PALS: Color-Coded Length-Based Resuscitation Tape

Equipment	GRAY 3-5 kg	PINK Small Infant 6-7 kg	RED Infant 8-9 kg	PURPLE Toddler 10-11 kg	YELLOW Small Child 12-14 kg
Resuscitation bag		Infant/child	Infant/child	Child	Child
Oxygen mask (NRB)		Pediatric	Pediatric	Pediatric	Pediatric
Oral airway (mm)		50	50	60	60
Laryngoscope blade (size)		1 Straight	1 Straight	1 Straight	2 Straight
ET tube (mm)		3.5 Uncuffed 3.0 Cuffed	3.5 Uncuffed 3.0 Cuffed	4.0 Uncuffed 3.5 Cuffed	4.5 Uncuffed 4.0 Cuffed
ET tube insertion length (cm)	3 kg 9-9.5 4 kg 9.5-10 5 kg 10-10.5	10.5-11	10.5-11	11-12	13.5
Suction catheter (F)		8	8	10	10
BP cuff	Neonatal #5/ infant	Infant/child	Infant/child	Child	Child
IV catheter (ga)		22-24	22-24	20-24	18-22
IO (ga)		18/15	18/15	15	15
NG tube (F)		5-8	5-8	8-10	10
Urinary catheter (F)	5	8	8	8-10	10
Chest tube (F)		10-12	10-12	16-20	20-24

Equipment	WHITE Child 15-18 kg	BLUE Child 19-23 kg	ORANGE Large Child 24-29 kg	GREEN Adult 30-36 kg
Resuscitation bag	Child	Child	Child	Adult
Oxygen mask (NRB)	Pediatric	Pediatric	Pediatric	Pediatric/adult
Oral airway (mm)	60	70	80	80
Laryngoscope blade (size)	2 Straight	2 Straight or curved	2 Straight or curved	3 Straight or curved
ET tube (mm)	5.0 Uncuffed 4.5 Cuffed	5.5 Uncuffed 5.0 Cuffed	6.0 Cuffed	6.5 Cuffed
ET tube insertion length (cm)	14-15	16.5	17-18	18.5-19.5
Suction catheter (F)	10	10	10	10-12
BP cuff	Child	Child	Child	Small adult
IV catheter (ga)	18-22	18-20	18-20	16-20
IO (ga)	15	15	15	15
NG tube (F)	10	12-14	14-18	16-18
Urinary catheter (F)	10	10-12	12	12
Chest tube (F)	20-24	24-32	28-32	32-38

PALS: Respiratory Emergencies

FYI Medications to Avoid in Children w/ Neuromuscular Disease	Recall that the use of succinylcholine for intubation of children w/ neuromuscular diseases may trigger life-threatening conditions, such as hyperkalemia or malignant hyperthermia. Several commonly used drugs, such as aminoglycosides, have intrinsic neuromuscular blocking activity that can worsen respiratory muscle weakness.

The Management of Respiratory Emergencies Flowchart summarizes general management of respiratory emergencies and specific management by etiology. Note that this chart does not include all respiratory emergencies; it provides key management strategies for a limited number of diseases.

Management of Respiratory Emergencies Flowchart

- Airway positioning
- Suction as needed
- Oxygen
- Pulse oximetry
- ECG monitor (as indicated)
- BLS as indicated

Specific Management for Selected Conditions

Upper Airway Obstruction

parainfluenza/influenza —> swelling of trachea/larynx **Croup**	**Anaphylaxis**	R inferior and R middle lobes **Aspiration Foreign Body**
• Nebulized epinephrine • Corticosterioids	• IM epinephrine (or autoinjector) • Albuterol • Antihistamines • Corticosteroids	• Allow position of comfort • Specialty consultation

Lower Airway Obstruction

RSV **Bronchiolitis**	**Asthma** see pg 188 for asthma ladder	
• Nasal suctioning • Bronchodilator trial not typically done anymore, consider palivizumab (mAB) or ribavirin for immunocompromised	• Albuterol ± ipratropium • Corticosteroids • Subcutaneous epinephrine	• Magnesium sulfate • Terbutaline

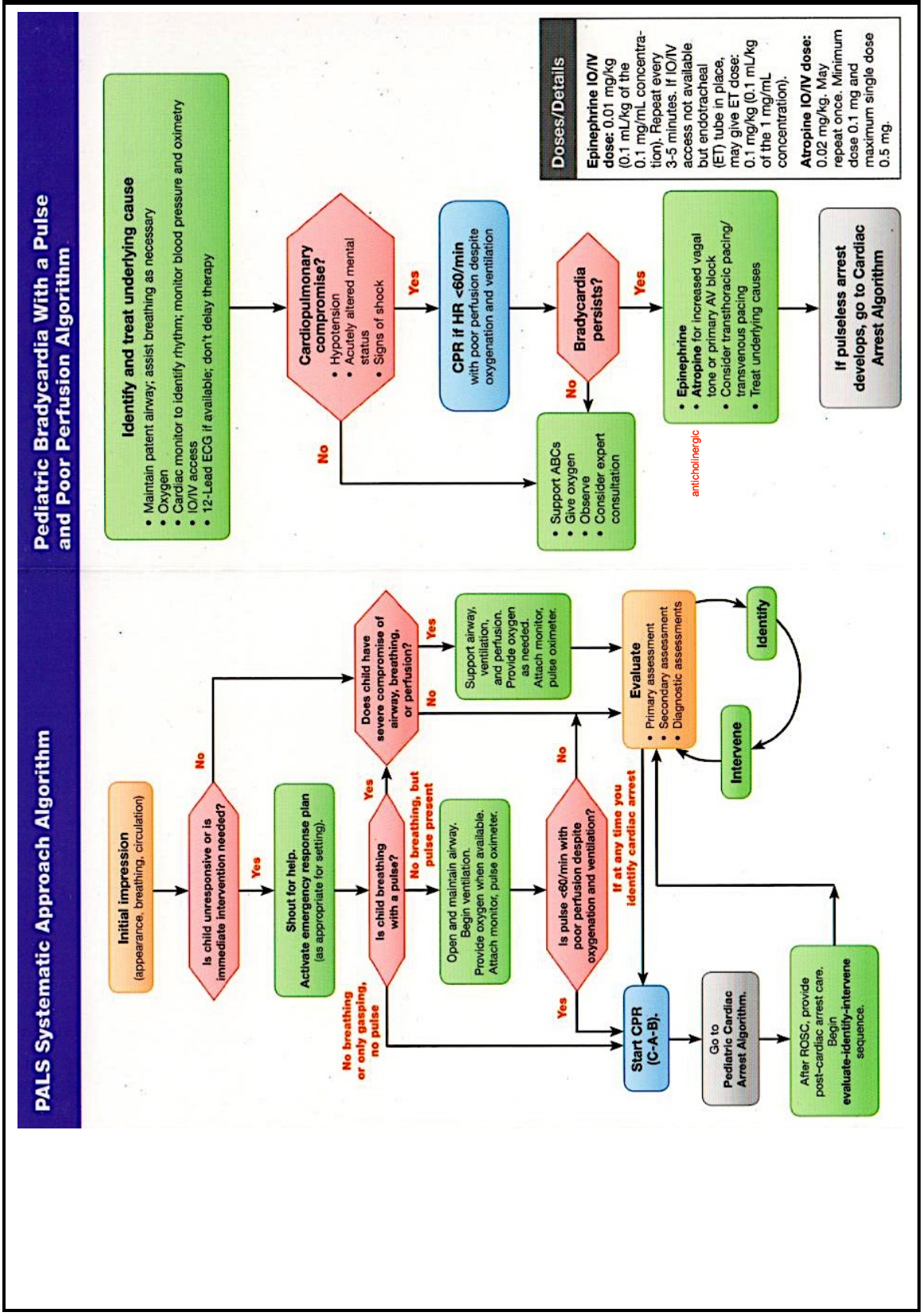
Lung Tissue Disease

Pneumonia/Pneumonitis Infectious Chemical Aspiration	**Pulmonary Edema Cardiogenic or Noncardiogenic (ARDS)**
• Albuterol • Antibiotics (as indicated)	• Consider noninvasive or invasive ventilatory support w/ PEEP • Consider vasoactive support • Consider diuretic

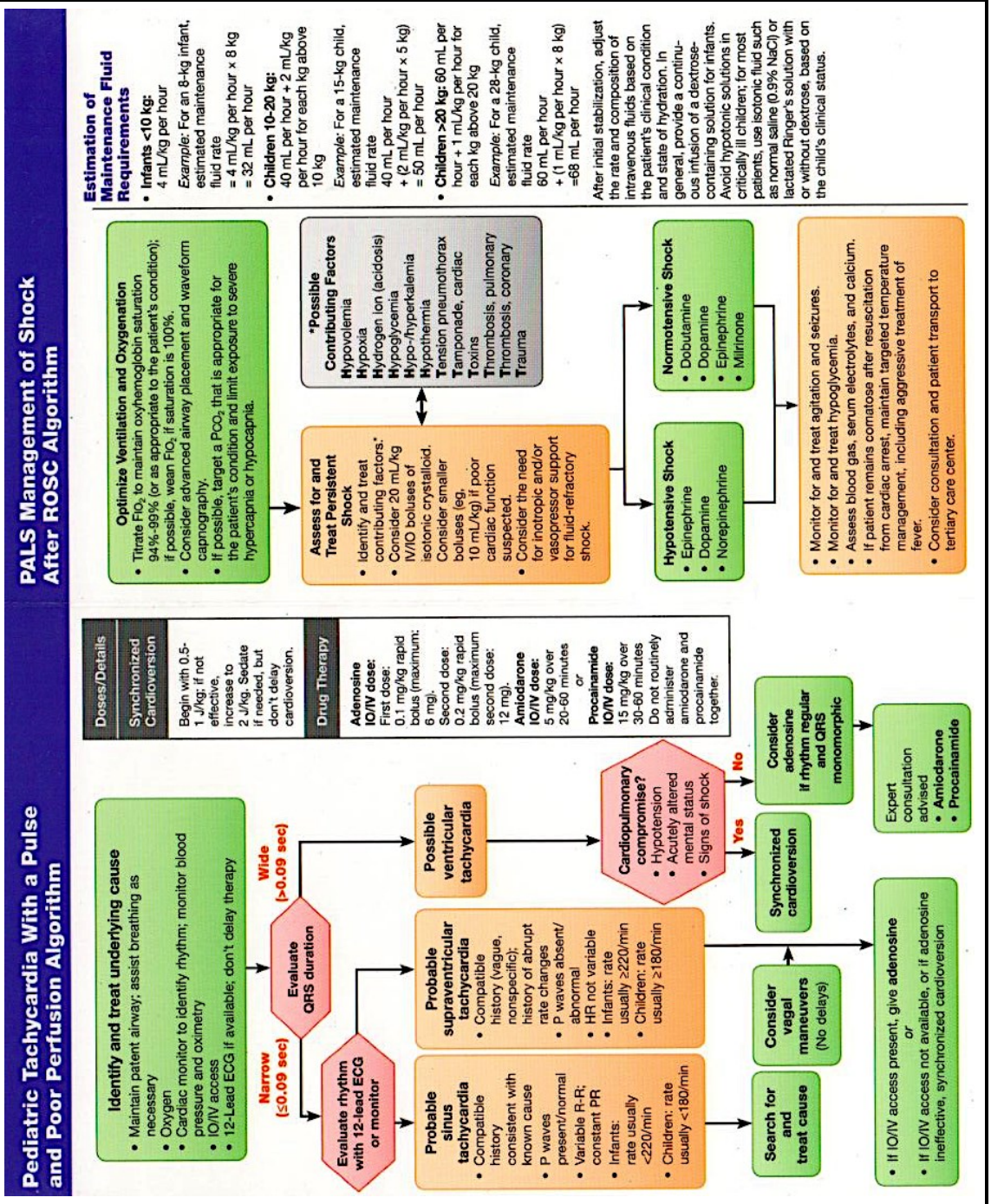
Disordered Control of Breathing

Increased ICP	**Poisoning/Overdose**	**Neuromuscular Disease**
• Avoid hypoxemia • Avoid hypercarbia • Avoid hyperthermia	• Antidote (if available) • Contact poison control	Consider noninvasive or invasive ventilatory support

PALS: Systemic Approach & Bradycardia w/ Poor Perfusion



PALS: Tachycardia w/ Poor Perfusion and Mgmt of Shock after ROSC



PALS: Recognition and Management of Shock

Recognition of Shock Flowchart

Clinical Signs		Hypovolemic	Distributive	Cardiogenic	Obstructive
A	Patency	Airway open and maintainable/not maintainable			
B	Respiratory Rate	Increased			
	Respiratory Effort	Normal to increased		Labored	
	Breath Sounds	Normal	Normal (± crackles)	Crackles, grunting	
C	Systolic Blood Pressure	**Compensated Shock → Hypotensive Shock**			
	Pulse Pressure	Narrow	Variable	Narrow	
	Heart Rate	Increased			
	Peripheral Pulse Quality	Weak	Bounding or weak	Weak	
	Skin	Pale, cool	Warm or cool	Pale, cool	
	Capillary Refill	Delayed	Variable	Delayed	
	Urine Output	Decreased			
D	Level of Consciousness	Irritable early Lethargic late			
E	Temperature	Variable			

Management of Shock Flowchart

• Oxygen • Pulse oximetry • ECG monitor	• IV/IO access • BLS as indicated • Point-of-care glucose testing

Specific Management for Selected Conditions

Hypovolemic Shock

Nonhemorrhagic	Hemorrhagic
• 20 mL/kg NS/LR bolus, repeat as needed • Consider colloid	• Control external bleeding • 20 mL/kg NS/LR bolus, repeat 2 or 3x as needed • Transfuse PRBCs as indicated

Distributive Shock

Septic	Anaphylactic	Neurogenic
Management Algorithm: • Septic Shock	• IM epinephrine (or autoinjector) • Fluid boluses (20mL/kg NS/LR) • Albuterol • Antihistamines, corticosteroids • Epinephrine infusion	• 20mL/kg NS/LR bolus, repeat PRN • Vasopressor

PALS: Recognition and Management of Shock

Management of Shock Flowchart

Cardiogenic Shock

Bradyarrhythmia/Tachyarrhythmia	Other (e.g. CHD, Myocarditis, Cardiomyopathy, Poisoning)
Management Algorithm: • Bradycardia • Tachycardia w/ poor perfusion	• 5 to 10 mL/kg NS/LR bolus, repeat PRN • Vasoactive infusion • Consider expert consultation

Obstructive Shock

Ductal-Dependent (LV Outflow Obstruction)	Tension Pneumothorax	Cardiac Tamponade	Pulmonary Embolism
• Prostaglandin E_1 • Expert consultation	• Needle decompression • Tube thoracostomy	• Pericardiocentesis • 20 mL/kg NS/LR bolus	• 20 mL/kg NS/LR bolus, repeat PRN • Consider thrombolytics, anticoagulants • Expert consultation

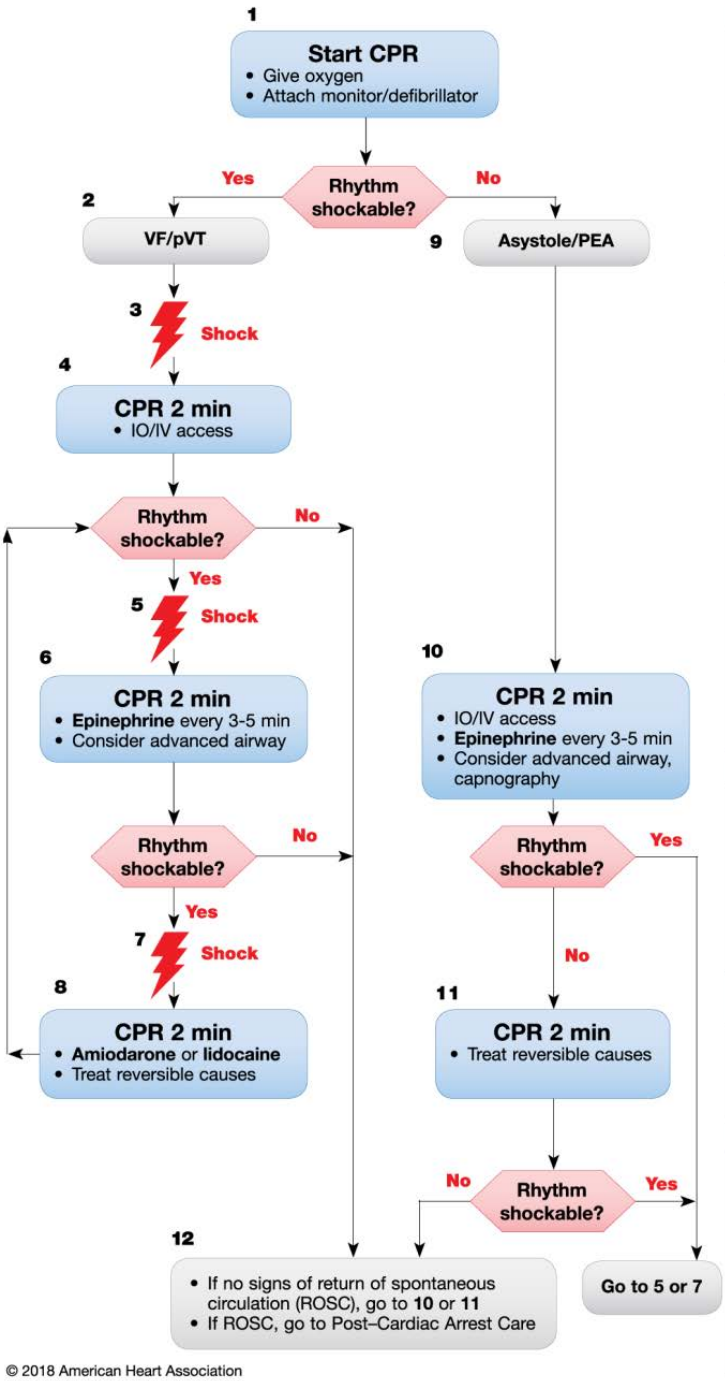
Shock

Hemodynamic Parameters in Shock

Type	Examples	Preload (CVP, PCWP)	Afterload (SVR)	CO (SV*HR)	Mixed venous O_2	Treatment
Distributive	• Sepsis • Anaphylaxis • Severe neurologic injury (loss of α-1 activity)	↓	↓	↑ *then* ↓	↑	• **Sepsis**: crystalloid (20 cc/kg NS, repeat PRN) + abx • **Anaphylaxis**: epi + crystalloid • **Neurogenic**: crystalloid + α-active pressors, (norepi @ 0.05-2 mcg/kg/min)
Hypovolemic	• Blood loss • GI or Renal losses • ↓ intake	decreased not increased!! ↑	↑	decreased not increased!! ↑	↓	• **Crystalloid replacement**: 20 cc/kg, repeat PRN • For blood loss: c/s PRBCs
Cardiogenic	• Myocarditis • MI • Dysrhythmia	↑	↑	decreased not increased!! ↑	↓	Targeted at etiology - **inotropes**, revascularization, **anti-arrhythmics**, cardiovert
Obstructive	• Tamponade • PE	↑	↑	decreased not increased!! ↑	↓	**Fix obstruction** (pericardiocentesis, thrombectomy/lysis for PE)

PALS: Cardiac Arrest

Pediatric Cardiac Arrest Algorithm—2018 Update



CPR Quality

- Push hard (≥⅓ of anteroposterior diameter of chest) and fast (100-120/min) and allow complete chest recoil.
- Minimize interruptions in compressions.
- Avoid excessive ventilation.
- Change 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 mL/kg of the 0.1 mg/mL concentration). Repeat every 3-5 minutes. If no IO/IV access, may give endotracheal dose: 0.1 mg/kg (0.1 mL/kg of the 1 mg/mL concentration).
- **Amiodarone IO/IV dose:** 5 mg/kg bolus during cardiac arrest. May repeat up to 2 times for refractory VF/pulseless VT.

-OR-

Lidocaine IO/IV dose: Initial: 1 mg/kg loading dose. Maintenance: 20-50 mcg/kg per minute infusion (repeat bolus dose if infusion initiated >15 minutes after initial bolus therapy).

Advanced Airway

- Endotracheal intubation or supraglottic advanced airway
- Waveform capnography or capnometry to confirm and monitor ET tube placement
- Once advanced airway in place, give 1 breath every 6 seconds (10 breaths/min) with continuous chest compressions

Return of Spontaneous Circulation (ROSC)

- Pulse and blood pressure
- Spontaneous arterial pressure waves with intra-arterial monitoring

Reversible Causes

- **H**ypovolemia
- **H**ypoxia
- **H**ydrogen ion (acidosis)
- **H**ypoglycemia
- **H**ypo-/hyperkalemia
- **H**ypothermia
- **T**ension pneumothorax
- **T**amponade, cardiac
- **T**oxins
- **T**hrombosis, pulmonary
- **T**hrombosis, coronary

PALS: Cardiac Arrest

Doses/Details for the Pediatric Cardiac Arrest Algorithm

CPR Quality

- Push hard (≥⅓ of anteroposterior 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 mL/kg of the 0.1mg/mL concentration). Repeat every 3-5 minutes. If no IO/IV access, may give endotracheal dose: 0.1 mg/kg (0.1 mL/kg of the 1 mg/mL concentration).
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- **H**ypothermia
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- **T**amponade, cardiac
- **T**oxins
- **T**hrombosis, pulmonary
- **T**hrombosis, coronary

Estimating Endotracheal Tube Size

The formula for estimation of proper endotracheal tube size (internal diameter [i.d.]) for children 2 to 10 years of age, based on the child's age:

Uncuffed endotracheal tube size (mm i.d.) = (age in years/4) + 4

The formula for estimation of a cuffed endotracheal tube size is as follows:

Cuffed endotracheal tube size (mm i.d.) = (age in years/4) + 3.5

Typical cuffed inflation pressure should be <20 to 25 cm H_2O.

Drugs Used in PALS

Drug	Indications/Dosages
Adenosine	**SVT** • 0.1 mg/kg IV/IO *rapid* push (max 6 mg), second dose 0.2 mg/kg IV/IO *rapid* push (max 12 mg)
Albuterol	**Asthma, anaphylaxis (bronchospasm), hyperkalemia** • MDI: 4 to 8 puffs via inhalation q 20 minutes PRN with spacer (*or* ET if intubated) • Nebulizer: 2.5 mg/dose (wt <20 kg) *or* 5 mg/dose (wt >20 kg) via inhalation q 20 minutes PRN • Continuous nebulizer: 0.5 mg/kg per hour via inhalation (max 20 mg/h)
Amiodarone	**SVT, VT (with pulses)** • 5 mg/kg IV/IO *load* over 20 to 60 minutes (max 300 mg), repeat to daily max 15 mg/kg (2.2 g in adolescents) **Pulseless arrest (ie, VF/pulseless VT)** • 5 mg/kg IV/IO *bolus* (max 300 mg), repeat to daily max 15 mg/kg (2.2 g in adolescents)
Atropine sulfate	**Bradycardia (symptomatic)** • 0.02 mg/kg IV/IO (max single dose 0.5 mg), may repeat dose once in 3 to 5 minutes, max total dose child 1 mg, max total dose adolescent 3 mg • 0.04 to 0.06 mg/kg ET **Toxins/overdose (eg, organophosphate, carbamate)** • <12 years: 0.05 mg/kg IV/IO initially; then repeated and doubling the dose every 5 minutes until muscarinic symptoms reverse • ≥12 years: 1 mg IV/IO initially; then repeated and doubling the dose every 5 minutes until muscarinic symptoms reverse
Calcium chloride 10%	**Hypocalcemia, hyperkalemia, hypermagnesemia, calcium channel blocker overdose** • 20 mg/kg (0.2 mL/kg) IV/IO *slow* push during arrest, repeat PRN
Calcium gluconate	**Hypocalcemia, hyperkalemia, hypermagnesemia, calcium channel blocker overdose** • 60 mg/kg (0.6 mL/kg) IV/IO *slow* push during arrest; repeat PRN
Dexamethasone	**Croup** • 0.6 mg/kg PO/IM/IV (max 16 mg)
Dextrose (glucose)	**Hypoglycemia** • 0.5 to 1 g/kg IV/IO ($D_{25}W$ 2 to 4 mL/kg; $D_{10}W$ 5 to 10 mL/kg)
Dobutamine	**Heart failure, cardiogenic shock** • 2 to 20 mcg/kg per minute IV/IO infusion; titrate to desired effect
Dopamine	**Cardiogenic shock, distributive shock** • 2 to 20 mcg/kg per minute IV/IO infusion; titrate to desired effect
Epinephrine	**Pulseless arrest, bradycardia (symptomatic)** • 0.01 mg/kg (0.1 mL/kg of the 0.1 mg/mL concentration) IV/IO q 3 to 5 minutes (max single dose 1 mg) • 0.1 mg/kg (0.1 mL/kg of the 1 mg/mL concentration) ET q 3 to 5 minutes **Hypotensive shock** • 0.1 to 1 mcg/kg per minute IV/IO infusion (consider higher doses if needed) **Anaphylaxis** • IM autoinjector 0.3 mg (for patient weighing ≥30 kg) or IM junior autoinjector 0.15 mg (for patient weighing 10 to 30 kg) • 0.01 mg/kg (0.01 mL/kg of the 1 mg/mL concentration) IM q 15 minutes PRN (max single dose 0.3 mg) • 0.01 mg/kg (0.1 mL/kg of the 0.1 mg/mL concentration) IV/IO q 3 to 5 minutes (max single dose 1 mg) if hypotensive • 0.1 to 1 mcg/kg per minute IV/IO infusion if hypotension persists despite fluids and IM injection **Asthma** • 0.01 mg/kg (0.01 mL/kg of the 1 mg/mL concentration) subcutaneously q 15 minutes (max 0.3 mg or 0.3 mL) **Croup** • 0.25 to 0.5 mL *racemic* solution (2.25%) mixed in 3 mL NS via inhalation • 3 mg (3 mL of the 1 mg/mL concentration) epinephrine mixed with 3 mL NS (which yields 0.25 mL racemic epinephrine solution) via inhalation

Drugs Used in PALS

Drug	Indications/Dosages
Etomidate	**RSI** rapid sequence intubation • 0.2 to 0.4 mg/kg IV/IO infused over 30 to 60 seconds (max 20 mg) will produce rapid sedation that lasts for 10 to 15 minutes
Hydrocortisone	**Adrenal insufficiency** • 2 mg/kg IV bolus (max 100 mg)
Ipratropium bromide	**Asthma** • 250 to 500 mcg via inhalation q 20 minutes PRN x 3 doses
Lidocaine	**VF/pulseless VT, wide-complex tachycardia (with pulses)** • 1 mg/kg IV/IO bolus • Maintenance: 20 to 50 mcg/kg per minute IV/IO infusion (repeat bolus dose if infusion initiated >15 minutes after initial bolus) • 2 to 3 mg/kg ET
Magnesium sulfate	**Asthma (refractory status asthmaticus), torsades de pointes, hypomagnesemia** • 25 to 50 mg/kg IV/IO *bolus* (max 2 g) (pulseless VT) *or* over 10 to 20 minutes (VT with pulses) *or slow* infusion over 15 to 30 minutes (status asthmaticus)
Methyl-prednisolone	**Asthma (status asthmaticus), anaphylactic shock** • Load: 2 mg/kg IV/IO/IM (max 60 mg); only use acetate salt IM • Maintenance: 0.5 mg/kg IV/IO q 6 hours (max 120 mg/d)
Milrinone	**Myocardial dysfunction and increased SVR/PVR** • Loading dose: 50 mcg/kg IV/IO over 10 to 60 minutes followed by 0.25 to 0.75 mcg/kg per minute IV/IO infusion
Naloxone	**Narcotic (opiate) reversal** • Total reversal required (for narcotic toxicity secondary to overdose): 0.1 mg/kg IV/IO/IM/subcutaneous bolus q 2 minutes PRN (max 2 mg) • Total reversal *not* required (eg, for respiratory depression associated with therapeutic narcotic use): 1 to 5 mcg/kg IV/IO/IM/subcutaneously; titrate to desired effect • Maintain reversal: 0.002 to 0.16 mg/kg per hour IV/IO infusion
Nitroglycerin	**Heart failure, cardiogenic shock** • Initiate at 0.25 to 0.5 mcg/kg per minute IV/IO infusion; titrate by 1 mcg/kg per minute q 15 to 20 minutes as tolerated. Typical dose range 1 to 5 mcg/kg per minute (max 10 mcg/kg per minute) • In adolescents, start with 5 to 10 mcg *per minute* (***not*** per kilogram per minute) and increase to max 200 mcg *per minute*
Nitroprusside	**Cardiogenic shock (ie, associated with high SVR), severe hypertension** • 0.3 to 1 mcg/kg per minute initial dose; then titrate up to 8 mcg/kg per minute PRN
Norepinephrine	**Hypotensive (usually distributive) shock (ie, low SVR and fluid refractory)** • 0.1 to 2 mcg/kg per minute IV/IO infusion; titrate to desired effect
Procainamide	**SVT, atrial flutter, VT (with pulses)** • 15 mg/kg IV/IO load over 30 to 60 minutes (do not use routinely with amiodarone)
Prostaglandin E_1 (PGE_1)	**Ductal-dependent congenital heart disease (all forms)** • 0.05 to 0.1 mcg/kg per minute IV/IO infusion initially; then 0.01 to 0.05 mcg/kg per minute IV/IO
Sodium bicarbonate	**Metabolic acidosis (severe), hyperkalemia** • 1 mEq/kg IV/IO *slow* bolus **Sodium channel blocker overdose (eg, tricyclic antidepressant)** • 1 to 2 mEq/kg IV/IO bolus until serum pH is >7.45 (7.50 to 7.55 for severe poisoning) followed by IV/IO infusion of 150 mEq $NaHCO_3$/L solution titrated to maintain alkalosis
Terbutaline	**Asthma (status asthmaticus), hyperkalemia** • 0.1 to 10 mcg/kg per minute IV/IO infusion; consider 10 mcg/kg IV/IO load over 5 minutes • 10 mcg/kg subcutaneously q 10 to 15 minutes until IV/IO infusion is initiated (max single dose 0.4 mg)
Vasopressin	**Catecholamine-resistant hypotension** • 0.0002 to 0.002 unit/kg per minute (0.2 to 2 milliunits/kg per minute) continuous infusion