

## Diuretics

### Key Terms

<i>dehydration</i>	<i>hypokalemia</i>
<i>diuretic</i>	<i>hyponatremia</i>
<i>edema</i>	<i>orthostatic</i>
<i>filtrate</i>	<i>hypotension</i>
<i>glaucoma</i>	<i>postural hypotension</i>
<i>hyperkalemia</i>	

### Chapter Objectives

On completion of this chapter, the student will:

- List the five general types of diuretics.
- Discuss the uses, general drug actions, adverse reactions, contraindications, precautions, and interactions of the diuretics.
- Describe important preadministration and ongoing assessment activities the nurse should perform on the patient taking a diuretic.
- List some nursing diagnoses particular to a patient taking a diuretic.
- Discuss ways to promote an optimal response to therapy, how to manage common adverse reactions, and important points to keep in mind when educating patients about the use of diuretics.

**A diuretic** is a drug that increases the secretion of urine (ie, water, electrolytes, and waste products) by the kidneys. Many conditions or diseases, such as heart failure, endocrine disturbances, and kidney and liver diseases can cause retention of excess fluid (**edema**). When the patient shows signs of excess fluid retention, the primary health care provider may order a diuretic. There are various types of diuretic drugs, and the primary health care provider selects the one that best suits the patient's needs and effectively reduces the amount of excess fluid in body tissues.

The different types of diuretic drugs are:

- Carbonic anhydrase inhibitors
- Loop diuretics
- Osmotic diuretics
- Potassium-sparing diuretics
- Thiazides and related diuretics

The Summary Drug Table: Diuretics lists examples of the different types of diuretic drugs. Most diuretics act on the tubules of the kidney nephron (Fig. 46-1), the functional unit of the kidney. Each kidney contains about one million nephrons, which filter the bloodstream to remove waste products. During this process,

water and electrolytes are also selectively removed. The **filtrate** (ie, the fluid removed from the blood) normally contains ions (potassium, sodium, chloride), waste products (ammonia, urea), water, and at times other substances that are being excreted from the body, such as drugs. The filtrate then passes through the proximal tubule, the loop of Henle, and the distal tubules. At these points, selective reabsorption of amino acids, glucose, some electrolytes, and water occurs. Ions and water that are required by the body to maintain fluid and electrolyte balance are returned to the bloodstream by means of the minute capillaries that surround the distal and proximal tubules and the loop of Henle. Ions and water that are not needed by the body are excreted in the urine.

Diuretics are used in a variety of medical disorders. The primary health care provider selects the type of diuretic that will most likely be effective for treatment of a specific disorder. In some instances, hypertension may be treated with the administration of an antihypertensive drug and a diuretic. The diuretics used for this combination therapy include the loop diuretics and the thiazides and related diuretics. The specific uses of each type of diuretic drug are discussed in the following sections.

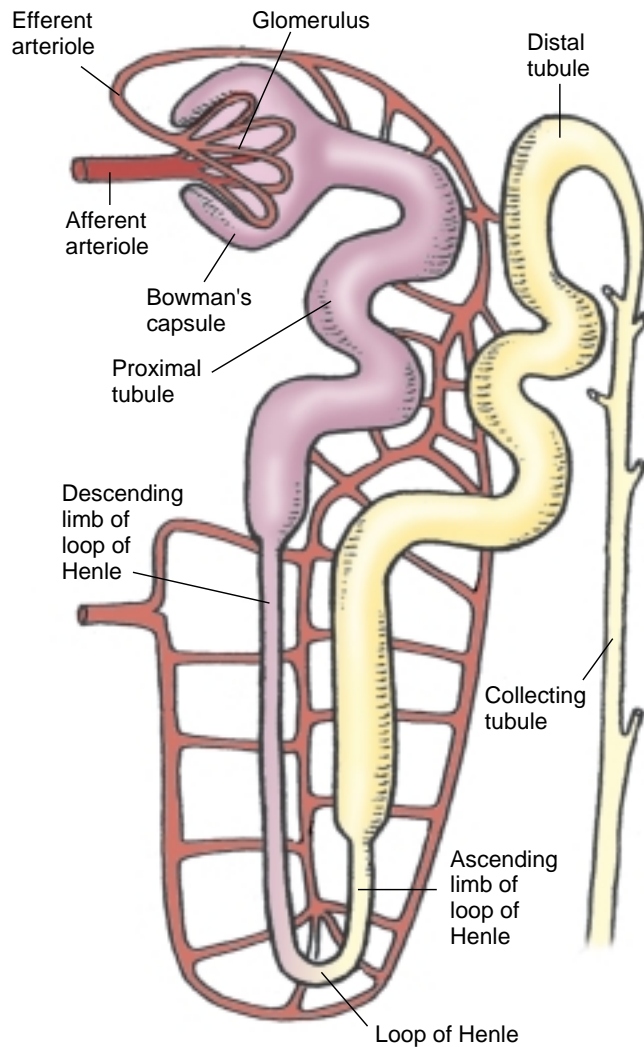
## SUMMARY DRUG TABLE DIURETICS

GENERIC NAME	TRADE NAME*	USES	ADVERSE REACTIONS	DOSAGE RANGES
<b>Carbonic Anhydrase Inhibitors</b>				
acetazolamide <i>a-set-a-zole'-a-mide</i>	Diamox, <i>generic</i>	Open-angle glaucoma, secondary glaucoma, preoperatively to lower intraocular pressure (IOP), edema due to CHF, drug-induced edema, centrencephalic epilepsy	Fever, rash, paresthesias, photosensitivity, crystalluria, acidosis, urticaria, pruritus, hematuria, weakness, malaise, anorexia, hematologic changes, convulsions	Glaucoma: up to 1 g/d PO in divided doses; acute glaucoma: 500 mg initially then 125–250 mg PO q4h; epilepsy: 8–30 mg/kg/d in divided doses; CHF and edema: 250–375 mg/d PO
methazolamide <i>meth-a-zoe'-la-mide</i>	Neptazane	Glaucoma	Same as acetazolamide	50–100 mg PO BID, TID
<b>Loop Diuretics</b>				
bumetanide <i>byoo-met'-a-nide</i>	Bumex, <i>generic</i>	Edema due to CHF, cirrhosis of the liver, renal disease, acute pulmonary edema (IV)	Electrolyte imbalances, anorexia, nausea, vomiting, dizziness, rash, photosensitivity reactions, postural or orthostatic hypotension, glycosuria	0.5–10 mg/d PO, IV, IM
ethacrynic acid <i>eth-a-krin-ik</i>	Edecrin, Edecrin Sodium	Same as bumetanide plus ascites due to malignancy, idiopathic edema, lymphedema	Electrolyte imbalances, anorexia, nausea, vomiting, fever, chills, anxiety, confusion, hematologic changes	50–200 mg/d PO; 0.5–1 mg/kg IV
furosemide <i>fur-oh'-se-mide</i>	Lasix, <i>generic</i>	Same as bumetanide plus hypertension (PO)	Same as bumetanide	Edema: up to 600 mg/d PO in single or divided doses, 20–40 mg IM, IV; hypertension: up to 40 mg PO BID; acute pulmonary edema: 40–80 mg IV
toremide <i>tor'-se-myde</i>	Demadex	Same as bumetanide	Headache, dizziness, diarrhea, electrolyte imbalances, ECG abnormalities, nausea, anorexia, drowsiness	CHF: 10–20 mg/d PO, IV; renal failure: 20 mg/d PO, IV; cirrhosis, hypertension: 5–10 mg/d PO, IV
<b>Osmotic Diuretics</b>				
glycerin (glycerol) <i>gli-ser-in</i>	Osmoglyn	Glaucoma, before and after surgery	Fluid and electrolyte imbalance	1–2 g/kg PO
isosorbide <i>eye-soe-sor'-bide</i>	Ismotic	Same as glycerin	Same as glycerin	1–3 mg/kg BID-QID PRN PO
mannitol <i>man'-i-tole</i>	Osmitol, <i>generic</i>	To promote diuresis in acute renal failure, reduction of IOP, treatment of cerebral edema	Edema, fluid and electrolyte imbalance, headache, blurred vision, nausea, vomiting, diarrhea, urinary retention	50–200 g/24 h IV; IOP: 1.5–2 g/kg IV
urea <i>your-ee'-a</i>	Ureaphil	Reduction of IOP, reduction of intracranial pressure	Headache, nausea, vomiting, fluid and electrolyte imbalance, syncope	Up to 120 g/d IV
<b>Potassium-Sparing Diuretics</b>				
amiloride hydrochloride <i>a-mill'-oh-ride</i>	Midamor	CHF, hypertension, hypokalemia from other diuretics, prevention of hypokalemia in at-risk patients	Headache, nausea, anorexia, diarrhea, vomiting, weakness, hyperkalemia, dizziness, rash, hypotension	5–20 mg/d PO

## SUMMARY DRUG TABLE DIURETICS (Continued)

GENERIC NAME	TRADE NAME*	USES	ADVERSE REACTIONS	DOSAGE RANGES
spironolactone <i>speer-on-oh-lak'-tone</i>	Aldactone, <i>generic</i>	Hypertension, edema due to CHF, cirrhosis, renal disease; hypokalemia, prophylaxis of hypokalemia in those taking digitalis, hyperaldosteronism	Cramping, diarrhea, drowsiness, lethargy, rash, drug fever, hyperkalemia, gastritis, headache, inability to achieve an erection, gynecomastia	Up to 400 mg/d PO in single dose or divided doses
triamterene <i>trye-am'-ter-een</i>	Dyrenium	Prevention of hypokalemia, edema due to CHF, cirrhosis, renal disease	Diarrhea, nausea, vomiting, hyperkalemia, photosensitivity reactions, azotemia, thrombocytopenia	Up to 300 mg/d PO in divided doses
<b>Thiazides and Related Diuretics</b>				
bendroflumethiazide <i>ben-droe-floo-me-thye'-a-zide</i>	Naturetin	Edema associated with CHF, hypertension	Hypotension, dizziness, vertigo, light-headedness, anorexia, gastric distress, nausea, hematologic changes, photosensitivity reactions, weakness, hyperglycemia, fluid and electrolyte imbalances, diarrhea, constipation, rash	Edema: 5–20 mg/d; hypertension: 5–20 mg/d PO
benzthiazide <i>benz-thye'-a-zide</i>	Exna	Edema associated with CHF, hypertension	Same as bendroflumethiazide	5–200 mg/d PO
chlorothiazide <i>klor-oh-thye'-a-zide</i>	Diuril, <i>generic</i>	Hypertension, edema due to CHF, cirrhosis, corticosteroid and estrogen therapy	Same as bendroflumethiazide	Hypertension: up to 2 g/d PO in divided doses; edema: 0.5–2 g PO, IV QID or BID
chlorthalidone <i>klor-thal'-i-done</i>	Hygroton, <i>generic</i>	Same as chlorothiazide	Same as chlorothiazide	Hypertension: 25–100 mg/d PO; edema: 50–200 mg/d PO
hydrochlorothiazide <i>hye-droe-klor-oh-thye'-a-zide</i>	HydroDiuril, <i>generic</i>	Same as chlorothiazide	Same as chlorothiazide	Hypertension: 25–50 mg/d PO; edema: 25–200 mg/d PO
hydroflumethiazide <i>hye-droe-floo-me-thye'-a-zide</i>	Diucardin, Saluron	Same as chlorothiazide	Same as chlorothiazide	Hypertension: 50–200 mg/d PO; edema: 25–200 mg/d PO
indapamide <i>in-dap'-a-mide</i>	Lozol, <i>generic</i>	Hypertension, edema due to CHF	Same as chlorothiazide	Hypertension: 2.5–5 mg/d PO; edema: 2.5–5 mg/d PO
metolazone <i>me-tole'-a-zone</i>	Mykrox, Zaroxolyn	Edema in CHF, cirrhosis, corticosteroids, estrogen therapy, renal dysfunction	Same as bendroflumethiazide	Zaroxolyn: hypertension 2.5–5 mg/d PO; Mykrox: hypertension, 0.5–1 mg/d PO
methychlothiazide <i>meth-i-kloe-thye'-a-zide</i>	Aquatensen, Enduron, <i>generic</i>	Same as chlorothiazide	Same as chlorothiazide	Hypertension: 2.5–5 mg/d PO; edema: 2.5–10 mg/d PO
polythiazide <i>pol-i-thye'-a-zide</i>	Renese	Same as chlorothiazide	Same as chlorothiazide	Hypertension: 2–4 mg/d PO; edema: 1–4 mg/d PO
quinethazone <i>kw-in-eth'-a-zone</i>	Hydromox	Same as bendroflumethiazide	Same as bendroflumethiazide	50–200 mg/d PO
trichlormethiazide <i>trye-klor-meth-eye'-a-zide</i>	Diurese, Metahydrin, Naqua, <i>generic</i>	Same as bendroflumethiazide	Same as bendroflumethiazide	Edema: 2–4 mg/d PO; hypertension: 2–4 mg/d PO

\*The term *generic* indicates the drug is available in generic form.  
CHF, congestive heart failure; IOP, intraocular pressure.



**FIGURE 46-1.** The nephron is the functional unit of the kidney. Note the various tubules, the site of most diuretic activity. The loop of Henle is the site of action for the loop diuretics. Thiazide diuretics act at the ascending portion of the loop of Henle and the distal tube of the nephron.

## ACTION

### Carbonic Anhydrase Inhibitors

Carbonic anhydrase is an enzyme that produces free hydrogen ions, which are then exchanged for sodium ions in the kidney tubules. Carbonic anhydrase inhibitors inhibit the action of the enzyme carbonic anhydrase. This effect results in the excretion of sodium, potassium, bicarbonate, and water. Carbonic anhydrase inhibitors also decrease the production of aqueous humor in the eye, which in turn decreases intraocular pressure (IOP) (ie, the pressure within the eye).

### Loop Diuretics

The loop diuretics, furosemide (Lasix) and ethacrynic acid (Edecrin), increase the excretion of sodium and chloride by inhibiting reabsorption of these ions in the

distal and proximal tubules and in the loop of Henle. This mechanism of action at these three sites appears to increase their effectiveness as diuretics. Torsemide (Demadex) also increases urinary excretion of sodium, chloride, and water but acts primarily in the ascending portion of the loop of Henle. Bumetanide (Bumex) primarily increases the excretion of chloride but also has some sodium-excreting ability. This drug acts primarily on the proximal tubule of the nephron.

### Osmotic Diuretics

Osmotic diuretics increase the density of the filtrate in the glomerulus. This prevents selective reabsorption of water, which allows the water to be excreted. Sodium and chloride excretion is also increased.

### Potassium-Sparing Diuretics

Potassium-sparing diuretics work in either of two ways. Triamterene (Dyrenium) and amiloride (Midamor) depress the reabsorption of sodium in the kidney tubules, therefore increasing sodium and water excretion. Both drugs additionally depress the excretion of potassium and therefore are called potassium-sparing (or potassium-saving) diuretics. Spironolactone (Aldactone), also a potassium-sparing diuretic, antagonizes the action of aldosterone. Aldosterone, a hormone produced by the adrenal cortex, enhances the reabsorption of sodium in the distal convoluted tubules of the kidney. When this activity of aldosterone is blocked, sodium (but not potassium) and water are excreted.

### Thiazides and Related Diuretics

Thiazides and related diuretics inhibit the reabsorption of sodium and chloride ions in the ascending portion of the loop of Henle and the early distal tubule of the nephron. This action results in the excretion of sodium, chloride, and water.

## USES

### Carbonic Anhydrase Inhibitors

**Glaucoma** is an increase in the IOP that, if left untreated, can result in blindness. Normally the eye is filled with aqueous humor in an amount that is carefully regulated to maintain the shape of the eyeball. In glaucoma, aqueous humor is increased, which causes the IOP to rise and can, without treatment, damage the retina.

Acetazolamide (Diamox) is used in the treatment of simple (open-angle) glaucoma, secondary glaucoma, and preoperatively in acute angle-closure glaucoma when delay of surgery is desired to lower the IOP. These drugs

are also used in the treatment of edema caused by congestive heart failure (CHF), drug-induced edema, and control of epilepsy (absence [formerly petit mal] and non-localized seizures). Methazolamide (Neptazane) is used in the treatment of glaucoma.

## Loop Diuretics

Loop diuretics are used in the treatment of edema associated with CHF, cirrhosis of the liver, and renal disease, including the nephrotic syndrome. These drugs are particularly useful when a greater diuretic effect is desired. Furosemide is the drug of choice when a rapid diuresis is needed or if the patient has renal insufficiency. Furosemide and torsemide are also used to treat hypertension. Ethacrynic acid is also used for the short-term management of ascites caused by a malignancy, idiopathic edema, or lymphedema.

## Osmotic Diuretics

Mannitol (Osmitol) is used for the promotion of diuresis in the prevention and treatment of the oliguric phase of acute renal failure, as well as for the reduction of IOP and the treatment of cerebral edema. Urea (Ureaphil) is useful in reducing cerebral edema and in the reduction of IOP. Glycerin (Osmoglyn) and isosorbide (Ismotic) are used in the treatment of acute glaucoma and to reduce IOP before and after eye surgery.

## Potassium-Sparing Diuretics

Amiloride (Midamor) is used in the treatment of CHF and hypertension and is often used with a thiazide diuretic. Spironolactone and triamterene are also used in the treatment of hypertension and edema caused by CHF, cirrhosis, and the nephrotic syndrome. Amiloride, spironolactone, and triamterene are also available with hydrochlorothiazide, a thiazide diuretic that enhances the antihypertensive and diuretic effects of the drug combination while still conserving potassium.

## Thiazides and Related Diuretics

Thiazides and related diuretics are used in the treatment of hypertension, edema caused by CHF, hepatic cirrhosis, corticosteroid and estrogen therapy, and renal dysfunction.

## ADVERSE REACTIONS

### Carbonic Anhydrase Inhibitors

Adverse reactions associated with short-term therapy with carbonic anhydrase inhibitors are rare. Long-term use of these drugs may result in fever, rash, paresthesia

(numbness, tingling), photosensitivity reactions (exaggerated sunburn reaction when the skin is exposed to sunlight or ultraviolet light), anorexia, and crystalluria (crystals in the urine). On occasion, acidosis may occur, and oral sodium bicarbonate may be used to correct this imbalance.

## Loop Diuretics

Adverse reactions seen with the loop diuretics may include anorexia, nausea, vomiting, dizziness, rash, **postural hypotension** (dizziness and light-headedness when rising suddenly from a sitting or lying position), **orthostatic hypotension** (hypotension after standing in one place for a long time), photosensitivity reactions, and glycosuria (glucose in the urine). Patients with diabetes who take these drugs may experience an elevation of the blood glucose level.

## Osmotic Diuretics

The osmotic diuretics urea and mannitol are administered intravenously (IV), whereas glycerin and isosorbide are administered orally. Administration by the IV route may result in a rapid fluid and electrolyte imbalance, especially when these drugs are administered before surgery with the patient in a fasting state.

## Potassium-Sparing Diuretics

**Hyperkalemia** (increase in potassium in the blood), a serious event, may be seen with the administration of potassium-sparing diuretics. Hyperkalemia is most likely to occur in patients with an inadequate fluid intake and urine output, those with diabetes or renal disease, the elderly, and those who are severely ill. In patients taking spironolactone, gynecomastia (breast enlargement in the male) may occur. This reaction appears to be related to both dosage and duration of therapy. The gynecomastia is usually reversible when therapy is discontinued, but in rare instances, some breast enlargement may remain.

Additional adverse reactions of these drugs are listed in the Summary Drug Table: Diuretics. When a potassium-sparing diuretic and a thiazide diuretic are given together, the adverse reactions associated with both drugs may be seen.

## Thiazides and Related Diuretics

Administration of thiazides and related diuretics may be associated with numerous adverse reactions. However, many patients take these drugs without

experiencing adverse reactions other than excessive fluid and electrolyte loss, which often can be corrected with an adequate fluid intake, a balanced diet, supplemental oral electrolytes, or the eating of foods or fluids high in the electrolytes that are being lost. Some of the adverse reactions that may be seen, in addition to those listed in the Summary Drug Table: Diuretics, include gastric irritation, abdominal bloating, reduced libido, dizziness, vertigo, headache, photosensitivity, and weakness. The administration of a thiazide diuretic and a digitalis glycoside may result in cardiac arrhythmias.

## CONTRAINDICATIONS, PRECAUTIONS, AND INTERACTIONS

### Carbonic Anhydrase Inhibitors

The carbonic anhydrase inhibitors are contraindicated in patients with known hypersensitivity to the drugs, electrolyte imbalances, severe kidney or liver dysfunction, or anuria, and for long-term use in chronic non-congestive angle-closure glaucoma (may mask worsening glaucoma).

Diuretics are used cautiously in patients with renal dysfunction. The diuretics are Pregnancy Category C drugs and must be used cautiously during pregnancy and lactation. The safety of these drugs for use during pregnancy and lactation has not been established, so they should be used only when the drug is clearly needed and when the potential benefits to the patient outweigh the potential hazards to the fetus.

There is an increased risk of cyclosporine toxicity when the drug is administered with acetazolamide. Decreased serum and urine concentrations of primidone occur when the drug is administered with acetazolamide.

### Loop Diuretics

Loop diuretics are contraindicated in patients with known hypersensitivity to the loop diuretics or to the sulfonamides, severe electrolyte imbalances, hepatic coma, or anuria, and in infants (ethacrynic acid).

Loop diuretics are used cautiously in patients with renal dysfunction. The loop diuretics are Pregnancy Category B (ethacrynic acid and torsemide) and C drugs (furosemide and bumetanide) and must be used cautiously during pregnancy and lactation. Furosemide is used in children but should be used cautiously. The loop diuretics are used cautiously in patients with liver disease, diabetes, lupus erythematosus (may exacerbate or activate the disease), or diarrhea. Patients with

sensitivity to the sulfonamides may show allergic reactions to furosemide, torsemide, or bumetanide. Additive hypotensive effects occur when the loop diuretics are given with alcohol, other antihypertensive drugs, or nitrates. Loop diuretics may increase the effectiveness of the anticoagulants or the thrombolytics. There is an increased risk of glycoside toxicity and digitalis-induced arrhythmias if the patient experiences hypokalemia while taking the loop diuretics. Ototoxicity is more likely to occur if loop diuretics are given with the aminoglycosides. Plasma levels of propranolol may increase when the drug is administered with furosemide. There is an increased risk of lithium toxicity when lithium is administered with a loop diuretic. Hydantoins (phenytoin) may reduce the diuretic effects of furosemide. The effects of the loop diuretics may be decreased when they are administered with the NSAIDs.

### Osmotic Diuretics

The osmotic diuretics are contraindicated in patients with known hypersensitivity to the drugs, electrolyte imbalances, severe dehydration, or anuria and those who experience progressive renal damage after instituting therapy (mannitol). Mannitol is contraindicated in patients with active intracranial bleeding (except during craniotomy).

Osmotic diuretics are used cautiously in patients with renal or kidney impairment or electrolyte imbalances. The osmotic diuretics are Pregnancy Category B (isosorbide) and C (glycerin, mannitol, and urea) drugs and must be used cautiously during pregnancy and lactation. Additive hypotensive effects occur when the osmotic diuretics are given with other antihypertensive drugs or nitrates.

### Potassium-Sparing Diuretics

The potassium-sparing diuretics are contraindicated in patients with known hypersensitivity to the drugs, serious electrolyte imbalances, significant renal impairment, or anuria, and those receiving another potassium-sparing diuretic. The potassium-sparing diuretics are contraindicated in patients with hyperkalemia and are not recommended for children. The potassium-sparing diuretics are used cautiously in patients with renal or kidney impairment. The diuretics are Pregnancy Category B (amiloride, triamterene) and D (spironolactone) drugs and must be used cautiously during pregnancy and lactation. The potassium-sparing diuretics are used cautiously in patients with liver disease, diabetes, or gout.

Additive hypotensive effects occur when the potassium-sparing diuretics are given with alcohol, other

antihypertensive drugs, or nitrates. When the potassium-sparing diuretics are administered to patients taking angiotensin-converting enzyme (ACE) inhibitors (see Chap. 42), there is an increased risk for hyperkalemia. When the potassium-sparing diuretics are administered with potassium preparations, severe hyperkalemia may occur, possibly with cardiac arrhythmias or cardiac arrest. When spironolactone is administered with anticoagulant drugs or the NSAIDs, there is a decreased effectiveness of the anticoagulant or NSAID. When spironolactone or triamterene is administered with the ACE inhibitors, significant hyperkalemia may occur.

## Thiazides and Related Diuretics

The thiazide diuretics are contraindicated in patients with known hypersensitivity to the thiazides or related diuretics, electrolyte imbalances, renal decompensation, hepatic coma, or anuria. A cross-sensitivity reaction may occur with the thiazides and sulfonamides. Some of the thiazide diuretics contain tartrazine, which may cause allergic-type reactions or bronchial asthma in individuals sensitive to tartrazine.

All of the thiazide diuretics are Pregnancy Category B drugs, with the exception of bendroflumethiazide, benzthiazide, hydroflumethiazide, methyclothiazide, which are Pregnancy Category C drugs. The thiazide diuretics must be used cautiously during pregnancy and lactation. These drugs are used in children but should be used cautiously.

The thiazide diuretics are used cautiously in patients with liver or kidney disease, lupus erythematosus (may exacerbate or activate the disease), or diabetes. Additive hypotensive effects occur when the thiazides are given with alcohol, other antihypertensive drugs, or nitrates.

Concurrent use of the thiazides with allopurinol may increase the incidence of hypersensitivity to allopurinol. The effects of anesthetics may be increased by thiazide administration. The effects of anticoagulants may be diminished when they are administered with a thiazide diuretic. Because thiazide diuretics may raise blood uric acid levels, dosage adjustments of antigout drugs may be necessary. Thiazide diuretics may prolong antineoplastic-induced leukopenia. Hyperglycemia may occur when the thiazides are administered with the antidiabetic drugs. Synergistic effects may occur when the thiazide diuretics are administered concurrently with the loop diuretics, causing profound diuresis and serious electrolyte abnormalities. There is an increased risk of glycoside toxicity if the patient experiences hypokalemia while taking the thiazide diuretics.

## Herbal Alert: Diuretics

Numerous herbal diuretics are available as over-the-counter (OTC) products. Most plants and herbal extracts available as OTC diuretics are nontoxic. However, most are either ineffective or no more effective than caffeine. The following are selected herbals reported to possess diuretic activity: celery, chicory, saffrafras, juniper berries, St. John's wort, foxglove, horsetail, licorice, dandelion, digitalis purpurea, ephedra, hibiscus, parsley, and elderberry.

There is very little and in many instances no scientific evidence to justify the use of these plants as diuretics. For example, dandelion root is a popular preparation once thought to be a strong diuretic. However, scientific research has found dandelion root safe but ineffective as a diuretic. No herbal diuretic should be taken unless approved by the primary care provider.

Diuretic teas such as juniper berries and shave grass or horsetail are contraindicated. Juniper berries have been associated with renal damage, and horsetail contains severely toxic compounds. Teas with ephedrine should be avoided, especially by individuals with hypertension.

## NURSING PROCESS

### ● The Patient Receiving a Diuretic

#### ASSESSMENT

##### *Preadministration Assessment*

Before administering a diuretic, the nurse takes the vital signs and weighs the patient. Current laboratory tests, especially the levels of serum electrolytes, are carefully reviewed. If the patient has peripheral edema, the nurse inspects the involved areas and records in the patient's chart the degree and extent of edema. If the patient is receiving a carbonic anhydrase inhibitor for increased IOP, the patient's description of pain and vital signs are obtained. The preadministration physical assessment of the patient receiving a diuretic for epilepsy includes vital signs and weight. The nurse reviews the patient's chart for a description of the seizures and the frequency of their occurrence.

If the patient is to receive an osmotic diuretic, the focus of the assessment is on the patient's disease or disorder and the symptoms being treated. For example, if the patient has a low urinary output and the osmotic diuretic is given to increase urinary output, the nurse reviews the intake and output ratio and symptoms the patient is experiencing. In addition, the nurse weighs the patient and takes the vital signs as part of the physical assessment before starting drug therapy.

##### *Ongoing Assessment*

During initial therapy, the nurse observes the patient for the effects of drug therapy. The type of assessment will depend on factors such as the reason for the

### Nursing Diagnoses Checklist

- ✓ **Risk for Deficient Fluid Volume** related to excessive diuresis secondary to administration of a diuretic
- ✓ **Risk for Injury** related to adverse drug effects (light-headedness, dizziness)
- ✓ **Impaired Urinary Elimination: Increased Frequency** related to action of the diuretics

administration of the diuretic, the type of diuretic administered, the route of administration, and the condition of the patient. The nurse measures and records fluid intake and output and reports to the primary health care provider any marked decrease in the output. During ongoing therapy, the nurse weighs the patient at the same time daily, making certain that the patient is wearing the same amount or type of clothing. Depending on the specific diuretic, frequent serum electrolyte, uric acid, and liver and kidney function tests may be performed during the first few months of therapy and periodically thereafter.

### NURSING DIAGNOSES

Drug-specific nursing diagnoses are highlighted in the Nursing Diagnoses Checklist. Other nursing diagnoses applicable to these drugs are discussed in depth in Chapter 4.

### PLANNING

The expected outcomes for the patient depend on the reason for administration of the diuretic but may include an optimal response to drug therapy, management of adverse drug reactions, correction of a fluid volume deficit, absence of injury, and an understanding of and compliance with the postdischarge drug regimen.

### IMPLEMENTATION

#### *Promoting an Optimal Response to Therapy*

Before the first dose of a diuretic is given, the nurse explains to the patient the purpose of the drug (ie, to rid the body of excess fluid), when diuresis may be expected to occur, and how long diuresis will last (Table 46-1). These drugs are administered early in the day to prevent any nighttime sleep disturbance caused by increased urination. Some patients may exhibit anxiety related to the fact that it will be necessary to urinate at frequent intervals. To reduce anxiety, the nurse explains the purpose and effects of the drug. The nurse tells the patient that the need to urinate frequently will probably decrease. For some patients, the need to urinate frequently decreases after a few weeks of therapy. The nurse makes sure that the patient on bed rest has a call light and, when necessary, a bedpan or urinal within easy reach. The nurse informs the patient that the drug will be given early in the

TABLE 46-1

### Examples of Onset and Duration of Activity of Diuretics

DRUG	ONSET	DURATION OF ACTIVITY
acetazolamide tablets	1–1.5 h	8–12 h
sustained-release capsules	2 h	18–24 h
IV	2 min	4–5 h
amiloride	2 h	24 h
bumetanide	30–60 min	4–6 h
ethacrynic acid		
PO	Within 30 min	6–8 h
IV	Within 5 min	2 h
furosemide		
PO	Within 1 hr	6–8 h
IV	Within 5 min	2 h
mannitol (IV)	30–60 min	6–8 h
spironolactone	24–48 h	48–72 h
thiazides and related diuretics	1–2 h	Varies*
triamterene	2–4 h	12–16 h
urea (V)	30–45 min	5–6 h

\*Duration varies with drug used. Average duration is 12–24 h with polythiazide and chlorthalidone. Indapamide has a duration of more than 24 h.

day so nighttime sleep will not be interrupted. Although the duration of activity of most diuretics is about 8 hours or less, some diuretics have a longer activity, which may result in a need to urinate during nighttime hours. This is especially true early in therapy.

Diuretics are used to treat many different types of conditions. Therefore, promoting an optimal response to therapy for patients taking diuretics will often depend on the specific diuretic and the patient's condition.

**CARBONIC ANHYDRASE INHIBITORS.** If a carbonic anhydrase inhibitor is given for glaucoma, the nurse evaluates the patient's response to drug therapy (relief of eye pain) every 2 hours. The nurse notifies the primary health care provider immediately if eye pain increases or if it has not begun to decrease 3 to 4 hours after the first dose. If the patient has acute closed-angle glaucoma, the nurse checks the pupil of the affected eye every 2 hours for dilation and response to light. If the patient is ambulatory and has reduced vision because of glaucoma, the nurse may need to assist the patient with ambulatory and self-care activities.

### Nursing Alert

The nurse notifies the primary health care provider immediately if eye pain increases or if it has not begun to decrease 3 to 4 hours after the first dose. If the patient has acute closed-angle glaucoma, the nurse checks the pupil of the affected eye every 2 hours for dilation and response to light.



If a carbonic anhydrase inhibitor is being given for absence or nonlocalized epileptic seizures, the nurse assesses the patient at frequent intervals for the occurrence of seizures, especially early in therapy and in patients known to experience seizures at frequent intervals. If a seizure does occur, the nurse records a description of the seizure in the patient's chart, including time of onset and duration. Accurate descriptions of the pattern and the number of seizures occurring each day helps the primary health care provider plan future therapy and adjust drug dosages as needed.

**OSMOTIC DIURETICS.** Mannitol is administered only via the IV route. The nurse inspects the solution carefully before administration because, when exposed to low temperatures, mannitol solution may crystallize. If crystals are observed, the bottle is warmed in a hot water bath, a dry heat oven, or autoclave to dissolve the crystals. The solution must be cooled to body temperature or lower before administering. The rate of administration and concentration of the drug is individualized. The nurse must monitor the urine output hourly. The rate of administration is adjusted to maintain a urine flow of at least 30 to 50 mL/h.

When a patient is receiving the osmotic diuretic mannitol or urea for treatment of increased intracranial pressure caused by cerebral edema, the nurse monitors the blood pressure, pulse, and respiratory rate every 30 to 60 minutes or as ordered by the primary health care provider. The nurse immediately reports to the primary health care provider any increase in blood pressure, decrease in the pulse or respiratory rate, or any changes in the neurologic status. The nurse performs neurologic assessments (such as vital signs, response of the pupils to light, level of consciousness, or response to a painful stimulus) at the time intervals ordered by the primary health care provider. The nurse evaluates and records the patient's response to the drug, that is, the signs and symptoms that may indicate a decrease in intracranial pressure.

**POTASSIUM-SPARING DIURETICS.** Patients taking the potassium-sparing diuretics are at risk for hyperkalemia. Serum potassium levels are monitored frequently, particularly during initial treatment.

### Nursing Alert

*Symptoms of hyperkalemia include paresthesia (numbness, tingling, or prickling sensation), muscular weakness, fatigue, flaccid paralysis of the extremities, bradycardia, shock, and electrocardiographic (ECG) abnormalities (see Display 46-1 for additional symptoms).*

The drug is discontinued and the primary care provider is notified immediately if the patient experiences these symptoms or if the serum potassium levels

exceed 5.3 mEq/mL. Treatment includes administration of IV bicarbonate (if the patient is acidotic) or oral parenteral glucose with rapid-acting insulin. Persistent hyperkalemia may require dialysis.

**THIAZIDE AND RELATED DIURETICS.** When the thiazide diuretics are administered, renal function should be monitored periodically. These drugs may precipitate azotemia (accumulation of nitrogenous wastes in the blood). If nonprotein nitrogen (NPN) or blood urea nitrogen (BUN) rises, the primary care provider may consider withholding the drug or discontinuing its use. In addition, serum uric acid concentrations are monitored periodically during treatment with the thiazide diuretics because these drugs may precipitate an acute attack of gout. The patient also is monitored for any joint pain or discomfort. Because hyperglycemia may occur, insulin or oral antidiabetic drug dosages may require alterations. Serum glucose concentrations are monitored periodically.

**THE PATIENT WITH EDEMA.** Patients with edema caused by heart failure or other causes are weighed daily or as ordered by the primary health care provider. A daily weight is taken to monitor fluid loss. Weight loss of about 2 lb/d is desirable to prevent dehydration and electrolyte imbalances. The nurse carefully measures and records the fluid intake and output every 8 hours. The critically ill patient or the patient with renal disease may require more frequent measurements of urinary output. The nurse obtains the blood pressure, pulse, and respiratory rate every 4 hours or as ordered by the primary health care provider. An acutely ill patient may require more frequent monitoring of the vital signs.

The nurse examines areas of edema daily to evaluate the effectiveness of drug therapy and records the findings in the patient's chart. The nurse examines the patient's general appearance and condition daily or more often if the patient is acutely ill.

**THE PATIENT WITH HYPERTENSION.** The nurse monitors the blood pressure, pulse, and respiratory rate of patients with hypertension receiving a diuretic, or a diuretic along with an antihypertensive drug, before the administration of the drug. More frequent monitoring may be necessary if the patient is critically ill or the blood pressure excessively high.

### Monitoring and Managing Adverse Reactions

**ELECTROLYTE IMBALANCE.** The most common adverse reaction associated with the administration of a diuretic is the loss of fluid and electrolytes (see Display 46-1), especially during initial therapy with the drug. In some patients, the diuretic effect is moderate, whereas in others a large volume of fluid is lost. Regardless of the amount of fluid lost, there is always the possibility of excessive electrolyte loss, which is potentially serious.

### DISPLAY 46-1 • Signs and Symptoms of Common Fluid and Electrolyte Imbalances Associated With Diuretic Therapy

#### DEHYDRATION (EXCESSIVE WATER LOSS)

- Thirst
- Poor skin turgor
- Dry mucous membranes
- Weakness
- Dizziness
- Fever
- Low urine output

Sodium (normal laboratory values 132–145 mEq/L)

#### HYPONATREMIA (AN EXCESSIVE LOSS OF SODIUM)

- Cold, clammy skin
- Decreased skin turgor
- Confusion
- Hypotension
- Irritability
- Tachycardia

Magnesium (normal laboratory values 1.5–2.5 mEq/L or 1.8–3 mg/dL)

#### HYPOMAGNESEMIA (LOW LEVELS OF MAGNESIUM)

- Leg and foot cramps
- Hypertension
- Tachycardia
- Neuromuscular irritability
- Tremor
- Hyperactive deep tendon reflexes
- Confusion
- Visual or auditory hallucinations
- Paresthesias

Potassium (normal laboratory values 3.5–5 mEq/L)

#### HYPOKALEMIA (LOW BLOOD POTASSIUM)

- Anorexia
- Nausea
- Vomiting
- Depression
- Confusion
- Cardiac arrhythmias
- Impaired thought processes
- Drowsiness

#### HYPERKALEMIA (HIGH BLOOD POTASSIUM)

- Irritability
- Anxiety
- Confusion
- Nausea
- Diarrhea
- Cardiac arrhythmias
- Abdominal distress

The most common imbalances are a loss of potassium and water. Other electrolytes, namely magnesium, sodium, and chlorides, are also lost. When too much potassium is lost, **hypokalemia** (low blood potassium) occurs (see Home Care Checklist: Preventing Potassium Imbalances). In certain patients, such as those also receiving a digitalis glycoside or those who currently have a cardiac arrhythmia, hypokalemia has the potential to create a more serious arrhythmia. Hypokalemia is

treated with potassium supplements or foods with high potassium content or by changing the diuretic to a potassium-sparing diuretic. In addition to hypokalemia, patients taking the loop diuretics are prone to magnesium deficiency (see Display 46-1). If too much water is lost, **dehydration** occurs, which also can be serious, especially in elderly patients.

Whether a fluid or electrolyte imbalance occurs depends on the amount of fluid and electrolytes lost and the ability of the individual to replace them. For example, if a patient receiving a diuretic eats poorly and does not drink extra fluids, an electrolyte and water imbalance is likely to occur, especially during initial therapy with the drug. However, even when a patient drinks adequate amounts of fluid and eats a balanced diet, an electrolyte imbalance may still occur and require electrolyte replacement (see Chapter 58 and Display 58-2 for additional discussion of fluid and electrolyte imbalances).



#### Gerontologic Alert

*Older adults are particularly prone to fluid volume deficit and electrolyte imbalances (see Display 46-1) while taking a diuretic. The older adult is carefully monitored for hypokalemia (when taking the loop or thiazide diuretics) and hyperkalemia (with the potassium-sparing diuretics).*

To prevent a fluid volume deficit, the nurse encourages oral fluids at frequent intervals during waking hours. A balanced diet may help prevent electrolyte imbalances. The nurse encourages patients to eat and drink all food and fluids served at mealtime. The nurse encourages all patients, especially the elderly, to eat or drink between meals and in the evening (when allowed). The nurse monitors the fluid intake and output and notifies the primary health care provider if the patient fails to drink an adequate amount of fluid, if the urinary output is low, if the urine appears concentrated, if the patient appears dehydrated, or if signs and symptoms of an electrolyte imbalance are apparent.



#### Nursing Alert

*Warning signs of a fluid and electrolyte imbalance include dry mouth, thirst, weakness, lethargy, drowsiness, restlessness, muscle pains or cramps, confusion, gastrointestinal disturbances, hypotension, oliguria, tachycardia, and seizures.*

The nurse must closely observe patients receiving a potassium-sparing diuretic for signs of hyperkalemia (see Display 46-1), a serious and potentially fatal electrolyte imbalance. The patient is closely monitored for hypokalemia during loop or thiazide diuretic therapy. A supplemental potassium supplement may be prescribed to prevent hypokalemia. The primary health care provider may also encourage the patient to include



## Home Care Checklist

### PREVENTING POTASSIUM IMBALANCES

Diuretics increase the excretion of water and sodium. Some of these drugs also increase the excretion of potassium, which places your patient at risk for hypokalemia, a possibly life-threatening condition. So be sure your patient knows what foods to eat to replace the potassium lost. Teach about the following potassium-rich foods:



#### Meats

- Beef
- Chicken
- Pork
- Turkey
- Veal



#### Fish

- Flounder
- Haddock
- Halibut
- Salmon
- Sardines, canned
- Scallops
- Tuna



#### Fruits

- Apricots
- Bananas
- Dates
- Plums
- Raisins
- Fresh orange juice
- Tomato juice
- Oranges
- Dried fruit
- Cantaloupe
- Peaches
- Prunes
- Avocado



#### Vegetables

- Carrots
- Lima beans
- Potatoes
- Radishes
- Spinach
- Sweet potatoes
- Tomatoes



#### Other sources

- Gingersnaps
- Graham crackers
- Molasses
- Peanuts
- Peanut butter
- Coffee
- Tea
- Nuts

foods high in potassium in the daily diet. See Home Care Checklist: Preventing Potassium Imbalances for a listing of foods high in potassium. Sometimes a potassium-sparing diuretic is prescribed along with a thiazide diuretic to keep potassium levels within normal limits. If excessive electrolyte loss occurs, the primary care provider may reduce the dosage or withdraw the drug temporarily until the electrolyte imbalance is corrected.

**CARDIAC ARRHYTHMIAS AND DIZZINESS.** Patients receiving a diuretic (particularly a loop or thiazide diuretic) and a digitalis glycoside concurrently require frequent monitoring of the pulse rate and rhythm because of the possibility of cardiac arrhythmias. Any significant changes in the pulse rate and rhythm are immediately reported to the primary health care provider.

Some patients experience dizziness or light-headedness, especially during the first few days of therapy or when a rapid diuresis has occurred. Patients who are dizzy but are allowed out of bed are assisted by the nurse with ambulatory activities until these adverse drug effects disappear.

### **Educating the Patient and Family**

The patient and the family require a full explanation of the prescribed drug therapy, including when to take the drug (diuretics taken once a day are best taken early in the morning), if the drug is to be taken with food, and the importance of following the dosage schedule printed on the container label. The nurse also explains the onset and duration of the drug's diuretic effect. The patient and family must also be made aware of the signs and symptoms of fluid and electrolyte imbalances and adverse reactions that may occur when using a diuretic.

To ensure compliance with the prescribed drug regimen, the nurse stresses the importance of diuretic therapy in treating the patient's disorder. If the patient states that taking a diuretic at a specific time will be a problem, the nurse questions the patient in an attempt to identify the difficulty associated with drug therapy. Once a problem is identified, the nurse can identify solutions or make suggestions. The nurse includes the following points in a patient teaching plan:

- Do not stop taking the drug or omit doses, except on the advice of a primary health care provider.
- If gastrointestinal upset occurs, take the drug with food or milk.
- Take the drug early in the morning (once-a-day dosage) unless directed otherwise to minimize the effects on nighttime sleep. Twice-a-day dosing should be administered early in the morning (eg, 7:00 AM and early afternoon (eg, 2:00 PM) or as directed by the primary care provider. These drugs will initially cause an increase in urination, which should subside after a few weeks.
- Avoid alcohol and nonprescription drugs unless their use has been approved by the primary health care provider. Hypertensive patients should be careful to avoid medications that increase blood pressure, such as over-the-counter drugs for appetite suppression and cold symptoms.
- Notify the primary health care provider if any of the following should occur: muscle cramps or weakness, dizziness, nausea, vomiting, diarrhea, restlessness, excessive thirst, general weakness, rapid pulse, increased heart rate or pulse, or gastrointestinal distress.
- If dizziness or weakness occurs, observe caution while driving or performing hazardous tasks, rise slowly from a sitting or lying position, and avoid standing in one place for an extended time.
- Weigh yourself weekly or as recommended by the primary health care provider. Keep a record of these weekly weights and contact the primary health care provider if weight loss exceeds 3 to 5 lb a week.
- If foods or fluids high in potassium are recommended by the primary health care provider, eat the amount recommended. Do not exceed this amount or eliminate these foods from the diet for more than 1 day, except when told to do so by the primary health care provider (see Home Care Checklist: Preventing Potassium Imbalances).
- After a time, the diuretic effect of the drug may be minimal because most of the body's excess fluid has been removed. Continue therapy to prevent further accumulation of fluid.
- Thiazide and related diuretics, loop diuretics, potassium-sparing diuretics, carbonic anhydrase inhibitors, triamterene: Avoid exposure to sunlight or ultraviolet light (sunlamps, tanning beds) because exposure may cause exaggerated sunburn (photosensitivity reaction). Wear sunscreen and protective clothing until tolerance is determined.
- Loop and thiazide diuretics: patients with diabetes mellitus: Blood glucometer test results for glucose may be elevated (blood) or the urine positive for glucose. Contact the primary health care provider if results of home testing of blood glucose levels increase or if urine tests positive for glucose.
- Potassium-sparing diuretics: Avoid eating foods high in potassium and avoid the use of salt substitutes containing potassium. Read food labels carefully. Do not use a salt substitute unless a particular brand has been approved by the primary health care provider. Avoid the use of potassium supplements. Male patients taking spironolactone may experience gynecomastia. This is usually reversible when therapy is discontinued.
- Thiazide diuretics may cause gout attacks. Contact the primary care provider if significant, sudden joint pain occurs.

- Carbonic anhydrase inhibitors: During treatment for glaucoma, contact the primary health care provider immediately if eye pain is not relieved or if it increases. When a patient with epilepsy is being treated for seizures, a family member of the patient should keep a record of all seizures witnessed and bring this to the primary health care provider at the time of the next visit. Contact the primary health care provider immediately if the seizures increase in number.

### EVALUATION

- The therapeutic effect is achieved.
- Adverse reactions are identified, reported to the primary health care provider, and managed successfully through appropriate nursing interventions.
- Fluid volume deficit (if present) is corrected.
- No evidence of injury is seen.
- The patient verbalizes the importance of complying with the prescribed treatment regimen.
- The patient and family demonstrate an understanding of the drug regimen.

### ● Critical Thinking Exercises

1. Mr. Walsh, age 46 years, sees his primary health care provider and is prescribed a thiazide diuretic for hypertension. He tells you that it will be inconvenient for him to take his drug in the morning and he would prefer to take it at night. Other than asking him why taking the drug in the evening is more convenient, discuss what other questions you would ask Mr. Walsh. Analyze the situation to determine what explanation regarding present and future actions of this diuretic you would tell this patient.
2. Mr. Rodriguez, age 68 years, is taking amiloride for hypertension. He and his wife stopped by the clinic for a routine blood pressure check. Mrs. Rodriguez states that her husband has been confused and very irritable for the last 2 days. He complains of nausea and has had several “loose” stools. Discuss what actions you would take, giving a rationale for each action.
3. Ms. Palmer, age 88 years, is a resident in a nursing home. Her primary health care provider prescribes a thiazide diuretic for CHF. The nurse in charge advises you to evaluate Ms. Palmer for signs and symptoms of dehydration and hyponatremia. Discuss the assessment you would make. Identify which of these signs and symptoms might be difficult to evaluate considering the patient’s age.

### ● Review Questions

1. When evaluating the effectiveness of acetazolamide (Diamox) given for acute glaucoma, the nurse questions the patient about \_\_\_\_\_.
  - A. the amount of urine each time the patient voids
  - B. the relief of eye pain
  - C. the amount of fluid being taken
  - D. occipital headaches
2. When a patient taking mannitol for increased intracranial pressure is being assessed, which of the following findings would be most important for the nurse to report?
  - A. A serum potassium of 3.5 mEq/mL
  - B. Urine output of 20 mL for the last 2 hours
  - C. A blood pressure of 140/80 mm Hg
  - D. A heart rate of 72 bpm
3. When administering spironolactone (Aldactone), the nurse monitors the patient closely for which of the following electrolyte imbalances?
  - A. Hypernatremia
  - B. Hyponatremia
  - C. Hyperkalemia
  - D. Hypokalemia
4. When a diuretic is being administered for heart failure, which of the following would be most indicative of an effective response of diuretic therapy?
  - A. Output of 30 mL/h
  - B. Daily weight loss of 2 lb
  - C. An increase in blood pressure
  - D. Increasing edema of the lower extremities
5. Which electrolyte imbalance would the patient receiving a loop or thiazide diuretic most likely develop?
  - A. Hypernatremia
  - B. Hyponatremia
  - C. Hyperkalemia
  - D. Hypokalemia
6. Which of the following foods would the nurse most likely recommend the patient include in the daily diet to prevent hypokalemia?
  - A. Green beans
  - B. Apples
  - C. Bananas
  - D. Corn

### ● Medication Dosage Problems

1. The primary care provider prescribes spironolactone (Aldactone) 100 mg PO. The drug is available in 50-mg tablets. The nurse administers \_\_\_\_\_.
2. Furosemide (Lasix) 20 mg oral solution is prescribed. The oral solution is available in a concentration of 40 mg/5 mL. The nurse administers \_\_\_\_\_.