ASSISTING IN ENDOCRINOLOGY

SCENARIO

Miguel Vasco has been a certified medical assistant (CMA [AAMA]) for 10 years and has worked for the past 3 years with a multiphysician endocrinology and internal medicine practice. Although he has taken care of patients with many different disorders of the endocrine system, most of the practice's patients are individuals with diabetes mellitus type 2. One of Miguel's responsibilities is teaching patients newly diagnosed with diabetes how to monitor their blood glucose levels and maintain healthy lifestyles.

While studying this chapter, think about the following questions:

- What are the primary responsibilities of a medical assistant in an internal medicine practice?
- What clinical skills are required in this specialty practice?
- What common diseases and disorders of the endocrine system should medical assistants working in this field be able to discuss and explain?
- What diagnostic and treatment procedures typically are used in an endocrinology practice?
- What information should the medical assistant know regarding the management of diabetes and the possible complications associated with the disease?

LEARNING OBJECTIVES

1. Define, spell, and pronounce the terms listed in the vocabulary.
2. Apply critical thinking skills in performing the patient assessment and patient care.
3. Summarize the anatomy of the endocrine system.
4. Explain the mechanism of hormone action.
5. Differentiate among common endocrine disorders.
6. Describe the diagnostic criteria for diabetes mellitus.
7. Outline the treatment plan and management of diabetes mellitus.
8. Perform blood glucose screening with a glucometer.
9. Identify the characteristics of hyperglycemia and hypoglycemia.
10. Compare and contrast prediabetes, diabetes type 1, diabetes type 2, and gestational diabetes.
11. Categorize the complications associated with diabetes mellitus.
VOCABULARY

adrenocorticotropic hormone (ACTH) (uh-dren-o-cor-ti-kotro'-pik) A hormone that stimulates the production and secretion of glucocorticoids; it is released by the anterior pituitary gland.

follicle-stimulating hormone (FSH) A hormone secreted by the anterior pituitary; it stimulates oogenesis and spermatogenesis.

gluconeogenesis (gli-kul-ne-uh-jé'-nuy-suhs) The formation of glucose in the liver from proteins and fats.

glycogen The sugar (starch) formed from glucose; it is stored mainly in the liver.

glycosuria The abnormal presence of glucose in the urine.

growth hormone (GH) Also called somatotropic hormone; it stimulates tissue growth and restricts tissue glucose dependence when nutrients are not available.

luteinizing hormone (LH) (lu-te-uh-niz'-ing) A hormone produced by the anterior pituitary gland that promotes ovulation.

nocturia Excessive urination during the night.

polyphagia (pah-le-faj'-e-uh) Increased appetite.

prolactin (PRL) A hormone secreted by the anterior pituitary gland that stimulates the development of the mammary gland.

satiety The state of being satisfied or feeling full after eating.

specific gravity The density of urine compared with an equal volume of water.

thyroid-stimulating hormone (TSH) A hormone secreted by the anterior pituitary gland that stimulates the secretion of hormones produced by the thyroid gland.

Individuals with disorders of the endocrine system usually are seen first by the primary care physician (PCP), who may refer them to an internist or an endocrinologist for specialized care. Patients with certain endocrine disorders, such as diabetes mellitus (DM), also may be seen in a clinic for follow-up and treatment. A medical assistant employed in any of these ambulatory care settings assists with diagnostic procedures, specialized examinations, and patient education. It is important that medical assistants recognize the dynamics of endocrine system diseases so that they can help patients understand how to administer their medications and prevent long-term complications from the disease.

ANATOMY AND PHYSIOLOGY OF THE ENDOCRINE SYSTEM

Both the nervous system and the endocrine system control the body's physiologic responses to internal and external stimuli. The nervous system is electrical in nature and sends immediate messages along a nerve pathway to evoke a response; the endocrine system relies on the bloodstream to carry hormonal messages to a target cell for action. Through hormonal action, the endocrine system regulates all body functions. Endocrinology is the study of hormones, their receptor cells, and the results of hormone action.

The word part endo- means "in" or "within"; the suffix -crine means "secrete." The endocrine system consists of glands located throughout the body that produce and secrete chemicals known as hormones. Hormones are excreted directly into the bloodstream, which carries them to the target tissue. Hormones function as the body's chemical messengers, transferring information from one group of cells to another. Hormones control growth, mood, system functions, metabolism, sexual maturity, and reproduction. Hormone levels vary and can be affected by outside factors such as illness and stress.

Basic Anatomy

Glands are categorized as either exocrine or endocrine. Exocrine glands, such as sweat glands and salivary glands, secrete either through a duct or directly onto the surface of the skin or in the mouth. Endocrine glands release hormones directly into the bloodstream, which transports the hormones to target cells for action.

The glands of the endocrine system are the hypothalamus, pituitary, pineal gland, thyroid, parathyroids, thymus, and adrenals and the reproductive glands (i.e., the ovaries and testes) (Figure 45-1). Some nonendocrine organs, especially the pancreas, also can produce and release hormones. The hypothalamus, located in the inferior midportion of the brain, is the major connection between the nervous and endocrine systems. The hypothalamus controls the action of the pituitary, a pea-sized gland located below the hypothalamus. The pituitary often is called the
"master gland" because it secretes hormones that regulate multiple endocrine glands.

The pituitary gland is separated into two parts, the anterior and posterior lobes. The anterior pituitary, or adenohypophysis, regulates the functions of the thyroid, adrenals, and reproductive glands. It produces growth hormone (GH), thyroid-stimulating hormone (TSH), adrenocorticotropic hormone (ACTH), prolactin (PRL), follicle-stimulating hormone (FSH), and luteinizing hormone (LH). The posterior lobe of the pituitary, or neurohypophysis, secretes oxytocin, which stimulates the contractions of the smooth muscle of the uterus that occur during labor and the flow of breast milk toward the nipple when an infant breast-feeds. The posterior pituitary also produces antidiuretic hormone (ADH), which helps control fluid balance by acting on the kidneys to reabsorb fluid as needed to maintain homeostasis (Figure 45-2).

The pineal gland, which is located deep within the brain, secretes the hormone melatonin. Melatonin helps regulate waking and sleeping patterns and also may affect seasonal reactions to alterations in the availability of sunlight.

When stimulated by TSH, the thyroid gland produces the thyroid hormones triiodothyronine (T₃) and thyroxine (T₄), which control the body's metabolic rate and are important factors in bone growth and nervous system development in children. On the dorsal aspect of the thyroid gland are several small parathyroid glands, which release hormones (parathyroid and calcitonin) that regulate the level of calcium in the blood. The parathyroid hormone (PTH) maintains a constant concentration of calcium in the body by regulating the absorption of calcium from the gastrointestinal tract and stimulating the reabsorption of calcium stored in the bone as needed to maintain homeostasis. Calcitonin stimulates deposition of calcium into the bone when excess amounts of calcium are available.

The thymus gland, located behind the upper portion of the sternum, produces hormones that stimulate the production of specialized immune system cells called T cells. The thymus gland is present at birth, enlarges as the child ages, but begins to atrophy as the child reaches puberty. It once was thought that the thymus played no role in the physiology of adults, but we now know that its hormone action is crucial to T-cell maturation. (T cells are discussed in further detail in Chapter 54.)

On top of each kidney are the adrenal glands, which are triangular-shaped glands consisting of an outer layer, called the adrenal cortex, and an inner body, called the adrenal medulla. The adrenal cortex secretes corticosteroid hormones, including cortisol, aldosterone, and adrenal androgens, all of which influence a wide range of bodily functions. The adrenal medulla produces epinephrine, also called adrenaline, which activates the body's reaction to stress.

The gonads produce sex hormones. The male gonads are the testes; they secrete testosterone, which regulates the development of secondary sexual characteristics, such as voice changes and the
growth of facial and pubic hair, and promotes the production of sperm. The female gonads, the ovaries, produce eggs or ova (oogenesis) and secrete estrogen and progesterone. The female hormones control the development of breast tissue and other secondary sexual characteristics, regulate menstruation, and play important roles during pregnancy.

The pancreas performs essential endocrine functions by producing insulin and glucagon, which work together to maintain normal blood glucose levels and store glucose for energy.

**CRITICAL THINKING APPLICATION 45-1**

Miguel is asked to order educational supplies for patients with endocrine system disorders. Because he thinks it is important for patients to understand their health problems, he wants to order a brochure that clearly depicts and describes the anatomy of the endocrine system. What glands and organs should be included in the brochure?

### Mechanisms of Hormone Action

The goal of hormone regulation is to maintain homeostasis. Hormone secretion is regulated by a number of mechanisms, including nervous stimulation, endocrine control (a hormone from one gland, such as the anterior pituitary, stimulates the release of a hormone from another gland), and feedback systems. An example of nervous system regulation of endocrine function is the release of adrenaline from the adrenal medulla in response to stimulation from the sympathetic nervous system during a stressful episode. In the most common feedback system, negative feedback, an endocrine gland is activated by an imbalance and acts to correct the imbalance by stopping the secretion process. For example, if calcium blood levels fall below normal, the parathyroid glands are stimulated to release PTH. PTH acts to increase blood calcium levels either by stimulating the absorption of calcium from the gut or by demineralizing bone to release stored calcium. This change in the blood calcium level is detected by the parathyroid gland, which then stops production of PTH.

Each hormone released into the bloodstream has particular target cells for action. The target cells have receptors that attract only specific hormones and permit the hormone to pass through the cell membrane and affect cellular action.

### Diseases and Disorders of the Endocrine System

Faulty secretion of any hormone, whether too much or too little, can cause health problems for patients. The goal of treatment is either to control the hypersecretion of hormones or to replace hormones that are not being secreted at therapeutic levels.

#### Diabetes Insipidus

When ADH (vasopressin) is not produced or released in sufficient amounts, the patient develops a condition called diabetes insipidus. ADH increases the permeability of the renal tubules and the collecting tubules in the kidneys, permitting fluid to be reabsorbed and causing the urine to become more concentrated. Without the action of ADH, fluid is not reabsorbed from the renal tubules, which causes a large amount of fluid to be excreted in the urine, with the potential onset of dehydration. A lack of ADH results from a tumor either in the hypothalamus or the posterior pituitary gland, or diabetes insipidus may develop because of an inadequate response to ADH in the renal tubules.

Diabetes insipidus usually has an acute onset, and the patient presents with polyuria, polydipsia, nocturia, low urine specific gravity, and high blood plasma osmolality (concentration). It can result in fatal dehydration if fluid and electrolyte levels cannot be controlled. Replacement therapy with a synthetic vasopressin (desmopressin) nasal spray, oral tablets, or injections can be used to treat the disorder.
Disorders of the Thyroid

**Hypothyroidism**
Deficient secretion of the thyroid hormones may result from a number of factors. One cause of hypothyroidism is endemic iodine deficiency, a lack of iodine in the diet, resulting in the formation of a simple goiter. A *simple goiter* is any thyroid enlargement that has not been caused by an infection or neoplasm. Endemic goiters occur in certain geographic areas. If more than 10% of the children 6 to 12 years of age in a particular area have goiters, that geographic location is defined as endemic for goiters.

T$_3$ and T$_4$ are produced in the thyroid gland from iodine and are responsible for the regulation of metabolic activities in all body cells. When the thyroid gland is unable to obtain sufficient amounts of iodine from the circulating blood, it enlarges, or hypertrophies, in an attempt to produce the hormones needed by the body. A decreased amount of thyroid hormones results in a lower metabolic rate, heat loss, and poor mental and physical development. Iodine deficiency is rare in the United States because of the widespread use of iodized table salt and the distribution of foods from iodine-rich areas. The treatment for a simple goiter is to reduce its size by prescribing dietary supplements of iodine, thyroid hormone replacement, or surgery.

Improper development of the thyroid in an infant or young child usually is congenital. The absence of adequate levels of thyroid hormones results in a condition known as *cretinism*. Newborns have feeding problems, constipation, and a hoarse cry and sleep for extreme lengths of time. Symptoms include lethargy, bradycardia, stunted skeletal growth, and varying degrees of mental retardation, depending on the severity and the length of the hypothyroidism.

When severe or chronic hypothyroidism occurs in an adult or older child, the condition is called *myxedema*. The patient shows fatigue, weight gain, hair loss, a slower pulse rate, a lowered body temperature, muscle cramps, menorrhagia, and thick, dry, puffy
Disorders of the Adrenal Glands

Adrenal insufficiency is called Addison's disease. This condition is relatively rare and is caused by an autoimmune reaction that affects the adrenal cortex, which secretes corticosteroid hormones. Symptoms include hypoglycemia, increased pigmentation of the skin, muscle weakness, gastrointestinal disturbances, and fatigue. Cortisol and aldosterone deficiencies lead to retention of potassium and the excretion of water and sodium in the urine. Severe dehydration, low blood volume, low blood pressure, and circulatory shock can occur. Treatment includes replacement of cortisol with the long-term daily administration of glucocorticoids (e.g., prednisone) and replacement of aldosterone with fludrocortisone (Florinef) to control sodium and potassium levels and help maintain normal blood pressure levels. Patients should also be encouraged to eat a diet high in complex carbohydrates and protein and to maintain an adequate fluid intake. Patients with Addison's disease are at risk for Addisonian crisis, a life-threatening drop in blood pressure, hypoglycemia, and high blood potassium levels. A crisis can be brought on by stressful situations, infections, minor illness, or surgery. Treatment requires immediate administration of an intravenous saline and dextrose solution with corticosteroids.

Hypersecretion of the adrenal cortex, causing increased levels of cortisol, is known as Cushing's syndrome. Usually a benign pituitary tumor causes the release of excessive amounts of ACTH. Symptoms associated with Cushing's syndrome may be seen in individuals taking corticosteroids for medical reasons, such as organ transplantation, severe asthma, or rheumatoid arthritis. Excessive levels of cortisol cause an accumulation of adipose tissue in the trunk, a round, or "moon," face, and fat pads in the cervical spine region, causing the formation of a "buffalo hump" (Figure 45-5). The patient also has glucose intolerance because of insulin resistance at the target cell level.

Additional symptoms include hyperpigmentation, muscle wasting, problems with wound healing, hypertension, kidney stones, and osteoporosis. Female patients have menstrual irregularity, and many patients with Cushing's syndrome experience

**CRITICAL THINKING APPLICATION 45-3**

One of the internists, Dr. Misha, asks Miguel if he can describe the signs and symptoms of a patient with hypothyroidism or hyperthyroidism. Summarize Miguel's answer.
mental disorders such as irritability, depression, or severe psychiatric disorders. Treatment depends on the cause of the disorder; it includes medication to control cortisol levels, radiation therapy to reduce the size of the tumor, and surgery to remove the tumor.

**Endocrine Dysfunction of the Pancreas: Diabetes Mellitus**

Diabetes mellitus is a common hormonal imbalance that has reached epidemic proportions in the United States. Approximately 24 million Americans, or close to 8% of the population, have DM, and the number is growing. Diabetes occurs in people of all ages and races but is more common in older adults (23% of individuals over age 60) and in African-Americans, Latinos, Native Americans, and Asian-Americans/Pacific Islanders. DM is characterized by chronic hyperglycemia and problems with carbohydrate metabolism. This problem with glucose management is caused by a lack of insulin production and/or resistance to insulin at the target cell level. The pancreas contains islets of Langerhans, which produce and secrete the hormones insulin and glucagon. When the blood glucose level is too high, beta islet cells secrete insulin, which is sent through the bloodstream to the target tissue site to conduct glucose into the cell. When blood glucose levels are low, glucagon is secreted by the alpha islet cells to stimulate the liver to convert glycogen (stored glucose) into circulating glucose.

If there is resistance to insulin at the target cell membrane or if not enough insulin is available to help transport glucose from the blood into the cells, the person experiences a variety of symptoms, including glycosuria, polyuria, polydipsia, polyphagia, rapid weight loss, drowsiness, fatigue, itching of the skin, visual disturbances, and skin infections. The American Diabetes Association has identified four major types of diabetes: prediabetes, DM type 1, DM type 2, and gestational diabetes. If left untreated or managed poorly, DM can have serious, life-threatening consequences, such as cardiovascular disease, stroke, hypertension, blindness, kidney disease, nervous system disorders, amputations, pregnancy complications, and diabetic coma. Patient education is crucial for compliance with treatment and prevention of life-threatening complications.

**DIAGNOSTIC CRITERIA FOR DIABETES MELLITUS**

- **Plasma glucose level ≥ 200 mg/dL (norm is 80 to 120 mg/dL)** with the classic symptoms of polyuria, polydipsia, and unexplained weight loss
- **Fasting plasma glucose level ≥126 mg/dL (norm is 70 to 110 mg/dL)** on more than one occasion
- **Two-hour oral glucose tolerance test (OGTT) result ≥ 200 mg/dL**
- **Urinalysis positive for glucose and possibly ketones**
- **Glycosylated hemoglobin > 7% (normal is 4% to 6%)**

**Prediabetes**

Prediabetes is a condition in which a person's blood glucose level is higher than normal but not high enough for a diagnosis of diabetes type 2. It is estimated that 54 million adults in the United States have prediabetes. Some of the long-term damage to vascular and cardiac systems may be occurring during prediabetes. Studies indicate that most individuals with prediabetes develop diabetes type 2 within 10 years. However, if patients lower their blood glucose levels, they can delay or prevent its onset. Experts recommend that patients with prediabetes lose 5% to 10% of their weight and perform moderate physical activity for 30 to 60 minutes daily. A loss of just 10 to 20 pounds can make a huge difference in blood glucose levels.

Two tests are used to diagnose prediabetes: the fasting plasma glucose (FPG) test and the oral glucose tolerance test (OGTT). A person with prediabetes has a fasting blood glucose level between 100 and 125 mg/dL, and individuals with fasting plasma glucose (FPG) level of 126 mg/dL or higher are diagnosed as diabetic. A person with prediabetes has a 2-hour OGTT of 140 to 199 mg/dL, and diabetes is diagnosed if the OGTT is 200 mg/dL or higher.

**Type 1 Diabetes**

Diabetes type 1 most often develops in children and young adults. This disease previously was known as either juvenile-onset diabetes or insulin-dependent diabetes. In DM type 1 the pancreas is unable to produce insulin because of the destruction of the beta islet cells from autoimmune, genetic, or environmental factors. DM type 1 affects 5% to 10% of patients with diabetes, and it typically has an acute onset. Treatment of diabetes type 1 requires insulin administration. The goal for insulin therapy is to maintain blood glucose levels as close to normal as possible without causing hypoglycemia. Many types and brands of insulin are available, but to prevent allergic reactions, only genetically engineered human insulin should be used. At this time, the only method of insulin administration is injection, because gastrointestinal processes destroy insulin if it is given by mouth. However, multiple studies are underway on buccal, inhaled, and patch forms of the hormone. An inhaled form of insulin has been released but is no longer available because of concerns that the drug is associated with decreased pulmonary function. (Subcutaneous administration of insulin was presented in Chapter 35.)

The medical assistant usually is involved in teaching patients how to administer their insulin accurately. Table 45-1 summarizes the various types of insulin. Although insulin should be stored in the refrigerator, injecting the cold solution may be painful for the patient, and patients who must travel with insulin doses need to understand correct storage procedures. The physician may recommend that the patient store the bottle currently in use at room temperature. Depending on the type of insulin, it can be stored safely at room temperatures for 7 to 28 days. For example, Humalog and Regular insulins can be stored at room temperature for 28 days, whereas NPH and premixed solutions containing NPH can be stored this way only for 7 to 14 days. Extreme temperatures can damage the drug, so it should not be frozen, left in the sunlight, or carried in the glove compartment of a car. Therefore, temperatures below 59°F (15°C) or above 86°F (30°C) must be avoided.

Successful treatment of DM type 1 involves a complicated combination of insulin injections, in which various types of insulin are given in multiple injections (typically four) throughout the day. (See Procedure 35-9 for the steps for dispensing
and mixing two different types of insulin in one syringe.) The insulin type and dosage are balanced by the patient’s typical exercise regimen and diet (the diabetic diet was discussed in Chapter 30). The patient must monitor blood glucose levels with a glucometer periodically throughout the day to determine whether the levels are within the normal range. The physician typically prescribes glucometer testing in the morning before breakfast, before dinner, and possibly before lunch and at bedtime if the patient is having difficulty keeping blood plasma levels stabilized. An important responsibility of the medical assistant is to teach the patient how to perform glucometer screening (Procedure 45-1).

**ALTERNATIVE METHODS OF INSULIN ADMINISTRATION**

- **Insulin pump**: An insulin pump is a computerized device that administers a constant dose of insulin using a small portable pump. The pump is programmed to deliver a measured dose of insulin by continuous subcutaneous infusion through a catheter, which is placed in the abdomen or buttocks area. This method more closely resembles the body’s normal surge of insulin and is designed to maintain blood glucose levels consistently within normal limits.

- **Injector pen**: Injector pens are preloaded with insulin cartridges for easy use (Figure 45-6). Insulin pens are disposable or refillable and are easily portable and therefore can be used by patients with diabetes when they are away from home.

Glucometers are palm sized and use very small amounts of capillary blood from a site in the finger, forearm, upper arm, or abdomen (Figure 45-7). Many different types of glucometers are available, but all display test results within seconds, and the results are stored in the memory function of the machine for future reference. The medical assistant should stress that the accuracy of blood glucose results depends on following the instructions for the particular type of glucometer used by the patient. When teaching the patient about glucometer screening, the medical assistant must use the same machine the patient will use at home and must stress the importance of keeping a record of glucometer readings to determine long-term serum glucose control. Patients should be encouraged to bring their

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**TABLE 45-1 Types and Characteristics of Insulin**

<table>
<thead>
<tr>
<th>TYPE</th>
<th>ONSET OF ACTION</th>
<th>PEAK ACTION</th>
<th>EFFECTIVE DURATION</th>
<th>APPEARANCE</th>
<th>COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Rapid Acting</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Humalog (Lispro), NovoLog (Aspart)</td>
<td>10-15 min</td>
<td>1-2 hr</td>
<td>2-5 hr</td>
<td>Clear</td>
<td>Take just before or just after eating</td>
</tr>
<tr>
<td><strong>Short Acting</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Regular (Novolin R, Humulin R)</td>
<td>30-60 min</td>
<td>2-4 hr</td>
<td>3-5 hr</td>
<td>Clear</td>
<td>Take 30 min before meal</td>
</tr>
<tr>
<td><strong>Intermediate Acting</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NPH (Novolin N, Humulin N)</td>
<td>2-4 hr</td>
<td>4-10 hr</td>
<td>10-16 hr</td>
<td>Cloudy</td>
<td>Take at bedtime to minimize nighttime hypoglycemia</td>
</tr>
<tr>
<td>Lente (Novolin, Humulin L)</td>
<td>3-4 hr</td>
<td>4-12 hr</td>
<td>12-18 hr</td>
<td>Clear</td>
<td></td>
</tr>
<tr>
<td><strong>Long Acting</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ultralente</td>
<td>6-10 hr</td>
<td>Minimal peak</td>
<td>18-20 hr</td>
<td>Clear</td>
<td></td>
</tr>
<tr>
<td>Glargine (Lantus)</td>
<td>4-6 hr</td>
<td>Peakless</td>
<td>24 hr</td>
<td>Clear</td>
<td>Do not mix with other insulins</td>
</tr>
<tr>
<td><strong>Premixed</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Humulin, Novolin 70:30 (70% NPH, 30% Regular)</td>
<td>30-60 min</td>
<td>2-10 hr</td>
<td>10-16 hr</td>
<td>Cloudy</td>
<td></td>
</tr>
</tbody>
</table>

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**FIGURE 45-6** Novo Pen.

**FIGURE 45-7** Capillary puncture sites on the fingers.
glucometers with them to each office visit so that the physician can review the glucose levels.

The patient education intervention should include not only the steps for successfully checking blood glucose levels but also quality-control mechanisms as suggested by the manufacturer of the device (Figure 45-8). Some examples of quality controls include the following:

- Follow the manufacturer’s instructions exactly.
- Perform the instrument maintenance specified by the manufacturer, including correct cleaning and storage of the instrument.
- Check the expiration dates on test strips and solutions and store these products correctly.
- Match and correctly enter the test strip code into the instrument before use.
- Contact the physician if test results do not match the person’s symptoms.

Patients with diabetes also need to find the best method of disposing of their syringes and lancets. Local pharmacies or hospitals may offer assistance with disposal of used sharps. If the patient does not have access to a sharps return program, a

![Figure 45-8 Blood glucose monitoring device (TrueTrack Smart System).](Courtesy TrueTrack Smart System © by Home Diagnostics, Inc., Fort Lauderdale, Florida.)

**PROCEDURE 45-1**

**Assist the Physician with Patient Care: Perform a Blood Glucose Accu-Chek Test**

**GOAL:** To perform a blood test for diabetes mellitus accurately.

**EQUIPMENT and SUPPLIES**

- Accu-Chek glucose monitor or similar glucose monitoring device
- Accu-Chek glucose testing strip
- Lancet and autoloading finger-puncturing device
- Alcohol preps
- Gauze squares
- Sharps container
- Disposable gloves
- Patient’s record

**PROCEDURAL STEPS**

1. Check the physician’s order and collect the necessary equipment and supplies. Perform quality control measures according to the manufacturer’s guidelines and office policy.
2. Sanitize your hands and put on gloves.
   **PURPOSE:** To ensure infection control.
3. Ask the patient to wash his or her hands in warm soapy water and then rinse them in warm water and dry them completely.
   **PURPOSE:** To clean the area that will be punctured; also, warming the fingers may increase peripheral blood flow.
4. Check the patient’s index and ring fingers and select the site for puncture.
   **PURPOSE:** To make sure the site of puncture is free of trauma.
5. Turn on the Accu-Chek monitor by pressing the ON button (Figure 1).
6. Make sure the code number on the LED display matches the code number on the container of test strips.

**PURPOSE:** If the code numbers do not match, the device must be reprogrammed with the new code for the test results to be valid.
7. Remove a test strip from the vial and immediately replace the vial cover.

**PURPOSE:** The vial must be kept closed to protect unused strips from possible contamination and decomposition from light exposure.

![Figure 1](From Stepp CA, Woods MA: Laboratory procedures for medical office personnel, Philadelphia, 1990, Saunders.)
8. Check the strip for discoloration by comparing the color of the round window on the back of the test strip with the designated “unused” color chart provided on the label of the test strip vial.  
**PURPOSE:** To establish the validity of the testing procedure.

9. Do not touch the yellow test pad or round window on the back of the strip when handling the strip.

10. When the test strip symbol begins flashing in the lower right corner of the display screen, insert the test strip into the designated testing slot until it locks into place. If the test strip has been inserted correctly, the arrows on the test strip will face up and point toward the monitor (Figure 2).

11. Cleanse the selected site on the patient’s fingertip with the alcohol wipe and allow the finger to air dry.

12. Perform the finger puncture and wipe away the first drop of blood.  
**PURPOSE:** Tissue fluid may be present in the first drop of blood.

13. Apply a large, hanging drop of blood to the center of the yellow testing pad (Figure 3).

- Do not touch the pad with the patient’s finger.
- Do not apply a second drop of blood.
- Do not smear the blood with your finger.
- Make sure the yellow test pad is saturated with blood.

14. Give the patient a gauze square to hold securely over the puncture site.

15. The monitor automatically begins the measurement process as soon as it senses the drop of blood.

16. The test result will be shown in the display window in milligrams per deciliter (mg/dL).

17. Turn off the monitor by pressing the O button.

18. Discard all biohazard waste in the proper waste containers.  
**PURPOSE:** To ensure infection control.

19. Clean the glucometer according to the manufacturer’s guidelines, disinfect the work area, remove your gloves and dispose of them properly, and sanitize your hands.

20. Record the test results in the patient’s medical record.  
**PURPOSE:** A procedure is considered not done until it is recorded.

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**Type 2 Diabetes**

DM type 2, once called adult-onset or non-insulin-dependent diabetes, usually develops in adults but may be seen at any age. Factors that increase the risk of developing DM type 2 include a family history, a history of gestational diabetes, impaired glucose tolerance, physical inactivity, and obesity. In this type of DM, the pancreas produces insulin, but not enough, and/or the target cells are resistant to insulin action. Diabetes type 2 is responsible for 90% to 95% of cases of diabetes mellitus.

This form of diabetes frequently goes undetected for many years because of the gradual onset of hyperglycemia and the absence of classic diabetic symptoms. However, because of this insidious onset over time, patients with diabetes type 2 are at even greater risk of developing vascular complications. Insulin resistance at the target cell level may improve with weight reduction and/or pharmacologic treatment.

Treatment for diabetes type 2 includes weight loss, exercise, dietary restrictions, and oral hypoglycemic medications that act to stimulate insulin production and/or improve tissue response to insulin (Table 45-2). Medications for diabetes type 2 have multiple functions, including stimulating insulin secretion from
TABLE 45-2 Oral Hypoglycemics Used in the Treatment of Diabetes Type 2

<table>
<thead>
<tr>
<th>MEDICATION</th>
<th>CLASSIFICATION</th>
<th>ACTION</th>
<th>SIDE EFFECTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ornase, Tolnase, Diabenase</td>
<td>Sulfonylureas, first generation</td>
<td>Increase insulin production</td>
<td>Hypoglycemia, weight gain</td>
</tr>
<tr>
<td>Micronase, Glucotrol, Amaryl</td>
<td>Sulfonylureas, second generation</td>
<td>Increase insulin production</td>
<td>Hypoglycemia, weight gain</td>
</tr>
<tr>
<td>Prandin</td>
<td>Meglitinide</td>
<td>Increase insulin release from the pancreas</td>
<td>Hypoglycemia, weight gain</td>
</tr>
<tr>
<td>Metformin (Fortamet, Glucophage)</td>
<td>Biguanide</td>
<td>Reduce hepatic glucose production; slightly increase muscle glucose uptake</td>
<td>Nausea, diarrhea, metallic taste</td>
</tr>
<tr>
<td>Avandia</td>
<td>Thiazolidinediones</td>
<td>Reduce insulin resistance; increase glucose uptake; fat redistribution; reduce vascular inflammation; preserve beta cells in the pancreas</td>
<td>Minor weight increase; edema</td>
</tr>
<tr>
<td>Precose, Glyset</td>
<td>Alpha-glucosidase inhibitor</td>
<td>Slows absorption of complex carbohydrates</td>
<td>Gas and bloating, diarrhea</td>
</tr>
<tr>
<td>Glucovance (Micronase and Glucophage)</td>
<td>Sulfonlurea and biguanide</td>
<td>Reduce hepatic glucose production and increase insulin secretion</td>
<td>Hypoglycemia, weight gain</td>
</tr>
<tr>
<td>Avandamet (Avandia and Glucophage)</td>
<td>Thiazolidinedione and biguanide</td>
<td>Reduce hepatic glucose production; increase glucose uptake; reduce insulin resistance; preserve beta cells</td>
<td>Edema</td>
</tr>
</tbody>
</table>


pancreatic islet cells in patients with some pancreatic function; reducing insulin resistance at the cellular level; improving sensitivity to insulin in muscle and adipose tissue; and inhibiting hepatic gluconeogenesis.

As with diabetes type 1, the goal of treatment is to maintain blood glucose levels within the normal range. For some patients, exercise, diet, and weight loss are sufficient to control blood glucose levels. Sometimes just the loss of 10 to 20 pounds is enough to bring blood glucose levels under control. Other patients may need medication to maintain normal blood glucose levels; however, levels must be monitored daily with a glucometer to determine the success of treatment. Over time, the individual with diabetes type 2 may require insulin to control hyperglycemia.

CRITICAL THINKING APPLICATION 45-4
Carlos Vespa, a 47-year-old patient, recently was diagnosed with DM type 2. He has a BMI of 32; eats a high-fat, high-carbohydrate diet; and does not exercise. What health issues should Miguel include in his patient teaching intervention? Mr. Vespa tells Miguel he cannot afford the medication prescribed by the physician or the glucometer needed to monitor his blood glucose levels. Is there anything Miguel can do to help him with these issues?

Gestational Diabetes
A pregnant woman is diagnosed as having gestational diabetes if she meets any two of the following criteria:
- A fasting blood sugar (FBS) higher than 105 mg/dL
- During a 100-g OGGT: a 1-hour glucose level of 180 mg/dL or higher; a 2-hour glucose level of 155 mg/dL or higher; or a 3-hour glucose level of 140 mg/dL or higher.

Gestational diabetes affects about 4% of pregnant women in the United States each year, and it is considered a risk factor for the development of DM type 2 later in life. Factors that increase the risk of gestational diabetes are obesity; maternal age over 40; history of delivering infants who weigh more than 10 pounds at birth; a family history of diabetes; previous, unexplained stillbirth; previous birth with congenital anomalies; smoking; and belonging to certain ethnic groups, including Hispanics, Native Americans, Asian-Americans, and African-Americans. Some women are asymptomatic, whereas others show classic symptoms of diabetes. Because many pregnant women have gestational diabetes without obvious symptoms, all pregnant women are routinely screened between 24 and 28 weeks of pregnancy.

Gestational diabetes is precipitated by a buildup of insulin resistance at the cellular level, resulting in hyperglycemia. The elevated glucose in the mother’s blood passes through the

INJECTABLE DRUGS FOR THE MANAGEMENT OF DIABETES MELLITUS TYPES 1 AND 2
- Pramlintide (Symlin) is a synthetic form of the hormone amylin that works with insulin and glucagon to maintain normal blood glucose levels. Injections administered before meals help improve A1C levels by reducing the rate at which food moves through the stomach, thereby preventing a sharp increase in blood plasma levels after meals. The drug has been approved for people with diabetes type 1 who are not achieving the recommended A1C levels and for those with diabetes type 2 who are using insulin but not achieving A1C goals. The drug improves satiety, reduces caloric intake, and may assist with weight loss.
- Exenatide (Byetta) lowers blood glucose levels by increasing insulin secretion. It is injected 60 minutes before breakfast and dinner. The drug helps patients achieve modest weight loss and improved glycemic control. It is not for use by patients with diabetes type 1.
TABLE 45-3 Characteristics of Hyperglycemia and Hypoglycemia

<table>
<thead>
<tr>
<th>DISEASE</th>
<th>CAUSES</th>
<th>ONSET</th>
<th>SIGNS AND SYMPTOMS</th>
<th>TREATMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hyperglycemia (high serum glucose level)</td>
<td>Too little insulin; body not able to use insulin properly; excessive caloric intake; inadequate exercise; illness; stress</td>
<td>Rapid</td>
<td>Polyphagia, polyuria, glycosuria, ketonuria, weight loss, pruritus; possible ketoacidosis with shortness of breath, “fruity” breath, dry mouth, nausea and vomiting, lethargy</td>
<td>Exercise if blood glucose level &lt; 240 mg/dL. Reduce caloric intake. Physician may alter amount and timing of insulin.</td>
</tr>
<tr>
<td>Hypoglycemia (low serum glucose level)</td>
<td>Too much insulin; insufficient calories; excessive exercise; individual with diabetes type 2 using insulin-boosting medications</td>
<td>Slow</td>
<td>Shakiness, vertigo, palpitations, diaphoresis, headache, hunger, pellor, fatigue, confusion, irritability, poor judgment, visual disturbances, seizures, coma</td>
<td>Ingest sugar (glucose tablets recommended); monitor blood levels in 15 min. If still low and symptoms persist, take another glucose tablet. If patient passes out, physician may order injected glucagon; call for emergency services.</td>
</tr>
</tbody>
</table>

placenta into the baby, causing hyperglycemia with increased insulin production in the fetus. The extra carbohydrate energy is stored in the infant as fat and may result in a macrosomic, or “fat” baby who is at higher risk for breathing problems at birth, obesity, and diabetes type 2.

The treatment goal for gestational diabetes is to keep plasma glucose levels equal to those of pregnant women without the disorder. The treatment plan always includes diabetic diet counseling and regular physical activity. In obese women, a 30% calorie reduction reduces hyperglycemia. Some women may require insulin to maintain blood glucose levels within the therapeutic range and thereby reduce the possibility of fetal complications. Most women return to normal blood glucose levels after the baby is born; however, two out of three women experience gestational diabetes in future pregnancies. Because these women are at greater risk of developing diabetes type 2 later in life, patient education should stress the following:
- The patient should try to lose weight; if she is unable to reach a normal body mass index (BMI), losing 5% to 7% of her current body weight will make a big difference.
- The patient should exercise a minimum of 30 minutes a day.
- She should reduce her fat and calorie intake and increase her consumption of whole grains, complex carbohydrates, fruits, and vegetables.

Complications of Diabetes Mellitus:

Acute Complications. Two acute complications can occur in patients with diabetes, depending on the level of glucose in the bloodstream. If an adult patient’s blood glucose level is below 45 to 60 mg/dL, the symptoms seen are caused by hypoglycemia (Table 45-3). This reaction is related to insulin treatment and may also be called insulin shock. The goal is to prevent such episodes with adequate patient education and reinforcement of individualized medical management of diabetes, as well as frequent blood glucose monitoring. The treatment for hypoglycemia is immediate glucose replacement. The recommended form of sugar supplement is glucose tablets, because each tablet contains a known amount of glucose. The patient can use other sugar supplements, such as candy, orange juice with sugar, or non-diet soft drinks, but the amount of glucose in these items is unknown, and the patient actually may become hyperglycemic from ingestion of too much glucose. After the hypoglycemic crisis has ended, if the next meal is more than 1 hour away, the patient should have a mixed protein and carbohydrate snack (peanut butter crackers, cheese crackers) to maintain blood glucose levels until the next meal.

A second acute complication is diabetic ketoacidosis, or diabetic coma. In this case the person with diabetes is unable to use glucose for energy because insulin is absent or insufficient or there is resistance to insulin at the target cell site. Hyperglycemia results, with blood glucose levels rising to 300 to 750 mg/dL. Because cells cannot use carbohydrates for energy, the body begins to burn fat. Ketones are waste materials from fat metabolism that build up in the bloodstream and cause it to become more acidic. Although the development of ketoacidosis takes longer than insulin shock, it can become a medical emergency if the patient does not recognize the signs, monitor his or her blood glucose levels, and administer insulin as prescribed by the physician.

**TREATING HYPOGLYCEMIA: THE RULE OF 15**

1. Take 15 g of carbohydrate (CHO) if the glucometer reading is below 80 mg/dL.
2. Fifteen grams of CHO equals three glucose tablets, ½ cup of fruit juice, or five or six pieces of hard candy.
3. Wait 15 minutes and check the glucometer reading again; if the level is still low, repeat steps 1 and 2.
4. After the symptoms have been relieved, eat a regular meal as planned to maintain plasma glucose levels.
5. Treat hypoglycemia immediately, because it can cause fainting.
6. The physician may order injected glucagon to quickly raise blood plasma levels.
Crisis Thinking Application 45-5
Mr. Vespa returns to the office 1 week later and tells Dr. Misha that he has not been feeling well. Sometimes he feels very shaky, dizzy, and tired; he has been getting headaches and cannot think straight. Dr. Misha orders a glucometer reading, which shows Mr. Vespa’s blood glucose level at 65. Dr. Misha’s diagnosis is hypoglycemic episodes, and the physician asks Miguel to reinforce patient teaching about hypoglycemic and hyperglycemic signs and symptoms and treatment. What should Miguel include in the teaching intervention? How can he best reinforce the material so that Mr. Vespa will remember how to manage his disease?

Chronic Complications
Microvascular disease. Arterial changes at the capillary level can occur within 1 to 2 years of the onset of DM. Hyperglycemic episodes combined with the duration of the disease cause degeneration of tissue arterioles, which results in multiple system disorders, including diabetic retinopathy. Diabetes is a leading cause of new blindness in people 20 to 74 years of age and is often a result of 8 to 10 years of diabetes. Ninety percent of patients with diabetes type 1 and 65% of patients with diabetes type 2 develop retinopathy.

Hyperglycemic episodes damage the blood vessels in the retina; therefore, close glucose control helps delay the onset of retinopathy and slows its progression. The vision disturbances occur as a result of vascular changes in the capillaries of the retina. These complications can lead to retinal detachment and blindness. In addition, people with diabetes are at much higher risk for developing glaucoma and cataracts and should have yearly eye screenings and frequent ophthalmologic examinations during routine office visits for early diagnosis of diabetic retinopathy.

Microvascular disease also can cause diabetic nephropathy. Kidney disease is present in 10% to 21% of individuals with diabetes and is the most common cause of kidney failure in the United States. Diabetic kidney disease is the greatest threat to life in adults with diabetes type 1. Diabetes damages the small blood vessels in the kidneys and impairs their ability to filter waste from the blood. Degenerative changes cause destruction of the glomerular unit and can lead to renal failure. High blood pressure and smoking are associated with diabetic nephropathy. Because urinary protein usually is the first sign of kidney damage, frequent testing for albuminuria is suggested. Early treatment reduces the progression of kidney disease. Good glucose control can reverse the early stages of diabetic nephropathy. With disease progression, renal failure may occur, resulting in the need for dialysis and possibly kidney transplantation.

Macrovascular disease. Macrovascular disease, in the form of atherosclerosis, is a serious health issue for all patients with diabetes, especially those with DM type 2. People with diabetes are two to four times more likely to have atherosclerotic heart disease or strokes. Coronary artery disease (CAD) is the most common cause of death in those with diabetes type 2. The patients most affected are women at or before middle age. The longer the patient has had diabetes, the greater the risk of CAD. Cerebrovascular accidents (CVAs, or strokes) occur twice as often in patients with diabetes as in those without the disease. Hypertension is common in patients with diabetes and contributes to the rates of CAD and CVA.

Peripheral vascular disease (PVD), a disease process in blood vessels outside the heart, is associated with atherosclerotic changes in small arteries and arterioles and contributes to the incidence of gangrene and amputations in patients with diabetes. Patients with diabetes type 2 frequently have signs and symptoms of PVD when first diagnosed. Compromised circulation in the lower extremities causes the formation of ulcers, poor wound healing, and possible progression to gangrene. This progression of PVD may result in amputation of the toes, foot, or leg. Blockage of blood vessels can lead to impotence in men with diabetes. About 13% of men with diabetes type 1 and 8% of men with diabetes type 2 have impotence caused by diabetic vascular disease.

Diabetic neuropathy. Diabetic neuropathy is the most common complication of diabetes; 60% to 70% of those with diabetes have some form of diabetic nerve damage. This type of nerve damage is caused both by vascular changes and by hyperglycemia. The chief areas that show pathologic changes are the nerves and blood vessels in the eyes, kidneys, legs, and feet. The first signs of diabetic neuropathy usually are numbness, pain, or tingling in the hands, feet, or legs. The loss of sensation in the extremities is important, because it affects the patient’s ability to be aware of injuries, especially to the feet. Because of peripheral vascular compromise, foot injuries can develop into ulcers or lesions can become infected and ultimately lead to gangrene and amputation. Even a minor undetected injury, such as a foot blister, can lead to a serious problem for a patient with diabetes. Individuals with diabetes also may lose temperature sensation and thus are more susceptible to heat or cold injuries such as burns and frostbite (Figure 45-9). Patients with diabetes should have their feet inspected at every visit to the physician’s office to ensure early detection and treatment of problems. Healthcare providers should provide verbal and written advice to help prevent or reduce these potentially serious injuries.
QUESTIONS TO ASK WHEN SCREENING FOR DIABETIC NEUROPATHY

- Can you feel your feet when walking?
- Have you noticed weakness in the muscles of your feet and legs?
- Do you have problems with balance when standing or walking?
- Do you have trouble feeling heat or cold in your feet or hands?
- Do you have open sores on your feet and legs that heal slowly?
- Have you noticed that your feet have changed shape?
- Do your feet tingle or feel like "pins and needles," or do you have burning or shooting pains in your feet? Do they hurt at night? Are they numb?
- Are your feet very sensitive to touch?
- Do your feet and hands get very cold or very hot?

Infection. All patients with diabetes are at increased risk for infection because of a number of different factors. Those with impaired vision and neuropathies have an increased risk of injury because they may not be able to see or feel potentially dangerous items to prevent injury. Once an injury occurs and the integrity of the skin has been compromised, damaged or atherosclerotic blood vessels are able to deliver the blood needed for healing, and the thickened blood vessel walls impede the release of white blood cells (WBCs) to the area. The WBCs of patients with diabetes show reduced phagocytosis, so their ability to destroy pathogens is limited. In addition, some pathogens multiply rapidly in the glucose-rich environment of individuals with diabetes. Therefore, the best method of controlling infections in these patients is to prevent skin trauma or damage.

FOOT CARE FOR PATIENTS WITH DIABETES

Patients with diabetes need instruction about foot hygiene and foot inspection during each visit. Education guidelines should include the following:

- Wash your feet every day with warm (not hot) water and mild soap.
- Cut your nails straight across to prevent ingrown toenails and possible injuries.
- Apply lotion to the feet, especially the heels. If the skin is crocked or red, speak to your doctor.
- Check your feet every day, using a mirror if necessary. Call your doctor at the first sign of redness, swelling, or numbness.
- Speak with your doctor before treatment of corns, calluses, or bunions.
- Do not go barefoot or allow your feet to get too hot or cold.
- Check your shoes for foreign objects or rough areas before wearing them.
- Wear comfortable, well-fitting shoes.
- Stop smoking. Smoking causes vasoconstriction, which reduces circulation to the extremities.

CORRELATION BETWEEN A1C LEVELS AND AVERAGE PLASMA GLUCOSE LEVELS

<table>
<thead>
<tr>
<th>A1C (%)</th>
<th>Plasma Glucose (mg/dL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>135</td>
</tr>
<tr>
<td>7</td>
<td>170</td>
</tr>
<tr>
<td>8</td>
<td>205</td>
</tr>
<tr>
<td>9</td>
<td>240</td>
</tr>
<tr>
<td>10</td>
<td>275</td>
</tr>
</tbody>
</table>


FOLLOW-UP FOR PATIENTS WITH DIABETES

Experts agree that the best method of preventing diabetic complications is to maintain blood glucose levels consistently at near-normal ranges. Several laboratory tests can be ordered to monitor a patient's blood glucose levels. The fasting blood sugar (FBS) test (or FPG, discussed earlier) measures the glucose levels in a blood specimen from a fasting individual. The test requires a 12-hour fast. The normal range for an FBS is 70 to 110 mg/dL. Even though the physician may order periodic FBS tests, patients with diabetes still need to check their blood glucose levels as ordered with a home glucometer.

A routine test for monitoring long-term diabetes therapy is the glycosylated hemoglobin (HbA1c) test. This test has distinct advantages over routine FBS studies, because the FBS reflects glucose levels at a given point in time, whereas the glycosylated hemoglobin test reflects serum glucose control over several months. The test measures glucose levels that have been chemically bound to the hemoglobin molecule on the red blood cell (RBC) over a 120-day period (the lifespan of an RBC). The physician can assess average daily glucose levels over the preceding 2 to 3 months and evaluate treatment compliance and results. The patient does not need to restrict food or fluid intake for this test and should continue to take prescribed medication before the blood sample is drawn. The patient's total glycosylated hemoglobin level should be less than 7%. The higher the glycosylated hemoglobin result, the higher the risk the patient will develop diabetic complications.

DEVELOPING A DIABETIC PATIENT EDUCATION PLAN

The plan of care for individuals newly diagnosed with diabetes should be developed from a holistic point of view. Holistic care means that the diabetic team (including the medical assistant) considers all aspects of the patient's needs, including lifestyle factors, such as diet and level of exercise; medications and the education needed to comply with their use; education that
includes the details of the disease and its possible complications; demonstration and return demonstration as needed until the patient is proficient in glucometer testing and/or insulin administration; family involvement in the treatment process; and the use of community resources (e.g., a diabetic educator, support group, and dietician) to assist with management of the disease (Figure 45-10). The equipment and supplies needed to treat diabetes effectively can be extremely expensive, so the medical assistant should investigate alternative methods of getting these materials if the patient is unable to afford them. The need for continuous daily glucose control must be emphasized at each patient visit. The medical assistant can research various Web sites and suggest that these be explored.

- **Patient Education**

Because the management of endocrine disorders can be quite complicated, the medical assistant must make sure the patient understands the proper procedures for at-home treatment. By demonstrating a given procedure in the office, the medical assistant can address any inaccurate information or answer any questions the patient may have. Visual materials, such as brochures and procedure cards, are also helpful, because they can be taken from the office and used as a reminder. If the patient is taking medication, the medical assistant should review the dosage schedule with the individual, discuss the purpose of the treatment, and clear up any confusion over the physician's instructions. As always, if the medical assistant is uncertain of any procedures or information, he or she should ask the physician for assistance before explaining anything to the patient.

- **Legal and Ethical Issues**

Pathophysiology of the endocrine system can have far-reaching effects on the body's ability to function. Patient education interventions should be documented completely to establish legal proof of the information shared with the patient. Never assume that the patient understands the disease process and treatment recommendations. The following suggestions can help ensure patient welfare and promote risk management:

- Advise patients that a medic alert bracelet with his or her diagnosis and medication information is an important safeguard.
- Patients must take medication as prescribed, following the directions for dosage, route of administration, and storage; they also must be alert for possible side effects.
- Patients newly diagnosed with diabetes should not drive until glycemic control has stabilized. These patients also should be warned about possible visual impairment from the disease.
- Remember that you are always representing your profession and employer and respond to each situation accordingly.
- Ask for assistance or further information if you feel unprepared to perform a procedure or to give accurate information.

**IMPORTANT POINTS IN PATIENT EDUCATION FOR PATIENTS WITH DIABETES**

- Physical activity (too much or too little), stress, disease, medications, and diet all combine to affect blood glucose levels; following an effective dietary plan is the first step toward self-management.
- The medical assistant should weigh the patient and measure his or her height. The medical assistant also should reinforce the body mass index (BMI) recommended by the physician and provide information about the basic nutritional requirements needed to help the individual maintain his or her ideal body weight or to lose weight.
- The goal of a diet plan is to help maintain a homeostatic blood glucose level. If a healthy blood glucose level is maintained, the patient will avoid complications that can develop with hypoglycemia or hyperglycemia. Basic guidelines, according to the person's ethnic influences, age, gender, and physical activity, are used to establish a therapeutic meal plan (see Chapter 30). Family members should be involved in dietary health teaching, and appropriate community resources, such as a registered dietician, should be used to help the patient understand and comply with the dietary guidelines.
- The medical management of diabetes can be quite complicated and overwhelming for many patients. People with diabetes type 2 who are prescribed oral hypoglycemics must understand the drug's mechanism of action and accurate dosage. Patients with diabetes type 1 or type 2 who require daily insulin must be able to prepare and administer their medication accurately and must understand the connection between glucometer readings and insulin dosage. All patients with diabetes must be able to use a glucometer accurately and must be aware of the possible complications of the disease.
**SUMMARY OF SCENARIO**

In his interactions with patients, Miguel has learned to pay attention to both verbal and nonverbal messages. He has used this technique consistently when interacting with Mr. Vaspa. Miguel recognizes the complexity of endocrine system disorders and the importance of understanding the anatomy and physiology of the system, as well as the most frequently seen endocrine disorders. As a concerned medical assistant, Miguel continues to read professional journals and attend workshops so that he is prepared to answer questions from patients. He is especially interested in DM, because the practice for which he works has so many patients with diabetes. Miguel never hesitates to ask the attending physicians questions about the disease and its management.

**SUMMARY OF LEARNING OBJECTIVES**

1. Define, spell, and pronounce the terms listed in the vocabulary. Spelling and pronouncing medical terms correctly bolster the medical assistant's credibility. Knowing the definitions of these terms promotes confidence in communication with patients and co-workers.

2. Apply critical thinking skills in performing the patient assessment and patient care. Completing the Critical Thinking Application exercises throughout the chapter can help the student medical assistant become more adept at critical analysis of real-life situations.

3. Summarize the anatomy of the endocrine system. The endocrine system consists of glands located throughout the body that produce and secrete chemicals known as hormones. The glands of the endocrine system are the hypothalamus, pituitary, pineal glands, thyroid, thymus, parathyroids, thymus, adrenals, and reproductive glands (i.e., the ovaries and the testicles). Some nonendocrine organs, such as the pancreas, produce and release hormones. Through hormonal action, the endocrine system regulates all body functions.

4. Explain the mechanism of hormone action. Hormones are chemical transmitters produced by glands and transported to the target tissue by the bloodstream. Hormone secretion is regulated by a combination of nervous stimulation, endocrine control, and feedback systems. Each hormone released into the bloodstream has particular target cells on which it acts.

5. Differentiate among common endocrine disorders. Hypersecretion or hyposecretion of hormones can cause endocrine disorders. When ADH is not produced or is not released in sufficient amounts, the patient develops diabetes insipidus. Gigantism and acromegaly are both diseases of the pituitary gland involving GH. When this condition affects children, gigantism is the result; in adults, acromegaly causes excessive growth of the facial area and extremities. Deficient secretion of thyroid hormone may be caused by an endemic iodine deficiency, resulting in a simple goiter. Improper development of the thyroid in an infant or young child causes cretinism; in an adult or older child, the condition is called myxedema. Hypersecretion of the thyroid gland causes thyrotoxicosis, or Graves' disease. Adrenal cortex insufficiency is called Addison's disease. Hypersecretion of the adrenal cortex, which results in elevated levels of cortisol, is known as Cushing's syndrome.

6. Describe the diagnostic criteria for diabetes mellitus. Diabetes is diagnosed if the patient has a plasma glucose level of 200 mg/dL or higher with polyuria, polydipsia, and unexplained weight loss; an FPG level of 126 mg/dL or higher on more than one occasion; a 2-hour OGTT of 200 mg/dL or higher; a positive urinalysis result for glucose and possibly ketones; or a glycosylated hemoglobin greater than 7%.

7. Outline the treatment plan and management of diabetes mellitus. All patients with diabetes must monitor their blood glucose levels regularly to determine the effectiveness of treatment. The goal of treatment is to maintain plasma glucose levels as close to the normal range as possible, as much as possible. Management of DM is a complicated interaction involving exercise, a therapeutic diet, weight control, and medication. Patients with diabetes type 1 require daily injections of a combination of insulins. Patients with diabetes type 2 may be prescribed oral hypoglycemics or insulin if needed.

8. Perform blood glucose screening using a glucometer. Procedure 45-1 describes how to perform plasma glucose screening accurately with a glucometer. Many types of glucose meters are available, so it is important that the patient be taught how to perform testing using the type of device that will be used at home.

9. Identify the characteristics of hyperglycemia and hypoglycemia. With hyperglycemia, the patient experiences a sudden onset of polyphagia, polyuria, glycosuria, ketonuria, weight loss, pruritis, "fruity" breath, dry mouth, nausea and vomiting, and lethargy. This occurs as a result of an inadequate dosage of insulin, target cell resistance, overeating, lack of exercise, illness, or stress. Hypoglycemia causes shakiness, vertigo, headache, hunger, pallor, fatigue, confusion, irritability, visual disturbances, seizures, and possibly coma.

10. Compare and contrast prediabetes, diabetes type 1, diabetes type 2, and gestational diabetes. Prediabetes is a condition in which an individual has a higher than normal blood glucose level that is not high enough for a diagnosis of diabetes type 2. Diabetes type 1 is seen in children and young adults and is characterized by a complete absence of insulin production. Patients must receive daily injections of insulin to survive. Diabetes type 2 develops gradually because of an insufficient amount of insulin or resistance at the target cell site, or both. Weight management, diet therapy, exercise, and medications are used to control glucose levels. Gestational diabetes occurs in some pregnancies but typically resolves after the infant is born. Affected women may need insulin therapy for glucose metabolism.

11. Categorize the complications associated with diabetes mellitus. Complications of DM include hypoglycemia; hyperglycemia and diabetic coma; diabetic neuropathy; microvascular diseases, including diabetic
Patient education for patients with diabetes is an intricate mix of information on the dynamics of the disease; the importance of exercise, diet, and weight control in preventing complications and maintaining health; an understanding of the various types of insulin and when and how they should be administered; for patients with diabetes type 2, a knowledge of oral medications, their side effects and dosage; home care management, including proper use of glucose meters and insulin administration; prevention of complications through effective control of blood glucose levels; proper foot care; and monitoring for and immediately contacting the physician about infections or other complications.

CONNECTIONS

📖 Study Guide Connection: Go to the Chapter 45 Study Guide. Read and complete the activities.

🌐 Evolve Connection: Go to the Chapter 45 link at evolve.elsevier.com/kinn to complete the Chapter Review and Chapter Quiz. Use other resources listed for this chapter to increase your knowledge of Assisting in Endocrinology.