Potassium Imbalances

**KEY TERMS**

**Actual hyperkalemia**—Elevated serum potassium level with an increased number of potassium ions in the extracellular fluid (ECF).

**Actual hypokalemia**—Reduced serum potassium level with a decreased number of potassium ions in the ECF.

**Adenosine triphosphate**—A substance present in all living cells that contains a large amount of chemical energy; when adenosine triphosphate breaks down, it releases that energy, which is used for many metabolic processes; considered as the "universal energy currency for metabolism."

**Bradycardia**—An apical heart rate less than 60 bpm (in an adult client).

**Dysrhythmia**—Abnormal or irregular cardiac rhythm caused by a disturbance in the electrical conduction of the heart.

**Hyperkalemia**—Serum potassium (K⁺) greater than 5 mEq/L.

**Hypokalemia**—Serum potassium (K⁺) less than 3.5 mEq/L.

**Relative hyperkalemia**—Elevated serum potassium level without an actual increase in the number of potassium ions; caused by the movement of potassium out of the cells into the ECF.

**Relative hypokalemia**—Reduced serum potassium level without an actual decrease in the number of potassium ions; caused by the movement of potassium out of the ECF into the cells.

**Sodium-potassium pump**—Mechanism within the cell membrane of every cell in the body that actively transports potassium back into the cell and sodium back into the ECF to maintain electrolyte balance in the ECF.

**Tachycardia**—An apical heart rate greater than 100 bpm (in an adult client).

**Ventricular fibrillation**—A medical emergency in which the ventricles of the heart quiver rather than contract properly.

**Description**

Potassium (K⁺) is the most common cation in the intracellular fluid (ICF). The ICF contains approximately 98% of the body's potassium, while approximately 2% remains in the extracellular fluid (ECF). Potassium plays a significant role in neuromuscular activity and helps maintain acid-base balance. Dietary intake is usually sufficient to meet daily requirements. Guidelines suggest that most adults should consume at least 4,700 mg of potassium daily, but surveys show that Americans consume less than half that amount because the typical Western diet is low in fruits and vegetables. Potassium is absorbed in the intestines and excreted by the kidneys. To maintain homeostasis in the body, serum potassium levels must be tightly controlled. Minimal changes in potassium concentration can cause major alterations in the body. Potassium performs the following functions:

1. Facilitates nerve impulse conduction
2. Is essential for the normal electrical activity of the heart
3. Plays a key role in skeletal and smooth muscle contraction, making it important for normal digestive and muscular functioning
4. Assists in making protein using amino acids
5. Aids in the regulation of acid-base balance

**Normal Lab Value** The normal serum potassium level is 3.5 to 5.0 mEq/L.
**MAKING THE CONNECTION**

**Potassium Balance and the Sodium-Potassium Pump**

The sodium-potassium pump, which is found in the cell membrane of every cell in the body, regulates the amount of potassium in the ECF. Because the concentration of potassium is much higher in the ICF than in the ECF, potassium easily moves out of the cells down the concentration gradient via diffusion. The sodium-potassium pump then transports sodium and potassium ions across cell membranes against their concentration gradients. This process requires the expenditure of energy, which is provided by adenosine triphosphate. Potassium is moved out of the ECF, where its concentration is low, and into the cells, where the concentration is much higher. To control the amount of potassium in the blood and other extracellular fluids, sodium is moved in the opposite direction. The sodium-potassium pump removes three sodium ions from each cell for every two potassium ions returned to each cell [Fig. 4.1]. If an underlying disorder prevents the sodium-potassium pump from working properly, potential life-threatening electrolyte imbalances can occur.

**II. Potassium Imbalance**

Potassium imbalances occur when there is a decrease or increase in the potassium content of the ECF. To remember how potassium affects the body, associate low potassium levels (hypokalemia) with general hyporeflexia, flattened T waves on the electrocardiogram [ECG], and hyporeactive bowel sounds or constipation) because reduced potassium levels slow down nerve impulses. Associate high potassium levels (hyperkalemia) with general hyperactivity in the body (irritability, tall, tented T waves on the ECG; and hyperactive bowel sounds or diarrhea) because increased potassium levels speed up nerve impulses. The greatest danger related to either type of potassium imbalance is cardiac dysrhythmia because the heart muscle (myocardium) is highly excitable and most sensitive to changes in potassium levels.

**III. Types of Potassium Imbalance**

A. Hypokalemia, or potassium deficit, is a serum potassium level less than 3.5 mEq/L.

1. If potassium loss is gradual, the body can compensate for the change, and signs and symptoms of hypokalemia may not appear until potassium loss is extreme.
2. Consequences of hypokalemia are worsened by alkalosis, digoxin therapy, and hypokalemia.
3. Hypokalemia can lead to life-threatening dysrhythmias because it disrupts the electrical activity in cardiac, skeletal, and smooth muscles, resulting in cardiac dysrhythmias and profound muscle weakness.
4. Respiratory insufficiency and cardiac dysrhythmias are the most dangerous potential problems associated with hypokalemia.

**DID YOU KNOW?**

Chronic, moderate potassium deficiency is associated with increased blood pressure, increased sensitivity to salt, increased risk of kidney stones, and increased rate of bone remodeling.

B. Hyperkalemia, or potassium excess, is a serum potassium level greater than 5.0 mEq/L.

1. Hyperkalemia is dangerous because there are often no signs or symptoms.
2. Mild hyperkalemia is usually well tolerated.
3. Moderate hyperkalemia can produce ECG changes.
4. Sudden increases in serum potassium can cause severe problems at levels between 6.0 and 7.0 mEq/L, whereas gradual increases may not affect the client until the level reaches 8.0 mEq/L or greater.
5. Severe hyperkalemia suppresses the electrical activity of the heart, causing cardiac dysrhythmias or cardiac arrest.

**DID YOU KNOW?**

Cardiac dysrhythmia is the most common cause of death in clients with hyperkalemia.
A serum potassium level less than 2.5 mEq/L or greater than 6.5 mEq/L is a medical emergency and can lead to respiratory arrest and lethal dysrhythmias.

IV. Causes of Potassium Imbalance

Changes in fluid and potassium balance may result in actual or relative increases or decreases in potassium content. An actual increase or decrease in potassium occurs as a direct result of potassium gain or loss. A relative increase or decrease in potassium is most often caused by shifts in potassium between the ICF and ECF compartments (Table 4.1).

A. Actual hypokalemia may be caused by potassium loss or inadequate potassium intake or absorption, resulting in an actual decrease in potassium in the body.

1. Potassium loss
   a. Vomiting and chronic diarrhea result in the loss of water, sodium, and potassium.
   b. Prolonged gastric suctioning removes fluid and hydrochloric acid, causing the pH of the blood to increase (alkalosis) (see Chapter 8, Acidosis and Alkalosis).
   c. Diaphoresis (excessive sweating) caused by heat leads to the loss of water, sodium, and potassium as the body attempts to reduce its core temperature.
   d. Renal disease adversely affects the kidneys’ ability to reabsorb potassium.
   e. Hemodialysis and peritoneal dialysis lead to direct potassium loss.

Table 4.1 Causes of Potassium Imbalance

<table>
<thead>
<tr>
<th>Hypokalemia</th>
<th>Hyperkalemia</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Actual decrease in potassium</strong></td>
<td><strong>Relative decrease in potassium (dilutional)</strong></td>
</tr>
<tr>
<td>Potassium loss</td>
<td>Shifts between intracellular and extracellular compartments</td>
</tr>
<tr>
<td>• Vomiting</td>
<td>• Familial periodic paralysis</td>
</tr>
<tr>
<td>• Prolonged gastric suctioning</td>
<td>• Adrenal insufficiency</td>
</tr>
<tr>
<td>• Chronic diarrhea</td>
<td>• Excessive intake of hypotonic fluids (water, IV D_2W, tube feeding)</td>
</tr>
<tr>
<td>• Major surgical procedures</td>
<td>• Nephrotic syndrome</td>
</tr>
<tr>
<td>• Hemorrhage</td>
<td>• Wound irrigation with hypotonic fluids</td>
</tr>
<tr>
<td>• Medications (those that act on the kidneys to increase potassium excretion)</td>
<td>• Heart failure or congestive heart failure</td>
</tr>
<tr>
<td>• Corticosteroids</td>
<td>• Hyperglycemia</td>
</tr>
<tr>
<td>• Insulins</td>
<td>• Third spacing</td>
</tr>
<tr>
<td>• Loop diuretics</td>
<td>• Edema</td>
</tr>
<tr>
<td>• Non-potassium-sparing diuretics</td>
<td>• Ascites (liver failure, liver cirrhosis)</td>
</tr>
<tr>
<td>• Thiazide diuretics</td>
<td></td>
</tr>
<tr>
<td>Inadequate potassium intake or absorption</td>
<td></td>
</tr>
<tr>
<td>• Eating disorders</td>
<td></td>
</tr>
<tr>
<td>• Anorexia</td>
<td></td>
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<tr>
<td>• Bulimia</td>
<td></td>
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<tr>
<td>• Ingestion of clay (bentonite)</td>
<td></td>
</tr>
<tr>
<td>• Prolonged nothing-by-mouth status</td>
<td></td>
</tr>
<tr>
<td>• Hyperalimentation or total parenteral nutrition</td>
<td></td>
</tr>
<tr>
<td>• IV therapy with solutions that do not contain potassium</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Actual increase in potassium</strong></th>
<th><strong>Relative increase in potassium</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Potassium retention</td>
<td>Shifts between intracellular and extracellular compartments</td>
</tr>
<tr>
<td>• Acute kidney injury</td>
<td>• Metabolic acidosis</td>
</tr>
<tr>
<td>• Chronic kidney disease</td>
<td>• Burns</td>
</tr>
<tr>
<td>• Glomerulonephritis</td>
<td>• Surgical procedures</td>
</tr>
<tr>
<td>• Rejection of kidney transplant</td>
<td>• Trauma</td>
</tr>
<tr>
<td>• Addison’s disease</td>
<td>• Tumor invasion</td>
</tr>
<tr>
<td>• Medications (those that interfere with the urinary excretion of potassium)</td>
<td>• Water loss</td>
</tr>
<tr>
<td>• ACE inhibitors</td>
<td>• Kidney disease</td>
</tr>
<tr>
<td>• Angiotensin II receptor blockers</td>
<td>• Vomiting</td>
</tr>
<tr>
<td>• NSAIDs</td>
<td>• Diarrhea</td>
</tr>
<tr>
<td>• Potassium-sparing diuretics</td>
<td>• Burns</td>
</tr>
<tr>
<td>Excessive potassium intake</td>
<td></td>
</tr>
<tr>
<td>• Excessive intake of oral or parenteral potassium replacements</td>
<td></td>
</tr>
<tr>
<td>• Overuse of potassium-based salt substitutes</td>
<td></td>
</tr>
</tbody>
</table>
f. Elevated serum glucose levels lead to diuresis, causing potassium to be lost in the urine.
g. Medications, such as non-potassium-sparing diuretics, digitalis preparations, and corticos-teroids, act on the kidneys to increase potassium excretion.

2. Inadequate potassium intake or absorption
   a. Malnutrition or starvation
   b. Eating disorders, such as anorexia or bulimia
   c. Prolonged nothing-by-mouth (NPO) status without IV replacement therapy
   d. Alcoholism and pica
      1) Alcoholism causes a decrease in the absorption of potassium.
      2) Pica is the chronic ingestion of nonfood materials, such as animal feces, dirt, paper, laundry starch, or ice. If clay (bentonite) is ingested, it binds with potassium and decreases potassium absorption.

DID YOU KNOW?
Hypokalemia is one of the most common electrolyte imbalances associated with chronic alcoholism. Clients who abuse alcohol may experience potassium deficiency even if they consume an adequate daily amount, owing to a lack of absorption in the small intestine.

B. Relative hypokalemia results when potassium shifts out of the ECF and into the cells, resulting in a relative decrease in potassium content in the body.
   1. Water gain
      a. Excessive water intake dilutes the serum potassium content of the blood (dilutional hypokalemia).
   2. Shifts between intracellular and extracellular compartments
      a. Alkalosis (increased blood pH) causes potassium to move into the cells; hydrogen ions then move out of the cells to compensate for the pH imbalance.
      b. Stimulation of the sympathetic nervous system, particularly with beta-2-agonists such as albuterol or terbutaline, may increase cellular potassium uptake.
      c. Familial periodic paralysis is a genetic disorder that causes a sudden intracellular shift of potassium, resulting in transient episodes of profound hypokalemia.
      d. Insulin administration for hyperglycemia causes potassium to move into the skeletal muscles and hepatic cells; intracellular shifts of potassium are often episodic and self-limited.
   3. Third spacing
      a. Fluid, sodium, potassium, and other electrolytes often become "trapped" in areas that are inaccessible to the circulation.

DID YOU KNOW?
In clients taking digoxin (Lanoxin), hypokalemia increases the cardiac muscle's sensitivity to the drug, possibly resulting in digoxin toxicity.

C. Actual hyperkalemia is caused by excessive potassium intake or potassium retention, resulting in an actual increase of potassium in the body (see Table 4.1).
   a. Excessive intake of potassium
      a. Overconsumption of potassium-rich foods (rare when the kidneys are functioning normally)
      b. Overuse of salt substitutes that contain potassium
      c. Excessive or rapid infusion of IV solutions that contain potassium

DID YOU KNOW?
In the United States, a lethal dose of potassium chloride is the last of the three drugs administered during execution by lethal injection. Potassium chloride actually causes death by stopping the heart.

2. Potassium retention
   a. Acute kidney injury and chronic kidney disease result in decreased potassium excretion by the kidneys.
   b. Medications, such as potassium-sparing diuretics and angiotensin-converting enzyme (ACE) inhibitors, inhibit the excretion of potassium by the kidneys.
   c. Addison's disease occurs when the adrenal glands do not produce enough aldosterone (adrenal insufficiency).
   d. Hyperkalemia may also be caused by fluid volume deficit or when potassium shifts out of the cells, resulting in a relative increase in potassium in the body.

D. Relative hyperkalemia results when potassium is concentrated by excessive water loss or when potassium shifts out of the ICF and into the ECF, resulting in a relative increase in potassium content in the body or (see Table 4.1).
   a. Water loss
      a. Vomiting and diarrhea result in water loss in the ECF, which causes potassium and other electrolytes to become concentrated.
      b. Severe burns cause tissue damage and an increase in capillary permeability, resulting in profound dehydration; this water loss causes potassium to become concentrated, resulting in an elevation in the serum potassium level without an actual potassium gain.
   2. Shifts between intracellular and extracellular compartments
      a. Surgical procedures, tissue trauma, and crush injuries cause damaged cells to release
potassium into the bloodstream; breakdown of muscle tissue (rhabdomyolysis) also releases the protein myoglobin into the bloodstream, causing kidney damage and the retention of potassium.

b. Metabolic acidosis, or blood pH below 7.35, causes potassium to shift out of the cells in exchange for excess hydrogen ions (acid) as the body attempts to increase the blood pH.

c. Tumor invasion destroys healthy cells, causing them to release their potassium stores into the ECF and resulting in an increase in the serum potassium level without an actual gain in potassium (relative hyperkalemia).

d. In clients with severe burns, potassium shifts out of the cells of the burned tissue and into the ECF, resulting in relative hyperkalemia.

**MAKING THE CONNECTION**

**Addison’s Disease and Hyperkalemia**

Addison’s disease occurs when damaged or diseased adrenal glands do not produce enough glucocorticoid hormones (such as cortisol), sex hormones (such as androgens [male] and estrogens [female]), and mineralocorticoid hormones (such as aldosterone). Aldosterone causes the kidneys to conserve sodium and secrete potassium. The lack of aldosterone leads to the excretion of sodium and the retention of potassium, resulting in increased serum potassium levels (hyperkalemia).

**V. Nursing Assessment for Potassium Imbalances**

The nurse should conduct a focused nursing assessment for potassium imbalance, beginning with a thorough nursing history. Interview the client and family members to identify any risk factors or preexisting conditions that would contribute to potassium imbalance, such as vomiting, nasogastric suctioning, diarrhea, acute kidney injury, or other conditions associated with potassium loss or gain. The nurse should also assess the client’s ability to drink and tolerate oral fluids. Obtain a current dietary history, inquiring about the intake of potassium chloride–based salt substitutes. The nursing history should also include current medications, focusing on the use of diuretics and digoxin. Diuretic use increases the risk for potassium imbalance, and hypokalemia increases the risk of digoxin toxicity. A thorough physical assessment is necessary because potassium imbalances affect many body systems. Assess each body system, observing for signs and symptoms of potassium imbalance. Measure and record the client’s vital signs, and review the client’s laboratory data to assess for the presence of hypo- or hyperkalemia (Table 4.2).

**VI. Electrocardiogram Changes in Potassium Imbalance**

A. A hallmark finding of potassium imbalance is a change in the ECG. Potassium is needed to bring the cell membranes to a resting state after the heart contracts. Low potassium levels in the extracellular space cause the strength of the electrical current across the cell

### Table 4.2 Signs and Symptoms of Potassium Imbalance

<table>
<thead>
<tr>
<th>Vital Signs</th>
<th>Hypokalemia</th>
<th>Hyperkalemia</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blood pressure</td>
<td>Decreased, orthostatic hypotension</td>
<td>Decreased, orthostatic hypotension, or normal to elevated</td>
</tr>
<tr>
<td>Heart rate</td>
<td>Normal to decreased; may be irregular</td>
<td>Normal to decreased; may be irregular</td>
</tr>
<tr>
<td>Respiratory rate</td>
<td>May decrease in severe hypokalemia</td>
<td>May decrease in severe hyperkalemia</td>
</tr>
<tr>
<td>Temperature</td>
<td>Within normal limits</td>
<td>Within normal limits</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Signs and Symptoms by Body System</th>
<th>Hypokalemia</th>
<th>Hyperkalemia</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cardiovascular</strong></td>
<td>• Weak, thready pulse; may be irregular</td>
<td>• Irregular heartbeat, &quot;palpitations&quot;</td>
</tr>
<tr>
<td></td>
<td>• Bradycardia or tachycardia, depending on etiology</td>
<td>• Bradycardia</td>
</tr>
<tr>
<td></td>
<td>• Decreased blood pressure that progresses to severe orthostatic hypotension</td>
<td>• Slow, weak, or absent pulse</td>
</tr>
<tr>
<td></td>
<td><strong>Causes life-threatening cardiac dysrhythmias</strong></td>
<td>• Hypotension</td>
</tr>
<tr>
<td></td>
<td>• Premature ventricular contractions (PVCs)</td>
<td><strong>Causes life-threatening cardiac dysrhythmias</strong></td>
</tr>
<tr>
<td></td>
<td>• Ventricular tachycardia (VT)</td>
<td>• PVCs</td>
</tr>
<tr>
<td></td>
<td>• Ventricular fibrillation</td>
<td>• VT</td>
</tr>
<tr>
<td></td>
<td>• Asystole</td>
<td>• Ventricular fibrillation</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Complete heart block</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Asystole</td>
</tr>
</tbody>
</table>

Continued
membranes to increase, preventing the cell membranes of the heart from achieving a resting state. This leads to impaired cardiac conduction, which can result in premature ventricular contractions (PVCs), ventricular tachycardia, ventricular fibrillation, or asystole.

1. Hypokalemia can be identified in an ECG rhythm strip by looking for the triad of (1) ST segment depression, (2) low-amplitude T waves, and (3) prominent U waves (Fig. 4.2).

2. As hypokalemia worsens, U waves increase in size, QRS complexes widen, ST segments become depressed, and T waves flatten or invert (Fig. 4.3).

B. High potassium levels in the extracellular space cause the electrical current across the cell membranes to become “sluggish,” prolonging the resting state of the cell membranes of the heart. This leads to impaired cardiac conduction, which can result in ventricular fibrillation or asystole.

1. Hyperkalemia is characterized by bradycardia; peaked, tented T waves; and ventricular fibrillation (Fig. 4.4).

VII. Nursing Interventions for Clients With Potassium Imbalance (Table 4.3)

A. Identify high-risk clients.
B. Implement the health-care provider’s orders to treat the underlying cause of the imbalance.

1. The health-care provider’s orders may include oral or IV fluid administration, oral or IV potassium administration, and medication administration.
C. Monitor the client and the client’s serum potassium level.

1. Monitor the client’s serum potassium level as ordered by the health-care provider.

a. Normal reference range for serum potassium is 3.5 to 5.0 mEq/L.

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Table 4.2 Signs and Symptoms of Potassium Imbalance—cont’d

<table>
<thead>
<tr>
<th>Signs and Symptoms by Body System</th>
<th>Hypokalemia</th>
<th>Hyperkalemia</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cerebral</td>
<td>Fatigue</td>
<td>Frequently asymptomatic</td>
</tr>
<tr>
<td></td>
<td>Irritability</td>
<td>Fatigue</td>
</tr>
<tr>
<td></td>
<td>Anxiety</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Decreased level of consciousness</td>
<td></td>
</tr>
<tr>
<td>Electrocardiogram (ECG) changes</td>
<td>U waves increase in size; may become as prominent as T waves (prominent U wave) or fuse with T waves (see Figs. 4.2 and 4.3)</td>
<td>Heart block (first degree or second degree); may become complete heart block</td>
</tr>
<tr>
<td></td>
<td>QRS complexes widen</td>
<td>Bradycardia</td>
</tr>
<tr>
<td></td>
<td>ST segments may become depressed</td>
<td>Peaked, tented T waves</td>
</tr>
<tr>
<td></td>
<td>T waves may flatten or invert (see Fig. 4.3)</td>
<td>Ventricular fibrillation (see Fig. 4.4)</td>
</tr>
<tr>
<td>Gastrointestinal</td>
<td>Nausea, vomiting</td>
<td>Nausea</td>
</tr>
<tr>
<td></td>
<td>Abdominal distention</td>
<td>Hyperactive bowel sounds</td>
</tr>
<tr>
<td></td>
<td>Hypoactive bowel sounds</td>
<td>Diarrhea (may be frequent)</td>
</tr>
<tr>
<td></td>
<td>Constipation</td>
<td></td>
</tr>
<tr>
<td>Neuromuscular</td>
<td>Weakness (generalized)</td>
<td>Muscle weakness</td>
</tr>
<tr>
<td></td>
<td>Muscle aches, cramps, twitching</td>
<td>Muscle cramps and tingling, followed by circumoral and peripheral numbness as potassium level increases</td>
</tr>
<tr>
<td></td>
<td>Decreased deep tendon reflexes</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Paralysis</td>
<td></td>
</tr>
<tr>
<td>Respiratory</td>
<td>Shallow, ineffective respirations</td>
<td>May produce respiratory arrest because of muscle weakness</td>
</tr>
</tbody>
</table>

Laboratory Values

<table>
<thead>
<tr>
<th></th>
<th>Hypokalemia</th>
<th>Hyperkalemia</th>
</tr>
</thead>
<tbody>
<tr>
<td>Serum potassium</td>
<td>Less than 3.5 mEq/L</td>
<td>Greater than 5.0 mEq/L</td>
</tr>
</tbody>
</table>

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Fig 4.2 A prominent U wave in a QRS complex is associated with hypokalemia.
2. Monitor other laboratory values associated with hypokalemia. Normal reference ranges are as follows:
   a. Blood glucose: 65 to 99 mg/dL (adult, fasting)
   b. Serum calcium: 8.2 to 10.2 mg/dL (adults)
   c. Serum chloride: 95 to 108 mEq/L
   d. Urine osmolality: 250 to 900 mOsm/kg (children and adults)
3. Monitor for signs of metabolic acidosis (see Chapter 8).
   a. Observe for ECG changes (see Figs. 4.2, 4.3, and 4.4).
   b. Palpate peripheral pulses.
   c. Check orthostatic blood pressures.

**Activate the rapid response team if the client's heart rate falls below 60 bpm or if the client's T waves become spiked.**

5. Monitor for neuromuscular changes.
   a. Establish a baseline for the client's deep tendon reflexes, muscle strength, and tone.
   b. Monitor the client for muscle weakness, muscle twitching, or irregular muscle contractions during each nursing shift.
6. Monitor for gastrointestinal changes.
   a. Auscultate bowel sounds in all four quadrants.
   b. Observe the frequency and consistency of bowel movements.

D. Ensure client safety
   1. Implement fall precautions related to muscle weakness caused by potassium imbalances.
E. Educate the client
   1. Hypokalemia
      a. Teach the client or caregiver the causes of potassium deficit.
      b. Provide specific information regarding the client's medical diagnosis and related interventions and treatments.
      c. Teach the client or caregiver how to identify the signs and symptoms of potassium deficiency.
   d. Instruct the client and family to notify the primary health-care provider if the client exhibits any of the signs or symptoms of hypokalemia or if they have any other specific concerns.
   e. Teach the client how to prevent potassium deficiency.
   f. Teach the client about foods that contain potassium; because a lack of potassium is rare, there is no recommended daily allowance for this mineral.
Table 43 Nursing Interventions Specific to Hypokalemia and Hyperkalemia

<table>
<thead>
<tr>
<th>Hypokalemia</th>
<th>Hyperkalemia</th>
</tr>
</thead>
<tbody>
<tr>
<td>Increase potassium level</td>
<td>Decrease potassium level</td>
</tr>
<tr>
<td><strong>Mild to moderate hypokalemia</strong></td>
<td><strong>Mild to moderate hyperkalemia</strong></td>
</tr>
<tr>
<td>• Administer oral supplements, as ordered, to clients with serum potassium levels less than 3.5 mEq/L but greater than 3.0 mEq/L</td>
<td>• Limit dietary potassium, including potassium-based salt substitutes</td>
</tr>
<tr>
<td>• Dilute powders and liquids in juice or other desired liquid to improve palatability and prevent gastrointestinal irritation</td>
<td>• Discontinue or decrease potassium supplements</td>
</tr>
<tr>
<td>• Advise the client that potassium has an extremely unpleasant taste</td>
<td>• Discontinue or decrease medications that potentially cause hyperkalemia</td>
</tr>
<tr>
<td>• Follow the manufacturer’s instructions for the amount of fluid to be used as a diluent for the preparation; the most common dilution is 20 mEq potassium per 120 mL (4 oz)</td>
<td>• Hospitalize the client if ordered; usually treated without hospitalization</td>
</tr>
<tr>
<td>• Mix solutions thoroughly before administering them to the client</td>
<td><strong>Severe hyperkalemia</strong></td>
</tr>
<tr>
<td>• Administer liquid, capsule, or tablet potassium with food or meals to minimize gastrointestinal irritation</td>
<td>• Treat in an acute care facility with cardiac monitoring capabilities</td>
</tr>
<tr>
<td>• Do not crush tablets; do not open capsules</td>
<td>• Decrease the serum potassium level by direct removal (especially if renal failure is a cause)</td>
</tr>
<tr>
<td><strong>Severe hypokalemia</strong></td>
<td>• Hemodialysis</td>
</tr>
<tr>
<td>• Administer IV potassium, as ordered, to clients with serum potassium levels less than 3.0 mEq/L</td>
<td>• Continuous venovenous hemofiltration</td>
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<td></td>
<td>• Continuous renal replacement therapy</td>
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<tr>
<td></td>
<td>• Administer IV calcium, as ordered, to treat cardiac and skeletal muscle effects of hyperkalemia</td>
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<tr>
<td></td>
<td>• Administer IV glucose and insulin, as ordered, to decrease serum potassium levels temporarily by increasing movement back into the cells</td>
</tr>
<tr>
<td></td>
<td>• Administer IV sodium bicarbonate, as ordered, to reverse hyperkalemia caused by acidosis; promotes the movement of potassium from the ECF back into the ICF</td>
</tr>
<tr>
<td></td>
<td>• Administer medications as ordered</td>
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<tr>
<td></td>
<td>• Adrenergics to stimulate beta-2-adrenergic receptors to drive potassium back into cells</td>
</tr>
<tr>
<td></td>
<td>• Albuterol (Ventolin)</td>
</tr>
<tr>
<td></td>
<td>• Epinephrine (Ana-Guard)</td>
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<tr>
<td></td>
<td>• Cationic exchange resins to reduce serum potassium levels by exchanging sodium ions for potassium ions in the intestine and removing them via the gastrointestinal tract</td>
</tr>
<tr>
<td></td>
<td>• Sodium polystyrene sulfonate (Kayexalate) orally or via retention enema</td>
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<td></td>
<td>• Loop diuretics to decrease total serum potassium by increasing excretion by the kidneys</td>
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<tr>
<td></td>
<td>• bumetanide (Bumex)</td>
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<td>• ethacrynic acid (Edecrin)</td>
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<td></td>
<td>• furosemide (Lasix)</td>
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<tr>
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<td>• torsemide (Demadex)</td>
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<tr>
<td></td>
<td>• Thiazide diuretics to decrease total serum potassium by increasing excretion by the kidneys</td>
</tr>
<tr>
<td></td>
<td>• chlorothiazide (Diluril)</td>
</tr>
<tr>
<td></td>
<td>• hydrochlorothiazide</td>
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<tr>
<td></td>
<td>• methiazide (Zararolyn)</td>
</tr>
</tbody>
</table>

**IV potassium is a high-alert drug: DO NOT administer via IV push!**

- Infuse IV potassium slowly at 5–10 mEq/hr; never exceed 20 mEq/hr under any circumstances

**Rapid administration or high concentrations of potassium may cause cardiac arrest**

- Monitor cardiac function when infusing large amounts of potassium
- Do not administer potassium intramuscularly or subcutaneously because potassium is a severe tissue irritant
- Dilute potassium before IV infusion; a dilution of no more than 1 mEq/10 mL of solution is recommended
- Monitor the client’s IV site closely; infiltration of potassium is painful and may cause tissue damage, followed by necrosis and sloughing
- Potassium may cause severe irritation to veins
- Stop the infusion and notify the health-care provider if the client reports pain, even if the IV line is not infiltrated

---

1. Dilute powders and liquids in juice or another desired liquid.
2. Follow the manufacturer’s instructions for the amount of fluid to be used as a diluent for the preparation; commonly, 20 mEq potassium per 120 mL (4 oz).
3. Mix solutions thoroughly before drinking.
4. Administer liquid, capsule, or tablet potassium with food or meals to minimize gastrointestinal irritation.
5. Do not crush tablets; do not open capsules.
6. Do not take potassium supplements while taking a potassium-sparing diuretic.
7. Do not use salt substitutes containing potassium unless prescribed by the primary health-care provider.

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g. Teach the client how to prepare and take oral potassium supplements.
8) Report adverse effects, such as nausea, vomiting, diarrhea, and abdominal cramping, to the primary health-care provider.

h. Encourage the client to keep appointments for laboratory studies to evaluate serum potassium levels, because values can change dramatically; even small variations in serum potassium can have major effects on the body.

i. Ensure that client or caregiver understands the specifics, rationale, potential side effects, and desired effects of the treatment regimen.

j. Include medication administration, nutrition, hydration, dietary restrictions, and foods high in potassium in client teaching.

2. Hyperkalemia
   a. Teach the client or caregiver the causes of potassium excess.
   b. Provide specific information regarding the client's medical diagnosis and related interventions and treatments.
   c. Teach the client or caregiver how to identify the signs and symptoms of hyperkalemia.
   d. Instruct the client and family to notify the primary health-care provider if the client exhibits any of the signs or symptoms of hyperkalemia or if any other specific concerns.
   e. Teach the client how to prevent potassium excess.
      1) Avoid salt substitutes that contain potassium.
      2) Avoid foods high in potassium (Table 4.4).
      3) Choose low-potassium foods, such as eggs, apples, apricots, cherries, grapefruit (but note that grapefruit interferes with many medications), peaches, cranberries, cabbage, cauliflower, celery, eggplant, lettuce, green beans, onions, peas, and peppers.
      4) Eat less red meat and more lean meats and cold-water fish.
      5) Read food labels to determine the amount of potassium in each serving.
      6) Drink more fluids; dehydration worsens hyperkalemia.
   f. Ensure that the client or caregiver understands the specifics, rationale, potential side effects, and desired effects of the treatment regimen.
   g. Include medication administration, nutrition, hydration, dietary restrictions, and foods high in potassium in client teaching.

<table>
<thead>
<tr>
<th>Table 4.4 Foods High in Potassium</th>
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<tbody>
<tr>
<td><strong>Food (Standard Amount)</strong></td>
</tr>
<tr>
<td>Sweet potato, baked, 1 potato (146 gm)</td>
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<tr>
<td>Tomato paste, ¼ cup</td>
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<tr>
<td>Beet greens, cooked, ½ cup</td>
</tr>
<tr>
<td>Potato, baked, with flesh, 1 potato (156 gm)</td>
</tr>
<tr>
<td>White beans, canned, ½ cup</td>
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<tr>
<td>Yogurt, plain, nonfat, 8-oz container</td>
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<tr>
<td>Clams, canned, 3 oz</td>
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<tr>
<td>Prune juice, ¼ cup</td>
</tr>
<tr>
<td>Carrot juice, ¼ cup</td>
</tr>
<tr>
<td>Blackstrap molasses, 1 tsp</td>
</tr>
<tr>
<td>Soybeans, green, cooked, ¼ cup</td>
</tr>
<tr>
<td>Banana, 1 medium</td>
</tr>
<tr>
<td>Spinach, cooked, ¼ cup</td>
</tr>
<tr>
<td>Peaches, dried, uncooked, ¼ cup</td>
</tr>
<tr>
<td>Milk, nonfat, 1 cup</td>
</tr>
<tr>
<td>Prunes, stewed, ¼ cup</td>
</tr>
<tr>
<td>Apricots, dried, uncooked, ¼ cup</td>
</tr>
<tr>
<td>Cantaloupe, ¼ medium</td>
</tr>
<tr>
<td>Honeydew melon, ¼ medium</td>
</tr>
<tr>
<td>Orange juice, ¼ cup</td>
</tr>
</tbody>
</table>

F. Evaluate and document
   1. Document all assessment findings and interventions per institution policy.
   2. Evaluate and document the client's response to interventions and education.
      a. Serum potassium level should return to the normal reference range of 3.5 to 5.0 mEq/L.
      b. Other laboratory values should return to the normal reference range.
      c. Vital signs should return to baseline.
      d. Cardiac rate and rhythm should return to baseline.
      e. Underlying cause of potassium imbalance should be resolved.
CASE STUDY: Putting It All Together

Subjective Data
A 69-year-old client presents to the emergency department reporting fatigue, muscle aches, weakness, and severe cramping for 2 days. He reports being ill recently, with nausea, vomiting, and diarrhea that lasted 3 days. The client has a history of rheumatic fever, congestive heart failure (CHF), and hypertension. The client states that he follows a low-sodium diet, weighs himself daily, and has continued this regimen throughout the current illness.

The client has no known allergies, and his current medications are:
- metoprolol (Toprol-XL) 100 mg by mouth (PO) daily
- lisinopril (Zestril) 5 mg PO daily
- digoxin (Lanoxin) 0.25 mg PO daily
- aspirin 81 mg PO daily
- potassium chloride (K-Lor) 20 mEq PO daily
- furosemide (Lasix) 40 mg PO daily

Objective Data

**Nursing Assessment**
1. Alert, oriented to person, place, and time
2. Heart sounds S1 and S2 present but irregular; no murmur
3. Orthostatic hypotension
4. Pedal and radial pulses irregular, 1+, and weak bilaterally
5. Deep tendon reflexes 1+ (hypoactive) bilaterally
6. Bowel sounds hypoactive in all four quadrants
7. Chest x-ray: cardiomegaly, no evidence of CHF
8. ECG: sinus tachycardia with intraventricular conduction defect (left anterior fascicular block), occasional to frequent PVCs, prominent U wave

**Vital Signs**
- Temperature: 97.8°F (36.6°C) orally
- Blood pressure: 115/65 mm Hg supine, 106/58 mm Hg sitting, 92/54 mm Hg standing
- Heart rate: 112 bpm, irregular
- Respiratory rate: 20
- \( O_2 \) saturation: 96%

**Laboratory Results**
- Serum Na+: 140 mEq/L
- Serum K+: 2.7 mEq/L
- Blood glucose: 80 mg/dL
- Serum BUN: 30 mg/dL
- Serum creatinine: 1.3 mg/dL
- Digoxin level: 2.3 ng/mL (normal 0.5 to 2 ng/mL)

**Health-Care Provider Orders**
1. Place on telemetry
2. Fall precautions
3. Vital signs every 15 minutes x 1 hour and every 30 minutes x 1 hour, then every 4 hours if stable
4. Monitor intake and output
5. Administer IV solution now: 40 mEq of potassium diluted in 500 mL of normal saline solution at 10 mEq/hr
6. Hold digoxin, metoprolol, and lisinopril
7. Administer IV ondansetron (Zofran) 4 mg every 6 hours as needed for nausea
8. Clear liquid diet
9. Repeat ECG, serum potassium, glucose, and electrolytes in 4 to 6 hours, and notify health-care provider of results
10. Refer to primary health-care provider to restart digoxin and adjust potassium chloride, furosemide, metoprolol, and lisinopril dosages

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**Case Study Questions**

A. What subjective assessment findings indicate that the client is experiencing a health alteration?

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<table>
<thead>
<tr>
<th>Case Study Questions</th>
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<td>7.</td>
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</table>

**B. What objective assessment findings indicate that the client is experiencing a health alteration?**

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**C. After analyzing the data collected, what primary nursing diagnosis should the nurse assign to this client?**

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**D. What interventions should the nurse plan and/or implement to meet this client’s needs?**

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**E. What client outcomes should the nurse plan to evaluate the effectiveness of the nursing interventions?**

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8. 


**REVIEW QUESTIONS**

1. A nurse in the emergency department admits an elderly client who is diagnosed with moderate hyperkalemia secondary to a decline in renal function. The nurse anticipates administering a medication that works by exchanging sodium ions for potassium ions in the gastrointestinal tract to help reduce the client’s potassium level. Which medication is being described by the nurse?
   1. Sodium bicarbonate
   2. Calcium gluconate
   3. Sodium polystyrene sulfonate
   4. Regular insulin and dextrose

2. When caring for a newborn, which condition should a nurse associate with inadequate serum potassium?
   1. Diarrhea
   2. Hyperactive bowel sounds
   3. Muscle weakness
   4. Anemia

3. Which clinical manifestation should a nurse associate with the development of hypokalemia if it is observed in a newly admitted client?
   1. Skeletal muscle weakness
   2. Widened QRS complex
   3. Diarrhea
   4. Tall T waves

4. Which outcome would be most appropriate for a nurse to establish when caring for a client who has a nursing diagnosis of Risk for Falls Related to Skeletal Muscle Weakness Secondary to Electrolyte Imbalance?
   1. The client’s serum electrolyte levels will return to the normal reference range.
   2. The nurse will promote oral fluid intake as appropriate.
   3. The dietitian will teach the client how to increase dietary potassium intake.
   4. The client will remain free from injury throughout the hospital stay.

5. A nurse is caring for an elderly client who is at risk for falls secondary to muscle weakness associated with hypokalemia. Which actions should the nurse take when implementing fall precautions for this client? Select all that apply.
   1. Perform a fall risk assessment.
   2. Maintain the bed in the Trendelenburg position.
   3. Place assistive devices (walkers, canes) at the end of the client’s bed.
   4. Instruct the client to request assistance to ambulate.
   5. Request that family members remain with the client if necessary.

6. Which assessment should a nurse perform to identify whether a client is developing a potentially dangerous side effect of the medication lisinopril (Zestril)?
   1. Assessment for deep tendon hyporeflexia
   2. Assessment for irregular heartbeat
   3. Assessment for increased urine output
   4. Assessment of the client’s nutritional status

7. A nurse is reviewing the ECG strip of a client who has been diagnosed with a fluid and electrolyte imbalance. Based on the exhibit provided, which imbalance should the nurse suspect?

8. An elderly client is prescribed furosemide (Lasix) 40 mg by mouth daily for the treatment of CHF. A nurse teaches the client to observe for signs of potassium imbalance while taking this medication. Which signs should the nurse include in client teaching?
   1. Muscle twitching, diarrhea, increased gastrointestinal motility
   2. Confusion, agitation, muscle twitching
   3. General muscle weakness; constipation; weak, thready pulse
   4. Increased blood pressure and heart rate, constipation
9. A nurse is caring for an adult client with a serum potassium level of 2.0 mEq/L. Which order for potassium chloride should the nurse identify as being most appropriate for this client? 
1. Administer potassium chloride 40 mEq/L intramuscularly now.
2. Administer potassium chloride 40 mEq/L by mouth twice daily.
3. Administer potassium chloride 40 mEq/L by IV push now.
4. Administer potassium chloride 40 mEq/L by IV infusion over 4 hours.

10. A nurse evaluates the laboratory data for a hospitalized pregnant client who is diagnosed with hyperemesis gravidarum. The client has a serum potassium level of 2.8 mEq/L and is to receive IV potassium therapy. When preparing to administer IV potassium to this client, which actions should the nurse plan to take to ensure client safety? Select all that apply. 
1. Infuse the potassium at a rate of 30 mEq/hr, as ordered by the health-care provider.
2. Check the concentration of the potassium solution with another registered nurse.
3. Use a controlled infusion device to administer the potassium solution.
4. Assess the client’s IV site every 2 hours for phlebitis or infiltration.
5. Administer IV bumetanide (Bumex) 1 mg, as ordered by health-care provider.

11. Understanding that potassium is a nutrient most likely to be lacking in the diets of childbearing women, which is the most appropriate nursing intervention to include when teaching a pregnant adolescent client? 
1. Encourage the adolescent to eat foods she likes and is accustomed to eating.
2. Recommend the ingestion of low-calorie foods to restrict weight gain.
3. Identify the adolescent’s sources of peer pressure and dietary habits.
4. Improve the adolescent’s nutritional knowledge, meal planning, and food preparation skills.

12. A nurse is preparing to administer 40 mEq of IV potassium. To ensure that the medication is diluted properly, how many milliliters of solution would be required to obtain a concentration of 1 mEq/10 mL? Record your answer as a whole number.

13. A nurse is preparing to administer 60 mEq of potassium by mouth in three divided doses. The dosage on hand is a 20 mEq/tablet. How many tablets should the nurse plan to administer at each dose? Record your answer as a whole number.

14. A nurse is preparing to administer 10 mEq of IV potassium diluted in 100 mL of normal (0.9%) saline solution. The nurse plans to infuse the solution via peripheral IV access over 2 hours, using microdrip tubing with a drop factor of 60 gtt/mL. How many mL/hr should the nurse program the IV pump to deliver? Record your answer as a whole number.

15. A nurse notes nonsustained ventricular tachycardia (VT) on the cardiac monitor of a client with a fluid or electrolyte imbalance. Which fluid or electrolyte imbalances should the nurse associate with this finding? Select all that apply.
1. Hyponatremia
2. Hypernatremia
3. Hypokalemia
4. Hyperkalemia
5. Fluid volume deficit
6. Fluid volume excess

16. Which information obtained from a client’s history should a nurse associate with the development of hyperkalemia?
1. History of corticosteroid use
2. History of diuretic use
3. History of urinary incontinence
4. History of uncontrolled diabetes mellitus

17. A nurse admits a client who is diagnosed with uncontrolled diabetes mellitus and who has a serum potassium level of 6.6 mEq/L, with no ECG changes. Which possible interventions should a nurse anticipate a health-care provider ordering to decrease this client’s serum potassium level? Select all that apply.
1. Administer sodium polystyrene sulfonate (Kayexalate) 15 gm in sorbitol PO four times daily.
2. Administer IV regular insulin 7 units simultaneously with 50 mL 50% glucose at 250 mL/hr.
3. Administer IV 10% calcium gluconate 15 mL over 5 to 10 minutes.
4. Administer albuterol (Proventil) (5 mg/mL concentration) 20 mg inhaled over 10 minutes.

18. A nurse is caring for a client whose serum potassium is 2.5 mEq/L. Based on this information, which physician orders should the nurse question? Select all that apply.
1. Implement fall precautions.
2. Implement seizure precautions.
3. Administer IV potassium chloride 40 mEq.
5. Administer chlorothiazide (Diuril) 125 mg daily by mouth.
19. Which manifestation should a nurse investigate first when assessing an elderly client who is admitted with a 2-day history of vomiting and diarrhea?
1. Blood pressure 100/45 mm Hg
2. Weakness and lightheadedness
3. Pulse 100 bpm
4. Shallow respirations with tachypnea

20. A nurse assesses a client who has CHF and is taking the following medications: digoxin (Lanoxin), furosemide (Lasix), and benazepril (Lotensin). Which assessment finding should the nurse act on immediately?
1. Mental confusion
2. Dysrhythmias
3. Abdominal distention
4. Hypotension

21. Which nursing diagnoses should a nurse assign to a client who has a serum potassium level of 3.1 mEq/L? Select all that apply.
1. Diarrhea Related to Spastic Colonic Activity
2. Constipation Related to Smooth Muscle Atony
3. Decreased Cardiac OutputRelated to Dysrhythmia
4. Impaired Physical Mobility Related to Skeletal Muscle Weakness
5. Potential for Respiratory Insufficiency Related to Muscle Weakness

22. A nurse assesses that a client with a nasogastric tube in place to allow suctioning has a potassium level of 2.8 mEq/L. Which nursing diagnosis should receive priority in this client?
1. Impaired Physical Mobility Related to Skeletal Muscles Weakness
2. Decreased Cardiac Output Related to Dysrhythmias
3. Risk for Falls Related to Skeletal Muscle Weakness
4. Constipation Related to Smooth Muscle Atony

23. An elderly client diagnosed with CHF is receiving furosemide (Lasix) 40 mg by mouth daily, increasing the client's risk for hypokalemia. Which ECG finding should a nurse identify as indicative of hypokalemia?
1. 

24. A client diagnosed with chronic kidney disease presents to the emergency department reporting shortness of breath, nausea, and muscle weakness. The client did not have dialysis, as scheduled yesterday and is experiencing hyperkalemia. Which ECG finding should a nurse identify as indicative of hyperkalemia?
1. 
25. A nurse is caring for a client with fluid volume excess and a serum potassium level of 3.0 mEq/L. Which medication should the nurse identify as being most appropriate for this client?
1. chlorothiazide (Diuril)
2. bumetanide (Bumex)
3. spironolactone (Aldactone)
4. furosemide (Lasix)
**Review Answers**

1. **Answer:** 3.
   **Rationale:**
   1. Sodium bicarbonate works by shifting potassium from the ECF to the ICF and is used to decrease serum potassium levels quickly in the presence of severe hyperkalemia (greater than 7.0 mEq/L).
   2. Calcium gluconate decreases the myocardial irritability associated with hyperkalemia but does not promote potassium loss.
   3. The nurse is describing sodium polystyrene sulfonate (Kayexalate), which is a cationic exchange resin that reduces serum potassium levels by exchanging sodium ions for potassium ions in the intestine and removes potassium via the gastrointestinal tract.
   4. Regular insulin and dextrose work by shifting potassium from the ECF to the ICF and are used to decrease serum potassium levels quickly in the presence of severe hyperkalemia (greater than 7.0 mEq/L).
   **Test-Taking Tip:** Remember that sodium polystyrene sulfonate is the generic name for Kayexalate, an agent that is commonly used to treat hyperkalemia and is administered by mouth or rectally as a retention enema. In the intestine, 1 gm of Kayexalate is exchanged for 1 mEq of potassium.
   **Content Area:** Adult Health
   **Integrated Processes:** Nursing Process: Planning
   **Client Need:** Physiological Integrity
   **Cognitive Level:** Knowledge

2. **Answer:** 3.
   **Rationale:**
   1. Diarrhea is associated with hyperkalemia, not hypokalemia.
   2. Hyperactive bowel sounds are associated with hyperkalemia, not hypokalemia.
   3. The nurse should suspect a low serum potassium level if the infant has muscle weakness. Infants require 2 to 3 mEq/kg/day of potassium to maintain growth, acid-base balance, cellular energy, and electrical charge balance. A potassium deficiency may result in myocardial damage, dysrhythmia, hypotension, and muscle weakness.
   4. Anemia is associated with inadequate iron levels, not with potassium imbalances.
   **Test-Taking Tip:** The signs of hypokalemia are similar in infants and adults. Review the signs and symptoms of hypokalemia if you had difficulty answering this question.
   **Content Area:** Child Health
   **Integrated Processes:** Nursing Process: Assessment
   **Client Need:** Physiological Integrity
   **Cognitive Level:** Application

3. **Answer:** 1.
   **Rationale:**
   1. The nurse should associate skeletal muscle weakness with the development of hypokalemia. Neuromuscular manifestations of hypokalemia include anxiety, lethargy, skeletal muscle weakness, and deep tendon hyporeflexia.
   2. A widened QRS complex may indicate hyperkalemia, not hypokalemia.
   3. Diarrhea may indicate hyperkalemia, not hypokalemia.
   4. Tall T waves may indicate hyperkalemia, not hypokalemia.
   **Test-Taking Tip:** Recall that adequate serum potassium is necessary for proper muscle function.
   **Content Area:** Adult Health
   **Integrated Processes:** Nursing Process: Assessment
   **Client Need:** Physiological Integrity
   **Cognitive Level:** Application

4. **Answer:** 4.
   **Rationale:**
   1. The symptom regarding the client’s serum electrolyte level is not an appropriate outcome for a nursing diagnosis of Risk for Falls Related to Skeletal Muscle Weakness Secondary to Electrolyte Imbalance.
   2. Promoting oral fluid intake is an intervention and does not pertain to client safety.
   3. Teaching the client is an intervention and does not pertain to client safety.
   4. The most appropriate outcome for a client with a nursing diagnosis of Risk for Falls Related to Skeletal Muscle Weakness Secondary to Electrolyte Imbalance is to remain free from injury throughout the hospital stay.
   **Test-Taking Tip:** Rule out options that are not client outcomes.
   **Content Area:** Adult Health
   **Integrated Processes:** Nursing Process: Planning
   **Client Need:** Safe and Effective Care Environment
   **Cognitive Level:** Application

5. **Answer:** 1, 4, 5.
   **Rationale:**
   1. When implementing fall precautions, the nurse should perform a fall risk assessment.
   2. The client’s bed should be maintained in the lowest position with the wheels locked. In the Trendelenburg position, the client lies flat on the back (supine) with the feet higher than the head. This was previously the standard position for treating shock, but it has fallen out of favor.
   3. Assistive devices should be placed beside the client’s bed, not at the end of it, so they are within the client’s reach.
   4. When implementing fall precautions, the nurse should instruct the client to request assistance when ambulating.
   5. When implementing fall precautions, the nurse should request family members to remain with the client if necessary.
   **Test-Taking Tip:** Consider each option and determine which ones would prevent a client from falling.
   **Content Area:** Older Adult Health
   **Integrated Processes:** Nursing Process: Implementation
   **Client Need:** Safe and Effective Care Environment
   **Cognitive Level:** Application
6. **ANSWER: 2.**

**Rationale:**
1. A potentially dangerous side effect of the medication lisinopril (Zestril) is hyperkalemia. Deep tendon hyporeflexia is seen in hyperkalemia, not hypokalemia.
2. When a client is taking lisinopril, an angiotensin-converting enzyme (ACE) inhibitor, the nurse should assess for an irregular heartbeat. ACE inhibitors may cause hyperkalemia, which may cause cardiac dysrhythmias. Cardiovascular changes are the most severe problems associated with hyperkalemia.
3. Increased urinary output would be associated with the use of diuretics, not ACE inhibitors.
4. The nutritional status of the client would not be affected by the medication lisinopril (Zestril).

**TEST-TAKING TIP:** Recall that lisinopril (Zestril) is an ACE inhibitor that adversely affects kidney function, which may lead to hyperkalemia.

**Content Area:** Adult Health

**Integrated Processes:** Nursing Process: Assessment

**Client Need:** Physiological Integrity

**Cognitive Level:** Application


7. **ANSWER: 3.**

**Rationale:**
1. Although hyponatremia does result in cardiovascular changes, it is not associated with ECG changes.
2. Although hypernatremia does result in cardiovascular changes, it is not associated with ECG changes.
3. The nurse should suspect that this client is experiencing hypokalemia. Hypokalemia causes ST segment depression, flat or inverted T waves, and increased U waves.
4. Hyperkalemia results in prolonged P-R intervals; flat or absent P waves; wide QRS complexes; and tall, peaked T waves.

**TEST-TAKING TIP:** Recall that in hypokalemia, electrical activity in the body slows down, resulting in depressed ST segments, flat T waves, and increased U waves visible on an ECG. Conversely, in hyperkalemia, excitable tissues are more sensitive to stimuli, resulting in prolonged P-R intervals; flat or absent P waves; wide QRS complexes; and tall, peaked T waves visible on an ECG.

**Content Area:** Adult Health

**Integrated Processes:** Nursing Process: Evaluation

**Client Need:** Physiological Integrity

**Cognitive Level:** Application


8. **ANSWER: 3.**

**Rationale:**
1. The administration of non-potassium-sparing diuretics, such as furosemide, places the client at risk for hypokalemia. Muscle twitches, diarrhea, and increased gastrointestinal motility are signs of hyperkalemia, not hypokalemia.
2. The administration of non-potassium-sparing diuretics, such as furosemide, places the client at risk for hypokalemia. Confusion, agitation, and muscle twitching are signs of hyperkalemia, not hypokalemia.

3. The administration of non-potassium-sparing diuretics, such as furosemide, places the client at risk for hypokalemia. The nurse should teach the client to observe for general muscle weakness, constipation, and a weak, thready pulse, which may indicate that the client’s serum potassium level is too low.
4. The administration of non-potassium-sparing diuretics, such as furosemide, places the client at risk for hypokalemia. Increased blood pressure, increased heart rate, and constipation are early manifestations of hyperkalemia, not hypokalemia.

**TEST-TAKING TIP:** Recall that furosemide is a non-potassium-sparing diuretic that may cause a decrease in serum potassium (hypokalemia). Select the option that describes the signs of hypokalemia.

**Content Area:** Adult Health

**Integrated Processes:** Nursing Process: Planning

**Client Need:** Physiological Integrity

**Cognitive Level:** Application


9. **ANSWER: 4.**

**Rationale:**
1. Potassium should not be administered intramuscularly because it is a severe tissue irritant.
2. A serum potassium level of 2.0 mEq/L is considered a severe deficit and requires an IV infusion of potassium for replacement.
3. Potassium should never be given by IV push or bolus because the rapid infusion of potassium chloride can result in death.
4. The nurse should identify potassium chloride 40 mEq/L by IV infusion over 4 hours as the most appropriate order to treat hypokalemia in this adult client with a serum potassium level of 2.0 mEq/L. A serum potassium level of 2.0 mEq/L is considered a severe deficit and requires an IV infusion of potassium for replacement.

**TEST-TAKING TIP:** Potassium is a high-alert medication. Be familiar with its administration: IV infusions of potassium should not exceed a rate of 10 mEq/hr for adults.

**Content Area:** Adult Health

**Integrated Processes:** Nursing Process: Planning

**Client Need:** Physiological Integrity

**Cognitive Level:** Application


10. **ANSWER: 2, 3, 4.**

**Rationale:**
1. To ensure the safety of a client receiving IV potassium therapy, the nurse should infuse the medication slowly, at a rate of no more than 10 mEq/hr via peripheral line or 20 mEq/hr via central line, with continuous cardiac monitoring. Potassium should never be infused at a rate of 30 mEq/hr.
2. To ensure the safety of a client receiving IV potassium therapy, the nurse should plan to check the concentration of the potassium solution with another registered nurse to confirm that the medication has been properly diluted.
3. To ensure the safety of a client receiving IV potassium therapy, the nurse should plan to use a controlled infusion
device to administer the potassium solution to ensure that the medication is infused slowly, at no more than 10 mEq/hr via peripheral line or 20 mEq/hr via central line, with continuous cardiac monitoring.

4. To ensure the safety of a client receiving IV potassium therapy, the nurse should assess the client’s IV site every 2 hours to monitor for signs of phlebitis or infiltration because IV potassium is extremely irritating to the veins.

5. The nurse should not administer bumetanide because it is a non-potassium-sparing diuretic, which would worsen the client’s fluid volume deficit and hypokalemia.

**TEST-TAKING TIP:** Read each option carefully. Rule out the options that would cause harm to the client.

**Content Area:** Maternal Health

**Integrated Processes:** Nursing Process: Planning

**Client Need:** Physiological Integrity

**Cognitive Level:** Application


**Rationale:**

1. The nurse’s goal when teaching a pregnant adolescent should be to improve nutritional knowledge, meal planning, and food preparation skills, not to encourage the adolescent to eat foods she likes and is accustomed to eating. Adolescents are more likely than adults to have unhealthy dietary habits, such as eating nonnutritional snacks and ingesting inadequate amounts of nutrients.

2. Recommending the ingestion of low-calorie foods to restrict weight gain is an intervention, not a goal—and in this case, it would be an inappropriate intervention. Pregnant adolescents should be encouraged to select a weight-gain goal at the upper end of their body mass index range to reduce the incidence of low-birth-weight infants.

3. Identifying sources of peer pressure and eating habits is an assessment, not a goal. This assessment is necessary when evaluating the client’s diet history to achieve the goal of improved nutritional knowledge, meal planning, and food preparation skills.

4. The nurse’s goal when teaching a pregnant adolescent should be to improve nutritional knowledge, meal planning, and food preparation skills. Adolescents are more likely than adults to have unhealthy dietary habits, such as eating nonnutritional snacks and ingesting inadequate amounts of nutrients. In addition, they are highly susceptible to peer influence. Identifying these influences and eating habits is necessary when assessing the client’s diet history to achieve the goal of improved nutritional knowledge, meal planning, and food preparation skills.

**TEST-TAKING TIP:** A goal is a broad statement about the client’s status that a nurse hopes to achieve by implementing nursing interventions. Rule out options that are interventions (options 1 and 2) and assessments (option 3) to identify the nursing goal.

**Content Area:** Maternal Health

**Integrated Processes:** Nursing Process: Planning

**Client Need:** Physiological Integrity

**Cognitive Level:** Application


12. ANSWER: 400.

**Rationale:**

Use the following formula to calculate the dose:

\[ \text{Dosage on hand/Dosage unit} = \frac{\text{Desired dosage} \times \text{Dose given}}{\text{mEq/liter} \times \text{mL}} \]

\[ = \frac{1 \text{ mEq/liter} \times 10 \text{ mL}}{40 \text{ mEq/liter} \times 1 \text{ mL}} \times 1 \text{ mL} \]

\[ = \frac{10 \text{ mL}}{400 \text{ mL}} \times 1 \text{ mL} \]

\[ X = 400 \text{ mL} \]

**TEST-TAKING TIP:** Potassium is a high-alert medication. Always double-check medication calculations and confirm the concentration of potassium-containing solutions with another registered nurse before administration.

**Content Area:** Adult Health

**Integrated Processes:** Nursing Process: Implementation

**Client Need:** Physiological Integrity

**Cognitive Level:** Application


13. ANSWER: 1.

**Rationale:**

60 mEq = 3 doses = 20 mEq each dose

20 mEq = 1 tablet

**TEST-TAKING TIP:** Potassium is a high-alert medication. Always double-check medication calculations before administration.

**Content Area:** Adult Health

**Integrated Processes:** Nursing Process: Implementation

**Client Need:** Physiological Integrity

**Cognitive Level:** Application


14. ANSWER: 50.

**Rationale:**

Use the following formula to calculate the dose:

\[ \text{Volume} \times \text{Drop factor} \times \text{Time} = \text{Rate} \]

\[ = 100 \text{ mL} \times 60 \text{ gtt}/\text{min} \times 6000/\text{60} = 100 \text{ mL/hr} + 2 \text{ hr} = 50 \text{ mL/hr} \]

**TEST-TAKING TIP:** Read the question carefully. Note that the solution is to be infused over 2 hours.

**Content Area:** Adult Health

**Integrated Processes:** Nursing Process: Implementation

**Client Need:** Physiological Integrity

**Cognitive Level:** Application


15. ANSWER: 3, 4.

**Rationale:**

1. Sodium imbalances do not cause VT.

2. Sodium imbalances do not cause VT.

3. The nurse should associate nonsustained VT with the development of either hypokalemia or hyperkalemia. Hypokalemia increases the likelihood that the cardiac cells will depolarize spontaneously and cause PVCs, which may lead to VT.

4. The nurse should associate nonsustained VT with the development of either hypokalemia or hyperkalemia.
Hyperkalemia increases the excitability of the cardiac cell membrane and makes it more sensitive to stimuli (more irritable), increasing the likelihood of spontaneous depolarization leading to VT.

5. Fluid imbalances do not directly cause VT but may contribute to electrolyte imbalances that result in VT.

6. Fluid imbalances do not directly cause VT but may contribute to electrolyte imbalances that result in VT.

**TEST-TAKING TIP:** Recall that sodium imbalances do not cause cardiac dysrhythmias. Fluid imbalances contribute indirectly to cardiac dysrhythmias because they are associated with various electrolyte imbalances.

**Content Area:** Adult Health

**Integrated Processes:** Nursing Process: Analysis

**Client Need:** Physiological Integrity

**Cognitive Level:** Application


**ANSWER:** 4.

**Rationale:**

1. A history of corticosteroid use would predispose a client to hypokalemia, not hyperkalemia.

2. A history of diuretic use would predispose a client to hypokalemia, not hyperkalemia.

3. Urinary incontinence is not a risk factor for hyperkalemia or hypokalemia.

4. The nurse should associate a history of uncontrolled diabetes mellitus with the development of hyperkalemia. Uncontrolled diabetes mellitus causes a relative increase in potassium. Insulin increases the activity of the sodium-potassium pumps that move potassium out of the ECF and into the cell. Conversely, the lack of insulin decreases the activity of the sodium-potassium pumps, leaving potassium in the ECF and increasing serum potassium levels.

**TEST-TAKING TIP:** Review the pathophysiology associated with uncontrolled type 1 diabetes mellitus if you had difficulty answering this question.

**Content Area:** Adult Health

**Integrated Processes:** Nursing Process: Analysis

**Client Need:** Physiological Integrity

**Cognitive Level:** Application


**ANSWER:** 1, 2, 4.

**Rationale:**

1. A serum potassium level greater than 6.5 mEq/L is considered severe hyperkalemia that requires aggressive therapy. The nurse should anticipate that a health-care provider will order sodium polystyrene sulfonate by mouth as an adjunct to remove potassium via the gastrointestinal tract.

2. A serum potassium level greater than 6.5 mEq/L is considered severe hyperkalemia that requires aggressive therapy. The nurse should anticipate that a health-care provider will order regular insulin administered simultaneously with 50% glucose and albuterol inhalation to rapidly decrease the client’s serum potassium level by shifting potassium back into the cells.

3. Because the client is not experiencing ECG changes, it is unlikely that calcium gluconate would be ordered because this medication antagonizes the effect of hyperkalemia on cardiac muscle.

4. A serum potassium level greater than 6.5 mEq/L is considered severe hyperkalemia that requires aggressive therapy. The nurse should anticipate that a health-care provider will order regular insulin administered simultaneously with 50% glucose and albuterol inhalation to rapidly decrease the client’s serum potassium level by shifting potassium back into the cells.

**TEST-TAKING TIP:** Consider that the client is experiencing severe hyperkalemia with no ECG changes. Review the emergency treatment for severe hyperkalemia if you had difficulty answering this question.

**Content Area:** Adult Health

**Integrated Processes:** Nursing Process: Planning

**Client Need:** Physiological Integrity

**Cognitive Level:** Application


**ANSWER:** 2, 5.

**Rationale:**

1. A serum potassium level of 2.5 mEq/L is below normal and is considered hypokalemia. Implementation of fall precautions is appropriate and should not be questioned. Fall precautions are necessary because hypokalemia causes muscle weakness, which increases the risk of falls.

2. A serum potassium level of 2.5 mEq/L is below normal and is considered hypokalemia. The nurse should question the order to implement seizure precautions because hypokalemia does not cause seizures, as hypotension would.

3. A serum potassium level of 2.5 mEq/L is below normal and is considered hypokalemia. Administration of IV potassium is appropriate and should not be questioned. Potassium replacement is required to correct hypokalemia.

4. A serum potassium level of 2.5 mEq/L is below normal and is considered hypokalemia. Continuous telemetry monitoring is appropriate and should not be questioned. Cardiac monitoring is important in clients with potassium imbalances because of the potential for dysrhythmias.

5. A serum potassium level of 2.5 mEq/L is below normal and is considered hypokalemia. The nurse should question the order to administer chlorothiazide (Diuril), which would further deplete the already low serum potassium level. The use of chlorothiazide or any other non-potassium-sparing diuretic would be contraindicated for this client.

**TEST-TAKING TIP:** Read the question carefully and select the incorrect options.

**Content Area:** Adult Health

**Integrated Processes:** Nursing Process: Analysis

**Client Need:** Safe and Effective Care Environment

**Cognitive Level:** Analysis

Rationale:
1. A blood pressure of 100/45 mm Hg may be present in a client admitted with a 2-day history of vomiting and diarrhea and at increased risk for hypokalemia, but respiratory alterations should be the priority.
2. Weakness and lightheadedness may be present in a client admitted with a 2-day history of vomiting and diarrhea and at increased risk for hypokalemia, but respiratory alterations should be the priority.
3. A pulse of 100 bpm may be present in a client admitted with a 2-day history of vomiting and diarrhea and at increased risk for hypokalemia, but respiratory alterations should be the priority.
4. The nurse should investigate the client’s shallow respirations and tachypnea first, because vomiting and diarrhea place the client at increased risk for hypokalemia. Respiratory changes are likely with hypokalemia because of weakness of the muscles needed for breathing.

TEST-TAKING TIP: Remember the “ABCs” of assessment. Alterations in respiration should be the priority.

Content Area: Older Adult Health
Integrated Processes: Nursing Process: Implementation
Client Need: Safe and Effective Care Environment
Cognitive Level: Analysis

20. ANSWER: 2.
Rationale:
1. Although the nurse should investigate mental confusion, this should not be the nurse’s priority over cardiac dysrhythmias.
2. The nurse should immediately intervene in the event of cardiac dysrhythmias. Cardiac dysrhythmias are life-threatening manifestations of potassium imbalances. Because this client has been taking furosemide (a non-potassium-sparing diuretic) for treatment of CHF, the client is most likely experiencing an actual loss of potassium.
3. Although the nurse should investigate abdominal distention, this should not be the nurse’s priority over cardiac dysrhythmias.
4. Although the nurse should investigate hypotension, this should not be the nurse’s priority over cardiac dysrhythmias. Cardiac dysrhythmias may be the cause of hypotension.

TEST-TAKING TIP: The most life-threatening manifestation should always be the first priority.

Content Area: Adult Health
Integrated Processes: Nursing Process: Implementation
Client Need: Safe and Effective Care Environment
Cognitive Level: Analysis

21. ANSWER: 2, 3, 4, 5.
Rationale:
1. Diarrhea related to Spastic Colonic Activity is associated with hyperkalemia, not hypokalemia.
2. The nurse should assign the diagnosis Constipation Related to Smooth Muscle Atony to this client. The client is experiencing hypokalemia, which results in muscle weakness, smooth muscle atony, and cardiac dysrhythmias.
3. The nurse should assign the diagnosis Decreased Cardiac Output Related to Dysrhythmia to this client. The client is experiencing hypokalemia, which results in muscle weakness, smooth muscle atony, and cardiac dysrhythmias.
4. The nurse should assign the diagnosis Impaired Physical Mobility Related to Skeletal Muscle Weakness to this client. The client is experiencing hypokalemia, which results in muscle weakness, smooth muscle atony, and cardiac dysrhythmias.
5. The nurse should assign the diagnosis Potential for Respiratory Insufficiency Related to Muscle Weakness to this client. The client is experiencing hypokalemia, which results in muscle weakness, smooth muscle atony, and cardiac dysrhythmias.

TEST-TAKING TIP: Become familiar with the similarities and differences in the signs and symptoms of hypokalemia and hyperkalemia.

Content Area: Adult Health
Integrated Processes: Nursing Process: Analysis
Client Need: Physiological Integrity
Cognitive Level: Analysis

22. ANSWER: 2.
Rationale:
1. The nursing diagnosis Impaired Physical Mobility Related to Skeletal Muscle Weakness is appropriate for this client but should not be the nurse’s first priority.
2. The nurse should give priority to the nursing diagnosis Decreased Cardiac Output Related to Dysrhythmia because cardiac dysrhythmias are potentially life threatening.
3. The nursing diagnosis Risk for Falls Related to Skeletal Muscle Weakness is appropriate for this client but should not be the nurse’s first priority.
4. The nursing diagnosis Constipation Related to Smooth Muscle Atony is appropriate for this client but should not be the nurse’s first priority.

TEST-TAKING TIP: The most life-threatening manifestation should always be the first priority.

Content Area: Adult Health
Integrated Processes: Nursing Process: Analysis
Client Need: Physiological Integrity
Cognitive Level: Analysis

23. ANSWER: 2.
Rationale:
1. ECG strip 1 shows normal sinus rhythm, not a rhythm indicative of hypokalemia.
2. The nurse should identify ECG strip 2 as indicative of hypokalemia because it displays a normal sinus rhythm with prominent U waves, which are a classic ECG change associated with serum potassium levels less than 3.5 mEq/L.
3. ECG strip 3 shows sinus tachycardia (heart rate greater than 100 bpm), not a rhythm indicative of hypokalemia.
4. ECG strip 4 shows sinus bradycardia (heart rate less than 60 bpm), not a rhythm indicative of hypokalemia.

**TEST-TAKING TIP:** Review the effects of hypokalemia on the electrical conduction of the heart, and choose the option that reflects those effects.

**Content Area:** Older Adult Health

**Integrated Processes:** Nursing Process: Evaluation

**Client Need:** Physiological Integrity

**Cognitive Level:** Analysis


24. **ANSWER:** 3.

**Rationale:**
1. ECG strip 1 shows the prominent U waves associated with hypokalemia, not hyperkalemia.
2. ECG strip 2 shows normal sinus rhythm, not a rhythm indicative of potassium imbalance.
3. The nurse should identify ECG strip 3 as indicative of hyperkalemia because it displays peaked, tented T waves, which are a classic ECG change associated with serum potassium levels greater than 5.0 mEq/L.
4. ECG strip 4 shows atrial fibrillation, which is not related to electrolyte imbalance.

**TEST-TAKING TIP:** Review the effects of hyperkalemia on the electrical conduction of the heart, and choose the option that reflects those effects.

**Content Area:** Adult Health

**Integrated Processes:** Nursing Process: Evaluation

**Client Need:** Physiological Integrity

**Cognitive Level:** Analysis


25. **ANSWER:** 3.

**Rationale:**
1. Chlorothiazide is not an appropriate choice for this client. Chlorothiazide is a non-potassium-sparing diuretic that would increase the renal excretion of potassium and worsen the client’s hypokalemia.
2. Bumetanide is not an appropriate choice for this client. Bumetanide is a non-potassium-sparing diuretic that would increase the renal excretion of potassium and worsen the client’s hypokalemia.
3. The nurse should identify spironolactone, a potassium-sparing diuretic, as most appropriate for this client. Potassium-sparing diuretics increase urine output (decreasing fluid volume excess), without increasing potassium loss.
4. Furosemide is not an appropriate choice for this client. Furosemide is a non-potassium-sparing diuretic that would increase the renal excretion of potassium and worsen the client’s hypokalemia.

**TEST-TAKING TIP:** Differentiate between potassium-sparing and non-potassium-sparing diuretics. A potassium-sparing diuretic should be administered to a client who needs to conserve potassium.

**Content Area:** Adult Health

**Integrated Processes:** Nursing Process: Analysis

**Client Need:** Physiological Integrity

**Cognitive Level:** Analysis
