CHAPTER 34

Vital Signs

Learning Objectives

After completing this chapter, you should be able to:

34.1 Define and spell the terms for this chapter.
34.2 Demonstrate weight conversions between pounds and kilograms.
34.3 Identify factors that affect body temperature.
34.4 Demonstrate temperature conversions between Fahrenheit (F) and Celsius (C).
34.5 Describe how to select the proper method to measure body temperature.
34.6 Compare different types of thermometers.
34.7 Describe characteristics of pulse rate.
34.8 List average pulse rates according to age.
34.9 Identify the nine pulse site locations on the human body.
34.10 Describe characteristics of respirations.
34.11 List average respiratory rates according to age.
34.12 Describe the five phases of Korotkoff sounds.
34.13 List average blood pressure readings according to age.
34.14 Identify situations that could cause a variation or error in blood pressure readings.
34.15 Describe pulse oximetry.

Case Study

Elanya Jordan, age 13, is seeing Dr. Salpega for persistent headaches. David Dolan, RMA, obtains her vital signs, which are T: 98.6°F, P: 88 bpm, R: 18 rpm, BP: 118/80. Elanya is 5 feet, 1 inch tall and weighs 104 pounds. Her mother, Mary Ellen, states that she has lost 6 pounds during the past three weeks because she has lost her appetite since the headaches began.

Terms to Learn

afebrile
anthropometry
apical
apnea
arrhythmia
asymptomatic
bounding pulse
bradycardia
bradypnea
cyanosis
diastolic blood pressure
dysrhythmia
eupnea
febrile
frenulum linguae
hyperpyrexia
hypertension (HTN)
hyperthermia
hyperventilation
hypotension
hypothermia
hypoventilation
intermittent pulse
Korotkoff sounds
manometer
orthostatic hypotension
oxygen saturation
pulse deficit
pulse oximeter
pulse pressure
pyrexia
rate
respiratory cycle
rhythm
sphygmomanometer
syncope
systolic blood pressure
tachycardia
tachypnea
thready pulse
tympanic membrane thermometer
vital signs
volume

In many medical offices, the medical assistant is responsible for taking vital signs. As the name implies, vital signs are able to give quick snapshots regarding how the body is functioning. For example, a body temperature reading that is too high could signify infection within the body, while a blood pressure reading that is too low may be due to low blood volume, nutritional deficiencies, or age. It is important for medical assistants to understand the importance of obtaining accurate vital signs because accuracy is something that physicians expect and patients depend on.

MEASURING WEIGHT AND HEIGHT

Weight and height are two important measurements, even though they are not considered vital signs in the true sense of the term. Weight and height are called anthropometric measurements because they relate to **anthropometry**, which is the science of size, proportion, weight, and height. The majority of physician offices will obtain a weight measurement at each patient visit, whereas a height measurement might only be obtained during an annual physical examination. However, older patients and women may be measured more frequently, for example, to observe for signs of osteoporosis (bone loss).

Weight and height can also provide indications of a person's general health. For example, infants who fail to gain weight, or "fail to thrive," require close supervision of weight gains and losses. If a child has an abnormal growth pattern, this may lead to a diagnosis of a hormonal imbalance. Diabetic patients, pregnant women, patients suffering cardiac problems, patients with fluid retention, and patients suffering from eating disorders, such as anorexia or bulimia, also often require frequent weight monitoring.

Weight

When measuring a patient's weight, it is important to be discreet and provide patients sufficient privacy. Weight can particularly be a sensitive and personal issue for both men and women. Patients can remain fully clothed when obtaining a weight measurement. However, it should be noted in the patient's chart if they have already disrobed and donned a gown for examination before being weighed. Both shoes and outerwear (heavy jackets or coats) should be removed before obtaining weight because they may significantly inflate a person's weight. Patients who cannot stand may be weighed on a chair or bed scale (Figure 34-1). Some patients may refuse to get weighed. When this situation occurs, it is important not to argue with the patient. Rather, make appropriate documentation by simply noting "refused weight" in the patient's medical record and notify the physician. Procedure 34-1 lists the steps for obtaining the weight and height of a patient.

There are many different types of scales that can be used to weigh patients. Scales may be upright scales, balance scales, electronic scales, or digital scales (Figure 34-2). As medical practices and offices evolve with changing technology, it is likely that most scales in medical facilities will be electronic. Scales may be calibrated in either kilograms (metric weight) or pounds.

Although many of these scales are able to change measuring units from kilograms to pounds at the press of a button, the medical assistant must know how to do the correct mathematical conversions. Table 34-1 shows these conversions.

Height

The patient's true height must be measured without shoes. While measuring the patient's height, the patient's weight may also be obtained. When you are measuring height, the patient

TABLE 34-1 | Converting Pounds and Kilograms

To Convert Kilograms to Pounds (kg to lb)

1 kilogram (kg) = 2.2 pounds (lb)

Multiply the number of kilograms by 2.2 lb
Example: If a patient weighs 64 kilograms, multiply 64 by 2.2.

64 × 2.2 = 140.8 or 141 pounds

To Convert Pounds to Kilograms (lb to kg)

1 pound = 0.45 kilograms

Multiply the number of pounds by 0.45.
Example: If a patient weighs 130 pounds, multiply 130 by 0.45.

130 × 0.45 = 58.5 or 59 kilograms

FIGURE 34-1 Patients unable to stand may be weighed using a chair scale.

FIGURE 34-2 An electronic scale.

PROCEDURE 34-1

Measuring Adult Weight and Height

Objective ◆ *Obtain height and weight measurements, and perform math conversions.*

EQUIPMENT AND SUPPLIES

Balance scale with bar to measure height; paper towel; pen; patient's medical record

METHOD

1. Perform hand hygiene.
2. Greet and identify the patient.
3. Explain the procedure to the patient.
4. Instruct the patient to remove shoes, and place a paper towel on the scale if the patient is in bare feet.
   a. Heavy objects such as keys or purses should be set aside.
5. Set all the weights to zero. The balance bar pointer should float in the center of the frame.
   a. If the balance bar is not centered at zero, balance the scale by adjusting the small knob at one end until the balance bar pointer floats in the center of the frame. (A coin can be used to make this adjustment.)
6. Assist the patient onto the scale.
7. Ask the patient to stand still while the measurement is being obtained.
8. Move the large weight into the groove closest to the weight you estimate for the patient. (You may refer to the patient's last recorded weight in the medical record.)
   a. If the balance bar pointer touches the bottom of the bar, then move the large weight to the left, one notch.
9. Then move the small weight by tapping it gently until it reaches a point in which the pointer floats in the center of the frame.
10. Leave the weights in place as you proceed to obtain the patient's height.
11. Ask the patient to place his back to the scale, standing erect, and looking straight ahead.
    a. The patient's heels, buttocks, and back of head should be touching the scale.
12. Raise the height bar in a collapsed position making sure the tip is over the patient's head.
13. Open the bar into the horizontal position, and bring it down gently to touch the top of the patient's head. Leave this setting in place (Figure A).
14. Assist the patient in stepping off the scale.
15. Calculate the patient's weight by adding the numbers at the large and small weight groove markings. Record the weight to the nearest ¼ pound.
    a. For example, if the large weight is seated within the 150-pound groove and the small weight marking is at 23¼ pounds, the total weight is 173¼ pounds.
16. Record this measurement on the patient's record.
17. Read the height as marked behind the movable level of the ruled bar.
    a. Individual medical offices have their own policies about documenting height as feet and inches, total inches, or total centimeters.
18. Record this measurement to the nearest ¼ inch or centimeter, as appropriate, on the patient's record.
19. Return the weights to zero and the height bar to the normal position, and discard the paper towel.
20. Perform hand hygiene.

FIGURE A The height bar is gently lowered until it touches the top of the patient's head.

CHARTING EXAMPLE

2/14/YY 8:00 A.M. wt. 140¼ lbs without shoes;
ht. 5'7" = 67 inches.
.....M. King, CMA

stands with heel, buttocks, and back of head touching the measuring stick or bar. The L-shaped arm is raised and then lowered until it rests on the top of the head, not on the top of the hair. The height is then read, and it may be recorded in feet and inches or in centimeters. To convert inches to centimeters, multiply the inches by 2.5. To convert centimeters to inches, divide the centimeters by 2.5.

VITAL SIGNS

A healthy human body is able to self-regulate through homeostasis, which is the body's natural ability to maintain a stable internal environment by correcting abnormal conditions and balancing bodily processes. **Vital signs** are indicators of the body's ability to maintain homeostasis. Temperature (T), pulse (P), respiration (R), and blood pressure (BP) measurements are considered vital signs because they measure some of the body's vital functions and provide necessary information about the patient's physical well-being. Thus, vital signs must be obtained and calculated with the utmost care and accuracy.

Vital signs are routinely measured by medical assistants before physical examinations. Temperature, pulse, respiration, and blood pressure are usually taken in this order. For proper charting of vital signs in the medical record, it is helpful to remember the *T, P, R, BP* sequence and record the results in that order. During some office visits, only one of the vital signs may be measured. For example, only blood pressure may be taken in a patient who is seeing the doctor for a medication check for hypertension.

Although details of standard precautions are not repeated for each procedure in this text, all health care professionals are to adhere to standard precautions in order to maintain infection control while measuring vital signs. As a medical assistant, you are expected to know and continually apply the techniques recommended by the Centers for Disease Control and Prevention (CDC), as discussed in the "Infection Control" chapter.

The remainder of this chapter discusses the physiology of body temperature, pulse rate, respirations, blood pressure, and the body processes that produce these signs. Normal vital sign readings for patients, based on age, are presented. Methods and types of equipment for measuring vital signs are also discussed, along with guidelines and methods for choosing the best equipment for each specific procedure.

TEMPERATURE

When measuring body temperature, use critical thinking skills to execute the task in a way that will achieve the most accurate reading. Take into consideration the patient's age and health status, and be able to recall normal healthy body temperature ranges in order to identify abnormalities.

Physiology of Body Temperature

Body temperature is regulated by balancing the amount of heat the body produces with the amount of heat the body loses. Body heat is produced as a by-product of metabolism, which is the sum of all biochemical and physiological processes that take place in the body. The hypothalamus, a gland located in the brain, acts as a thermoregulator. It is able to adjust body temperature that results in either increasing or decreasing heat production throughout the day.

Heat can be lost from the body by the following processes:

- **Radiation**—Heat given off from the body and released in the cooler air temperature; 65 percent of the body's heat is released this way
- **Convection**—Dispersion of heat by air currents; 10–15 percent of heat is released through this method
- **Conduction**—Transfer of heat from the body to a cooler source (e.g., when a patient with high fever is placed in cool water)
- **Evaporation**—Heat released from body through respiration (breathing) and sweating

See Figure 34-3 for an example of one way the body can react to increased temperature.

FIGURE 34-3 The hypothalamus helps regulate body temperature.

TABLE 34-2 | Factors Affecting Body Temperature

Time of Day	Body temperature is lower in the morning upon waking, when metabolism is still slow. The body's temperature is lowest between 2:00 A.M. and 6:00 A.M., and the body's highest temperature usually occurs in the evening between 5:00 P.M. and 8:00 P.M. Daily variation in normal temperature can range from 97.6°F to 99.6°F (36.4°C to 37.3°C).
Age	Infants and children normally have a higher body temperature than adults because of immature heat regulation. Children often tend to spike a fever late in the day. Older adults usually have lower-than-normal body temperature.
Gender	Women may experience a slight increase in body temperature at the time of ovulation.
Physical Exercise	Body temperature will rise during exercise as a result of increased muscle contraction and increased blood flow caused by heightened cardiovascular activity.
Emotions	Emotions such as crying and anger can cause an increase in body temperature.
Pregnancy	An increase in metabolism during pregnancy may cause the body temperature to rise.
Environmental Changes	Hot weather can cause serious consequences for older adults whose bodies are less able to regulate body temperature because of decreased metabolic functioning. Exposure to excessively cold temperatures will lower body temperature. Cool environments that may feel fine to a younger adult can cause hypothermia in an older person.
Infection	An elevated temperature may be one of the first signs of an infection. A fever is the body's way of fighting or killing off infectious organisms.
Drugs	Drugs may increase muscular activity or metabolism, which in turn increases temperature. Antipyretic (fever-reducing) drugs such as aspirin lower the above-normal temperature.
Food	The process of eating and digestion may cause a rise in the body temperature. Fasting decreases metabolism, which will lower body temperature.

Temperature: Normal Values and Terms

Body temperature is recorded in either degrees Fahrenheit (F) or degrees Celsius (C). The average body temperature of a healthy person is 98.6°F (37°C). However, there may be a 1- to 2-degree Fahrenheit fluctuation (increase or decrease) throughout the day. For example, temperature is lowest when a person gets up in the morning and will be at its highest in late afternoon. Table 34-2 describes some causes of variations in body temperature. Slight variance in body temperature is normal, but it is important to keep in mind that greater changes from normal body temperature may be the first signs of illness. Medical assistants should always be alert to the causes for changes in body temperature. For example:

- If an infant is crying during an examination, the elevated temperature may be a result of the infant's crying and not necessarily because of illness.
- Acetaminophen or aspirin can lower body temperature. Patients should be asked if they have recently taken any medicine, including over-the-counter medications.
- Older adults, who normally have body temperatures below normal, may be ill even when their temperatures are within a range that would be normal for younger adults.

Fahrenheit and Celsius Conversions

The Fahrenheit (F) scale of temperature measurement is widely used throughout the United States. However, some physicians, hospitals, and medical facilities use the Celsius (or centigrade) (C) scale, which is more commonly used outside the United States. Figure 34-4 shows calibration examples of Fahrenheit and Celsius in non-mercury thermometers. Table 34-3 discusses temperature scale conversion formulas and comparisons.

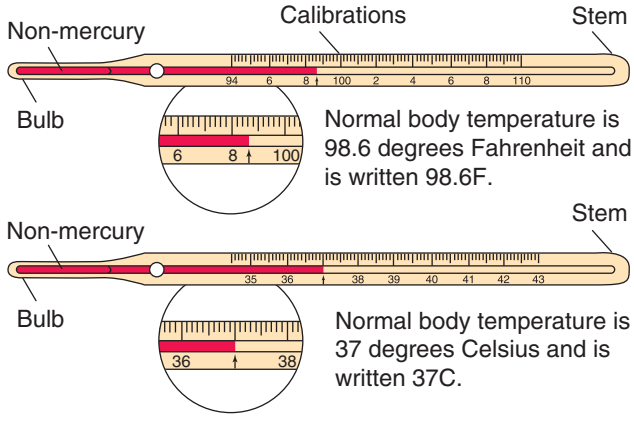

FIGURE 34-4 Fahrenheit and Celsius thermometers.

TABLE 34-3 | Temperature Conversions

- To convert Celsius to Fahrenheit:
  Fahrenheit degrees = (Celsius degrees × 9/5) + 32
- To convert Fahrenheit to Celsius:
  (Fahrenheit degrees − 32) × 5/9

Examples of Celsius and Fahrenheit readings in degrees:

Celsius (C)	Fahrenheit (F)
34.0	95.0
34.5	95.9
36.0	96.8
36.5	97.7
37.0	98.6 (normal oral)
37.5	99.5
38.0	100.4
38.5	101.3
39.0	102.2
39.5	103.1
40.0	104.0
40.5	104.9
41.0	105.8

Abnormal Temperatures

Fever and Hyperthermia

Fever or **pyrexia** is a body temperature above 100.4°F (38°C). When the body is in a feverish state, it is producing more heat than it is losing. A condition caused by fever is termed **febrile**; a condition not caused by fever is termed **afebrile**. For example, a febrile seizure is a seizure caused by fever, whereas an afebrile seizure is caused by something other than a fever, such as a head trauma.

Clinical signs and symptoms of fever include increased heart rate, increased respiratory rate, shivering, chills, decreased appetite, headache, facial flushing (redness to the skin), and sweating. The four most common types of fevers are:

- **Intermittent fever**—Body temperature that alternates between febrile and afebrile states
- **Remittent fever**—Elevated body temperature that remains high throughout the day, fluctuating more than 2 degrees Fahrenheit
- **Relapsing fever**—Febrile periods that last for a couple of days, go away, and then return
- **Constant (continuous) fever**—Elevated body temperatures throughout the day with minimal temperature fluctuation (usually not more than 1 degree Fahrenheit) over a 24-hour period

When the body temperature exceeds 106.7°F (41.5°C), a serious condition known as **hyperpyrexia** or **hyperthermia** develops. Hyperpyrexia is a very high fever resulting from a regulated rise in core body temperature, usually a response to a physiological threat, such as an infection. Hyperpyrexia may lead to serious complications, such as seizures in infants and small children. Hyperthermia, by contrast, is an unregulated rise in core body temperature and is the result of the body's inability to thermoregulate. Hyperthermia may be caused by exposure to high external temperatures, such as being outdoors on a very hot day. As body temperature increases, signs and symptoms of hyperthermia advance in severity. They include muscle cramps, fatigue, loss of coordination, drowsiness, confusion, convulsions, the inability to sweat, and possibly death.

Hypothermia

The reverse of hyperthermia is a below normal body temperature or **hypothermia**. Hypothermia is defined as a body temperature below 95°F (35°C) and is the result of the body losing more heat than it is producing. Hypothermia commonly occurs in cases of environmental exposure to cool or cold temperatures and/or submersion in cold water. In general, a body temperature below 92°F (33.3°C) is considered severe hypothermia and may be life-threatening. Clinical signs of hypothermia are lack of muscle coordination; slurred speech; violent shivering; decreased pulse and respirations; pale, waxy, cool skin; and drowsiness and dazed consciousness progressing to coma and death.

Sites for Measuring Body Temperature

Body temperature can be measured in a variety of ways: oral (mouth); aural (ear) or tympanic membrane (eardrum); axillary (under the arm); rectal (rectum); and temporal artery (forehead). Oral and rectal temperatures measure the body's core temperature and are considered the most accurate. Tympanic membrane, axillary, and temporal artery temperatures are more variable but are acceptable for tracking significant changes.

Professionalism The Law

The medical assistant has an ethical and professional responsibility to use careful, proper techniques when performing procedures to measure vital signs. Incorrect readings could result in a misdiagnosis and serious consequences for the patient. In addition to proper technique, following through with proper documentation is just as critical. Incorrect documentation of vital signs can lead to serious complications for the patient and legal consequences for both the physician and the medical assistant.

TABLE 34-4 | Selecting a Method for Measuring Body Temperature

Method	Advisable	Inadvisable
Oral ("O")	Most adults and children who are able to follow instructions for properly holding the thermometer.	Patients who have had oral surgery, mouth sores, dyspnea; uncooperative patients; patients on oxygen; infants and small children; patients with facial paralysis or nasal obstruction; anyone unable to form an airtight seal around the thermometer.
Rectal ("R")	Infants and small children; patients who have had oral surgery; mouth-breathing patients; unconscious patients.	Active children; fragile newborns; patients with heart conditions (it can stimulate the vagus nerve leading to arrhythmias); those with recent rectal surgery or complaints of diarrhea.
Axillary ("AX")	Small children	Patients who have underarm rash, excessive perspiration, or cannot form an airtight seal around the thermometer.
Tympanic (Aural) ("T")	Small children	Patient with in-the-ear hearing aids, impacted cerumen, earaches, or ear infections.
Temporal Artery ("TA")	Most adults, infants, and small children; patients who have had oral surgery; mouth-breathing patients; unconscious patients.	No restrictions—possibly difficult with combative children or newborns.

Use the guidelines given in Table 34-4 to determine which method to use when measuring a patient's body temperature.

Normal Values

The normal temperature, based on statistical averages, is as follows for each measurement site:

Oral	98.6°F (37°C)
Rectal	99.6°F (37.6°C)
Axillary (under arm)	97.6°F (36.4°C)
Aural (ear)	98.6°F (37°C)
Temporal artery	98.6°F (37°C)

Temperature obtained through the rectal method registers 1°F (or 0.6°C) higher than the oral temperature. Axillary temperatures register 1°F (0.6°C) lower than oral temperatures. Thus, when recording a temperature reading, you must document in the patient's record the body site where the temperature was measured. Temperatures taken rectally are abbreviated with the letter "R" next to the reading, axillary by the abbreviation "AX," tympanic membrane (aural) by "T," or temporal artery with "TA." "O" would indicate an oral measurement, although generally if there is no abbreviation next to a temperature reading, it is assumed the reading was obtained orally.

Oral

The oral method of temperature measurement is most commonly used. Some facilities do not require the designation "O" when documenting this measurement, whereas others do.

When taking oral temperature, insert the thermometer under the tongue on either side of the **frenulum linguae**, which is the longitudinal fold of mucous membrane connecting the tongue to the bottom of the mouth. For an accurate measurement, you must advise the patient not to talk during the procedure and to close the lips tightly around the thermometer. The potential for error with this method is that the patient may not form a tight enough closure around the thermometer, which allows air to enter the mouth and produce a false temperature reading. Ask if the patient either smoked or drank fluids before the appointment. If so, you must wait 15 minutes before obtaining an oral temperature.

Aural (Ear)/Tympanic Membrane

This method uses the tympanic membrane (the eardrum) for temperature measurement. Tympanic membrane thermometers are able to detect heat waves in the ear canal and calculate body temperature from these readings. The aural method is sometimes preferred over the oral method because the space in the external auditory canal is a more tightly closed cavity than the mouth, producing a more accurate measurement. Another benefit of this method of measurement is that it does not come in contact with saliva or mucus, which helps prevent the spread of infection, particularly from a sick patient. However, a tympanic thermometer should not be used if the patient has complaints of ear pain (internal or external) or has impacted cerumen (earwax).

Axillary

The axillary (under the arm) method has proven to be the least accurate of the temperature measurement sites. However, it is the recommended site for small children or for patients unable to properly hold an oral thermometer in their mouths, such as those who have recently had oral surgery, mouth-breathing patients, or when a tympanic membrane thermometer is not available. In axillary temperature readings, the underarm area should be patted dry for an accurate reading because perspiration (sweat) may affect the reading.

Rectal

A rectal body temperature reading is considered to be the most accurate and reliable method. This is because the mucous membrane lining the rectum does not come into contact with air, as it does with the oral and axillary methods, which could interfere with accuracy. The rectal route is advised for unconscious patients, infants and small children, and mouth-breathing patients.

A separate thermometer should be used for rectal readings, and it should be properly labeled "rectal" to prevent it from being used to take an oral temperature. The rectal method should be avoided when there is a danger of rectal wall perforation. Because the rectal method is the most invasive and uncomfortable method for patients, you must show care, sensitivity, and professionalism when you obtain a body temperature by this route.

Temporal Artery

Temporal artery measurement is a newer, noninvasive method of obtaining body temperature. The temporal artery is located close to the skin surface on the forehead and temple area. The temporal thermometer uses an infrared scanning device that detects the temperature of the blood as it is flowing through the temporal artery, which is then recorded as the body temperature. Similar to the tympanic membrane thermometer, it is a fast and fairly accurate method of obtaining body temperature. A number of commercial devices are available to measure the temporal artery temperature.

Types of Thermometers

There are many types of thermometers available for measuring body temperature. However, in 2002, the American Hospital Association (AHA) agreed to eliminate mercury from the health care environment because of the frequency of breakage and the potential danger of mercury. Mercury is toxic and can be harmful to both humans and animals.

FIGURE 34-5 Electronic digital thermometers are accurate and easy to read.

Electronic or Digital Thermometer

Electronic or digital thermometers are the most commonly used and are accurate, easy to read, sanitary, and fast. They require very minimal cleaning and disinfection. Some electronic thermometers are battery operated with digital windows for easy reading (Figure 34-5). Other types of electric thermometers are charged by plugging them into a base receptacle, which is often mounted on a wall in the patient room.

The electronic thermometer has a metal probe containing a heat sensor that can accurately register body temperature within a few seconds. The electronic thermometer can be used for oral, rectal, and axillary body temperature readings. The metal probes are color coded: blue for both oral and axillary, and red for rectal. The probe is attached to the battery unit by a flexible cord. A nonflexible, plastic disposable probe cover fits over the metal probe to provide each patient with a new and sanitary thermometer.

To use, hold the thermometer in place while the measurement is quickly obtained (Figure 34-6). The unit will emit

FIGURE 34-6 The medical assistant holds the position of the thermometer while the temperature is being obtained.

a signal, usually a beep, when the temperature has registered. Once the thermometer has been removed from the patient, press the release button to eject the plastic probe cover into a waste container and replace the probe and thermometer unit into the battery-powered storage unit. Procedure 34-2 provides the steps for measuring an oral temperature with an electronic thermometer.

The electronic method is the most widely used method of obtaining a rectal temperature. After lubricating the tip of the probe, insert the rectal probe ½ inch into an adult's

PROCEDURE 34-2

Measuring Oral Temperature Using an Electronic Thermometer

Objective ◆ *Perform all steps of the procedure, and provide an accurate temperature reading.*

EQUIPMENT AND SUPPLIES

Electronic thermometer (rechargeable); blue (oral) probe; probe cover; waste container; pen; patient's medical record

METHOD

1. Perform hand hygiene.
2. Assemble equipment, ensuring that the electronic thermometer is properly charged.
3. Greet and identify the patient, and explain the procedure.
4. Attach the correct probe that would be used to measure an oral temperature.
5. Attach a disposable probe cover by inserting the thermometer probe into the disposable tip (probe cover) box, and secure the disposable cover onto the probe (Figure A).
6. Insert the thermometer into the patient's mouth, under the tongue on either side of the frenulum linguae. Instruct the patient to close her mouth, forming a tight seal around the thermometer.
7. When the temperature signal is seen or heard, remove the thermometer from the patient's mouth and read the result displayed on the LED window.
8. Dispose of the probe cover in a waste container (Figure B).
9. Return the thermometer probe to the storage place (Figure C).
10. Return the entire unit to the rechargeable base.
11. Perform hand hygiene.
12. Document the results.

CHARTING EXAMPLE

07/25/YY 4:00 P.M. T: 99.6°FE. Leonard, RMA

FIGURE A–C **(A)** Attach a disposable probe cover by inserting the probe into the box and securing a cover. **(B)** Eject the probe cover into the waste container. **(C)** Return the probe to the storage holder.

rectum and ¼ inch into a child's rectum. You may have to angle the probe slightly posteriorly (toward the patient's back) to ensure contact with the rectal mucosa and to prevent tearing of the rectal wall. Procedure 34-3 provides the steps for measuring a rectal temperature with an electronic thermometer.

Electronic thermometers are time saving but expensive. Additionally, the battery-operated thermometers must be calibrated and readjusted to maintain accuracy. It is important to always follow the manufacturer's instructions regarding proper care, use, and storage of electronic thermometers.

Axillary Thermometer

Although it is the least accurate, the axillary area (area under the arm) is considered ideal in some circumstances because it is easily accessible and noninvasive. As mentioned earlier, perspiration can affect the reading, so it is important to pat the armpit to remove wetness. However, do not rub the area because friction from rubbing can generate heat and increase the temperature. The process for measuring axillary temperature is given in Procedure 34-4.

PROCEDURE 34-3

Measuring Rectal Temperature Using an Electronic Thermometer

Objective ◆ *Perform all steps of the procedure, and provide an accurate temperature reading.*

EQUIPMENT AND SUPPLIES

Electronic thermometer; red (rectal) probe; disposable probe cover; disposable gloves; patient's medical record; paper and pen; tissue; water-soluble lubricant; biohazard waste container

METHOD

1. Perform hand hygiene.
2. Don a pair of gloves.
3. Greet and identify the patient.
4. Explain the procedure. If the patient is a child, explain the procedure to both the parent and child.
5. Instruct the patient to remove appropriate clothing so that the rectal area can be accessed.
   a. Excuse yourself from the room while the patient disrobes to ensure patient privacy. Provide a drape or gown, as necessary.
6. Assist the patient onto the exam table, and help assist him into the Sims' position (lying on left side with top leg bent).
7. Because of the delicate nature of the procedure, be mindful of the patient's privacy and adjust draping, as necessary, to provide maximum coverage.
8. Remove the electronic thermometer from the base, and choose the correct probe for a rectal temperature.
9. Attach a disposable probe cover on the thermometer probe.
10. Place a small amount of lubricant on a tissue. Dip the tip of the probe in the lubricant.
11. With one hand, raise the upper buttock to expose the anus or anal opening.
    a. If unable to see the anal opening, ask the patient to bear down slightly. This will expose the opening.
12. With the other hand, gently insert the lubricated thermometer probe ½ inch into the anal canal.
    a. Do not force the thermometer into the anal canal; if any resistance is felt, discontinue the procedure.
13. Hold the thermometer still and in place until the result is signaled.
14. Gently withdraw the thermometer, and dispose of the probe cover by ejecting it into a biohazard container.
15. Make note of the temperature, which will be recorded later.
16. Wipe the anus from front to back to remove any excess lubricant.
17. Assist the patient from the examination table. Instruct the patient to re-dress or don an examination gown. If necessary, provide assistance. If no assistance is needed, excuse yourself from the room to allow the patient privacy.
18. Remove gloves and place in a biohazard waste container.
19. Perform hand hygiene.
20. Record the temperature in the patient's record using (R) to indicate a rectal temperature was obtained.
21. Return the probe to its appropriate storage place, and then return the entire thermometer unit to the rechargeable base.
    a. Perform appropriate sanitization of the thermometer unit according to the manufacturer's instructions or office protocol, possibly by cleaning the unit with a disinfecting wipe.

CHARTING EXAMPLE

2/14/YY 4:00 P.M. T: 99.6°F (R) ..... M. King, CMA

PROCEDURE 34-4

Measuring Axillary Temperature

Objective ◆ *Perform all steps of the procedure, and provide an accurate temperature reading.*

EQUIPMENT AND SUPPLIES

Electronic thermometer and appropriate probe (blue oral probes are used for axillary temperatures); disposable probe cover; paper and pen; patient's medical record; tissue; waste container

METHOD

1. Perform hand hygiene.
2. Greet and identify the patient.
3. Explain the procedure. If the patient is a child, explain the procedure to both the parent and child.
4. Remove the electronic thermometer from its charging base, select the appropriate probe, and attach a disposable probe cover.
5. Ask the patient to expose the axilla (under the arm).
   a. If the patient is an infant or child, ask the parent to take the child's arm out of clothing to expose axilla.
6. Using a tissue, pat the axilla dry of any perspiration. Do not rub the area.
7. Place the probe with cover into the axillary space.
8. Ask the patient to remain still and to hold the arm tightly next to the body while the temperature registers (Figure A).
9. When the thermometer signals completion, remove the thermometer and discard the probe cover in a waste container.
10. Record the temperature in the patient's medical record, making sure to note that the temperature was obtained via the axillary route (AX) and which side was used (Figure B).
11. Return the thermometer probe to its appropriate storage location, and then return the entire unit to the rechargeable base.
12. Perform hand hygiene.

CHARTING EXAMPLE

2/14/YY 4:00 P.M. T: 97.6°F Lt. (AX) ..... M. King, CMA

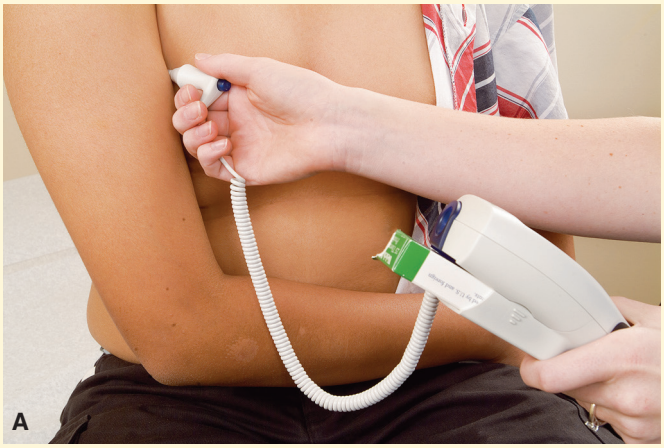

FIGURE A–B (A) The probe is placed in the axillary space while the patient holds his arm tightly to his body. **(B)** Record the body temperature measurement as displayed, indicating (AX) in the patient's medical record.

Tympanic Membrane Thermometer

The **tympanic membrane thermometer**, or aural thermometer, is used for an aural (ear) temperature. As discussed previously, the tympanic membrane thermometer is able to detect the heat waves generated within the external ear canal near the eardrum (tympanic membrane). It is very important to straighten the ear canal when obtaining a tympanic membrane temperature. This is done by:

- Pulling the outer ear upward and out for patients ages 4 and up; or
- Pulling the ear downward and back for younger patients (ages 3 and under).

FIGURE 34-7 A tympanic membrane (aural) thermometer.

Figure 34-7 shows an example of a tympanic membrane thermometer. Procedure 34-5 lists the steps required to obtain a temperature reading using a tympanic membrane thermometer.

Disposable Thermometer

There are several types of single-use, disposable thermometers. A chemical disposable thermometer uses liquid dots, heat-sensitive bars, or patches applied to the forehead that change color to indicate body temperature (Figure 34-8). Procedure 34-6 lists the steps to measure body temperature using a heat-sensitive wearable thermometer. When using these unique thermometer devices, hold the thermometer in place for about 15 seconds and read the strip by noting the highest reading among the selection of dots that have changed color. Both the chemical disposable thermometer and the heat-sensitive wearable thermometer are excellent methods when dealing with small children or with large numbers of patients who need to be evaluated in rapid succession.

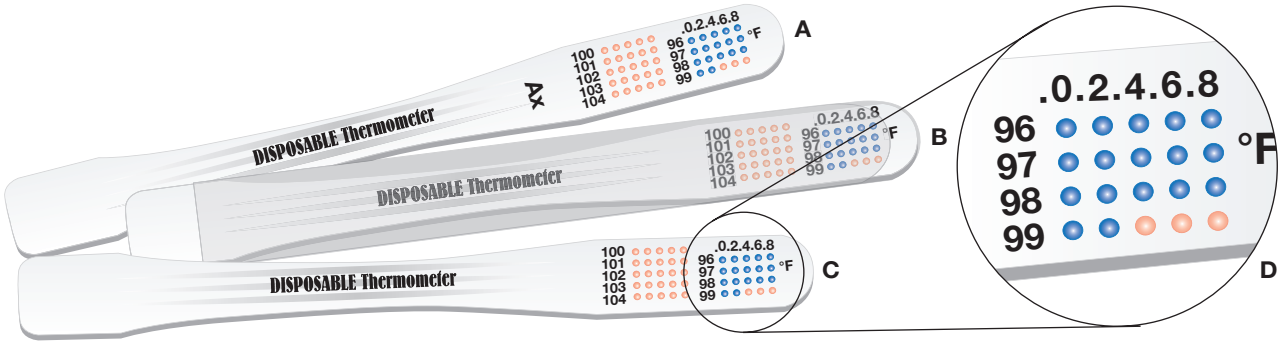

FIGURE 34-8 Disposable thermometers with chemical dots. **(A)** Axillary thermometer (marked "AX"); **(B)** rectal thermometer with plastic cover; **(C)** oral; **(D)** enlargement showing a reading of 99.2°F.

PROCEDURE 34-5

Measuring Temperature Using a Tympanic Membrane (Aural) Thermometer

Objective ◆ *Perform all steps of the procedure, and provide an accurate temperature reading.*

EQUIPMENT AND SUPPLIES

Tympanic membrane thermometer; disposable protective probe cover; paper and pen; patient's medical record; waste container

METHOD

1. Perform hand hygiene.
2. Greet and identify the patient.
3. Explain the procedure to the patient.
4. Remove the thermometer from its base. The display should read "Ready."
5. Attach a disposable probe cover to the earpiece.
6. With one hand, gently pull upward and out on the patient's outer ear if an adult. Pull back and downward if the patient is an infant or child (Figure A).
7. Gently insert the plastic-covered tip of the probe into the ear canal (Figure B).
8. Activate the thermometer by pressing the scan button.
9. Observe the temperature reading in the display window.
10. Gently withdraw the thermometer from the ear canal.

FIGURE A–B **(A)** Pull the outer ear downward and back for a child age 3 or under. **(B)** Gently insert the probe into the patient's ear canal while pulling the patient's ear (age 4 and up) upward and out.

11. Dispose of the used probe cover into a waste container by pressing the eject button.
12. Record the temperature in the patient's medical record, indicating a tympanic membrane temperature (T) was obtained and which ear was used.
13. Return the tympanic membrane thermometer to its base.
14. Perform hand hygiene.

CHARTING EXAMPLE

10/23/YY 4:00 P.M. T: 99.2°F Rt. (T) ..... M. King, CMA (AAMA)

PROCEDURE 34-6

Measuring Temperature Using a Heat-Sensitive Wearable Thermometer

Objective ◆ *Perform all steps of the procedure, and provide an accurate temperature reading.*

EQUIPMENT AND SUPPLIES

Wearable heat-sensitive thermometer (chemical strip, liquid crystal); paper and pen; patient's medical record; tissue; watch with second hand; waste container

METHOD

1. Perform hand hygiene.
2. Greet and identify the patient.
3. Explain the procedure.
4. Dry the patient's forehead by patting it with a tissue. Do not rub the area.
5. Place the thermometer strip on the forehead (Figure A), and begin timing for 15 seconds.
6. After 15 seconds, read the correct temperature by reading the color changes.
7. Record the temperature in the patient's chart indicating the type of thermometer used.
8. Discard the strip in the waste container.
9. Perform hand hygiene.

FIGURE A Temperature-sensitive skin tape.

CHARTING EXAMPLE

07/11/YY 9:08 A.M. T: 98.6°F (temp.-sensitive skin tape) .... L. Kenney, RMA

Temporal Artery Thermometer

A temporal artery (TA) thermometer is a scanner that, when stroked gently across the forehead, measures the heat emitted through the skin from the temporal artery, which lies directly below. The instrument actually takes multiple readings per second and selects the most accurate. These devices have been gaining popularity in medical facilities because they are a quick, accurate, and noninvasive method of obtaining body temperature. They are also replacing the tympanic membrane thermometer, which was popular because of its less invasive nature. Temporal artery thermometers have the further advantage of not requiring proper patient positioning, as tympanic membrane thermometers do with the ear canal.

TA temperature is comparable to rectal temperature, about 1 degree Fahrenheit higher than oral temperature, and 2 degrees higher than axillary temperature. TA readings are not affected by factors such as smoking, drinking, or coughing that may interfere with oral measurements.

When measuring a TA temperature, assess the side of the head that is exposed rather than the side covered by hair or resting on a pillow. The latter may cause a higher reading because heat is not allowed to dissipate. Slide the thermometer in a fairly straight line across the forehead, starting at the center of the forehead and moving toward the temple. At this point, the temporal artery is less than 2 millimeters below the surface of the skin. Do not slide the thermometer down the side of the face. Procedure 34-7 lists the steps to measure body temperature using a TA thermometer.

PROCEDURE 34-7

Measuring Temperature Using a Temporal Artery Thermometer

Objective ◆ *Measure body temperature using a temporal thermometer.*

EQUIPMENT AND SUPPLIES

Paper and pen; patient's medical record; alcohol swab; temporal artery thermometer

METHOD

1. Perform hand hygiene.
2. Greet and identify the patient.
3. Explain the procedure.
4. Brush aside the patient's hair, tucking it behind the ear if necessary to keep it out of the way.
5. Remove the cap from the probe of the thermometer, and disinfect the probe by gently wiping it with an alcohol swab.
6. Place the probe flush on the center of the forehead, and depress the red button (Figure A).
7. Keep the button depressed, and slowly slide the probe at the midline across the forehead to one side of the head toward the hairline.
8. Lift the probe from the forehead, and touch it on the neck just behind the earlobe.
9. Release the button, and read the temperature.
10. Record the results in the patient's medical record, indicating the temperature was obtained via a temporal artery (TA) measurement and which side of the forehead.
11. Perform hand hygiene.

FIGURE A A temporal artery thermometer.

CHARTING EXAMPLE

12/18/YY 10:00 A.M. T: 100°F Lt. (TA) ..... L. Cohen, CMA

TABLE 34-5 | Factors That Influence Pulse Rate

Exercise	Activity increases pulse rate. Rate may increase 20–30 bpm, based on the intensity of activity.
Age	As age increases, pulse rate decreases. Infants and children have a faster pulse rate than adults.
Gender	Female pulse rate is about 10 bpm higher than a male of the same age.
Size	Pulse rate is proportionate to the size of the body. Heat loss is greater in a small body, resulting in the heart pumping faster to compensate. Larger males have slower pulse rates than smaller males. During sleep and rest, the pulse rate drops.
Physical Condition	Athletes and people in good physical condition have lower pulse rates. The lower rate is a result of a more efficient circulatory system. Pulse rate of 60 or below can be normal for athletes.
Disease Conditions	Pulse rate is increased in certain disease conditions such as thyroid disease, fever, and shock because of increased metabolism.
Medications	Many medications can either raise or lower the pulse rate. Medications such as digoxin are given to regulate the heartbeat. Caffeine and nicotine can increase the heart rate in certain people. Drugs used recreationally, such as cocaine and methamphetamine, increase the pulse rate.
Depression	May lower the pulse rate.
Fear, Anxiety, Anger	May raise the pulse rate.

PULSE

Pulse rate is the number of times the heart beats per minute (bpm). During the cardiac cycle, the pulse is the wave of blood that courses through the body when the left ventricle contracts. After contraction, the heart rests as the cardiac muscle relaxes and the ventricle is filling with blood again. Each pulse beat represents one complete cardiac cycle or one heartbeat: contraction and relaxation.

In a healthy adult, a normal per-minute resting heart rate ranges from 60 to 100 beats a minute. With physical exertion, the muscles require more oxygen, resulting in an increased heart (pulse) rate and respiration (breathing) rate. The general method to calculate the maximum heart rate is to subtract the patient's age from 220. For example, if a patient is 45 years old, subtract 45 from 220 to get that patient's maximum heart rate of 175. This is the maximum number of times a person's heart should beat per minute while exercising.

A resting pulse rate above 100 bpm is considered to be a rapid pulse rate, or **tachycardia**, and a rate below 60 bpm is considered to be a slow pulse rate, or **bradycardia**.

Factors Influencing Pulse Rate

The pulse rate is influenced by numerous factors including exercise, age, gender, body size, physical conditions, disease states, medications, and emotional states, such as depression, fear, anxiety, and anger. Table 34-5 describes factors that influence pulse rate, and Table 34-6 lists average pulse rates based on age.

TABLE 34-6 | Average Pulse Rates by Age

Less than 1 year	120–160 bpm
2–6 years	80–120 bpm
7–10 years	80–100 bpm
11–16 years	70–90 bpm
Adult	60–80 bpm
Older adult	50–65 bpm

Characteristics of Pulse Rate

The following characteristics need to be taken into consideration when taking pulse rates and are often noted in the patient's record:

- **Rate** is the number of pulse beats per minute (bpm).
- **Volume**, or force, refers to the strength of the pulse when the heart contracts. Volume is influenced by the forcefulness of the heartbeat, the condition of the arterial walls, and hydration or dehydration. A variance in intensity of the pulse may indicate heart disease. The most common volume characteristics are:
  - A full or **bounding pulse**, indicating an increase in blood volume.
  - A weak or **thready pulse**, indicating a barely perceptible force or blood volume.

- **Rhythm** refers to the regularity, or equal spacing, of all the beats of the pulse. Normally, the intervals between each heartbeat are of the same duration. A pulse with an irregular rhythm is known as a **dysrhythmia** or **arrhythmia**. The irregular rhythm may be either a set of random irregular beats or a predictable pattern of irregular beats. An **intermittent pulse** occurs when the heart occasionally skips a beat. This is not considered abnormal if it does not happen frequently. Exercise or drinking a caffeine-rich beverage may cause this to occur. However, if arrhythmia occurs on a consistent basis, it may indicate heart disease and should be brought to the attention of the physician. If an irregular pulse is detected, the apical pulse should be assessed. The physician may also order further testing, such as an electrocardiogram (ECG), to further assess the arrhythmia.

Pulse Sites

There are nine areas in the body that allow for easy measurement of the pulse. These pulse sites are at the temporal, carotid, apical, femoral, brachial, radial, popliteal, posterior tibial, and dorsalis pedis arteries (Figure 34-9). Table 34-7 describes these nine common pulse sites, and Figure 34-10A–G illustrates the location of pulse sites on an actual patient. Procedure 34-8 provides the steps for accurately measuring a radial pulse.

Apical Pulse Rate

The **apical** pulse rate is counted at the apex of the heart (the lowest portion of the heart) with the use of a stethoscope that is placed over the apex. This is considered to be a very accurate heart rate and is most often used as the pulse

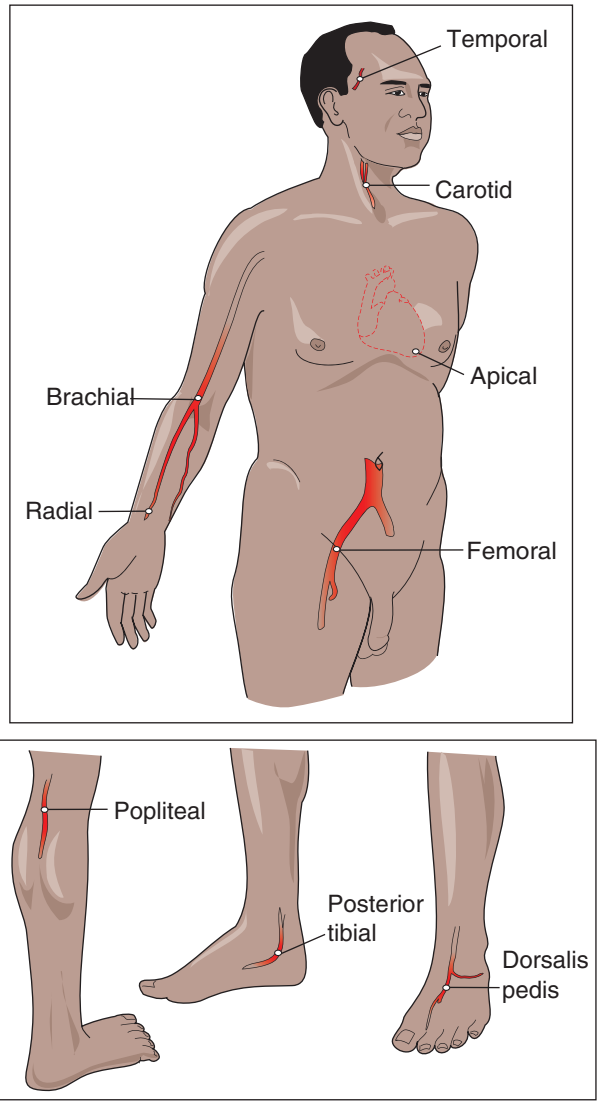

FIGURE 34-9 Nine pulse sites on the human body.

TABLE 34-7 | Location of Common Pulse Sites

Site	Location
Radial	Thumb side of wrist about 1 inch below base of thumb (most frequently used site)
Brachial	Inner (antecubital fossa/space) aspect of the elbow (pulse heard when taking BP)
Carotid	At side of neck between larynx and sternocleidomastoid muscle (pulse used in CPR)
Temporal	At side of head just above the ear
Femoral	In groin where femoral artery passes to leg
Popliteal	Behind the knee; pulse located deeply behind the knee and felt when knee is slightly bent
Posterior Tibial	On medial surface of ankle near ankle bone
Dorsalis Pedis	On top of foot slightly lateral to midline; helps assess adequate blood circulation to the foot
Apical	At apex of heart; left of sternum, 4th or 5th intercostal space below the nipple

FIGURE 34-10 **(A)** Brachial pulse; **(B)** radial pulse; **(C)** carotid pulse; **(D)** femoral pulse; **(E)** popliteal pulse; **(F)** posterior tibial pulse; **(G)** dorsalis pedis pulse.

PROCEDURE 34-8

Measuring Radial Pulse

Objective ◆ *Perform all steps of the procedure, and provide an accurate radial pulse reading.*

EQUIPMENT AND SUPPLIES

Paper and pen; patient's medical record; watch with second hand

1. Perform hand hygiene.
2. Greet and identify the patient.
3. Explain the procedure.
4. Ask if the patient has recently smoked or performed physical activity. Both of these factors can cause the pulse rate to increase.
5. Ask the patient to sit down and place the arm in a comfortable, supported position. The hand should be at or below chest level with the palm facing up.

FIGURE A Measuring a patient's radial pulse.

6. Place fingertips on the radial artery on the thumb side of the wrist (Figure A).
   a. Apply enough pressure to feel the pulse. Use caution in pressing too hard because this may collapse the artery and interrupt the pulse.
7. Check the characteristics of the pulse for volume and rhythm.
8. Start counting pulse beats when the second hand on the watch is at 3, 6, 9, or 12.
9. Count the pulse for 1 full minute (60 seconds).
   a. Some medical offices may allow a count for 30 seconds, which is then multiplied by 2. When this is the case, the pulse rate will always be an even number.
10. Perform hand hygiene.
11. Record the pulse beats per minute in the patient's medical record, describing any characteristics or abnormalities in pulse rate.

CHARTING EXAMPLE

2/14/YY 4:00 P.M. P: 72 bpm, regular and strong ..... M. King, CMA

measurement in infants and young children. The physician may also request an apical rate be taken when a patient is on heart medications.

Normally, a patient's pulse rates are the same, regardless of the location where they are taken. However, an apical–radial (A-R) pulse rate may be taken to determine if there is a difference between the pulse rates at the two sites. An A-R pulse must be taken for a full minute, rather than a 30-second count multiplied by two, which is common for pulse measurements at other locations. It is most often performed by two people, taking count at the same time. When taking an A-R pulse, have only one person responsible for using the watch. This person will raise one finger or nod the head when counting begins and lower the finger or nod again when a minute has passed. Coordination of timing is imperative when performing this procedure. When only one person is doing the procedure, the apical pulse rate is taken first and then the radial pulse rate.

After the A-R pulse is taken, the radial measurement is subtracted from the apical measurement to determine the **pulse deficit**. The radial pulse should never be greater than the apical pulse. A pulse deficit may indicate that the heart contractions are not strong enough to produce a palpable radial pulse. An A-R pulse will be performed only when ordered by the physician. Refer to Procedure 34-9 for taking an A-R pulse.

PROCEDURE 34-9

Measuring Apical–Radial Pulse (Two Person)

Objective ◆ *Perform all steps of the procedure, and provide an accurate apical–radial pulse reading.*

EQUIPMENT AND SUPPLIES

Stethoscope; alcohol wipe/cotton balls with 70 percent isopropyl alcohol; paper and pen; patient's medical record; watch with second hand

METHOD

1. Perform hand hygiene.
2. Disinfect the stethoscope using an alcohol wipe to cleanse the earpieces and diaphragm of scope.
3. Greet and identify the patient.
4. Explain the procedure. If the patient is a child, explain the procedure to both the parent and child.
5. Uncover the left side of the patient's chest. Provide privacy with a drape, if necessary.
6. The first person will place the earpieces of the stethoscope in her ears, with openings of the ear tips pointing forward.
7. Locate the apex of the patient's heart by palpating to the left fifth intercostal space (between the fifth and sixth ribs) at the midclavicular line, just below the nipple (Figure A).

FIGURE A–C **(A)** The first medical assistant locates the apical pulse. **(B)** The second medical assistant locates the radial pulse. **(C)** One medical assistant takes responsibility for watching the time during the 1 minute of counting.

8. Warm the chest piece by holding it in the palm of the hand before placing onto patient's chest.
9. The second person will locate the radial pulse in the thumb side of the wrist, 1 inch below the base of the thumb (Figure B).
10. The first person places the chest piece of the stethoscope at the apex of the heart. When the heartbeat is heard, a nod is made to indicate to the second person that counting should begin. The count should begin when the second hand is at 3, 6, 9, or 12 (Figure C).
11. Count for 1 full minute (60 seconds), and nod to the second person when time is up and counting should cease.
12. Remove the stethoscope and earpieces.
13. Record the rate and quality of the heartbeats. Include both apical and radial rates using the designation "AP" and "R," respectively. Calculate the pulse deficit by subtracting the radial pulse rate from the apical pulse rate.
14. Assist the patient with dressing, if necessary, and from the examining table.
15. Wipe the earpieces and chest piece of the stethoscope with alcohol wipes or cotton balls and alcohol.
16. Perform hand hygiene.

Note: Both systole and diastole (or "lub/dub") counts as one beat.

CHARTING EXAMPLE

2/14/YY 4:00 P.M. P: 82 (AP), 78 (R); Pulse deficit 4. Quality of beat strong. ..... M. King, CMA

RESPIRATION

Respiration, or the act of breathing, is the process of inhaling oxygen into the body and exhaling carbon dioxide. One respiration, also called the **respiratory cycle**, consists of one expiration (exhalation) and one inspiration (inhalation). Respiratory rate is an indicator of how well oxygen is being provided to the tissues of the body. Respirations are counted by watching, listening, or feeling the movement of inspiration and expiration on the patient's back, stomach, or chest. A stethoscope also may be used to assist with counting respirations.

Characteristics of Respiration

Medical assistants often observe and count a patient's respiration rate immediately after the pulse rate has been taken.

Respiration rates should not be measured if the patient has recently experienced exertion, such as climbing stairs or exercising, unless so ordered by the physician. When counting a patient's respiration rate, watch or feel the rise and fall of the chest. Each rise and fall constitutes one complete respiration.

The patient's respiration rate should be measured without the patient knowing. This is because, if patients are aware their rate is being measured, they will often exert control over their breathing rate, either consciously or subconsciously. It is recommended that you count respirations while you appear to be counting the pulse. This will result in a more accurate measurement of the patient's respiratory rate.

In general, the respiratory rate is one-quarter of the pulse rate. However, it is never appropriate to calculate a respiration by dividing the pulse rate by four. Respiration rates must always be counted and measured for one full minute (60 seconds).

When the respiration rate is taken, several characteristics should be noted: rate, rhythm, depth, and the quality or characteristics of breathing. Procedure 34-10 describes how to measure the patient's respiration rate.

Respiratory Rate

Respiratory rate is the number of respirations per minute. The normal respiration rate for healthy adults at rest is 12 to 20 cycles per minute. Children have a more rapid rate of breathing than adults, with an average of 30 to 60 cycles per minute, depending on age. Table 34-8 lists respiratory rates for various age groups. An adult respiratory rate below 12 (**bradypnea**) or above 20 (**tachypnea**) should be considered a

PROCEDURE 34-10

Measuring Respirations

Objective ◆ *Perform all steps of the procedure, and provide an accurate respiration measurement.*

EQUIPMENT AND SUPPLIES

Patient's medical record; watch with sweeping second hand; paper and pen

METHOD

1. Perform hand hygiene.
2. Greet and identify the patient.
3. Assist the patient into a comfortable position.
4. Place your hand on the patient's wrist in position to take the pulse, or place your hand on the patient's chest or back (Figure A).
5. Count each breathing cycle by observing or feeling the rise and fall of the chest, back, or upper abdomen.
6. Count for 1 full minute (60 seconds) using a watch with a second hand. If the rate is atypical or unusual in any way, count respirations again for another minute.
7. Record the respiratory rate in the patient's medical record, noting any abnormality in rate, rhythm, and depth.
8. Perform hand hygiene.

FIGURE A A patient who knows her respirations are being counted may alter her breathing, so the medical assistant counts respirations while appearing to be taking a pulse.

CHARTING EXAMPLE

2/14/YY 4:00 P.M. R: 20 and regular. ..... M. King, CMA

TABLE 34-8 | Respiratory Rate Ranges of Various Age Groups

Newborn	30–50
1–2 years old	20–30
3–8 years old	18–26
9–11 years old	16–22
12–Adult	12–20

serious symptom and immediately brought to the physician's attention. Rapid respirations are usually shallow in depth because the lungs are unable to fully expand. **Apnea** means the absence of breathing for a period lasting longer than 19 seconds, and **eupnea** refers to normal breathing.

Many factors may affect the respiratory rate: elevated temperature, age, pain, medications, and some medical conditions. For example, an elevated body temperature in both adults and children can result in an elevated respiratory rate. Extreme pain may also cause respirations to increase. Table 34-9 lists situations that may affect respiratory rate.

Respiratory Rhythm

Respiratory rhythm, similar to pulse rhythm, refers to the regular and equal spacing of breaths. In a regular respiratory rhythm, the cycles of inspiration and expiration have about the same rate and depth. With irregular breathing patterns, the depth and amount of air inhaled and exhaled and the rate of respirations per minute will vary.

When you detect abnormalities in respiratory rhythm, continue assessment and measurement of breathing for 2 to 3 more minutes. This will help establish a more complete pattern of what is happening with the patient's respiratory cycle. Patients with emphysema may not experience difficulty with inhalation but may struggle to fully exhale. Asthma may also cause an irregularity in breathing rhythm.

TABLE 34-9 | Situations Causing Changes in Respiratory Rate

Increased Rate	Decreased Rate
Allergic reactions	Certain drugs (e.g., morphine)
Certain drugs (e.g., epinephrine)	Decrease of CO_2 in blood
Disease (e.g., asthma, heart disease)	Disease (stroke, coma)
Exercise	
Excitement/anger	
Fever	
Hemorrhage	
High altitudes	
Nervousness	
Obstruction of air passage	
Pain	
Shock	

Respiratory Depth

The depth of respiration is the volume of air that is inhaled and exhaled. It is described as either "shallow" or "deep." Rapid but shallow respirations occur in some disease conditions, such as high fever, shock, and severe pain. **Hyperventilation** refers to deep and rapid respirations, and **hypoventilation** refers to shallow and slow respirations.

When a patient is unable to take in enough oxygen during inhalation, the body becomes deprived of the amount of oxygen needed for proper functioning. If oxygen deprivation continues, the skin around the mouth and nail beds of the hands and feet may appear bluish in color because of the increase of carbon dioxide (CO_2). The resulting condition is called **cyanosis**. In this situation, you must note both the depth of respiration and the signs of cyanosis in the patient's record.

Respiratory Quality

Respiratory quality or character refers to breathing patterns—both normal and abnormal. Labored breathing refers to respirations that require greater effort from the patient.

Breath Sounds

Normal respirations do not usually have any noticeable sounds. However, certain diseases and illnesses can cause irregular respiration sounds. Terms for describing these abnormal breath sounds include the following:

- **Stridor**—A shrill, harsh sound, heard more clearly during inspiration but that can occur during expiration. This sound may occur when there is airway blockage, such as in children with croup and patients with laryngeal obstruction.
- **Stertor** (stertorous breathing)—Noisy sounds during inspiration, sounds similar to those heard in snoring.
- **Crackles** (also called rales)—Crackling sounds resembling crushing tissue paper, caused by fluid accumulation in the airways. Crackles can be further defined as coarse or fine. Crackles can be heard with pulmonary edema, asthma, early congestive heart failure, and some types of pneumonia.

- **Rhonchi**—Rattling, whistling, low-pitched sounds made in the throat. Rhonchi can be heard in patients with pneumonia, chronic bronchitis, cystic fibrosis, or COPD (chronic obstructive pulmonary disease).
- **Wheezes**—Sounds similar to rhonchi but more high-pitched, made when airways become obstructed or severely narrowed, as in asthma or COPD.
- **Cheyne-Stokes breathing**—Irregular breathing that may be slow and shallow at first, then faster and deeper, and that may stop for a few seconds before beginning the pattern again. This type of breathing may be seen in certain patients with traumatic brain injury, strokes, and brain tumors.

BLOOD PRESSURE

Blood pressure (BP) is one of the most important vital signs because it aids in diagnosis and treatment, especially for cardiovascular health. Blood pressure readings are almost always taken at every medical visit, even if it is the only vital sign obtained.

Blood Pressure Readings

Blood pressure is the amount of force exerted on the arterial walls while the heart is pumping blood—specifically, when the ventricles contract. Blood pressure is measured by gauging the force of this pressure through two specific readings: systolic and diastolic. **Systolic blood pressure** is the highest pressure that occurs as the left ventricle of the heart is contracting. **Diastolic blood pressure** is the lowest pressure level that occurs when the heart is relaxed and the ventricle is at rest and refilling with blood. The pulse beat is felt (or heard) at the systolic pressure level and is absent at the diastolic pressure level.

While blood pressure is read in millimeters (mm) of mercury (Hg), or "mmHg," it is not necessary to reference millimeters of mercury when recording blood pressure readings in the patient's medical record. Blood pressure is recorded using just the systolic (highest pressure) reading over the diastolic (lowest pressure), similar to writing a fraction. For example, 120/80 would indicate a systolic pressure of 120 (mmHg) and a diastolic reading of 80 (mmHg). **Pulse pressure** is the difference between the systolic and diastolic readings and calculated by subtracting the diastolic reading from the systolic reading. If the blood pressure is 120/80, the pulse pressure is 40. In general, a pulse pressure that is *greater than 40 mmHg* is considered widened, and one that is *less than 30 mmHg* is considered to be narrowed. A widened pulse pressure may be an indicator for cardiovascular disease and anemia. A narrowed pulse pressure may be an indicator for congestive heart failure (CHF), stroke, or shock. Although pulse pressure is useful in predicting cardiovascular risk in patients, it should not be used alone and depends on various other factors, such as the patient's BP and age.

Measuring blood pressure as a routine part of office visits starts with children ages 5 and over. Readings on younger patients may also be obtained if it is considered medically necessary and ordered by the physician. Often, patients who are newly diagnosed with hypertension will have specialized office visits to routinely evaluate their blood pressure and to see if recommended lifestyle changes and/or medications are effectively lowering blood pressure. These office visits are generally short in length, 15 minutes or less, and are usually scheduled every 3 to 6 months once the patient's blood pressure is stable. Patients with sustained high blood pressure measurements may require more office visits and further diagnostic testing for the presence of other disease conditions to lower the blood pressure. It is important to control a patient's blood

Professionalism The Life Span

As a medical assistant, you will assess vital signs on patients at both ends of the age spectrum. The following are a few considerations to keep in mind when dealing with infants:

- If an infant is crying, all vital signs will be increased. Try to calm the infant by having the parent hold the infant before obtaining the full set of vital signs.
- Always measure the infant's apical pulse when obtaining a pulse rate.
- When assessing the respiratory rate, try to calm the infant. Place your hand on the abdomen to feel inhalation and exhalation.
- When measuring the weight and length of an infant, safety should be your number one priority.

Professionalism The Workplace

As a medical assistant, you should have your own personal equipment to help you perform your daily job functions. You should have your own stethoscope, which also helps to prevent the spread of infection among coworkers. You should also have a watch with a sweeping second hand so you can accurately count pulse and respiration rates.

pressure because it can lower that person's risk of stroke and heart attack.

Many patients experience "white coat syndrome," which is apprehension about visiting the physician. This apprehension may result in elevated blood pressure readings. Often these same individuals, when tested at home, have readings that are within the normal range. If a patient's blood pressure reading deviates higher from that person's normal range, blood pressure should be tested again before the end of the office visit.

Ideally, blood pressure is measured while the patient is seated in an upright position with both feet flat on the floor. Sitting with legs crossed at the knees can elevate blood pressure readings. If warranted by the patient's condition, blood pressure may be measured while the patient is lying down on an examination table. When this is the case, it should be properly noted in the patient's medical record.

A rise or fall in blood pressure is an indication for many medical conditions. Table 34-10 shows the recommended blood pressure range for healthy adults. Having a systolic above 120 mmHg and a diastolic above 80 mmHg are considered abnormal increases and may lead to **hypertension (HTN)**. As shown in the table, a patient may still have hypertension even if one measurement is low and the other high. This is called isolated hypertension.

Hypertension can be categorized as primary (essential) HTN or secondary HTN. Primary (essential) HTN has no known clear cause but it is thought to result from genetics, poor diet, lack of exercise, or obesity. However, many people who are healthy and frequently exercise may still have primary hypertension. In secondary HTN, the high blood pressure results from another medical condition, such as renal (kidney) or cardiovascular disease, pregnancy, or an endocrine disorder. Patients diagnosed with HTN may often be **asymptomatic** (without any symptoms), which is why it is often called the "silent killer." Other patients, however, may experience headache, blurred vision, and chest pain.

Hypotension is low blood pressure and may be a result of emotional shock, trauma, central nervous system disorders, or medications. Symptoms of hypotension include dizziness and **syncope** (fainting).

Korotkoff Sounds

Korotkoff sounds, named after the Russian neurologist, Nicolai Korotkoff, are the rhythmic, tapping sounds heard while taking blood pressure as the arterial wall distends under the compression of the cuff. These sounds appear and disappear as the blood pressure cuff is inflated and deflated.

With the blood pressure cuff placed and inflated on the brachial artery, no sound can be heard through the stethoscope because the brachial artery is fully compressed and no blood is flowing through it. As the cuff deflates and air is slowly removed from the cuff, the Korotkoff sounds become audible.

There are five phases of Korotkoff sounds, sometimes denoted as Phase I–V or KI–V. The medical assistant should practice taking blood pressure readings slowly to be able to identify each phase. The systolic pressure is the measurement that is read when the first distinct clear tapping sound is heard as the cuff deflates, which is in Phase I. The diastolic pressure is the pressure measurement at which the last sound is heard, which occurs in either Phase IV or V. Some facilities and physicians measure the diastolic pressure at Phase IV when the sound changes from a clear tapping or thumping sound to a more muffled, softer sound. When the fourth sound is used as the diastolic pressure, three readings are often made: systolic, first diastolic (fourth Korotkoff sound), and second diastolic (last sound). Such a reading might be recorded as 138/86/78. Korotkoff sounds are described in Table 34-11 and Figure 34-11.

Blood Pressure Guidelines

Blood pressure readings can vary among adults, regardless of their health. Because of this, blood pressure ranges have been established to identify normal and abnormal blood pressure measurements. A deviation of 20 to 30 mmHg from the patient's baseline measurement can be a significant indicator of a change in health status for that patient. Average normal blood pressure readings by age are listed in

TABLE 34-10 | **Blood Pressure Guidelines**

Blood Pressure Category	Systolic (mmHg)		Diastolic (mmHg)
Normal	less than 120	and	less than 80
Prehypertension	120–139	or	80–89
Hypertension	140–179	or	90–109
Hypertensive Crisis (Emergency)	Higher than 180	or	Higher than 110

TABLE 34-11 | Five Phases of Korotkoff Sounds	
Phase I	This is the first faint sound heard as the cuff is deflated. The number that appears on the blood pressure gauge at that moment is recorded as the systolic pressure reading. The cuff must first be inflated to a level high enough to hear this first sound during relaxation. If the cuff is not inflated high enough and a pulse is heard immediately after deflation, stop the procedure, remove the cuff, wait a couple of minutes, and then start the procedure again, inflating the cuff at least 20 mmHg above the first attempt.
Phase II	The second phase occurs as the cuff continues to be deflated and more blood flows through the artery. This sound has a swishing quality. The cuff has to be slowly deflated to hear this soft sound. An auscultatory gap is said to have occurred if there is a total loss of sound that then reoccurs later. An auscultatory gap can occur in certain cases of heart disease and hypertension and should be reported to the physician.
Phase III	During this phase, the sound will become less muffled and develop a crisp tapping sound as the blood flow moves easily through the artery. If the BP cuff was not inflated enough to hear the Phase I sound, then the Phase III sound may be heard and incorrectly stated as the systolic reading.
Phase IV	This phase is characterized by the sound beginning to fade and become muffled. The American Heart Association, which believes Phase IV is the best indicator of the diastolic pressure, recommends the reading at this phase be recorded as the diastolic pressure for a child.
Phase V	Sound will disappear during this phase. Some physicians may require both Phase IV and Phase V recorded for the diastolic pressure reading.

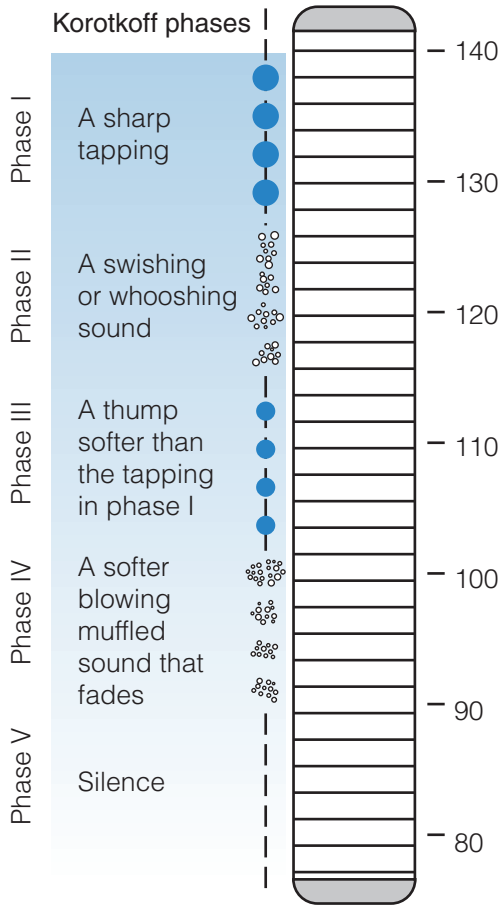

FIGURE 34-11 Phases of the Korotkoff sounds.

Table 34-12. Although an average blood pressure is listed for a newborn, blood pressure readings are not generally taken on infants.

TABLE 34-12 | Average Normal Blood Pressure Readings	
Newborn	75/55
6–9 years of age	90/55
10–15 years of age	100/65
16 years to adulthood	118/76
Adult	119/78

Factors Affecting Blood Pressure

Many physiological factors may affect blood pressure, including volume or amount of blood in the arteries, peripheral resistance of the vessels, condition of the heart muscle, and elasticity of vessels. These four factors are discussed in Table 34-13.

In addition, other factors may affect blood pressure, especially gender and age. Women generally have a lower blood pressure than men. Blood pressure is lowest at birth and tends to increase as people age. The time of day can also cause blood pressure variations. For example, blood pressure is usually at its lowest early in the morning and just before waking. Activities such as standing, sitting, or lying down can affect blood pressure. Additionally, the blood pressure reading in the right arm is usually 3 to 4 mmHg higher than in the left arm, so it is often required to document which arm was used for the blood pressure reading. Numerous other situations that can affect blood pressure readings are listed in Table 34-14. Terms

TABLE 34-13 | Physiological Factors Affecting Blood Pressure

Volume of Blood	Increase of blood volume increases the BP. Decrease of blood volume decreases BP. *Example:* Hemorrhage (excessive bleeding) causes volume and BP to drop.
Peripheral Resistance	Relates to the size of the lumen (the cavity or space) within blood vessels and amount of blood flowing through it. *Example:* The smaller the diameter of the lumen, the greater the resistance to blood flow. Fatty cholesterol deposits result in high BP as a result of narrowing of the lumen.
Condition of Heart Muscle	Strength of the heart muscle affects volume of blood flow. The pumping action of the heart and how efficiently it circulates blood affect the BP. *Example:* A weak heart muscle can cause an increase or decrease in BP.
Elasticity of Vessels	The ability of blood vessels to expand and contract decreases with age. *Example:* Nonelastic blood vessels, as in arteriosclerosis, cause an elevated BP.

TABLE 34-14 | Causes of Blood Pressure Variations

Elevated/Increased BP	Lowered/Decreased BP
Anger	Anemia
Certain drug therapies, nicotine, caffeine	Approaching death
Endocrine disorders (hyperthyroidism)	Cancer
Exercise	Certain drug therapies (antihypertensives, narcotics, analgesics, diuretics)
Fear, excitement	Decreased arterial blood volume (hemorrhage)
Heart and liver disease	Decreased arterial BP
Increased arterial BP	Dehydration
Late pregnancy	Massive heart attack
Lying down position with legs elevated	Middle pregnancy
Obesity	Shock
Pain	Starvation
Renal disease	Sudden postural changes
Rigidity of blood vessels	Thyroid and adrenal disorders
Smoking	Time of day (during sleep and early morning)
Stress, anxiety	Weak heart
Taking pressure at the right arm	
Vasoconstriction or narrowing of peripheral blood vessels	

relating to abnormal blood pressure readings are described in Table 34-15.

Blood pressure is commonly measured while the patient is seated; measurements will vary depending on the patient's position. For example, the systolic pressure may be lower and diastolic pressure may be higher if the patient was supine (in a lying-down position). If the patient's arm is lower than the level of the heart, blood pressure measurements will be higher. Thus, when documenting blood pressure, it is important to indicate the patient's position if it is different than the normal seating position.

Orthostatic hypotension (or postural hypotension) refers to a drop in blood pressure that occurs when a patient changes positions from lying down or sitting to standing. Orthostatic hypotension can make you feel dizzy or lightheaded, and maybe even faint, especially if it occurs suddenly. Mild or short-term orthostatic hypotension often does not need treatment or further investigation. However, long-lasting orthostatic hypotension,

TABLE 34-15 | Terms Related to Abnormal Blood Pressure Readings

Benign	Slow-onset elevated blood pressure without symptoms.
Essential	Primary hypertension of unknown cause. It may be genetically determined.
Hypertension	A condition in which the patient's blood pressure is consistently above the norm for that patient's age group. Also called high blood pressure.
Hypotension	Condition of abnormally low blood pressure that may be caused by shock, hemorrhage, and central nervous system (CNS) disorders.
Malignant	Rapidly developing elevated blood pressure that may become fatal if not treated immediately.
Orthostatic (Postural)	A temporary fall in blood pressure caused by a sudden change in body position, such as a patient moving rapidly from a lying to a standing position. Dizziness and blurred vision can also be present.
Renal	Elevated blood pressure as a result of kidney disease.
Secondary	Elevated blood pressure associated with other conditions such as renal disease, pregnancy, arteriosclerosis, and obesity.

especially if a loss of consciousness occurs, may be a sign of a more serious underlying condition.

Although blood pressure is routinely measured at almost every office visit, it is especially important to obtain a measurement in the following patients:

- Patient is on antihypertensive drugs.
- Patient has a history of heart disease, diabetes, kidney disease, stroke, or hypertension.
- Patient (including children) is receiving a complete physical examination.
- Patient is pregnant.
- Patient is receiving preoperative or postoperative care.
- Patient is bleeding or in shock.
- Patient has symptoms of a neurological disorder.
- Patient is experiencing allergic reactions.

As with all vital signs, blood pressure readings should be interpreted in relation to the patient's baseline measurement. This means that the blood pressure reading taken when the patient was not ill should be used as that patient's "normal" measurement. All subsequent readings are then compared with that patient's "normal" baseline reading.

Equipment for Measuring Blood Pressure

Two pieces of equipment are necessary for measuring blood pressure: a sphygmomanometer and a stethoscope. The **sphygmomanometer**, more commonly referred to as a blood pressure cuff, is the instrument used for measuring the pressure that the blood exerts against the walls of the artery (Figure 34-12). The stethoscope is a diagnostic instrument that amplifies sound. It is used to detect sounds produced by blood pressure, as well as the heart and other internal organs such as the stomach.

FIGURE 34-12 A portable sphygmomanometer.

Sphygmomanometer

The components of a sphygmomanometer are a manometer, inflatable rubber bladder, cuff, and bulb. The **manometer** is a scale that registers the actual pressure reading. The core of the blood pressure cuff is the rubber bladder, which is inflated and temporarily constricts blood circulation in the arm. A soft material cuff covers the bladder and is placed next to the skin of the patient. The pressure bulb has a thumbscrew attached to a control valve that allows for inflation and deflation of the cuff.

Using the correct-size blood pressure cuff is critical and will ensure a more accurate blood pressure reading. A cuff that is too large may result in a lower reading, and a cuff that is too small may result in a higher reading. Three sizes are available: a small cuff for a child (blood pressure cuffs are not generally used on infants) or a frail or small-limbed adult; a

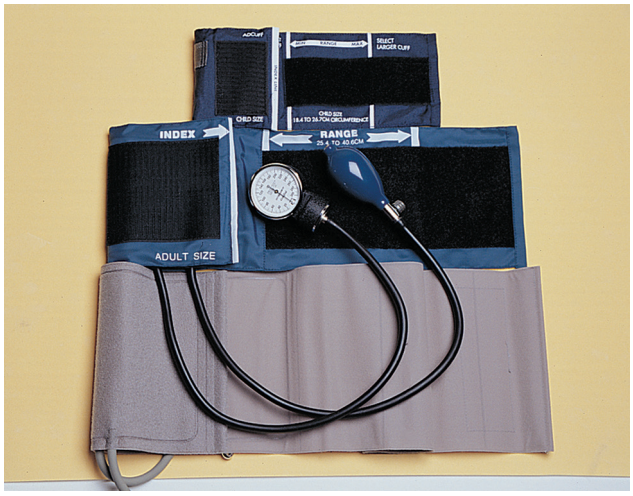

FIGURE 34-13 Three standard sizes of cuffs: a small cuff for a child or frail adult; a normal-size adult cuff; and a large-size cuff to measure blood pressure on the thigh or on the arm of an obese adult.

normal adult size; and a large size for measuring blood pressure on the leg (thigh) or on the arm of a large or obese adult (Figure 34-13). When a leg cuff is used, the popliteal artery (behind the knee) is palpated for a pulse.

There are three types of sphygmomanometers: mercury, aneroid, and electronic.

Mercury Sphygmomanometer. The mercury sphygmomanometer is not as widely used as the aneroid version (Figure 34-14). As stated earlier, mercury is a toxic substance and so mercury sphygmomanometers are being replaced for safety reasons. However, mercury instruments may still be found attached to the walls in many physicians' offices. They contain a column of mercury that rises as the pressure bulb is squeezed and the rubber bladder inflated. A calibrated scale

FIGURE 34-14 A portable mercury sphygmomanometer. Mercury versions are being phased out of medical offices and facilities.

FIGURE 34-15 An electric sphygmomanometer.

runs down both sides of the mercury column. The reading is taken at eye level at the top of the mercury line next to a calibrated scale. This type of instrument must be placed vertically on the wall or on a flat, level surface so that the mercury will rise in a vertical position. Periodic recalibration is necessary to maintain accuracy.

Aneroid Sphygmomanometer. The aneroid sphygmomanometer has a round dial that contains a scale calibrated in millimeters (mm). A needle is attached to the scale to register the reading. The needle must be at zero before starting the procedure. The aneroid sphygmomanometer should be recalibrated for accuracy every year either according to the manufacturer's instructions or by comparing it with a properly calibrated model.

Electronic Sphygmomanometer. The electronic version provides a digital readout on a lighted display. It is easy to use and does not require a stethoscope (Figure 34-15). Many hospitals and outpatient facilities have adopted the electronic sphygmomanometers for their efficiency and accuracy.

Stethoscope

The stethoscope is used to detect sounds produced by blood pressure. This instrument consists of a chest piece containing a diaphragm and/or bell, flexible tubing, binaural, a spring mechanism, and earpieces. The key components of the stethoscope are described in Table 34-16 and shown in Figure 34-16A–B. Besides measuring blood pressure, stethoscopes are used to measure apical pulse, heart sounds, and respiration rates.

Measuring Blood Pressure

Try to ensure that the patient is relaxed before obtaining a blood pressure reading, which will result in a more accurate measurement. After greeting the patient, explain in a calm, quiet manner what the procedure will entail and that the procedure is not painful. To the majority of patients, a blood

TABLE 34-16 | **Components of the Stethoscope**

Chest Piece	Portion of the instrument that is placed over the site where the sound is to be heard. May consist of a diaphragm or a bell or both.
Diaphragm	A disc-like sound sensor that picks up both low- and high-pitched sound frequencies. More useful for high sounds such as bowel and lung sounds.
Bell	A hollow, curved bell or cup-shaped sound sensor that may have one, two, or three "heads" that are useful in picking up sounds of the cardiovascular system.
Flexible Tubing	Rubber or plastic tubing to carry the sound from the patient to the binaurals. The usual length of tubing is 12 to 14 inches. Some people prefer using longer tubing, up to 22 inches. However, some of the sound clarity is lost as the tubing becomes longer.
Binaurals	Rigid, small metal tubes that connect the tubing to the earpieces.
Spring Mechanism	Flexible external metal spring that holds the binaural steady so that the earpiece will remain in the ear.
Earpieces	Molded plastic tips that attach to the end of the binaurals and are placed in the medical assistant's ears.

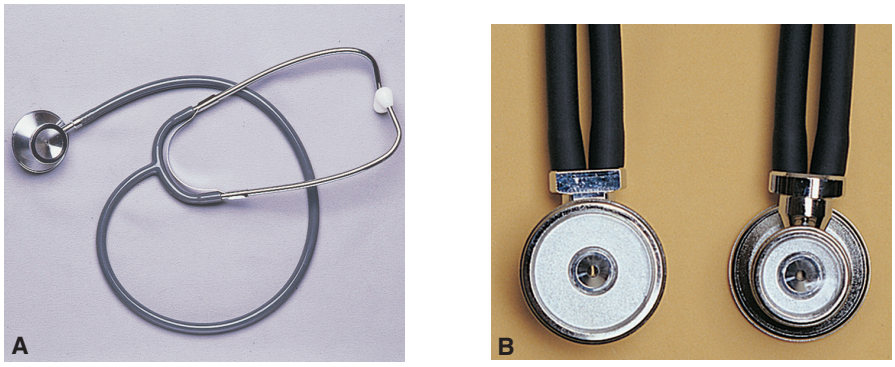

FIGURE 34-16 **(A)** Stethoscope with both a bell and flat disc amplifier. **(B)** Close-up view of a diaphragm amplifier on the left and a bell amplifier on the right.

pressure reading is not a new experience. Ask the patient if he has a history of hypertension and if the patient is aware of his normal blood pressure reading. This will guide you when you have to inflate the cuff (30 mmHg over the normal systolic pressure). It is also beneficial to check the patient's last recorded blood pressure readings from previous visits to serve as a guide.

If this is a new patient visit, a blood pressure reading should be obtained on each arm and recorded in the medical record. Procedure 34-11 lists the procedures for measuring systolic and diastolic blood pressures. Remember to be aware of your office protocol regarding informing patients of their blood pressure readings. Many offices require that the physician discuss the readings with the patient because it is the physician's duty to interpret and discuss results.

Causes of Error in Blood Pressure Measurements

Accuracy is very important in measuring blood pressure. Many diagnosis and treatment plans for a patient are based on a blood pressure assessment. Table 34-17 describes common causes of errors while taking a patient's blood pressure. It should be noted that one measurement of high blood pressure does not make the diagnosis of hypertension. It usually takes two to three readings at several office visits to diagnose hypertension. Further, abnormal blood pressure measurements are often found with other conditions, such as kidney disease and stress.

OXYGEN SATURATION

For patients with cardiac and pulmonary disorders, it may be necessary to determine the oxygen content of the blood, or **oxygen saturation**. An electronic **pulse oximeter** is a device that can be clipped on the bridge of the nose, forehead, earlobe, or tip of a finger and can determine the oxygen concentration in arterial blood. A pulse oximeter is useful in measuring blood oxygenation even before clinical signs of hypoxia (reduced oxygen in the body tissues) are present. The oximeter measurement, reported as SpO^2 (saturation of peripheral oxygen), can help determine if treatment is

PROCEDURE 34-11

Measuring Blood Pressure

Objective ◆ *Obtain an accurate systolic and diastolic blood pressure reading.*

EQUIPMENT AND SUPPLIES

Sphygmomanometer; stethoscope; 70 percent isopropyl alcohol; alcohol sponges or cotton balls; paper and pen; patient's medical record

METHOD

1. Perform hand hygiene.
2. Assemble the equipment. Using an alcohol wipe or cotton ball with 70 percent isopropyl alcohol, thoroughly cleanse the earpieces, bell, and diaphragm pieces of the stethoscope. Allow the alcohol to dry.
3. Greet and identify the patient, and explain the procedure.
4. Assist the patient into a comfortable position. BP may be taken with the patient in a sitting or supine (lying-down) position.
   a. The patient's arm should be at heart level. If the patient's arm is below heart level, the BP reading may be higher than normal.
   b. Patients should be reminded not to cross their legs or talk during the procedure.
5. Uncover the patient's arm 5 inches above the elbow. If the sleeve becomes constricting when rolled back, ask the patient to slip the arm out of the sleeve.
   a. Never take a BP reading through clothing.
   b. Sleeves that are too tight, when rolled up, will produce an inaccurate result.
6. Locate the brachial artery within the antecubital space (bend in the elbow) by palpating with your fingertips. If the pulse is stronger in one arm than the other, use the arm with the stronger brachial artery pulse.
7. Have the patient straighten the arm with palm up and apply the proper-size cuff of the sphygmomanometer over the brachial artery 1 to 2 inches above the antecubital space (Figure A).
   a. Many cuffs are marked with arrows or circles to be placed over the artery.
   b. Hold the edge of the cuff in place as you wrap the remainder of the cuff tightly around the arm. If the cuff has a Velcro closure, press it into place at the end of the cuff (Figure B).
   c. The manometer should be at eye level for a more accurate reading.
8. With the fingertips of your nondominant hand, palpate the pulse in the radial artery. Then, with your dominant hand, tighten the thumbscrew on the hand bulb and pump air into the cuff quickly and evenly. Pump 20–30 mmHg above the point at which the radial pulse is no longer palpable. Make note of this point. Rapidly deflate the cuff and wait 60 seconds before continuing.

FIGURE A–C **(A)** Have the patient extend the arm, palm up, and apply the blood pressure cuff over the brachial artery, 1–2 inches above the antecubital space. **(B)** Hold the cuff in place, and wrap the remainder of the cuff tightly around the arm. **(C)** Place the earpieces in your ears and the diaphragm or bell of the stethoscope over the pulsating brachial artery.

9. Place the earpieces in your ears and the diaphragm (or bell) of the stethoscope over the area of the pulsating brachial artery (Figure C).
    a. Hold the diaphragm in place with your nondominant hand, and avoid covering the diaphragm.
    b. The stethoscope tubing should hang freely and not touch the patient or any object during the reading.
10. Close the thumbscrew by turning clockwise with your dominant hand on the hand bulb so no air leaks out. Do not close so tightly that you will have difficulty reopening it with one hand.
11. Pump the cuff to the point where the radial artery pulse is no longer palpable (step 9).
12. Slowly turn the thumbscrew counterclockwise with your dominant hand, allowing the pressure reading to slowly and evenly fall 2 to 3 mmHg at a time.
13. Listen for the point at which the first clear "bump" sound is heard (Phase I). Take note where this occurred on the manometer. This is the systolic pressure.
14. Slowly continue to allow the cuff to deflate. The sounds will change from loud to murmur and then fade away (Phases I, II, III, and IV). Take note where no sound or "bump" is heard on the manometer. This is the diastolic pressure (Phase IV or V).
15. Quickly open the thumbscrew all the way to release the air and deflate the cuff completely.
16. If you are unsure about the BP reading, wait at least a minute or two before attempting to take a second reading.
    a. Never take more than two readings in one arm, because blood stasis may have occurred, resulting in an inaccurate reading and discomfort for the patient.
17. Remove the cuff from the patient's arm.
18. Clean the earpieces and diaphragm or bell of the stethoscope with an alcohol wipe.
19. Perform hand hygiene.
20. Document the patient's BP as a fraction into the patient's medical record, making note of which arm was used and the patient's position.

CHARTING EXAMPLE

2/14/YY 9:00 A.M. B/P: 134/88 left arm, sitting .....
..... M. King, CMA

TABLE 34-17 | Causes of Error in Blood Pressure Readings

Equipment Errors	• Cuff is improper size. The cuff bladder should be 20 percent wider than the diameter of the extremity where the cuff is placed. Large cuffs for obese arms and small cuffs for children should be available in all offices. • Air leaks in the cuff bladder delay the inflation rate and could give a false high reading. Air leaks may also occur along the tubing if it is old or worn. • Sphygmomanometer is not properly calibrated. • Velcro on the cuff may be worn and does not hold.
Procedural Errors	• Patient's arm is not uncovered, and reading is obtained through clothing. • Medical assistant is too far away from manometer to accurately read gauge. • Cuff is improperly applied (too loose or too small). • Cuff is not centered over the brachial artery, 1 to 2 inches above the antecubital space. • End of the cuff is not secured tightly. • Part of stethoscope tubing or chest piece touches the blood pressure cuff while taking the pressure reading. • Failure to locate brachial pulse before placing stethoscope in position. • The rubber bladder in the cuff was not deflated completely before beginning the procedure. • Valve on bulb is not completely closed before beginning to pump air into cuff. • Cuff was not inflated to a level 20 to 30 mmHg above the palpated or previously measured systolic pressure or 200 mmHg. • Deflation occurs too rapidly to accurately determine the sounds. • The arm used for the reading is not at the same level as the heart. • Failure to wait 1 to 2 minutes before taking second reading. • Failure to notice the auscultatory gap.
Patient-Related Errors	• Patient is nervous or anxious, resulting in a false high reading (such as "white coat syndrome"). • Patient's arm is too large for accurate reading with available equipment.

needed. As the medical assistant, you may obtain a pulse oximetry reading as a part of the vital signs or when the patient presents with symptoms indicating respiratory distress. Figure 34-17 shows a pulse oximeter.

Normal oxygen saturation (SpO^2) is 95 to 100 percent. Oxygen treatment and bronchodilators may be initiated when the patient has a SpO2 reading below 90 percent. A reading below 70 percent indicates a life-threatening situation.

FIGURE 34-17 A pulse oximeter.

Pulse oximeters are selected based on the patient's age, size, and condition. In an adult patient, the fingertip pulse oximeter is generally used. Nail polish should be removed before attaching the pulse oximeter so that the polish does not produce an inaccurate result. See Procedure 34-12 for how to use a pulse oximeter to measure oxygen saturation.

SUMMARY

Vital signs are an important objective indication of the patient's overall physical condition. One vital sign measurement taken alone does not necessarily provide a complete picture. Thus, the medical assistant must be able to skillfully take all vital measurements and be able to assess what she is observing, and whether the observations are considered normal based on the patient's age, gender, and physical condition.

The accuracy of obtaining and recording vital sign measurements is critical for the diagnosis and treatment of the patient. Measurements, such as height and weight, are an

PROCEDURE 34-12

Measuring Oxygen Saturation

Objective ◆ *Attach an oximeter, and measure oxygen saturation of patient.*

EQUIPMENT AND SUPPLIES

Pulse oximeter; nail polish remover; alcohol wipe; patient's medical record

METHOD

1. Perform hand hygiene.
2. Assemble equipment based on the type of sensor that will be used.
3. Warmly greet and identify the patient and explain the procedure.
4. Wipe the selected finger with an alcohol wipe, and allow it to air-dry. Remove nail polish as needed.
   a. If circulation is poor in the patient's hands, select an alternative location, such as the patient's feet, earlobe, or bridge of the nose.
5. Turn on the oximeter device, and verify it is properly functioning.
6. When prompted, attach the device to the patient's finger and wait for the beep (Figure A).
7. After the beep, record the oxygen saturation level in the patient's medical record as SpO_2 and a percentage.
8. If the oxygen saturation level is abnormal, immediately notify the physician of the results.

FIGURE A A fingertip oximeter.

9. Perform hand hygiene, and return the oximeter to its storage location.

CHARTING EXAMPLE

11/11/YY 9:15 A.M. HT: 67" WT: 186 lb P: 74 bpm BP: 136/84 SpO_2: 97%..... L. Morton CMA

important part of patient examination. Changes in height and weight can be indicators of a metabolic condition or other diseases that could affect the body. Body temperature is regulated by the hypothalamus, and slight fluctuations in temperature are normal throughout the day. A fever, or increased body temperature, can be indicative of an infection within the body. Pulse rate varies based on the patient's age, with infants having faster pulse rates and adults having slower pulse rates. Various factors can cause the pulse rate to increase or decrease. Medical assistants must be able to accurately measure the rate and quality of a patient's pulse. Respiratory rate is the number of times that a patient breathes (one complete inhalation and exhalation) in a minute. Respiration must also be assessed in regard to quality, specifically the rhythm and depth. Blood pressure measures the amount of force that is placed on the arterial walls during ventricular contraction. High blood pressure (or hypertension) is considered the "silent killer" because it often presents as asymptomatic in the patient. Thus, medical assistants must be able to obtain blood pressure measurement, as well as the other vital sign measurements, with accuracy and competency.

Although important in all aspects of medical assisting work, communication skills are essential when obtaining vital measurements. A positive and empathetic approach when interacting with patients will put the patient at ease and may result in obtaining more valid vital sign measurements.

34 CHAPTER REVIEW

COMPETENCY REVIEW

1. Define and spell the terms for this chapter.
2. Identify the formula for converting pounds to kilograms and vice versa.
3. Name five factors that affect body temperature.
4. Name the four types of fever.
5. What characteristics are considered when assessing respirations?
6. Explain what systolic and diastolic readings are.
7. What is the desirable range for blood pressure in an adult?
8. Name and locate the different pulse sites.
9. Why is hypertension referred to as the silent killer?
10. Explain orthostatic hypotension.

PREPARING FOR THE CERTIFICATION EXAM

1. An abnormally slow pulse rate is
   a. extrasystole.
   b. tachycardia.
   c. thready pulse.
   d. pulse volume.
   e. bradycardia.

2. Systolic pressure of 140 or above is referred to as
   a. bradycardia.
   b. tachycardia.
   c. hypertension.
   d. hypotension.
   e. pulse pressure.

3. Normal pulse rate for an adult is
   a. 12–20.
   b. 40–60.
   c. 60–100.
   d. 90–100.
   e. 100–200.

4. The normal rate of respiration per minute for adults is
   a. 6–10.
   b. 10–13.
   c. 12–20.
   d. 18–22.
   e. 22–28.

5. Although often taken at an office visit, which of the following is *not* considered a vital sign?
   a. weight
   b. respiration
   c. pulse
   d. temperature
   e. blood pressure

6. Which of the Korotkoff sounds represents the systolic pressure?
   a. absence of sound
   b. the muffled sound
   c. the first distinct sound
   d. the change of sound
   e. the light tapping sound

7. The term used to describe difficult or labored breathing is
   a. apnea.
   b. eupnea.
   c. orthopnea.
   d. tachypnea.
   e. dyspnea.

8. If a patient has a normal oral temperature, what is the patient's rectal temperature reading?
   a. 97.6°F
   b. 99.6°F
   c. 30.0°C
   d. 34.0°C
   e. 36.8°C

9. If pulse is taken at the wrist, the artery used is the
   a. temporal.
   b. carotid.
   c. popliteal.
   d. femoral.
   e. radial.

10. An increase in pulse rate may be caused by
    a. fever.
    b. pain relievers.
    c. mental depression.
    d. rest.
    e. chronic disease.

CRITICAL THINKING

Refer to the case study at the beginning of the chapter and use what you have learned to answer the following questions.

1. Elanya's vital signs are almost normal based on her age; however, one vital sign is out of range. Identify the vital sign that is out of range and indicate what it should be, based on Elanya's age.
2. The physician would like to prescribe Elanya a medication for her headaches. The medication dosage is based on body weight in kilograms. What is Elanya's body weight in kilograms?
3. Would the pain that Elanya is experiencing because of her headaches have influence on her vital signs? Explain your answer.

ON THE JOB

Lakisha Smith is working in an OB/GYN clinic affiliated with a major teaching hospital. Her general responsibilities include registering patients, handling phone calls when the receptionist is on a break, escorting patients into the examination room, taking vital signs, running selected laboratory tests, setting up the clinic examination rooms for gynecological examinations, and providing patient education.

The following is the morning's schedule of patients and visitors:

9:00 Adele Bishop	New mother checkup
9:15 Amy Campbell	First OB visit
9:30	
9:45 Maria Lopez	OB patient in last month of pregnancy
10:00 Meg Rivers	Regular OB checkup
10:15 Vanessa Brown	New gynecology patient w/ovarian cyst
10:30	
10:45 Tiffany Baker	Regular OB checkup
11:00 Vern Simmons	Pelvic inflammatory disease
11:15 Latonya Pike	1st visit after miscarriage
11:30 Emma Thompson	Yearly checkup, gynecology patient
12:00 Lunch break	

During the morning, the following occurs:

When Maria Lopez arrives, she tells Lakisha that she has been bleeding since the weekend.

A pharmaceutical representative comes in at 10:00 A.M. and asks to see the doctor.

Supplies are delivered that must be signed for.

Dr. Williams is called away to perform a childbirth at 11:00 A.M.

Vital signs including TPR, BP, and weight are taken for all OB patients.

Urinalysis is performed by another medical assistant assigned to the clinic laboratory.

What are your responses to the following?

1. How should Lakisha handle the pharmaceutical representative?
2. Should Maria Lopez's bleeding be considered an emergency? If so, what is Lakisha's responsibility?
3. Because Dr. Williams was called away for a childbirth, how should the patients be rescheduled? What about the patients who are already in the waiting room?

INTERNET ACTIVITY

Go to the American Heart Association website, and look for dietary guidelines for hypertension.