENE

Dyrenium and generics

Diuretic, potassium sparing

C/D



?



Yes



Yes



No

Caps: 50, 100 mg**Hypertension:**

Child: 1–2 mg/kg/24 hr PO ÷ BID. May increase up to a **max.** of 3–4 mg/kg/24 hr up to 300 mg/24 hr.

Adult: 50–100 mg/24 hr ÷ once daily–BID PO; **max. dose:** 300 mg/24 hr.

Do not use if GFR <10 mL/hr or in severe hepatic disease. **Adjust dose in renal impairment** (see Chapter 31) and cirrhosis. Monitor serum electrolytes. May cause hyperkalemia, hyponatremia, hypomagnesemia, and metabolic acidosis. Interstitial nephritis, thrombocytopenia, and anaphylaxis have been reported.



Concurrent use of ACE inhibitors may increase serum potassium. **Use with caution** when administering medications with high potassium load (e.g., some penicillins) and in patients with hepatic impairment or on high potassium diets. Cimetidine may increase effects. This drug is also available as a combination product with hydrochlorothiazide; erythema multiforme and toxic epidermal necrolysis have been reported with this combination product. Administer doses with food to minimize GI upset. Pregnancy category changes to "D" if used in pregnancy-induced hypertension.

TRIFLURIDINE

Generics; previously available as Viroptic

Antiviral, ophthalmic

C



?



No



No



No

Ophthalmic solution: 1% (7.5 mL); contains thimerosal**Herpes keratoconjunctivitis:**

≥6 yr, adolescent and adult: Instill 1 drop into affected eye(s) Q2 hr while awake up to a **maximum** of 9 drops/24 hr. Reduce dose when there is re-epithelialization of the corneal ulcer to 1 drop Q4 hr (**minimum** 5 drops/24 hr) × 7 days. If improvement does not occur in 7–14 days, consider alternative therapy. **DO NOT EXCEED** 21 days of treatment.

Burning sensation in eyes and palpebral edema are common side effects. Rare cross sensitivity with idoxuridine, increased intraocular pressure, keratoconjunctivitis, and ocular hyperemia have been reported.



Avoid touching the applicator tip to eye, fingers, or other surfaces, and do not wear contact lenses during treatment of ocular infections. Apply pressure to the lacrimal sac during and for 1–2 min after dose administration to reduce risk of systemic absorption.

Store medication in the refrigerator (2–8°C). Storage at room temperature will result in a decrease in pH to cause stinging and ocular discomfort when in use.

D

TRIKAFTA

See Elexacaftor/Tezacaftor/Ivacaftor

TRILISATE

See Choline Magnesium Trisalicylate

TRIMETHOBENZAMIDE HCL

Tigan and generics

Antiemetic



?

?

Yes

Yes

No

Caps: 300 mg

Injection (Tigan): 100 mg/mL (2, 20 mL); multidose vials may contain 0.45% phenol

Child (PO): 15–20 mg/kg/24 hr ÷ TID–QID.



Alternative dosing:

<13.6 kg: 100 mg TID–QID

13.6–40 kg: 100–200 mg/dose TID–QID

>40 kg: 300 mg/dose TID–QID

Adult:

PO: 300 mg/dose TID–QID

IM: 200 mg/dose TID–QID

Do not use in premature or newborn infants. **Avoid** use in patients with hepatotoxicity, acute vomiting, medications with CNS depressant effects, or allergic reaction. CNS disturbances are common in children (extrapyramidal symptoms, drowsiness, confusion, dizziness).



Hypotension, especially with IM use, may occur. **IM not recommended in children.**

Consider reducing dosage in the presence of renal impairment since a significant amount of drug is excreted and eliminated by the kidney.

TRIMETHOPRIM AND SULFAMETHOXAZOLE

See Sulfamethoxazole and Trimethoprim

U**URSODIOL**

Actigall, Urso 250, Urso Forte, and generics

Gallstone solubilizing agent, cholelitholytic agent



B

1

No

Yes

No

Oral suspension: 20, 25, 50, 60 mg/mL



Caps (Actigall and generics): 300 mg

Tabs:

Urso 250 and generics: 250 mg

Urso Forte and generics: 500 mg

Continued

URSODIOL *continued***Biliary atresia:**

Infant and child (limited data): 10–20 mg/kg/24 hr ÷ BID–TID PO

**Pruritis from cholestasis:**

Infant, child, and adolescent (limited data): 15–30 mg/kg/24 hr ÷ once daily –BID PO

TPN-induced cholestasis:

Infant and child (limited data): 30 mg/kg/24 hr ÷ TID PO

Cystic fibrosis (to improve fatty acid metabolism in liver disease; limited data):

Child: 15–30 mg/kg/24 hr ÷ BID–TID PO

Gallstone dissolution:

Adult: 8–10 mg/kg/24 hr ÷ BID–TID PO

Contraindicated in calcified cholesterol stones, radiopaque stones, bile pigment stones, or stones >20 mm in diameter. **Use with caution** in patients with nonvisualizing gallbladder and chronic liver disease. May cause GI disturbance, rash, arthralgias, anxiety, headache, and elevated liver enzymes (elevated ALT, AST, alkaline phosphatase, bilirubin, GGT).



Monitor LFTs every month for the first 3 months after initiating therapy and every 6 months thereafter. Thrombocytopenia has been reported in clinical trials.

Aluminum-containing antacids, cholestyramine, and oral contraceptives decrease ursodiol effectiveness. Dissolution of stones may take several months. Stone recurrence occurs in 30% to 50% of patients within 5 yr.

V**VALACYCLOVIR**

Valtrex and generics

Antiviral agent



B 1 Yes Yes No

Tabs/Caplets: 500, 1000 mg

Oral suspension: 50 mg/mL



Child: Recommended dosages based on steady-state pharmacokinetic data in immunocompromised children. Efficacy data is incomplete.

To mimic an IV acyclovir regimen of 250 mg/m²/dose or 10 mg/kg/dose TID:

30 mg/kg/dose PO TID OR alternatively by weight:

4–12 kg: 250 mg PO TID

13–21 kg: 500 mg PO TID

22–29 kg: 750 mg PO TID

≥30 kg: 1000 mg PO TID

To mimic a PO acyclovir regimen of 20 mg/kg/dose 4 or 5 times a day:

20 mg/kg/dose PO TID OR alternatively by weight:

6–19 kg: 250 mg PO TID

20–31 kg: 500 mg PO TID

≥32 kg: 750 mg PO TID

Chickenpox (immunocompetent patient; initiate therapy at earliest signs or symptoms, within 24 hr of rash onset):

Infant ≥3 mo, child, and adolescent: 20 mg/kg/dose PO TID × 5 days; **max. dose:** 1 g/dose TID

HSV treatment (immunocompetent):

Child 3 mo–11 yr: 20 mg/kg/dose PO BID (**max. dose:** 1000 mg/dose) × 7–10 days

VALACYCLOVIR continued

Herpes zoster (shingles; see remarks):

Adult (immunocompetent): 1 g/dose PO TID \times 7 days within 48–72 hours of onset of rash.

Genital herpes:

Adolescent and adult:

Initial episodes: 1 g/dose PO BID \times 10 days.

Recurrent episodes: 500 mg/dose PO BID \times 3 days

Suppressive therapy:

Immunocompetent patient: 500–1000 mg/dose PO once daily \times 1 year, then reassess

for recurrences. Patients with <9 recurrences per yr may be dosed at 500 mg/dose PO once daily \times 1 yr.

Herpes labialis (cold sores; initiated at earliest symptoms):

≥ 12 yr and adult:

Immunocompetent: 2 g/dose PO Q12 hr \times 2 doses (1 day)

HIV positive: 1 g/dose PO Q12 hr \times 5–10 days

This pro-drug is metabolized to acyclovir and L-valine with better oral absorption than acyclovir. **Use with caution in hepatic or renal insufficiency (adjust dose; see Chapter 31).** Thrombotic thrombocytopenic purpura/hemolytic uremic syndrome (TTP/HUS) has been reported in patients with advanced HIV infection and in bone marrow and renal transplant recipients. Probenecid or cimetidine can reduce the rate of conversion to acyclovir.

Headache, nausea, and abdominal pain are common adverse events in adults. Headache is common in children. See Acyclovir for additional drug interactions and adverse effects.

For initial episodes of genital herpes, therapy is most effective when initiated within 48 hr of symptom onset. Therapy should be initiated immediately after the onset of symptoms in recurrent episodes (no efficacy data when initiating therapy $>$ 24 hr after onset of symptoms). Data are not available for use as suppressive therapy for periods $>$ 1 yr.

Valacyclovir **CANNOT** be substituted for acyclovir on a one-to-one basis. Doses may be administered with or without food.



VALGANCICLOVIR

Valcyte and generics

Antiviral agent



C

3

Yes

Yes

No

Tabs: 450 mg

Oral solution: 50 mg/mL (88 mL); contains saccharin and sodium benzoate

Oral suspension: 60 mg/mL

Neonate and infant:

Symptomatic congenital CMV (from pharmacokinetic [PK] data in 8 infants 4–90 days old

(mean: 20 days) and 24 neonates 8–34 days old): 15–16 mg/kg/dose PO BID produced similar levels to IV ganciclovir 6 mg/kg/dose BID. A comparison of 6 weeks vs. 6 months of therapy in 96 neonates (>32 wk gestation and ≥ 1.8 kg) showed modest improvement in long-term hearing and developmental outcomes at 1–2 yr of age with the longer duration of therapy of 6 months.

Child (1 mo–16 yr):

CMV prophylaxis in kidney (4 mo–16 yr), heart (1 mo–16 yr), or liver (4 mo–16 yr) transplantation (see remarks): Once daily PO dosage initiated within 10 days of transplantation is calculated with the following equation:

Daily mg dose (**max. dose:** 900 mg) = 7 X BSA X CrCl. BSA is determined by the Mosteller equation and CrCl is determined by a modified Schwartz equation (**max. value:** 150 mL/min/1.73m²).

Mosteller BSA (m²) equation: square root of [(height (cm) X weight (kg)) \div 3600]



VALGANCICLOVIR *continued*

Modified Schwartz (mL/min/1.73 m²) equation (max. value: 150 mL/min/1.73 m²): k X height (cm) ÷ serum creatinine (mg/dL); where k = 0.33 if patient is <1 yr old with low birth weight for gestational age; k = 0.45 if patient is <1 yr old with birth weight appropriate for gestational age or if patient is 1 to <2 yr old; k = 0.55 for males 2 to <13 yr old and females aged 2 to <16 yr old; k = 0.7 if males 13–16 yr old.

Duration of therapy:

Kidney transplantation (≥4 mo to 16 yr): 200 days

Heart transplantation (≥1 mo to 16 yr): 100 days

Liver transplantation (≥4 mo to 16 yr): 100–200 days; limited data.

Adolescent (>16 yr) and adult:**CMV retinitis:**

Induction therapy: 900 mg PO BID × 14–21 days with food

Maintenance therapy: 900 mg PO once daily with food for a minimum of 3–6 mo.

CMV prophylaxis in heart, kidney, and kidney-pancreas transplantation: 900 mg PO once daily starting within 10 days of transplantation until 100 days post heart or kidney-pancreas transplantation; or until 200 days post kidney transplantation.

This pro-drug is metabolized to ganciclovir with better oral absorption than ganciclovir.

Contraindicated with hypersensitivity to valganciclovir/ganciclovir; ANC <500 mm³; platelets <25,000 mm³; hemoglobin <8 g/dL; and patients on hemodialysis. **Use with caution in renal insufficiency (adjust dose; see Chapter 31)**, preexisting bone marrow suppression, or receiving myelosuppressive drugs or irradiation. Has not been evaluated in hepatic impairment. May cause headache, insomnia, peripheral neuropathy, diarrhea, vomiting, neutropenia, anemia, and thrombocytopenia. Neutropenia incidence is greater at day 200 versus day 100 in pediatric kidney transplant patients.

Use effective contraception during and for at least 90 days after therapy; may impair fertility in men and women. See Ganciclovir for drug interactions and additional adverse effects.

Monitor CBC with differential, platelets, and serum creatinine at baseline and periodically during therapy. Consider changes in serum creatinine and body changes to height and body weight for prophylaxis dosing.

Valganciclovir **CANNOT** be substituted for ganciclovir on a one-to-one basis. All doses are administered with food. **Avoid** direct skin or mucous membrane contact with broken or crushed tablets.

**VALPROIC ACID**

Generics; previously available as Depakene (PO) and Depacon (IV)

[Depakote: See Divalproex Sodium]

Anticonvulsant

D/X



2



No



Yes



Yes

Caps: 250 mg

Oral solution: 250 mg/5 mL (473 mL); may contain parabens

Injection: 100 mg/mL (5mL)

**Seizures (PO):**

Initial: 10–15 mg/kg/24 hr ÷ once daily–TID

Increment: 5–10 mg/kg/24 hr at weekly intervals to **max. dose** of 60 mg/kg/24 hr.

Maintenance: 30–60 mg/kg/24 hr ÷ BID–TID. Due to drug interactions, higher doses (up to 100 mg/kg/24 hr ÷ TID–QID) may be required in children on other anticonvulsants. If using divalproex sodium, administer BID.

VALPROIC ACID *continued*

Intravenous route (use only when PO is not possible):

Use same PO daily dose \div Q6 hr. Convert back to PO as soon as possible.

Rectal route (use syrup, diluted 1:1 with water, given PR as a retention enema):

Load: 20 mg/kg/dose

Maintenance: 10–15 mg/kg/dose Q8 hr

Migraine prophylaxis:

Child (limited data): Start at 10–15 mg/kg/24 hr PO \div BID (**max. initial dose:** 250 mg/dose). If needed, increase dose over 4–6 wk to 40–45 mg/kg/24 hr PO \div BID up to a **maximum** of 1000 mg/24 hr. Alternative dosing for child ≥ 12 yr is 250 mg PO BID (**max. dose:** 1000 mg/24 hr).

Adult: Start with 500 mg/24 hr \div PO BID. Dose may be gradually increased to a **max.** of 1000 mg/24 hr \div PO BID. If using divalproex sodium extended-release tablets, administer daily dose once daily.

Contraindicated in hepatic disease, pregnancy (for migraine indication), urea cycle disorders (e.g., OTC deficiency), mitochondrial disorders with mutations in DNA polymerase γ (e.g., Alpers-Huttenlocher syndrome), and children <2 yr suspected of the aforementioned mitochondrial disorder. May cause GI, liver, blood, and CNS toxicity; weight gain; transient alopecia; pancreatitis (potentially life-threatening); nausea; sedation; vomiting; headache; thrombocytopenia (dose-related); platelet dysfunction; rash (especially with lamotrigine); and hyperammonemia. Hepatic failure has occurred especially in children <2 yr (especially those receiving multiple anticonvulsants, with congenital metabolic disorders, with severe seizure disorders with mental retardation, and with organic brain disease). Idiosyncratic life-threatening pancreatitis has been reported in children and adults. Hyperammonemic encephalopathy has been reported in patients with urea cycle disorders. Suicidal behavior or ideation, male infertility, elevated testosterone, decreased bone mineral density, DRESS, encephalopathy without elevated ammonia levels, hair texture/color changes, and nail/nail bed disorders have been reported.

Valproic acid is a substrate for CYP 450 2C19 isoenzyme and an inhibitor of CYP 450 2C9, 2D6, and 3A3/4 (weak). It increases amitriptyline/nortriptyline, rufinamide, phenytoin, propofol, diazepam, and phenobarbital levels. Concomitant estrogen-containing contraceptives, phenytoin, phenobarbital, topiramate, meropenem, cholestyramine, and carbamazepine may decrease valproic acid levels. Amitriptyline or nortriptyline may increase valproic acid levels. May interfere with urine ketone and thyroid tests.

Do not give syrup with carbonated beverages. Use of IV route has not been evaluated for >14 days of continuous use. Infuse IV over 1 hr up to a **max. rate** of 20 mg/min. Depakote and Depakote ER are **NOT** bioequivalent; see package insert for dose conversion.

Therapeutic levels: 50–100 mg/L. Recommendations for serum sampling at steady state: Obtain trough level within 30 min prior to the next scheduled dose after 2–3 days of continuous dosing. Levels of 50–60 mg/L and as high as 85 mg/L have been recommended for bipolar disorders. Monitor CBC and LFTs prior to and during therapy.

Valproic acid and divalproex should not be used in pregnant women. Increased risk of neural tube defects, decreased child IQ scores, craniofacial defects, and cardiovascular malformations have been reported in babies exposed to valproic acid and divalproex sodium.

Pregnancy category is "X" when used for migraine prophylaxis and is "D" for all other indications.

VALSARTAN

Diovan and generics

Angiotensin II Receptor Blocker, antihypertensive agent



D



3



Yes



Yes



No

Tabs: 40, 80, 160, 320 mg

Oral suspension: 4 mg/mL

VALSARTAN *continued***Hypertension (see remarks):**

Child 1–5 yr (≥ 8 kg; limited data): A reported range of 0.4–3.4 mg/kg/dose PO once daily with the following maximum doses:

<18 kg: 40 mg/24 hr

≥ 18 kg: 80 mg/24 hr

Child 6–16 yr: Start at 1.3 mg/kg/dose (**max. dose:** 40 mg) PO once daily. Dose may be increased up to the 2.7 mg/kg/dose up to 160 mg (whichever is lower); doses greater than this have not been studied.

Adolescent ≥ 17 yr and adult (non-volume depleted status): Start 80 or 160 mg PO once daily; usual dose range is 80–320 mg once daily. **Max. dose:** 320 mg/24 hr.

Contraindicated with aliskiren use in diabetic patients. Discontinue use immediately after when pregnancy is detected. **Use with caution** in renal ($\text{CrCl} < 30$ mL/min) and liver insufficiency, heart failure, post-myocardial infarction, renal artery stenosis, renal function changes, and volume depletion.

Hypotension, dizziness, headache, cough, and increases in BUN and sCr are common side effects.

Hyperkalemia (most commonly reported in children < 6 yr with underlying renal disease in clinical trials; also consider salt substitutes, foods, and medications which may increase potassium levels), bullous dermatitis, angioedema, acute renal failure, and dysgeusia have been reported. May increase lithium levels resulting in toxicity for those receiving concurrent lithium therapy; monitor lithium levels closely.

Onset of initial antihypertensive effects is 2 hr with maximum effects after 2–4 wk of chronic use.

Patients may require higher doses of oral tablet dosage form than with the oral suspension due to increased bioavailability with the oral suspension.

VANCOMYCIN

Vancomycin, Firvanq, and generics

Antibiotic, glycopeptide



C/B



1



Yes



No



No

Injection: 0.25, 0.5, 0.75, 1, 1.5, 5, 10 g

Premixed injection:

In D5W or NS: 500 mg/100 mL, 750 mg/150 mL, 1000 mg/200 mL

In water and polyethylene glycol: 500 mg/100 mL, 1000 mg/200 mL, 1500 mg/300 mL, and 2000 mg/400 mL; contains D-alanine and L-lysine

Caps: 125, 250 mg

Oral solution: 25 mg/mL

Firvanq and generics: 25 mg/mL (80, 150, 300 mL); may contain sodium benzoate

Firvanq: 50 mg/mL (150, 210, 300 mL); may contain sodium benzoate

Initial empiric dosage; patient-specific dosage defined by therapeutic drug monitoring (see remarks).

Neonate, IV (see following table for dosage interval):

Bacteremia: 10 mg/kg/dose

Meningitis, pneumonia: 15 mg/kg/dose

Post-menstrual age (weeks) ^a	Post-natal age (days)	Dosage interval (hr)
≤ 29	0–14	18
	>14	12
30–36	0–14	12
	>14	8
37–44	0–7	12
	>7	8
≥ 45	All	6

VANCOMYCIN *continued***Infant, child, adolescent, and adult, IV:**

Age	General dosage	CNS infections, endocarditis, osteomyelitis, pneumonia, and septic arthritis
1 mo–12 yr	15 mg/kg/dose Q6 hr	20 mg/kg/dose Q6 hr
Adolescent (>12 to <18 yr) ^a	15 mg/kg/dose Q6–8 hr	20 mg/kg/dose Q6–8 hr
Adult (≥ 18 yr)	15 mg/kg/dose Q8–12 hr	20 mg/kg/dose (max. 2 g) Q8–12 hr

^aUse Q8 hr dosing interval for older adolescent***Clostridium difficile colitis (PR route of administration may be preferable for complete ileus):*****Child:** 40–50 mg/kg/24 hr ÷ Q6 hr PO × 7–10 days**Max dose:** 500 mg/24 hr; higher maximum of 2 g/24 hr have also been used for severe/fulminant disease.**Adult:** 125 mg/dose PO Q6 hr × 7–10 days; dosages as high as 2 g/24 hr ÷ Q6–8 hr have also been used for severe/fulminant disease.***Endocarditis prophylaxis for GU or GI (excluding esophageal) procedures (complete all antibiotic dose infusion(s) within 30 min of starting procedure):*****Moderate-risk patients allergic to ampicillin or amoxicillin:****Child:** 20 mg/kg/dose (max. 1 g/dose) IV over 1–2 hr × 1**Adult:** 1 g/dose IV over 1–2 hr × 1**High-risk patients allergic to ampicillin or amoxicillin:****Child and adult:** Same dose as moderate-risk patients plus gentamicin 1.5 mg/kg/dose (**max. dose:** 120 mg/dose) IV/IM × 1

Ototoxicity and nephrotoxicity may occur and may be exacerbated with concurrent aminoglycoside use. Greater nephrotoxicity risk has been associated with higher therapeutic serum trough concentrations (≥15 mg/mL), concurrent piperacillin/tazobactam therapy, and receiving furosemide in the intensive care unit. **Adjust dose in renal failure (see Chapter 31).** Use total body weight for obese patients when calculating dosages. Low concentrations of the drug may appear in CSF with inflamed meninges. Nausea, vomiting, and drug-induced erythroderma are common with IV use. “Red man syndrome” associated with rapid IV infusion may occur. Infuse over 60 min (may infuse over 120 min if 60-min infusion is not tolerated). **NOTE:** Diphenhydramine is used to reverse red man syndrome. Allergic reactions (including drug rash with eosinophilia and systemic symptoms [DRESS]), neutropenia, and immune-mediated thrombocytopenia have been reported.

Although current extrapolated adult guidelines suggest measuring only trough levels, an additional post-distributional level may be useful in characterizing enhanced/altered drug clearance for quicker dosage modification to attain target levels; this may be useful for infants with known faster clearance and patients in renal compromise. Consult a pharmacist.

The following therapeutic trough level recommendations are based on the assumption that the pathogen's Vancomycin MIC is ≤ 1 mg/L.

Indication	Goal trough level
Uncomplicated skin and soft tissue infection, uncomplicated bacteremia, febrile neutropenia, sepsis	10–15 mg/L
CNS infections, endocarditis, pneumonia, osteomyelitis, septic arthritis	15–19 mg/L

Peak level measurement (20–50 mg/L) has also been recommended for patients with burns, clinically nonresponsive in 72 hr of therapy, persistent positive cultures, and CNS infections (≥30 mg/L).

VANCOMYCIN *continued*

Recommended serum sampling time at steady state: Trough within 30 min prior to the fourth consecutive dose and peak 60 min after the administration of the fourth consecutive dose. Infants with faster elimination (shorter $T_{1/2}$) may be sampled around the third consecutive dose.

Recent evidence strongly suggests moving away from serum trough vancomycin monitoring to a pharmacokinetic/pharmacodynamics (PK/PD) target of area under the curve (AUC) to MIC ratio. An $AUC_{[24]}$ of 400–600 mg \cdot h/L is associated with clinical efficacy and reduced risk for AKI. Vancomycin therapeutic monitoring guidelines are currently being revised by the IDSA in collaboration with PIDS, SIDP, and ASHP and are forthcoming. Consult with an ID specialist and pharmacist to see how best this monitoring method is operationalized at your institution.

ORAL USE for *C. difficile*: Vancomycin (PO) or metronidazole (PO) are currently the recommended first-line therapy for children, whereas vancomycin (PO) or fidaxomicin is recommended for adults. See Clinical Infectious Diseases 66(7):e1–e48 for the 2017 IDSA/SHEA Clinical Practice Guidelines. Common adverse effects with oral vancomycin capsules in adults include nausea, abdominal pain, and hypokalemia.

Pregnancy category “C” for the intravenous route and “B” for the oral route of administration.

VARICELLA-ZOSTER IMMUNE GLOBULIN (HUMAN)

Varizig, VZIG

Hyperimmune globulin, varicella-zoster

C

2

No

No

No

Injection: 125 Units (1.2 mL); contains 10% maltose, 0.03% polysorbate 80, and <40 mCg/mL IgA; preservative free. May contain low levels of anti-Protein S antibodies.

Dose should be given within 48 hr of varicella exposure and no later than 96 hr post exposure. IM administration:



<2 kg: 62.5 Units

2.1–10 kg: 125 Units

10.1–20 kg: 250 Units

20.1–30 kg: 375 Units

30.1–40 kg: 500 Units

>40 kg: 625 Units

Max. dose: 625 Units/dose

If patient is high risk and re-exposed to varicella for more than 3 weeks after a prior dose, another full dose may be given.

Contraindicated in severe thrombocytopenia due to IM injection, immunoglobulin



A-deficiency (anaphylactic reactions may occur), and known immunity to varicella zoster virus. See Chapter 16 for indications. Local discomfort, redness, and swelling at the injection site, and headache may occur.

Hyperviscosity of the blood may increase risk for thrombotic events. Interferes with immune response to live virus vaccines such as measles, mumps and rubella; defer administration of live vaccines 6 mo or longer after VZIG dose. See latest AAP Red Book for additional information.

Avoid IM injection into the gluteal region due to risk for sciatic nerve damage and **do not exceed age-specific single max. IM injection volume.**

VASOPRESSIN

Vasostrict, generics, 8-Arginine Vasopressin; previously available as Pitressin

Antidiuretic hormone analog



Injection: 20 Units/mL (aqueous) (1, 10 mL); may contain 0.5% chlorobutanol, especially in the 10 mL multidose vial

Diabetes insipidus: Titrate dose to effect (see remarks).

SC/IM:

Child: 2.5–10 Units BID–QID

Adult: 5–10 Units BID–TID



Continuous infusion (adult and child): Start at 0.5 milliunit/kg/hr (0.0005 Units/kg/hr). Increase dosage by 0.5 milliunit/kg/hr every 10 min PRN up to **max. dose** of 10 milliunit/kg/hr (0.01 Units/kg/hr).

Growth hormone and corticotropin provocative tests:

Child: 0.3 Units/kg IM; **max. dose:** 10 Units

Adult: 10 Units IM

GI hemorrhage (IV; NOTE: dosage metric is Units/kg/min for children and Units/min for adults):

Child: Start at 0.002–0.005 Units/kg/min. Increase dose as needed to **max. dose** of 0.01 Units/kg/min.

Adult: Start at 0.2–0.4 Units/min. Increase dose as needed to **max. dose** of 0.8 Units/min.

Cardiac arrest, ventricular fibrillation, and pulseless ventricular tachycardia:

Child (use following 2 doses of epinephrine; limited data): 0.4 Units/kg IV × 1

Vasodilatory shock with hypotension (unresponsive to fluids and pressors; NOTE: dosage metric is Units/kg/min for children and Units/min for adults):

Infant, child, adolescent (various reports): 0.00017–0.008 Units/kg/min via continuous IV infusion in combination with pressors.

Adult: 0.01–0.04 Units/min via continuous IV infusion in combination with pressors.



Use with caution in seizures, migraine, asthma, and renal, cardiac, or vascular diseases.

Side effects include tremor, sweating, vertigo, abdominal discomfort, nausea, vomiting, urticaria, anaphylaxis, hypertension, and bradycardia. May cause vasoconstriction, water intoxication, and bronchoconstriction. Drug interactions: lithium, demeclocycline, heparin, and alcohol reduces activity; carbamazepine, tricyclic antidepressants, fludrocortisone, and chlorpropamide increases activity.

Do not abruptly discontinue IV infusion (taper dose). Patients with variceal hemorrhage and hepatic insufficiency may respond to lower dosages. Monitor fluid intake and output, urine specific gravity, urine and serum osmolality, plasma osmolality, and sodium.

VECURONIUM BROMIDE

Various generics; previously available as Norcuron

Nondepolarizing neuromuscular blocking agent



C ? Yes Yes No

Injection: 10, 20 mg; contains mannitol



Neonate:

Initial: 0.1 mg/kg/dose IV

Maintenance: 0.03–0.15 mg/kg/dose IV Q1–2 hr PRN

Infants (>7 wk to 1 yr) (see remarks):

Initial: 0.08–0.1 mg/kg/dose IV

Maintenance: 0.05–0.1 mg/kg/dose IV Q1 hr PRN; may administer via continuous infusion at 0.06–0.09 mg/kg/hr IV

VECURONIUM BROMIDE *continued***>1 yr-adult (see remarks):****Initial:** 0.08–0.1 mg/kg/dose IV**Maintenance:** 0.05–0.1 mg/kg/dose IV Q1 hr PRN; may administer via continuous infusion at 0.09–0.15 mg/kg/hr IV.**Use with caution** in patients with renal or hepatic impairment, and neuromuscular disease.

Dose reduction may be necessary in hepatic insufficiency. Infants (7 wk to 1 yr) are more sensitive to the drug and may have a longer recovery time. Children (1–10 yr) may require higher doses and more frequent supplementation than adults. Enflurane, isoflurane, aminoglycosides, β -blockers, calcium channel blockers, clindamycin, furosemide, magnesium salts, quinidine, procainamide, and cyclosporine may increase the potency and duration of neuromuscular blockade. Calcium, caffeine, carbamazepine, phenytoin, steroids (chronic use), acetylcholinesterases, and azathioprine may decrease effects. May cause arrhythmias, rash, and bronchospasm. Severe anaphylactic reactions have been reported.

**Neostigmine, pyridostigmine, or edrophonium are antidotes.** Onset of action within 1–3 min.Duration is 30–40 min. See **Chapter 1** for rapid sequence intubation.**VERAPAMIL**

Calan, Calan SR, Verelan, Verelan PM, and generics

Calcium channel blocker

C

2

Yes

Yes

No

Tabs: 40, 80, 120 mg**Extended/sustained-release tabs (Calan SR and generics):** 120, 180, 240 mg**Extended/sustained-release caps (Verelan, Verelan PM and generics; for q24 hr dosing):** 100, 120, 180, 200, 240, 300, 360 mg**Injection:** 2.5 mg/mL (2, 4 mL)**Oral suspension:** 50 mg/mL**IV for dysrhythmias:** Give over 2–3 min. May repeat once after 30 min.**1–16 yr, for PSVT:** 0.1–0.3 mg/kg/dose \times 1 may repeat dose in 30 min; **max. dose:** 5 mg first dose, 10 mg second dose.**Adult, for SVT:** 5–10 mg (0.075–0.15 mg/kg) \times 1 may administer second dose of 10 mg (0.15 mg/kg) 15–30 min later.**Hypertension (PO):****Adult:****Immediate release dosage forms:** 120–360 mg/24 hr PO \div TID**Sustained release dosage forms:** 200–480 mg/24 hr PO once daily. **Max. dose:** 480 mg/24 hr (400 mg/24 hr for Verelan PM).

No longer recommended as an antihypertensive agent for children. **Contraindications** include hypersensitivity, cardiogenic shock, severe CHF, sick sinus syndrome, or AV block. **Use with caution** in hepatic and renal (reduce dose in renal insufficiency; see Chapter 31) impairment. Owing to negative inotropic effects, verapamil should not be used to treat **SVT in an emergency setting in infants**. Avoid **IV use** in neonates and young infants due to apnea, bradycardia and hypotension. May cause constipation, headache, dizziness, edema, and hypotension. EPS has been reported.

Monitor ECG. Have calcium and isoproterenol available to reverse myocardial depression. May decrease neuromuscular transmission in patients with Duchenne muscular dystrophy and worsen myasthenia gravis.

VERAPAMIL *continued*

Drug is a substrate of CYP 450 1A2 and 3A3/4, and an inhibitor of CYP 3A4 and P-gp transporter.

Barbiturates, sulfipyrazone, phenytoin, vitamin D, and rifampin may decrease serum levels/effects of verapamil; erythromycin, quinidine, and grapefruit juice may increase serum levels/effects. Verapamil may increase effects/toxicity of β -blockers (severe myocardial depression), carbamazepine, cyclosporine, sirolimus, everolimus, digoxin, ethanol, fentanyl, lithium, nondepolarizing muscle relaxants, prazosin, and tizanidine. Use with telithromycin has resulted in hypotension, bradycardia, and lactic acidosis. Bradycardia has been reported with concurrent use of clonidine, and increased bleeding times has been reported with use with aspirin.

Do not crush or chew extended-release dosage forms.

VIGABATRIN

Sabril, Vigadron, and generics

Anticonvulsant

C



?



Yes



Yes



No

Tabs (Sabril and generics): 500 mg

Powder for oral solution (Sabril, Vigadron, and generics): 500 mg per packet to be dissolved in 10 mL water (50s)



Infantile spasms (1 mo–2 yr; see remarks for discontinuation of therapy): Start at 50 mg/kg/24 hr \div BID PO, if needed and tolerated, may titrate dosage upwards by 25–50 mg/kg/24 hr increments Q3 days up to a maximum of 150 mg/kg/24 hr \div BID. Withdrawal therapy if no clinical benefit is seen in 2–4 weeks.

Adjunctive therapy for refractory complex partial seizures (withdrawal therapy if no clinical benefit is seen in 3 months; see remarks for discontinuation of therapy):

Child ≥ 2 yr and ≥ 10 kg, and adolescent ≥ 16 yr: Start at 40 mg/kg/24 hr \div BID PO, if needed and tolerated, adjust dose to the following maintenance dose:

10–15 kg: 500–1000 mg/24 hr \div BID

16–30 kg: 1000–1500 mg/24 hr \div BID

31–50 kg: 1500–3000 mg/24 hr \div BID

>50 kg: 2000–3000 mg/24 hr \div BID

Adolescent (≥ 16 yr) and adult (see remarks for discontinuation of therapy): Start at 500 mg BID PO, if needed and tolerated, increase daily dose by 500 mg increments at 7-day intervals. Usual recommended dose: 1500 mg BID; **max. dose:** 6000 mg/24 hr. Doses >3 g/24 hr has not shown to provide additional benefit and is associated with more side effects.

Use with caution in renal impairment (reduce dose; see Chapter 31) and other CNS depressants (enhanced effects). Can cause progressive and permanent vision loss (risk increases with dose and duration); periodic vision testing is required. Common side effects in children and adults include rash, weight gain, GI disturbances, arthralgia, visual disturbances, vertigo, sedation, headache, confusion, and URLs. Liver failure, anemia, psychotic disorder, angioedema, Stevens Johnson syndrome, TEN, alopecia, and suicidal ideation have been reported. Dose-dependent abnormal MRIs and intramyelinic edema (in postmortem exams) have been reported in infants treated for infantile spasms.



Ketorolac, naproxen, and mefloquine may decrease the effect of vigabatrin. Vigabatrin may decrease the effects/levels of phenytoin but increase the levels/toxicity of carbamazepine.

Use in adjunctive therapy for refractory complex partial seizure has labeled indication for ≥ 10 -yr-old patients when potential benefits outweigh the risk of vision loss.

Continued

VIGABATRIN *continued*

DO NOT rapidly withdraw therapy. Dosage needs to be tapered when discontinuing therapy to minimize increased seizure frequency. The following tapering guidelines have been recommended:

Infant: decrease by 25–50 mg/kg every 3–4 days

Child: decrease dose by 1/3 every 7 days for 3 weeks

Adult: decrease by 1 g/24 hr every 7 days.

Doses may be administered with or without food. Access to this medication is restricted to prescribers and pharmacies registered under a special restricted distribution program (SABRII REMS Program) in the United States. Call 888-457-4273 or see www.SabriIREMS.com for more information.

VITAMIN A

Aquasol A and generics

Vitamin, fat soluble

A/X



2



No



No



No

Caps [OTC]: 7,500, 8,000, 10,000, 25,000 IU

Tabs [OTC]: 10,000, 15,000 IU

Injection for IM use (Aquasol A): 50,000 IU/mL (2 mL); contains polysorbate 80 and chlorobutanol

Conversion: 10,000 IU is equivalent to 3000 mcg vitamin A

US RDA: See Chapter 21.

Supplementation in measles (a third dose may be administered 2–4 wk after the second dose if patient has ocular signs of vitamin A deficiency or is severely malnourished; see remarks):

<6 mo: 50,000 IU/dose once daily PO × 2 days.

Infant 6 mo to <1 yr: 100,000 IU/dose once daily PO × 2 days.

Child 1–5 yr: 200,000 IU/dose once daily PO × 2 days.



Malabsorption syndrome prophylaxis:

Child >8 yr and adult: 10,000–50,000 IU/dose once daily PO of water miscible product.

Cystic fibrosis (usually dosed in cystic fibrosis specific multi-vitamins; monitor serum concentrations):

Infant: 1,500 IU/dose once daily PO

Child 1–3 yr: 5,000 IU/dose once daily PO

Child 4–8 yr: 5,000–10,000 IU/dose once daily PO

Child ≥9 yr and adolescent: 10,000 IU/dose once daily PO

High doses above the U.S. RDA are teratogenic (category X). The use of vitamin A in measles is recommended in children 6 mo–2 yr of age who are either hospitalized or who have any of the following risk factors: immunodeficiency, ophthalmologic evidence of vitamin A deficiency, impaired GI absorption, moderate to severe malnutrition, and recent immigration from areas with high measles mortality. May cause GI disturbance, rash, headache, increased ICP (pseudotumor cerebri), papilledema, and irritability. Large doses may increase the effects of warfarin. Mineral oil, cholestyramine and neomycin will reduce vitamin A absorption. **Do not** access vitamin A levels during an acute inflammatory condition as falsely low levels have been reported.

**VITAMIN B1**

See Thiamine

VITAMIN A *continued***VITAMIN B2**

See Riboflavin

VITAMIN B3

See Niacin

VITAMIN B6

See Pyridoxine

VITAMIN B12

See Cyanocobalamin

VITAMIN C

See Ascorbic Acid

VITAMIN D2

See Ergocalciferol

VITAMIN D3

See Cholecalciferol

VITAMIN E/ α -TOCOPHEROL

Aqueous Vitamin E, Nutr-E-Sol, and many others including generics

Vitamin, fat soluble



A/C



2



No



No



No

Tabs [OTC]: 100, 200, 400 IU

Caps [OTC]: 100, 200, 400, 1000 IU

Oral solution (Aqueous Vitamin E and generics [OTC]): 50 IU/mL (12, 30 mL); may contain propylene glycol, polysorbate 80, and saccharin

Oral liquid (Nutr-E-sol) [OTC]: 400 IU/15 mL (473 mL)

Conversion: 400 IU is equivalent to 180 mg of vitamin E

Continued

VITAMIN E/α-TOCOPHEROL *continued***US RDA:** See Chapter 21.**Vitamin E deficiency, PO:** Follow levels.

Use water miscible form with malabsorption.

Neonate: 25–50 IU/24 hr × 1 week followed by recommended dietary intake.**Child:** 1 IU/kg/24 hr**Adult:** 60–75 IU/24 hr; doses as high as 300 IU/24 hr may be necessary**Cystic fibrosis (use water miscible form; usually dosed in cystic fibrosis specific multi-vitamins):**5–10 IU/kg/24 hr PO once daily; **max. dose:** 400 IU/24 hr.

Adverse reactions include GI distress, rash, headache, gonadal dysfunction, decreased serum thyroxine and triiodothyronine, and blurred vision. Necrotizing enterocolitis has been associated with large doses (>200 units/24 hr) of a hyperosmolar product administered to low birth weight infants. May increase hypoprothrombinemic response of oral anticoagulants (e.g., warfarin), especially in doses >400 IU/24 hr.

In malabsorption, water miscible preparations are better absorbed. Therapeutic levels: 6–14 mg/L.

Pregnancy category changes to "C" if used in doses above the RDA.

VITAMIN K

See Phytonadione

VORICONAZOLE

Vfend and generics

Antifungal, triazole**Tabs:** 50, 200 mg; contains povidone**Oral suspension:** 40 mg/mL (75 mL); may contain sodium benzoate**Injection:** 200 mg; contains 3200 mg sulfobutyl ether β-cyclodextrin (SBECD) (see remarks)**Empiric doses and consider pharmacogenomic based recommendations (see remarks).**

Between patient and inter-occasion pharmacokinetic variability is high. Monitor trough level and adjust dose accordingly.

**Infant and child <2 yr (limited data):** Start with 9 mg/kg/dose IV/PO Q12 hr; monitor levels and adjust dose.**Child 2–12 yr and 12–14 yr weighing <50 kg:**

Invasive aspergillosis, candidemia (nonneutropenic), other deep tissue candida infections or other rare molds (e.g., *Scedosporium* and *Fusarium*):

Loading dose: 9 mg/kg/dose IV Q12 hr × 2 followed by maintenance dose

Maintenance dose: 8 mg/kg/dose IV Q12 hr and convert to the oral suspension dosage form after significant clinical improvement at a dose of 9 mg/kg/dose PO Q12 hr (**max. dose:** 350 mg Q12 hr). The oral suspension dosage form was used in clinical trials and the bioequivalence of this dosage form and tablets has not been evaluated in children. Dosage increments and decrements of 1 mg/kg (or 50 mg) steps has been recommended for those with inadequate response and who are unable to tolerate their dosage level, respectively.

VORICONAZOLE *continued*

Esophageal candidiasis:

Treatment:

IV: 4 mg/kg/dose Q12 hr

PO: 9 mg/kg/dose Q12 hr; **max. dose:** 350 mg Q12 hr.

Prophylaxis for candidiasis in high-risk AML, ALL, and allogeneic HSCT patients (limited data):

IV: 9 mg/kg/dose Q12 hr × 2 doses followed by 8 mg/kg/dose Q12 hr

PO (oral suspension): 9 mg/kg/dose Q12 hr; **max. dose:** 350 mg/dose.

Child 12–14 yr weighing ≥50 kg, >15 yr (any weight), and adult:

Invasive aspergillosis, candidemia (nonneutropenic), Fusarium/Scedosporiosis, or other serious fungal infections:

Loading dose: 6 mg/kg/dose IV Q12 hr × 2 doses followed by maintenance dose

Maintenance dose:

Candidemia (nonneutropenic): 3–4 mg/kg/dose IV Q12 hr

Invasive aspergillosis, Fusarium/Scedosporiosis, or other serious fungal infections: 4 mg/kg/dose IV Q12 hr; if patient unable to tolerate, reduce dose to 3 mg/kg/dose IV Q12 hr

PO maintenance dose: Initial dose may be increased to the maximum dose when response is inadequate; if dose is not tolerated, reduce dose by 50 mg decrements, until tolerated, with minimum of the initial recommended dose.

<40 kg: 100 mg Q12 hr; **max. dose:** 300 mg/24 hr

≥40 kg: 200 mg Q12 hr; **max. dose:** 600 mg/24 hr

Esophageal candidiasis (treat for a minimum of 14 days and until 7 days after resolution of symptoms):

Initial dose may be increased to the maximum dose when response is inadequate by 50 mg increments for patients <40 kg and by 100 mg increments for ≥40 kg. If a titrated dose is not tolerated, reduce dose by 50 mg decrements until tolerated with the minimum of the initial recommended dose.

<40 kg: 100 mg Q12 hr PO; **max. dose:** 300 mg/24 hr

≥40 kg: 200 mg Q12 hr PO; **max. dose:** 600 mg/24 hr

Contraindicated with concomitant administration with rifampin, carbamazepine, long-acting barbiturates, ritonavir, efavirenz, rifabutin, ergot alkaloids, or St. John's Wort (decreases voriconazole levels); and with terfenadine, astemizole, cisapride, pimozide, quinidine, or sirolimus (voriconazole increases levels of these drugs to increase side effects). **Use with caution** in proarrhythmic conditions (e.g., congenital/acquired QTc prolongation, cardiomyopathy, and sinus bradycardia), severe hepatic disease, galactose intolerance, and concurrent use with CYP 450 3A4 substrates that can lead to prolonged QTc interval (e.g., cisapride, pimozide, and quinidine).

Drug is a substrate and inhibitor for CYP 450 2C9, 2C19 (major substrate), and 3A4 isoenzymes.

Specific CYP 2C19 phenotype and use recommendation for children and adults are as follows:



CYP 450 2C19 Phenotype	Pediatric Use Recommendation	Adult Use Recommendation
Ultrarapid metabolizer	Use alternative medication ^a	Use alternative medication ^a
Rapid metabolizer	Initiate with standard dosing with TDM ^b	Use alternative medication ^a
Intermediate metabolizer	Initiate with standard dosing with TDM ^b	Initiate with standard dosing with TDM ^b
Poor metabolizer	Use alternative medication ^a ; if voriconazole must be used, use a lower dose with TDM ^b	Use alternative medication ^a ; if voriconazole must be used, use a lower dose with TDM ^b

^aAlternative medication should not be dependent on CYP 2C19 metabolism and may include agents such as isavuconazole, liposomal amphotericin B, and posaconazole.

^bTDM= therapeutic drug monitoring

Continued

VORICONAZOLE *continued*

Currently approved for use in invasive aspergillosis; candidemia and disseminated candidiasis in skin, abdomen, kidney, bladder wall, and wounds; candidal esophagitis; and serious infections caused by *Fusarium* species and *Scedosporium apiospermum* in children ≥ 2 yr of age.

Common side effects include GI disturbances, fever, headache, hepatic abnormalities, photosensitivity (higher incidence in children; **avoid** direct sunlight and use protective measures), rash (6%), and visual disturbances (30%). Serious but rare side effects include anaphylaxis, liver or renal failure, and Stevens-Johnson syndrome. Pancreatitis has been reported in children. Monitor serum transaminase and bilirubin levels weekly for the first month of therapy followed by reduced frequency has been recommended. Higher frequency of LFT elevations has reported with children. Dermatological follow up is recommended for those who develop photosensitivity reactions as squamous cell carcinoma has been reported in those who experience this adverse reaction.

Correct potassium, magnesium, and calcium levels before and during voriconazole therapy. **Adjust dose in hepatic impairment** by decreasing only the maintenance dose by 50% for patients with a Child-Pugh Class A or B. **Do not use** IV dosage form for patients with GFR < 50 mL/min because of accumulation of the cyclodextrin excipient; switch to oral therapy if possible. Patients receiving concurrent phenytoin should increase their voriconazole maintenance doses (IV: 5 mg/kg/dose Q 12 hr; PO: double the usual dose).

Inter-occasion pharmacokinetic variability is high, thus requiring serum level monitoring. Therapeutic levels: trough: 1–5.5 mg/L. Levels < 1 mg/L have resulted in treatment failures and levels > 5.5 mg/L have resulted in neurotoxicity such as encephalopathy. Recommended serum sampling time: obtain trough within 30 min prior to a dose. Steady state is typically achieved after 5–7 days of initiating therapy.

Oral bioequivalence of the oral suspension and tablet has not been evaluated in children. Administer IV over 1–2 hr with a **max. rate** of 3 mg/kg/hr at a concentration ≤ 5 mg/mL. Administer oral doses 1 hr before and after meals.

W

WARFARIN

Coumadin, Jantoven, and generics

Anticoagulant



Tabs: 1, 2, 2.5, 3, 4, 5, 6, 7.5, 10 mg

Infant and child (see remarks): To achieve an INR between 2 and 3.5 directed by specific indication.



Loading dose on day 1:

Baseline INR ≤ 1.3 : 0.2 mg/kg/dose PO; **max. dose:** 7.5 mg/dose

Liver dysfunction, baseline INR > 1.3 , cardiopulmonary bypass within previous 10 days, NPO status/poor nutrition, receiving broad spectrum antibiotics, receiving medications that significantly inhibit CYP 450 2C9, or slow metabolizers of warfarin (see remarks): 0.05–0.1 mg/kg/dose PO; **max. dose:** 5 mg/dose

Immediate post-operative period after a Fontan procedure: 0.05 mg/kg/dose PO; **max. dose:** 2.5 mg/dose

WARFARIN *continued****Loading dose on days 2–4:***

Day 2		Days 3 & 4	
INR level	Dose Adjustment	INR level	Dose Adjustment
1.1–1.3	Repeat day 1 loading dose	1.1–1.4	Increase previous dose by 20%–50%
1.4–1.9	Decrease day 1 loading dose by 50%	1.5–1.9	Continue current dose
≥2	Hold dose for 24 hr, then give 50% of day 1 loading dose on day 3	2–3	Use 25%–50% of day 1 loading dose
		3.1–3.5	Use 25% of day 1 loading dose
		>3.5	Hold dose until INR < 3.5, then restart at ≤ 25% of day 1 loading dose

Maintenance dose (therapy day ≥5):

Goal INR 2–3		Goal INR 2.5–3.5	
INR	Dose Adjustment	INR	Dose Adjustment
1.1–1.4	Increase previous dose by 20%	1.1–1.9	Increase previous dose by 20%
1.5–1.9	Increase previous dose by 10%	2–2.4	Increase previous dose by 10%
2–3	No change	2.5–3.5	No change
3.1–3.5	Decrease previous dose by 10%	3.6–4	Decrease previous dose by 50% for one dose, then restart at a dose (prior to 50% dose decrease) decreased by 20% the next day
>3.5	Hold dose until INR < 3.5, then restart at 20% less than the last dose	>4	Hold dose for one day, then restart at a dose decreased by 20% of the last dose

Usual maintenance dose for INR goal of 2–3 (see remarks): ~0.1 mg/kg/24 hr PO once daily; range: 0.05–0.34 mg/kg/24 hr. Reported average dosages include the following:

Infant < 1 yr: 0.33 mg/kg/24 hr PO once daily

Adolescent 11–18 yr: 0.09 mg/kg/24 hr PO once daily

Adult (see remarks): 5–10 mg PO once daily × 2–5 days. Adjust dose to achieve the desired INR or PT. Maintenance dose range: 2–10 mg/24 hr PO once daily.

Contraindicated in severe liver or kidney disease, uncontrolled bleeding, GI ulcers, and malignant hypertension. Acts on vitamin K-dependent coagulation factors II, VII, IX, and X. Side effects include fever, skin lesions, skin necrosis (especially in protein C deficiency), anorexia, nausea, vomiting, diarrhea, hemorrhage, and hemoptysis.

Warfarin is a substrate for CYP 450 1A2, 2C8, 2C9, 2C18, 2C19, and 3A3/4. Amiodarone, azole anti-fungals (e.g., fluconazole, voriconazole), broad spectrum antibiotics (e.g., cefepime, meropenem, piperacillin/tazobactam), chloramphenicol, chloral hydrate, cimetidine, corticosteroids, delavirdine, fluoroquinolones (e.g., ciprofloxacin, levofloxacin), fluoxetine, metronidazole, indomethacin, large doses of vitamins A or E, nonsteroidal anti-inflammatory agents, omeprazole, oxandrolone, quindine, salicylates, SSRIs (e.g., fluoxetine, paroxetine, sertraline), sulfonamides, and zafirlukast may increase warfarin's effect. Ascorbic acid, barbiturates, carbamazepine, cholestyramine, dicloxacillin, griseofulvin, oral contraceptives, nafcillin, ribavirin, rifampin, spironolactone, sucralfate, and vitamin K (including foods with high content) may decrease warfarin's effect.

WARFARIN *continued*

Younger children generally require higher doses to achieve desired effect. Children receiving Fontan cardiac surgery may require smaller doses than children with either congenital heart disease (without Fontan) or no congenital heart disease. (See *Chest* 2004;126:645–687S and *Blood* 1999;94(9):3007–3014 for additional information.)

Lower doses should be considered for patients with pharmacogenetic variations in CYP 2C9 (e.g., *2 and *3 alleles) and VKORC1 (e.g., 1639G>A allele) enzymes, especially in European ancestry. Elderly and/or debilitated patients, and patients with a potential to exhibit greater than expected PT/INR response to warfarin should also consider using of lower doses.

Z

ZIDOVUDINE

Retrovir, AZT, and generics

Antiviral agent, nucleoside analogue reverse transcriptase inhibitor

C

2

Yes

Yes

No

Caps: 100 mg**Tabs:** 300 mg**Oral syrup:** 50 mg/5 mL (240 mL); contains 0.2% sodium benzoate**Injection:** 10 mg/mL (20 mL); preservative free solution (vial stoppers may contain latex)**In combination with lamivudine (3TC) as Combivir and generics:****Tabs:** 300 mg zidovudine + 150 mg lamivudine**In combination with abacavir and lamivudine (3TC) as Trizivir and generics:****Tabs:** 300 mg zidovudine + 300 mg abacavir + 150 mg lamivudine**HIV:** See www.aidsinfo.nih.gov/guidelines.**Prevention of HIV vertical transmission:****14–34 weeks of pregnancy (maternal dosing):****Until labor (see Perinatal guidelines for currently recommended combination antiretroviral therapies which may or may not include zidovudine):** 600 mg/24 hr PO ÷ BID–TID**During labor:** 2 mg/kg/dose IV over 1 hour followed by 1 mg/kg/hr IV infusion until umbilical cord clamped.**Premature infant (initiate therapy within 6–12 hr of birth and continue until 4–6 wk of age):**

Gestational age (wk)	Oral (PO) Dosage	Intravenous (IV) Dosage ^a
<30	2 mg/kg/dose Q12 hr, increase to 3 mg/kg/dose Q12 hr at 4 wk of age	1.5 mg/kg/dose Q12 hr, increase to 2.3 mg/kg/dose Q12 hr at 4 wk of age
30–34	2 mg/kg/dose Q12 hr, increase to 3 mg/kg/dose Q12 hr at postnatal age of 15 days	1.5 mg/kg/dose Q12 hr, increase to 2.3 mg/kg/dose Q12 hr at postnatal age of 15 days
≥35	4 mg/kg/dose Q12 hr, increase to 12 mg/kg/dose Q12 hr at 4 wk of age	3 mg/kg/dose Q12 hr, increase to 9 mg/kg/dose Q12 hr at 4 wk of age

^aConvert to PO route when possible**Term neonate and infant <6 wk (initiate therapy within 6–12 hr of birth and continue until 4–6 wk of age):****PO:** 2 mg/kg/dose Q6 hr, or 4 mg/kg/dose Q12 hr, increase dose to 12 mg/kg/dose Q12 hr at 4 wk of age**IV:** 1.5 mg/kg/dose Q6 hr or 3 mg/kg/dose Q12 hr, administered over 60 min. Increase dose to 9

ZIDOVUDINE *continued*

HIV post exposure prophylaxis (all therapies to begin within 2 hr of exposure if possible for a total of 28 days): See www.aidsinfo.nih.gov/guidelines for the most recent preferred and alternative regimens. Zidovudine is dosed using HIV treatment doses and used in combination with lamivudine and additional antiretroviral agent(s).

HIV treatment (see www.aidsinfo.nih.gov/guidelines for additional antiretroviral therapies and dosing information):

Neonate:

Gestational age (wk)	Oral (PO) Dosage	Intravenous (IV) Dosage ^a
<30	Birth to 4 wk of age: 2 mg/kg/dose Q12 hr 4 wk to 8—10 wk of age: 3 mg/kg/dose Q12 hr > 8—10 wk of age: 12 mg/kg/dose Q12 hr	Birth to 4 wk of age: 1.5 mg/kg/dose Q12 hr 4 wk to 8—10 wk of age: 2.3 mg/kg/dose Q12 hr > 8—10 wk of age: 9 mg/kg/dose Q12 hr
30—34	Birth to 2 wk of age: 2 mg/kg/dose Q12 hr >2 wk to 6—8 wk of age: 3 mg/kg/dose Q12 hr > 6—8 wk of age: 12 mg/kg/dose Q12 hr	Birth to 2 wk of age: 1.5 mg/kg/dose Q12 hr >2 wk to 6—8 wk of age: 2.3 mg/kg/dose Q12 hr > 6—8 wk of age: 9 mg/kg/dose Q12 hr
≥35	Birth to 4 wk of age: 4 mg/kg/dose Q12 hr >4 wk of age: 12 mg/kg/dose Q12 hr	Birth to 4 wk of age: 3 mg/kg/dose Q12 hr >4 wk of age: 9 mg/kg/dose Q12 hr

^aConvert to PO route when possible.

Infant (≥ 35 wk PCA, > 4 wk of age, and ≥ 4 kg), child, and adolescent:

PO: 180–240 mg/m²/dose BID or the following by weight category:

4 to <9 kg: 12 mg/kg/dose BID or 8 mg/kg/dose TID

9 to <30 kg: 9 mg/kg/dose BID or 6 mg/kg/dose TID

≥ 30 kg: 300 mg BID or 200 mg TID

IV:

Infant (≥ 3 mo), child, and adolescent (<30 kg): 120 mg/m²/dose Q6 hr; max. dose: 160 mg/dose

Adolescent ≥ 30 kg: 1–2 mg/kg/dose Q4 hr

See www.aidsinfo.nih.gov/guidelines for additional remarks.



Use with caution in patients with impaired renal or hepatic function. Dosage reduction is recommended in severe renal impairment and may be necessary in hepatic dysfunction. Drug penetrates well into the CNS. Most common side effects include: anemia, granulocytopenia, nausea, and headache (dosage reduction, erythropoietin, filgrastim/GCSF, or discontinuance may be required depending on event). Seizures, confusion, rash, myositis, myopathy (use > 1 yr), hepatitis, and elevated liver enzymes have been reported. Macrocytosis is noted after 4 wk of therapy and can be used as an indicator of compliance. Lactic acidosis and severe hepatomegaly with steatosis, including fatal cases, have been reported. Neutropenia and severe anemia have been reported in advanced HIV disease. Use of injectable dosage form may cause allergic reactions in latex-sensitive individuals.

Do not use in combination with stavudine because of poor antiretroviral effect. Effects of interacting drugs include: increased toxicity (acyclovir, trimethoprim-sulfamethoxazole); increased hematological toxicity (ganciclovir, interferon-alpha, marrow suppressive drugs); and granulocytopenia (drugs which affect glucuronidation). Methadone, atovaquone, cimetidine, valproic acid, probenecid, and fluconazole may increase levels of zidovudine, whereas rifampin, rifabutin, and clarithromycin may decrease levels.

ZIDOVUDINE *continued*

Do not administer IM. IV form is incompatible with blood product infusions and should be infused over 1 hr (intermittent IV dosing). Despite manufacturer recommendations of administering oral doses 30 min prior to or 1 hr after meals, doses may be administered with food.

ZINC SALTS, SYSTEMIC

Galzin, Orazinc, and generics

Trace mineral

A/C



?



Yes



No



No

Sulfate salt (23% elemental Zn):**Tabs as sulfate (Orazinc and generics) [OTC]:** 66, 110, 220 mg**Caps as sulfate (Orazinc, and generics) [OTC]:** 220 mg**Liquid as sulfate:** 10 mg elemental Zn/mL **Injection as sulfate:** 5 mg elemental Zn/mL (5 mL); may contain benzyl alcohol**Acetate salt (30% elemental Zn):****Caps as acetate (Galzin):** 25, 50 mg elemental per capsule**Liquid as acetate:** 5 mg elemental Zn/mL **Chloride salt (48% elemental Zn):****Injection as chloride:** 1 mg elemental Zn/mL (10 mL)**Zinc deficiency (see remarks):****Infant and child:** 0.5–1 mg elemental Zn/kg/24 hr PO ÷ once daily–TID**Adult:** 25–50 mg elemental Zn/dose (100–220 mg Zn sulfate/dose) PO TID**Wilson disease:****Child (≥ 10 yr):** 75 mg/24 hr elemental Zn PO ÷ TID; if needed, may increase to 150 mg/24 hr elemental Zn PO ÷ TID**U.S. RDA:** See Chapter 21.

For supplementation in parenteral nutrition, see Chapter 21.

Nausea, vomiting, GI disturbances, leukopenia, and diaphoresis may occur. Gastric ulcers, hypotension, and tachycardia may occur at high doses. Patients with excessive losses (burns) or impaired absorption require higher doses. Therapeutic levels: 70–130 mCg/dL.



Parenteral products may contain aluminum; use with caution in renal impairment. May decrease the absorption of penicillamine, tetracycline, and fluoroquinolones (e.g., ciprofloxacin). Drugs that increase gastric pH (e.g., H₂ antagonists and proton pump inhibitors) can reduce the absorption of zinc. Excessive zinc administration can cause copper deficiency.

Approximately 20%–30% of oral dose is absorbed. Oral doses may be administered with food if GI upset occurs. Pregnancy category is “A” for zinc acetate and “C” for all other salt forms.

ZOLMITRIPTAN

Zomig, Zomig ZMT, and generics

Antimigraine agent, selective serotonin agonist

C



3



Yes



Yes



No

Tabs:**Zomig and generics:** 2.5 mg (scored), 5 mg**Oral disintegrating tabs (ODT):****Zomig ZMT and generics:** 2.5, 5 mg; contains aspartame**Nasal spray:****Zomig:** 2.5 mg single unit nasal spray (6s), 5 mg single unit nasal spray (6s)

ZOLMITRIPTAN *continued*

Treatment of acute migraines with or without aura:

Nasal (Safety of an average of > 4 headaches in a 30-day period has not been established; see remarks):

≥ 12 yr and adult: Start with 2.5 mg inhaled into a single nostril \times 1. If needed in 2 hr, a second dose may be administered. Dose may be increased to a **maximum** single dose of 5 mg if needed.

Max. daily dose: 10 mg/24 hr.

Patients receiving concurrent cimetidine: Limit maximum doses to 2.5 mg as the **max. single dose** and **do not exceed** 5 mg in any 24 hr period.

Oral (Safety and efficacy in children have not been established with the oral route. One randomized placebo-controlled trial in 696 adolescents 12–17 yr old did not establish efficacy and had similar adverse events as seen in adult trials):

Adult (Safety of an average of > 3 headaches in a 30-day period has not been established; see remarks):

PO tabs: Start with 1.25–2.5 mg PO \times 1. If needed in 2 hr, a second dose may be administered. Dose may be increased to a **maximum** single dose of 5 mg if needed. **Max. daily dose:** 10 mg/24 hr.

ODT tabs: Use the same dosage recommendation for PO tabs but with a 2.5 mg initial dose.

Patients receiving concurrent cimetidine: Limit **maximum** doses to 2.5 mg as the **max. single dose** and **do not exceed** 5 mg in any 24 hr period for both PO and ODT tabs.

Contraindicated in ischemic bowel disease; ischemic coronary artery disease; uncontrolled hypertension; peripheral vascular disease; history of stroke or TIA, arrhythmias, hemiplegic, or basilar migraine; significant cardiovascular disease; and coronary artery vasospasm.

Do not administer with any ergot-containing medications, any other 5-HT1 agonist (e.g., triptans), methylene blue, or within 2 wk of discontinuing a MAO inhibitor or linezolid. Cimetidine may increase the zolmitriptan levels; see dosage section for reduced maximum dosage. Patients with multiple cardiovascular risk factors and negative cardiovascular evaluation should have their first dose administered in a medically supervised facility.

Use **not recommended** in moderate/severe hepatic impairment. Severe renal impairment (CrCl 5–25 mL/min) reduces zolmitriptan clearance by 25%.

Common adverse reactions for all dosage forms unless otherwise indicated include nausea, taste alteration (nasal route), xerostomia, dizziness, hyperesthesia (nasal route), paresthesia, somnolence, sensation of hot and cold, throat pain, and asthenia (oral route). Hypertension, coronary artery spasm, MI, cerebral hemorrhage, and headaches have been reported.

For intranasal use, blow nose gently prior to dosing. Block opposite nostril while administering dose by breathing in gently.

When using the ODT, place the whole tablet on the tongue, allow the tablet to dissolve, and swallow with saliva. Administration with liquids is optional. **Do not** break the ODT tablet.

ZONISAMIDE

Zonegran and generics

Anticonvulsant

C

3

Yes

Yes

No

Caps: 25, 50, 100 mg

Oral syrup: 10 mg/mL

Infant and child (data is incomplete):

Suggested dosing from a review of Japanese open-label studies for partial and generalized seizures: Start with 1–2 mg/kg/24 hr PO \div BID. Increase dosage by 0.5–1 mg/kg/24 hr

Q2 wk to the usual dosage range of 5–8 mg/kg/24 hr PO \div BID.

ZONISAMIDE *continued*

Infant and child (data is incomplete; cont.):

Recommended higher alternative dosing: Start with 2–4 mg/kg/24 hr PO ÷ BID–TID. Gradually increase dosage PRN at 2-wk intervals to 4–8 mg/kg/24 hr; **max. dose:** 12 mg/kg/24 hr.

Infantile spasms (regimen that was effective in a small study from Japan; additional studies needed): Start with 2–4 mg/kg/24 hr PO ÷ BID. Then increase by 2–5 mg/kg/24 hr every 2–4 day until seizures disappear, up to a **maximum** of 20 mg/kg/24 hr.

> 16 yr–adult:

Adjunctive therapy for partial seizures: 100 mg PO once daily × 2 wk. Dose may be increased to 200 mg PO once daily × 2 wk. Additional dosage increments of 100 mg/24 hr can be made at 2-wk intervals to allow attainment of steady-state levels. Effective doses have ranged from 100–600 mg/24 hr ÷ once daily–BID (BID dosing may provide better efficacy). No additional benefit has been shown for doses > 400 mg/24 hr.

Because zonisamide is a sulfonamide, it is **contraindicated** in patients allergic to sulfonamides (may result in Stevens-Johnson syndrome or TEN). Common side effects of drowsiness, ataxia, anorexia, gastrointestinal discomfort, headache, rash, and pruritis usually occur early in therapy and can be minimized with slow dose titration. Children are at increased risk for hyperthermia and oligohydrosis, especially in warm or hot weather. Suicidal behavior or ideation, acute pancreatitis, urolithiasis, metabolic acidosis (more frequent and severe in younger patients), DRESS/multi-organ hypersensitivity, rhabdomyolysis, and elevated creatinine phosphokinase have been reported.

Although not fully delineated, therapeutic serum levels of 20–30 mg/L have been suggested as higher rates of adverse reactions have been seen at levels > 30 mg/L.

Zonisamide is a CYP 450 3A4 substrate. Phenytoin, carbamazepine, and phenobarbital can decrease levels of zonisamide.

Use with caution in renal or hepatic impairment; slower dose titration and more frequent monitoring is recommended. **Do not use** if GFR is <50 mL/min. **Avoid** abrupt discontinuation or radical dose reductions. Swallow capsules whole and **do not** crush or chew.



Chapter 31

Drugs in Renal Failure

Elizabeth A.S. Goswami, PharmD and Namrata Trivedi, PharmD

I. DOSE ADJUSTMENT METHODS

A. Maintenance Dose

In patients with renal insufficiency, the dose may be adjusted using the following methods:

1. **Interval extension (I):** Lengthen intervals between individual doses, keeping dose size normal. For this method, a suggested interval is shown.
2. **Dose reduction (D):** Reduce number of individual doses, keeping interval between doses normal; recommended when relatively constant blood level of drug is desired. For this method, percentage of usual dose is shown. For some medications and indications, specific dosing is provided.
3. **Interval extension and dose reduction (DI):** Both lengthen interval and reduce dose.
4. **Interval extension or dose reduction (D, I):** In some instances, either dose or interval can be changed.

NOTE: These dose adjustment methods do not apply to patients in the neonatal period. For neonatal renal dosing, please consult a neonatal dosage reference (see [Chapter 18](#)). Dose modifications given are only approximations and may not be appropriate for all patients or indications. **Each patient must be monitored closely for signs of drug toxicity, and serum levels must be measured when available; drug doses and intervals should be adjusted accordingly.** When in doubt, always consult a nephrologist or pharmacist who has expertise in renal dosing.

B. Dialysis

General recommendations are provided when available. However, factors such as patient age, indication for use, residual native kidney function, specific peritoneal dialysis (PD) or intermittent hemodialysis (IHD) settings, etc., will affect the medication dosing needs of each individual patient.

Consult with a nephrologist or pharmacist who is familiar with medication dosing in dialysis prior to prescribing medications for a dialysis patient.

II. ANTIMICROBIALS REQUIRING ADJUSTMENT IN RENAL FAILURE (Table 31.1)

TABLE 31.1

ANTIMICROBIALS REQUIRING ADJUSTMENT IN RENAL FAILURE¹⁻⁵

Drug	Pharmacokinetics				Adjustments in Renal Failure		
	Route of Excretion ^a	Normal t _{1/2} (hr)	Normal Dose Interval	Method	eGFR (mL/min/1.73 m ²)	Percentage of Usual Dose	Interval
Acyclovir (IV)	Renal (60%–90%)	2–3	Q8 hr	D, I	25–50	100%	Q12 hr
					10–25	100%	Q24 hr
					<10/IHD ^b /PD	50%	Q24 hr
Amantadine Note: On day 1, give normal dose, then decrease subsequent doses based on renal function.	Renal (80%–90%)	10–30	Q12–24 hr	D, I	30–50	50%	Q24 hr
					15–29	50%	Q48 hr
					<15/IHD/PD	100%	Q7 days
Amikacin	Renal (>95%)	1.5–3	Q8–12 hr	I	<60/IHD/PD	Administer a standard one-time dose. Determine the appropriate interval for redosing based on serum concentrations. For IHD, redose based on concentrations.	
Amoxicillin Note: Do not administer 875 mg immediate release or 775 mg extended release tablets with eGFR <30 mL/min/1.73 m ² .	Renal (60%)	1–2	Q8–12 hr	D, I	10–30	50–100%	Q12 hr
					<10/IHD ^b /PD	50–100%	Q24 hr
Amoxicillin/clavulanate	Renal (60%/25%–40%)	1–2/1	Q8–12 hr	D, I	10–30	50%–100%	Q12 hr
Note: Do not administer 875 mg immediate release or 1000 mg XR extended release tablet with eGFR <30 mL/min/1.73 m ² .					<10/IHD ^b /PD	50%–100%	Q24 hr

Continued

Amphotericin B	Renal (40%)	Initial: 12–25 Terminal: 15 days	Q24 hr		No guidelines established.		
Amphotericin B lipid complex (Abelcet)	Renal (1%)	Terminal: 7 days	Q24 hr		No guidelines established.		
Amphotericin B, liposomal (AmBisome)	Renal (10%)	Initial: 7–10 Terminal: 4–6 days	Q24 hr		No guidelines established.		
Ampicillin (IV)	Renal (90%)	1–2	Q4–6 hr	I	10–30 <10/IHD ^d /PD	100% 100%	Q8 hr Q12 hr
Ampicillin/sulbactam	Renal (90%/ 75%–85%)	1–2/1	Q4–6 hr	I	15–29 <15/IHD ^d /PD	100% 100%	Q12 hr Q24 hr
Aztreonam Note: Administer full dose for initial dose, then adjust subsequent doses for kidney function.	Renal (60%–70%) (hepatic)	1–2	Q6–8 hr	DI	10–30 <10/IHD/PD	50%–66% 25%–33%	Q8 hr Q12 hr
						IHD: Administer 12% of the full dose as an additional supplemental dose after dialysis in severe infections. ⁶	
Cefaclor	Renal (80%)	0.5–1	Q8–12 hr	D	<10/IHD ^d /PD	50%	Q8–12 hr
Cefadroxil	Renal (>90%)	1–2	Q12 hr	I	10–25/IHD ^b <10/PD	100% 100%	Q24 hr Q36 hr
Cefazolin Note: Administer full dose for initial dose, then adjust subsequent doses for kidney function.	Renal (80%–100%)	1.5–2	Q8 hr	DI	11–30 ≤10/IHD ^b /PD	25 mg/kg 25 mg/kg	Q12 hr Q24 hr

TABLE 31.1**ANTIMICROBIALS REQUIRING ADJUSTMENT IN RENAL FAILURE—cont'd**

Drug	Pharmacokinetics			Adjustments in Renal Failure			
	Route of Excretion ^a	Normal t _½ (hr)	Normal Dose Interval	Method	eGFR (mL/min/1.73 m ²)	Percentage of Usual Dose	Interval
Cefdinir	Renal (10%–20%)	1–2	Q12–24 hr	D, I	<30 IHD ^d /PD	7 mg/kg (max 300 mg) 7 mg/kg (max 300 mg)	Q24 hr Q48 hr
Cefepime	Renal (85%)	2	Q8 hr	D, I	30–60 10–29 <10/PD/HD	100% 100% 50%	Q12 hr Q24 hr Q24 hr
Note: Administer full dose for initial dose, then adjust subsequent doses for kidney function.							
Cefixime ^c	Renal (50%)/ (biliary)	3–4	Q12–24 hr	D	21–60/IHD <20/PD	65% 45%	Q12–24 hr Q12–24 hr
Cefotaxime	Renal (60%)	1–1.5	Q6–8 hr	I	30–50 10–29 <10/IHD ^b /PD	100% 100% 100%	Q8–12 hr Q12 hr Q24 hr
Cefotetan	Renal (50%–80%) (biliary)	3–4.5	Q12 hr	D, I	10–30 <10/IHD ^d /PD	50% 50%	Q12 hr Q24 hr
Cefoxitin	Renal (85%)	0.75–1	Q4–8 hr	I	30–50 10–30 <10/IHD ^b /PD	100% 100% 100 %	Q8 hr Q12 hr Q24 hr
Cefpodoxime	Renal (30%)	2–3	Q12 hr	I	<30 IHD	100% Administer thrice weekly after dialysis sessions	Q24 hr
Cefprozil	Renal (60%)	1.5	Q12–24 hr	D	<30/IHD ^b /PD	50%	Q12–24 hr

Continued

Ceftaroline ^c	Renal (88%)	1.5–2.5	Q8–12 hr	D, I	31–50 15–30 <15 IHD ^b	66% 50% 33% 33%	Q8–12 hr Q8–12 hr Q8–12 hr Q12 hr
Ceftazidime	Renal (80%–90%)	1–2	Q8 hr	D, I	30–50 10–30 <10/IHD ^b /PD	100% 100% 50%	Q12 hr Q24 hr Q24 hr
Note: Administer full dose for initial dose, then adjust subsequent doses for kidney function. ³							
Ceftibuten	Renal (60%)	2–2.5	Q24 hr	D	30–49 5–29 IHD	50% 25% 100%	Q24 hr Q24 hr After each dialysis session.
Cefuroxime (IV)	Renal (>90%)	1.5–2	Q8 hr	I	10–29 <10/IHD ^d /PD	100% 100%	Q12 hr Q24 hr
Cephalexin	Renal (>90%)	0.5–2.5	Q6–12 hr	I	30–50 10–29 <10/IHD ^b /PD	100% 100% 100%	Q8 hr Q12 hr Q24 hr
Ciprofloxacin	Renal (30%–50%) (hepatic)	3–5	Q8–12 hr	I	10–29 <10/IHD ^b /PD	100% 100%	Q18 hr Q24 hr

TABLE 31.1**ANTIMICROBIALS REQUIRING ADJUSTMENT IN RENAL FAILURE—cont'd**

Drug	Pharmacokinetics			Adjustments in Renal Failure			
	Route of Excretion ^a	Normal t _½ (hr)	Normal Dose Interval	Method	eGFR (mL/min/1.73 m ²)	Percentage of Usual Dose	Interval
Clarithromycin	Renal (20%–40%) (hepatic)	3–7	Q12 hr	D, I	<30 <10/IHD ^b /PD ≤30/IHD/PD	50% 50% 50%	Q12 hr Q24 hr Q12–24 hr
Ertapenem ^c	Renal (80%) (hepatic)	2.5–4	Q12–24 hr	D	IHD: If administered within 6 hr before dialysis, administer 30% of the daily dose as a supplemental dose after dialysis		
Erythromycin	Hepatic (renal [\leq 15%])	1.5–2	Q6–12 hr	D	<10/IHD/PD	50%–75%	Q6–12 hr
Ethambutol ⁷	Renal (50%) (hepatic)	2.5–3.5	Q24 hr	I	<30, IHD ^b PD	100% Data are not available. Begin with IHD dosing. Monitor closely and consider therapeutic drug monitoring ⁷	3 times weekly

Famciclovir ^c	Renal (73%) (hepatic)	Penciclovir: 2–3	Q8 hr	D, I	Herpes Zoster Treatment^c	
					40–59	500 mg
					20–39	500 mg
					<20	250 mg
					IHD	250 mg
						Q12 hr
						Q24 hr
						Q24 hr
						After each dialysis session
					Recurrent Genital Herpes Treatment—Single Day Regimen^c	
					40–59	500 mg
					20–39	500 mg
					<20	250 mg
					IHD	250 mg
						Q12 hr ×1 day
						Once
						Once
						Once after dialysis
					Recurrent Genital Herpes Suppression^c	
					20–39	125 mg
					<20	125 mg
					IHD	125 mg
						Q12 hr
						Q24 hr
						After each dialysis session
					Recurrent Herpes Labialis—Single Dose Regimen^c	
					40–59	750 mg
					20–39	500 mg
					<20	250 mg
					IHD	250 mg
						Once
						Once
						Once
						Once after dialysis
					Recurrent Orolabial or Genital Herpes in HIV-Infected Patients^c	
					20–39	500 mg
					<20	250 mg
					IHD	250 mg
						Q24 hr
						Q24 hr
						After each dialysis session

Continued

TABLE 31.1**ANTIMICROBIALS REQUIRING ADJUSTMENT IN RENAL FAILURE—cont'd**

Drug	Pharmacokinetics			Adjustments in Renal Failure			
	Route of Excretion ^a	Normal t _½ (hr)	Normal Dose Interval	Method	eGFR (mL/min/1.73 m ²)	Percentage of Usual Dose	Interval
Fluconazole	Renal (80%)	20–25	Q24 hr	D, I	10–50 <10/PD IHD	50% 50% 100%	Q24 hr Q48 hr After each dialysis session
Flucytosine ⁸ Note: If available, therapeutic drug monitoring should be used to guide optimal dosing. Avoid flucytosine in children with severe kidney impairment. ⁹	Renal (90%)	3–8	Q6 hr	I	20–40 10–20 <10/PD IHD	100% 100% 100% 100%	Q12 hr Q24 hr Q48 hr After each dialysis session
Foscarnet	Renal (80%–90%)	Plasma: 3–4 Terminal: 88	Induction: Q8 h Maintenance: Q24 hr	D, I	See package insert for adjustments for induction and maintenance. ¹⁰		
Ganciclovir	Renal (>80%)	2.5–3.5	Induction: Q12 hr Maintenance: Q24 hr	D, I	Induction IV 50–69 25–49 10–24 <10/PD/IHD ^b	2.5 mg/kg 2.5 mg/kg 1.25 mg/kg 1.25 mg/kg	Q12 hr Q24 hr Q24 hr Thrice weekly

Continued

							Maintenance IV	
							50–69	2.5 mg/kg Q24 hr
							25–49	1.25 mg/kg Q24 hr
							10–24	0.625 mg/kg Q24 hr
							<10/PD/IHD ^b	0.625 mg/kg Thrice weekly
Gentamicin	Renal (70%)	1.5–3	Q8–12 hr	I	<50/IHD/PD	Administer standard initial dose. Determine appropriate interval for redosing based on serum concentrations.		
Imipenem/cilastatin ^c Note: Patients with eGFR ≤15 should not receive imipenem/cilastatin unless dialysis will be initiated within 48 hr. ¹¹	Renal (70%)	1	Q6 hr	D, I	60–89 30–59 10–29 <10/IHD ^b /PD	75% 50% 50% 50%	Q8 hr Q6 hr Q12 hr Q24 hr	
Isoniazid	Renal (75%–95%) (hepatic)	Slow acetylator: 2–5 Fast acetylator: 0.5–1.5	Q24 hr		IHD ^b	100%	Q24 hr	
Lamivudine ^{12,c} Note: Administer full dose for initial dose, then adjust subsequent doses for kidney function. If eGFR <5 or IHD, administer 50% of full dose as initial dose.	Renal	2	Q12 hr	D, I	30–49 15–29 5–14 <5/IHD ^b /PD	100% 66% 33% 17%	Q24 hr Q24 hr Q24 hr Q24 hr	

TABLE 31.1**ANTIMICROBIALS REQUIRING ADJUSTMENT IN RENAL FAILURE—cont'd**

Drug	Pharmacokinetics			Adjustments in Renal Failure			
	Route of Excretion ^a	Normal t _½ (hr)	Normal Dose Interval	Method	eGFR (mL/min/1.73 m ²)	Percentage of Usual Dose	Interval
Levofloxacin Note: Administer full dose for initial dose, then adjust subsequent doses for kidney function.	Renal (90%)	5–8	Q12	I	10–29	100%	Q24 hr
				D, I	<10/IHD/PD	100%	Q48 hr
		1–1.5	Q8 hr	I	10–29	100%	Q48h
				D	<10/IHD/PD	67%	Q48h
Meropenem	Renal (70%)	1–1.5	Q8 hr	D, I	30–50	100%	Q12 hr
					10–29	50%	Q12 hr
					<10/IHD ^b /PD	50%	Q24 hr
Metronidazole	Hepatic [renal (15%)]	6–12	Q6–12 hr	D	<10	Renally eliminated metabolites may accumulate and lead to adverse events. Monitor patient. Some recommend a dose of 4 mg/kg at standard intervals. ^{1,2}	
					IHD ^d	4 mg/kg	Q6 hr
					PD	4 mg/kg	Q6 hr
Norfloxacin ^c	Hepatic (renal [30%])	3–4	Q12 hr	I	<30	100%	Q24 hr

Oseltamivir ^c	Oseltamivir carboxylate: Renal (>99%)	Oseltamivir carboxylate: 6–10	Q12–24 hr	D, I	Influenza Treatment		
	31–60	50%			Q12 hr	Q24 hr	Once, then after each dialysis session
	11–30	50%					
	<10/IHD	25–40%					
	PD	50%			Once		
	Influenza Prophylaxis						
	31–60	50%			Q24 hr		
	10–30	50%			Q48 hr		
	<10	No recommended dosage regimen.					
	IHD	50%			Once, then after every other dialysis session		
	PD	50%			Weekly for duration of prophylaxis		

Continued

TABLE 31.1**ANTIMICROBIALS REQUIRING ADJUSTMENT IN RENAL FAILURE—cont'd**

Drug	Pharmacokinetics			Adjustments in Renal Failure			
	Route of Excretion ^a	Normal t _½ (hr)	Normal Dose Interval	Method	eGFR (mL/min/1.73 m ²)	Percentage of Usual Dose	Interval
Penicillin G—aqueous (K ⁺ , Na ⁺) (IV) Note: Administer full dose for initial dose, then adjust subsequent doses for kidney function.	Renal (60%–85%) (hepatic)	0.5–1.2 hr	Q4–6 hr	D	10–50 <10/IHD ^b /PD	75% 50%	Q4–6 hr Q4–6 hr
Penicillin V K ⁺ (PO)	Renal (20–40%) (hepatic)	0.5 hr	Q6–8 hr	I	<10/IHD ^b /PD	100%	Q8 hr
Pentamidine ²	Renal	5–9	Q24 hr	I	10–30 <10/IHD ^b /PD	100% 100%	Q36 hr Q48 hr
Piperacillin/tazobactam ^{1,2}	Renal (75%–90%/>80%)	0.7–1/0.7–1.5	Q6 hr	D, I	20–40 <20 IHD ^b /PD	70% 70% 70%	Q6 hr Q8 hr Q8–12 hr
Posaconazole	Fecal (Renal)	24–36	Oral suspension: Q8h Oral extended release, IV: Q12–24 hr	NA	<50	Consider risks and benefits of use of the IV product as solubilizing agent may accumulate. With PO products, exposure may vary, and breakthrough infections may occur.	

Rifabutin	Metabolites: Renal (50%) (hepatic)	35–45	Q24 hr	D	<30	50%–100%	Q24 hr
Streptomycin sulfate ^c Note: Determine appropriate interval for redosing based on serum concentration when available.	Renal (30%–90%)	2–5	Q24 hr	I	10–50 <10 IHD/PD	100% 100% 100%	Q24–72 hr Q48–96 hr. Administer 2–3 times weekly after dialysis
Sulfamethoxazole/trimethoprim	Renal (85%)/Renal (65%)	Sulfamethoxazole: 9–12 Trimethoprim: 3–8	Q8–12 hr	D	<30, IHD ^b /PD	50%	Q8–12 hr
Tetracycline ^{a,b}	Renal (30%–60%) (hepatic)	6–12	Q6 hr	I	50–80 10–50 <10	100% 100% 100%	Q8–12 hr Q12–24 hr Q24 hr
Tobramycin	Renal (>90%)	1.5–3	Q8–24 hr	I	<60	Administer standard initial dose. Determine appropriate interval for redosing based on serum concentrations.	

Continued

TABLE 31.1**ANTIMICROBIALS REQUIRING ADJUSTMENT IN RENAL FAILURE—cont'd**

Drug	Route of Excretion ^a	Pharmacokinetics			Adjustments in Renal Failure		
		Normal t _½ (hr)	Normal Dose Interval	Method	eGFR (mL/min/1.73 m ²)	Percentage of Usual Dose	Interval
Valacyclovir Note: For IHD for all indications, dose for eGFR <10 and administer dose after dialysis. For PD for all indications, administer 500 mg Q48 hr. ⁴	Hepatic to acyclovir.	Valacyclovir: ~30 min Acyclovir: 2–3	Q8–24 hr	D, I	Herpes Zoster (Adults) 30–49 10–29 <10	100% 100% 50%	Q12 hr Q24 hr Q24 hr
					Genital Herpes (Adolescents/Adults): Initial Episode 10–29 <10	100% 50%	Q24 hr Q24 hr
					Genital Herpes (Adolescents/Adults): Recurrent Episode <30	100%	Q24 hr
					Genital Herpes (Adolescents/Adults): Suppressive <30	500 mg OR 500 mg	Q24 hr (for usual dose of 1 g Q24 hr) Q48 hr (for usual dose of 500 mg Q24 hr)
					Herpes Labialis (Adolescents/Adults) 30–49 10–29 <10	50% 25% 25%	Q12 hr ×2 doses Q12 hr ×2 doses Single dose

Valganciclovir	Ganciclovir: Renal (>80%)	Valganciclovir: Ganciclovir:	Q12–24 hr 2.5–3.5	D, I	Children Normal dosing accounts for kidney function: Once daily dose (mg) = 7 × body surface area × creatinine clearance. Adults—Induction
Note: For dosing in children, a maximum eGFR value of 150 mL/min/1.73 m ² should be used to calculate the dose. Calculate eGFR using modified Schwartz formula where k = 0.33 in infants aged <1 year, with low birth weight for gestational age, 0.45 in infants aged <1 year, with birth weight appropriate for gestational age, 0.45 in children aged 1 to <2 years, 0.55 in boys aged 2 to <13 years and girls aged 2 to <16 years, and 0.7 in boys aged 13–16 years. Consider use of k = 0.413 when enzymatic creatinine assays are used.					40–59 450 mg Q12 hr 25–39 450 mg Q24 hr 10–24 450 mg Q48 hr <10/IHD ^b (limited data-consider 200 mg Thrice weekly ganciclovir)
					Adults—Maintenance 40–59 450 mg Q24 hr 25–39 450 mg Q48 hr 10–24 450 mg Twice weekly <10/IHD ^b (limited data-consider 200 mg Thrice weekly ganciclovir)

Continued

TABLE 31.1**ANTIMICROBIALS REQUIRING ADJUSTMENT IN RENAL FAILURE—cont'd**

Drug	Pharmacokinetics			Adjustments in Renal Failure			
	Route of Excretion ^a	Normal $t_{1/2}$ (hr)	Normal Dose Interval	Method	eGFR (mL/min/1.73 m ²)	Percentage of Usual Dose	Interval
Vancomycin	Renal (80%–90%)	2.2–8	Q6–12 hr	I	<50	Administer standard initial dose. Determine appropriate interval for redosing based on serum concentrations.	
					IHD/PD	Administer standard initial dose. Obtain serum concentration after dialysis to determine need to redose. Obtain levels 4–6 hr after dialysis to allow for redistribution from peripheral compartment. If patient is unstable, may obtain sooner with knowledge that concentration may be lower than steady state.	

^aPercentage in parenthesis represents the amount of drug and/or metabolites excreted in the urine. Route in parentheses indicates secondary route of excretion.

^bFor IHD administer after dialysis on dialysis days.

^cIn adults; guidelines not established in children.

^dAdminister a supplemental dose after dialysis

D, Dose reduction; eGFR, estimated glomerular filtration rate; HIV, human immunodeficiency virus; hr, hour; I, interval extension; IHD, intermittent hemodialysis; IM, intramuscular; IV, intravenous; K⁺, potassium; NA, not applicable; Na⁺, sodium; PD, peritoneal dialysis; PO, oral; Q, every; $t_{1/2}$, half-life with normal renal function.

III. NONANTIMICROBIALS REQUIRING ADJUSTMENT IN RENAL FAILURE (Table 31.2)

TABLE 31.2

NONANTIMICROBIALS REQUIRING ADJUSTMENT IN RENAL FAILURE^{1–5}

Drug	Pharmacokinetics			Adjustments in Renal Failure			
	Route of Excretion ^a	Normal $t_{1/2}$ (hr)	Normal Dose Interval	Method	eGFR (mL/min/1.73 m ²)	Percentage of Usual Dose	Interval
Acetaminophen	Hepatic	2–4	Q4–6 hr	I	10–50 <10/IHD/PD	100% 100%	Q6 hr Q8 hr
Acetazolamide	Renal (>70%)	2.4–5.8	Q6–24 hr	I	10–50 IHD ^b	100% 12.5%—titrate to effect Avoid use	Q12 hr Q12–24 hr
Allopurinol	Renal	1–3	Q6–24 hr	D	10–50 <10/IHD/PD	50% 30%	Q6–24 hr Q6–24 hr
Aminocaproic acid	Renal (76%)	1–2	Q4–6 hr, continuous	D	Oliguria/ESRD	12%–25%	Q4–6 hr, continuous
Aspirin	Hepatic (renal)	Dose dependent: 3–10	Q4–24 hr	I	10–50 IHD ^b <10/PD	100% 100% Avoid use for analgesia and antiinflammatory indications	Q4–24 hr Q24 hr
Atenolol	Renal (50%)	3.5–7	Q12–24 hr	D, I	15–35 <15/IHD ^b /PD	1 mg/kg up to 50 mg 1 mg/kg up to 25 mg	Q24 hr Q48 hr
Azathioprine	Hepatic to 6-mercaptopurine (renal)	2	Q24 hr	D	10–50 <10/IHD ^b /PD	75% 50%	Q24 hr Q24 hr

Continued

TABLE 31.2**NONANTIMICROBIALS REQUIRING ADJUSTMENT IN RENAL FAILURE—cont'd**

Drug	Pharmacokinetics			Adjustments in Renal Failure				
	Route of Excretion ^a	Normal t _{1/2} (hr)	Normal Dose Interval	Method	eGFR (mL/min/1.73 m ²)	Percentage of Usual Dose	Interval	
Bismuth subsalicylate	Hepatic (renal)	Salicylate: 2–5 Bismuth: 21–72 days	Q3–4 hr		Avoid use in patients with renal failure.			
Bosentan	Hepatic (renal)	5	Q12 hr		Dose adjustment not required. Significant clearance by dialysis is not expected.			
Calcium supplements	GI (renal [20%])	Variable	Variable		<25	May require dosage adjustment depending on calcium level.		
Captopril	Renal (95%) (hepatic)	1.5–2	Q6–24 hr	D	10–50 <10/IHD ^b /PD	75% 50%	Q6–24 hr Q6–24 hr	
Carbamazepine	Hepatic (renal)	Initial: 25–65 Subsequent: 8–17	Q6–12 hr	D	<10/IHD ^b /PD	75%	Q6–12 hr	
NOTE: Avoid use of IV product in moderate to severe kidney dysfunction. Solubilizing agent may accumulate and lead to toxicity.								
Cetirizine ²	Renal (70%) (hepatic)	6–8	Q12–24 hr	D	10–29/IHD/PD ≤10	50% Use not recommended.	Q24 hr	
Chloroquine	Renal (70%) (hepatic)	3–5 days	Weekly	D	<10/IHD/PD	50%	Weekly	
Chlorothiazide	Renal (>90%)	0.75–2	Q12–24 hr	NA	<30 <10	May be ineffective. Use not recommended.		

Continued

Cimetidine	Renal (50%) (hepatic)	1.5–2	Q6–12 hr	D, I	10–50 <10/IHD ^b /PD	50% 100%	Q6–12 hr Q8–12 hr
Clobazam	Renal (82%) (Hepatic, GI)	Children: 16 Adults: 36–42	Q12–24 hr	D	<30	Use with caution; has not been studied.	
Desloratadine ^c	Renal (87%) (GI)	27	Q24 hr	I	<50	100%	Q48 hr
Digoxin	Renal (50%–70%) (GI)	18–48		D, I	Digitalizing Dose ESRD	50%	NA
					Maintenance Dose 30–50	75%	Q12–24 hr
					10–29	50%	Q12–24 hr
					OR 100%	Q36 hr	
					<10/IHD/PD	25%	Q12–24 hr
					OR 100%	Q48 hr	
Disopyramide ^c	Renal (40%–60%) (GI)	3–10	Q6 hr	I	30–40	100%	Q8 hr
					15–30	100%	Q12 hr
					<15	100%	Q24 hr

TABLE 31.2**NONANTIMICROBIALS REQUIRING ADJUSTMENT IN RENAL FAILURE—cont'd**

Drug	Pharmacokinetics			Adjustments in Renal Failure			
	Route of Excretion ^a	Normal t _{1/2} (hr)	Normal Dose Interval	Method	eGFR (mL/min/1.73 m ²)	Percentage of Usual Dose	Interval
EDTA calcium disodium ^c Note: Do not administer in patients with anuria or severe oliguria.	Renal	1.5 (IM) 0.3–1 (IV)	IM: Q8–12 hr IV: Q24 hr	D, I	IV: Adult Serum Creatinine-Based Dosing ≤2 mg/dL 2–3 mg/dL 3–4 mg/dL >4 mg/dL	1 g/m ² 500 mg/m ² 500 mg/m ² 500 mg/m ²	Q24 hr × 5 days Q24 hr × 5 days Q48 hr × 3 doses Once weekly
Enalapril (IV: enalaprilat)	Renal (60%–80%) (hepatic)	1.5–6 (PO) 5–20 (IV)	Q6–24 hr	D	10–50 <10	75% 50%	Q6–24 hr Q6–24 hr
					Manufacturer does not recommend in infants and children aged ≤16 years with GFR <30 mL/min/1.73 m ² .		
Enoxaparin ^c	Renal (40%)	4.5–7	Q12–24 hr	I	<30 IHD/PD	100% Serious bleeding complications may occur in this population. Avoid use. If used, reduce dose and monitor anti-Xa activity. ⁵	Q24 hr
Epoprostenol	Hydrolyzed to renally eliminated metabolites (85%)	6 min	Continuous infusion	D	Manufacturer does not recommend renal dose reduction. Titrate to clinical effect.		
Famotidine	Renal (70%)	2–3	Q12–24 hr	D, I	30–50 10–29 <10/IHD/PD	100% 50% 25%	Q24 hr Q24 hr Q24 hr

Continued

Felbamate ^c	Renal (50%)	20–30	Q6–8 hr	D	<50	50%	Q6–8 hr
Fentanyl	Hepatic (renal [75%])	Single dose: 2–4 Prolonged infusion: 21	Q30 min–1 hr, continuous Patch: Q72 hr	D	Injection <50 Patch Mild–moderate impairment Severe impairment	Manufacturer does not recommend dose reduction. Titrate to clinical effect.	
						Initial dose: 50%	Q72 hr
Fexofenadine	GI (renal [12%])	14	Q12 hr	I	<50	100%	Q24 hr
Flecainide ^c	Hepatic (Renal [>80%])	8–20	Q8–12 hr	D	<35	50%	Q12 hr
Furosemide	Renal (50%–80%) (hepatic)	0.5	PO: Q6–24 hr IV: Q6–12 hr		Avoid use in oliguria.		
Gabapentin	Renal (>75%) (GI)	5	Q8 hr	D, I	30–59 15–29 <15/IHD ^d /PD	75% 75% 75%	Q12 hr Q24 hr Q48 hr
Hydralazine ^e	Hepatic (renal [14%])	2–8	IV: Q4–6 hr PO: Q6–12 hr	I	10–50 <10/IHD/PD	100% 100%	Q8 hr (fast acetylator) Q8–16 hr Q12–24 hr (slow acetylator)
Iloprost ^c	Renal (70%) [Hepatic]	20–30 min	Q2–4 hr inhalation, continuous inhalation	D, I	<10/IHD/PD	Use with caution; has not been studied.	
Insulin (regular) ^f	Hepatic (renal)	IV: 0.5–1 Subcutaneous: 1.5	Variable	D	10–50 <10/IHD/PD	75% 50%	No change No change

TABLE 31.2**NONANTIMICROBIALS REQUIRING ADJUSTMENT IN RENAL FAILURE—cont'd**

Drug	Pharmacokinetics			Adjustments in Renal Failure		
	Route of Excretion ^a	Normal t _{1/2} (hr)	Normal Dose Interval	Method	eGFR (mL/min/1.73 m ²)	Percentage of Usual Dose
Ivacaftor	Hepatic (>85%)	12	Q12 hr	NA	<30	Use with caution.
Lacosamide ^c	Renal (95%) (GI)	13	Q12 hr	D	<30	Maximum dose: 300 mg/24-hr period
					IHD	Administer 50% dose supplementation after 4-hr dialysis session.
Levetiracetam	Renal (66%)	5–8	Q12 hr	D, I	Children <50 IHD ^{d/e} /PD Adults 50–80 30–50 <30 IHD ^{d/e} /PD	50% 50% 500–1000 mg 250–750 mg 250–500 mg 500–1000 mg
Lisinopril	Renal	11–13	Q24 hr	D	10–50 <10/IHD ^{b/f} /PD	50% 25%
Lithium ¹	Renal (>90%)	18–36	Q8–12 hr	D	10–50 <10 IHD	50–75% 25–50% Dose after dialysis. Doses may vary, use serum concentrations to guide.
Note: Monitor serum concentrations. Due to high volume of distribution, lithium concentrations rebound after dialysis. ²						

Continued

Loratadine	Hepatic (renal 40%)	Loratadine: 8.4 Metabolite: 28	Q24 hr	I	<10/IHD	100%	Q48 hr
Lumacaftor + Ivacaftor	Hepatic (renal)	Lumacaftor: 26 Ivacaftor: 9	Q12 hr	NA	<30	Use with caution.	
Meperidine Note: Accumulation of normeperidine can lead to tremors and seizures. Limit duration to ≤48 hr in all patients. Avoid use in patients with kidney dysfunction. ¹	Renal (hepatic) (normeperidine, renal)	Meperidine: 2.3–4 Normeperidine: 8–20	Q3–4 hr	D	10–50	75%	Avoid use, especially repeat administrations.
					<10	50%	Avoid use, especially repeat administrations.
Methadone	Hepatic (renal [<10%])	20–35	Q6–12 hr	D	<10/IHD/PD	50%–75%	Q6–12 hr
Methyldopa	Hepatic (renal [70%])	1–3	PO: Q6–12 hr IV: Q6–8 hr	I	>50 10–50 <10/IHD ^b /PD	100% 100% 100%	Q8 hr Q8–12 hr Q12–24 hr
Metoclopramide	Renal (85%)	2.5–6	PO: Q6 hr IV: Q6–8 hr	D	30–50 10–30 <10/IHD/PD	75% 50% 25%	No change No change No change

TABLE 31.2**NONANTIMICROBIALS REQUIRING ADJUSTMENT IN RENAL FAILURE—cont'd**

Drug	Pharmacokinetics			Adjustments in Renal Failure			
	Route of Excretion ^a	Normal t _{1/2} (hr)	Normal Dose Interval	Method	eGFR (mL/min/1.73 m ²)	Percentage of Usual Dose	Interval
Midazolam Note: Metabolite α -hydroxymidazolam [>60% as α -hydroxymidazolam] can accumulate in kidney failure, leading to prolonged sedation after midazolam is discontinued. ⁴	Hepatic (renal)	2.5–4.5	Variable	D	<10	50%	No change
Milrinone	Renal (>85%)	1.5–2.5	Continuous infusion	D	50 40 30 20 10 5	0.43 mCg/kg/min 0.38 mCg/kg/min 0.33 mCg/kg/min 0.28 mCg/kg/min 0.23 mCg/kg/min 0.2 mCg/kg/min	
Morphine	Hepatic (renal [5%–15%])	1–8	Variable	D	10–50 <10/IHD/PD	75% 50%	No change No change
Neostigmine	Hepatic (renal [50%])	0.5–2	Variable	D	10–50 <10	50% 25%	No change No change
Oxcarbazepine	Hepatic (Renal)	Oxcarbazepine: 2 MHD metabolite: 9	Q12 hr	D	<30	Initial dose: 50%. Titrate slowly.	Q12 hr
Pancuronium bromide	Renal (40%) (hepatic)	1.5–2.5	Q30–60 min OR continuous infusion	D	10–50 <10/IHD/PD	50% Avoid use.	No change

Phenazopyridine	Renal (65%) (hepatic)	Unavailable	Q8 hr for 2 days	I	50–80 <50	100% Contraindicated	Q8–16 hr
Phenobarbital	Hepatic (renal [20%–50%])	35–140	Q8–12 hr	I	<10/IHD ^b	100%	Q24 hr
Primidone	Hepatic (renal [20%])	Primidone: 10–12 PEMA metabolite: 16 Phenobarbital: 35–140	Q6–12 hr	I	>50 10–50 <10/IHD ^b	100% 100% 100%	Q12 hr Q12–24 hr Q24 hr
Note: Due to complex metabolism, it is preferred to use other options when available for patients with kidney failure. ⁵							
Procainamide	Hepatic (renal [Procainamide 50%, NAPA 80%])	Procainamide: 1.7–4.7 NAPA: 6	PO: Q4–6 hr IV: continuous	D	IV Loading Dose <10 IV Maintenance^c <10 IHD	12 mg/kg Initiate at low end of dosing range and titrate to effect. Monitor levels. Supplementation may be needed.	Once
Quinidine	Renal (15%–25%)	2.5–8	Q6–12 hr	D	<10/IHD ^b /PD	75%	Q6–12 hr
Ranitidine	Renal (30%–70%) (hepatic)	1.5–2.5	PO: Q12 hr IV/IM: Q6–8 hr	D, I	30–50 10–29 <10/IHD ^b /PD	100% 50% 50%	Q12 hr Q12 hr Q24 hr
Sodium phenylacetate and sodium benzoate	Renal	Unavailable	Continuous	D	<50	Use with caution and close monitoring.	

Continued

TABLE 31.2**NONANTIMICROBIALS REQUIRING ADJUSTMENT IN RENAL FAILURE—cont'd**

Drug	Pharmacokinetics			Adjustments in Renal Failure		
	Route of Excretion ^a	Normal t _{1/2} (hr)	Normal Dose Interval	Method	eGFR (mL/min/1.73 m ²)	Percentage of Usual Dose
						Interval
Spironolactone	Renal (hepatic/biliary)	Spironolactone: 1.3–1.4 Metabolite: 13–24	Q6–24 hr	I	30–50 <30	100% Avoid use.
Terbutaline	Renal (60%) (hepatic)	2.9–14	PO: Q8 hr Subcutaneous: Q2–6 hr IV: Continuous	D	<50	Manufacturer does not recommend dose reduction. Use with caution.
Tezacaftor + Ivacaftor	Hepatic (renal)	Tezacaftor: 15 Ivacaftor: 13	Combo product in AM, ivacaftor 12 hr after	NA	<30	Use with caution.
Treprostinil	Renal (80%)	4	Oral: Q8–12 hr SubQ/IV: continuous	D, I	Manufacturer does not recommend dose reduction. Use with caution.	
Triamterene	Hepatic (renal [21%])	1.6–2.5	Q12–24 hr	I	<30	Do not use due to risk of hyperkalemia. ¹
Verapamil	Renal (70%) (hepatic)	2–8	Variable	D	<10	Dose reduction may be needed; use caution. Monitor blood pressure, ECG for PR prolongation, and other signs of overdose.

Vigabatrin	Renal (80%)	5–10	Q12 hr	D	50–80 30–50 10–30	75% 50% 25%	Q12 hr Q12 hr Q12 hr
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^aPercentage in parentheses represents the amount of drug and/or metabolites excreted in the urine. Route in parentheses indicates secondary route of excretion.

^bFor IHD administer after dialysis on dialysis days.

^cIn adults; guidelines not established in children.

^dAdminister supplemental dose after every 4 hours of dialysis, based on daily dose as follows (daily dose/recommended supplemental dose): 100 mg/125 mg; 125 mg/150 mg; 150 mg/200 mg; 200 mg/250 mg; 300 mg/350 mg.

^eDose interval varies for rapid and slow acetylators with normal and impaired renal function.

^fRenal failure may cause hyposensitivity or hypersensitivity to insulin. Empiric dosing recommendations may not be appropriate for all patients; adjust to clinical response and blood glucose.

^gAdminister a supplemental dose after dialysis.

D, Dose reduction; ECG, electrocardiogram; EDTA, ethylenediaminetetraacetic acid; eGFR, estimated glomerular filtration rate; ESRD, end-stage renal disease; GI, gastrointestinal; I, interval extension; IHD, hemodialysis; IM, intramuscular; IV, intravenous; MHD, 10-monohydroxy metabolite; NA, not applicable; NAPA, N-acetylprocainamide; PD, peritoneal dialysis; PO, oral; Q, every; SubQ, subcutaneous; $t_{1/2}$, half-life.

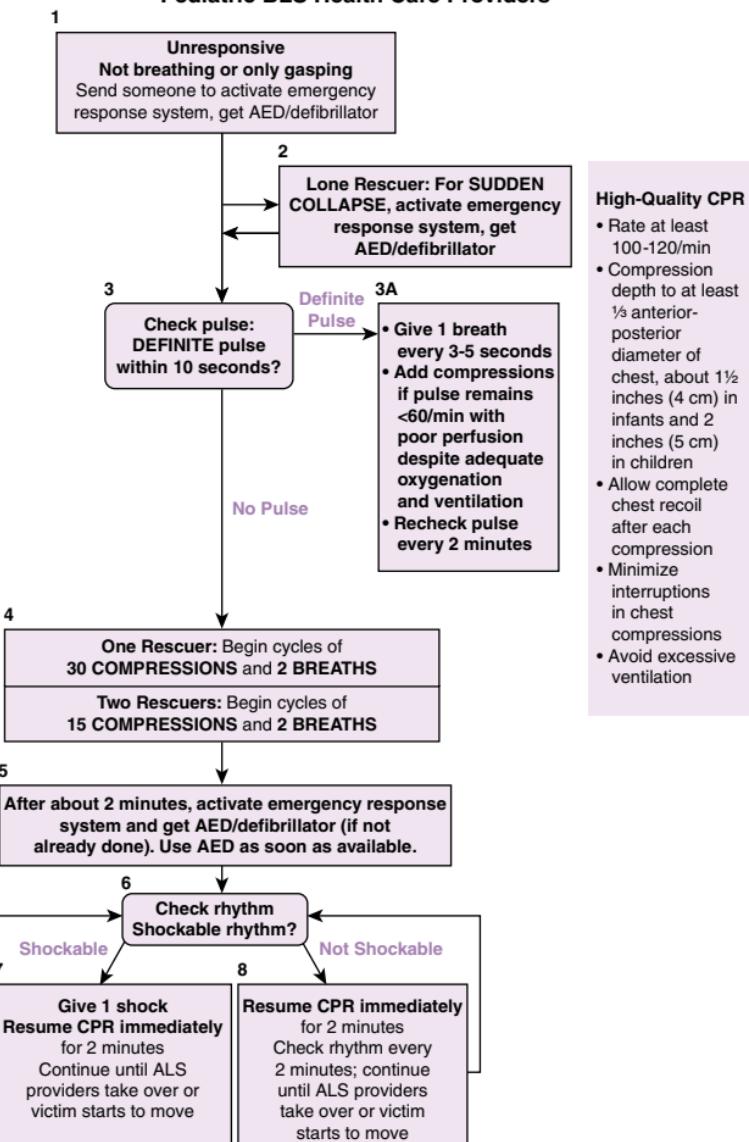
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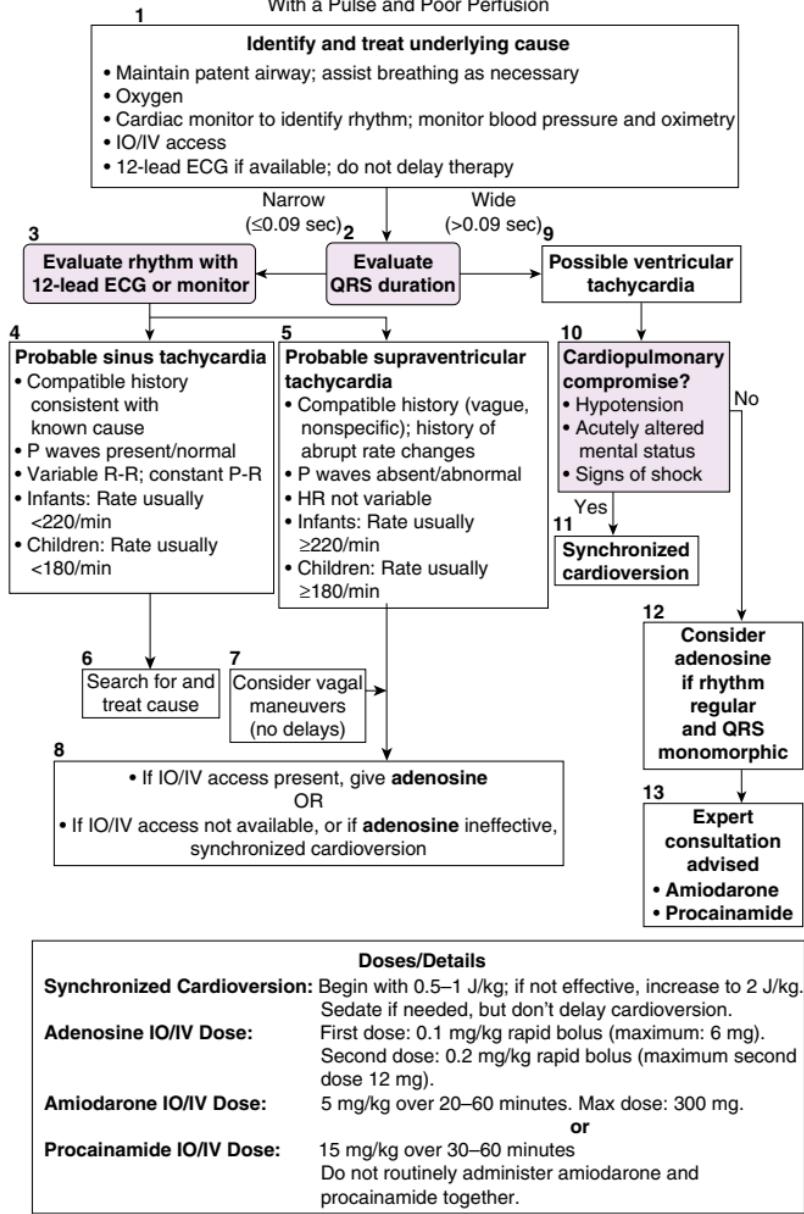
Pediatric BLS Health Care Providers



Note: The boxes bordered with dashed lines are performed by health care providers and not by lay rescuers

Pediatric BLS health care providers algorithm. (Reprinted with permission. Atkins DL, Berger S, Duff JP, et al. Part 11: pediatric basic life support and cardiopulmonary resuscitation quality: 2015 American Heart Association Guidelines Update for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care. *Circulation*. 2015;132(suppl 2):S519-S525.)

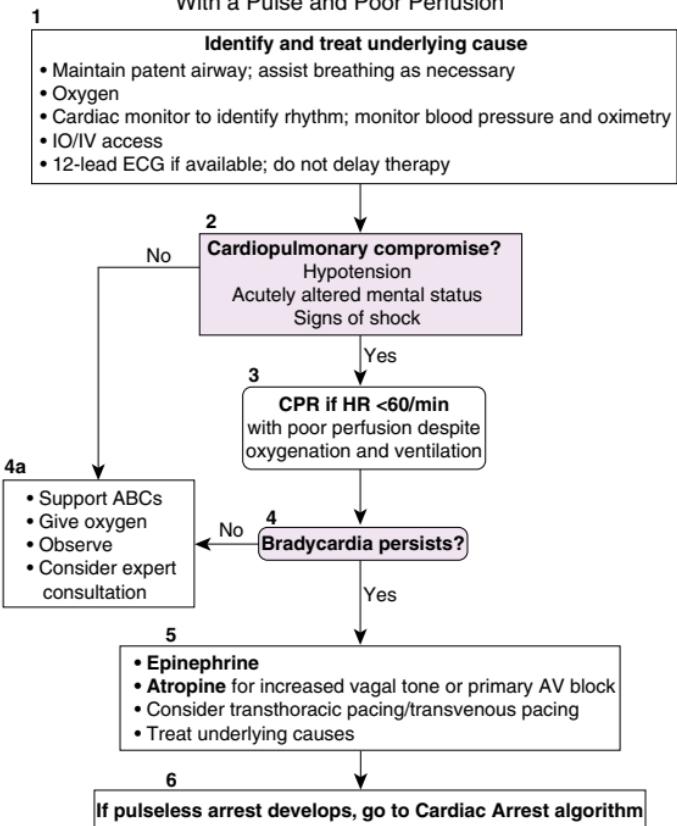
Pediatric Tachycardia
With a Pulse and Poor Perfusion



Pediatric tachycardia algorithm. (Reprinted with permission. 2015 American Heart Association Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care. Part 14: Pediatric advanced life support. *Circulation*. 2015;122:S888. © 2015 American Heart Association, Inc.)

Pediatric Bradycardia

With a Pulse and Poor Perfusion



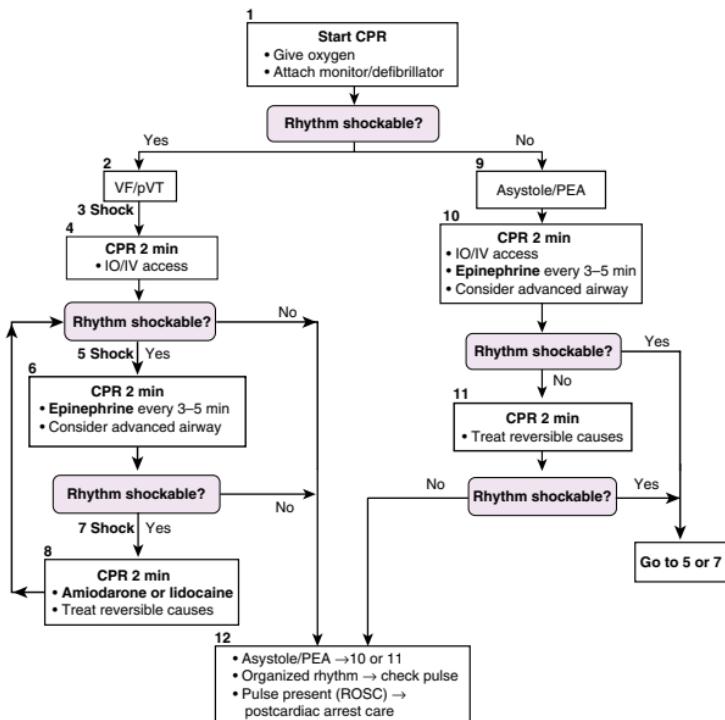
Doses/Details

Epinephrine IO/IV Dose: 0.01 mg/kg (0.1 mg/mL concentration). Max dose: 1 mg (10 mL). Repeat every 3–5 minutes. If IO/IV access not available but endotracheal (ET) tube in place, may give ET dose: 0.1 mg/kg (1 mg/mL concentration, max 2.5 mg).

Atropine IO/IV Dose: 0.02 mg/kg. May repeat once after 5 min. Minimum dose 0.1 mg and maximum single dose 0.5 mg.

Pediatric bradycardia algorithm. (Reprinted with permission. 2015 American Heart Association Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care. Part 14: Pediatric advanced life support. *Circulation*. 2015;122:S887. © 2015 American Heart Association, Inc.)

Pediatric Cardiac Arrest



CPR Quality

- Push hard ($\geq \frac{1}{2}$ of anterior-posterior diameter of chest) and fast (100–120/min) and allow complete chest recoil
- Minimize interruptions in compressions
- Avoid excessive ventilation
- Rotate compressor every 2 minutes or sooner if fatigued
- If no advanced airway, 15:2 compression-ventilation ratio.

Shock Energy for Defibrillation

First shock 2 J/kg, second shock 4 J/kg, subsequent shocks ≥ 4 J/kg, maximum 10 J/kg or adult dose.

Drug Therapy

- Epinephrine IO/IV Dose:** 0.01 mg/kg (0.1 mg/mL concentration). Max dose: 1 mg (10 mL). Repeat every 3–5 minutes. If no IO/IV access, may give endotracheal dose: 0.1 mg/kg (1 mg/mL concentration, max 2.5 mg).
- Amiodarone IO/IV Dose:** 5 mg/kg bolus during cardiac arrest. Max dose: 300 mg. May repeat up to 2 times for refractory VF/pulseless VT.
- Lidocaine IO/IV Dose:** Initial: 1 mg/kg loading dose. Max dose: 100 mg. Maintenance: 20–50 mcg/kg per minute infusion (repeat bolus dose if infusion initiated >15 min after initial bolus therapy).

Advanced Airway

- Endotracheal intubation or supraglottic advanced airway
- Waveform capnography or capnometry to confirm and monitor endotracheal tube placement
- Once advanced airway in place give 1 breath every 6 seconds (10 breaths per minute) with continuous chest compressions

Return of Spontaneous Circulation (ROSC)

- Pulse and blood pressure
- Spontaneous arterial pressure waves with intra-arterial monitoring

Reversible Causes

- | | |
|----------------------------|-------------------------|
| – Hypovolemia | – Tension pneumothorax |
| – Hypoxia | – Tamponade, cardiac |
| – Hydrogen ion (acidosis) | – Toxins |
| – Hypoglycemia | – Thrombosis, pulmonary |
| – Hypokalemia/hyperkalemia | – Thrombosis, coronary |
| – Hypothermia | |

Pediatric cardiac arrest algorithm. (Reprinted with permission. de Caen AR, Berg MD, Chameides L, et al. Part 12: pediatric advanced life support: 2015 American Heart Association Guidelines Update for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care. *Circulation*. 2015;132(suppl):S526-S542.)