"Our *intent when we lay hands on the patient in bodily care is to comfort."*

Lydia Hall (1906–1969) • an innovator in nursing practice, she developed the theory that the direct nurse-to-patient relationship is itself therapeutic and that nursing care is the chief therapy for critically ill patients.

U • N • I • T

VI

Actions Basic to Nursing Care

Unit VI focuses on the actions basic to nursing practice—those commonly planned, implemented, and evaluated to meet the healthcare needs of patients at any age, at any point along the health–illness continuum, and in all settings. The nursing actions discussed in this unit include taking vital signs, conducting a health history and assessment, maintaining safety, administering medications, and providing perioperative care.

Chapter 24 describes nursing responsibilities related to the assessment of vital signs, and Chapter 25 discusses conducting a health history and assessment. Nursing assessment is both an art and a science. The art of performing a skill is integrated into the science of nursing so that variations from normal are identified and evaluated and necessary nursing actions are implemented. The findings from assessments provide a database necessary to maintain or restore health and promote wellness.

Nurses are responsible for meeting basic human needs for physical safety and security. Chapter 26 discusses environmental safety, includ-

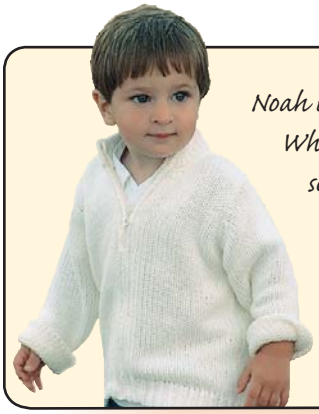
ing threats from bioterrorism, plus nursing actions necessary for identifying risk factors for patients at any age and for implementing teaching and other nursing actions to prevent accidents. Chapter 27 explains medical and surgical aseptic techniques to prevent and to control the spread of microorganisms. Chapter 28 discusses complementary and alternative therapies, an ever-increasing component of healthcare.

Chapters 29 and 30 focus on collaborative and independent nursing actions necessary when administering medications and providing perioperative care. In most instances, the physician prescribes the medications and performs the surgery while the nurse orders and implements nursing interventions to promote patient safety and knowledge and to facilitate optimal function or recovery in both hospital and home settings. Although procedures and protocols are often used in these situations, nursing actions are individualized to the unique needs of each person requiring care.

Unit VI introduces the learner to the knowledge and skills basic to nursing practice in any setting. Using the nursing process, nurses make accurate assessments, ensure safety, prevent and control the spread of microorganisms, administer medications knowledgeably and safely, and provide perioperative care for patients in the hospital, home, and community.

CHAPTER 24

Vital Signs

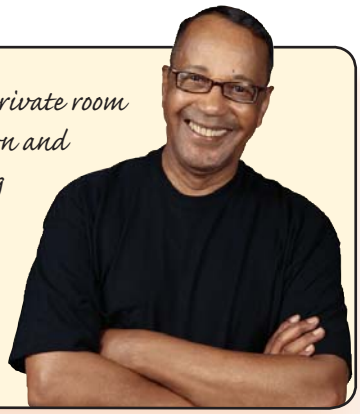


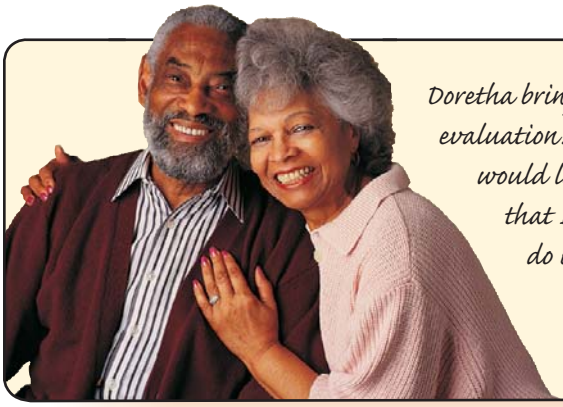
Noah Shoolin

Noah is a 2-year-old who is brought to the emergency department by his mother. When the nurse attempts to obtain a tympanic temperature, the child begins to scream uncontrollably, crying and pushing the device away from his ear.

Tomas Esposito

Tomas is a middle-aged man admitted to the hospital. He is placed in a private room with specialized infection-control precautions, requiring staff to don a gown and gloves when entering the room each time. A morning assessment, including vital signs, is needed.





Doretha Renfrow

Doretha brings her 65-year-old hypertensive husband to the clinic for evaluation. He is 5'10 and overweight. Mrs. Renfrow states "I really would like to learn how to take my husband's blood pressure so that I can keep track of his progress. Can you teach me how to do it?"

Focusing on Blended Skills

The types of blended skills you'll need to respond to the case scenarios include:

Cognitive Skills

- Knowledge of the anatomy and physiology underlying vital signs and the significance of normal and abnormal findings
- Knowledge of nursing responsibilities in assessing temperature, pulse, respirations, and blood pressure
- Knowledge of how to tailor vital signs technology to meet the individualized needs of patients (eg, best methods to assess the temperature of a 2-year-old, the fact that a larger cuff is needed to accurately assess the blood pressure of an overweight man)
- Knowledge of how to teach patients and their family caregivers how to assess vital signs and how to respond to significant findings
- Ability to incorporate factors affecting vital signs into a patient's plan of care
- Ability to use critical thinking skills to intervene appropriately in situations involving an upset toddler, an inquiring daughter, and a middle-aged man requiring infection-control precautions

Technical Skills

- Ability to correctly use the equipment necessary to assess and document vital signs
- Ability to adapt techniques to meet the needs of patients, such as the toddler and an overweight man with hypertension
- Ability to identify limitations in performance of skills, asking for assistance as necessary when performing them
- Ability to maintain infection-control measures when encountering difficulties in a patient's care
- Ability to integrate time-management and organizational skills when caring for multiple patients, including a patient with an infection requiring vital sign assessment

Interpersonal Skills

- Strong people skills to establish a trusting relationship with a toddler, a daughter seeking information, and a middle-aged man who is irritable and requires infection-control measures
- Ability to communicate and interact effectively with patients and their caregivers while assessing vital signs and teaching others how to assess vital signs accurately
- Confidence in own abilities and interpersonal competence to interact with other healthcare personnel, confronting the appropriate persons when help is needed
- Ability to demonstrate respect for the patient's human dignity throughout the patient's care

Ethical and Legal Skills

- Commitment to safety and quality nursing care
- Strong sense of responsibility and accountability
- Ability to put the need for accurate assessment over own discomfort about your beginning ability to auscultate heart and lung sounds
- Knowledge of ethical and legal principles related to assessing and documenting vital signs in patients of varying ages and with differing needs
- Ability to document temperature, pulse, respirations, and blood pressure findings accurately and according to agency policy

Learning Objectives

After completing the chapter, you will be able to accomplish the following:

1. Explain the physiologic processes involved in homeostatic regulation of temperature, pulse, respirations, and blood pressure.
2. Compare and contrast factors that increase or decrease body temperature, pulse, respirations, and blood pressure.
3. Identify sites for assessing temperature, pulse, and blood pressure.
4. Accurately assess temperature, pulse, respirations, and blood pressure.
5. Know the normal ranges for body temperature, pulse, respirations, and blood pressure.
6. Provide information to patients about taking temperature, pulse, and blood pressure at home.

Key Terms

afebrile
apnea
blood pressure
bradycardia
bradypnea
diastolic pressure
dyspnea
dysrhythmia
eupnea
febrile
fever
hypertension
hyperthermia
hypotension
hypothermia
Korotkoff sounds
orthopnea
orthostatic hypotension
pulse
pulse deficit
pulse pressure
respiration
systolic pressure
tachycardia
tachypnea
temperature
vital signs

Vital signs are a person's temperature, pulse, respiration, and blood pressure (abbreviated as T, P, R, and BP). Health status is reflected in these indicators of body functions, regulated through homeostatic mechanisms and falling within certain normal ranges. A change in vital signs might indicate a change in health.

Assessing vital signs is part of nursing care in any setting. Institutional and agency policies govern when and how frequently vital signs are to be assessed. Vital signs are assessed at least every 4 hours in hospitalized patients with elevated temperatures, with high or low blood pressures, with changes in pulse rate or rhythm, or with respiratory difficulty, as well as in patients who are taking medications that affect cardiovascular or respiratory function or who have had surgery. Severely ill patients may have vital signs taken more frequently. In critical care settings, technologically advanced devices are often used for continual monitoring of patients' vital signs. In the home and in some self-care and psychiatric units, assessments are made as frequently as the nurse judges necessary.

Although vital sign assessment may be delegated to other healthcare personnel, it is the nurse's responsibility to ensure accuracy of data and to report abnormal findings. (See the accompanying Reflective Practice box for an example.) If a patient has abnormal or unusual physical symptoms (eg, chest pain or dizziness) or has unexpected changes in vital signs, the nurse should double-check the findings and further assess the patient.

Recall Tomas Esposito, the patient requiring initial assessment described in the Reflective Practice display? The nurse's inability to auscultate heart and lung sounds would be an important finding that requires additional assessment. The nurse would need to evaluate these findings in conjunction with the patient's vital signs.

The nurse should also know the normal variations in vital signs that occur at various ages (Table 24-1).

Vital signs are taken and compared with accepted normal values and the patient's usual patterns in a wide variety of instances, including screenings at health fairs and clinics, in the home, upon admission to a healthcare setting, when certain medications are given, before and after diagnostic and surgical procedures, before and after certain nursing interventions, and in emergency situations (Box 24-1). Nurses take vital signs as often as a patient's condition requires such assessment. How to assess each of the vital signs, with a discussion of normal and abnormal findings, is presented in this chapter. See Chapter 25 for additional information about health assessment. Pain, which is often included as a vital sign, is discussed in Chapter 41.

TEMPERATURE

Body **temperature** is the heat of the body measured in degrees. Body temperature indicates the difference between production of heat and loss of heat. Heat is generated by metabolic processes in the core tissues of the body, transferred to the skin surface by the circulating blood, and then dissipated to the environment. Core body temperature is normally maintained within a range of 36.0°C (97.0°F) to 37.5°C (99.5°F). There are individual variations of these temperatures as well as normal changes during the day, with core body temperatures being lowest in the early morning and highest in the late afternoon (Porth, 2005).

Reflective Practice

Challenge to Ethical and Legal Skills

At clinical 2 weeks ago, I had four patients for the first time and I was very busy. One of my patients, Tomas Esposito, required specialized infection-control precautions, so every time I entered his room, I had to put on a gown and gloves. It was getting to be late in the morning and I still had not completed this patient's full assessment, including his vital signs. Upon entering the patient's room, I discovered that the separate stethoscope usually found in isolation rooms was not there. As a result, I had to remove my gown and gloves and go find the nurse to help me locate the stethoscope. Ultimately, the nurse had to get me a new isolation stethoscope set and put it together for me. Unfortunately, these stethoscopes are poor in quality.

I went back to the patient's room and put on a new gown and gloves. By this time, Mr. Esposito was very irritable and just wanted me to do the assessment quickly and leave him alone. I attempted to listen to his heart sounds but I couldn't hear them. I played with the stethoscope for a few minutes and tried again, but I still couldn't hear his heart or lung sounds. My patient kept telling me to leave him alone. Being a 4th-year nursing student and self sufficient in doing the basic patient assessment, I felt stupid going to get the nurse or my instructor and telling her I couldn't hear anything. I was really pressed for time and now was faced with a critical decision.

Thinking Outside the Box: Possible Courses of Action

- Remove my gown and gloves, get my instructor and the nurse and tell them that I was unable to hear heart and lung sounds, and request their assistance.
- Leave the patient alone as he requested, saving precious time, pretending that I completed the assessment, and charting the same findings as the previous shift's assessment.
- Explain to the nurse that the patient wasn't cooperating and ask her to do the assessment without my instructor knowing about it.
- Try to complete the assessment using my own stethoscope and risk passing the patient's infections on to my other patients.

Evaluating a Good Outcome: How Do I Define Success?

- Patient receives the highest quality of care.
- Professional integrity of all healthcare team members involved is maintained.
- All information charted is accurate.
- Ethical and legal principles are maintained.

Personal Learning: Here's to the Future!

Luckily my conscience and my desire to always give the best care to my patients pushed me to the right decision. I took the time to remove my gown and gloves and went to find my instructor and the nurse. I told the nurse that I was having trouble hearing the patient's heart and lung sounds. She was very understanding and came to the room with me and tried herself. Upon further investigation, we found that the problem was a broken stethoscope, not my incompetence to complete an assessment. After assessing the patient with a properly functioning stethoscope, I found expiratory wheezing and documented it. This finding also provided a clue that I should probably keep a very close eye on this patient. Mr. Esposito ended up experiencing increasing difficulty breathing and his oxygen saturation levels began to drop into the 80% range. As a result, I realized just how important the initial assessment is when caring for a patient throughout the day. Hopefully, the lesson about how important it is to do the "right" thing for the patient will stick with me forever.

Reflection

How do you think you would respond in a similar situation? Why? What does this tell you about yourself and about the adequacy of your skills for professional practice? Can you think of other ways to respond? What might the nursing student have done to prevent the numerous trips in and out of the patient's room? To determine whether the stethoscope was functioning properly? How do you think the nursing student's time management and organizational skills affected the situation? What other skills (cognitive, interpersonal, technical, ethical/legal) would you need to respond well in this situation? What ethical principles did the nursing student incorporate into the response to the situation? What responses related to the patient's irritability would have been appropriate by the nursing student? Do you agree with the criteria to evaluate a successful outcome? Did the nursing student meet these criteria? Please explain.

Catherine Barrell, Georgetown University

Temperatures also differ in various parts of the body, with core body temperatures being higher than surface body temperatures. Core temperatures are measured at tympanic or rectal sites, but they may also be measured in the esophagus, pulmonary artery, or bladder by invasive monitoring devices. Surface body temperatures are measured at oral (sublingual) and axillary sites.

Physiology of Body Temperature

The core body temperature of a healthy person is maintained within a fairly constant range by the thermoregulatory center in the hypothalamus. This center receives messages from cold and warm thermal receptors located throughout the body, compares that information with its temperature set

TABLE 24-1 Age-Related Variations in Normal Vital Signs

Age	Temperature (°C)	Pulse (beats/min)	Respirations (breaths/min)	Blood Pressure (mm Hg)
Newborn	36.8 (Axillary)	80–180	30–80	73/55
1–3 yr	37.7 (Rectal)	80–140	20–40	90/55
6–8 yr	37 (Oral)	75–120	15–25	95/75
10 yr	37 (Oral)	75–110	15–25	102/62
Teens	37 (Oral)	60–100	15–20	102/80
Adults	37 (Oral)	60–100	12–20	120/80
>70 yr	36 (Oral)	60–100	15–20	120/80

point, and initiates responses to either produce or conserve body heat or to increase heat loss.

Heat Production

The primary source of heat in the body is metabolism, with heat produced as a byproduct of metabolic activities that generate energy for cellular functions. Various mechanisms increase body metabolism, including hormones and exercise. When additional heat is required to maintain balance, epinephrine and norepinephrine (sympathetic neurotransmitters) are released and alter metabolism so that energy production decreases and heat production increases. Thyroid hormone, produced by the thyroid gland, also increases metabolism and heat production, but over a much longer time period. Shivering, a response that increases the production of heat, is initiated by the hypothalamus and results in muscle tremors. The contraction of pilomotor muscles of the skin, as occurs with shivering, causing piloerection, or "goose bumps" and reduces the size of the surface to minimize heat loss. Exercise increases heat production through muscle movements.

Heat Loss

The skin is the primary site of heat loss. The circulating blood brings heat to the skin's surface, where small connections between the arterioles and the venules lie directly below the surface. These connections, called arteriovenous shunts, may remain open to allow heat to dissipate (for example, during exercise in hot environmental temperatures) to the skin and then to the external environment, or they may close and retain heat in the body (for example, when the body is exposed to cold environmental temperatures). The sympathetic nervous system controls the opening and closing of the shunts in response to changes in core body temperature and in environmental temperature (Porth, 2005).

Other heat losses occur through evaporation of sweat, through warming and humidifying of inspired air, and through elimination of urine and feces. Heat is transferred to the external environment through the physical processes of radiation, convection, evaporation, and conduction. These processes are defined and illustrated in Table 24-2.

BOX 24-1 When to Assess Vital Signs

- On admission to any healthcare agency or institution
- Based on agency or institutional policy and procedures
- Any time there is a change in the patient's condition
- Any time there is a loss of consciousness
- Before and after any surgical or invasive diagnostic procedure
- Before and after activity that may increase risk, such as ambulation after surgery
- Before administering medications that affect cardiovascular and respiratory function

Factors Affecting Body Temperature

A variety of different factors affect body temperature. These factors include circadian rhythms, age, gender, stress, and environmental temperatures. Figure 24-1 illustrates the usual ranges of human body temperature.

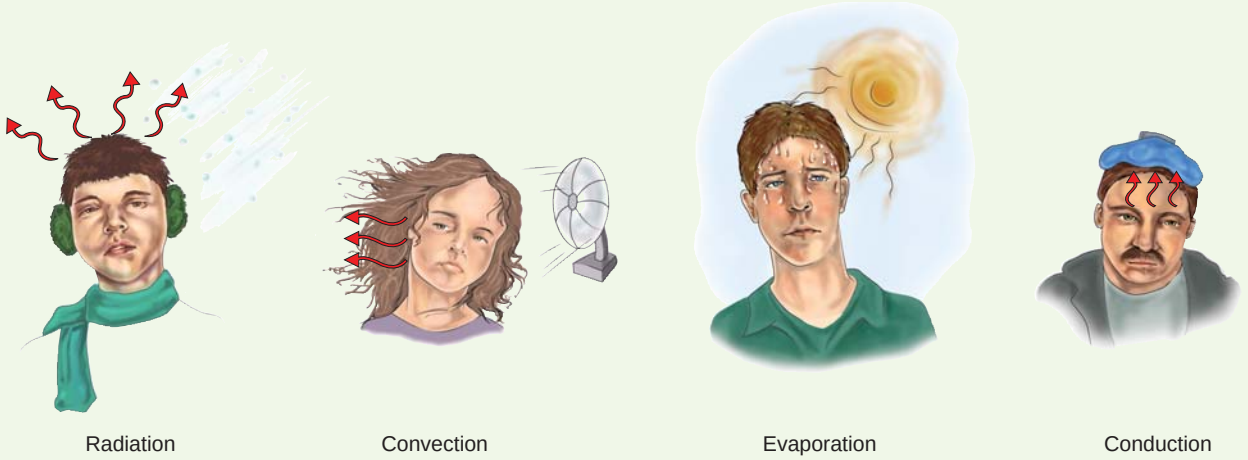
Circadian Rhythms

Many environmental and physiologic processes occur in repeated cycles of time. Some events in humans recur at 24-hour intervals, referred to as circadian (meaning nearly every 24 hours) rhythm. Predictable fluctuations in measurements of body temperature and blood pressure are examples of functions that have a circadian rhythm. For instance, body temperature is usually about 0.6°C (1°–2°F) lower in the early morning than in the late afternoon and early evening. This variation tends to be somewhat greater in infants and children. Research indicates that the peak elevation of a person's temperature occurs in late afternoon, between 4 and 7 p.m.

Age and Gender

Both the very young and the very old are more sensitive to changes in environmental temperature. The body temperature

TABLE 24-2 Mechanisms of Heat Transfer

	Radiation	Convection	Evaporation	Conduction
Definition	The diffusion or dissemination of heat by electromagnetic waves	The dissemination of heat by motion between areas of unequal density	The conversion of a liquid to a vapor	The transfer of heat to another object during direct contact
Example	The body gives off waves of heat from uncovered surfaces.	An oscillating fan blows currents of cool air across the surface of a warm body.	Body fluid in the form of perspiration and insensible loss is vaporized from the skin.	The body transfers heat to an ice pack, causing the ice to melt.
Illustration				
	Radiation	Convection	Evaporation	Conduction

of infants and children changes more rapidly in response to both heat and cold air temperatures.

Consider Noah Shoolin, the 2-year-old brought to the emergency department by his mother. The nurse assessing the child's temperature would need to keep in mind the effect of environmental temperature changes on the child's temperature. Efforts to prevent chilling and overheating would be incorporated into the child's plan of care.

Older adults lose some thermoregulatory control with aging and are at risk for harm from extremes of temperature.

Women tend to have more fluctuations in body temperature than do men, probably the result of changes in hormones. The increase in progesterone secretion at ovulation increases body temperature as much as 0.5° to 1°F.

Environmental Temperature

Most of us respond to changes in environmental temperature by wearing clothing that either allows increased heat loss when it is hot or retains heat when it is cold. When one is exposed to extreme cold without adequate protective clothing, heat loss may be increased to the point of **hypothermia** (low body temperature). Similarly, if one is exposed to extremes of heat for long periods of time, **hyperthermia** (high body temperature) may result. Both hypothermia and hyperthermia may cause serious illness or death.

Normal Body Temperature

Body temperature varies among individuals, with a range of 0.3° to 0.6°C (0.5°–1.0°F) from the average temperature considered to be within normal limits. Even wider variations from the average temperature have been found to be normal for certain people. A person with a normal body temperature is referred to as **afebrile** ("without fever"). Table 24-3 shows the average normal temperature standards for healthy adults at various body sites.

Increased Body Temperature

Fever (pyrexia) is an increase above normal (considered to be 37°C or 98.6°F) in body temperature in response to trauma or illness. A person with a fever is said to be **febrile.** Fever results from a response to bacterial or viral infections. It also occurs in response to tissue injury, such as from myocardial infarction, pulmonary emboli, cancer, trauma, and surgery. In children, this response is often seen quickly. However, a mild elevation in temperature might indicate a serious infection in infants younger than 3 months of age who do not have

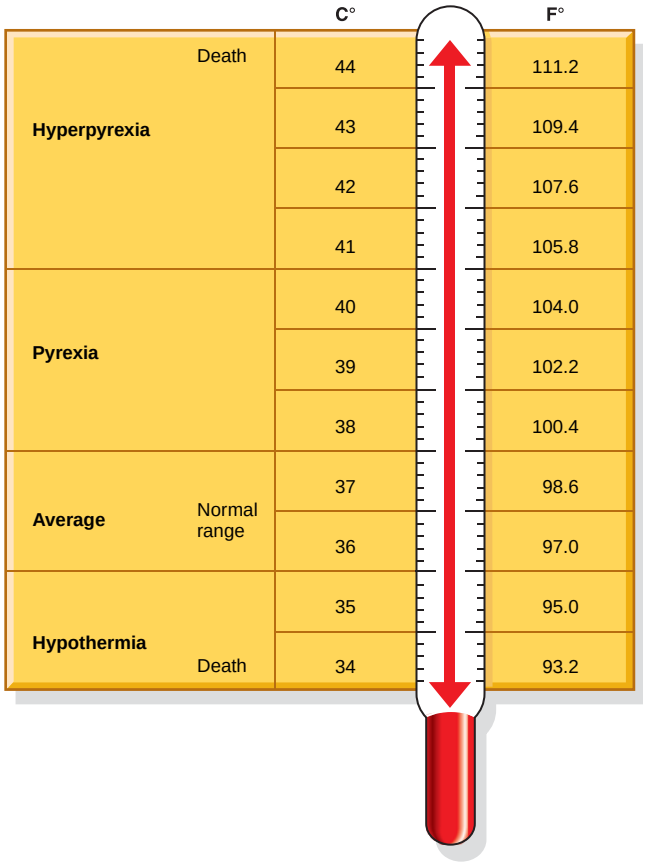


Figure 24-1. The range of human body temperature, as measured orally.

well-developed temperature-control mechanisms. In older adults, who often have a lower baseline body temperature, fever may be one of the later signs of illness, and the temperature may be elevated only 1° or 2° above normal, even when pathologic processes are extensive.

When the set point is increased, the hypothalamus initiates shivering and vasoconstriction. After the body temperature rises to the new set point, heat-loss mechanisms again keep the body temperature from rising to dangerous levels. Most fevers are self-limiting, and the temperature returns to normal range after the factors causing it are controlled. The onset of an elevated body temperature may be sudden or gradual. Terms used to describe types of fever are listed in Box 24-2. Hyperpyrexia is a high fever, usually above 41°C (105.8°F).

Other types of increased body temperature are hyperthermia, neurogenic fever, and fever of unknown origin. Hyperthermia differs from fever in that the hypothalamic set point is not changed, but in situations of extreme heat exposure or excessive heat production (for example, during strenuous exercise), the mechanisms that control body temperature are ineffective. Neurogenic fever is usually the result of damage to the hypothalamus from intracranial trauma, intracranial bleeding, or increased intracranial pressure. Neurogenic fever does not respond to antipyretic medications (Porth, 2005). If the cause of any type of fever is difficult to determine, it is often diagnosed as a fever of unknown origin (FUO).

Physical Effects of Fever

Patients with fever usually experience loss of appetite, headache, hot, dry skin, flushed face, thirst, and general malaise. Young children or other people with high fevers may experience periods of delirium or seizures. Observing for other potentially dangerous manifestations of a fever, such as dehydration, decreased urinary output, and rapid heart rate, is an important nursing assessment.

Methods of Reducing Fever

Nursing interventions for the patient with a fever are outlined in Examples of Nursing Interventions Classification. Antipyretic (fever-reducing) drugs, such as aspirin or acetaminophen, may be administered in certain circumstances. These drugs are believed to lower the elevated set point regulated by the hypothalamus. They do not affect body temperature when it is within normal range. Aspirin should not be given to children under 2 years of age unless prescribed and medical supervision is available. Aspirin also should not be given to children and teenagers with chickenpox or influenza because of a possible association with Reye's syndrome. If the fever is the result of a bacterial infection, an appropriate antibiotic is administered. Body temperature may also be lowered through other interventions, including cool sponge baths, cool packs, and cooling blankets (discussed in Chap. 38).

TABLE 24-3 **Average Normal Temperatures for Healthy Adults at Various Sites**

Oral	Rectal	Axillary	Tympanic	Forehead
37.0°C 98.6°F	37.5°C 99.5°F	36.5°C 97.6°F	37.5°C* 99.5°F	34.4°C† 94.0°F

* The average normal tympanic temperature depends on the calibration and mode setting of the tympanic membrane thermometer.
† The manufacturer of Digitemp forehead thermometer (Hallcrest Products, 1820 Pickwick Lane, Glenview, IL 60025) says, "Most older children and adults have normal forehead temperatures between 93 and 95 degrees F."

BOX 24-2 Terms and Definitions for Types of Fever

Intermittent: The body temperature alternates regularly between a period of fever and a period of normal or subnormal temperature.
Remittent: The body temperature fluctuates several degrees more than 2°C (3.6°F) above normal but does not reach normal between fluctuations.
Constant: The body temperature remains consistently elevated and fluctuates less than 2°C (3.6°F).
Relapsing: The body temperature returns to normal for at least a day, but then the fever recurs.
Crisis: The fever returns to normal suddenly.
Lysis: The fever returns to normal gradually.

Examples of Nursing Interventions Classification (NIC)
FEVER TREATMENT

- Monitor temperature as frequently as is appropriate.
- Monitor for insensible fluid loss.
- Monitor skin color and temperature.
- Monitor blood pressure, pulse, and respiration, as appropriate.
- Monitor for decreasing levels of consciousness.
- Monitor for seizure activity.
- Monitor white blood cell count, hemoglobin, and hematocrit levels.
- Monitor intake and output.
- Monitor for electrolyte abnormalities.
- Monitor for acid–base imbalance.
- Administer antipyretic medication, as appropriate.
- Administer a tepid sponge bath, as appropriate.
- Encourage increased intake of oral fluids, as appropriate.
- Encourage or give oral hygiene, as appropriate.

McCloskey Dochterman, J., & Bulechek, G. (2004). *Nursing interventions classification (NIC)* (4th ed., p. 382). St. Louis, MO: C. V. Mosby. A full listing of nursing activities for each nursing intervention can be found in this book.

Decreased Body Temperature

Hypothermia is a body temperature below the lower limit of normal. Death may occur when the temperature falls below about 34°C (93.2°F), but survival has been reported in isolated cases when body temperatures have fallen in the range of severe hypothermia (28°C, or 82.4°F). This may happen to a person drowning in cold water or buried by snow. Rates of chemical reactions in the body are slowed, thereby decreasing the metabolic demands for oxygen.

Assessing Temperature

To accurately assess body temperature, the nurse must know what equipment to use, which site to choose, and what method is appropriate.

Equipment

Body temperature may be assessed with a variety of devices—electronic and digital thermometers, tympanic membrane thermometers, glass thermometers, disposable single-use thermometers, temporal artery thermometers, and automated monitoring devices.

Think back to Tomas Esposito, the patient requiring infection-control precautions and assessment. Because the patient required infection-control measures and a special "isolation stethoscope," the nurse should anticipate the need for using a thermometer designed for individual patient use, such as a disposable one.

Electronic and Digital Thermometers

Electronic and digital thermometers measure oral, rectal, or axillary body temperature from 1 to 60 seconds, depending on the site and product used. These battery-operated devices provide a temperature display and disposable probe covers. Some models also provide the last measurement, a full 60-second pulse timer, and automatic conversion from the Fahrenheit to the Celsius scale. Assessing body temperature with an electronic thermometer is described in Skill 24-1.

Tympanic Membrane Thermometer

Tympanic membrane thermometers use infrared sensors to detect heat given off by the tympanic membrane. The probe is covered with a probe cover and inserted into the ear canal tightly enough to seal the opening (see Skill 24-1). The reading takes from 1 to 3 seconds, depending on the product.

Remember Noah Shoolin, the toddler described at the beginning of the chapter? Although this type of thermometer yields a quick reading, the nurse would need to verify the accuracy of the reading, especially in light of the child's current upset state, possibly by asking the mother if she had taken the child's temperature before coming to the emergency department or by using an alternative method.

Glass Thermometer

Although a glass thermometer with a mercury bulb has traditionally been used to measure body temperature, the danger of mercury poisoning has made this type almost obsolete. Many healthcare institutions no longer use or are phasing out mercury in any type of equipment, based on federal safety recommendations. However, many people still have mercury thermometers at home and might be continuing to use them. In some instances, glass thermometers might be used for patients in critical care units or on isolation. Information about the dangers of mercury, as well as how to handle a broken mercury thermometer, are important for nurses to know and teach. See Teaching to Promote Health at Home 24-1 for suggested teaching content.

Teaching to Promote Health at Home 24-1

Mercury Thermometers

Health Topic	Teaching Tip	Why Is This Important?
What is mercury?	• Mercury is a heavy, odorless, silver liquid. • Glass thermometers containing mercury are easily broken.	Mercury is a toxic and hazardous material that affects the central nervous system. The liquid and the vapors from the liquid are both considered dangerous. Mercury not only is hazardous to people, but also pollutes the environment (especially if it gets into water). Mercury poisoning can lead to problems with mental development and learning disabilities.
What to do if a mercury thermometer breaks	**What Not to Do** • Sweep the area. • Vacuum the area. • Pour mercury down the drain. • Wash mercury-contaminated clothes. • Use household cleaning agents to clean the spill.	Sweeping breaks the mercury into smaller droplets. Mercury contaminates the vacuum. Mercury contaminates the washing machine and stays in the plumbing. Cleansing agents react with mercury, releasing a toxic gas.
	What to Do • Open windows and close off the room from the rest of the house. Use fans for at least an hour if possible. • Use an eyedropper, a piece of heavy paper, or duct tape to scoop up the broken glass and beads of mercury. • Put the mercury, broken glass, and any materials used to scoop them up in a plastic zipper bag, and seal tightly with tape. Place this bag into a second bag and seal with tape, and then the second bag into a third bag, sealed with tape. Place the bags in a plastic wide-mouth sealable container. • Throw everything away that was exposed to the mercury (including linens, clothing, and towels). • Call your local health department to find out an approved disposal site. • Wash your hands with soap and water. Take a shower if you think any mercury touched other parts of the skin.	

Non-mercury glass thermometers are available. Non-mercury thermometers may be either spirit-filled (using a petroleum-based liquid) or alcohol-based. This type of thermometer has a bulb at the end of a stem. The bulb contains a liquid that expands with heat and rises within the stem. Most commonly, a long, thin bulb is found on glass thermometers used to take oral temperatures, and a blunt bulb is found on glass thermometers used to take rectal temperatures.

Glass thermometers are generally calibrated in degrees of either centigrade (Celsius, C) or Fahrenheit (F) (see Fig. 24-1) in a range of about 34°C (94°F) to about 42.2°C (108°F). The degrees on a thermometer using the Celsius scale are subdivided into gradients of 0.1°; the subdivisions on a thermometer using the Fahrenheit scale are the equivalent of 0.2°. Table 24-4 illustrates comparable centigrade and Fahrenheit temperatures and explains how temperatures are converted from one scale to the other.

If glass thermometers are used within a healthcare institution, each patient has his or her own thermometer for the duration of inpatient care. The thermometer is kept in the patient's room, usually in a container of liquid disinfectant. It is recommended that glass thermometers used for patients with hepatitis (an infectious disease of the liver) or acquired immune deficiency syndrome (AIDS) be discarded when the patient is discharged.

In the home, clean thermometers in lukewarm soapy water, rinse in cool water, and then store for reuse. If the thermometer is to be used by more than one person or if the person has a known or suspected infection transmitted by oral secretions, disinfect the thermometer with an appropriate solution (such as alcohol) after cleaning. Follow the manufacturer's recommendations for the care and disposal of electronic and other types of thermometers and their probe covers.

Disposable Single-Use Thermometers

Disposable single-use thermometers register within seconds and are nonbreakable. Because they are used only once, they eliminate the danger of cross-infection.

Temperature-sensitive patches or tape, commonly applied to the abdomen or forehead, change color at different temperature ranges. These devices may be used to check the temperature of a toddler or young child. A thermometer should be used to reassess the temperature if the color on the tape or patch indicates that the temperature is out of the normal average range.

Temporal Artery Thermometer

Temporal artery thermometers measure body temperature by capturing the heat emitted from the skin over the temporal artery. These devices are battery operated and have a temperature display. They are swiped across the skin over the temporal artery, taking 1,000 readings per second and selecting the most accurate (Bauer, 2003).

Automated Monitoring Devices

Automated monitoring devices are used in various healthcare settings to measure body temperature, pulse, and blood pressure simultaneously. They require less of the nurse's time, especially when these assessments are required frequently.

Sites and Methods of Assessing Body Temperature

Health agency policies and procedures often specify the site to be used for assessing patients' temperatures; however, the nurse is expected to select and to use alternative sites when indicated. Factors affecting the site selection include the patient's age, state of consciousness, amount of pain, and other care or treatments (such as oxygen administration) being provided. It is customary to indicate the site used to assess the temperature when recording the measurement.

The sites most commonly used to assess body temperature are sublingual, anal, axillary, and tympanic. An electronic probe or thermometer is placed under the tongue (sublingual area) of a person's mouth to assess an oral temperature, in the anal canal to assess a rectal temperature, or in an axilla (armpit) to assess an axillary temperature. A probe is placed in the ear to assess a tympanic temperature. For most clinical purposes, it would appear equally satisfactory to assess an oral, a rectal, a tympanic, or an axillary temperature, provided proper technique is used and normal variations among the methods are

TABLE 24-4 Equivalent Centigrade and Fahrenheit Temperatures*

Centigrade	Fahrenheit	Centigrade	Fahrenheit
34.0	93.2	38.5	101.3
35.0	95.0	39.0	102.2
36.0	96.8	40.0	104.0
36.5	97.6	41.0	105.8
37.0	98.6	42.0	107.6
37.5	99.5	43.0	109.4
38.0	100.4	44.0	111.2

* To convert centigrade to Fahrenheit, multiply by 9/5 and add 32. To change Fahrenheit to centigrade, subtract 32 and multiply by 5/9.

considered. Comparing the recordings using two different sites is a method for double-checking the validity of an unusual measurement.

Assessing a Tympanic Membrane Temperature

The tympanic membrane temperature is considered a core body temperature. Infrared sensors in the thermometer sense heat from the body as it is given off by a heat source; in the ear canal, the primary heat source is the tympanic membrane. The thermometer does not touch the tympanic membrane (see Skill 24-1). This site allows easy and safe measurement of temperature and is readily accessible. It should not be used for clients who have drainage from the ear or scars on the tympanic membrane. Temperature readings are not significantly altered by the presence of cerumen (ear wax) or otitis media (infection of the middle ear).

Assessing an Oral Temperature

One important consideration for selecting the oral site is that the patient must be able to close his or her mouth around the thermometer or probe. Assessing an oral temperature using a glass thermometer is contraindicated in unconscious, irrational, and seizure-prone patients and in infants and young children because of the danger of breaking the glass thermometer in the mouth. Oral temperatures also are contraindicated in people with diseases of the oral cavity and in those who have had surgery of the nose or mouth. If a patient has had either hot or cold food or fluids or has been smoking or chewing gum, it is generally recommended to wait 15 to 30 minutes to allow the oral tissues to return to normal temperature. Traditionally, oral temperatures have not been assessed in patients receiving nasal oxygen because it was believed that the oxygen causes a falsely low reading. Research is challenging this opinion. Oral temperatures should not be assessed in patients receiving oxygen by mask, however, because the time it takes to assess a reading is likely to result in a serious drop in the patient's blood oxygen level. The procedure for assessing an oral temperature is given in Skill 24-1.

Assessing a Rectal Temperature

The rectal temperature, a core temperature, is considered to be one of the most accurate. The rectal site is an alternative whenever the oral site is contraindicated (see Skill 24-1). However, patients are typically uncomfortable having their temperature taken rectally, so avoid this site if possible. Measuring rectal temperature is contraindicated in newborns, small children, and in patients who have undergone rectal surgery or have diarrhea or a disease of the rectum. Because the insertion of the thermometer can slow the heart rate by stimulating the vagus nerve, assessing a rectal temperature may not be allowed in some institutions for people with certain heart diseases or after cardiac surgery. In addition, assessing a rectal temperature is contraindicated in clients who are neutropenic (have low white blood cell counts, such as in leukemia) and in clients who have certain neurologic disorders (for example, spinal cord injuries).

Assessing an Axillary Temperature

The axillary site may be used when both oral and rectal sites are contraindicated or when these sites are inaccessible. An axillary temperature is often assessed in healthy newborns to avoid the risk for perforating the wall of the rectum with the thermometer. If the axilla has just been washed, delay assessing the temperature 15 to 30 minutes. Most authorities believe that when proper procedure is used, axillary temperatures are as accurate as oral or rectal temperatures. The procedure for assessing an axillary temperature is described in Skill 24-1.

Nursing Diagnoses

Examples of NANDA nursing diagnoses for alterations in body temperature are listed in the accompanying box.

Examples of NANDA Nursing Diagnoses: *Altered Body Temperature*

Nursing Diagnoses	Related Factors
Hyperthermia	Streptococcal upper respiratory infection Exposure to environmental heat without adequate cooling Surgery with general anesthesia
Hypothermia	Exposure to below freezing environmental temperature without adequate clothing
Risk for Imbalanced Body Temperature	Age (92 years) and head injury causing loss of consciousness
Ineffective Thermoregulation	Premature infant delivered at 30 weeks gestation

PULSE

The **pulse** is a throbbing sensation that can be palpated over a peripheral artery or auscultated (listened to) over the apex of the heart. It results as a wave of blood is pumped into the arterial circulation by the contraction of the left ventricle. Each time the left ventricle of the heart contracts to eject blood into an already full aorta, the arterial walls in the cardiovascular system expand to compensate for the increase in pressure of the blood. Characteristics of the pulse, including rate, quality, rhythm, and volume of blood ejected with each heartbeat (also referred to as stroke volume), provide information about the effectiveness of the heart as a pump and the adequacy of peripheral blood flow.

Physiology of the Pulse

The pulse is regulated by the autonomic nervous system through the cardiac sinoatrial (SA) node (often called the pacemaker). Parasympathetic stimulation of the SA node via the vagus nerve decreases the heart rate, and sympathetic stimulation of the SA node increases the heart rate and force of contraction. The pulse rate is the number of pulsations felt over a peripheral artery or heard over the apex of the heart in 1 minute. This rate normally corresponds to the same rate at which the heart is beating.

Factors Affecting the Pulse

Many factors can affect both the heart rate and volume; however, compensatory mechanisms attempt to maintain a sufficient supply of blood to the cells at all times. For example, when the stroke volume decreases, such as when the blood volume is decreased because of hemorrhage, the heart rate increases to try to maintain the same cardiac output. Conversely, in a physically fit athlete whose heart pumps a maximum volume of blood per stroke, the heart rate may be at the low range or below the range of normal, yet the body cells remain adequately supplied.

Pulse Rate

The pulse rate increases and decreases in response to a variety of physiologic mechanisms. It also might be altered by activity, medications, emotions, pain, heat and cold, and disease processes. Normal pulse rates change across the life span, gradually diminishing from birth to adulthood, as shown in Table 24-5. The normal pulse rate for adolescences and adults ranges from 60 to 100 beats per minute.

Increased Pulse Rate

As the heart rate increases, cardiac output tends to increase. However, a rapid rate (**tachycardia**) decreases cardiac filling time, which, in turn, decreases stroke volume and cardiac output. An adult has tachycardia when the pulse rate is 100 to 180 beats/min. The factors contributing to tachycardia are listed in Box 24-3.

TABLE 24-5 Normal Pulse Rates (Beats per Minute) at Various Ages

Age	Approximate Range	Approximate Average
Newborn to 1 mo	120–160	140
1 to 12 mo	80–140	120
12 mo to 2 yr	80–130	110
2 to 6 yr	75–120	100
6 to 12 yr	75–110	95
Adolescence to adult	60–100	80

Decreased Pulse Rate

Bradycardia is a pulse rate below 60 beats/min in an adult. The pulse rate is normally slower during sleep, in men, and in people who are thin. It slows during hypothermia as metabolic processes decrease. With aging, the pulse tends to become slower. Some medications, such as cardiotonic glycosides, slow the heart rate while also strengthening the force of contraction to increase cardiac output.

Sinus bradycardia results from the sinus node creating a slower-than-normal impulse rate. This type of bradycardia occurs at times when metabolic needs are decreased (eg, during sleep, in hypothermia, and in trained athletes at rest); from certain medications, such as beta blockers; from vagal stimulation (eg, from bearing down to have a bowel movement), during suctioning, or with severe pain, and in increased intracranial pressure and myocardial infarction. The nurse should immediately report bradycardia associated with difficult

BOX 24-3 Factors Contributing to Tachycardia

- A decrease in blood pressure, such as occurs with blood loss, when the heart's compensatory mechanisms attempt to meet the need for increased cardiac output
- An elevated temperature, which usually causes an increase of about 7 to 10 beats/min for each 0.6°C (1°F) of elevation above normal
- Any condition resulting in poor oxygenation of blood, for example, chronic pulmonary disease or anemia
- Exercise, when the heart's compensatory ability attempts to meet the need for increased blood circulation
- Prolonged application of heat
- Pain
- Strong emotions, such as fear, anger, anxiety, and surprise
- Some medications (eg, epinephrine [Adrenalin])

breathing, changes in level of consciousness, decreased blood pressure, ECG changes, and angina (heart pain). Emergency treatment consists of administering atropine intravenously to block vagal stimulation and to restore normal heart rate.

Pulse Amplitude and Quality

The pulse amplitude describes the quality of the pulse in terms of its fullness and reflects the strength of left ventricular contraction. It is assessed by the feel of the blood flow through the vessel. The amplitude of each pulse beat is normally strong at all areas where an artery can be palpated. Table 24-6 presents a scale often used to describe and document pulse amplitude.

In addition, the peripheral pulse may be described as full and bounding when it is forceful or weak and thready when it is feeble.

Pulse Rhythm

The pulse rhythm is the pattern of the pulsations and the pauses between them. This pattern is normally regular. An irregular pattern of heartbeats is called a **dysrhythmia.** Any irregularity in the heartbeat should be reported immediately. Common pulse rhythms are described and illustrated in Box 24-4.

Assessing the Pulse

The pulse may be assessed by palpating peripheral arteries or by auscultating the apical pulse with a stethoscope. The nurse needs to know how to use a stethoscope and which site and method are appropriate.

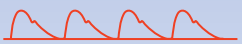
TABLE 24-6 Pulse Amplitude

Number	Definition	Description
0	Absent pulse	No pulsation is felt despite extreme pressure.
1+	Thready pulse	Pulsation is not easily felt, and slight pressure causes it to disappear.
2+	Weak pulse	Stronger than a thready pulse; light pressure causes it to disappear.
3+	Normal pulse	Pulsation is easily felt, takes moderate pressure to cause it to disappear.
4+	Bounding pulse	The pulsation is strong and does not disappear with moderate pressure.

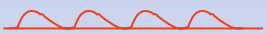
BOX 24-4 Pulse Rhythms

Regular Rhythms
The pulse rhythms and the pauses occur similarly.

Normal



Weak



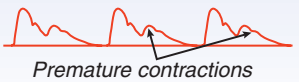
Bounding

Dysrhythmias
The pulsations or lengths of pauses occur with no pattern or predictability.

Bisferiens

Pulsus alternans

Bigeminal



Remember Tomas Esposito, the middle-aged man requiring infection-control measures and assessment? Although the nurse had difficulty auscultating his heart and lung sounds, the nurse would need to assess his pulse radially and apically. It is possible that by palpating his radial pulse and then attempting to auscultate his apical pulse and not hearing anything, the nurse might have gotten a clue leading her to suspect that the stethoscope was not functioning properly.

Equipment

The nurse most often assesses the pulse by palpating (feeling) the radial artery with his or her fingers but various types of equipment may be used to assess the pulse. The stethoscope is used to auscultate the apical pulse in most healthcare settings. A cardiac monitor may be used to assess the apical pulse in critical care or emergency department care. The monitor produces a graph or digital reading of the pulse rate and amplitude.

Stethoscope

The acoustical stethoscope, the most common type used, has an amplifying mechanism connected to earpieces by tubing (Fig. 24-2).

The most common amplifying devices are the diaphragm, which is a large, flat disk, and the bell, which has a hollowed, upright, curved appearance. The diaphragm is more useful for hearing high-frequency sounds, such as respiratory sounds, because it screens out low-frequency sounds. The bell screens out high-frequency sounds and is more useful for hearing low-frequency sounds, such as those commonly made by the heart and the blood within the vessels.

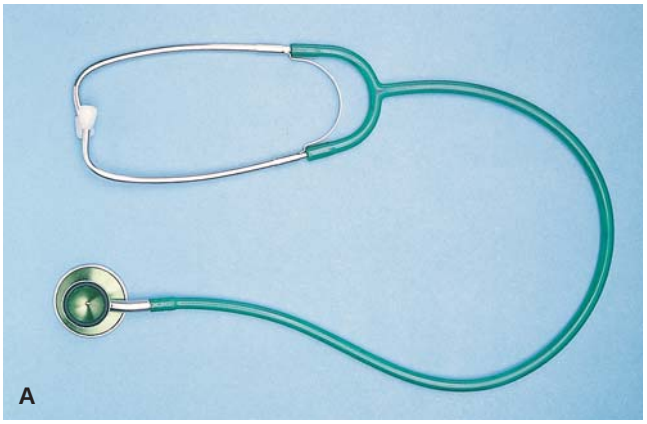


Figure 24-2. (**A**) Stethoscope. (**B**) Two sides of stethoscope amplifier. *(Photo © Ken Kasper.)*

The ear tips of the stethoscope should be selected to fit one's ear canals comfortably and snugly for the most effective auscultation. The tips should be large enough to block out extraneous noises in the environment when the stethoscope is being used. The tips should be directed into the ear canal, not against the ear itself.

Doppler Ultrasound Stethoscope

A Doppler ultrasound stethoscope may be used to assess pulses that are difficult to palpate or auscultate. The device has an earpiece connected to an audio unit with an ultrasound transducer. Techniques for assessing pulses with a Doppler ultrasound stethoscope are outlined in Guidelines for Nursing Care 24-1.

Sites and Methods of Assessing the Pulse

Nurses must know the correct site and method for assessing the pulse. Although peripheral pulses are most commonly assessed, an apical pulse or an apical-radial pulse should be assessed in certain situations, described below.

Assessing Peripheral Arterial Pulses

There are many peripheral artery sites that might be used to assess the pulse by palpation. Those most commonly used are illustrated in Figure 24-3.

Of these sites, the radial pulse site is used most often in children and adults. Peripheral pulses are assessed by placing the middle three fingers over the artery and lightly compressing the artery so pulsations can be felt and counted. See Skill 24-2 for assessing the a peripheral pulse.

Guidelines for Nursing Care 24-1

Using a Doppler Ultrasound Stethoscope to Assess Pulse and Blood Pressure

A Doppler ultrasound stethoscope may be used to assess pulses or a blood pressure that are difficult to palpate or auscultate. This device has an ultrasound transducer and an audio unit and transmits the sounds of red blood cells moving through the blood vessel. The procedure for using this device is as follows:

- Perform hand hygiene.
- Collect the Doppler ultrasound stethoscope, the transducer in the Doppler probe (the probe looks like a small transistor radio), a stethoscope headset, and transmission gel.
- Plug the headset into one of the two output jacks next to the volume control.
- Apply a small amount of transmission gel to either the probe or to the patient's skin over the selected area.
- Use the "on" button to activate the transducer.
- Hold the probe at a 90-degree angle to the skin over the pulse site while maintaining contact with the skin and the transmission gel.
- Listen for pumping sounds, indicating arterial pulse.
- Count the rate of the pulse for 1 minute; when used for blood pressure, usually the only measurement that can be assessed is the systolic reading (first sound heard).
- Remove gel from the probe and the patient's skin; do not use alcohol to clean the transducer because it may damage the transducer covering.
- Perform hand hygiene, and document pulse rate by Doppler.

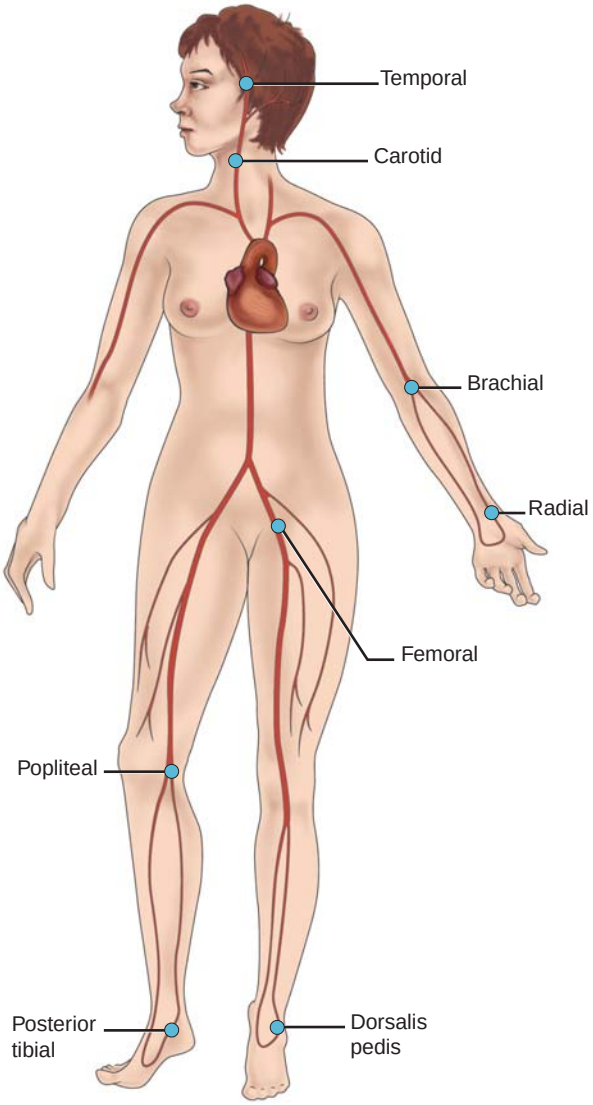


Figure 24-3. These arteries are located near the surface of the body. The pulse can be detected in any of these sites by light palpation.

Circulation to the legs and feet is assessed at the femoral, popliteal, posterior tibial, and dorsalis pedis sites. The carotid pulse site is used during emergency assessments, such as for patients who are in shock or have had a cardiac arrest. When taking a carotid pulse, lightly palpate only one side to prevent any decrease in cerebrovascular circulation. The brachial pulse site is used for infants who have had a cardiac arrest.

Assessing the Apical Pulse

If a peripheral pulse is difficult to assess accurately because it is irregular, feeble, or extremely rapid, the apical rate should be assessed. An apical pulse is also assessed when giving medications that alter heart rate and rhythm. In adults, the apical rate is counted for 1 full minute by listening with a stethoscope over the apex of the heart. The contraction of the heart can be heard in the space between the fifth and the sixth ribs, about 8 cm (3 inches) to the left of the median line and slightly below the nipple (see Guidelines for Nursing Care 24-2). The apical rate of an infant is easily palpated with the fingertips.

Assessing the Apical-Radial Pulse

When the radial pulse is irregular, counting the pulse at the apex of the heart and at the radial artery simultaneously is used to assess the apical-radial pulse rate. The techniques for taking an apical-radial pulse are outlined in Guidelines for Nursing Care 24-3.

A difference between the apical and radial pulse rates is called the **pulse deficit** and indicates that all of the heartbeats are not reaching the peripheral arteries or are too weak to be palpated.

Nursing Diagnoses

Examples of NANDA nursing diagnoses for alterations in the pulse are listed in the accompanying box.

RESPIRATIONS

Respiration involves several physiologic events. Pulmonary ventilation (or breathing) is movement of air in and out of the lungs; inspiration (or inhalation) is the act of breathing in, and expiration (or exhalation) is the act of breathing out. External respiration is the exchange of oxygen and carbon dioxide between the alveoli of the lungs and the circulating blood. Internal respiration is the exchange of oxygen and carbon dioxide between the circulating blood and tissue cells.

Although nurses assess the manifestations of changes in all of these respiratory events, the part that is measured as a vital sign is pulmonary ventilation, called respirations. Respiratory system assessment is described further in Chapter 25.

Physiology of Respirations

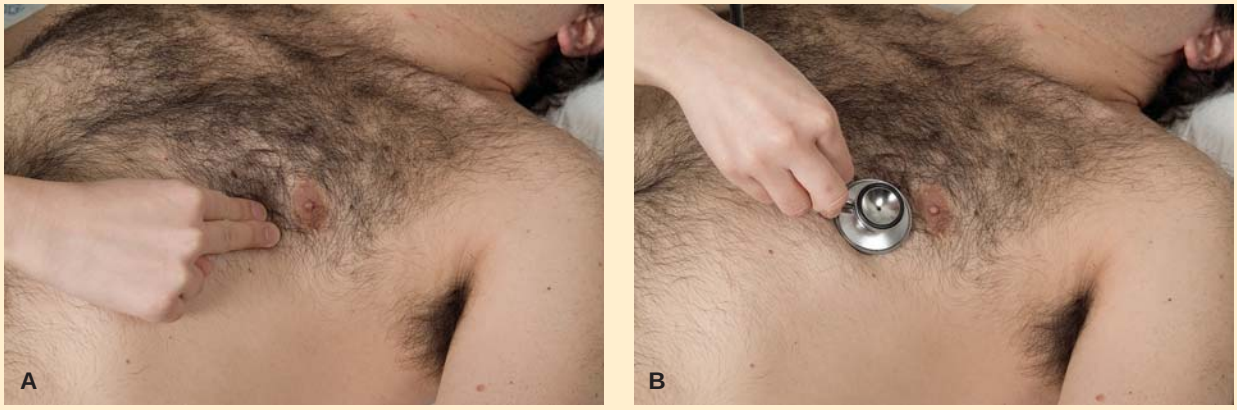
The rate and depth of breathing can change in response to body demands. These changes are brought about by the inhibition or stimulation of the respiratory muscles by respiratory centers in the medulla and pons. The respiratory centers are activated by impulses from chemoreceptors located in the aortic arch and carotid arteries, from stretch and irritant receptors in the lungs, and from receptors in muscles and joints. An increase in carbon dioxide is the most powerful respiratory stimulant, causing an increase in respiratory depth and rate. The cerebral cortex of the brain allows voluntary control of breathing, such as when singing or playing a musical instrument. See Chapter 45 for a detailed discussion of respiratory physiology.

The rate and depth of inhalation and exhalation are normally smooth, effortless, and without conscious effort. However, factors ranging from environmental changes to pathophysiologic alterations in various body systems may result in increases or decreases in respiratory rate and depth.

Guidelines for Nursing Care 24-2

Assessing the Apical Pulse

- Perform hand hygiene.
- Use alcohol swab to clean the diaphragm of the stethoscope. Use another swab to clean the earpieces if necessary.
- Assist patient to a sitting or reclining position and expose chest area.
- Move the patient's clothing to expose only the apical site.
- Hold the stethoscope diaphragm against the palm of your hand for a few seconds (to warm it).
- Palpate the space between the fifth and sixth ribs (fifth intercostal space), and move to the left midclavicular line. Place the diaphragm over the apex of the heart (see Figure).
- Listen for heart sounds ("lub-dub"). Each "lub-dub" counts as one beat.
- Using a watch with a second hand, count the heartbeat for 1 minute.
- Cover the patient and help him or her to a position of comfort.
- Clean diaphragm of the stethoscope with an alcohol swab.
- Remove gloves, if necessary. Perform hand hygiene.



The apical pulse is usually found at (**A**) the fifth intercostal space just inside the midclavicular line and can be heard (**B**) over the apex of the heart.

Guidelines for Nursing Care 24-3

Taking an Apical-Radial Pulse

The following techniques are recommended to assess an apical-radial pulse rate:

- Two nurses are needed; one listens with a stethoscope over the apex of the heart for the heartbeat, and the other counts the rate at the radial artery.
- The patient's chest wall is exposed so that the stethoscope can be placed directly on the skin of the chest wall.
- One watch with a sweep second hand is placed, so that both nurses can read it simultaneously.
- The nurses determine where they can best hear and feel the pulse and decide on a time to start counting, such as when the second hand on the watch is at a specified place (such as the number 12).
- Both nurses count for 1 full minute and record their counts.

Examples of NANDA Nursing Diagnoses: *Altered Pulse*

Nursing Diagnoses	Related Factors
Decreased Cardiac Output	History of congestive heart failure and dysrhythmias Traumatic injury with extensive blood loss
Ineffective Tissue Perfusion: Peripheral	History of peripheral vascular disease with decreased popliteal pulses
Deficient Fluid Volume	Exposure to high environmental temperature, increased age, and tachycardia
Acute Pain	First postoperative day following major surgery, crying, and tachycardia

Factors Affecting Respiration

Many different factors affect respiratory rate and depth. These factors include exercise, respiratory and cardiovascular disease, alterations in fluid, electrolyte, and acid–base balances, medications, trauma, infection, pain, and emotions. Factors that affect respiratory rate, depth, and movements are outlined in Box 24-5.

Respiratory Rate

Under normal conditions, healthy adults breathe about 12 to 20 times each minute, whereas infants and young children breathe more rapidly. Normal respiration is called **eupnea.** The relationship of one respiration to four heartbeats is fairly consistent in healthy people. Respiratory rate increases in response to exercise, pain, and emotions.

Think back to Noah Shoolin, the 2-year-old brought to the emergency department. The nurse would anticipate that the child's respiratory rate would be increased most likely as a result of his screaming and emotional upset.

Increased Respiratory Rate

Tachypnea, an increased respiratory rate, often occurs in response to the increased metabolic rate when a person has a fever. Cells require more oxygen at this time and have more carbon dioxide that must be removed. The rate increases as much as 4 breaths/min with every 0.6°C (1°F) that the temperature rises above normal. Any condition causing an increase in carbon dioxide and a decrease in oxygen in the blood also tends to increase the rate and depth of respirations.

Decreased Respiratory Rate

Bradypnea, a decrease in respiratory rate, occurs in some pathologic conditions. An increase in intracranial pressure depresses the respiratory center, resulting in irregular or shallow breathing, slow breathing, or both. Certain drugs, such as narcotics (eg, morphine, meperidine [Demerol]), depress the respiratory rate.

BOX 24-5 Factors Affecting Respiratory Rate, Depth, and Movements

- **Age:** The respiratory rate decreases with age, ranging from a normal range of 30–60 breaths/min in a newborn to 12–20 breaths/min in an adult.
- **Gender:** In males, respiratory movements are primarily diaphragmatic, whereas in women, there is greater intercostal muscle movement.
- **Exercise:** Exercise increases respiratory rate and depth.
- **Acid–base balance:** Alterations in acid–base balance (especially acidosis) commonly result in increased rate and depth of respirations (hyperventilation).
- **Brain lesions:** Lesions of the brain (such as hemorrhage or tumors) or brainstem can cause a change in both the depth and rate of respirations, most commonly manifested as Cheyne-Stokes respirations.
- **Increased altitude:** As an adaptation to higher altitudes, healthy people may exhibit Cheyne-Stokes respirations, especially when asleep. Higher altitudes also increase respiratory rate and depth prior to adaptation by increasing hemoglobin levels.
- **Respiratory diseases:** Any alterations in the normal respiratory structures may result in changes in respiratory rate, depth, and patterns, most often manifested as difficult breathing, using accessory muscles of respiration (such as the intercostal muscles), and increased rate. The depth may be shallower. Smoking can alter the pulmonary airways, resulting in an increase in respiratory rate at rest.
- **Anemia:** Anemia, a decrease in oxygen-carrying hemoglobin, may result in an increased rate of respirations.
- **Anxiety:** Anxiety can cause sighing type respirations (increased depth) and increased rate.
- **Medications.** Medications, such as narcotics, sedatives, and general anesthetics slow respiratory rate and depth. Other drugs, including amphetamines and cocaine, may increase rate and depth.
- **Acute pain:** Acute pain increases respiratory rate but may decrease respiratory depth.

Respiratory Depth and Rhythm

The depth of respirations normally varies from shallow to deep. The depth of each respiration is about the same when resting or sleeping. Periodically, each person automatically inhales deeply (sighs), filling the lungs with more air than with the usual depth of respiration.

Certain terms are used to describe the nature and depth of respirations. **Apnea** refers to periods during which there is no breathing. If apnea lasts longer than 4 to 6 minutes, brain damage and death might occur. **Dyspnea** is difficult or labored breathing. A dyspneic patient usually has rapid, shallow respirations and appears anxious. Dyspneic people can often breathe more easily in an upright position, a condition known as **orthopnea.** While sitting or standing, gravity lowers organs in the abdominal cavity away from the diaphragm. This gives more room for the lungs to expand within the chest, providing intake of more air with each breath. Table 24-7 describes and illustrates various respiratory patterns.

Assessing Respirations

The nurse assesses respiratory rate (breaths per minute), depth (deep or shallow), and rhythm (regular or irregular) by inspection (observing and listening) or by listening with the stethoscope. Other methods of assessing respiratory effectiveness include monitoring arterial blood gas results and using a pulse oximeter to determine oxygenation of blood. A description of a pulse oximeter and a procedure for using it are found in Chapter 45. Skill 24-3 describes how to assess the respiratory rate. Further assessments of respirations are described in Chapter 25.

Nursing Diagnoses

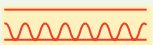
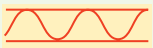
Examples of NANDA nursing diagnoses for alterations in respirations are listed in the accompanying box.

BLOOD PRESSURE

Blood pressure refers to the force of the blood against arterial walls. Maximum blood pressure is exerted on the walls of arteries when the left ventricle of the heart pushes blood through the aortic valve into the aorta at the beginning of systole. The pressure rises as the ventricle contracts and falls as the heart relaxes. This continuous contraction and relaxation of the left ventricle creates a pressure wave that is transmitted through the arterial system (Porth, 2005). The highest pressure is the **systolic pressure.** When the heart rests between beats during diastole, the pressure drops. The lowest pressure present on arterial walls at this time is the **diastolic pressure.** The difference between the two is called the **pulse pressure.**

Blood pressure is measured in millimeters of mercury (mm Hg) and is recorded as a fraction. The numerator is the

TABLE 24-7 **Patterns of Respiration**

	Description	Pattern	Associated Features
Normal	12–20 breaths/min Regular		Normal pattern
Tachypnea	>24 breaths/min Shallow		Fever, anxiety, exercise, respiratory disorders
Bradypnea	<10 breaths/min Regular		Depression of the respiratory center by medications, brain damage
Hyperventilation	Increased rate and depth		Extreme exercise, fear, diabetic ketoacidosis (Kussmaul's respirations), overdose of aspirin
Hypoventilation	Decreased rate and depth; irregular		Overdose of narcotics or anesthetics
Cheyne-Stokes respirations	Alternating periods of deep, rapid breathing followed by periods of apnea; regular		Drug overdose, heart failure, increased intracranial pressure, renal failure
Biot's respirations	Varying depth and rate of breathing, followed by periods of apnea; irregular		Meningitis, severe brain damage

Examples of NANDA Nursing Diagnoses: *Altered Respirations*

Nursing Diagnoses	Related Factors
Ineffective Breathing Pattern	Anxiety about diagnostic procedure for possible malignancy Increased intracranial pressure following head injury Infant delivered by cesarean delivery at 28 weeks gestation
Impaired Gas Exchange	Presence of acute respiratory distress following smoke inhalation
Risk for Activity Intolerance	History of smoking two packs of cigarettes a day for 20 years

systolic pressure; the denominator is the diastolic pressure. For example, if the blood pressure is 120/80 mm Hg, 120 is the systolic pressure and 80 is the diastolic pressure. The pulse pressure, in this case, is 40 mm Hg.

Physiology of the Blood Pressure

Blood pressure regulation is controlled by a variety of mechanisms to maintain adequate tissue perfusion. The arterial blood pressure has constant minor variations from activities of daily living, such as rising from a sitting to a standing position, exercise, or emotions (Porth, 2005).

Recall Doretha Renfrow, the wife of a man with hypertension. The nurse would need to integrate physiologic information about blood pressure regulation when developing the teaching plan for Mrs. Renfrow.

Peripheral Resistance and Compliance

Blood leaving the heart circulates through a continuous loop of blood vessels consisting of arteries, arterioles, capillaries, venules, and veins. Arterioles are very small elastic tubes that can contract or dilate to regulate the distribution of blood to various organs, tissues, or cells, depending on their moment-by-moment requirements. Normally, arterioles are in a state of partial contraction, resulting in a relatively constant level of resistance to blood flow. The state, called peripheral resistance, is one of the main factors affecting blood pressure.

Arteries have a considerable quantity of elastic tissue that allows them to stretch and distend (called compliance). When the heart rests between each beat, the walls of the arteries recoil (return to their original position) although pressure in them does not drop to zero. The state of pressure keeps the blood entering the capillaries in a continuous flow rather than in spurts. Simultaneously, the arterioles offer resistance. Therefore, the elasticity of the walls, in addition to the resistance of the arterioles, helps to maintain normal blood pressure. With increased age, the walls of arterioles become less elastic, which interferes with their ability to stretch and dilate. This can subsequently limit adequate blood flow and contribute to rising pressure within the vascular system.

Neural and Humoral Mechanisms

The autonomic nervous system mediates control mechanisms that function to maintain short-term regulation of blood pressure. These mechanisms include circulatory system baroreflex and chemoreceptor-mediated reflexes, as well as factors outside the circulatory system, such as pain and cold, that affect blood pressure responses. Blood pressure may change in response to central nervous system ischemia (decreased blood flow), mood, and emotion.

Many different hormones and humoral mechanisms also help regulate blood pressure. The renin-angiotensin-aldosterone system controls vasoconstriction to increase peripheral vascular resistance and also increases sodium and water retention by the kidneys to increase circulatory fluid volume and thus increase blood pressure. Antidiuretic hormone (ADH, vasopressin) is released from the posterior pituitary when stimulated by decreased blood volume and blood pressure, or by an increased osmolarity of the blood. As a result, water is retained to increase circulatory fluid volume and, in turn, increase blood pressure.

Cardiac Output

The quantity of blood forced out of the left ventricle with each contraction is called the stroke volume (SV). The cardiac output (CO) is the amount of blood pumped per minute, and averages from 3.5 L/min to 8.0 L/min in a healthy adult (Porth, 2005). This volume is determined by using the following formula: Cardiac Output = Stroke Volume × Heart Rate. Thus, the cardiac output of an adult with a stroke volume of 70 mL and a heart rate of 70 beats/min is 4.9 L/min. Cardiac output increases during exercise and decreases during sleep; it also varies depending on body size and metabolic needs. Trained athletes participating in maximal exercise may have a CO as great as 32 L/min (Porth, 2005).

An increased cardiac output results in increased blood pressure. When cardiac output is decreased, blood pressure

falls. Thus, a weak cardiac pumping action results in a lower blood pressure than a strong pumping action.

Factors Affecting Blood Pressure

Studies of healthy people indicate that blood pressure can be within a wide range and still be normal. Because of considerable individual differences, it is important to know the normal blood pressure of a particular person. A rise or fall of 20 to 30 mm Hg in a person's blood pressure is significant, even if it is within the generally accepted normal range. Although blood pressure varies constantly, sustained long-term changes are not normal. Blood pressure categories for adults are found in Table 24-8.

Factors that commonly cause variations in blood pressure are listed in Box 24-6. Because of the many factors that influence blood pressure, a single blood pressure measurement is not necessarily significant. The American Heart Association recommends that blood pressure readings be averaged on two or more subsequent occasions before diagnosing high blood pressure. Measurements should be taken after the patient rests for at least 5 minutes and has not consumed caffeine or smoked for 30 minutes before the measurement.

Increased Blood Pressure

Hypertension is blood pressure that is above normal for a sustained period. It is one of the most common health problems in adults and the leading cause of cardiovascular disorders. It is estimated that 50 million Americans and 1 billion persons worldwide have hypertension (Porth, 2005). Primary (also called essential) hypertension is hypertension without a known cause. When the hypertension is caused by a known pathology, it is called secondary hypertension. Hypertension is a major risk factor for heart disease and is the most important risk factor associated with stroke. It is often called "the silent killer" because there are few symptoms beyond the increased blood pressure.

The basis for hypertension is dysfunction of the neurohormonal system. Overactivation of both angiotensin and aldosterone result in an increase in blood pressure. Over time, this sustained increase results in a permanent remodeling and thickening of the blood vessels. As a result, there is increased peripheral resistance, and a back-up of pressure to organs affected by the vascular system, such as the brain, heart, and kidneys. Disorders of these organs include thickening of the myocardium, enlargement of the ventricles, congestive heart failure, myocardial infarctions, stroke, and kidney damage.

There are many risk factors for the development of hypertension. Significant risks are a family history of hypertension, sedentary lifestyle, obesity, and continual stress. Other high-risk factors include cigarette smoking, alcohol consumption, high salt intake, and a high-fat, high-calorie diet. Although the exact reason has not been determined, hypertension is almost twice as common in African Americans as in Americans of European descent.

Remember Mrs. Renfrow, the wife of a man who is overweight and diagnosed with hypertension? The nurse would need to incorporate information about various risk factors for developing hypertension as well as information about risk related to hypertension in the teaching plan for Mrs. Renfrow.

Hypertension can be controlled by medications and lifestyle changes. The categories of antihypertensive medications include diuretics (to decrease fluid volume), beta-adrenergic blockers (to block sympathetic stimulation and decrease cardiac output), vasodilators and calcium channel blockers (to relax smooth muscles of arterioles and decrease peripheral vascular resistance), and ACE inhibitors (to prevent vasoconstriction by angiotensin II and decrease circulatory fluid volume by reducing aldosterone production). Lifestyle changes include following a low-calorie, low-fat diet; losing

TABLE 24-8 Categories for Blood Pressure Levels in Adults (Ages 18 and older)

Category	Blood Pressure Level (mm Hg)	
	Systolic	Diastolic
Normal		
(In regard to risk of heart disease, optimal is defined as less than 120/80 mm Hg.)	<120	<80
High Blood Pressure		
Prehypertension	120–139	80–89
Stage 1	140–159	90–99
Stage 2	≥160	≥100

These categories are from the National Heart, Lung, and Blood Institute, National Institutes of Health, new clinical guidelines, 2003, and are available from http://www.nhlbi.nih.gov/hbp/detect/categ.htm.

BOX 24-6 Factors Contributing to Blood Pressure Variations in Healthy People

- **Age:** The older adult has decreased elasticity of the arteries, which increases peripheral resistance and therefore increases blood pressure.
- **Circadian rhythm:** Normal fluctuations occur during the day. The blood pressure is usually lowest on arising in the morning. The blood pressure has been noted to rise as much as 5 to 10 mm Hg by late afternoon, and it gradually falls again during sleep.
- **Gender:** Women usually have lower blood pressure than men of the same age until menopause.
- **Food intake:** Blood pressure increases after eating food.
- **Exercise:** Systolic blood pressure rises during periods of exercise and strenuous activity.
- **Weight:** Blood pressure is usually higher in people who are obese than in those who are thin.
- **Emotional state:** Emotions, such as anger, fear, excitement, and pain, generally cause the blood pressure to rise, but the pressure falls to normal when the situation passes.
- **Body position:** Blood pressure tends to be lower in a prone or supine position than when sitting or standing.
- **Race:** Race is a factor in increased blood pressure (hypertension), which is more prevalent and more severe in African American men and women.
- **Drugs/Medications:** Oral contraceptives cause a mild increase in blood pressure in many women.

excess weight and maintaining weight loss; limiting alcohol intake; eliminating smoking; reducing salt intake; and having regular physical activity. Nurses can influence the health of the public through screenings, education, and referrals.

Decreased Blood Pressure

Hypotension is below-normal blood pressure. A consistently low blood pressure (eg, a systolic reading of 90–115 mm Hg) is normal in some adults, such as highly trained athletes. Most cases of hypotension are the result of pathology. Pathologic hypotension might result from vasodilation of the arterioles, failure of the heart to function as an effective pump, or loss of blood volume (such as with a hemorrhage). The nurse should immediately report assessments of hypotension, tachycardia, pallor, increased sweating, and confusion.

Orthostatic hypotension (postural hypotension) is a low blood pressure associated with weakness or fainting when one rises to an erect position (either supine to sitting, supine to standing, or sitting to standing). It is the result of peripheral vasodilation without a compensatory rise in cardiac output. Patients most at risk for postural hypotension are older adults, patients who have been on prolonged bed rest, and those who are dehydrated or have sustained a significant blood loss. Some drugs, such as meperidine hydrochloride (Demerol) cause hypotension.

Arising and moving about slowly, especially after a period of bed rest, might prevent orthostatic hypotension. When ambulating the postoperative patient, the nurse should first raise the head of the bed, then assist the client to a sitting position on the side of bed (often called "dangling") for a few minutes to assess for dizziness or faintness, and then assist to a standing position. If the patient becomes dizzy or feels faint, he or she should be returned to bed and placed in a supine position, which restores blood flow to the brain. See Guidelines for Nursing Care 24-4 for how to assess orthostatic hypotension.

Assessing Blood Pressure

To accurately assess blood pressure, the nurse must know how to describe the sounds that are heard, appropriate equipment to use, and which site to choose.

Korotkoff Sounds

The series of sounds for which the nurse listens when assessing the blood pressure are called **Korotkoff sounds,** described and illustrated in Table 24-9.

In some adults, each of these sounds is distinct, whereas in others only the beginning and ending sounds are heard. It is important to determine institutional policy for recording

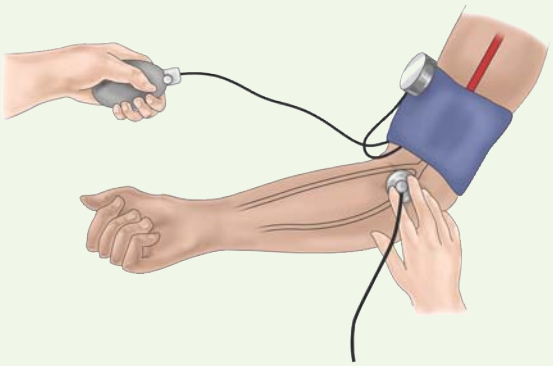
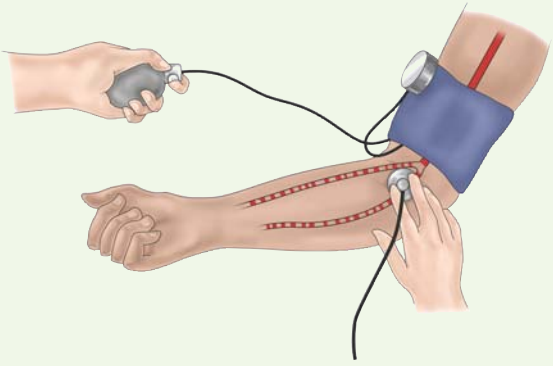
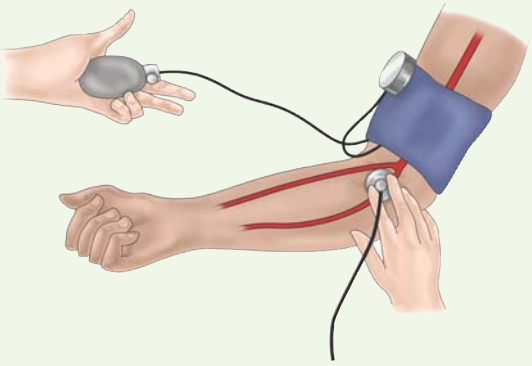
Guidelines for Nursing Care 24-4

Assessing Orthostatic Hypotension

If orthostatic blood pressures are ordered, the following guidelines should be used:

- Ask the patient to lie in a supine position for 3 to 5 minutes and take the blood pressure and pulse.
- Assist the patient to sit. After 1 minute, take the blood pressure and pulse.
- Assist the patient to stand. After 1 minute, take the blood pressure and pulse.
- Record the findings for each position. An increase of 40 beats in the pulse rate or a decrease in blood pressure of 30 mm Hg are abnormal.

TABLE 24-9 Korotkoff Sounds

Phase	Description	Illustration
Phase I	Characterized by the first appearance of faint but clear tapping sounds that gradually increase in intensity; the first tapping sound is the systolic pressure	
Phase II	Characterized by muffled or swishing sounds; these sounds may temporarily disappear, especially in hypertensive people; the disappearance of the sound during the latter part of phase I and during phase II is called the *auscultatory gap* and may cover a range of as much as 40 mm Hg; failing to recognize this gap may cause serious errors of underestimating systolic pressure or overestimating diastolic pressure.	
Phase III	Characterized by distinct, loud sounds as the blood flows relatively freely through an increasingly open artery	
Phase IV	Characterized by a distinct, abrupt, muffling sound with a soft, blowing quality; in adults, the onset of this phase is considered to be the first diastolic figure	
Phase V	The last sound heard before a period of continuous silence; the pressure at which the last sound is heard is the second diastolic measurement	

blood pressure sounds and to be consistent in taking and documenting the readings.

The first sound heard through the stethoscope, which is the onset of phase I, represents the systolic pressure. It is recorded as the first number in the fraction—for example, if the blood pressure reading is 120/80 mm Hg, 120 is the systolic pressure. The second number, which represents the diastolic pressure (in this case, 80), notes the level at which either a change in or a cessation of the loud, distinct sounds took place. This occurs in either phase IV or phase V.

The blood pressure is most commonly recorded with two numbers written as a fraction, with the bottom number indicating either the change of the sound or the last sound heard. However, the American Heart Association recommends that in instances when both a change in the sounds and a cessation of the sounds are heard, all numbers should be recorded. In this case, the blood pressure would be recorded as 120/80/64. If the sounds were heard all the way down to zero, the blood pressure recording would be 120/80/0. It is important to know the procedure for recording blood pressure at each agency or institution so that readings are consistent.

Equipment

Blood pressure may be assessed with different types of devices. Most commonly, nurses assess blood pressure by using a stethoscope and sphygmomanometer. Blood pressure

may also be estimated with a Doppler ultrasound stethoscope (described with the discussion of the pulse), estimated by palpation, and assessed with electronic or automated devices.

Equipment used to measure blood pressure must be in good repair and function properly to avoid inaccurate measurements. Any time the accuracy of the equipment is questionable, it should be checked and repaired or replaced, as indicated. If mercury leaks out of a manometer, it should be reported to the proper authorities as a hazardous waste spill.

Sphygmomanometer

A sphygmomanometer is used to assess blood pressure. The sphygmomanometer consists of a cuff and the manometer (Fig. 24-4).

The cuff contains an airtight, flat rubber bladder covered with cloth. A cuff of the proper width (ranging from neonate to adult thigh) must be selected to obtain an accurate blood pressure reading. The width of the cuff should be about 40% of the circumference of the limb to be used. The bladder inside the cuff should enclose at least two thirds of the adult limb and all of a child's limb. If the cuff is too narrow, the reading could be erroneously high because the pressure is not evenly transmitted to the artery. This occurs, for example, when an average-sized cuff is used on an obese or overweight person.

Think back to Mrs. Renfrow, the wife of a patient with hypertension who is overweight. The nurse would need to caution Mrs. Renfrow to make sure that the device she uses to measure her husband's blood pressure is sized adequately. Otherwise, the readings may be erroneous, possibly leading to inappropriate management based on inaccurate readings or a false sense of security that the hypertension is being controlled.

If a cuff is too wide (eg, using an adult cuff on the arm of a child), the reading may be erroneously low because pressure is dispersed over a disproportionately large surface area. Recommendations for the selection of an appropriately sized cuff are given in Table 24-10.

Depending on the product, cuffs may be disposable or reusable. They are closed around the limb with contact closures, such as nylon fabric that can be fastened to itself with Velcro or hooks. Some long cuffs are applied by encircling the arm several times. Two tubes are attached to the bladder within the cuff. One is connected to a manometer and the other is attached to a bulb used to inflate the bladder. The bladder is inflated enough to obstruct the flow of blood through the artery. A needle valve on the bulb allows the cuff to be deflated while the pressure is being read.

A mercury manometer has a mercury-filled cylinder or tube calibrated in millimeters. When mercury rises in the tube, the upper or top surface of the mercury forms a convex curve called the meniscus. When determining blood pressure with a mercury manometer, the top of the curve of the meniscus within the calibrated cylinder indicates the pressure. If the meniscus is observed above eye level, the pressure reading appears higher than it really is. If the meniscus is lower than eye level, it appears lower than it really is. Another type of manometer is called the aneroid manometer. It too has a cuff, but it is attached to a round, calibrated dial with a needle that indicates pressure.

Noninvasive Blood Pressure Monitors

Electronic blood pressure monitors sense vibrations within the artery wall, record the pressure readings, and display them in digital numbers (Fig. 24-5).

They also may provide measurements of pulse rate, pulse oximetry, and/or temperature.

Doppler Ultrasound

The blood pressure may be taken with an ultrasound or Doppler apparatus, which amplifies sounds. This is especially useful if the sounds are indistinct or are inaudible with a regular stethoscope. See Guidelines for Nursing Care 24-1.

Direct Electronic Measurement

It is possible to measure blood pressure directly through the insertion of a thin catheter into an artery (an arterial line). The tip of the catheter senses the pressure and transmits this information to a machine that displays the systolic and diastolic pressure in a waveform. This technique is used primarily in intensive care areas.

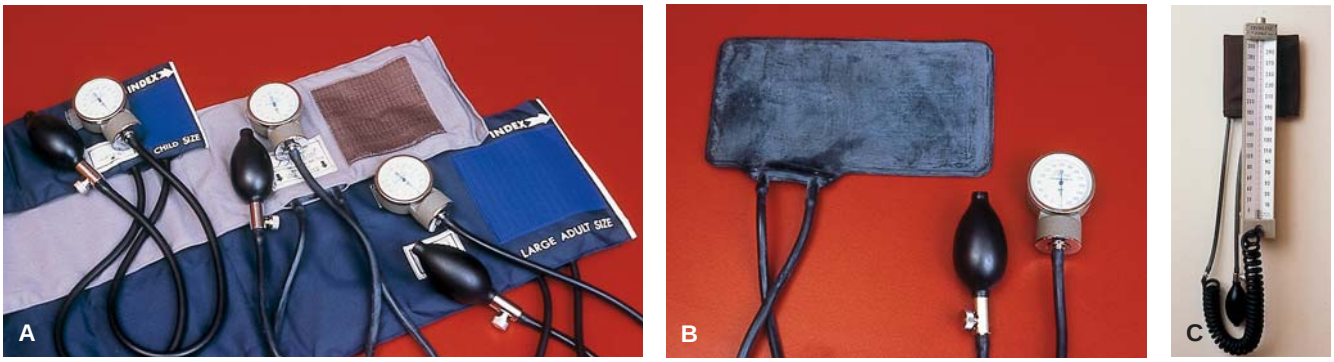


Figure 24-4. Parts of a sphygmomanometer. (**A**) Three cuff sizes: a small cuff for a child or a small or frail adult; a normal adult-sized cuff; and a large cuff, called a leg cuff, for measuring blood pressure on a leg, or for use on an obese adult. (**B**) An aneroid manometer. (**C**) A mercury manometer.

TABLE 24-10 Acceptable Bladder Dimensions (in cm) for Arms of Different Sizes*

Cuff	Bladder Width (cm)	Bladder Length (cm)	Arm Circumference Range at Midpoint (cm)
Newborn	3	6	<6
Infant	5	15	6–15†
Child	8	21	16–21†
Small adult	10	24	22–26
Adult	13	30	27–34
Large adult	16	38	35–44
Adult thigh	20	42	45–52

*There is some overlapping of the recommended range for arm circumferences to limit the number of cuffs; it is recommended that the larger cuff be used when available.
†To approximate the bladder width: arm circumference ratio of 0.40 more closely in infants and children, additional cuffs are available.
Circulation. 1993;88:2460–2467. Requests for reprints should be sent to the Office of Scientific Affairs, American Heart Association, 7272 Greenville Avenue, Dallas, TX 75231-4596.

Sites and Methods of Assessing the Blood Pressure

Although various sites may be used to assess the blood pressure, the brachial artery and the popliteal artery are most commonly used.

Assessing a Brachial Artery Blood Pressure

Skill 24-4 describes how to assess the blood pressure with a mercury manometer using the brachial artery. It is important to follow the recommended techniques to avoid the common errors identified in Table 24-11.

A brachial artery blood pressure assessment should not be taken on an arm with an intravenous line or with an arteriovenous fistula or shunt. Blood pressure assessment should also be avoided in the arm on the side of an axillary node dissection or mastectomy because the pressure might increase the risk of lymphedema developing in the affected arm.

Figure 24-5. The automatic blood-pressure monitor reports systolic, diastolic, and mean blood pressure. *(Photo © B. Proud.)*

Assessing a Popliteal Artery Blood Pressure

When the patient's brachial artery is inaccessible, the nurse can assess the blood pressure using the popliteal artery in the leg. The systolic pressure is normally 10 to 40 mm Hg higher at this site, although the diastolic pressure is the same. The technique for assessment is outlined in Guidelines for Nursing Care 24-5.

Palpating the Blood Pressure

Assessing the blood pressure through palpation is sometimes referred to as the sensory detection method. It requires only the use of the sphygmomanometer. The cuff is inflated 30 mm Hg above the point at which the pulsation in the artery disappears. As the air in the cuff is released, the nurse feels for the return of the pulse. Usually, no diastolic pressure is recorded because the artery continues to pulsate as long as blood flows through it. Some home patients assess their blood pressure this way. Instead of palpating the artery, however, the person notes the pressure on the manometer when experiencing the onset and disappearance of the throbbing sensation.

Nursing Diagnoses

Examples of NANDA nursing diagnoses for alterations in blood pressure are listed in the accompanying box.

TEACHING VITAL SIGNS FOR HOME CARE

Patients at home often need to check their own temperature, pulse, or blood pressure. Guidelines for teaching self-assessment and care of equipment are presented in the accompanying display, Teaching to Promote Health at Home 24-2.

TABLE 24-11 Blood Pressure Assessment Errors and Contributing Causes

Error	Contributing Causes	Error	Contributing Causes
Falsely low assessments	• Hearing deficit • Noise in the environment • Viewing the meniscus from above eye level • Applying too wide a cuff • Inserting eartips of stethoscope incorrectly • Using cracked or kinked tubing • Releasing the valve rapidly • Misplacing the bell beyond the direct area of the artery • Failing to pump the cuff 20 to 30 mm Hg above the disappearance of the pulse	Falsely high assessments	• Using a manometer not calibrated at the zero mark • Assessing the blood pressure immediately after exercise • Viewing the meniscus from below eye level • Applying a cuff that is too narrow • Releasing the valve too slowly • Reinflating the bladder during auscultation

Guidelines for Nursing Care 24-5

Assessing Blood Pressure in the Leg

- Place the patient in the prone position, if possible. If that position is not possible, place the patient in the supine position with the knee slightly flexed.
- Use a cuff that is specifically made for this assessment, or one that is large enough to make an accurate assessment.
- Place the cuff 2.5 cm (1 inch) above the popliteal artery, with the bladder over the posterior of the midthigh.
- Follow the same procedure for auscultation as for the brachial artery.

Examples of NANDA Nursing Diagnoses: *Altered Blood Pressure*

Nursing Diagnoses	Related Factors
Decreased Cardiac Output	Serious blood loss with hypovolemia Myocardial infarction with damage to cardiac pacemaker
Ineffective Health Maintenance	Lack of financial resources to seek medical care for hypertension
Effective Therapeutic Regimen Management	Blood pressure remains within normal limits for 6 months
Risk for Falls	History of falls, age (86 years) and presence of orthostatic hypotension

Teaching to Promote Health at Home 24-2

Self-Checking Temperature, Pulse, and Blood Pressure

Health Topic	Teaching Tip	Why Is This Important?
Taking the Temperature	• The temperature may be taken with a glass thermometer, a digital thermometer, a single-use disposable thermometer, or a temperature-sensitive tape.	
	• Adults who use a glass thermometer usually take an oral temperature. It is important that the temperature be taken at least 30 minutes after eating or drinking hot or cold foods or fluids, or after smoking. Infants and small children should have their temperature taken either with a temperature-sensitive tape on the forehead or a single-use thermometer in the axilla (armpit).	This will ensure an accurate temperature is assessed. Infants and small children should not have rectal temperatures taken because of the risk for damage to the rectal area.
	• Shake the liquid down into the bulb of the thermometer until the level of the liquid is below 98°F (36.5°C). To see the liquid level, hold the thermometer sideways at eye level and rotate it until the liquid can be seen. If the thermometer uses a Fahrenheit scale, each long mark is one degree and each short mark is two tenths of a degree; a centigrade scale uses long marks for one half of a degree and short marks for one tenth of a degree.	To ensure accuracy of the temperature when it is taken.
	• Place the glass thermometer as far back as possible under the side of the tongue and close the lips. Do not talk while the thermometer is in the mouth.	
	• Leave the thermometer in place for 2 to 3 minutes.	
	• Remove the thermometer and determine the point at which the liquid is level. This is the body temperature. Call your healthcare provider if the temperature is greater than 100°F (37.7°C), or if you are concerned.	
	• Wash the thermometer with soap and warm water, rinse it with cold water, dry it well, and store it in a clean, dry area. Do not use the thermometer to take another person's temperature unless it has been cleaned. If several members of the household have an infection or illness, the thermometer should soak in 70% isopropyl alcohol between uses; be sure to rinse off the alcohol with cold water before using it again.	Cleaning the thermometer is necessary to prevent transfer of illness from one family member to another.

Teaching to Promote Health at Home 24-2

Self-Checking Temperature, Pulse, and Blood Pressure *(continued)*

Health Topic	Teaching Tip	Why Is This Important?
Taking the Pulse	• The pulse is often taken before taking certain medications, such as those to make the heartbeat stronger. People who exercise and want to monitor the effect of the exercise on heart function also take their pulse. • It is necessary to be able to see a watch or a clock with a second hand when taking the pulse. • Place one arm on a firm surface so that the palm is upward. Using the middle three fingers of the other hand, gently feel the outside of the arm just below the wrist with the fingertips. Do not press hard. When pulsations are felt, watch the second hand of the watch or clock and begin to count when the second hand reaches 12 (any number is fine, but it is often easier to remember to always begin counting when the second hand is on 12). Count each pulsation (beat) for 1 minute (when the second hand again reaches 12), and write the number down.	If the pulse is very fast, very slow, or irregular, or if you have any concerns, contact your healthcare provider.
Taking the Blood Pressure	• The blood pressure is often taken to determine how well medications are working to control high blood pressure. The blood pressure is usually checked once a week. A record of blood-pressure readings over time is more important than one reading. • The blood pressure can be measured at home with a blood-pressure monitoring device or by using the mechanical devices found in many grocery or discount stores with a pharmacy. • If a home device is used, be sure the cuff is the proper size and that all parts of the device are working properly. The measurement should be taken while sitting comfortably, and the arm should be supported on a firm surface.	If the blood pressure numbers increase or decrease by more than 10, or if you have any concerns, contact your healthcare provider. It is important to use the same device or machine each time and to write down the numbers.

SKILL 24-1

Assessing Body Temperature

EQUIPMENT

Digital or electronic thermometer
Disposable probe covers
Water soluble lubricant for rectal temperature measurement
Nonsterile gloves, if appropriate
Toilet tissue, if needed
Pencil or pen, paper or flow sheet

IMPLEMENTATION

ACTION	RATIONALE
1. Check the physician's order or nursing care plan for frequency and route. More frequent temperature measurement may be appropriate based on nursing judgment.	Provides for patient safety.
2. Identify the patient. Discuss procedure with patient and assess the patient's ability to assist with the procedure.	Identifying the patient ensures the right patient receives the intervention and helps prevent errors. This discussion promotes reassurance and provides knowledge about the procedure. Dialogue encourages patient participation and allows for individualized nursing care.
3. Ensure the electronic or digital thermometer is in working condition.	Improperly functioning thermometer may not give an accurate reading.
4. Close curtains around bed and close door to room if possible.	Provides for patient privacy.
5. **Perform hand hygiene and put on gloves if appropriate or indicated.**	Hand hygiene deters the spread of microorganisms. Gloves prevent contact with blood and body fluids. Gloves are usually not required for an oral, axillary, or tympanic temperature measurement, unless contact with blood or body fluids is anticipated. Gloves should be worn for rectal temperature measurement.
6. Select the appropriate site based on previous assessment data.	Ensures safety and accuracy of measurement.
7. Follow the steps as outlined below for the appropriate type of thermometer.	
8. When measurement is completed, remove gloves, if worn. Perform hand hygiene.	Hand hygiene deters the spread of microorganisms.

Measuring a Tympanic Membrane Temperature

1. If necessary, push the "on" button and wait for the "ready" signal on the unit (Figure 1).	For proper function, thermometer must be turned on and warmed up.
2. Attach tympanic probe covering.	Use of the covering deters the spread of microorganisms.
3. **Insert the probe snugly into the external ear using gentle but firm pressure, angling the thermometer toward the patient's jaw line (Figure 2). Pull pinna up and back to straighten the ear canal in an adult.**	If the probe is not inserted correctly, the patient's temperature may be noted as lower than normal.

Figure 1. Turning unit on and awaiting the ready signal.

Figure 2. Inserting tympanic thermometer into the patient's ear.

SKILL 24-1

Assessing Body Temperature *(continued)*

ACTION	RATIONALE
4. Activate the unit by pushing the trigger button. The reading is immediate (usually within 2 seconds). Note the reading.	The digital thermometer must be activated to record the temperature.
5. Discard the probe cover in an appropriate receptacle by pushing the probe release button or use rim of cover to remove from probe (Figure 3). Replace the thermometer in its charger, if necessary.	Discarding the probe cover ensures that it will not be reused accidentally on another patient. Proper disposal prevents the spread of microorganisms. If necessary, the thermometer should stay on the charger so that it is ready to use at all times.
Assessing Oral Temperature	
1. Remove the electronic unit from the charging unit, and remove the probe from within the recording unit.	Electronic unit must be taken into the patient's room to assess the patient's temperature. On some models, by removing the probe the machine is already turned on.
2. Cover thermometer probe with disposable probe cover and slide it on until it snaps into place (Figure 4).	Using a cover prevents contamination of the thermometer probe.

Figure 3. Disposing of probe cover.

Figure 4. Putting probe cover on the thermometer.

3. **Place the probe beneath the patient's tongue in the posterior sublingual pocket (Figure 5). Ask the patient to close his or her lips around the probe.**	When the probe rests deep in the posterior sublingual pocket, it is in contact with blood vessels lying close to the surface.
4. **Continue to hold the probe until you hear a beep (Figure 6).** Note the temperature reading.	If left unsupported, the weight of the probe tends to pull it away from the correct location. The signal indicates the measurement is completed. The electronic thermometer provides a digital display of the measured temperature.
5. Remove the probe from the patient's mouth. Dispose of the probe cover by holding the probe over an appropriate receptacle and pressing the probe release button (Figure 7).	Disposing of the probe cover ensures that it will not be reused accidentally on another patient. Proper disposal prevents spread of microorganisms.
6. Return the thermometer probe to the storage place within the unit. Return the electronic unit to the charging unit, if appropriate.	The thermometer needs to be recharged for future use. If necessary, the thermometer should stay on the charger so that it is ready to use at all times.
Assessing Rectal Temperature	
1. Place the bed at an appropriate working height. Put on nonsterile gloves.	Having the bed at the right height reduces strain on the nurse's back.

(continued)

SKILL 24-1

Assessing Body Temperature *(continued)*

ACTION	RATIONALE

Figure 5. Inserting thermometer under the tongue in the posterior sublingual socket.

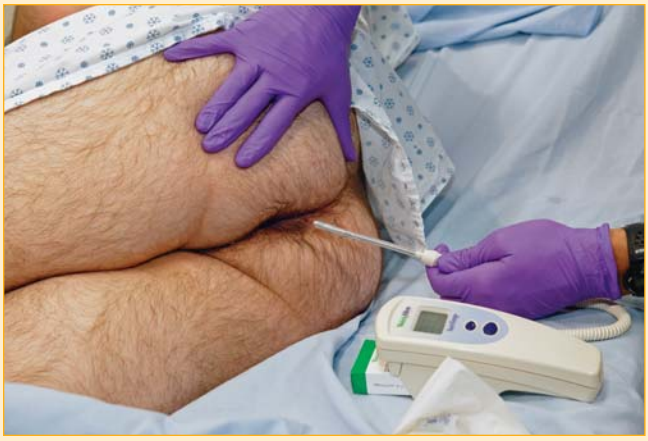
Figure 6. Holding probe in the patient's mouth.

Figure 7. Pushing button to dispose of cover.

2. Assist the patient to a side-lying position. Pull back the covers enough to expose only the buttocks.	The side-lying position allows the nurse to visualize the buttocks. Exposing only the buttocks keeps the patient warm and maintains his or her dignity.
3. Remove the rectal probe from within the recording unit of the electronic thermometer. Cover the probe with a disposable probe cover and slide it into place until it snaps in place (Figure 8).	Using a cover prevents contamination of the thermometer.
4. **Lubricate about 1″ of the probe with a water-soluble lubricant (Figure 9).**	Lubrication reduces friction and facilitates insertion, minimizing the risk of irritation or injury to the rectal mucous membranes.
5. Reassure the patient. Separate the buttocks until the anal sphincter is clearly visible.	If not placed directly into the anal opening, the thermometer probe may injure adjacent tissue or cause discomfort.
6. **Insert the thermometer probe into the anus about 1.5″ in an adult or 1″ in a child (Figure 10).**	Depth of insertion must be adjusted based on the patient's age. Rectal temperatures are not normally taken in an infant.

SKILL 24-1

Assessing Body Temperature *(continued)*

ACTION	RATIONALE
	
Figure 8. Removing appropriate probe and attaching disposable probe cover.	
	
Figure 9. Lubricating thermometer tip.	**Figure 10.** Inserting thermometer into the anus.
7. Hold the probe in place until you hear a beep, then carefully remove the probe. Note the temperature reading on the display.	If left unsupported, movement of the probe in the rectum could cause injury and/or discomfort. The signal indicates the measurement is completed. The electronic thermometer provides a digital display of the measured temperature.
8. Dispose of the probe cover by holding the probe over an appropriate waste receptacle and pressing the release button.	Proper probe cover disposal reduces risk of microorganism transmission.
9. Using toilet tissue, wipe the anus of any feces or excess lubricant. Dispose of the toilet tissue.	Wiping promotes cleanliness. Disposing of the toilet tissue avoids transmission of microorganisms.
10. Cover the patient and help him or her to a position of comfort.	Ensures patient comfort.
11. Remove gloves and discard them. Perform hand hygiene.	Hand hygiene avoids transmission of microorganisms.
12. Place the bed in the lowest position; elevate rails as needed.	These actions provide for the patient's safety.
13. Return the thermometer to the charging unit.	The thermometer needs to be recharged for future use.

(continued)

SKILL 24-1

Assessing Body Temperature *(continued)*

ACTION	RATIONALE
Assessing Axillary Temperature	
1. Place the bed at an appropriate working height.	Having the bed at the right height reduces strain on the nurse's back.
2. Move the patient's clothing to expose only the axilla (Figure 11).	The axilla must be exposed for placement of the thermometer. Exposing only the axilla keeps the patient warm and maintains his or her dignity.
3. Remove the probe from the recording unit of the electronic thermometer. Place a disposable probe cover on by sliding it on and snapping it securely.	Using a cover prevents contamination of the thermometer probe.
4. **Place the end of the probe in the center of the axilla (Figure 12). Have the patient bring the arm down and close to the body.**	The deepest area of the axilla provides the most accurate measurement; surrounding the bulb with skin surface provides a more reliable measurement.
5. Hold the probe in place until you hear a beep, and then carefully remove the probe. Note the temperature reading.	Axillary thermometers must be held in place to obtain an accurate temperature.
6. Cover the patient and help him or her to a position of comfort.	Ensures patient comfort.
7. Dispose of the probe cover by holding the probe over an appropriate waste receptacle and pushing the release button.	Discarding the probe cover ensures that it will not be reused accidentally on another patient.
8. Place the bed in the lowest position and elevate rails as needed. Leave the patient clean and comfortable.	Low bed position and elevated side rails provide for patient safety.
9. Return the electronic thermometer to the charging unit.	Thermometer needs to be recharged for future use.

Figure 11. Exposing axilla to assess temperature.

Figure 12. Placing thermometer in center of axilla.

Unexpected Situations and Associated Interventions

Temperature reading is higher or lower than expected based your assessment: Reassess temperature with a different thermometer. The thermometer may not be calibrated correctly. If using a tympanic thermometer, you will get lower readings if the probe is not inserted far enough into the ear.

During rectal temperature assessment, the patient reports feeling lightheaded or passes out: Remove the thermometer immediately. Quickly assess the patient's blood pressure and heart rate. Notify the physician. Do not attempt to take another rectal temperature on this patient.

General Considerations

When using a tympanic thermometer, make sure to insert the probe into the ear canal tightly enough to seal the opening to ensure an accurate reading.

Axillary temperatures are generally about 1° less than oral temperatures; rectal temperatures are generally about 1° higher.

If the patient smoked, chewed gum, or consumed hot or cold food or fluids, wait 15 to 30 minutes before taking an oral temperature to allow the oral tissues to return to baseline temperature.

SKILL 24-1

Assessing Body Temperature *(continued)*

Nasal oxygen is not thought to affect oral temperature readings. Oral temperatures should not be assessed for patients receiving oxygen by mask. Removal of the mask for the time period required for assessment could result in a serious drop in the patient's blood oxygen level.

If the patient's axilla has been recently washed, wait 15 to 30 minutes before taking an axillary temperature to allow the skin to return to baseline temperature.

Infant and Child Considerations

Small children have a limited attention span and have difficulty keeping their lips closed long enough to obtain an accurate oral temperature reading. For children younger than 6 years, use the axillary or tympanic site or use a temperature-sensitive tape (although research is ongoing to determine the accuracy of the measurements).

Children with a high grade fever (over 38.5°C) should have their temperatures rechecked at a different site.

Chemical dot thermometers (liquid crystal skin contact thermometers) are sometimes used as alternatives in pediatric settings. These single-use, disposable, flexible thermometers have specific chemical mixtures in circles on the thermometer that change color to measure temperature increments of 0.2°. Keep this type of thermometer in the mouth for 1 minute, in the axilla 3 minutes, and the rectum 3 minutes. Read the color change 10 to 15 seconds after removing the thermometer. Read away from any heat source. Wearable, continuous-use chemical dot thermometers are available. These are placed under the axilla. They must be in place at least 2 to 3 minutes before taking the first reading; continuously thereafter. Replace the thermometer and assess underlying skin every 48 hours.

Home Care Considerations

Teach patients using electronic or digital thermometers to clean the probe after use to prevent transmission of microorganisms between family members. Clean according to manufacturer's directions.

Teach patients using non-mercury glass thermometers to clean the thermometer after use in lukewarm soapy water and rinse in cool water. Store in an appropriate place to prevent breakage and injury from the glass.

SKILL 24-2

Assessing a Peripheral Pulse by Palpation

EQUIPMENT

Watch with second hand or digital readout | Pencil or pen, paper or flow sheet | Disposable gloves, if appropriate

IMPLEMENTATION

ACTION	RATIONALE
1. Check physician's order or nursing care plan for frequency of pulse assessment. More frequent pulse measurement may be appropriate based on nursing judgment.	This provides for patient safety.
2. Identify the patient.	Identifying the patient ensures patient safety.
3. Explain the procedure to the patient.	Explanation reduces apprehension and encourages cooperation.
4. Close curtains around bed and close door to room if possible.	Provides for patient privacy.
5. Perform hand hygiene and put on gloves as appropriate.	Hand hygiene deters the spread of microorganisms. Gloves are not usually worn to obtain a pulse measurement unless contact with blood or body fluids is anticipated. Gloves prevent contact with blood and body fluids.
6. Select the appropriate peripheral site based on assessment data.	Ensures safety and accuracy of measurement.
7. Move the patient's clothing to expose only the site chosen.	The site must be exposed for pulse assessment. Exposing only the site keeps the patient warm and maintains his or her dignity.

(continued)

SKILL 24-2

Assessing a Peripheral Pulse by Palpation *(continued)*

ACTION	RATIONALE
8. Place your first, second, and third fingers over the artery (Figure 1). **Lightly compress the artery so pulsations can be felt and counted.**	The sensitive fingertips can feel the pulsation of the artery.
9. **Using a watch with a second hand, count the number of pulsations felt for 30 seconds (Figure 2). Multiply this number by 2 to calculate the rate for 1 minute. If the rate, rhythm, or amplitude of the pulse is abnormal in any way, palpate and count the pulse for 1 minute or longer.**	Ensures accuracy of measurement and assessment.
10. **Note the rhythm and amplitude of the pulse.**	Provides additional assessment data regarding the patient's cardiovascular status.
11. Cover the patient and help him or her to a position of comfort.	Ensures patient comfort.
12. Remove gloves, if necessary. Perform hand hygiene.	Hand hygiene deters the spread of microorganisms.

Figure 1. Palpating the radial pulse.

Figure 2. Counting the pulse.

Unexpected Situations and Associated Interventions

The pulse is irregular: Monitor the pulse for a full minute. If this is a change for the patient, notify the physician.

The pulse is palpated easily but then disappears: Apply only moderate pressure to the pulse. Applying too much pressure may obliterate the pulse.

You cannot palpate a pulse: Use a portable ultrasound Doppler to assess the pulse. If this is a change in assessment, notify the physician. If you cannot find the pulse using an ultrasound Doppler, notify the physician. If you can find the pulse using an ultrasound Doppler, place a small X over the spot where the pulse is located. This can make palpating the pulse easier because the exact location of the pulse is known.

General Considerations

The normal heart rate varies by age.

When palpating a carotid pulse, lightly press only one side of the neck at a time. Never attempt to palpate both carotid arteries at the same time.

If a peripheral pulse is difficult to assess accurately because it is irregular, feeble, or extremely rapid, the apical rate should be assessed.

Infant and Child Considerations

The apical pulse is the most reliable for infants and small children.

Home Care Considerations

Teach the patient and family members how to take the patient's pulse, if appropriate.

Inform the patient and family about digital pulse monitoring devices.

Teach family members how to locate and monitor peripheral pulse sites, if appropriate.

SKILL 24-3

Assessing Respiration

EQUIPMENT

Watch with second hand or digital readout Pencil or pen, paper, or flow sheet

IMPLEMENTATION

ACTION	RATIONALE
1. **While your fingers are still in place for the pulse measurement, after counting the pulse rate, observe the patient's respirations (Figure 1).**	The patient may alter the rate of respirations if he or she is aware they are being counted.

Figure 1. Assessing respirations.

2. Note the rise and fall of the patient's chest.	A complete cycle of an inspiration and an expiration composes one respiration.
3. Using a watch with a second hand, count the number of respirations for 30 seconds. Multiply this number by 2 to calculate the respiratory rate per minute.	Sufficient time is necessary to observe the rate, depth, and other characteristics.
4. If respirations are abnormal in any way, count the respirations for at least 1 full minute.	Increased time allows the detection of unequal timing between respirations.
5. Note the depth and rhythm of the respirations.	Provides additional assessment data regarding the patient's respiratory status.
6. Perform hand hygiene.	Hand hygiene deters the spread of microorganisms.

Unexpected Situations and Associated Interventions

The patient is breathing with such shallow respirations that you cannot count the rate: Sometimes it is easier to count respirations by auscultating the lung sounds. Auscultate lung sounds and count respirations for 30 seconds. Multiply by 2 to calculate the respiratory rate per minute. Notify the physician of respiratory rate and the shallowness of the respirations.

General Considerations

If respiratory rate is irregular, count respirations for 1 minute.

Infant and Child Considerations

In infants, count respirations for 1 full minute due to a normally irregular rhythm.

SKILL 24-4

Assessing a Brachial Artery Blood Pressure

Practice & Learn

EQUIPMENT

Stethoscope
Sphygmomanometer
Blood pressure cuff of appropriate size
Pencil or pen, paper or flow sheet
Alcohol swab

IMPLEMENTATION

ACTION	RATIONALE
1. Check physician's order or nursing care plan for frequency of blood pressure measurement. More frequent measurement may be appropriate based on nursing judgment.	Provides for patient safety.
2. Identify the patient.	Identifying the patient provides patient safety.
3. Explain the procedure to the patient.	Explanation reduces apprehension and encourages cooperation.
4. Perform hand hygiene and put on gloves if appropriate or indicated.	Hand hygiene deters the spread of microorganisms. Gloves prevent contact with blood and body fluids. Gloves are usually not required for blood pressure measurement, unless contact with blood or body fluids is anticipated.
5. Close curtains around bed and close door to room if possible.	Provides for patient privacy.
6. **Select the appropriate arm for application of cuff.**	Measurement of blood pressure may temporarily impede circulation to the extremity.
7. Have the patient assume a comfortable lying or sitting position with the forearm supported at the level of the heart and the palm of the hand upward (Figure 1).	This position places the brachial artery on the inner aspect of the elbow so that the bell or diaphragm of the stethoscope can rest on it easily.
8. Expose the brachial artery by removing garments, or move a sleeve, if it is not too tight, above the area where the cuff will be placed.	Clothing over the artery interferes with the ability to hear sounds and may cause inaccurate blood pressure readings. A tight sleeve would cause congestion of blood and possibly inaccurate readings.
9. **Palpate the location of the brachial artery. Center the bladder of the cuff over the brachial artery, about midway on the arm, so that the lower edge of the cuff is about 2.5 to 5 cm (1″ to 2″) above the inner aspect of the elbow. Line up the artery marking on the cuff with the patient's brachial artery. The tubing should extend from the edge of the cuff nearer the patient's elbow (Figure 2).**	Pressure in the cuff applied directly to the artery provides the most accurate readings. If the cuff gets in the way of the stethoscope, readings are likely to be inaccurate. A cuff placed upside-down with the tubing toward the patient's head may give a false reading.

Figure 1. Proper positioning for blood pressure assessment using brachial artery.

Figure 2. Placing the blood pressure cuff.

SKILL 24-4

Assessing a Brachial Artery Blood Pressure *(continued)*

ACTION	RATIONALE
10. Wrap the cuff around the arm smoothly and snugly, and fasten it. Do not allow any clothing to interfere with the proper placement of the cuff.	A smooth cuff and snug wrapping produce equal pressure and help promote an accurate measurement. A cuff too loosely wrapped results in an inaccurate reading.
11. Check that the needle on the aneroid gauge is within the zero mark (Figure 3). If using a mercury manometer, check to see that the manometer is in the vertical position and that the mercury is within the zero level with the gauge at eye level.	If the needle is not in the zero area, the blood pressure may not be accurate. Tilting a mercury manometer, inaccurate calibration, or improper height for reading the gauge can lead to errors in determining the pressure measurements.
Estimating Systolic Pressure	
12. **Palpate the pulse at the brachial or radial artery by pressing gently with the fingertips (Figure 4).**	Palpation allows for measurement of the approximate systolic reading.

Figure 3. Ensuring gauge starts at zero.

Figure 4. Palpating the brachial pulse.

13. Tighten the screw valve on the air pump.	The bladder within the cuff will not inflate with the valve open.
14. **Inflate the cuff while continuing to palpate the artery. Note the point on the gauge where the pulse disappears.**	The point where the pulse disappears provides an estimate of the systolic pressure. To identify the first Korotkoff sound accurately, the cuff must be inflated to a pressure above the point at which the pulse can no longer be felt.
15. Deflate the cuff and wait 15 seconds.	Allowing a brief pause before continuing permits the blood to refill and circulate through the arm.
Obtaining Blood Pressure Measurement	
16. **Assume a position that is no more than 3 feet away from the gauge.**	A distance of more than about 3 feet can interfere with accurate readings of the numbers on the gauge.
17. Place the stethoscope earpieces in your ears. Direct the earpieces forward into the canal and not against the ear itself.	Proper placement blocks extraneous noise and allows sound to travel more clearly.
18. **Place the bell or diaphragm of the stethoscope firmly but with as little pressure as possible over the brachial artery (Figure 5). Do not allow the stethoscope to touch clothing or the cuff.**	Having the bell or diaphragm directly over the artery allows more accurate readings. Heavy pressure on the brachial artery distorts the shape of the artery and the sound. Placing the bell or diaphragm away from clothing and the cuff prevents noise, which would distract from the sounds made by blood flowing through the artery.
19. Pump the pressure 30 mm Hg above the point at which the systolic pressure was palpated and estimated. Open the valve on the manometer and allow air to escape slowly (allowing the gauge to drop 2 to 3 mm per heartbeat).	Increasing the pressure above the point where the pulse disappeared ensures a period before hearing the first sound that corresponds with the systolic pressure. It prevents misinterpreting phase II sounds as phase I.

(continued)

SKILL 24-4

Assessing a Brachial Artery Blood Pressure *(continued)*

ACTION	RATIONALE

Figure 5. Proper placement of diaphragm of stethoscope.

20. **Note the point on the gauge at which the first faint, but clear, sound appears that slowly increases in intensity. Note this number as the systolic pressure (Figure 6).**	Systolic pressure is the point at which the blood in the artery is first able to force its way through the vessel at a similar pressure exerted by the air bladder in the cuff. The first sound is phase I of Korotkoff sounds.
21. Read the pressure to the closest even number.	It is common practice to read blood pressure to the closest even number.
22. Do not reinflate the cuff once the air is being released to recheck the systolic pressure reading.	Reinflating the cuff while obtaining the blood pressure is uncomfortable for the patient and may cause an inaccurate reading. Reinflating the cuff causes congestion of blood in the lower arm, which lessens the loudness of Korotkoff sounds.
23. **Note the pressure at which the sound first becomes muffled. Also observe the point at which the sound completely disappears (Figure 7). These may occur separately or at the same point.**	The point at which the sound changes corresponds to phase IV Korotkoff sounds and is considered the first diastolic pressure reading. According to the American Heart Association, this is used as the diastolic pressure recording in children. The last sound heard is the beginning of phase V and is the second diastolic measurement in adults.

Figure 6. Measuring systolic blood pressure.

Figure 7. Measuring diastolic blood pressure.

SKILL 24-4

Assessing a Brachial Artery Blood Pressure *(continued)*

ACTION	RATIONALE
24. Allow the remaining air to escape quickly. Repeat any suspicious reading, but wait 30 to 60 seconds between readings to allow normal circulation to return in the limb. Deflate the cuff completely between attempts to check the blood pressure.	False readings are likely to occur if there is congestion of blood in the limb while obtaining repeated readings.
25. Remove the cuff, and clean and store the equipment.	Equipment should be left ready for use.
26. Remove gloves, if worn. Perform hand hygiene.	Deters the spread of microorganisms.

General Considerations

If this is the initial nursing assessment of a patient, take the blood pressure on both arms. It is normal to have a 5- to 10-mm Hg difference in the systolic reading between arms. Use the arm with the higher reading for subsequent pressures.

If you have difficulty hearing the blood pressure sounds, raise the patient's arm, with cuff in place, over his or her head for 15 seconds before rechecking the blood pressure. Inflate the cuff while the arm is elevated, and then gently lower the arm while continuing to support it. Position the stethoscope and deflate the cuff at the usual rate while listening for Korotkoff sounds. Raising the arm over the head helps relieve congestion of blood in the limb, increases pressure differences, and makes the sounds louder and more distinct when blood enters the lower arm.

Blood pressure may be assessed using an electronic device or Doppler ultrasound.

Many electronic devices are not recommended for patients with irregular heart rates, tremors, or the inability to hold the extremity still. The machine will continue to inflate, causing pain for the patient.

Infant and Child Considerations

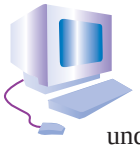
In infants and small children, the lower extremities are commonly used for blood pressure monitoring. The more common sites are the popliteal, dorsalis pedis, and posterior tibial. Blood pressures obtained in the lower extremities are generally higher than if taken in the upper extremities.

In newborns, take blood pressure in all four extremities and document. Large differences among blood pressure readings can indicate heart defects.

Home Care Considerations

Use a cuff size appropriate for limb circumference. Inform the patient that cuff sizes range from a pediatric cuff to a large thigh cuff and that a poorly fitting cuff may result in an inaccurate measurement.

Inform the patient about digital blood pressure monitoring equipment. Though costly, most provide an easy-to-read recording of systolic and diastolic measurements.



The Taylor Suite offers these additional resources to enhance learning and facilitate understanding of this chapter:

- thePoint online resource, http://thepoint.lww.com/Taylor6E
- Student CD-ROM included with the book
- Study Guide to Accompany Taylor's Fundamentals of Nursing
- Skills Checklist Accompany Taylor's Fundamentals of Nursing
- Taylor's Video Guide to Clinical Nursing Skills: *Vital Signs*
- Taylor's Interactive Nursing Skills: *Vital Signs*

Developing Critical Thinking Skills

1. Take your own pulse several times a day, such as when you first get up, before and after meals, and before and after exercise. Write down the rate, rhythm, and quality of the pulse. What changes did you see? What are the physiologic rationales for these changes?
2. Describe differences you might expect to find in the vital signs of the following individuals, and include the physiologic reasons for these differences:
   - A teenager who has his first football practice in 95°F heat
   - An infant with a bacterial ear infection
   - A young woman arriving at the emergency department after an attempted assault
   - A middle-aged man who sustained serious trauma and bleeding in an automobile crash
   - A 92-year-old woman with a chronic respiratory disease

Practicing for NCLEX

1. An elevation of the body temperature above normal is labeled
   a. Fever
   b. Hypothermia

c. Hypertension
d. Afebrile

2. For which of the following patients would you use an oral thermometer?
   a. 6-month-old infant
   b. Patient receiving oxygen therapy by mask
   c. 42-year-old healthy woman
   d. Unconscious patient
3. Insertion of a rectal thermometer may cause a potentially harmful condition. This condition is
   a. An increase in heart rate
   b. A decrease in heart rate
   c. An involuntary loss of stool
   d. An increase in respirations
4. While taking an adult patient's pulse, a student finds the rate to be 140 beats/min. What should the student do next?
   a. Check the pulse again in 2 hours.
   b. Check the blood pressure.
   c. Record the information.
   d. Report the rate.
5. A patient complains of severe abdominal pain. When assessing the vital signs, the nurse would not be surprised to find
   a. An increase in the pulse rate
   b. A decrease in body temperature
   c. A decrease in blood pressure
   d. An increase in body temperature
6. What equipment is necessary to assess the apical pulse?
   a. Sphygmomanometer
   b. Electronic thermometer
   c. Stethoscope
   d. Doppler apparatus
7. The difference between the apical and radial pulse rates is called the
   a. Pulse deficit
   b. Pulse amplitude
   c. Ventricular rhythm
   d. Heart arrhythmia
8. The normal respiratory rate in adults is considered to be
   a. 1 to 6 breaths/min
   b. 12 to 20 breaths/min
   c. 60 to 80 breaths/min
   d. 100 to 120 breaths/min
9. A patient is having dyspnea. What would the nurse do first?
   a. Remove pillows from under the head
   b. Elevate the head of the bed
   c. Elevate the foot of the bed
   d. Take the blood pressure
10. What does the blood pressure measure?
    a. Flow of blood through the circulation
    b. Force of blood against arterial walls
    c. Force of blood against venous walls
    d. Flow of blood through the heart
11. With aging, blood pressure is often higher due to
    a. Loss of muscle mass
    b. Changes in exercise and diet
    c. Decreased peripheral resistance
    d. Decreased elasticity in arterial walls
12. A patient has a blood pressure reading of 130/90 mm Hg when visiting a clinic. The nurse would recommend
    a. Follow-up measurements of blood pressure
    b. Immediate treatment by a physician
    c. Nothing, because the nurse considers this reading is due to anxiety
    d. A change in diet and exercise
13. In recording a blood pressure of 120/80 mm Hg, the 120 represents the
    a. Pulse rate
    b. Diastolic pressure
    c. Systolic pressure
    d. Pulse deficit
14. It is important to have the appropriate cuff size when taking the blood pressure. A cuff that is too large or too small may result in
    a. An incorrect reading
    b. Injury to the patient
    c. Prolonged pressure on the arm
    d. Loss of Korotkoff sounds
15. A patient has intravenous fluids infusing in the right arm. When taking a blood pressure on this patient, the nurse would
    a. Take the blood pressure in the right arm
    b. Take the blood pressure in the left arm
    c. Use the smallest possible cuff
    d. Report inability to take the blood pressure

Answers With Rationales

1. The correct response is *a*. Fever is an elevation of body temperature. Hypothermia (*b*) is low body temperature. Hypertension (*c*) is elevated blood pressure. Afebrile (*d*) means that there is no elevation of body temperature.
2. The correct response is *c*. Use of oral thermometers is contraindicated in infants (*a*), patients receiving oxygen therapy (*b*), and unconscious patients (*d*).
3. The correct response is *b*. Insertion of a rectal thermometer may stimulate the vagus nerve, which, in turn, would decrease heart rate. This may potentially be harmful for patients with cardiac problems.
4. The correct response is *d*. A rate of 140 beats/min in an adult is an abnormal pulse and should be reported to the instructor or the nurse in charge of the patient.
5. The correct response is *a*. The pulse often increases when an individual is experiencing pain. Pain does not affect body temperature and may increase (not decrease) blood pressure.
6. The correct response is *c*. The apical pulse can only be assessed by listening with a stethoscope.
7. The correct response is *a*. The difference between the apical and radial pulse rate is called the pulse deficit. The other responses are names given to volume and rhythm of the pulse.
8. The correct response is *b*. The normal respiratory rate for adults is 12 to 20 breaths/min.
9. The correct response is *b*. Dyspnea is difficult respirations. Elevating the head of the bed allows the abdominal organs to descend, giving the diaphragm greater room for expansion and facilitating lung expansion. Any other intervention would not facilitate respirations.

10. The correct response is *b*. Blood pressure is the measurement of the force of blood against arterial walls. Other responses are incorrect in describing blood pressure.
11. The correct response is *d*. With aging, elasticity in arterial walls is decreased, contributing to an elevated blood pressure reading. The other responses may contribute to changes in readings, but they are not the physiologic basis for blood pressure findings in the older adult.
12. The correct response is *a*. A single blood pressure reading that is mildly elevated is not significant, but the measurement should be taken again over time to determine if hypertension is a problem. The nurse would recommend a return visit to the clinic for a recheck.
13. The correct response is *c*. The systolic pressure is 120 mm Hg. The diastolic pressure is 80 mm HG. The other responses relate to pulse rather than blood pressure.
14. The correct response is *a*. A blood pressure cuff that is not the right size may cause an incorrect reading. It will not cause injury (*b*) or loss of sounds (*d*).
15. The correct response is *b*. The blood pressure should be taken in the arm opposite the one with the infusion. Blood pressure should not be taken in the arm with an intravenous infusion because the pressure of inflating the cuff may allow the artery to clot.

Bibliography

American Nurses Association. (2004). *New goals for healthy blood pressure*. Available at http://www.healthyblood pressure.org/index2.asp.

Anderson, M., Wolfe, B., Purvis, A., Steinman, R., & Trimble, T. (2005). Pediatric routine vital signs. *Journal of Emergency Nursing, 31*(3), 292–293.

Bauer, J. (2003). Market choices: Thermometers. *RN, 66*(3), 6–64.

Lobel, K., & Mann, S. (2005). Treating elevated pulse pressure. *Clinical Advisor, 8*(4), 55.

Malta, F. (2005). Teaching patients how to take their pulse. *Clinical Advisor, 8*(1), 65.

Mason, P. (2005). Understanding why routine observations improve practice. *Nursing Times, 101*(5), 43.

Mehta, M. (2003). Assessing respiratory status: Learn how to evaluate your patient's lungs through sight, sound, and touch. *Nursing, 33*(2), 54–56.

NANDA International. (2005). *Nursing diagnoses: Definitions & classification 2005–2006*. Philadelphia: Author.

National Heart, Lung, and Blood Institute, National Institutes of Health. (2003). *The seventh report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure*. Available at http://www.jama.com.

Porth, C. (2005). *Pathophysiology: Concepts of altered health states* (7th ed.). Philadelphia: Lippincott Williams & Wilkins.

Rappaport, L. (2004). Unusual breathing patterns—something to worry about? *Contemporary Pediatrics, 21*(4), 20.

Rushing, J. (2005). Clinical do's & don'ts: Assessing for orthostatic hypotension. *Nursing, 35*(1), 30.

Snyder, M. (2005). Learn the chilling facts about hypothermia. *Hospital Nursing, 35*(2), 1–4.

Trim, J. (2005a). Monitoring pulse. *Nursing Times, 101*(21), 30–31.

Trim, J. (2005b). Respirations. *Nursing Times, 101*(22), 30–31.

Weber, J., & Kelley, J. (2007). *Health assessment in nursing* (3rd ed.). Philadelphia: Lippincott Williams & Wilkins.

Woodrow, P. (2003). Assessing pulse in older people. *Nursing Older People, 15*(8), 38–40.

Woods, A. (2004). Loosening the grip of hypertension. *Nursing, 34*(12), 36–45.