

*Pharmacology**

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The icon ♦ denotes content of special importance for NCLEX®.

* Please note: All drugs/medications with actions, expected outcomes, and side effects are included at the end of each section in the Medical–Surgical section and at the end of each chapter.

DRUG METABOLISM

Stages of Metabolism

Definition: Drug metabolism in the human body is accomplished in four basic stages—absorption, transportation, biotransformation, and excretion. For a drug to be completely metabolized, it must first be given in sufficient concentration to produce the described effect on body tissues. When this critical drug concentration level is achieved, body tissues change.

A. Absorption.

1. The first stage of metabolism refers to the route a drug takes from the time it enters the body until it is absorbed in the circulating fluids.
- ◆ 2. Drugs are absorbed by the mucous membranes, the gastrointestinal tract, the respiratory tract, and the skin.
 - a. The mucous membranes are one of the most rapid and effective routes of absorption because they are highly vascular.
 - b. Drugs are absorbed through these membranes by diffusion, infiltration, and osmosis.
3. Drugs given by mouth are absorbed in the gastrointestinal (GI) tract.
 - a. Portions of these drugs dissolve and absorb in the stomach.
 - b. The rate of absorption depends on the pH of the stomach's contents, the food contained in the stomach at the time of ingestion, and the presence of disease conditions. This is why some drugs must be given on an empty stomach, while others should be given with food.
 - c. Most of the drug concentrate dissolves in the small intestine, where the large vascular surface and moderate pH level enhance the process of dissolution.
4. Methods of injection include intradermal, subcutaneous, intravenous, intramuscular, and intra-arterial injections.
 - a. Parenteral methods are the most direct, reliable, and rapid route of absorption.
 - b. The actual administration site will depend on the type of drug, its action, and the client.
5. Another route of administration is inhalation or nebulization through the respiratory system.
 - a. This method is not as rapid as parenteral injections but is faster than the GI tract.
 - b. Drugs administered through the respiratory tract must be made up of small particles that can pass through to the alveoli in the lungs.

6. The final mode of absorption is the skin.

- a. Most drugs, when applied to the skin, produce a local rather than a systemic effect. Exceptions are nitrates and pain medications.
- b. The degree of absorption will depend on the strength of the drug as well as location where it is applied on the body surface.

B. Distribution.

- ◆ 1. The second stage of metabolism refers to the way in which a drug is transported from the site of introduction to the site of action.
- 2. First a drug enters or is absorbed by the body.
 - a. The drug binds to plasma protein in the blood.
 - b. Then the drug is transported through circulation to all parts of the body.
- 3. As a drug moves from the circulatory system, it crosses cell membranes and enters the body tissues.
 - a. Some of the drug is distributed to and stored in fat and muscle.
 - b. Greater masses of tissue (such as fat and muscle) attract the drug.
- ◆ 4. The amount of drug that is distributed to body tissues depends on the permeability of the membranes and the blood supply to the absorption area.
- 5. A drug that first accumulates in the brain may move into fat and muscle tissue and then back to the brain because the drug is still chemically active.
 - a. The drug is released in small quantities from the tissues and travels back to the brain.
 - b. Equal drug and blood concentration levels in the body are maintained.

C. Metabolism or biotransformation.

1. The third stage of metabolism takes place as the drug—a foreign substance in the body—is converted by enzymes into a less active and harmless agent that can be easily excreted.
- ◆ 2. Most of this conversion occurs in the liver.
 - a. Both synthetic and biochemical reactions take place.
 - b. Some conversion does take place in the kidney, plasma, and intestinal mucosa.
3. Synthetic reactions: liver enzymes conjugate the drug with other substances to make it less harmful for the body.
4. Biochemical reactions: drugs are oxidized, reduced, hydrolyzed, and synthesized so they become less active and more easily eliminated from the body.

- D. Excretion.
 - 1. The final stage in metabolism takes place when the drug is changed into an inactive form or excreted from the body.
 - 2. The kidneys are the most important route of excretion.
 - ◆ 3. The kidneys eliminate both the pure drug and the metabolites of the parent drug.
 - a. During excretion these two substances are filtered through the glomeruli.
 - b. They are then secreted by the tubules.
 - c. Finally, they are reabsorbed through the tubules or directly excreted.
 - 4. Other routes of excretion include the lungs (which exhale gaseous drugs), feces, saliva, tears, and mother's milk.

Factors That Affect Drug Metabolism

- A. Personal attributes.
 - 1. Body weight.
 - 2. Age.
 - 3. Sex.
- B. Physiological factors.
 - 1. State of health.
 - 2. Disease processes.
- C. Acid-base and fluid and electrolyte balance.
- D. Permeability.
- E. Diurnal rhythm.
- F. Circulatory capability.
- G. Genetic and immunologic factors.
- H. Drug tolerance.
 - I. Cumulative effect of drugs.
- J. Other factors.
 - 1. Psychological.
 - 2. Emotional.
 - 3. Environmental.
- K. Responses to drugs vary.
 - 1. Responses depend on the speed with which the drug is absorbed into the blood or tissues.
 - 2. Responses depend on the effectiveness of the body's circulatory system.

◆ Factors That Affect Drug Absorption

- A. Absorption factors.
 - 1. Solubility of the drug.
 - 2. Route of administration: oral, subcutaneous, topical, sublingual, or intramuscular.
 - 3. Client's sex, age, and health status.
 - a. Females absorb IM injections slower than males because they have increased adipose tissue and a smaller blood supply.

- b. Older clients respond slower to oral medications, and this is often related to lower gastric acid in the stomach.
- c. Certain diseases decrease tissue perfusion.
- B. Distribution factors.
 - 1. Cardiac output and circulation influence how the drug reaches the target tissues.
 - ◆ 2. If a drug is attached to serum proteins and the protein level is low, there would be more free drug in the bloodstream; this condition indicates that dosage should be decreased with certain drugs (warfarin, phenytoin, and barbiturates).
 - ◆ 3. Drug half-life is the time it takes for the half of the amount of the drug taken to be eliminated or metabolized. The shorter the half-life of a drug, the quicker it is eliminated.
 - a. If the client takes 20 mg of a drug with a half-life of 2 hours, only 10 mg of the drug will be in the body 2 hours after administration.
 - b. Two hours later, there will only be 5 mg of the drug left.
 - c. The half-life of a drug can be influenced by many factors such as metabolism and genetics.
 - d. It is important to note that the half-life for any drug is the half-life for a healthy person.
 - e. The half-life of drugs for individuals with liver or kidney dysfunction would be different.
 - ◆ C. Clients with impaired liver function or liver disease may lose much of the therapeutic value of a drug.
 - 1. Drugs that pass through the liver (called first-pass effect) before being absorbed into the bloodstream may be affected by the liver status.
 - 2. Certain drugs that go from the GI tract to the portal vein to the liver may need to have their oral dosages adjusted upward to compensate for partial deactivation (lidocaine, morphine, propranolol, verapamil).
 - D. Kidneys also play a role in drug absorption—depends on tissue perfusion, disease, and urinary pH.
 - 1. Renal disease interferes with renal clearance, and drugs (potassium chloride or digoxin) can reach toxic levels in the bloodstream.
 - 2. The more alkaline the urine, the faster certain drugs are excreted (salicylates, barbiturates, and sulfonamides). Sodium bicarbonate will make urine more alkaline.
 - 3. Some drugs are excreted faster when urine is acidic (amphetamines and ephedrine). Vitamin C will make urine more acidic.

ORIGIN AND NOMENCLATURE OF DRUGS

Common Sources

- A. Plant sources.
 - 1. Roots, bark, sap, leaves, flowers, and seeds from medicinal plants can be used as drug components.
 - 2. Component substances.
 - a. Alkaloid.
 - (1) Alkaline (base) in reaction.
 - (2) Bitter in taste.
 - (3) Physiologically powerful in activity.
 - b. Glycoside: a compound containing a carbohydrate molecule.
 - c. Resin: soluble in alcohol; insoluble in water.
 - d. Gum.
 - (1) Mucilaginous (gelatinlike) excretion.
 - (2) Used in bulk laxatives; may absorb water.
 - (3) Used in skin preparations as a soothing effect (e.g., Karaya gum).
 - e. Oil.
 - (1) Fixed oil: Does not evaporate on warming; occurs as a solid, semisolid, or liquid (e.g., castor oil).
 - (2) Volatile oil: Evaporates readily; occurs in aromatic plants (e.g., peppermint).
 - B. Animal sources.
 - 1. Processed from an organ, from organ secretion, or from organ cells.
 - 2. Insulin, as an example, is a derivative from the pancreas of sheep, cattle, or hogs.
 - C. Mineral sources.
 - 1. Inorganic elements occurring in nature, but not of plant or animal origin; may be metallic or nonmetallic.
 - 2. Usually form a base or acid salt in food.
 - 3. Dilute hydrochloric acid (HCl), as an example, is diluted in water and then taken through a straw to prevent damage to teeth by acid.
 - D. Synthetic sources.
 - 1. A pure drug made in a laboratory from chemical, not natural, substances.
 - 2. Many drugs—sulfonamides, for example—are synthetics.

Methods of Naming Drugs

- A. Chemical name.
 - 1. Precise description of chemical constituents with the exact placement of atom groupings.
 - 2. “N-methyl-4-carbethoxypiperidine hydrochloride” is an example of a chemical name.

- B. Generic name.
 - 1. Reflects chemical name of the drug, but is simpler.
 - 2. It is never changed and used commonly in medical terminology.
 - 3. The synthetic narcotic “meperidine” is an example of a generic name.
- C. Trademark name (brand name, proprietary name).
 - 1. Appears in literature with the sign ® (e.g., Demerol®).
 - 2. The sign indicates the name is registered; use of the name is restricted to the manufacturer that is its legal owner.
 - 3. Trademark name is capitalized or shown in parentheses if generic name stated.

DRUG CLASSIFICATION

Classification by Action

- ◆ A. Anti-infectives.
 - 1. Antiseptics.
 - a. **Action**—inhibit growth of microorganisms (bacteriostatic).
 - b. **Purpose**—application to wounds and skin infections, sterilization of equipment, and hygienic purposes.
 - 2. Disinfectants.
 - a. **Action**—destroy microorganisms (bactericidal).
 - b. **Purpose**—destroy bacteria on inanimate objects (not appropriate for living tissue).
- ◆ B. Antimicrobials.
 - 1. Sulfonamides.
 - a. **Action**—inhibit the growth of microorganisms.
 - b. **Usage**—reduce or prevent infectious process, especially for urinary tract infections.
 - 2. Antibiotics (e.g., penicillin).
 - a. **Action**—interfere with microorganism metabolism.
 - b. **Usage**—reduce or prevent infectious process.
 - c. Specific drug and dosage based on culture and sensitivity of organism.
- ◆ C. Metabolic drugs.
 - 1. Hormones obtained from animal sources, found naturally in foods and plants.
 - 2. Synthetic hormones.
- D. Diagnostic materials.
 - 1. **Action**—dyes and opaque materials ingested or injected to allow visualization of internal organs.
 - 2. **Purpose**—to analyze organ status, disease state, and function.

- E. Vitamins and minerals.
 - 1. **Action**—necessary to obtain healthy body function.
 - 2. Found naturally in food or through synthetic food supplements.
- ◆ F. Vaccines and serums.
 - 1. **Action**—prevent disease or detect presence of disease.
 - 2. Types.
 - a. Antigenics produce active immunity.
 - (1) Vaccines—attenuated suspensions of microorganisms.
 - (2) Toxoids—products of microorganisms.
 - b. Antibodies—stimulated by microorganisms or their products.
 - (1) Antitoxins.
 - (2) Immune serum globulin.
 - c. Allergens—agents for skin immunity tests.
 - (1) Extracts of materials known to be allergenic.
 - (2) Can be used to relieve allergies.
 - d. Antivenins—substances that neutralize venom of certain snakes and spiders.
- ◆ G. Antifungals—check growth of fungi.
- ◆ H. Antihistamines.
 - 1. **Action**—prevent histamine action.
 - 2. **Purpose**—relieve symptoms of allergic reaction.
- ◆ I. Antineoplastics—prevent growth and spread of malignant cells.

CLASSIFICATION BY BODY SYSTEM

Central Nervous System

- A. Drugs affect central nervous system (CNS) by either inhibiting or promoting the actions of neural pathways and centers.
 - 1. Action-promoting drug groups (stimulants).
 - a. Antidepressants—psychic energizers used to treat depression.
 - b. Caffeine—increases mental activity and lessens drowsiness.
 - c. Ammonia—used for revival for fainting spell (client smells cap, not contents of bottle).
 - 2. Action-inhibiting drug groups (depressants).
 - ◆ a. Analgesics—reduce pain by interfering with conduction of nerve impulses.
 - (1) Narcotic analgesics—opium derivatives may depress respiratory centers; must be used with caution when the respiratory rate is less than 12.

- (a) Adverse reactions can differ from drug to drug and can include: constipation, respiratory depression, blurred vision, nausea, vomiting, drowsiness, dizziness, weakness, dry mouth, confusion, difficulty urinating, itching.
- (b) Clients must be assessed for adverse reactions.
- (c) A narcotic antagonist drug counteracts depressant drugs.
- (d) The most common antagonist drug is Narcan (naloxone).
- (2) Nonnarcotic antipyretics—reduce fever and relieve pain.
- (3) Antirheumatics—analgesics given to relieve arthritis pain; may reduce joint inflammation.
- ◆ b. Alcohol—stimulates appetite when given in small doses but is classified as a depressant.
- ◆ c. Hypnotics—sedatives that induce sleep; common form is the barbiturates.
- ◆ d. Antispasmodics—relieve skeletal muscle spasms; anticonvulsants prevent muscle spasms or convulsions.
- ◆ e. Tranquilizers.
 - (1) Relieve tension and anxiety, preoperative and postoperative apprehension, headaches, menstrual tension, chronic alcoholism, skeletal muscle spasticity, and other neuromuscular disorders.
 - (2) Tranquilizers and analgesics frequently given together (in reduced dosage); the one drug enhances the action of the other (synergy).
- f. Anesthetics—produce the state of unconsciousness or conscious sedation painlessly.
- ◆ B. Precautions to be taken with CNS drugs.
 - 1. Drugs that act on CNS may potentiate other CNS drugs.
 - 2. Client may be receiving other medications; find out drug name and dosage.
 - 3. Dependence on CNS drugs may occur.

Autonomic Nervous System

- A. The autonomic nervous system (ANS) governs several body functions so that drugs that affect it will at the same time affect other system functions.
- B. The ANS is made up of two nerve systems—the sympathetic and parasympathetic.
 - 1. Sympathetic—the protective emergency system.
 - 2. Parasympathetic—the stabilizing system.

- C. Each system has a separate basic drug group acting on it.
 - ◆ 1. Adrenergics—mimic the actions of sympathetic system.
 - a. Vasoconstrictors—stimulants such as adrenalin.
 - (1) Action is to constrict peripheral blood vessels, thereby increasing blood pressure.
 - (2) Dilate bronchial passages.
 - (3) Relax gastrointestinal tract.
 - b. Vasodilators—depressants such as nicotinic acid.
 - (1) Antagonists of epinephrine and similar drugs.
 - (2) Vasodilate blood vessels.
 - (3) Increase tone of GI tract.
 - (4) Reduce blood pressure.
 - (5) Relax smooth muscles.
 - (6) *Caution:* If drug is to be stopped, reduce dosage gradually over a period of a week; do not stop it suddenly.
 - ◆ 2. Cholinergics—mimic actions of parasympathetic system.
 - a. Cholinergic stimulants (e.g., Prostigmin or neostigmine).
 - (1) Decrease heart rate.
 - (2) Contract smooth muscles.
 - (3) Contract pupil in eye.
 - (4) Increase peristalsis.
 - (5) Increase gland secretions.
 - b. Cholinergic inhibitors (anticholinergics).
 - (1) Decrease gland secretion.
 - (2) Relax smooth muscle.
 - (3) Dilate pupil in eye.
 - (4) Increase heart action.

Eye

- A. Anesthetics.
 - 1. **Use:** brief local anesthesia used for measurement of intraocular pressure, removal of foreign bodies, or other superficial procedures.
 - 2. **Caution:** If used repeatedly, may result in increased risk of CNS and cardiovascular toxicity.
- B. Anti-infectives/antifungals/antivirals.
 - 1. **Use:** superficial ophthalmic infections like bacterial conjunctivitis.
 - 2. **Caution:** Hypersensitivity may occur when small amounts absorbed.
- C. Beta blockers.
 - 1. **Use:** management of chronic open-angle glaucoma.

- 2. **Caution:** Systemic absorption minimal but may occur and may result in bradycardia, hypotension, bronchospasm, or delirium in elderly.
- D. Cholinergics (direct-acting).
 - 1. **Use:** treatment of open-angle glaucoma.
 - 2. **Caution:** Avoid conditions in which pupillary constriction occurs. If significant systemic absorption occurs, bronchospasm, sweating, and salivation may occur.
- E. Cholinergics (cholinesterase inhibitors).
 - 1. **Use:** treatment of glaucoma not controlled with short-acting miotics or other agents.
 - 2. **Caution:** May intensify the actions of cocaine and some other local anesthetics; additive toxicity with antimuscarinics, anticholinergics. Use cautiously in clients with history or risk of retinal detachment.
- F. Corticosteroids.
 - 1. **Use:** management of inflammatory eye conditions.
 - 2. **Caution:** Used to treat infectious ocular processes (avoid use in herpes simplex keratitis, fungal, and viral ocular infections as it may mask symptoms; diabetes, glaucoma, or epithelial compromise).
- G. Cycloplegic mydriatics.
 - 1. **Use:** management of uveitis.
 - 2. **Caution:** Use cautiously in clients with a history of glaucoma; systemic absorption may cause anticholinergic effects such as confusion, unusual behavior, flushing, hallucinations, slurred speech, drowsiness, tachycardia, dry mouth.

Gastrointestinal System

- A. Drugs affecting GI system act on muscular and glandular tissues.
- ◆ B. Antacids—counteract excess acidity.
 - 1. Have alkaline base.
 - 2. Used in the treatment of ulcers.
 - 3. Neutralize hydrochloric acid in the stomach.
 - 4. Given frequently (2-hour intervals or more often).
 - 5. May be given with water.
 - 6. May cause constipation, depending on type of medication.
 - 7. Baking soda is a systemic antacid which changes the pH balance in the body. Most other antacids coat the mucous membrane and neutralize hydrochloric acid.
- C. Emetics—produce vomiting (emesis).
- D. Antiemetics—blocks the body's response that produces nonbeneficial nausea and vomiting.

- ◆ E. H₂-receptor antagonists—block gastric acid secretion (e.g., cimetidine [may inhibit the absorption of warfarin], ranitidine).
- ◆ F. Antilulcer drugs—Sucralfate; give 1 hour AC and at HS; nonsystemic.
- G. Digestants—relieve enzyme deficiency by replacing secretions in digestive tract.
- H. Antidiarrheals prevent diarrhea by thickening the stool or by slowing intestinal spasms.
- I. Cathartics—affect intestine and produce defecation.
 1. Provide temporary relief for constipation.
 2. Rid bowel of contents before surgery, and prepare viscera for diagnostic studies.
 3. Counteract edema.
 4. Treat diseases of GI tract.
 5. Are contraindicated when abdominal pain is present.
 6. Classifications.
 - a. By degree of action.
 - (1) Laxative—mild action.
 - (2) Cathartic—moderate action.
 - (3) Purgative—severe action.
 - b. By method of action.

Respiratory System

- A. Drugs that act on respiratory tract, tissues, and cough center.
- B. Action is to suppress, relax, liquefy, and stimulate depth and rate of respiration.
- ◆ C. Bronchodilators—relax smooth muscle of trachea and bronchi.
 1. Sympathomimetics.
 - a. Taken PO or inhaled (fewer side effects).
 - b. Beta₂ agonists preferred (e.g., albuterol, metaproterenol).
 2. Anticholinergics (e.g., atropine sulfate by nebulizer or metered dose inhaler).
 3. Theophyllines.
 - a. Monitor serum levels.
 - b. Examples: theophylline PO, aminophylline IV.
 4. Anti-inflammatory agents—reduce bronchospasm.
 - a. Mast cell inhibitor (e.g., cromolyn sodium).
 - b. Corticosteroids (PO, IV, or inhaled).

Urinary System

- A. Drugs that act on kidneys and urinary tract.
- B. Action is to increase urine flow, destroy bacteria, and perform other important body functions.
- ◆ 1. Diuretics.

- a. Rid body of excess fluid and relieve edema associated with heart failure, pulmonary edema, certain renal diseases, cirrhosis, and liver failure.
- b. Increase sodium excretion resulting in water excretion from the kidneys.
- c. Some can result in significant loss of potassium, which can cause fatal cardiac arrhythmias. Some drugs that act on the GI tract and circulatory system also are diuretic in action.
- 2. Urinary antiseptics choice based on susceptible bacteria found in urine culture. Some drugs are more active with alkaline urine.
- 3. Acidifiers and alkalinizers—certain foods will also increase body acidity and alkalinity.
- 4. Urinary tract stimulant.
 - a. Increase contraction of the urinary bladder.
 - b. Used in postoperative nonobstructive urinary retention caused by neurogenic bladder.

Circulatory System

- A. Drugs that act on heart, blood, and blood vessels.
- B. Action is to change heart rhythm, rate, and force and to dilate or constrict vessels.
- ◆ 1. Cardiotonics—used for heart-strengthening.
 - a. Direct heart stimulants that speed heart rate (e.g., caffeine, adrenalin).
 - b. Indirect heart stimulants (e.g., digoxin).
 - (1) Stimulate vagus nerve.
 - (2) Slow heart rate and strengthen it.
 - (3) Improve cardiac output, thereby improving circulation.
 - (4) Do not administer if apical pulse below 60.
- ◆ 2. Cardioprotective drugs.
 - a. Beta-adrenergic blockers.
 - b. Calcium-entry blockers.
- ◆ 3. Antiarrhythmic drugs—used clinically to convert irregularities to a normal sinus rhythm.
- ◆ 4. Drugs that alter blood flow.
 - a. Anticoagulants—inhibit blood-clotting action (e.g., heparin, warfarin).
 - b. Thrombolytic agents (streptokinase, urokinase)—clot busters used to lyse already formed blood clots where ischemia may be fatal (myocardial infarction, pulmonary embolism, ischemic stroke, or arterial thrombosis). Very precise indications rule the use of these drugs, which are not free from serious side effects (bleeding).

- c. Platelet-inhibiting agents (aspirin, dipyridamole)—agents that decrease platelet aggregation and inhibit thrombus formation. Antiplatelet drugs are most effective for arterial clots that are composed largely of platelets.
- d. Vasodilators (nitroglycerine)—increase blood flow; can decrease ischemic episodes associated with activity if given prior to activity.
- e. Hemorrhagic agents (e.g., Trental [pentoxifylline])—help blood flow more easily through narrowed arteries, increasing the amount of oxygen delivered by the blood when the muscles need more (such as during exercise) thereby increasing walking distance/duration and decreasing pain.
- 5. Blood replacement.

DOSAGE AND PREPARATION FORMS

Solids

- A. Extract—obtained by dissolving drug in water or alcohol and allowing solution to evaporate; residue is the extract.
- B. Powder—finely ground drugs.
- C. Pill—common term for tablet; made by rolling drug and binder into a sphere.
- D. Suppository.
 - 1. Contains drugs mixed with a firm base.
 - 2. Liquefies at body temperature when inserted into orifice.
 - 3. Releases drug to produce a local or systemic effect.
- E. Ointment—semisolid mixture of drugs with a fatty base.
- F. Lozenge—flavored flat tablet that releases drug slowly when held in mouth.
- G. Medication patch.
 - 1. Premeasured medication paper (also called transdermal medication).
 - 2. Check manufacturer's directions for application.
- H. Capsule.
 - 1. Drugs in small, cylindrical gelatin containers that disguise the taste of the drug.
 - 2. Capsule can be opened and drug mixed with food or jam to mask taste.
- I. Tablets.
 - 1. Dried, powdered drugs that are compressed into a small disk, which easily disintegrates in water.
 - 2. Enteric coated—tablet does not dissolve until reaching intestines, where release of drug occurs.

Liquids

- A. Fluid extract.
 - 1. Concentrated fluid preparation of drugs produced by dissolving crude plant drug in a solvent.
 - 2. Strength of extract is such that 1 mL (about $\frac{1}{4}$ teaspoon or 15 to 16 gtt) represents 1 g of the drug at 100% strength.
- B. Tincture.
 - 1. Diluted alcoholic extract of a drug.
 - 2. Varies in strength from 10% to 20%.
- C. Spirit—preparation of volatile (easily vaporized) substances dissolved in alcohol.
- D. Syrup—drug contained in a concentrated sugar solution.
- E. Elixir—solution of drug made with alcohol, sugar, and some aromatic or pleasant-smelling substance.
- F. Suspension.
 - 1. Undissolved, finely divided particles of drug dispersed in a liquid.
 - 2. Shake all bottles of suspension well before giving.
- G. Emulsion—suspension of unmixed oils, fats, or petrolatum in water.
- H. Liniment and lotion—liquid suspension of medication applied to the skin.

Packaging Methods and Dispensing

- A. Unit dosage package method.
 - 1. Package contains premeasured amount of drug in proper form for administering.
 - 2. Procedures for delivery and storage vary from hospital to hospital.
 - 3. Nurse administers the medication to the client.
- B. Traditional method.
 - 1. Nurse prepares medication on the unit.
 - 2. Supplies come from stock or bulk on the ward or from client's multiple-dose bottle.
- C. The nurse is responsible for accuracy of the medication given, regardless of the packaging or dispensing method used.

ROUTES OF ADMINISTRATION

Oral Route

- A. Ingested (swallowed).
- B. Sublingual (under tongue).
- C. Buccal (on mucous membrane of cheek or tongue).

Rectal Route

- A. Suppository.
- B. Liquid (retention enema).

◆ Parenteral Route

- A. Intravenous.
 - 1. The response is fast and immediate.
 - 2. More than 5 mL medication can be given.
 - ◆ 3. Drug *must be* given slowly and usually in diluted form.
 - 4. Check medication leaflets to determine if medication route is IM or IV. Some drugs **but not all** are prepared to be given either IM or IV.
- B. Intradermal.
 - 1. Injected below the surface of the skin; usual site is inner aspect of forearm or scapular area of back.
 - 2. A short bevel 25–27 gauge, $\frac{3}{8}$ – $\frac{1}{2}$ -inch needle is used.
 - ◆ 3. Needle must be inserted with bevel up.
 - 4. This route is usually used to inject antigens for skin or tuberculin tests. It is sometimes used to check for medication allergy as the dermis has limited blood supply so absorption of drug injected is reduced and occurs very slowly. This method is not used for administration of medications.
 - 5. Amount injected ranges from 0.01 to 0.1 mL.
- C. Subcutaneous.
 - 1. A 25–29 gauge, $\frac{3}{8}$ – $\frac{5}{8}$ -inch needle is used.
 - 2. Injection site is the fatty layer under skin.
 - a. Abdomen—stay at least 2 inches away from the navel and/or any scars.
 - b. Lateral upper arm or thigh.
 - ◆ 3. This route is usually used for injecting medication that is to be absorbed slowly with a sustained effect.
 - 4. Amount injected ranges from 0.5 to 2 mL.
 - 5. Rotation of sites no longer necessary because newer human insulins have lower risk for hypertrophy.
 - 6. Several new technologies are available for administration of subcutaneous injections.
 - a. **Injection pens**—clients can use to self-administer medications (e.g., Epipen [epinephrine], insulin, interferon) subcutaneously.
 - b. **Needleless injection systems**—use high pressure to penetrate the skin with the medication into the subcutaneous tissue.
 - D. Continuous subcutaneous infusion (CSQI or CSCl).
 - 1. Fewer risks and less expense than IV administration, easy to operate.

- 2. Used for selected medications (e.g., opioids, insulin).
- 3. Improves oncologic and postoperative pain control in infants, children, and adults.
- 4. Use the needle with the shortest length and the smallest gauge necessary to establish and maintain the infusion.
- 5. Site selection depends on a client's activity level and the type of medication delivered. Avoid sites where the tubing of the pump could be disturbed.
- 6. Rotate sites used for medication administration at least every 2 to 7 days, or whenever complications such as leaking occur.
- 7. The CSQI route requires a computerized pump with safety features, including lockout intervals and warning alarms.
- 8. After initiating CSQI, immediately document medication administration details per policy in client's medical record.
- 9. Report adverse effects from medication or infection at insertion site according to agency policy.
- 10. Teaching.
 - a. Follow client teaching instructions that come with each pump.
 - b. Instruct client to wear medical alert bracelet along with medical information, including disease (e.g., diabetes), allergies, and a contact phone number for the pump manufacturer.
- 11. Pediatric.
 - a. CSQI used with insulin improves glycemic control in children and adolescents and offers greater flexibility for adolescents, placing the responsibility of diabetes management on the child.
 - b. Extensive child and family education is needed in using CSQI.
- 12. Gerontologic
 - a. CSQI delivers isotonic IV solutions to dehydrated older adults, known as *hypodermoclysis therapy*.
 - (1) Easy to use.
 - (2) Safe.
 - (3) Cost-effective alternative to IV hydration for older adults.
 - b. Avoids the need to transfer a client from home or a long-term care facility to an acute care hospital.
 - c. Infuse fluids slowly (e.g., 30 mL/hr) during the first hour of therapy.
 - (1) If the client remains comfortable, increase the rate of infusion.
 - (2) Infusion rates do not exceed 60 mL/hr.

13. Home care
- Clients need a responsible family caregiver.
 - Educate the client, family, and/or significant others about:
 - The desired effect of the medication.
 - Side effects and adverse effects of the medication.
 - Operation of the pump.
 - How to evaluate the effectiveness of the medication.
 - When and how to assess and rotate injection sites.
 - When to call a healthcare provider about problems.
 - Where and how to obtain and dispose of all required supplies.
 - Clients managing CSQI at home may use an antibacterial soap (e.g., Hibiclens, pHisoHex) instead of alcohol and chlorhexidine to clean the insertion site.
- E. Intramuscular
- Needle gauge and length will vary with site.
 - Deltoid—located by having client raise arm.
 - A 23- to 25-gauge, $\frac{5}{8}$ - to 1-inch needle is used.
 - Administer no more than 2 mL.
 - Thigh.
 - Needle must be long enough to reach muscle; may vary from 2 to 8 cm.
 - Needle gauge depends upon substance of medication.
 - Oil bases require 20 gauge; water bases require 22 gauge.
 - Absorption rate of IM medication dependent on circulation of person injected.
 - This route usually used for systemic effect of an irritating drug.
 - Amount of medication must not be over 5 mL, as absorption would be prolonged, difficult, and painful. It is best to limit to 3 mL.
 - Techniques for lessening pain for the client using an IM medication.
 - Reduce puncture pain by “darting” needle.
 - Prevent antiseptic from clinging to needle during insertion by waiting until skin antiseptic is dry.
 - If medication must be drawn through a rubber stopper, use a new needle for injection.
 - Avoid sensitive or hardened body areas.
 - After needle is under skin, aspirate to be certain that needle is not in a blood vessel.
 - Inject slowly.
 - Maintain grasp of syringe.
 - Withdraw needle quickly after injection.
 - Apply gentle pressure. Do not massage site as this will damage underlying tissue.
 - Z-track method of IM injection is the preferred method for administering IM injections because it prevents leakage, or tracking, of medication into the subcutaneous tissue. Displacement of the skin during the injection helps to seal the drug in the muscle. Other than lateral displacement of the skin, procedure for administration is same as for any IM injection including aspiration before injection, maximum amount to be injected.
 - Observe for side effects of medication following injection.

Other Routes

- Inhalation route.
- Topical route.

NURSE PRACTICE ACT GUIDELINES FOR DRUG ADMINISTRATION

- ♦ Nurses must not administer a specific drug unless allowed to do so by the particular state's Nurse Practice Act.
 - Nurses must not administer any drug without a specific physician order.
 - Nurses are to take every safety precaution in whatever they are doing.
 - Nurses are to be certain that employer's policy allows them to administer a specific drug.
 - Nurses must not administer a controlled substance if the physician's order is outdated.
 - A drug may not lawfully be administered unless all the above items are in effect.
 - Nurses are not permitted to fill prescriptions and in most states cannot write prescriptions.
- ♦ General rules for drug dispensing
- Never leave prepared medicines unattended.
 - Always report errors immediately.
 - Send labeled bottles or packages that are unintelligible back to pharmacist for relabeling.
 - Store internal and external medicines separately if possible.

MEDICATION ADMINISTRATION

Basic Guidelines for Medication Administration

- ♦ A. Determine the correct dosage, actions, side effects, and contraindications of any medication before administration.
- B. Determine if medications ordered by the physician are appropriate for client's condition. This is part of the nurse's professional responsibility.

- C. Question the physician about any medication orders that are incomplete, illegible, or inappropriate for the client's condition.
 - ◆ 1. Remember, the nurse may be liable if a medication error is made.
 - 2. Report every medication error to the physician and nursing administrator.
 - 3. Complete a medication incident report.
- D. Check to determine if the medication ordered is compatible with the client's condition and with other medications prescribed.
- E. Ascertain what the client has been eating or drinking before administering a medication.
 - 1. Determine what effect the client's diet has on the medication.
 - 2. Do not administer medication if contraindicated by diet. For example, do not give a monoamine oxidase (MAO) inhibitor to a client who has just ingested cheddar cheese or wine.
- F. Check that calculated drug dosage is accurate for the client, paying particular attention to young children, elderly people, or for very thin or obese clients. These age and weight groups require smaller or larger dosages.

THE SIX RIGHTS OF MEDICATION ADMINISTRATION

1. **Right medication.**
 - a. Compare drug card with drug label three times.
 - b. Know general purpose or action, dosage, method of administration.
 - c. Know side effects of drug.
2. **Right client.** Check ID band and have client state name. Use two client identifiers other than room number.
3. **Right time.** Give medication 30 minutes before or after ordered time.
4. **Right method or route of administration.**
5. **Right dose.**
 - a. Check all calculations of divided dosages with another nurse.
 - b. Check heparin, insulin, and IV digoxin doses with another nurse.
6. **Documentation** is now considered the sixth right. Document the drug name, dose, route, and time of administration. Client's reaction to the medication may also be included.

DOCUMENTATION OF MEDICATIONS

Medication Orders

- ◆ A. Medication administered to client must have a physician's order or prescription before it can be legally administered.
- B. Physician's order is a verbal or written order, recorded in a book, file, or client's chart or electronic medication/medical record.

- C. If order is given verbally over the telephone, nurse must write a verbal order in client's chart for the physician to sign at a later date per hospital policy.
- D. Written orders are safer—they leave less room for potential misunderstanding or error.
- ◆ E. Drug order should consist of seven parts.
 1. Name of the client.
 2. Date the drug was ordered.
 3. Name of the drug.
 4. Dosage.
 5. Route of administration and any special rules of administration.
 6. Time and frequency the drug should be given.
 7. Signature of the individual who ordered the drug.

Types of Medication Schedules

- A. Routine orders.
 1. Administered according to instructions until it is canceled by another order.
 2. Can also be used for PRN drugs.
 - a. Administered when client needs the medication.
 - b. Not given on a routine time schedule.
 3. Continued validity of any routine order should be assessed—physicians occasionally forget to cancel an order when it is no longer appropriate for client's condition.
- B. One-time orders.
 1. Administered as stated, only one time.
 2. Given at a specified time or "STAT," which means immediately.

Legal Implications of Medication Errors

- ◆ A. Nurse who prepares a medication must also give it to the client and chart it.
 1. If client refuses drug, chart that medication was refused—report this information to the physician per hospital policy.
 2. When charting medications, use the correct and approved abbreviations and symbols.
- ◆ B. If error in a drug order is found, it is the nurse's responsibility to question the order.
 1. If order cannot be understood or read, verify with the physician.
 2. Do not guess at the order as this constitutes gross negligence.
 3. In many hospitals it is the pharmacist's responsibility to contact physicians when medication orders are unclear.
 4. Even when drug dose is prepared by pharmacy, it is the nurse's responsibility to know correct drug and dose.

- C. Always report medication errors to the physician immediately.
 - 1. This action minimizes potential danger to the client.
 - 2. Measures can be taken immediately to assess and evaluate the client's status.
 - 3. A plan of action can be implemented to reverse the effects of the medication.
- D. Errors in medication are documented in an unusual occurrence or incident report and on the client's record.
 - 1. This action is necessary for both legal reasons and nursing audits.
 - 2. Nursing audits are conducted to determine problems in medication administration.
 - a. A particular source of problems.
 - b. A range of problems that seem to have no connection.

ADMINISTERING MEDICATIONS

If the facility has a computerized medication administration program, follow the steps to properly administer and document medications.

Oral Medication

Assessment

- A. Assess that oral route is the most efficient means of medication administration.
- B. Check medication orders for their completeness and accuracy.
- C. Research unfamiliar drugs.
- D. Review client's record for allergies, lab data, etc.
- ◆ E. Assess client's physical ability to take medication as ordered.
 - 1. Swallow reflex present.
 - 2. State of consciousness.
 - 3. Signs of nausea and vomiting.
 - 4. Uncooperative behavior.
- F. Check client's medication administration record (MAR) with previous day's MAR to make sure you have the correct medication for the client.
- G. Assess correct dosage when calculation is needed.

Implementation

- A. Preparing oral medications.
 - 1. Obtain client's MAR. Medication record may be a drug card, medication sheet, drug Kardex, or electronic medication sheet, depending on the method of dispensing medications in the hospital.
 - 2. Compare the MAR with the most recent physician's order.
 - 3. Perform hand hygiene.

- 4. Gather necessary equipment.
- 5. Follow the hospital/agency policy for administration with client identifiers, check for order and bar code scanning.
- 6. Retrieve the medication.
- 7. Compare the label on the bottle or drug package to the MAR. Scan bar code on drug package or bottle.
- 8. Correctly calculate dosage if necessary and check the dosage to be administered with another nurse.
- 9. Pour the medication from the bottle into the lid of the container and then into the medicine cup. With unit dosage, take drug package and place in medication cup. Do not remove drug from drug package.
- 10. Check medication label again to ensure correct drug and dosages.
- 11. Place medication cup on a tray, if not using medication cart.
- 12. Return the multidose vial bottle to the storage area. If medication to be given is a narcotic, sign out the narcotic record sheet with your name as directed per hospital policy.
- B. Administering oral medications to adults.
 - 1. Take medication to client's room; scan bar code on bracelet, scan bar code on medication package; check against medication card, sheet, or electronic record.
 - 2. Place client in sitting position, if not contraindicated by his or her condition.
 - 3. Tell the client what type of medication you are going to give and explain the actions this medication will produce.
 - ◆ 4. Check the client's identifying band and ask client to state name and date of birth so that you are sure you have correctly identified him or her.
 - 5. If prepackaged medication is used, read label, take medication out of package, and put into medication cup.
 - 6. Give the medication cup to the client.
 - 7. Offer a fresh glass of water or other liquid to aid swallowing, and give assistance with taking medications.
 - 8. Make sure the client swallows the medication.
 - 9. Discard used medicine cup.
 - 10. Position client for comfort.
 - 11. Record the medication on the appropriate forms.
- C. Administering oral medications to children.
 - ◆ 1. Follow the procedures for the previous intervention, keeping the following guidelines in mind.
 - a. Play techniques may help to elicit a young child's cooperation.

- b. Remember, the smaller the quantity of diluent (food or liquid), the greater the ease in eliciting the child's cooperation.
- c. Never use a child's favorite food or drink as an enticement when administering medication because the result may be the child's refusal to eat or drink these later.
- d. Be honest and tell the child that you have medicine, not candy.
- 2. Assess child for drug action and possible side effects.
- 3. Explain medication action and side effects to parents.

Narcotic Medication

- A. Check medication sheet for narcotic orders.
- B. Check dose and time last narcotic administered.
- C. Unlock and open narcotic drawer and find appropriate narcotic container.
- D. Follow agency/hospital policy for count prior to removing the medication for the client.
- ♦ E. Check narcotic sign-out sheet and be sure that number of narcotics matches number on sign-out sheets.
- F. Rectify situation before proceeding with narcotic administration if narcotics and sign-out sheets do not coincide.
- G. Sign out for narcotic on narcotic sheets, after taking narcotic out of drawer or cupboard.
- H. Lock drawer or cupboard after taking out medication.
- I. Sign out narcotics on MAR according to usual procedure.
- J. For unit narcotic stock, check narcotics every 8 hours.
 - 1. One off-going and one on-going nurse check the narcotics.
 - 2. Number of medications listed on sign-out sheets must match remaining number of narcotics.
 - 3. Each narcotic sheet is checked for accuracy.
- K. For automated dispensing system, enter ID code number and user password and continue with dispensing process.

♦ Patient-Controlled Analgesia

Patient-controlled analgesia (PCA) is a delivery system with which clients self-administer predetermined doses of analgesic medication to relieve their pain. It is a safe method of analgesic administration for acute and chronic pain, including conditions such as postoperative, cancer, and end-of-life pain.

- A. Advantages of PCA.
 - 1. Provides consistent level of pain control.

- 2. Allows client to self-administer pain medication.
- 3. Allows client to feel in control of pain management.
- 4. This method of administration:
 - a. Optimizes the daily management of postoperative pain.
 - b. Contains the following variables that are determined and set based on client individual characteristics and needs. These include:
 - (1) Initial load.
 - (2) Loading dose.
 - (3) Demand dose.
 - (4) Lockout interval to prevent overdosing.
 - (5) Background infusion rate and 1-hour or 4-hour limits.
 - (6) May be programmed to deliver continuous infusion, a bolus dose, or both.
 - c. Concerns include errors and pump failure.
- B. Procedure.
 - 1. PCA infuser pump is prepared and attached to IV.
 - 2. Morphine sulfate or Dilaudid (hydromorphone) is delivered in loading dose as ordered and initiates pain management.
 - 3. Client is instructed in PCA use and continues to self-administer narcotic.
 - 4. Dose calculation is double checked with another RN.
 - a. PCA infuser delivers in milliliters.
 - b. Maximum rate of administration is based on client needs with preset maximum.
 - c. Four-hour limit is set for infuser.
- C. Recording and reporting.
 - 1. Record drug, concentration, dose, time started, lockout time, and amount of IV solution infused and remaining solution. Many agencies have special PCA documentation forms.
 - 2. Record regular assessment of client response to analgesia on PCA medication form, in nurses' notes, on pain assessment flow sheet, or on other documentation according to institutional policy.
 - 3. Teaching
 - a. Give instructions while client is pain free or in pain-reduced state—preop is best.
 - b. Push PCA button at first pain indication.
 - c. Inform client of nonpharmacologic strategies to help relieve pain.
 - d. Only the client pushes the button, not family and friends.

- e. Explain regimen to the family so they can support and help the client (but not push the button for the client).
- f. Inform client and family that client will not overdose with PCA if only the client pushes the button.
- 4. Gerontologic considerations.
 - a. Dosage considerations.
 - (1) Reduced renal and liver function slows opioid metabolism and excretion, causing a faster peak effect and a longer duration of action of the opioid.
 - (2) Start low and titrate upward slowly until pain relief is achieved.
 - b. Adjust PCA use if client becomes confused.
 - c. Get orders to lower the dose, lengthen the lockout, or add a nonopioid analgesic to reduce the opioid dose.
 - d. Confusion may be caused by pain rather than by the medications.
- 5. Pediatric.
 - a. PCA is an effective means of pain control in children as young as 5 years old who can understand the concept.
 - b. Must consider a client's developmental and cognitive levels and motor skills.
 - c. Particularly effective with adolescents because it leads to feelings of control.
 - (1) Epidural analgesia: used for acute pain during labor, after surgery; chronic pain.
 - (2) Safe, efficient; rarely complications.
 - (3) Administered into the epidural space that contains a network of vessels, nerves, and fat.
 - (4) Analgesic is distributed by diffusion through the dura mater into the cerebrospinal fluid, by blood vessels in the epidural space.
 - (5) Analgesic acts by binding to opiate receptors in the dorsal horn of the spinal column blocking transmission of the pain impulse to the cerebral cortex.

PARENTERAL MEDICATIONS

Assessment

- A. Determine appropriate method for administration of drug.
 - 1. Intradermal (intracutaneous): Injection is made below surface of the skin; 25–27-gauge, $\frac{3}{8}$ – $\frac{1}{2}$ -inch needle; 0.01 to 0.1 mL.

- 2. Subcutaneous: Small amount of fluid is injected beneath the skin in the loose connective tissues; 25–29-gauge, $\frac{3}{8}$ – $\frac{5}{8}$ -inch needle; to 2 mL.
- 3. Intramuscular: Larger amount of fluid is injected into large muscle masses in the body; 23–25-gauge, $\frac{5}{8}$ –1-inch needle; up to 2 mL for deltoid and 5 mL for other sites; 21–22 gauge ($1\frac{1}{2}$) needles may be used for deep IM.
- 4. Intravenous: Medication is injected or infused directly into a vein—route used when immediate drug effect is desired.
- B. Evaluate condition of administration site for presence of lesions, rash, inflammation, lipodystrophy, ecchymosis, and other problems.
 - 1. Ventrogluteal site (client side-lying).
 - 2. Vastus lateralis site (supine with thigh available).
 - 3. Deltoid site (exposed upper arm).
- C. Assess for tissue damage from previous injections.
- ◆ D. Assess client's level of consciousness.
 - 1. **For client in shock:** Certain methods (subcutaneous) will not be used.
 - 2. **For presence of anxiety:** Make sure client is allowed to express his or her fear of injections and offer explanations of ways in which injections will be less frightening.
 - ◆ E. Check client's written and verbal history for past allergic reactions. Do not rely solely on client's chart.
 - F. Review client's chart noting previous injection sites, especially insulin and heparin administration sites.
 - G. Check label on medication bottle to determine if medication can be administered via route ordered.

SPECIAL CONSIDERATIONS FOR ADMINISTRATION OF INSULIN

- A. Clients choose one anatomic area to be used (e.g., the abdomen).
- B. Systematically rotate sites within that region to maintain consistent insulin absorption from day to day.
- C. When healthcare providers plan insulin injection times, blood glucose levels are used to determine when the client will eat.
- D. Knowing the peak action and duration of the insulin is essential when developing an effective diabetes management plan to stabilize blood sugar.

SPECIAL CONSIDERATIONS FOR ADMINISTRATION OF HEPARIN

- A. Provides therapeutic anticoagulation.
- B. Reduces the risk for thrombus formation by suppressing clot formation.
- C. Results from coagulation blood tests (e.g., activated partial thromboplastin time [aPTT] and partial thromboplastin time [PTT]) allow you to monitor the desired therapeutic range for IV heparin therapy.

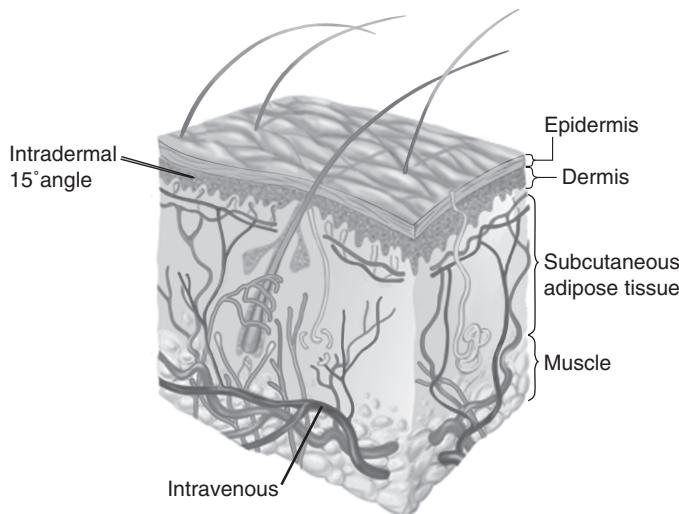


Figure 5-1 Insert needle at 15-degree angle under the epidermis for intradermal injection.

- D. Before administering:
 - 1. Assess for preexisting conditions that contraindicate its use, including cerebral or aortic aneurysm, cerebrovascular hemorrhage, severe hypertension, and blood dyscrasias.
 - 2. Assess for conditions in which increased risk for hemorrhage is present.

- Implementation**
- A. Preparing medications.
 - 1. Perform hand hygiene.
 - 2. Obtain equipment for injection: safety needle and syringe, antimicrobial wipes, medication cart or dispenser.
 - 3. Select the appropriate size needle, considering the size of the client's muscle mass and the viscosity of the medication.
 - 4. Open the wipe and cleanse top of vial or break top of ampule.
 - 5. Remove the needle guard. If using ampule, use filter needle to reduce the risk of shattered glass being injected.
 - 6. Pull back on barrel of syringe to markings where medication will be inserted.
 - 7. Pick up vial, insert needle into vial, and inject air in an amount equal to the solution to be withdrawn by pushing barrel of syringe down. If using an ampule, break off top at colored line, insert syringe with a filter needle attached, but do not inject air into ampule.
 - 8. Extract the desired amount of fluid. Remove needle from container and cover needle with guard. Filter needle must be changed to the correct size and length for the type of administration.

- B. Administering intradermal injections (if facility has computerized medication administration program follow the steps to administer properly).
 - 9. Double-check drug and dosage against drug card or medication sheet and vial or ampule.
 - 10. Place syringe on tray.
 - 11. Check label and drug card or medication sheet for accuracy before returning multidose vial to correct storage area.
 - 12. Return multidose vial to correct storage area or discard used vial or ampule.
 - 13. Activate safety needle and discard supplies in appropriate container.
 - 14. Chart the medication and site used.

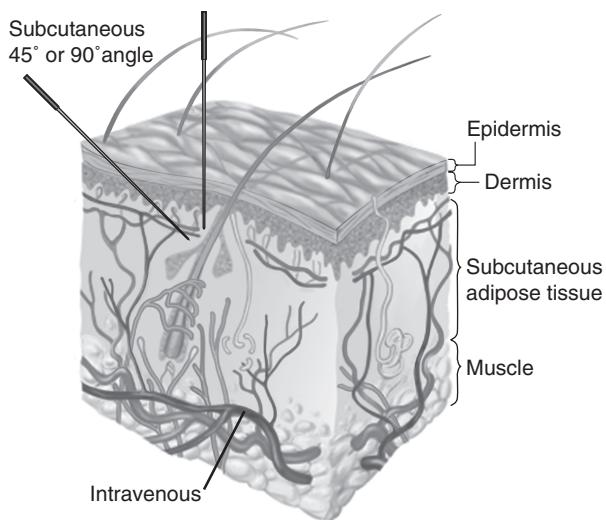


Figure 5-2 Insert needle at 45- or 90-degree angle for subcutaneous injection.

- C. Administering subcutaneous (SUB Q) injections.
 1. Take medication to client's room.
 2. Set tray on a clean surface, not the bed.
 3. Check client's identifying band and ask client to state name and date of birth.
 4. Explain action of medication and procedure of administration.
 5. Provide privacy when injection site is other than on the arm.
 6. Perform hand hygiene and don gloves.
 7. Select site for injection by identifying anatomical landmarks. Remember to alternate sites each time injections are given.
 8. Cleanse area with antimicrobial wipe. Using a circular motion, cleanse from inside outward.
 9. Take off needle guard.
 10. Express any air bubbles from syringe.
 11. Insert the needle at a 45- or 90-degree angle. (See **Figure 5-2**.)
 12. Inject the medication slowly.
 13. Withdraw needle quickly and massage area with wipe to aid absorption and lessen bleeding. Do not massage after administering certain drugs, e.g., heparin, insulin. Put on bandage if needed.
 14. Activate needle safety feature and discard in puncture-proof container.
 15. Return client to a position of comfort.
 16. Chart the medication and site used.
- ◆ D. Administering insulin injections: Be sure to check policy to see if another RN must verify.
 1. Gather equipment and check medication orders and injection site. Opened insulin does not need to be refrigerated.

2. Perform hand hygiene.
3. Obtain specific insulin syringe for strength of insulin being administered (U50 or U100).
4. Rotate insulin bottle between hands to bring solution into suspension.
5. Wipe top of insulin bottle with antimicrobial swab.
6. Take off needle guard.
7. Pull plunger of syringe down to desired amount of medication and inject that amount of air into the insulin bottle.
8. Draw up ordered amount of insulin into syringe.
9. Expel air from syringe.
10. Replace needle guard.
11. Check medication card, bottle, and syringe with another RN for accuracy.
12. Take medication to client's room.
13. Double-check site of last injection with client.
- ◆ 14. Rotating injection site from one body area to another is no longer recommended due to variation in insulin absorption and action.
 - a. Move injection site one inch from previous site.
 - b. Absorption is most predictable in abdomen.
 - c. Avoid injecting into extremity.
15. Provide privacy.
16. Perform hand hygiene.
17. Follow protocol for administration of medications by subcutaneous injections.
- ◆ E. Administering intramuscular (IM) injections.
 1. Take medication to client's room. Check room number against medication card or sheet.
 2. Set tray on a clean surface, not the bed.
 3. Explain the procedure to client.
 4. Check client's identifying band and have client state name and date of birth
 5. Provide privacy for client.
 6. Perform hand hygiene and don gloves.
 7. Select the site of injection by identifying anatomical landmarks. (See **Figure 5-3**.) Remember to alternate sites each time injections are given.
 8. Cleanse the area with antimicrobial wipe. Using a circular motion, cleanse from inside outward.
 9. Hold the syringe; take off needle cover.
 10. Express air bubbles from syringe. Some clinicians suggest leaving a small air bubble at the tip so that all medicine will be expelled.
 11. Insert the needle at 90-degree angle. (See **Figure 5-3**.)
 12. Pull back on plunger. If blood returns, you know you have entered a blood vessel;

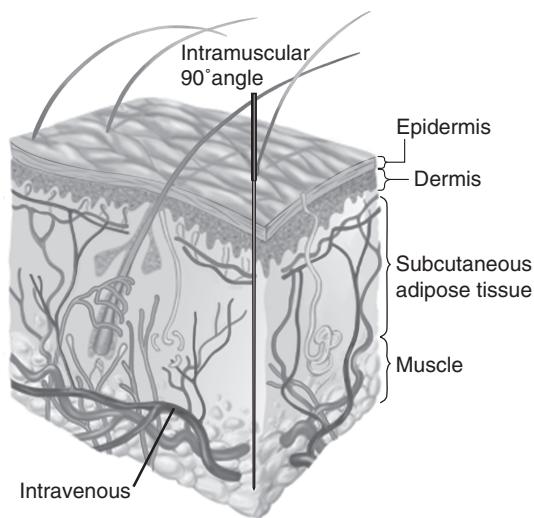


Figure 5-3 Insert needle at 90-degree angle and deep into muscle tissue for intramuscular injections.

textbooks advocate discarding all equipment and medication and starting over with new syringe and medication.

13. Inject the medication slowly.
14. Withdraw the needle, activate safety feature, and apply pressure to area while massaging with alcohol wipe. Put on a bandage, if needed.
15. Return client to a comfortable position.
16. Discard supplies in appropriate area.
17. Chart the medication and site used.

HERB-DRUG INTERACTIONS

- A. Mixing herbs with traditional medicines may increase or decrease the effects—in some cases this can be dangerous.
 1. Unlike prescription medicines, herbal products are not regulated by the Food and Drug Administration (FDA).
 2. More than 60 million Americans spend \$4 billion annually on herbs; more than 15 million adults are at risk for potential drug-herb interactions.
 3. **Table 5-1** lists some of the most popular herbs and their interactions with specific drugs.

Table 5-1 ALTERNATIVE NURSING: HERB-DRUG INTERACTIONS

Herb	Action	Side Effects	Drug Interaction	Drugs Affected
Black cohosh	An herb for females, especially during menopause for hot flashes—maintains healthy levels of luteinizing hormone Decreases menstrual discomfort Sedative, diuretic Lowers blood pressure	Overdose may cause nausea, vomiting, headache, dizziness, tremors, and depressed heart rate	Increases effects of drugs—especially synthetic hormones Congestive heart failure clients and pregnant women should not use this herb	Hormone replacement therapy (HRT) Contraceptives Heart/cardiac medications
Echinacea	Immunostimulant Treatment for colds (URIs) and influenza Bladder infections Blood purifier Helps preserve white cells during radiation treatment	Possible, but not common: diarrhea, heartburn, intestinal upset, skin rash	Stimulates immune system and may alter effect of certain drugs Do not use if clients are taking immunosuppressants or have AIDS, or if they are pregnant	Anabolic steroids Amiodarone Methotrexate Ketoconazole
Ephedra (ma huang)	Promotes weight loss and acts as a stimulant (asthma) Considered toxic by FDA	Stimulant, insomnia, headaches, nervousness, seizures, death	Heart attack, seizure, or death Additive effect; increased thermogenesis (related to stimulants/coffee) Elevation of BP (related to MAO inhibitors) Reduces drug action—may cause arrhythmias Increased steroid drug clearance/may reduce effectiveness	Decongestants (Actifed, Dristan, Sinutab, Sudafed) Stimulants—caffeine MAO inhibitors Beta blockers Cardiac glycosides Steroids (anti-inflammatories)
Feverfew	Eases pain and nausea of migraine headaches Prevents blood vessel spasms Interferes with action of platelets (which clump together to form clots) Lowers blood pressure	Nervousness, insomnia, and tiredness Gastrointestinal symptoms	Severe bleeding Pregnant women, children under age 2, and people taking drugs as listed should not take this herb	Coumadin (warfarin) Aspirin NSAIDs (ibuprofen)

(Continues)

Table 5-1 ALTERNATIVE NURSING: HERB-DRUG INTERACTIONS (Continued)

Herb	Action	Side Effects	Drug Interaction	Drugs Affected
Garlic	Contains allicin, a natural antibiotic—effective against bacteria and viruses Lowers total cholesterol and increases HDL Reduces blood pressure Reduces blood clot formation (when arteries are narrowed)	Intestinal problems—upset stomach, heartburn, strong garlic odor Sedative effect to treat anxiety	Excessive thinning of blood (bleeding) when used with blood thinners	Warfarin Aspirin Antihypertensives NSAIDs Clients who have blood disorders should use this herb with caution
Ginger	Relieves nausea associated with seasickness, motion sickness, or anesthesia Digestive aid; increased secretion of bile Reduces side effects of chemotherapy Reduces congestion and fevers Supports cardiovascular system	Heartburn	Excessive thinning of blood (bleeding) when used with blood thinners Interferes with platelet action Increases gut absorption (may increase drug bioavailability)	Warfarin Take cautiously with all cardiac or diabetic medications; blood pressure therapy
Ginkgo biloba	Improves circulation by thinning blood Enhances flow of oxygen and blood to brain Improves memory and mental function May delay progression of Alzheimer's disease (jury still out) Asthma, peripheral vascular disease	Headache Indigestion, nausea Nervousness Allergic skin reactions	Anticoagulant effect and may cause spontaneous or excessive bleeding Those with blood clotting disorders should not take this drug	Aspirin NSAIDs Cox-2 inhibitors Coumadin (warfarin) Vitamin K antagonists Diuretics
Siberian ginseng	Tonic, boosts energy and stamina Reduces stress Improves sexual performance, regulates hormones Strengthens immune system Raises "good" cholesterol, HDL Protects against heart attacks Preventive for aging	Insomnia, hypertension Low blood glucose Affects insulin level Allergy symptoms Increased alcohol clearance Diarrhea	Increases anticoagulant effect and bleeding Headache, manic behavior Monitoring effect of drug may be difficult—may increase digoxin levels Stimulates alcohol metabolism Those who have blood-clotting problems, high blood pressure, asthma or emphysema, and children and pregnant women should not take this herb Improves blood sugar and diabetic symptoms (could reduce amount of insulin needed)	Coumadin (warfarin) Aspirin NSAIDs Nardil (MAO inhibitor) Lanoxin (digoxin) Alcohol Insulin Antidepressants (phenelzine sulfate)
Kava kava	Sedative effect to treat anxiety	GI problems, liver problems (even failure has been reported) Allergic skin reaction	Sedation, and even coma when taken with certain drugs	Sleeping meds Antipsychotics Alcohol Xanax (alprazolam; antidepressant) Drugs treating Parkinson's disease
Licorice root	Helps steroid drug withdrawal Helps to heal gastric ulcers Diuretic effect	Raises blood pressure Headache Lethargy Cardiac dysfunction	Potentiates drug levels and offsets effects of NSAIDs Antibiotics reduce herb activity Diuretic effect could result in decreased potassium leading to toxicity, electrolyte imbalance Increased sensitivity to digoxin or other cardiac glycosides Pregnant and nursing women, and those with glaucoma, hypertension, stroke, and heart disease should not take this herb	Corticosteroids Thiazides Oral contraceptives Antibiotics

Table 5-1 ALTERNATIVE NURSING: HERB-DRUG INTERACTIONS

Herb	Action	Side Effects	Drug Interaction	Drugs Affected
Saw palmetto	Supports health of prostate gland—benign prostatic hypertrophy Improves urine flow Maintains healthy testosterone metabolism Anti-inflammatory	Relatively few: mild nausea, gastrointestinal disturbance, hypertension, headache	The safety profile of this herb is very good—no known drug interactions	
Silymarin (milk thistle)	Increases liver detoxification capacity Supports liver function Protects liver from drug damage	Nausea, GI disturbance	Reduces drug toxicity to liver and protects liver from drug damage Reduces toxic side effects of chemotherapy Potentially dangerous for transplant clients—reduces levels of immunosuppressives	Aspirin Alcohol Chemotherapy
St. John's wort	Relieves mild to moderate depression by countering monamine oxidase (avoid same foods—tyramine—as if taking an MAO inhibitor) Immune stimulating properties—useful with AIDS because it is antiviral Helps bruises and hemorrhoids	Dry mouth, dizziness, fatigue, digestive problems (fewer side effects than prescription antidepressants) Sensitivity to light	Decreases immunosuppressant therapy Additive serotonin-like effects—serotonin syndrome (serious condition: fever, dizziness, sweating) Could affect action of epilepsy drugs Clients with hypertension and those on immunosuppressive therapy should not use this herb	Tetracyclines Cyclosporine Digoxin Oral contraceptives Zoloft and anti-depressants Other SSRIs Anticonvulsants Warfarin
Valerian	Quiets and calms neurological system Promotes sleep Used for headache, anxiety, and nervousness	Restlessness, headache, giddiness, nausea, and blurred vision	Use may be affected by alcohol or barbiturates—use cautiously Not for children younger than 2 years Effect may be enhanced with sleeping tablets Additive effect—may be used to wean off drugs (diazepam)	Alcohol Barbiturates Sleeping tablets Benzodiazepines

- B. On the whole, herbal medicine is safe and a gentle form of therapy. However, if the health problem is serious or the person is taking strong orthodox medications, teaching is indicated.
- C. Client teaching with herbs.
1. When completing a nursing history, ask about taking herbs.
 2. Educate yourself about herbs—check for known side effects, drug interactions, and potential risk with certain drugs.
 3. Remind the client to tell his or her physician about any herbs being taken.
- D. The top five herbs clients take but do not tell their physicians about:
1. Black cohosh.
 2. Echinacea.
 3. Ginkgo biloba.
 4. Saw palmetto.
 5. St. John's wort.

Source: Crock, R. (September 2003). Herbal medicine consultant.

GOVERNING LAWS

Federal Food, Drug, and Cosmetic Act of 1938

- A. The act is an update of the Food and Drug Act first passed in 1906.
- B. It designates *United States Pharmacopeia* and *National Formulary* as official standards.
- C. The government has the power to enforce standards.
- D. Provisions of the act.
 1. Drug manufacturer must provide adequate evidence of drug's safety.
 2. Correct labeling and packaging of drugs.
- E. Amended in 1952 to include control of barbiturates by restricting prescription refills.
- F. Amended in 1962 to require substantial investigation of drug and evidence that drug is effective in terms of labeling claims.

Harrison Narcotic Act of 1914

- A. Provisions of the act.
 - 1. Regulates manufacture, importation, and sale of opium, cocaine, and their derivatives.
 - 2. Amendments have added addictive synthetic drugs to the regulated drug listing.
- B. Applications of the act.
 - 1. Individuals who produce, sell, dispense (pharmacists), and prescribe (dentists, physicians) these drugs must be licensed and registered; prescriptions must be in triplicate.
 - 2. Hospitals order drugs on special blanks that bear hospital registry number. The following information is recorded for each dose:
 - a. Name of drug.
 - b. Amount of drug.
 - c. Date and time drug obtained.
 - d. Name of physician prescribing drug.
 - e. Name of client receiving drug.
 - f. Nurse's signature and type of license (RN, LVN, or LPN).

Controlled Substance Act of 1970

- A. Provisions of the act.
 - 1. Regulates potentially addictive drugs as to prescription, use, and possession.
 - a. Regulations refer to use in hospital, office, research, and emergency situations.
 - b. Regulations cover narcotics, cocaine, amphetamines, hallucinogens, barbiturates, and other sedatives.
 - 2. Controlled drugs are placed in five different schedules or categorical listings, each governed by different regulations.
 - a. The regulations govern manufacture, transport, and storage of the controlled drugs.
 - b. The use of the drugs is controlled as to prescription, authorization, the mode of dispensation, and administration.
- B. Application of the act for use of controlled drugs in hospitals.
 - 1. The nurse is to keep the stock supply of controlled drugs under lock and key.
 - a. Nurse must sign for each dose (tablet, mL) of drug.
 - b. Key is held by the nurse responsible for administration of medication.
 - c. At the end of each shift, nurse must account for all controlled drugs in the stock supply.

- 2. Violations of the Controlled Substance Act.
 - a. Violations are punishable by fine, imprisonment, or both.
 - b. Nurses, upon conviction of violation, are subject to losing their licenses to practice nursing.

Prescription and Medication Orders

- A. A prescription is a written order for dispensation of drugs that can be used only under a licensed independent practitioner (LIP) or a physician's supervision.
- B. Prescriptions outside the hospital.
 - 1. Formula to pharmacist for dispensing drugs to client.
 - 2. Consists of four parts.
 - a. Superscription (symbolized by Rx, meaning "take").
 - (1) Client's name.
 - (2) Client's address (required only for controlled drugs).
 - (3) Age (required only if age is a factor in the dose preparation).
 - (4) Date (must always be included).
 - b. Inscription.
 - (1) Specifies ingredients and their quantities.
 - (2) May specify other ingredients necessary to a specific drug form.
 - c. Subscription—directions to the pharmacist as to method of preparation.
 - d. Signature—consists of two parts.
 - (1) Accurate instructions to client as to when, how, and in what quantities to take medication; typed on label.
 - (2) Physician's signature and refill instructions.
 - C. Orders inside the hospital.
 - 1. Physician writes medication order in book, file, or client's chart; if given over phone, nurse writes verbal order that physician later signs.
 - 2. An order consists of six parts.
 - a. Name of drug.
 - b. Dosage.
 - c. Route of administration with time drug was or is to be given.
 - d. Reason drug is required (not always included).
 - e. Length of time client is to receive drug (not always included).
 - f. Signature of individual who ordered drug.

Example: Aspirin 325 mg × PO q3h for pain for 3 days.

D. Smith, M.D.

INFORMATIONAL RESOURCES

Official Publications

- A. A drug listed in the following publications is designated as official by the Federal Food, Drug, and Cosmetic Act (FDC).
 - 1. *United States Pharmacopeia* (USP).
 - 2. *National Formulary* (NF).
 - 3. *Homeopathic Pharmacopeia of the United States*.
- B. These publications establish standards of purity and other criteria for product acceptability; these standards are binding according to law.
- C. Publications contain information on each drug entry.
 - 1. Source.
 - 2. Chemical and physical composition.
 - 3. Method of storage.
 - 4. General type or category.
 - 5. Range of dosage and usual therapeutic dosage.

Appendix 5-1. SYSTEMS OF MEASUREMENT

Metric System

- A. French-invented system based on rationally and related derived units.
 - 1. Developed in the eighteenth century.
 - 2. Basic units of measure used in drug administration are the gram and liter.
 - 3. Other units are decimal, fractions, and Arabic numerals.
 - 4. Number and fraction placed before symbol.
- B. Common metric measures and symbols.

gram	g, gm, or G
kilogram	kg
milligram	mg
milliliter	mL
liter	L or l

Other Publications

- A. *American Hospital Formulary* is a publication indexed by generic and proprietary names.
- B. *Physicians' Desk Reference* (PDR).
 - 1. Annual publication with quarterly supplements.
 - 2. Handy source of information about dosage and drug precautions.

Miscellaneous Resources

- A. Package inserts from manufacturers that accompany the product.
- B. Pharmacist.
- C. Physician.
- D. Nursing journals.
- E. Pharmaceutical and medical treatment texts.

- C. Weight and volume equivalents with corresponding symbols.

$$\begin{array}{ll} 1 \text{ gram} = 1000 \text{ milligrams} & 1 \text{ g} = 1000 \text{ mg} \\ 1 \text{ liter} = 1000 \text{ milliliters} & 1 \text{ L} = 1000 \text{ mL} \end{array}$$

Household System

- A. System based on familiar measures used in the home.
 - 1. Most measures not sufficiently accurate for measure of medicines.
- B. Common household measures and their abbreviations.

$$\begin{array}{llll} \text{pint} & \text{pt} & \text{tablespoon} & \text{T} \\ \text{teaspoon} & \text{t/tsp} & \text{quart} & \text{qt} \end{array}$$

Appendix 5-2. MATHEMATIC CONVERSIONS

Approximate Equivalents

- A. The metric system is the universal system of weights and measures.
- B. If there is occasion to compute, have computations checked by another licensed nurse.
 - 1. Do not compute unless allowed to do so by your state's Nurse Practice Act.
 - 2. Check hospital policy for further guidelines.

Computation

- A. Drugs are not always labeled clearly as to number of tablets to administer, so computation may be necessary. Always have your computation checked by another licensed nurse.

- B. Method.

1. Both desired (ordered) dose and dose on hand must be in same unit of measurement (e.g., grams, milligrams).
2. If not the same, convert so that unit of measure is the same.
3. After converting, divide desired dose by dose on hand to find amount to administer.

◆ Calculation of Dosages

- A. Calculating oral dosages of drugs.
 - 1. To calculate oral dosages, use the following formula:

$$\frac{D}{H} = x$$

(Continues)

Appendix 5-2. MATHEMATIC CONVERSIONS (Continued)

where D = dose desired

H = dose on hand

x = dose to be administered

Example: Give 500 mg of ampicillin when the dose on hand is in capsules containing 250 mg.

$$\frac{500 \text{ mg}}{250 \text{ mg}} = 2 \text{ capsules}$$

2. To calculate oral dosages of liquids, use the following formula:

$$\frac{D}{H} \cdot Q = x$$

where D = dose desired

H = dose on hand

Q = quantity

x = dose to be administered

Example: Give 375 mg of ampicillin when it is supplied as 250 mg/5 mL.

$$\frac{375 \text{ mg}}{250 \text{ mg}} \cdot .5$$

$$1.5 \cdot 5 = 7.5 \text{ mL}$$

You can also set up a direct proportion and, following the algebraic principle, cross multiply:

$$\frac{375 \text{ mg}}{x} = \frac{250 \text{ mg}}{5 \text{ mL}}$$

$$250 \times = 1875$$

$$x = 7.5 \text{ mL}$$

(of strength 250 mg/5 mL)

B. Calculating parenteral dosages of drugs.

1. To calculate parenteral dosages, use the following formula:

$$\frac{D}{H} \cdot Q = x$$

Example: Give the client 40 mg gentamicin.

On hand is a multidose vial with a strength of 80 mg/2 mL.

$$\frac{40}{80} \times 2 = 1 \text{ mL}$$

2. Check your calculations before drawing up the medication.

◆ **Calculation of Solutions**

A. Types of solutions.

- Volume to volume (v/v): A given volume of solute is added to a given volume solvent.
- Weight to weight (w/w): A stated weight of solute is dissolved in a stated weight of solvent.
- Weight to volume (w/v): A given weight of solute is dissolved in a given volume of solvent, which results in the proper amount of solution.

B. Preparing solutions.

1. Solutions of varying strengths.

- Determine the strength of the solution, the strength of the drug on hand, and the quantity of solution required.
- Use this formula for preparing solutions:

$$\frac{D}{H} \cdot Q = x$$

where D = desired strength

H = strength on hand

Q = quantity of solution desired

x = amount of solute

2. Example: You have a 100% solution of hydrogen peroxide on hand. You need a liter of 50% solution.

$$\frac{(D)}{(H)} \cdot \frac{50\%}{100\%} \cdot (Q) 1000 \text{ mL} = (x) 500 \text{ mL} \text{ (solute)}$$

Add 500 mL of the solute to an additional 500 mL of desired solvent to make 1 liter of 50% solution.

- C. If the strength desired and strength on hand are not in like terms, you need to change one of the terms.

- Example: You have 1 liter of 50% solution on hand. You need a liter of 1:10 solution. 1:10 solution is the same as 10%.

$$\frac{10\%}{50\%} \cdot 1000 \text{ mL} = 200 \text{ mL}$$

Add 200 mL of the drug to 800 mL of the solvent to make 1 liter of 10% solution.

2. Volume to volume solutions. Use the formula:

$$\frac{D}{H} \cdot Q = x$$

where x = amount of stock solution used

Appendix 5-3. ABBREVIATIONS AND SYMBOLS FOR ORDERS, PRESCRIPTIONS, AND LABELS

aa	of each	PC	after meals
AC	before meals	per	by, through
ad lib	freely, as desired	PO	by mouth
Ba	barium	PRN	whenever necessary
BID	twice each day	QH	every hour
c	with	QID	four times each day
C	carbon	qs	as much as required
Ca	calcium	q2h	every 2 hours
Cl	chlorine	q3h	every 3 hours
et	and	q4h	every 4 hours
GI	gastrointestinal	Rx	treatment, "take thou"
gt or gtt	drop(s)	s	without
H ₂ O	water	STAT	immediately
H ₂ O ₂	hydrogen peroxide	TID	three times a day
IM	intramuscular	tsp	teaspoon
in	inch	WBC	white blood cell
K	potassium	°	degree
lb or #	pound	-	minus, negative, alkaline reaction
Mg	magnesium	+	plus, positive, acid reaction
N	nitrogen, normal	%	percent
Na	sodium	v	Roman numeral five
NPO	nothing by mouth	vii	Roman numeral seven
oob	out of bed	ix	Roman numeral nine
os	mouth	xiii	Roman numeral thirteen

Adapted from: 2005 Nursing Spectrum drug handbook. Available at www.nursesdrughandbook.com.**Appendix 5-4. HOUSEHOLD EQUIVALENTS (VOLUME)**

Metric	Household	30 mL	2 tablespoonfuls
0.06 mL	1 drop	180 mL	1 teacupful
5(4) mL	1 teaspoonful	240 mL	1 glassful
15 mL	1 tablespoonful		

Appendix 5-5. MOST COMMONLY USED DRUGS**Medical–Surgical Nursing**

- Tylenol (acetaminophen)
- Cordarone (**amiodarone HCl**)
- Amoxil (amoxicillin)
- Lipitor (atorvastatin calcium)
- Zithromax (**azithromycin**)
- Cipro (ciprofloxacin)
- Cleocin (clindamycin)
- Klonopin (clonazepam)
- Codeine
- Flexeril (cyclobenzaprine)
- Diltiazem (diltiazem hydrochloride)
- Intropin (dopamine)
- Doryx (doxycycline)
- Dyazide (hydrochlorothiazide and triamterene)
- Vasotec (enalapril)

- Epinephrine (adrenalin)
- Lasix (furosemide)
- Neurontin (gabapentin)
- Heparin sodium
- Esidix (hydrochlorothiazide)
- Advil, Motrin (ibuprofen)
- Insulin
- Levaquin (levofloxacin)
- Zestril (lisinopril)
- Claritin (loratadine)
- Ativan (lorazepam)
- Cozaar (losartan)
- Lyrica (pregabalin)
- Glucophage (metformin)
- Lopressor (metoprolol)
- Morphine sulfate

(Continues)

Appendix 5-5. MOST COMMONLY USED DRUGS (Continued)

- Aleve, Naprosyn (naproxen)
- Nitroglycerine
- Prilosec (omeprazole)
- Oxycontin (oxycodone)
- Protonix (pantoprazole)
- Potassium chloride
- Prednisone
- Ultram (tramadol)
- Viagra (sildenafil citrate)

Psychiatric/Mental Health

- Abilify (aripiprazole)
- Ativan (lorazepam)
- Buspar (buspirone HCl)
- Celexa (citalopram)
- Concerta (methylphenidate ER)
- Cymbalta (duloxetine)
- Desyrel (trazodone HCl)
- Effexor (venlafaxine XI)
- Lexapro (escitalopram)
- Paxil (paroxetine HCl)
- Pristiq (desvenlafaxine)
- Prozac (fluoxetine HCl)
- Risperdal (risperidone)
- Seroquel (quetiapine)
- Valium (diazepam)
- Vyvanse (lisdexamfetamine)
- Wellbutrin (bupropion HCl XI)
- Xanax (alprazolam)
- Zoloft (sertraline)
- Zyprexa (olanzapine)

Maternity Nursing

- Advil, Motrin (ibuprofen)
- Brethine (terbutaline sulfate)
- Cervidil (dinoprostone)
- Magnesium sulfate
- NUBAIN (nalbuphine hydrochloride)
- Penicillin
- Phenergan (promethazine hydrochloride)
- Pitocin (oxytocin)
- Tylenol (acetaminophen)

Pediatric Nursing

- Amoxil (amoxicillin)
- Augmentin (amoxicillin clavulanate)
- Flonase (fluticasone propionate)
- Hydrocortisone (topical)
- Proventil (albuterol)
- Ritalin (**Methylphenidate**)
- Septra/Bactrim (sulfamethoxazole/trimethoprim)
- Singulair (montelukast sodium)
- Zyrtec (cetirizine)

Because these are the most commonly used drugs in each specialty area, be sure you are familiar with their actions, side effects, and the average dosages. NCLEX focuses 12–18% of test questions on pharmacological and parenteral therapies.

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PHARMACOLOGY REVIEW QUESTIONS

1. Following surgery, a client has an order for nalbuphine HCl (Nubain) for moderate to severe pain. The assessment for possible adverse reactions should include observing for
 1. Blurred vision, palpitations, and urinary retention.
 2. Increased pulse rate, drowsiness, and nausea.
 3. Increased confusion, tachycardia, and anorexia.
 4. Irregular pulse, hypotension, and oliguria.
2. The nurse is assigned to a client who is receiving mydriatic eye drops. Which of the following symptoms indicates a systemic anticholinergic effect?
 1. Complaints of lightheadedness and headache.
 2. Respirations becoming more shallow.
 3. Sweating blurred vision.
 4. Decreased pulse and blood pressure.
3. A female client with a history of multiple sclerosis has orders for Dantrium (dantrolene sodium). The nurse will know the client understands the action of the drug when she says
 1. "I need to use a sunscreen when I go outside."
 2. "I can't take any other medications when I'm on this drug."
 3. "I take this drug only when my spasms are bad."
 4. "I should see a marked change in my muscle strength within 2 to 3 days."
4. Urecholine (bethanechol chloride) is ordered PRN for a client following a transurethral resection (TUR). Which of the following conditions would need to be present for the nurse to administer this drug?
 1. Complaints of bladder spasms.
 2. Complaints of severe pain.
 3. Inability to void.
 4. Frequent episodes of painful urination.
5. Which one of the statements is most accurate about the drug Tagamet (cimetidine) and should be discussed with clients who take the medication?
 1. Tagamet should be taken with an antacid to decrease GI distress, a common occurrence with the drug.
 2. Tagamet should be used cautiously with clients on Coumadin (warfarin) because it could inhibit the absorption of the drug.
 3. Tagamet should be taken on an empty stomach for better absorption.
 4. Tagamet is usually prescribed for long-term prevention of gastric ulcers.
6. You are caring for a client who is to receive 2000 units of heparin by IV push. The vial contains heparin 5000 U/mL. The client will receive _____ mL.
7. A client is receiving lithium carbonate for manic behavior. Administration of this medication should be guided by
 1. Maintaining a therapeutic dose of 900 mg TID.
 2. Encouraging regular blood studies (serum lithium levels) until the maintenance dose is stabilized.
 3. Telling the client that a lag of 7 to 10 days can be expected between the initiation of lithium therapy and the control of manic symptoms.
 4. Telling the client that muscle weakness indicates severe toxicity, and the physician should be notified.
8. Some clients with severely active lupus erythematosus are managed with steroids. A positive response to steroid therapy would be evidenced by
 1. An increase in platelet count.
 2. A normal gamma globulin count.
 3. A decrease in anti-DNA titer.
 4. Negative syphilis serology.
9. A client in liver failure from cirrhosis with ascites is receiving spironolactone. The expected outcome when this drug is given is
 1. Increased urine sodium.
 2. Increased urinary output.
 3. Decreased potassium excretion.
 4. Prevention of metabolic alkalosis.
10. A client with a fractured right hip has Buck's traction applied and orders for prophylactic anticoagulant therapy. The nurse anticipates that the physician will order
 1. Aspirin.
 2. Dextran.
 3. Heparin.
 4. Coumadin (warfarin).

- 11.** A client with a urinary tract infection is given an aminoglycoside (gentamicin) antimicrobial therapy. The nurse understands that this drug is more active when the urine is
1. Concentrated.
 2. Dilute.
 3. Alkaline.
 4. Acid.
- 12.** A client with the diagnosis of systemic lupus erythematosus is placed on Plaquenil (hydroxychloroquine), an antimalarial drug, to reduce skin inflammation. A toxic reaction to this drug that the nurse will teach the client to report is
1. Muscle cramps.
 2. Decreased visual acuity.
 3. Cardiac arrhythmias.
 4. Joint pain.
- 13.** A client with thrombophlebitis has orders for continuous heparin infusion. What is the antidote that must be available?
1. Vitamin K.
 2. Protamine sulfate.
 3. Mephyston (phytonadione).
 4. Calcium gluconate.
- 14.** The physician orders dexamethasone (Decadron) to be administered to a client with a head injury. Based on nursing knowledge of this medication, the nurse would question the physician if he did not order which of the following additional medications?
1. Morphine sulfate.
 2. Sodium bicarbonate.
 3. Cimetidine.
 4. Levophed (norepinephrine).
- 15.** A male client is currently taking digoxin 0.25 mg daily, Lasix (furosemide) 100 mg daily, acyclovir 10 mg QID, and Tagamet (cimetidine) 300 mg QID. Which one of the following drugs has potential side effects that are the most life-threatening?
1. Digoxin.
 2. Lasix.
 3. Acyclovir.
 4. Tagamet.
- 16.** A client with the diagnosis of multiple sclerosis has the drug baclofen ordered. The most accurate information the nurse should tell him about the drug is that he should
1. Not drive a car until he knows if any CNS effects occur with the use of the drug.
- 17.** Take the medication on an empty stomach for better absorption.
3. Notify the physician if diarrhea occurs.
 4. Notify the physician if any side effects occur.
- 18.** Which of the following actions is not accurate or safe when administering a medication using the Z-track method?
1. Placing 0.3 to 0.5 mL of air into the syringe.
 2. Using a 2- to 3-inch needle.
 3. Inserting the needle and injecting medication without aspirating.
 4. Pulling skin laterally away from the injection site before inserting the needle.
- 19.** A 68-year-old client has an IV infusing at 50 mL per hour. The IV administration set delivers 15 gtt/mL. When adjusting the flow rate, the nurse would regulate the rate at _____ drops per minute.
- 20.** After a client begins taking a prescribed antianxiety agent, the nurse would observe her for side effects of
1. Sedation and slurred speech.
 2. Photosensitivity and muscular rigidity.
 3. Tremors and hypertension.
 4. A paradoxical reaction and hypoactivity.
- 21.** When administering a one-time dose of Valium (diazepam; a benzodiazepine drug) to a client, the nurse needs to inform the client that
1. Valium has sedative properties.
 2. There are no important side effects to consider because it is a one-time dose.
 3. Valium should never be mixed with foods containing tyramine.
 4. Valium directly affects the blood pressure as a vasoconstrictor.
- 22.** The drug that will most likely be used in the treatment of malignancy of the prostate is
1. Human chorionic gonadotropin (HCG).
 2. Cytoxan (cyclophosphamide).
 3. Diethylstilbestrol (DES).
 4. Nitrogen mustard.
- 23.** A 65-year-old with the diagnosis of organic brain syndrome has orders for Seconal at bedtime. The nurse's understanding of this drug is that it has the effect on the body of
1. Tranquilization.
 2. Sedation.

3. Mood elevation.
4. Stimulation.
- 23.** A client has developed agranulocytosis as a result of medications he is taking. In counseling the client, the nurse knows that one of the most serious consequences of this condition is
1. The potential danger of excessive bleeding, even with minor trauma.
 2. Generalized ecchymosis on exposed areas of the body.
 3. High susceptibility to infection.
 4. Extreme prostration.
- 24.** The instructions to a client whose physician recently ordered nitroglycerin are that this medication should be taken
1. Every 2 to 3 hours during the day.
 2. Before every meal and at bedtime.
 3. At the first indication of chest pain.
 4. Only when chest pain is not relieved by rest.
- 25.** The nurse is counseling a client taking corticosteroids who has developed an infectious process. How would the infection affect the medication dosage?
1. Corticosteroid dose would be increased.
 2. Corticosteroid dose would be discontinued.
- 26.** You have just admitted a client and you observe that he brought a bottle of ginkgo biloba with him to the hospital. When you ask, he says that he takes it every day to help his brain. The next question you should ask is
1. What does this do for your brain?
 2. Did your physician prescribe this?
 3. Which medications are you taking?
 4. What are the side effects of ginkgo biloba?
- 27.** You are admitting a pregnant woman with a diagnosis of pneumonia. She is 6 weeks pregnant. When you are taking her history, she tells you she is taking the herb feverfew for migraine headaches. You counsel her to
1. Continue with the herb.
 2. Discontinue the herb while pregnant.
 3. Ask her physician about taking the herb.
 4. Go to her herbalist and ask about taking the herb while pregnant.

Please note that many questions on specific drugs, side effects, and other issues are integrated throughout the text and relate to specific conditions or diseases.

PHARMACOLOGY ANSWERS WITH RATIONALE

1. (1) These are symptoms associated with adverse reactions to Nubain (nalbuphine HCl). Drowsiness, nausea, confusion, bradycardia, and anorexia are also adverse reactions. Tachycardia (3), irregular pulse, and hypotension (4) are not symptoms associated with adverse effects of Nubain.

NP:E; CN:PH; CA:S; CL:C

2. (3) Sweating and blurred vision are signs of a systemic anticholinergic effect. In addition to these symptoms, the client may experience loss of sight, difficulty breathing, flushing, or eye pain. If these symptoms occur, the medication must be discontinued and the physician notified.

NP:E; CN:PH; CA:M; CL:A

3. (1) This drug has the potential for photosensitivity; therefore, the client should protect her skin by wearing a hat and using sunscreen.

NP:E; CN:PH; CA:M; CL:A

4. (3) Urecholine stimulates the parasympathetic nervous system. It increases the tone and motility of the smooth muscles of the urinary tract. It is used frequently following a TUR when the client has a lack of muscle tone and is unable to void. Bladder spasms can be relieved with belladonna or opium suppositories.

NP:A; CN:PH; CA:S; CL:AN

5. (2) Tagamet (cimetidine) can interfere with the absorption of Coumadin (warfarin) and several other drugs such as Dilantin, Lidocaine, or Inderal; therefore, the serum levels of the drugs should be monitored closely. Tagamet should not be taken within 1 hour of an antacid, because this will interfere with the absorption (1). It is best to take the drug with food (3). Tagamet is usually ordered for short-term treatment of duodenal and active gastric ulcers (4).

NP:AN; CN:PH; CA:M; CL:A

6. The answer is 0.4 mL . Divide 5000 units into 2000 units and the answer is 0.4 mL .

NP:P; CN:PH; CA:M; CL:A

7. (3) There will be 7 to 10 days before the client will experience a decrease in the manic symptoms. A therapeutic dose is 300 mg TID (1); regular blood studies must be continued throughout drug therapy (2); muscle weakness is an expected side effect and does not indicate toxicity (4).

NP:P; CN:PH; CA:PS; CL:A

8. (3) Anti-DNA antibody levels correlate most specifically with lupus disease activity. A positive response to steroids would show a decrease in these levels. Twenty percent of clients with lupus develop a positive syphilis serology (4), and many have hypergammaglobulinemia (2) and a decreased platelet count (1).

NP:E; CN:PH; CA:M; CL:A

9. (1) The primary action of spironolactone is to increase urine sodium and thereby cause diuresis. It is also potassium sparing (3) and helps counteract metabolic alkalosis (4) by this mechanism.

NP:E; CN:PS; CA:M; CL:AN

10. (3) Anticoagulant prophylaxis would be initiated with intermittent heparin therapy, which is effective immediately. Dextran (2) is frequently given postoperatively, and aspirin (1) is used in the recovery period during hospitalization to prevent venous thrombosis.

NP:P; CN:PH; CA:S; CL:C

11. (3) Aminoglycoside antibiotics are more active when the urine is alkaline, and the client may receive soda bicarbonate to accomplish creating this environment.

NP:AN; CN:PH; CA:M; CL:A

12. (2) Retinal damage can occur with the use of Plaquenil (hydroxychloroquine); the client should be assessed regularly for visual acuity.

NP:E; CN:PH; CA:M; CL:C

13. (2) The heparin antidote is protamine sulfate.

Answers (1) and (3) are antidotes to Coumadin (warfarin) derivatives. Calcium gluconate is given for hypocalcemia (4).

NP:I; CN:PH; CA:M; CL:A

14. (3) Decadron (dexamethasone) is an anti-inflammatory corticosteroid used in the treatment and prevention of cerebral edema. It is a very potent drug, often prescribed preoperatively and continued postoperatively for the neurosurgery client. Because the drug is irritating to the GI tract, it should be administered with antacids such as Maalox or Mylanta, or with drugs used to reduce gastric secretions such as Tagamet (cimetidine) (3) or Zantac (ranitidine). The nurse must be alert for signs of toxic side effects associated with steroid administration. In particular, the nurse must know that the drug must never be abruptly withdrawn and a gradual tapering of the dose is necessary.

NP:E; CN:PH; CA:M; CL:AN

15. (2) Although each of these drugs has significant side effects, Lasix (furosemide) has the potential for life-threatening cardiac arrhythmias. Potassium is lost as a result of the drug use. Because 100 mg is a large dose, a low serum potassium level could easily occur, leading to ventricular arrhythmias.

NP:E; CN:PH; CA:M; CL:AN

16. (1) Several CNS-related side effects are common, including drowsiness, dizziness, headache, and confusion. Therefore, until the client knows if he will experience these side effects, he should not drive a car. The drug causes nausea and GI distress, so it should be taken with milk or meals (2). Constipation is a common side effect (3) and, therefore, a mild laxative should also be ordered.

NP:I; CN:PH; CA:M; CL:A

17. (3) This is not accurate or safe because the nurse should pull back on the plunger, or aspirate. This would ensure that the needle had not entered a blood vessel. This action would be included in the Z-track method.

NP:I; CN:PH; CA:M; CL:C

18. The answer is *12 drops per minute*. To calculate the drip factor, multiply the hourly rate times the drop factor ($50 \text{ mL} \times 15$). Divide the answer by 60 minutes ($750/60 = 12.5 \text{ gtt/min}$). Round off the answer to 12.

NP:I; CN:PH; CA:M; CL:A

19. (1) Sedation and slurred speech are the primary side effects. Photosensitivity, an increased susceptibility to sunlight and sunburn, is a common side effect of anti-psychotic medications. Muscular rigidity (2) is not a side effect of these medications; in fact, the antianxiety agents often act as muscle relaxants.

NP:A; CN:PH; CA:PS; CL:A

20. (1) Valium (diazepam) has sedative properties, and the client needs to be warned about possible side effects. For example, driving while taking Valium is dangerous. Also important is to inform the client about the life-threatening danger of mixing this drug with alcohol.

NP:AN; CN:PH; CA:PS; CL:A

21. (3) DES is used to treat cancer of the prostate. It antagonizes the androgens required by the androgen-dependent neoplasm. HCG (1) is used for treatment of undescended testicles in young boys. Cytoxan (cyclophosphamide) (2) and nitrogen mustard (4) are used in Hodgkin's disease.

NP:P; CN:PH; CA:M; CL:K

22. (2) Seconal is a common barbiturate used for sleeplessness. It has a sedative effect on the CNS. Its use should be monitored because of potential addiction or overdose, especially with the elderly.

NP:E; CN:PH; CA:PS; CL:C

23. (3) Agranulocytosis is characterized by neutropenia (decreased number of lymphocytes), which lowers the body's defenses against infection. Granulocytes are the first barrier to infection in the body.

NP:AN; CN:PH; CA:M; CL:A

24. (3) Nitroglycerin should be taken whenever the client feels a full pressure feeling or tightness in his chest, not waiting until chest pain is severe. It can also be taken prophylactically before engaging in an activity known to cause angina in order to prevent an anginal attack.

NP:I; CN:PH; CA:M; CL:A

25. (1) Infectious processes increase the body's need for steroids. During times of stress (infection), the dose needs to be increased to prevent adrenal insufficiency in previously steroid-dependent clients.

NP:AN; CN:PH; CA:M; CL:AN

26. (3) You would immediately want to know what medications he is taking because ginkgo biloba interferes with the action of Coumadin (warfarin), aspirin, NSAIDs, digoxin, and insulin. The herb is also dangerous for anyone with blood-clotting problems, high blood pressure, asthma, or emphysema. Answers

(1) and (4) are not as important, and answer (2) would be asked after option (1).

NP:AN; CN:PH; CA:M; CL:AN

27. (2) She should immediately discontinue taking feverfew because it interferes with platelet action. Her physician may not be aware that she is taking herbs, so it is important when taking any client's history to ask about medicinal herbs the client is taking, and check them against the prescribed medications.

NP:I; CN:PH; CA:MA; CL:A