Homeostasis, for the purposes of this chapter, is defined as the mechanism for maintaining a steady state in the body.

**FLUID AND ELECTROLYTES**

**Physiology**

A. Basic concepts of body fluid.
   1. Water is a primary body fluid. It is used to transport nutrients as well as to remove waste products.
      a. Infant: 70% to 80% of body weight is water.
      b. Adult: 50% to 60% of body weight is water.
      c. Older adult: 45% to 55% of body weight is water.
   2. Electrolytes: electrically charged particles; electrolytes found in intracellular fluid and in extracellular fluid are essentially the same; however, the concentrations differ.
   3. Intracellular fluid: fluid located within the cell wall.
      a. Approximately 40% to 50% of total body fluid.
      b. Potassium is the primary electrolyte.
   4. Extracellular fluid (ECF): fluid located outside the cell wall.
      a. Approximately 30% to 40% of total body water.
      b. An infant maintains a larger percentage of extracellular fluids than does an older child or adult.
      d. Interstitial: fluid surrounding tissue cells.
      e. Sodium is the primary electrolyte.

B. Dynamic transport of fluid and electrolytes.
   1. Diffusion: movement of molecules from an area of high concentration to an area of low concentration.
   2. Osmosis: movement of water through a semipermeable membrane from an area of low electrolyte concentration to an area of high concentration; osmotic pressure is the term used to describe osmosis (water goes where the salt is).
   3. Filtration: movement of water and electrolytes through a semipermeable membrane from an area of high pressure to an area of low pressure; hydrostatic pressure is the term used to describe the force of filtration.

C. Plasma to interstitial fluid shift.
   2. Hypovolemia may occur as a result of excessive fluid shift into the interstitial spaces, resulting in circulatory collapse.

**Fluid Imbalances (ECF)**

A. Fluid deficit: loss of or failure to replace body fluid.
   1. Sensible fluid loss: fluid loss of which an individual is aware, such as urine.
   2. Insensible fluid loss: fluid loss of which an individual is not aware. Approximately 1000 ml of fluid is lost every 24 hours through the skin and lungs in a normal adult.
   3. Causes of fluid deficit:
      a. Decrease in or lack of adequate fluid intake.
      b. Loss of body fluid - vomiting, diarrhea, nasogastric suctioning.
      a. Thirst.
      b. Dry skin and dry mucous membranes.
      c. Poor skin turgor.
      d. Weight loss.
      e. Urine.
         (1) Less than 30 ml/hr: oliguria.
         (2) Concentrated, dark, foul-smelling.
      f. Postural hypotension.
      g. Increased heart rate.
      h. Poor cerebral perfusion due to decreased blood volume.
         (1) Increased respiratory rate to compensate.
         (2) Restlessness, lethargy, confusion in the older adult client.
      i. Depressed fontanels in the infant; infants and children may have mottled skin color due to poor tissue perfusion.
   5. Laboratory findings:
      a. Increased specific gravity of urine (greater than 1.030)
      b. Increased blood urea nitrogen level (BUN over 25 mg/dl) without increase in creatinine level.
      c. Increased hematocrit: normal ratio of hematocrit (Hct) to hemoglobin (Hgb) is 3:1; for example, if the hemoglobin is 12 g, the hematocrit should be 36%.
      d. Hyperglycemia (blood glucose concentration higher than 120 mg/dl).

**NURSING PRIORITY:** Monitor diagnostic and lab results and modify a client’s care based on results.
B. Fluid excess: retention of both water and sodium.
      a. Excessive oral fluid intake.
      b. Failure to excrete fluids, as in renal disease and congestive heart failure.
      c. Iatrogenic - fluid increase due to excessive infusion of IV fluids.
      d. Excessive sodium intake.

*NURSING PRIORITY: Sodium is the major electrolyte that affects fluid balance. “Where goes the sodium, so goes the water.” Weight gain or loss is most significant indicator of fluid gain or loss.*

2. Clinical manifestations.
   a. Weight gain.
   b. Presence of pitting edema in lower extremities; sacral edema.
   c. Distended neck veins in semi-Fowler’s position
   d. Dyspnea with exertion, wet breath sounds which may precede pulmonary edema.
   e. Bounding pulse, increased pulse rate
   f. Lethargy, dizziness, headache, confusion.
   g. Variable urine volume.
   h. Increased blood pressure.

3. Laboratory findings:
   a. Decreased urine specific gravity (less than 1.010).
   b. Decreased hematocrit with a loss of the hemoglobin/hematocrit 1:3 ratio (12 g Hgb with a 27% [hemodilution] Hct).

*TEST ALERT: Monitor client’s hydration status (I&O, edema, signs and symptoms of dehydration); monitor output (e.g., NG drainage, emesis, stools, urine); adjust intake to improve fluid and electrolyte balance.*

C. Nursing management of client with fluid imbalances.
   1. Data collection.
      a. Evaluate client’s history and predisposing factors contributing to the problem.
      b. Evaluate skin turgor.
         (1) Assess skin turgor on the abdomen or the inner thigh in children (unless abdominal distention is present).
         (2) Assess skin turgor on the forehead or sternum in older adult clients.
         (3) Assess skin turgor on the sternum, abdomen, and anterior forearm in adults.
      c. Collect data to determine direction of fluid problem: fluid excess or deficit.
      d. Older adult clients and infants are more sensitive to problem with fluid balance.
      e. Evaluate client’s tolerance of fluid imbalance – vital signs, level of consciousness, respiratory status.

2. Nursing interventions.

*NURSING PRIORITY: Increased urine specific gravity, dark urine, decreased urine output and postural hypotension are very objective clues to fluid deficit.*

   a. Maintain accurate intake and output records.
   b. Obtain accurate daily weights – same scale, same time each day, same amount of clothing (1 L of fluid = 1 Kg [2.2 pounds]).
   c. Evaluate for presence of peripheral edema and sacral edema.
   d. Good skin care.
      (1) Evaluate skin and prevent problems with skin breakdown due to edema or areas of increased pressure.
      (2) Protect skin in areas of edema; prevent excoriation.
      (3) Do not use soap on skin of dehydrated client, cleans gently and apply lubricants to flaky dry skin.
   e. Monitor vital signs and assess client response to correction of the problem (decreased fluid intake, diuretic therapy, or increased fluid intake both PO and IV).
   f. Blood pressure is not a reliable indicator of problems of fluid balance in young children.
   g. Monitor respiratory status, maintain good respiratory hygiene; monitor pulse oximetry for changes in ventilation.
   h. Maintain safety – problems of orthostatic hypotension, confusion, and changes in respirations increase risk of falls.
   i. Monitor sodium intake – encourage decreased sodium diet.
   j. Replace fluid loss
      (1) Unless contraindicated, encourage 2000-3000mL fluid daily in the average adult client.
      (2) If no nausea and vomiting, encourage oral rehydrating solution, offer the client 2-4 ounces of fluid every hour.
   k. Monitor urine output.
      (1) Minimum amount of urine is 30mL per hour or about 720mL daily.
      (2) Check urine specific gravity.
      (3) Monitor BUN, and electrolyte values.

3. See appendixes on electrolyte imbalances and replacement (Appendixes 5-1 through 5-3).

*NURSING PRIORITY: Daily weight is the most reliable indicator of fluid loss or gain in all clients, regardless of age. Accurate daily weight: same time each day, preferably before breakfast; same scale; same clothing.*
INTRAVENOUS FLUID REPLACEMENT THERAPY

Goals of Fluid Therapy

- **Goal:** To maintain adequate fluid balance.
  - A. Client NPO.
  - B. Unable to take fluids by mouth due to disease process.
- **Goal:** To correct a fluid or electrolyte deficiency
- **Goal:** To maintain nutritional requirements (caloric replacement).
  - A. Nutritional requirements are in excess of the intake, as in burns, extensive surgery.
  - B. Unable to absorb food in small intestine.

**TEST ALERT:** Monitor client receiving peripheral IV fluids.

Intravenous Infusions

A. Factors influencing rate of fluid administration.
   1. Type of fluid.
   2. Age of client.
   3. Cardiac and renal status.
   4. Size of the vein and gauge of catheter/needle.
   5. Client’s response to fluids.
B. Maintain accurate intake and output records.
C. Average maintenance fluid rate is 2000 to 3000 mL over 24 hours.
D. Heparin lock.
   1. Maintain patency of IV access for intermittent administration of medication or fluid.
   2. May be flushed with a heparin flush solution or saline solution at regular intervals to maintain patency.
   3. Site may be converted to fluid infusion if necessary.
E. Intravenous (IV) infusion sites are changed on a regular basis, preferably before inflammation, irritation, or fluid extravasation occurring at the site.
F. Pediatric considerations - children are very susceptible to rapid fluid shifts resulting in fluid overload. IV solutions of normal saline or percentages of normal saline are frequently used to decrease the possibility of cerebral edema.

**测试警报:** 监测接收到周围静脉输液的病人。

**NURSING PRIORITY:** Determine the amount of fluid that has actually been infused and correlate with the rate set on the infusion pump or IV control settings. Monitor IV site and regulate flow rate.

**OLDER ADULT PRIORITY:**
(1) Fluids are generally administered at a slower rate due to decreased ability of the heart and kidneys to handle fluids.
(2) Older adult clients are prone to circulatory overload.
(3) Poor skin turgor is not a reliable indicator of fluid status in the older adult.

Complications of Intravenous Therapy

**Infiltration**

A. **Common causes:** Dislodging of the needle by client movement or obstruction of fluid flow, bevel of needle pushed through posterior aspect of vein during insertion, placement of catheter in an area of flexion, needle not taped or anchored properly.
B. **Signs and symptoms:** Edema, blanching of skin, discomfort at site, fluid that is flowing slowly or has stopped, cooler skin temperature. IV solution is much cooler than client’s body temperature.
C. **Preventive nursing management:**
   1. Use an armboard to stabilize catheter, especially in restless, confused clients, or those with catheters placed in the antecubital fossa area.
   2. Frequently check for coolness of skin around site.
   3. Avoid looping tubing below bed level.
   4. Check IV flow rate at least every 2 hours.
D. **Nursing interventions:** Elevate extremity, apply moist heat to increase fluid absorption; anticipate RN will resite the IV.

**Phlebitis**

A. **Common causes:** Overuse of a vein, infusion of irritating solutions or medications, catheter in vein for too long a period of time, use of large gauge catheters.
B. **Signs and symptoms:** Tenderness, pain along the course of the vein, edema, redness at insertion site, red streak along course of vein, arm with IV feels warmer than other arm.
C. **Preventive nursing management:**
   1. Dilute medications (IV antibiotics) with adequate diluent to provide less irritating solution.
   2. Infuse at prescribed rate.
   3. Change IV location site every 72 hours or per facility policy.
D. **Advisement:** 
   Advise RN if phlebitis occurs and anticipate the catheter will be removed and resited.
E. **Nursing interventions:** Apply warm compresses to stimulate circulation and promote absorption.
Circulatory Overload

A. **Common causes:** IV is positional and infuses too rapidly, preexisting medical conditions that make client more prone to develop pulmonary edema (more frequent in older adult clients and infants).

B. **Signs and symptoms:** increased blood pressure and central venous pressure (CVP), jugular vein distention with client’s head elevated, shortness of breath, increased respirations, wet breath sounds, coughing.

C. **Preventive nursing management:** use infusion control devices to maintain infusion at prescribed rate; closely monitor client at increased risk of problem with fluid excess.

D. **Nursing interventions:** reduce infusion rate to a “keep open” rate; notify RN and/or health care provider; position client in semi-Fowler’s and begin oxygen.

**NURSING PRIORITY:** Inspect intravenous site for infiltration and/or extravasation and report to the nursing supervisor or primary care provider (PCP); advise the RN if an IV site is over 72 hours old.

### Acid-Base Balance

#### Basic Concepts of Acid-Base Balance

A. Terms used to describe acid-base balance.
   1. pH: the chemical abbreviation for the negative logarithm of hydrogen ion concentration.
   2. CO$_2$: carbon dioxide.
   3. Pco$_2$: pressure of dissolved carbon dioxide gas in the blood.
   4. O$_2$: oxygen.
   5. Po$_2$: pressure of dissolved oxygen gas in the blood.
   6. HCO$_3$: bicarbonate.
   7. mm Hg: millimeters of mercury.

B. Normal blood gas values.
   1. pH 7.4 (7.35 to 7.45).
   2. PO$_2$: 80 to 100 mm Hg.
   3. Pco$_2$: 35 to 45 mm Hg.
   4. HCO$_3$: 22 to 26 milliequivalents (mEq/L).

C. The hydrogen ion (H$^+$) concentration determines the acidity or alkalinity of a solution. The higher the H$^+$ concentration; the more acid the solution. The increased H$^+$ concentration is reflected by a decrease in the pH.

D. Acid:base ratio is determined by sampling arterial blood. This provides a reliable index of overall body function.

E. The body maintains a normal or neutral state of acid-base balance. The stable concentration of H$^+$ balance is reflected in arterial blood with a relatively constant pH of 7.35 to 7.45.

### Regulation of Acid-Base Balance

A. **Buffer system:** the most rapid-acting of the regulatory systems. The buffer system is activated where there is an excess acid or base present.
   1. A buffer is a chemical that helps maintain a normal pH.
   2. The buffer system chemicals are paired. The primary buffer chemicals are sodium bicarbonate and carbonic acid. The buffers are capable of absorbing or releasing hydrogen ions as necessary.
   3. An effective buffer system depends on normal-functioning respiratory and renal systems.

B. **Respiratory system:** the second most rapid response in the regulation of acid-base balance. Carbonic acid is transported to the lungs via the veins, where it is converted to carbon dioxide and water, and then excreted.
   1. Carbon dioxide is considered an acid substance because it combines with water to form carbonic acid.
   2. Increased respirations will decrease carbon dioxide levels, thus decreasing the carbonic acid concentration and resulting in decreased H$^+$ concentration and an increase in the pH.
   3. Decreased respirations will cause a retention of carbon dioxide, increasing the carbonic acid concentrations and resulting in increased H$^+$ concentration and a decrease in the pH.
   4. With excessive acid formation, the respiratory center in the medulla is stimulated, which results in an increase in the depth and rate of respirations. This promotes a decrease in the carbon dioxide levels and attempts to return the pH to a more normal point.
   5. With excessive base formation, the respiratory rate slows in order to promote retention of carbon dioxide and decrease the alkalotic state. The Pco$_2$ levels are influenced only by respiratory system.

C. **Renal system:** the slower but most effective mechanism of acid-base regulation.
   1. The kidneys reabsorb sodium (Na), and produce and conserve sodium bicarbonate (NaHCO$_3$).
   2. In acidosis the kidneys will attempt to excrete more H$^+$.

### Alterations in Acid-Base Balance

A. **Respiratory acidosis:** characterized by an excessive retention of carbon dioxide due to hypoventilation.
   1. Primary causes: conditions that cause decreased respiratory function.
      a. Head injuries.
      b. Oversedation with sedatives and/or narcotics.
      c. Infection of CNS.
      d. Postoperative anesthesia.
      e. Conditions decrease effective pulmonary function.
         (1) Obstructive pulmonary diseases.
CHAPTER 5  \hspace{1cm} \textbf{Homeostasis}

(2) Pneumonia.
(3) Cystic fibrosis.
(4) Atelectasis.
(5) Occlusion of respiratory passages (asthma).

2. Clinical manifestations.
   a. Dyspnea on exertion.
   b. Rapid, shallow respirations.
   c. Disorientation, decreased level of consciousness.
   d. Tachycardia, arrhythmias.
   e. Muscle weakness.

   a. pH decreases below 7.35.
   b. $P_{\text{CO}_2}$ increases above 45 mm Hg.
   c. $HCO_3^-$ may remain within normal limits.

4. Nursing management.
   a. Use preventive management.
      (1) Have postoperative or immobilized client turn, cough, and deep breathe every 2 hours.
      (2) Decrease use of narcotics as client begins to experience less pain postoperative.
      (3) Maintain adequate hydration.
   b. Position in semi-Fowler’s to facilitate breathing.
   c. Thoroughly assess client’s pulmonary function.
   d. Try postural drainage and percussion followed by suction to remove excessive pulmonary secretions.
   e. Anticipate use of bronchodilator either systemically or aerosol.
   f. Report any changes in the client’s respiratory status.

B. \textit{Respiratory alkalosis}: characterized by a low $P_{\text{CO}_2}$ most often due to hyperventilation.

1. Primary cause of respiratory alkalosis.
   a. Emotional origin (hysteria, fear, apprehension).
   b. Hyperventilation due to disease entity.
   c. CNS problems (encephalitis, increased intracranial pressure).

2. Clinical manifestations.
   a. Deep, rapid breathing.
   b. Muscle twitching.
   c. Tingling of extremities.
   d. Seizures.
   e. Confusion.
   f. Hyperreflexia.

   a. pH increases above 7.45.
   b. $P_{\text{CO}_2}$ normal.
   c. $HCO_3^-$ increases above 26 mEq/L.

4. Nursing management.
   a. Preventive.
      (1) Provide foods high in potassium and chloride for client on diuretics.
      (2) Administer potassium supplement to clients on long-term diuretics.
      (3) Monitor IV solution with replacement electrolytes.
   b. Maintain accurate intake and output records.

D. \textit{Metabolic acidosis}: characterized by a decrease in bicarbonate level in the serum.

1. Primary causes (deficit of a base or an increase in acid).
   a. Diabetic acidosis.
   b. Abnormal loss of alkaline substances.
      (1) Deep, prolonged vomiting may precipitate acidosis due to a loss of base products.
      (2) Severe diarrhea and loss of pancreatic secretions may precipitate an acidic state.
   c. Renal insufficiency: kidney loses ability to retain $HCO_3^-$ and to excrete $H^+$.
   d. Salicylate poisoning due to accumulation of ketone bodies produced as a result of the increased metabolic rate.

2. Clinical manifestations.
   a. Disorientation.
   b. Deep, rapid respirations (Kussmaul’s respirations).
   c. Changes in level of consciousness (drowsiness, stupor, coma).
   d. Muscle twitching.
   e. Arrhythmias.

   a. pH decreases below 7.35.
   b. $P_{\text{CO}_2}$ remains normal.
   c. $HCO_3^-$ decreases below 22 mEq/L.
4. Nursing management.
   b. Maintain accurate intake and output records.
   c. Evaluate client for hydration due to excessive fluid loss.
   d. Support respiratory system.

3. Antiinflammatory medications (corticosteroids) may be administered to the client when the swelling is impeding tissue perfusion.

4. Antiinflammatory medications may hamper the healing process and mask the symptoms of an infection.

C. Cardinal signs of inflammation.
   1. Local response (Table 5-1).
   2. Systemic response.
      a. Fever.
      b. Leukocytosis (increased number of neutrophils in circulation).
      c. Malaise.
      d. Nausea and anorexia.
      e. Weight loss.
      f. Increased pulse rate and respiration.

INFECTION

Infection is the process by which an organism (pathogen, pathogenic agent) invades the host and establishes a parasitic relationship.

A. Healthcare associated infections (HAIs, nosocomial infections): infections acquired from exposure to pathogens in a hospital setting or health care setting.

B. Iatrogenic infections are HAIs that result from a diagnostic or therapeutic procedure (urinary tract infection from urinary catheterization).

C. Emerging infection is an infectious disease that has increased over past 20 years.

D. Development of multiple drug-resistant organisms (MDRO) has further complicated treatment of infections (they are resistant to antibiotics).

Chain of Transmission

A. Pathogens.
   1. Incubation period: the period of time from exposure to the pathogen until symptoms of infection occur in the host.
   2. A person can be asymptomatic and still transmit a pathogen that will produce an infection in someone else (carrier).
   3. Pathogens vary in how they interact with the host.

<table>
<thead>
<tr>
<th>CLINICAL SYMPTOM</th>
<th>PATHOPHYSIOLOGY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Redness</td>
<td>Hyperemia from vasodilation</td>
</tr>
<tr>
<td>Heat</td>
<td>Increased metabolism at site and local vasodilation</td>
</tr>
<tr>
<td>Pain</td>
<td>Pressure from fluid exudate on adjacent nerve endings, which leads to nerve stimulation; change in local pH</td>
</tr>
<tr>
<td>Edema</td>
<td>Fluid shift and accumulation in interstitial spaces</td>
</tr>
<tr>
<td>Loss of function</td>
<td>Decreased movement due to swelling and pain</td>
</tr>
</tbody>
</table>
4. Toxigenicity refers to the destructive potential of the toxin that is released by the pathogen.
5. Types of pathogens.
   a. Viruses.
   b. Bacteria: gram-negative and gram-positive.
   c. Fungi.
   d. Chlamydia.
   e. Protozoa.
   f. Mycoplasma.

B. Reservoir.
1. Environment within which the organism can live and multiply; is provided by some organic substance—human or animal.
2. Provides essential needs for organism survival.
3. A carrier provides an environment for the pathogen to grow and multiply, but shows no symptoms of the infection.

C. Exit port.
1. How the infection leaves the host.
2. Common ports of exit include feces, secretions, and body fluids.
3. Understanding port of exit is necessary to prevent transmission of pathogen.

D. Route of transmission.
1. Method by which the pathogen moves to another host.
2. Direct transmission is immediate transfer from one host to another, as in sexually transmitted diseases or inhalation of contaminated droplets from respiratory tract infections.
3. Indirect transmission occurs via an intermediate carrier, for example, mosquitoes, contaminated water, or contaminated food.

E. Port of entry into susceptible host.
1. May enter the host via inhalation, ingestion, through the mucous membranes, or percutaneously.
2. Whether an infectious disease will occur depends on the defense system of the invaded host.
3. Biological and personal characteristics of the new host will determine the lines of defense the host will have against the invading pathogen.

F. Control of transmission.
1. Transmission of a contagious disease can be broken by interfering with any link of the transmission chain.
2. Treatment is aimed at breaking the transmission chain at the most vulnerable and cost-effective point.
   a. Barrier precautions: gloves, gowns, condoms.
   b. Proper handling of food and water supplies.
   c. Avoidance of high-risk behavior: unsafe sex, IV drug use.
   d. Good hand hygiene technique and good personal hygiene.
3. Important to consider chain of transmission in order to protect health care workers.
4. Host susceptibility can be greatly reduced through immunizations (see Table 2-3, Figure 2-2).

TEST ALERT: Apply principles of infection control (e.g., hand hygiene, isolation, standard precautions, communicable disease reporting). Be able to apply this to clients of all ages and all categories of client care.

Nursing Interventions

 Goal: To prevent infection.
A. Hand hygiene is the single most effective mechanism for preventing spread of infection (see Box 5-2).
B. Monitor vital signs: increase in pulse, respiration, and temperature occurring 4 to 5 days after surgery may indicate infectious process.
C. Monitor for Staphylococcus and Pseudomonas pathogens (produce purulent, draining wounds).
D. Maintain aseptic technique in dressing changes and wound irrigations.
E. Maintain standard precautions (see Appendix 5-9).
F. Administer antibiotic medications (see Appendix 5-10).
G. Identify clients at increased risk for infections.
   1. Older adults (Box 5-3).
   2. Immunocompromised clients.
   3. Clients compromised by chronic health care problems.
   4. Poorly nourished clients.
   5. Client with high-risk lifestyle (IV drug use, unprotected sex).

 Goal: To promote healing.
A. Encourage high fluid intake when client has a fever: 2000-3000 mL daily for adults.
B. Encourage a diet high in protein, carbohydrates, and vitamins—specifically vitamins A, C, and B complex.
C. Immobilize an injured extremity with a cast, splint, or bandage.
D. Administer antipyretic medications (ASA, acetaminophen).

BOX 5-1 SIGNS OF INFECTION

Generalized
- Fever, localized inflammation, joint pain, fatigue, and increased white blood cells

Gastrointestinal Tract
- Diarrhea, nausea, and vomiting

Respiratory Tract
- Purulent sputum, sore throat, chest pain, and congestion

Urinary Tract
- Urgency and frequency, hematuria, purulent discharge, dysuria, and flank pain
E. Identify early signs of infection to facilitate treatment (Box 5-1).

- **Goal:** To decrease pain.
  - A. Cold packs applied after initial trauma may help decrease swelling and pain.
  - B. Heat may be used later to promote healing and to localize the inflammatory agents.
  - C. Elevate the injured area to decrease edema and promote venous return.

- **NURSING PRIORITY:** Use correct hand hygiene techniques—soap and water or an antimicrobial cleanser.

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**BOX 5-2 HAND HYGIENE**

*Hand hygiene is the most important and most basic action to prevent transmission of infections.*

**Hand Hygiene With Soap and Water**
- Hand washing should be done under flow of water.
- Wet hands and wrists under running water: keep hands and forearms lower than elbows.
- Using antibacterial soap, lather and wash hands using friction for at least 15 seconds.
- Rinse hands thoroughly under running water, keeping hands lower than elbows.
- Do not allow washed hands to touch inside of sink.
- Use soap and water any time the hands are visibly soiled.

**Hand Hygiene With Antiseptic Cleanser**
- Rub hands together covering all surfaces of the hands and fingers with cleanser.
- Rub hands together until cleanser is dry.
- Use if hands are not visibly soiled.

- **NURSING PRIORITY:** Hand hygiene must be performed before and after the use of gloves.

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**BOX 5-3 OLDER ADULT CARE FOCUS INFECTIONS**

- May be manifested by changes in behavior: confusion, disorientation.
- May not exhibit fever or pain.
- Closely monitor client response to antibiotics, especially with regard to renal function.
- Maintain adequate hydration.
- Monitor GI function; diarrhea is common with antibiotics.

- **NURSING PRIORITY:** Closely monitor a client with an infection for the development of a septic condition; identifying and reporting the problem are critical to the successful treatment.

---

**Prevention of Transmission of Infection in the Health Care Setting**

- **Goal:** To prevent complications.
  - A. Increase surveillance for clients with decreased white cell counts (leucopenia), or impaired circulation, clients receiving steroids that suppress inflammation or drugs that depress bone marrow as well as clients exposed to a communicable disease.
  - B. Protect healing wounds from injury that could be caused by pulling or stretching.
  - C. Identify clients with compromised immune response; they are at high risk for opportunistic infection.

---

**Systemic Inflammatory Response Syndrome (SIRS, sepsis)**

- **SIRS or sepsis occurs when pathogens enter the blood and are carried throughout the body.**
  - A. Gram-negative bacteria are most common.
  - B. Increased risk in clients with urinary catheters, respiratory infections, invasive procedures (arterial lines, CVP, any indwelling line).
  - C. At-risk clients: older adults, clients with chronic health problems, clients on immunosuppressive therapy and the clients who are malnourished.
  - D. Clinical manifestations (SIRS and septic shock).
    1. Compromised respiratory function.
      - a. Hypoventilation, and respiratory acidosis.
      - b. Hypoxia and respiratory failure (Chapter 10)
    2. Compromised cardiac function - development of hypotension and tachycardia.
    3. Fever and an elevated white blood cell count.
    4. May rapidly progress to septic shock.
**Treatment**

A. Prevention of infection.
B. Aggressive treatment of infections.
C. Aggressive pulmonary support.
D. Fluid resuscitation.

**Nursing Interventions**

- **Goal:** To maintain optimal functioning of organs involved.
  - A. Prevent transmission of infection.
  - B. Early identification of infectious process – complaints from client that indicate a urinary tract infection, upper respiratory problems, change in level of consciousness.
  - C. Support cardiac system.
    1. Maintain hydration status.
    2. Monitor blood pressure and tissue perfusion.
    3. Monitor for development of septic shock (Chapter 11).
  - D. Support respiratory system (Chapter 10).
    1. Prevention of hypoxia.
    3. Good pulmonary hygiene.

**Antibiotic-Resistant Infections**

A. Strains of bacteria that have developed a resistance to common antibiotics.
   1. Methicillin-resistant *Staphylococcus aureus*: wound, skin and soft tissue, pneumonia.
   3. Penicillin resistant *Streptococcus pneumoniae*: pneumonia.
B. Transmission.
   1. Most common mode of transmission is from client to client, caused by poor hand hygiene.
   2. Nosocomial infections or healthcare-associated infections (HAIs).
C. Clients at increased risk.
   1. Treatment with multiple antibiotics.
   2. Multiple hospitalizations.
   3. Older adults with chronic conditions.
   4. Immunosuppressed clients.

**Treatment**

Culture and sensitivity, then administration of antibiotics sensitive to the identified bacteria.

**Nursing Interventions**

- **Goal:** To decrease spread of infection.
  - A. Routine cultures of health care workers.
  - B. Identification of clients at increased risk.
  - C. If there is a draining wound or productive cough droplet and contact precautions are added to standard precautions:
    1. Private room.
    2. Gown and gloves.
    3. Masks are necessary with droplet precautions for a client with a respiratory tract infection.
    4. Teach family importance of gloves and gowns.
  - D. Most common mode of transmission is via the hands of health care workers; hand washing is critical, even after removal of gloves (Box 5-2).

**IMMUNE SYSTEM**

**Physiology of the Immune System**

- The immune system cannot be divided into specific compartments. Immunity includes all physiological mechanisms that enable the body to protect itself against invasion of foreign substances or proteins. An immunological reaction is the homeostatic protective response through which the body reorganizes and destroys foreign agents (antigens).
A. The immune system serves three primary functions.
   1. Defense against infection; protection of the body against invading microorganisms.

### TABLE 5-2 ACQUIRED IMMUNITY

<table>
<thead>
<tr>
<th>TYPE</th>
<th>CHARACTERISTICS</th>
<th>EXAMPLES</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Active</strong></td>
<td>Antibodies synthesized by body in response to antigen stimulation.</td>
<td>Recovery from childhood diseases (e.g., chicken pox, measles, mumps).</td>
</tr>
<tr>
<td><strong>Passive</strong></td>
<td>Antibodies produced in one individual and transferred to another.</td>
<td>Immunization with live or attenuated vaccines (varicella, IPV, MMR).</td>
</tr>
<tr>
<td></td>
<td><strong>Natural:</strong> Contact with an antigen through exposure; develops slowly, often lifetime protection.</td>
<td>Toxoid immunization (tetanus toxoid, diphtheria toxoid).</td>
</tr>
<tr>
<td></td>
<td><strong>Artificial:</strong> Immunization with an antigen develops slowly; may provide protection for several years, but “boosters” may be required.</td>
<td>Maternal immunoglobulin in the neonate.</td>
</tr>
<tr>
<td></td>
<td><strong>Natural:</strong> Immunity from placenta and colostrum transferred from mother to child; provides immediate temporary protection.</td>
<td>Gamma globulin; injection of animal hyperimmune serum (diphtheria antitoxin, tetanus antitoxin).</td>
</tr>
</tbody>
</table>
2. Maintain homeostasis by removing old cells; the primary organ involved is the spleen.
3. Surveillance of circulating cells with identification and destruction of the abnormal cells.

B. The body recognizes foreign proteins that are not part of the normal constituents of the body. These foreign proteins—antigens—elicit a response from the immune system. The immune system produces antibodies that attack and destroy the invading antigens.

Immunological Responses

A. Properties of the immunological response.
   1. **Specificity**: the formation of a specific antibody for each antigen. Antibodies produced against one bacteria will not protect the body from other types of bacteria.
      
      *Example*: Antibodies against chickenpox will not protect the body against measles.

   2. **Memory**: the ability to remember the specific antigen and make the appropriate antibody. Once the body responds to a particular antigen, memory cells are produced. This produces a stronger immune response the next time the body comes in contact with the same antigen.
      
      *Example*: The body remembers how to make the antibody against the chickenpox virus.

   3. **Self-recognition**: the ability of the body to recognize its own proteins and differentiate them from foreign protein. This allows foreign protein to be attacked without injury to the body’s own cells.
      
      *Example*: When the body does not recognize its own cells, the condition is called autoimmunity and can lead to autoimmune diseases or disorders.

Factors Affecting the Immune Response

A. **Age**: An infant’s immune system is not fully developed, and in the elderly the immune response is hypoactive.

B. **Metabolism**: Thyroid and adrenal hormone deficiencies decrease the immune response; steroids inhibit the inflammatory response.

C. **Emotional stress**: Stress may precipitate a decrease in the normal production of cells for the immune response.

D. **Hormonal influences**: Females have a greater incidence of autoimmune diseases than do males.

E. **Environment and lifestyle**: Unsanitary living conditions and exposure to pathogens may increase susceptibility to infections.

F. **Nutrition**: Poor nutrition can decrease the overall immune response.

Autoimmune Response

A. When the immune system can no longer recognize normal tissue and begins to destroy healthy tissue, an autoimmune response has occurred. Antibodies (autoantibodies) are then formed against the body’s own antigens.

B. Some autoimmune responses are very tissue-specific and only invade that tissue, while another response may cause effects throughout the entire body.

C. Autoimmune response may be systemic or organ-specific.
   1. **Systemic diseases**.
      a. Systemic lupus erythematosus (SLE).
      b. Rheumatoid arthritis.
   2. **Organ-specific diseases**.
      a. Myasthenia Gravis (CNS).
      b. Hyperthyroidism (Graves’ disease).
      c. Addison’s disease (adrenal glands).
      d. Insulin-dependent diabetes (type 1 diabetes mellitus).

Anaphylactic Reaction

* Type I occurs in clients who are highly sensitized to a specific allergen—medications, blood products, insect stings. The antigen-antibody response precipitates the release of histamine, causing vasodilatation and increased capillary permeability (Figure 5-1).

Data Collection

A. Risk Factors.
   1. History of exposure to allergen.
      a. Amount of allergen.
      b. Absorption of ingested allergen.
90 CHAPTER 5 Homeostasis

c. Antibody levels from previous exposure.

2. The more rapid the onset of symptoms after exposure, the more severe the reaction.

B. Clinical manifestations—depend on the level of prior sensitivity and the amount of allergen.

1. Mild to moderate: peripheral tingling/itching (pruritus, urticaria) sensation of warmth, edema of the lips and tongue, nasal congestion, flushing, anxiety.

2. May rapidly progress to acute anxiety, difficulty breathing (bronchospasm, laryngeal edema), GI cramping, cyanosis, and hypotension; can be fatal.

Diagnostics — based on symptoms and exposure to allergen.

Treatment

A. Mild to moderate reactions—antihistamines and/or epinephrine 0.2 to 0.5 mL (1:1000 solution), administered subcutaneously or intramuscularly (Appendix 5-12).

NURSING PRIORITY: When administering epinephrine, make sure you have the correct concentration of solution. It is most often administered in concentrations of 0.1% or 1:1,000 subcutaneously or IM.

B. Oxygen in high concentrations.

C. IV fluids to maintain circulatory status.

D. Maintain patent airway—intubation or tracheostomy may be necessary.

E. Corticosteroids to reduce inflammatory response (see Appendix 5-7).

TEST ALERT: When administering epinephrine, make sure you have the correct concentration of solution. It is most often administered in concentrations of 0.1% or 1:1,000 subcutaneously or IM.

NURSING PRIORITY: Airway positioning and mouth-to-mouth resuscitation will not provide adequate ventilation when client has airway edema. An emergency tracheotomy or intubation may be indicated.

A. Maintain bed rest; place client in low Fowler’s position with the legs elevated.

B. High oxygen concentrations if airway is compromised.

C. Anticipate use of airway adjuncts (tracheostomy, endotracheal intubation).

D. Administration of medications to reverse bronchospasm (albuterol, corticosteroid, epinephrine).

Goal: To maintain adequate ventilation.

Goal: To restore adequate circulation.

A. Monitor IV site and rate of IV fluids.

B. Carefully evaluate client response to fluid replacement—vital signs, urinary output, level of consciousness, breath sounds.

Goal: Client teaching to prevent recurrence.

A. Once causative agent is identified, instruct client accordingly.

B. Advise client to wear identification tag or bracelet.

C. Explain to client that if he or she had any level of allergic reaction previously, the next exposure could be worse (penicillin, insect stings, etc.).

TEST ALERT: Protect immunocompromised clients.

Systemic Lupus Erythematosus (SLE)

SLE is a multisystem inflammatory autoimmune disorder. SLE is characterized by a diffuse production of autoantibodies that attack and cause damage to body organs and tissue.

A. Tissue injury in SLE results from deposition of the immune complexes throughout the body (kidneys, heart, skin, brain, and joints); this activates the inflammatory response.

B. The severity of symptoms varies greatly throughout the course of the disease; periods of exacerbation and remission occur.

Data Collection

A. Clinical manifestations

1. Initially may be nonspecific: weight loss, fatigue, and fever.

2. Integumentary: characteristic “butterfly” rash over face in about 50% of clients; erythematous rash on
areas of the body exposed to sunlight (photosensitivity); alopecia; dry scaly scalp; palmer erythema.

B. Immune complexes form in the body and cause an inflammatory response in body systems. This inflammation leads to organ dysfunction (e.g., glomerulonephritis, pericarditis and vascular inflammation of small vessels, cerebral inflammation, pleural inflammation).

C. Diagnostics.
1. No specific test is diagnostic; assess configuration of symptoms.
2. Presence of antinuclear antibody (ANA), high levels of anti-DNA, and presence of anti-Smith antibodies are most suggestive of a diagnosis of SLE.
3. C-reactive protein (CRP), erythrocyte sedimentation rate (ESR)—monitor progress of inflammation.

Treatment
SLE has no known cure.
A. Nonsteroidal antiinflammatory medications (see Appendix 5-8).
B. Corticosteroids for exacerbations polyarthritis (see Appendix 5-7).
C. Immunosuppressants

Nursing Interventions
☐ Goal: To prevent exacerbations.
A. Maintain good nutritional status.
B. Avoid exposure to infections.
C. Teach client regarding skin problems and photosensitivity; observe for complications.
D. Teach client personal hygiene to prevent urinary tract infections.
E. Make sure client understands how to take medications.
F. Review with client signs and symptoms of infection; call health care provider (HCP) if fever, chills, anorexia, or worsening of symptoms occurs.
G. Avoid exposure to sunlight; use a heavy sunscreen when exposure is unavoidable.
H. Teach client to contact HCP before participating in any immunization procedures.
☐ Goal: To promote adequate tissue perfusion.
A. Assess for indications of impaired peripheral perfusion—numbness, tingling, and weakness of hands and feet.
B. Prevent injury to extremities—especially fingers.
C. Carefully evaluate fluid status with regard to cardiac output, fluid retention, and weight gain.
☐ Goal: To maintain homeostasis.
A. Effective pain control
   1. NSAIDs to control arthritic pain.
   2. Nonpharmacologic therapies to supplement analgesics (Chapter 3).
B. Identify problems with fluids and renal function.
C. Monitor for peripheral edema, hypertension, hematuria, decreased output.
D. Monitor for urinary tract infections (glomerulonephritis).
E. Assess for peripheral edema and excess fluid volume.

Acquired Immunodeficiency Syndrome (AIDS)
* Occurs as a result of being infected with the human immunodeficiency virus (HIV). Once a client is infected, he or she will harbor the virus for the rest of their life.

Transmission of HIV
A. Blood transmission.
   1. Needle-sticks that occur when the client has a high viral load carry a higher risk than those that occur when client is at a low viral load; sharing of contaminated needles accounts for a significant number of transmissions by infected blood.
   2. Exposure to an infected client’s blood via open wounds or mucous membranes.
   3. Transmission via blood transfusions has been greatly reduced with the screening of donated blood.
B. Sexual transmission—most common mode of transmission.
   1. Sexual practices, not preferences, place people at increased risk.
   2. Risk for infection is greater for the partner who receives the semen during oral, vaginal, or anal sex.
   3. Any sexual activity that involves direct contact with vaginal secretions and semen may transmit HIV.
C. Perinatal transmission.
   1. Exposure can occur during pregnancy, at the time of delivery, or during the postpartum period through breast milk.
   2. 25% of infants born to HIV-positive mothers are infected.
   3. Prophylactic antiviral medications during pregnancy can reduce rate of transmission.
D. HIV cannot be transmitted by:
   1. Hugging, kissing, holding hands, or other nonsexual contact.
   2. Inanimate objects (money, doorknobs, bathtubs, toilet seats, etc).
   3. Dishes, silverware, or food handled by an infected person.
   4. Animals or insects.
   5. Tears, saliva, urine, emesis, sputum, feces, or sweat.
F. The viral load in the semen, blood, vaginal secretions, or breast milk is an important variable in the transmission.

☐ NURSING PRIORITY: It is essential for the nurse to know the modes of transmission of HIV, activities that do not transmit the virus, and the nursing care to protect yourself, your AIDS client, and other clients under your care.
Clinical Manifestations

A. The disease progression is highly individualized; the average time between the HIV infection and the development of AIDS is about 11 years, during which the symptoms are frequently vague and nonspecific.

B. CD4+ T helper cells are the regulating cells in the immune system; the level of CD4+ T cells is used to monitor the progression of the virus; normal CD4+ T cell count is at least 800 cells/mm³ of blood.

C. Acute HIV infection.
   1. Intense viral replication and dissemination of HIV throughout the body.
   2. Symptoms are mild, ranging from no symptoms to flu-like (low fever, fatigue, lymphadenopathy) symptoms.
   3. Window of seroconversion: is the time period from when the person is infected with the virus until HIV antibodies can be detected.
   4. Average time for seroconversion to occur is 1 to 3 weeks.
   5. A client may have vague, nonspecific symptoms for years.
   6. During this period, there is a high viral load and the CD4+ T cell count falls, but only temporarily.

B. Early chronic infection—CD4+ T cell count greater than 500 cells/mm³ and low viral load.
   1. May be an asymptomatic phase; however, chronic vague symptoms persist.
   2. Persistent generalized lymph node enlargement.

C. Intermediate chronic infection—CD4+ T cell count between 200 and 500 cells/mm³ and increased viral load.
   1. Exacerbation of symptoms, client begins to experience localized infections, increased lymphadenopathy, and neurologic manifestations.
      a. Candida is a common problem—persistent oropharyngeal or vulvovaginal candidiasis.
      b. Hairy oral leukoplakia, which may also be indication of progression of disease.
      c. Shingles, oral or genital herpes lesions.
   2. Kaposi’s sarcoma.
      a. A cutaneous skin lesion that looks like a bruise; later will turn dark violet or black.
      b. Invades body organs, extremities, skin, and torso.
      c. May become very painful.

D. Late chronic infection, or AIDS (acquired immunodeficiency syndrome)—CD4+ T cell count less than 200 cells/mm³ and viral load increases. Diagnosis of AIDS is made when the HIV-positive client develops at least one of the following disease processes.
   1. CD4+ T cell count below 200 cells/mm³.
   2. AIDS dementia complex.
   3. Wasting syndrome caused by HIV.
   4. At least one opportunistic cancer—invasive cervical cancer, Kaposi’s sarcoma, primary lymphoma of the brain.
   5. At least one opportunistic infection—fungal, bacterial, or protozoal infection.

Opportunistic Diseases

A. Diseases and infections that occur in clients with AIDS are called opportunistic because they take advantage of the suppressed immune system.
   1. The severity of the infection depends on the extent of immunosuppression.
   2. Single opportunistic infections are rare; a client usually has multiple infections.

B. Infections may be delayed or prevented by antiretroviral therapy, vaccines (hepatitis B, influenza, and pneumococcal), and disease-specific prevention.

C. Coccidioides jiroveci pneumonia, Pneumocystis jirovecii pneumonia (previously called Pneumocystis carinii PCP).
   1. May be caused by a pathogen in the body that is dormant.
   2. Is not common in healthy individuals; immune system must be compromised for the infection to occur.
   3. Symptoms: fever, night sweats, nonproductive cough, progressive dyspnea.

D. Tuberculosis (see Chapter 10).

E. Kaposi’s sarcoma: a bruised, dry-appearing skin lesion; may be present internally as well.

F. Candidiasis of the esophagus, mouth, vagina.

Diagnostics

A. HIV-antibody testing.
   1. Enzyme immunoassay testing (EIA): detects the serum antibodies that bind to the HIV antigens. After the acute HIV invasion, an increase in the viral load and a decrease in CD4+ count occur; the client begins to develop antibodies to the HIV. If client has history of recent exposure, retesting is recommended at 3 weeks, 6 weeks, and 3 months.
   2. If the EIA test result is positive, then it is repeated; if it remains positive, the Western blot (WB) and immunofluorescence assay (IFA) tests are done to confirm the HIV-positive results.
   3. If the EIA is consistently positive and the WB and IFA results are positive, the client is considered to be HIV-antibody positive.

B. Rapid HIV tests—ready in minutes, but results are preliminary and must be confirmed; client needs to return for an antibody-based test (Western blot) 2-4 months later.

C. Serum monitoring after diagnosis.
   1. CD4+ T cell counts and plasma assays (HIV RNA viral load).
   2. Evaluation for drug resistance.
**Treatment**

A. Medications: antiretroviral therapy (ART) (Appendix 5-11).
   1. Prescribed according to the viral load and the CD4+ T cell counts.
   2. Women should begin ART even if they are pregnant.
   3. Combination drug therapy attacks virus at different stages of replication.

B. Medications will not cure the client, but will decrease the viral replication and slow disease process.

C. Adherence to drug schedules is critical—nonadherence to drug regimen can lead to mutations of the virus and increased virus resistance.

**Home Care**

A. An employee in a health care setting should advise employer of HIV-positive status.

B. Kitchen and bathroom facilities may be shared, provided that normal sanitary practices are observed.

C. Clean up spills of body fluids or waste immediately with a solution of 1 part bleach to 10 parts water. A bleach solution can be used to disinfect kitchen and bathroom floors, showers, sinks, and toilet bowls.

D. Towels and washcloths should not be shared without laundering.

E. Sanitary napkins, tampons, and any bloody dressings should be wrapped in a plastic bag and placed in a trash container.

F. Needles should not be recapped. Dispose of them in an impenetrable sealed container.

G. Do not donate blood or plasma, body organs, or semen.

**Pediatric Acquired Immunodeficiency Syndrome**

* The majority of children with AIDS were infected in the perinatal period. Cases related to blood transfusions are relatively rare.

**Data Collection**

A. Risk factors.
   1. Pediatric infection from transfused blood is virtually nonexistent.
   2. Sexual activity and IV drug use are the major causes of HIV infection in adolescents.
   3. Infants born to mothers who are HIV-positive account for the majority of children with HIV infection; ART therapy during pregnancy reduces risk for transmission to fetus.
   4. Children rarely have Kaposi’s sarcoma; PCP is most common opportunistic infection.

B. Clinical manifestations.
   1. Infants affected during the prenatal period have rapid disease progression.
   2. HIV-positive infants usually have symptoms by 18 to 24 months of age.
   3. Infants diagnosed within the first year of life have a poor prognosis, as do those who develop Pneumocystis jirovecii pneumonia (PCP) and progressive encephalopathy.
CHAPTER 5  Homeostasis

C. Diagnostics.
   1. EIA and WB for children 18 months or older.
   2. Newborn: polymerase chain reaction (PCR); p24 antigen detection; majority of infants who are HIV-positive can be identified by 3 months of age.
   3. Maternal antibodies to the HIV may persist for up to 18 months.
   4. Positive results on two separate occasions and from separate blood specimens for p24 antigen detection, polymerase chain reaction, and virus culture are required to confirm diagnosis of HIV infection.

Treatment
Treatment for children is essentially the same as that for an adult.

Nursing Interventions Specific to Children

- **Goal:** To maintain homeostasis.
  - A. Infants and children should receive the standard immunizations against childhood diseases. Measles-mumps-rubella (MMR) and varicella (chicken pox) vaccines may be given if the child is not severely immunocompromised.
  - B. Pneumococcal and influenza vaccines are recommended.
  - C. Nutritional support; high-calorie, high-protein diet.
  - D. Antifungal medications to prevent fungal infections.
  - E. Educate adolescents regarding safe sex.

Home Care

- **Goal:** To maintain homeostasis.
  - A. Teach parent(s) how to care for the child.
    1. How to administer medications and importance of administering medications as scheduled.
    3. Teach parents standard precautions, including proper handling of diapers and avoidance of contact with blood and body fluids.
    4. Help parents deal with child’s pain—multiple procedures, infections (abscessed tooth, otitis media).

Nursing Interventions for Immunocompromised Clients

An immunocompromised client does not have the protection of an effective immune system (clients with cancer and on chemotherapy, chronic progressive diseases, HIV).

- **Goal:** To monitor for and/or prevent opportunistic infections.
  - A. The type, location, and severity of the infection depend on the disease progress and the client’s immunosuppressive state.
  - B. Protect against health care related infections.
  - C. Observe hospitalized client and/or teach client symptoms of opportunistic infections.
    1. Persistent unexplained fever, night sweats.
    2. Thrush (white spots in the mouth).
    3. Persistent diarrhea and weight loss.

- **Goal:** To maintain ventilation and prevent pulmonary involvement.
  - A. Frequent assessments for pulmonary changes and hypoxemia.
  - B. Encourage activities if possible, assess response to activities.
  - C. Supplemental oxygen.
  - D. Coughing and deep-breathing exercises.
  - E. Adequate fluid intake, assess hydration status.

- **Goal:** To assist client to minimize the effects of neurologic changes.
  - A. Frequent assessment of neurologic status.
  - B. Assess for visual changes.
  - C. Observe for neurologic infections, specifically meningitis.
  - D. Provide a safe and supportive environment, based on client’s neurological status.
    1. Maintain safety in client’s room – beds, equipment, cords, etc.
    2. Initiate fall precautions.
    3. Provide frequent reorientation to environment.

- **Goal:** To maintain adequate nutritional intake.
  - A. Teach as well as provide client a high caloric intake (high-calorie, high-protein diet; nutrition to correct deficiencies).
  - B. Encourage high-calorie snacks and dietary supplements throughout the day.
  - C. Encourage client to eat several small meals throughout the day.
  - D. Avoid foods or beverages that may cause oral, esophageal, or gastric irritation.

- **Goal:** To prevent formation of pressure ulcers and excoriation of the skin.
  - A. Wash perineal and anal areas; allow areas to dry thoroughly.
  - B. Observe bony prominence for adequacy of circulation and development of a pressure ulcer.
  - C. Do not put any lotions on reddened areas or open lesions.
  - D. Teach client the importance of frequent changes in position.
E. Use gel pads, foam mattress pads, and other devices to prevent skin breakdown in pressure prone areas (heels and sacrum).

- **Goal:** To assist client to maintain psychologic equilibrium.
  A. Encourage client to express feelings and concerns.
  B. Encourage client to maintain as much independence as possible.
  C. Do not be judgmental regarding client’s lifestyle.
  D. Maintain frequent contact with the client.

---

**Home Care for the Immunocompromised Client**

A. Maintain personal hygiene and practice standard precautions; wash hands frequently.
B. Do not share personal items such as toothbrushes, razors, and enema equipment.
C. Teach client how to prevent infection.
  1. Cook all vegetables and meats, and peel fruit before eating; this eliminates many sources of microorganisms.
  2. Avoid contact with animal waste (e.g., litter boxes, bird cages, or fish); this further decreases contact with microorganisms.
  3. Avoid crowds and people with respiratory tract infections.
D. Do not get pregnant.

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**Study Questions: Homeostasis**

1. A client is being started on prednisone (Deltasone). What is important to teach the client regarding his medication?
   1. Increase fluid intake.
   2. Increase dose as needed.
   3. Do not discontinue medication abruptly.
   4. Do not take medication with food.

2. The nurse would identify what situation where a client’s condition could quickly deteriorate into severe respiratory difficulty and shock?
   1. Anaphylaxis.
   2. Allergic reaction.
   3. Serum sickness.
   4. Hay fever.

3. The nurse is caring for a client who has an autoimmune condition. What would the nurse identify as a physiological principle behind an autoimmune condition?
   1. A severe reaction to an allergen can quickly compromise the respiratory status of a client.
   2. A body response where the body does not recognize own body tissue.
   3. A severe compromise of the body’s immune system and inability to fight infection.
   4. Antibodies are synthesized in the body as a response to stimulation from a specific antigen.

4. A client is beginning long-term medication therapy with methylprednisolone (SoluMedrol). What is important to teach the client regarding the medication?
   1. The medication will decrease the client’s inflammatory response and ability to fight infections.
   2. The client should return to have anticoagulant blood studies drawn every 3 months.
   3. The client should carry a dose of epinephrine (EpiPen) in case of an allergic reaction.
   4. It will be important for the client to maintain a high fluid intake with supplemental potassium.

5. A child has received his 3-month series of vaccinations, what type of immunity does this provide?
   1. Autoimmune.
   2. Natural active immunity.
   3. Acquired passive immunity.
   4. Acquired active immunity.

6. A child develops a case of chicken pox. What has developed in the child’s immune system as a result of this exposure?
   1. Decreased CD4+ T cell count.
   2. An autoimmune response.
   3. Increased erythrocytes.
7. The nurse is evaluating an older adult client for adequacy of hydration. What would the nurse observe if the client has a fluid volume deficit?
   1. Peripheral edema
   2. Weight gain of 2 pounds in 24 hours.
   3. Dizziness when standing at bedside.
   4. Light color urine in increased amounts.

8. The nurse is evaluating the fluid balance on an older adult client. What is the most accurate measurement to determine changes in a client’s fluid balance?
   1. Adequacy of skin turgor.
   3. Measure intake and output.
   4. Measure circumference of the legs.

9. The nurse is checking a client’s foot for edema and finds barely detectable pitting. What is this level of edema?
   1. 4+.
   2. 3+.
   3. 2+.
   4. 1+.

10. What organ system is responsible for the regulation of the fluid and electrolyte balance in the body?
    1. Kidneys.
    2. Heart.
    3. Parathyroid.
    4. Liver.

11. A client has had a fever of 103˚F for the past 24 hours. What would be an important nursing action?
    1. Encourage intake of fluids.
    2. Monitor for problem with bradycardia.
    3. Assess lungs for presence of wet breath sounds.
    4. Assess for retention of excess fluids.

12. The nurse observes flushed, dry skin on a client. What would be important for the nurse to further evaluate on this client?
    1. Presence of edema in the lower extremities.
    2. Changes in blood pressure.
    3. Urinary output and concentration.
    4. Presence of upper respiratory infection.

13. The nurse is assessing an older adult client and determines the presence of dry mucous membranes and confusion. The nurse should continue to assess the client for what complication?
    1. Increased blood pressure.
    2. Retention of excess fluid.
    3. Excessive loss of body fluids.
    4. Problems with electrolyte balance.

14. Which client would the nurse identify as being at the greatest risk for having a significant fluid imbalance if their fluid intake was significantly reduced?
    1. 46-year-old diabetic adult.
    2. 3-week-old infant.
    3. 12-year-old underweight teenager.
    4. 25-year-old obese adult.

15. The nurse would identify what nursing situation that would require the use of protective eyewear?
    1. When emptying urinals and bedpans.
    2. While administering an IM injection.
    3. While performing direct client care for a client with droplet precautions.
    4. Whenever there is a chance of splashing blood or body fluids.

16. The nurse has been assigned a postoperative client. In report the nurse is told the client is experiencing a problem with respiratory acidosis. What nursing care will be important for this client?
    1. Increase fluid intake.
    2. Provide oxygen via a face mask.
    3. Observe for confusion.
    4. Turn, cough, and deep breathe.

17. What is important for the nurse to teach the HIV-positive client regarding transmission of the human immunodeficiency virus? It is most frequently transmitted:
    1. Via sexual contact with an infected individual.
    2. Through contact with contaminated blood.
    3. From the mother via the placenta at birth.
    4. By sharing a bathroom with an infected individual.

18. In caring for the client who is severely immunosuppressed, what is a priority nursing concern?
    1. Maintaining therapeutic communication.
    2. Preventing opportunistic infections.
    3. Promoting good skin care and wound healing.

19. A client is taking gentamicin (Garamycin). What serious side effect will it be important for the nurse to evaluate for on this client?
    1. Anaphylactic reaction
    2. Gastrointestinal bleeding.
    3. Increased susceptibility to infections.
    4. Decrease in ability to hear.

20. The nurse is performing a dressing change on a client who has a staphylococcus infection in an abdominal incision. What infection control precautions will the nurse implement? Select all that apply:
    ___ 1. Wear clean gloves to remove the old dressing.
    ___ 2. Put on a gown when entering the room.
    ___ 3. Wear a face shield.
    ___ 4. Dispose of the gown and mask in container outside client’s door.
    ___ 5. Leave all extra dressing supplies in the room.
    ___ 6. Carefully cleanse the stethoscope and scissors that came in contact with the client.

Answers and rationales to these questions are in the section at the end of the book titled Chapter Study Questions: Answers and Rationales.
## Appendix 5-1 POTASSIUM IMBALANCES

### NORMAL (K⁺) LEVELS: 3.5-5.0 mEq/L

<table>
<thead>
<tr>
<th>CAUSES</th>
<th>SYMPTOMS</th>
<th>NURSING IMPLICATIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>HYPOKALEMIA: Serum K⁺ below 3.5 mEq/L</strong></td>
<td>Fatigue, muscle weakness, cramps</td>
<td>1. Identify source of depletion and or increase – maintain good I&amp;O records.</td>
</tr>
<tr>
<td>Decreased intake of K⁺</td>
<td>Decreased reflexes</td>
<td>2. Monitor K⁺ levels.</td>
</tr>
<tr>
<td>GI loss:</td>
<td>Confusion, drowsiness, fatigue</td>
<td>3. Encourage foods high in K⁺ if deficit is present.</td>
</tr>
<tr>
<td>Vomiting, diarrhea</td>
<td>Bradycardia, weak irregular pulse</td>
<td>4. Encourage foods low is K⁺ if excess is present.</td>
</tr>
<tr>
<td>Nasogastric suction without replacement</td>
<td>Decreased bowel sounds.</td>
<td>5. Maintain accurate I&amp;O records.</td>
</tr>
<tr>
<td>Diuretics</td>
<td></td>
<td>7. Provide client education regarding diuretics.</td>
</tr>
<tr>
<td>Diabetics: Insulin and glucose moves K⁺ into cell</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| **HYPERKALEMIA: Serum K⁺ above 5.0 mEq/L**  | Drowsiness, irritability, anxiety              | See Nursing Implications under Hypokalemia.               |
| Decreased urinary excretion                 | Muscle weakness to flaccid paralysis in lower extremities |                                                           |
| Renal failure                               | Dysrhythmias:                                  |                                                           |
| Massive tissue injury:                      | Bradycardia, ventricular fibrillation,         |                                                           |
| Burns, trauma                               | cardiac arrest                                 |                                                           |
| Excessive administration of IV K⁺          | Diarrhea                                      |                                                           |
| Salt substitutes containing potassium       |                                               |                                                           |

## Appendix 5-2 POTASSIUM MEDICATIONS

### POTASSIUM SUPPLEMENTS

<table>
<thead>
<tr>
<th>Oral:</th>
<th>1. Sustained-release preparations are better tolerated and more convenient.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Potassium chloride (KCl)</td>
<td>2. Oral preparations generally have unpleasant taste and are irritating to GI system; they should be administered with a full glass of water or juice.</td>
</tr>
<tr>
<td>Sustained release:</td>
<td>3. Pediatric implications: make sure child/infant is urinating adequately before beginning supplementation.</td>
</tr>
<tr>
<td>K-Dur, Micro-K, Slow-K</td>
<td>4. IV K⁺ must be diluted and administered by IV drip. Do not give K⁺ IM or by IV push; may cause cardiac arrest.</td>
</tr>
<tr>
<td>Potassium gluconate (Kaon)</td>
<td>5. IV K⁺ solutions are irritating to the vein – notify RN if pain or redness occurs at site.</td>
</tr>
<tr>
<td>IV: Potassium acetate</td>
<td></td>
</tr>
</tbody>
</table>

### EXCHANGE RESIN

<table>
<thead>
<tr>
<th>Sodium polystyrene sulfonate (Kayexalate):</th>
<th>1. Laxatives are given to facilitate excretion of the resin.</th>
</tr>
</thead>
<tbody>
<tr>
<td>PO or rectal retention enema</td>
<td>2. Cleansing enema precedes the Kayexalate retention enema to enhance effectiveness.</td>
</tr>
<tr>
<td>(Medication is not absorbed systemically.)</td>
<td>3. Monitor serum electrolytes.</td>
</tr>
</tbody>
</table>
## Appendix 5-3 SODIUM IMBALANCES

### CAUSES | SYMPTOMS | NURSING IMPLICATIONS
--- | --- | ---
**NORMAL SERUM SODIUM (Na⁺) LEVELS: 135-145 mEq/L**  
**HYPONATREMIA:** Serum Na⁺ below 135 mEq/L (loss of sodium or water excess)

- Fluid gain, over hydration (dilutional)
- Excessive administration of D₂W
- Excessive fluid intake
- Increased excretion of sodium
- Diuretics
- Adrenal insufficiency

**Hypotension**

**Hypotension from fluid overload:**
- Bounding pulses, increased blood pressure
- Edema

**Hypotension from sodium loss:**
- CNS problems: confusion, headache, seizures
- Muscle weakness, twitching, cramping
- Abdominal cramps and diarrhea.

1. Identify source of depletion and or excess.
2. Maintain accurate I&O records, and determine weight daily (best measurement of fluid status).
3. Irrigate nasogastric tubes with normal saline solution to prevent depletion.
4. Seizure and fall precautions.
5. Restrict fluid intake if client has fluid excess.

**NURSING PRIORITY:** Older adult clients and infants are at higher risk because of variations in total body water; carefully monitor clients receiving fluid replacement with D₂W.

**HYPERNATREMIA:** Serum Na⁺ above 145 mEq/L (sodium retention or water loss).

- Decreased fluid intake
- Excessive salt intake
- Excessive water loss:
  - Diarrhea
  - Febrile state
  - Diuretics
- Increased renal retention
- Cushing’s syndrome

**Fluid excess (Na⁺ retention):**
- Symptoms of fluid excess.

**Fluid deficit (hemoconcentration of Na⁺, water loss):**
- Symptoms of fluid loss or dehydration.

**ADH**, antidiuretic hormone; **BP**, blood pressure; **CNS**, central nervous system; **CVP**, central venous pressure; **D₂W**, 5% dextrose in water; **I&O**, intake and output; **IV**, intravenously; **NPO**, nothing by mouth.

## Appendix 5-4 MEDICATIONS TO CORRECT SODIUM IMBALANCE

### MEDICATION | NURSING IMPLICATIONS
--- | ---
**SODIUM SUPPLEMENTS**
- Sodium chloride (NaCl, table salt)
- Saline solutions: 0.9% and 0.45% saline solution for infusion

1. Administer with caution in clients with CHF, renal problems, edema, or hypertension.
2. Determine weight daily; maintain accurate I&O records to evaluate fluid retention.
3. Evaluate serum Na⁺ levels.
4. Do not store containers of sodium chloride above a concentration of 0.9% (normal saline) on the nursing unit.
5. Diuretics to increase renal excretion of sodium for sodium excess.

**CHF**, Congestive heart failure; **I&O**, intake and output.
Appendix 5-5  CALCIUM IMBALANCES

CAUSES             SYMPTOMS                                 NURSING IMPLICATIONS

NORMAL SERUM CALCIUM (Ca++) LEVELS: 9-11 mg/dl OR 4-5 mEq/L

HYPOCALCEMIA: Serum Ca++ below 8.6 mg/dl or below 4 mEq/L, or below 3.5 mEq/L in infants
Acute pancreatitis
Laxative abuse
Dietary lack of Ca++ and vitamin D
Excessive blood transfusions
Excessive IV fluids

Tetany: + Chvostek’s sign; + Trousseau’s sign (Chapter 8)
Neuromuscular irritability
Numbness and tingling in extremities or around mouth
Laryngeal stridor
Seizures
Abdominal cramping and distention
Dysrhythmias

1. Identify origin of problem – either deficiency or excess.
2. Maintain seizure precautions.
3. Reduce environmental stimuli
4. Provide client education regarding Ca++ intake and supplemental vitamins.

HYPERCALCEMIA: Serum Ca++ above 10.5 mg/dl or above 5 mEq/L
Metastatic malignancy
Thiazide diuretics
Prolonged immobilization

Anorexia, nausea, constipation
CNS depression
Decreasing coordination
Pathological fractures
Dysrhythmias—increases sensitivity to digitalis preparations

1. Identify origin of increase.
2. Loop diuretics to facilitate removal of serum Ca++
3. Increase client’s fluid intake 3000 to 4000 mL/24 hours.
4. Decrease Ca++ intake.
5. Encourage client mobility.
6. Provide client education regarding supplemental vitamins.
7. Increase fiber intake.
8. Assess client taking digitalis for symptoms of toxicity.

CNS, Central nervous system; IV, intravenous.

Appendix 5-6  MEDICATIONS TO CORRECT CALCIUM IMBALANCE

MEDICATION                        NURSING IMPLICATIONS

CALCIUM SALTS
Calcium citrate (Citracal): PO  1. May be given in conjunction with vitamin D to enhance absorption.
Calcium gluconate: IV, PO  2. PO supplements are more effective if taken ½-1 hr after meals.
Calcium carbonate (TUMS, Rolaid): PO  3. Calcium citrate is absorbed more effectively than calcium carbonate.
Loop diuretics may be used to enhance excretion of calcium in treatment of hypercalcemia.
4. Prevent IV infiltration; Ca++ solutions cause tissue hypoxia and sloughing.
5. Use with caution for client receiving digitalis.
6. Corticosteroids decrease Ca++ absorption. Administer several hours apart.

IV, Intravenous; PO, by mouth.
### ANTIIINFLAMMATORY MEDICATIONS

#### General Nursing Implications
- Give oral medications with or after meals to decrease GI irritation and side effects.
- Following therapy, withdrawal from steroids must be done gradually.
- Client should not stop taking medications without directions from health care provider.
- For clients on long-term therapy, increased amounts of corticosteroids will be required during periods of stress such as surgery.
- Decreases client’s ability to respond to and fight infection.
- Closely evaluate the client on digitalis preparations and thiazide diuretics for the development of hypokalemia.
- Use with NSAIDs increases risk for intestinal irritation and perforation (Appendix 5-8).
- **Uses:** Inflammatory conditions—respiratory, gastrointestinal, joint inflammation, and skin conditions. Adrenocortical hormone replacement if adrenal glands are insufficient or have been removed. Suppress rejection of transplanted organs.

<table>
<thead>
<tr>
<th>Medications</th>
<th>Side Effects</th>
<th>Nursing Implications</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ADRENOCORTICAL HORMONES</strong> (Corticosteroids, Glucocorticoids):** Suppresses inflammatory response. Suppresses infiltration of area by lymphocytes, further reducing the immune response and inflammation. Used as immunosuppressant for delaying organ rejection. Long-term use will suppresses the function of the adrenal glands.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hydrocortisone base (Cortef): PO</td>
<td>Increased susceptibility to infections (bodywide)</td>
<td>1. Administer medication before 9:00 a.m. to decrease adrenal cortical suppression.</td>
</tr>
<tr>
<td>Dexamethasone (Decadron): PO, IV, IM, topical</td>
<td>Osteoporosis</td>
<td>3. Decrease salt intake in diet; encourage high-protein and high-potassium diet.</td>
</tr>
<tr>
<td>Prednisone (Deltasone, Meticorten): PO</td>
<td>Psychological disturbances (depression, euphoria)</td>
<td>4. Evaluate weight gain and blood pressure.</td>
</tr>
<tr>
<td>Methylprednisolone (Medrol): PO, IM, IV</td>
<td>Hypokalemia</td>
<td>5. Topical steroids usually do not provoke physical evidence of absorption.</td>
</tr>
<tr>
<td>Methylprednisolone sodium succinate (Solu-Medrol): IV</td>
<td>Hypertension (caused by sodium and water retention)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Cushing’s syndrome: moon face, buffalo hump, distended abdomen, thin arms and legs, excessive hair growth</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Cataracts</td>
<td></td>
</tr>
<tr>
<td><strong>Teaching:</strong> Take medication in the morning with food. Diet should include adequate K⁺ intake and decreased Na⁺ intake. Report to health care provider: any early signs of infection; or a weight gain of 5 lb or more in a week. Do not take a live virus vaccine (MMR, varicella) Do not take with aspirin products.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**NURSING PRIORITY:** It is critical that clients on corticosteroids do not stop taking the medications abruptly. This can result in a significant drop in blood pressure and hypoglycemia. Clients should advise all their health care providers if they are on steroids.

*GI, Gastrointestinal; IM, intramuscular; IV, intravenous; PO, by mouth (orally).*
Appendix 5-8    NONSTEROIDAL ANTIINFLAMMATORY DRUGS (NSAIDs) AND ACETAMINOPHEN

**General Nursing Implications**
- Give with a full glass of water, either with food or just after eating.
- Store in childproof containers and out of reach of small children.
- Do not exceed recommended doses.
- Discontinue 1-2 weeks before elective surgery.
- NSAIDs prolong bleeding time by decreasing platelet aggregation; may increase anticoagulant activity of warfarin products.
- Avoid in clients with history of peptic ulcer disease or bleeding problems.
- Acetaminophen may cause renal impairment.
- Do not crush enteric-coated tablets; if available, administer as enteric or buffered tablets.

**Uses:** Fever: acetaminophen, aspirin, ibuprofen; Inflammation: aspirin, naproxen; Arthritis: aspirin, ibuprofen, naproxen, piroxicam, sulindac; Dysmenorrhea: ibuprofen, naproxen

<table>
<thead>
<tr>
<th>Medications</th>
<th>Side Effects</th>
<th>Nursing Implications</th>
</tr>
</thead>
</table>
| **NONSTERoidal ANTIINFLAMMATory DRUGS (NSAIDs) AND ACETAMINOPHEN:** | Inhibit the enzyme cyclooxygenase, which is responsible for the synthesis of prostaglandins. Suppresses inflammation, relieves pain, and reduces fever. | 1. Most common agent responsible for accidental poisoning in small children.  
3. Assess for bleeding tendencies.  
4. Prophylactic use for colon cancer.  
5. Prophylactic use for cardiovascular problems due to the antiplatelet aggregation properties. |
| Acetylsalicylic acid (Aspirin, ASA): PO | **Salicylism:** skin reactions, redness, rashes, ringing in the ears, GI upset, hyperventilation, sweating, and thirst  
**Long-term use:** erosive gastritis with bleeding; increases anticoagulant properties of warfarin. | 1. Do not exceed 3.2 g per day in adults and older adult clients.  
2. Avoid taking with aspirin. |
| Ibuprofen (Motrin, Nuprin, Advil): PO | Dyspepsia (heartburn, nausea, epigastric distress)  
Dizziness, rash, dermatitis | 1. Avoid tasks requiring alertness until response is established.  
2. Take with food to decrease GI irritation.  
3. Primarily used for pain control. |
| Naproxen (Naprosyn); Naproxen sodium (Anaprox, Aleve): PO | Headache, dyspepsia, dizziness, drowsiness | 1. Maximum dose of acetaminophen, 4 g per day.  
2. Does not have anti-inflammatory properties.  
3. Overdose can cause severe liver injury; client should consult physician if intake of alcoholic beverage is in excess of 3 every day.  
4. Has not been conclusively linked to bleeding problems. |
| Acetaminophen (Tylenol, Datril, Tempra): PO | Anorexia, nausea, diaphoresis  
Toxicity: vomiting, RUQ tenderness, elevated liver function tests  
Antidote: acetylcysteine (Mucomyst, Acetadote) | 1. Most common agent responsible for accidental poisoning in small children.  
3. Assess for bleeding tendencies.  
4. Prophylactic use for colon cancer.  
5. Prophylactic use for cardiovascular problems due to the antiplatelet aggregation properties. |
| Piroxicam (Feldene): PO | Dyspepsia, nausea, dizziness, diarrhea, nephrotoxicity | **NURSING PRIORITY:** Aspirin is the only NSAID used to protect against MI and stroke. Advise client that CDC warns against giving aspirin to children or adolescents with a viral infection or influenza. |
| Sulindac (Clinoril): PO | **NURSING PRIORITY:** Frequently used in combination with OTC medications. Teach client to read labels to prevent overdosing. |**GI,** Gastrointestinal; **PO,** by mouth (orally); **RUQ,** right upper quadrant.
Appendix 5-9    INFECTION CONTROL PROCEDURES

GENERAL INFORMATION

• Many clients with disease-specific isolation precautions require only standard precautions.
• The specific substances covered by standard precautions include blood and all other body fluids, body secretions, and body excretions, even if blood is not visible. Moisture from perspiration (sweat) is an exception.
• Transmission-based precautions are followed, in addition to standard precautions, whenever a client is known or suspected to be infected with contagious pathogens.

STANDARD PRECAUTIONS

1. Practice good hand hygiene (Box 5-2).
   • Hand hygiene with an antiseptic cleanser after removing gloves.
   • Wash hands immediately with soap and water if visibly contaminated with blood or body fluids.
   • Wear gloves if there is a possibility you might come in contact with any body fluid or contaminated surfaces or objects.
2. Change gloves between tasks and procedures on the same client if moving from a contaminated body area (perineal area) to a clean body area. Do not wash gloves for reuse.
3. Wear gloves, gown, eye protection (goggles, glasses) or face shield and a mask during procedures likely to generate droplets of blood or body fluids.
4. Wear a gown when there is risk clothing will come in contact with body fluids. Perform hand hygiene after removing the gown. Do not reuse gowns, even if they are not soiled.
5. Have used client care equipment properly cleaned; discard any single-use items after use.
6. Ensure that hospital procedures for routine care, cleaning, and disinfection of environmental surfaces, beds, bedrails, and bedside equipment are followed.
7. Place contaminated linens in a leak-proof bag; handle contaminated linens in a manner that prevents contamination and transfer of microorganisms.
8. Discard all sharps in puncture resistant container. Do not bend, break, reinsert them into their original sheaths, or handle them unnecessarily. Discard them intact immediately after use.
9. Place clients who pose a risk for transmission to others in a private room. This includes clients who cannot contain secretions/excretions or wound drainage, infants with respiratory or intestinal infections.

RESPIRATORY HYGIENE AND COUGH ETIQUETTE

1. Educate health care personnel regarding measures to contain their own respiratory secretions.
2. Post signs in strategic places regarding covering the mouth and nose when coughing or sneezing; provide non-touch receptacles for disposal of tissue.

SAFE INJECTION PRACTICES

Use single-dose vials for parenteral administration when possible.
1. If multi-dose vials must be used, the needle or cannula and the syringe used to access the vial must be sterile.
2. Do not use the same syringe to administer medications to multiple clients, even if the needle is changed.
3. Do not keep multi-dose vials in the immediate client treatment area.

INFECTION CONTROL FOR LUMBAR PUNCTURES

Wear a surgical mask when placing a catheter or injecting material into the spinal column or subdural space (myelogram, lumbar puncture, spinal or epidural anesthesia).

AIRBORNE PRECAUTIONS (droplet smaller than 5 mcg)

1. Place client in airborne isolation infection room (AIIR) as soon as possible.
2. Personal protection equipment (PPE):
   • Wear respiratory protection (N95 respirator mask approved by the National Institute for Occupational Safety and Health [NIOSH]) when entering the room.
   • Wear gloves, and gown when entering the room, remove prior to leaving room.
3. Limit client transport and client movement out of the room. Health care personnel who are not immune are restricted from entering the client’s room.
4. Conditions requiring use of airborne precautions – pulmonary or laryngeal tuberculosis, varicella, rubella and smallpox.

Continued
### DROPLET PRECAUTIONS (droplets larger than 5 mcg)

1. Applicable to clients known to be, or suspected of being, infected with pathogens that are transmitted via respiratory droplets (sneezing, coughing, talking).
2. Place the client in a private room whenever possible; may place two clients in the same room if they are infected with the same pathogen.
3. PPE:
   - Wear a mask when entering the client room or examination area.
   - No recommendation regarding routine use of eye protection.
4. Place a mask on the client if transporting in the health care setting.
5. Instruct client and family regarding respiratory hygiene/cough etiquette.
6. Limit movement of the client from the room; if the client must leave the room, have him or her wear a surgical mask.

### CONTACT PRECAUTIONS

1. Applicable to clients with diseases easily transmitted by direct contact such as gastrointestinal, respiratory tract, skin, or wound infections and clients colonized with multidrug-resistant bacteria.
2. Place the client in a private room if condition may facilitate transmission—uncontrolled drainage, incontinence. May place two clients infected with same pathogen in the same room.
3. PPE:
   - Wear a gown when entering the client’s room; remove gown prior to leaving the room.
   - Wear gloves when entering the client’s room. Always change gloves after contact with infected material. Remove gloves before leaving the client’s room and perform hand hygiene; do not touch anything in the room as you are leaving.
   - Wear gloves when touching the client’s intact skin and surfaces and articles in close proximity to the client.
4. Dedicate use of client care equipment to the single client when possible; if common equipment use is unavoidable, the equipment must be disinfected before use on another client.
5. Limit the transport or movement of the client outside the room; if necessary to move client, ensure that infected or colonized areas of the client’s body are contained and covered.
6. Evidence shows that multiple drug-resistant organisms (MDROs) are carried from one person to another via the hands of health care personnel.

### PROTECTIVE ENVIRONMENT PRECAUTIONS

1. May be used for clients who are severely immunosuppressed—clients with stem cell transplants, clients with organ transplant, AIDS clients.
2. Place the client in a private room that has positive-pressure air flow and high-efficiency particulate air (HEPA) filtration for incoming air.
3. Wear respiratory protection (N95 respirator mask), gloves, and gown when entering the room.
4. Limit client transport and client movement out of the room.
5. No fresh flowers, fruits, or potted plants allowed in room.

---

**TEST ALERT:** Use critical thinking to ensure standard transmission-based precautions are implemented; prevent environmental spread of infectious diseases.

### General Nursing Implications
- Always assess for antibiotic allergies, especially penicillin allergy, before administration.
- Cultures should be obtained before the administration of the first dose.
- Teach the client to finish the entire prescribed course of medication even though he or she may feel well.
- Schedule IM and IV administration at evenly spaced intervals around the clock.
- Give most oral antibiotic drugs on an empty stomach (1 hour before or 2 hours after meals).
- Take medications with a full glass of water.
- Observe for hypersensitivity:
  - Anaphylaxis—hypotension, respiratory distress, urticaria, angioedema, vomiting, diarrhea
  - Serum sickness—fever, vasculitis, generalized lymphadenopathy, edema of joints, bronchospasm
- Observe for superinfection:
  - Stomatitis—sore mouth, white patches on oral mucosa, black furry tongue, diarrhea
  - Monilial vaginitis—rash in perineal area, itching, vaginal discharge
  - New localized signs and symptoms—redness, heat, edema, pain, drainage, cough
  - Recurrence of systemic signs and symptoms—fever, malaise

### Medications

<table>
<thead>
<tr>
<th>Medications</th>
<th>Side Effects</th>
<th>Nursing Implications</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Penicillin:</strong> Bactericidal</td>
<td>Interferes with the formation of the bacterial cell wall.</td>
<td>1. Observe for allergic reactions and have emergency equipment available.</td>
</tr>
<tr>
<td>Natural penicillins</td>
<td></td>
<td>2. Amoxicillin can be scheduled without regard to meals.</td>
</tr>
<tr>
<td>Aminopenicillins</td>
<td></td>
<td>4. Clients with beta-hemolytic strep infections should receive penicillin for a minimum of 10 days to prevent development of rheumatic fever or glomerulonephritis.</td>
</tr>
<tr>
<td>Amoxicillin (Amoxil): PO</td>
<td></td>
<td>5. Discard liquid forms of penicillin after 7 days at room temperature and 14 days when refrigerated.</td>
</tr>
<tr>
<td>Ampicillin (Principen, Totacillin): PO, IM, IV</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Penicillinase-resistant penicillins</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cloxacillin (Tegopen): PO</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nafcillin: IV</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Extended-spectrum penicillin</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ticarcillin disodium (Ticar): IM, IV</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Penicillin with beta-lactamase inhibitor</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Amoxicillin with clavulanic acid (Augmentin): PO</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Aminoglycoside: Bactericidal
Interferes with protein synthesis.

<table>
<thead>
<tr>
<th>Medications</th>
<th>Side Effects</th>
<th>Nursing Implications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gentamicin (Garamycin): IM, IV</td>
<td>Toxicity: Ototoxicity—hearing loss is irreversible. Nephrotoxicity—albuminuria, casts, oliguria. Skin rash, headache, hypotension, pain, and tenderness at injection site.</td>
<td>1. Monitor serum peak and trough levels to determine toxic levels.</td>
</tr>
<tr>
<td>Amikacin (Amikin): IM, IV</td>
<td></td>
<td>2. Assess for ototoxicity (change in hearing, ringing in the ears, dizziness, or unsteady gait) and nephrotoxicity (monitor BUN and creatinine).</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5. For IV piggyback medications, administer over 30-60 minutes.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>6. Neomycin PO may be used to suppress intestinal flora before surgery.</td>
</tr>
</tbody>
</table>

Continued
### CEPHALOSPORINS: Bactericidal: Broad-spectrum; interfere with the formation of the bacterial cell wall.

<table>
<thead>
<tr>
<th>Generation</th>
<th>Medication</th>
<th>Administration</th>
<th>Side Effects</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>First generation</strong></td>
<td>Cefadroxil (Duricef, Ultracil): PO</td>
<td>Hypersensitivity—rash, superinfection. GI upset, neutropenia (decreased WBCs), pain at injection site, renal damage seizures.</td>
<td>1. Give oral cephalosporins with food or milk. 2. Administer IM medications deep into the muscle. 3. Should not be given to clients with a known allergy to penicillin. 4. Decrease phlebitis at IV site by diluting IV solutions and administering slowly. 5. There is increasing antibacterial activity from first generation to fourth generation, treatment usually starts with first generation to prevent development of increased resistance.</td>
</tr>
<tr>
<td></td>
<td>Cephalexin (Keflex): PO</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Cefazolin (Kefzol, Ancef): IM, IV</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Second generation</strong></td>
<td>Cefuroxime (Ceftin, Zinacef): PO, IM, IV</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>Loracarbef (Lorabid): PO</td>
<td></td>
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</tr>
<tr>
<td></td>
<td>Cefoxitin (Mefoxin): IM, IV</td>
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<td></td>
</tr>
<tr>
<td><strong>Third generation</strong></td>
<td>Cefixime (Suprax): PO</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Ceftriaxone (Rocephin): IM, IV</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Fourth generation</strong></td>
<td>Cefepime (Maxipime): IM, IV</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### TETRACYCLINES: Bacteriostatic: Broad-spectrum; interfere with protein synthesis of infectious organism and thus diminish its growth and reproduction.

<table>
<thead>
<tr>
<th>Medication</th>
<th>Administration</th>
<th>Side Effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tetracycline (Sumycin): PO, IV, IM</td>
<td>PO may cause GI irritation (loose stools, diarrhea), sore throat, photosensitivity. Diarrhea may indicate severe suprainfection in bowel. Discoloration of teeth in children up to 8 years old. Can cause staining of developing teeth in the fetus if taken after fourth month of gestation.</td>
<td>1. Administer on empty stomach; withhold antacids, dairy foods, and foods high in calcium at least 2 hours after PO administration. Do not administer with milk. 2. Can give doxycycline and minocycline with food. 3. Do not give at the same time as iron preparations. Give them as far apart as possible (e.g., 2-3 hours). 4. Advise client to avoid direct or artificial sunlight. 5. If diarrhea occurs, it is important to determine cause. 6. Observe for development of superinfections.</td>
</tr>
<tr>
<td>Doxycycline (Vibramycin): PO, IV</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Demeclocycline (Declomycin): PO</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Minocycline (Minocin): PO, IV</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### SULFONAMIDES: Bacteriostatic: Suppress bacterial growth by inhibiting synthesis of folic acid.

<table>
<thead>
<tr>
<th>Medication</th>
<th>Administration</th>
<th>Side Effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sulfisoxazole (Gantrisin): PO, IV, IM</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trimethoprim sulfamethoxazole (TMP-SMZ, Bactrim, Septra): PO, IV</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sulfasalzine (Azulfidine): PO</td>
<td>Nausea, vomiting, diarrhea. Hepatitis, bone marrow suppression.</td>
<td></td>
</tr>
</tbody>
</table>

### MACROLIDES: Bacteriostatic: Inhibit protein synthesis.

<table>
<thead>
<tr>
<th>Medication</th>
<th>Administration</th>
<th>Side Effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clarithromycin (Biaxin): PO</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
# Appendix 5-10  ANTIBIOTIC MEDICATIONS—cont’d.

### FLUOROQUINOLONES: **Bactericidal:** Inhibit bacterial DNA.

<table>
<thead>
<tr>
<th>Medication</th>
<th>Administration</th>
<th>Side Effects</th>
<th>Precautions/Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ciprofloxacin (Cipro)</td>
<td>PO, IV</td>
<td>GI: Nausea, vomiting, abdominal distress, diarrhea.</td>
<td>1. Absorption is reduced by milk products, antacids. 2. Administer IV infusions over 60 minutes.</td>
</tr>
<tr>
<td>Levofloxacin (Levaquin)</td>
<td>PO, IV</td>
<td>CNS: dizziness, headache, confusion Superinfections.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>GI: Nausea, vomiting, abdominal distress, diarrhea.</td>
<td></td>
</tr>
</tbody>
</table>

### OTHER ANTI-INFECTIVE AGENTS

<table>
<thead>
<tr>
<th>Medication</th>
<th>Administration</th>
<th>Side Effects</th>
<th>Precautions/Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Metronidazole (Flagyl)</td>
<td>PO, IV</td>
<td>Nausea, dry mouth, headache. Disulfiram reaction when taken with alcohol: nausea, copious vomiting, flushing, palpitations, headache. May last 30 minutes to an hour.</td>
<td>1. Classified as an antiprotozoal antibiotic; is effective against anaerobic microorganisms. 2. Avoid use with alcohol or products containing alcohol. Will cause a disulfiram reaction.</td>
</tr>
<tr>
<td>Vancomycin (Vancocin)</td>
<td>PO, IV</td>
<td>Otoxicity, thrombophlebitis at site. Red man syndrome: flushing, rash, pruritus, tachycardia, and hypotension.</td>
<td>1. IV infusions over at least 60 minutes to prevent adverse effects. 2. Serum peak and trough levels are monitored.</td>
</tr>
<tr>
<td>Linezolid (Zyvox)</td>
<td>PO, IV</td>
<td>GI: diarrhea, nausea Myelosuppression—anemia, leukopenia, thrombocytopenia.</td>
<td>1. New class of antibiotics—oxazolidinones. 2. Monitor for blood dyscrasias. 3. Reserved for treatment of infections from MDROs.</td>
</tr>
<tr>
<td>Antifungal Nystatin (Mycostatin)</td>
<td>PO, topical</td>
<td></td>
<td>1. Used for treatment of candidiasis (mouth, esophagus, vagina). 2. Oral treatment encourage client to hold medication in their mouth and “swish” around to provide good contact with all affected areas.</td>
</tr>
</tbody>
</table>

*BUN*, Blood urea nitrogen; *GI*, gastrointestinal; *IM*, intramuscular; *IV*, intravenous; *PO*, by mouth; *MDRO*, multiple drug resistant organisms.
Appendix 5-11  
**ANTIRETROVIRAL THERAPY (ART)**

### General Nursing Implications
- Highly active antiretroviral therapy (HAART) used for treatment of clients with HIV and AIDS.
- Report any sore throat, fever, or other signs of infection to health care provider.
- Very important to administer the medication at the same time each day to maintain consistent blood levels and to decrease drug resistance.
- No vaccines or immunity-conferring agents while client is immunosuppressed.
- Maintain standard precautions, use contact, droplet, and airborne precautions as indicated.
- Medications do not cure AIDS or reduce the risk for transmission.

### Medications

<table>
<thead>
<tr>
<th>Medications</th>
<th>Side Effects</th>
<th>Nursing Implications</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>NONNUCLEOSIDE REVERSE TRANSCRIPTASE INHIBITORS (NNRTIS):</strong> All bind directly to the HIV transcriptase and inhibits the enzyme.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nevirapine (Viramune, NVP): PO</td>
<td>Rash (may be severe—blistering, joint pain, oral lesions), hepatotoxic.</td>
<td>Viramune: Monitor LFTs; rash may be so severe that drug is discontinued.</td>
</tr>
<tr>
<td>Delavirdine (Rescriptor, DLV): PO</td>
<td>Rash (may be severe), hepatoxic, GI symptoms.</td>
<td>Rescriptor: Monitor LFTs; rash may be so severe that drug is discontinued.</td>
</tr>
<tr>
<td>Efavirenz (Sustiva, EFV): PO</td>
<td>Rash, hepatotoxic, teratogenic, CNS symptoms.</td>
<td>Sustiva: Monitor LFTs, avoid pregnancy, avoid taking with St. John’s wort.</td>
</tr>
</tbody>
</table>

**NUCLEOSIDE/NUCLEOTIDE REVERSE TRANSCRIPTASE INHIBITORS (NRTIS):** Medications are given with other antiretroviral agents; they are not used alone due to rapid development of resistance.

<table>
<thead>
<tr>
<th>Medications</th>
<th>Side Effects</th>
<th>Nursing Implications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Didanosine (Videx): PO</td>
<td>Nausea, diarrhea, peripheral neuropathy, liver damage, pancreatitis.</td>
<td>Food decreases absorption; give on empty stomach 30 min before eating or 2 hr after. Report peripheral neuropathy; do not use in pregnancy.</td>
</tr>
<tr>
<td>Stavudine (Zerit): PO</td>
<td>Pancreatitis, lactic acidosis, diarrhea, peripheral neuropathy</td>
<td>Maintain upright position to decrease esophageal irritation; monitor levels of anemia and neutropenia.</td>
</tr>
<tr>
<td>Zidovudine (ZDV, Retrovir, AZT, azidothymidine): PO, IV</td>
<td>Bone marrow suppression, anemia, neutropenia</td>
<td></td>
</tr>
<tr>
<td>Lamivudine (Epivir): PO</td>
<td>Headache, nausea, malaise/fatigue, diarrhea</td>
<td>St. John’s wort may decrease concentration.</td>
</tr>
<tr>
<td>Abacavir (Ziagen): PO</td>
<td>Hypersensitivity, pulmonary problems.</td>
<td>ETOH increases risk for hypersensitivity reactions; report respiratory changes.</td>
</tr>
</tbody>
</table>

**PROTEASE INHIBITORS (PIs):** Render the virus immature and noninfectious; are not given alone due to development of increased resistance. **ADVERSE EFFECTS OF ALL PIS:** Fat maldistribution, hyperlipidemia, hyperglycemia, bone loss, hepatotoxic. **SHARED INTERACTIONS:** St John’s wort, decreases the effectiveness of PIs.

<table>
<thead>
<tr>
<th>Medications</th>
<th>Side Effects</th>
<th>Nursing Implications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Saquinavir (Fortovase, Invirase): PO</td>
<td>GI affects, headache</td>
<td>Do not give with grapefruit juice; take with food; check for drug interactions; Food increases levels; take with food for tolerance.</td>
</tr>
<tr>
<td>Ritonavir (Norvir): PO</td>
<td>GI discomfort, perioral paresthesia</td>
<td>Take 1 hr before or 2 hours after meals.</td>
</tr>
<tr>
<td>Indinavir (Crixivan): PO</td>
<td>GI discomfort, renal damage</td>
<td>Take with food.</td>
</tr>
<tr>
<td>Nelfinavir (Viracept): PO</td>
<td>Diarrhea, rash</td>
<td>Contraindicated in pregnancy, renal or hepatic failure; high-fat meals decrease absorption.</td>
</tr>
<tr>
<td>Ampranavir (Agenerase): PO</td>
<td>N/V, diarrhea, rash</td>
<td>Moderate fat meal increases absorption; take with food.</td>
</tr>
<tr>
<td>Lopinavir/ritonavir (Kaletra): PO</td>
<td>N/V, diarrhea, increased fatigue</td>
<td></td>
</tr>
</tbody>
</table>

**HIV FUSION INHIBITOR:** Blocks entry of HIV into CD4 T cells.

<table>
<thead>
<tr>
<th>Medications</th>
<th>Side Effects</th>
<th>Nursing Implications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enfuvirtide (Fuzeon, T-20): subQ</td>
<td>Injection site reaction, bacterial pneumonia, hypersensitivity reactions</td>
<td>Use small-gauge needle to decrease skin reaction; monitor respiratory status.</td>
</tr>
</tbody>
</table>

*AIDS,* Acquired immunodeficiency syndrome; *GI,* gastrointestinal; *HIV,* human immunodeficiency virus; *IV,* intravenous; *PO,* by mouth (orally); *subQ,* subcutaneous.
### MEDICATIONS FOR ALLERGIC REACTIONS

<table>
<thead>
<tr>
<th>Medications</th>
<th>Side Effects</th>
<th>Nursing Implications</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ANTIHISTAMINES:</strong> Selectively block histamine receptor sites.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>H1—First Generation</strong></td>
<td>Dry mouth, dizziness, blurred vision, urinary retention, constipation, and sedation</td>
<td>1. Advise client not to engage in activity that requires mental alertness for safety. 2. Should not take medication with alcohol. 3. Should not be used in clients with asthma.</td>
</tr>
<tr>
<td>Diphenhydramine (Benadryl): PO, IM, IV</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clemastine (Tavist Allergy): PO</td>
<td>Children: paradoxical reactions</td>
<td></td>
</tr>
<tr>
<td>Promethazine (Phenergan): PO, IV, IM</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>H1—Second Generation</strong></td>
<td>Dry mouth and throat</td>
<td>1. Second generation is nonsedating. 2. Do not have anticholinergic properties of first generation. 3. Should not be taken with alcohol. 4. Are much more expensive than first generation.</td>
</tr>
<tr>
<td>Cetirizine (Zyrtec): PO</td>
<td>Paradoxical reaction in children</td>
<td></td>
</tr>
<tr>
<td>Fexofenadine (Allegra) PO</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Loratadine (Claritin) PO</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Nasal Sprays</strong></td>
<td>Nasopharyngeal irritation.</td>
<td>1. Teach client to clear nasal passages before using. 2. Hold spray bottle upright and insert tip into nostril. 3. Used to treat allergic rhinitis.</td>
</tr>
<tr>
<td>Fluticasone (Flonase, Flovent)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Triamcinolone (Nasacort)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>ADRENERGIC AGONIST:</strong> Relaxes smooth muscle of bronchial tree (decreases respiratory distress), cardiac stimulant (increases cardiac rate), produces vasoconstriction (increases blood pressure), drug of choice for anaphylactic reactions.</td>
<td>Hypertension, dysrhythmias, angina, hyperglycemia</td>
<td>1. Clients at risk for anaphylaxis should always carry identification and emergency epinephrine (EpiPen). 2. <strong>EpiPen</strong>—sensitive to extreme heat and light; discard if it is brown in color, has a precipitate, or has passed its expiration date. 3. Advise clients to obtain medical assistance immediately if epinephrine is used. 4. 0.1 to 0.5 mL of 1:1000 dilution subQ or IM is used for mild to moderate reaction. 5. 0.5 mL of 1:10,000 dilution subcutaneously or IV is used for severe reactions and advanced cardiac life support. 6. Drug of choice for severe anaphylactic reactions. 7. Closely monitor pulse rate and blood pressure.</td>
</tr>
<tr>
<td>Epinephrine (Adrenalin, EpiPen): subQ, IV</td>
<td>Necrosis at IV site if extravasation occurs</td>
<td></td>
</tr>
<tr>
<td>1%—1:100—oral inhalation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.1%—1:1,000—subQ, IM</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.01%—1:10,000—IV, intracardiac.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*PO, by mouth (orally); IM, intramuscular; IV, intravenous; subQ, subcutaneous.*