SCENARIO

Leah Barney, a recent graduate of a CMA (AAMA) program, is a new employee at the Health Alliance Medical Clinic. The class on medical laboratory procedures was Leah’s favorite in her medical assisting program at the community college; in that class, she learned the principles of phlebotomy and performed several phlebotomy procedures both in the school’s laboratory and at her externship site. Her employer has arranged for Leah to spend time with an experienced phlebotomist at the clinic so that she is prepared to perform phlebotomy duties in her new position. Nervous but excited, she begins her training.

While studying this chapter, think about the following questions:

- How will Leah know which tubes or which needle size to use?
- How will Leah approach phlebotomy on a child or an elderly person?
- What conditions will require a capillary puncture?
- How can Leah make the clinic patients comfortable and at ease?
- How will Leah handle a difficult “stick”?

LEARNING OBJECTIVES

1. Define, spell, and pronounce the terms listed in the vocabulary.
2. Apply critical thinking skills in performing the patient assessment and patient care.
3. List the equipment needed for venipuncture.
4. Explain the purpose of a tourniquet.
5. Explain how to apply a tourniquet and three consequences of improper application.
6. Explain why the stopper colors on evacuated tubes differ.
7. State the correct order in which samples for various types of tubes should be collected.
8. Describe the types of sharps used in phlebotomy.
9. Explain why a syringe would be chosen for blood collection rather than an evacuated tube.
10. Discuss the use of sharps with engineered sharps injury protection.
11. Summarize postexposure management of needle sticks.
12. Detail patient preparation for venipuncture that shows sensitivity to the patient’s rights and feelings.
13. Describe and name the veins that may be used for blood collection.
14. List in order the steps of a routine venipuncture.
15. Collect a venous blood sample using the syringe method.
16. Collect a venous blood sample using the evacuated tube method.
17. Explain why a winged infusion set (butyfly needle) would be chosen over an evacuated tube.
18. Perform a venipuncture using a winged infusion set.
19. Summarize typical problems that may be associated with venipuncture.
20. Identify the major causes of hemolysis during venous blood collection.
21. List situations in which capillary puncture would be preferred over venipuncture.
22. Discuss proper dermal puncture sites.
23. Describe containers that may be used to collect capillary blood.
24. Explain why the first drop of blood is wiped away when a capillary puncture is performed.
25. Perform a capillary puncture.
26. Differentiate whole blood, serum, and plasma and give an example of a test performed with each.
27. Describe handling and transport methods for blood after collection.
**Vocabulary**

- **hemoconcentration**: A condition in which the concentration of blood cells is increased in proportion to the plasma.
- **hemolysis** (hi-mōl’-ə-sis): The destruction or dissolution of red blood cells, with subsequent release of hemoglobin.
- **plasma**: The liquid portion of whole blood that contains active clotting agents.
- **serum**: The liquid portion of whole blood that remains after the blood has clotted.
- **thixotropic gel**: A material that appears to be a solid until subjected to a disturbance, such as centrifugation, whereupon it becomes a liquid.

Phlebotomy, the practice of drawing blood, has its roots in the ancient practice of restoring the four body humors: blood, phlegm, yellow bile, and black bile. The foundation of all medical treatment was to keep these humors in balance by purging, starving, vomiting, or bloodletting.

The art of bloodletting was flourishing by the Middle Ages, and both barbers and surgeons performed it. Barbers advertised with a red and white striped pole; red represented blood, and white represented the tourniquet. The pole itself represented the stick the patient squeezed during the procedure. Typically, 16 to 30 ounces (1 to 4 pints) of blood were drained to treat an illness. When the patient became faint, the “treatment” was stopped.

Often, bleeding over large areas of the body was accomplished by multiple incisions. George Washington is reported to have died in 1799 after being drained of 9 pints of blood within 24 hours to cure a throat infection. In Washington’s day, it was believed that the blood was a carrier of the impurities of disease, and with bleeding, new and healthy blood would replace what was lost. By the end of the nineteenth century, bloodletting was declared quackery.

Today phlebotomy is performed primarily for diagnosis and to monitor a patient’s condition. According to the American Society of Clinical Pathologists (ASCP), nearly 80% of physicians’ decisions are based on laboratory tests, most of which are blood tests. Phlebotomy involves highly developed procedures and equipment to ensure the patient’s comfort and safety. The high standards necessary for the proper practice of phlebotomy led to the creation of different organizations that develop standards for training. Medical assistants are trained to perform phlebotomy. To be certified as a phlebotomist, they must complete course work and training at an accredited institution and then pass a national examination. Some medical assistant programs include this specialized training in their curriculum.

Certifying agencies include ASCP, the International Academy of Phlebotomy Sciences, the National Certification Agency (NCA), and the National Phlebotomy Association (NPA). Continuing education often is required to maintain certification. California and Louisiana were the first states to create state certification requirements. It is important that medical assistants become familiar with the guidelines of their home states, because not all states require a certificate to perform phlebotomy.

The most common method of obtaining blood is venipuncture, in which the blood is taken directly from a surface vein. The vein is punctured with a needle, and the blood is collected either in a syringe or in a stoppered tube. The procedure is safe when performed by a trained professional, but it must be performed with care. Much practice is required to become skilled and confident in the technique of venipuncture.

### Venipuncture Equipment

Proper collection of blood requires specialized equipment. A complete list of materials used in routine venipuncture is shown in the box. Phlebotomists generally carry the equipment in a portable tray (Figure 53-1). A physician’s office laboratory often has a permanent location where venipuncture is performed. In such cases, you likely will seat the patient in a venipuncture chair, which has an adjustable locking armrest to protect the patient if he or she faints (Figure 53-2). However, if the patient has a history of syncope, it is best to perform phlebotomy while the patient is lying on an examination table.

**Equipment Used in Routine Venipuncture**

- Double-pointed safety needles
- Evacuated, stoppered tubes
- Needle holder
- Sharps container
- Syringes
- Winged infusion sets (butterfly needles)
- Tourniquet
- Marking pen
Gloves

Employers must provide employees with gloves, including the hypoallergenic, powderless, and vinyl types, as needed. Remember, even though an employee may not have a latex allergy, the patient may be allergic. Therefore, it is important to ask patients about allergies each time they visit the office. If the patient is allergic to latex, alternative gloves (e.g., vinyl) must be worn; in addition, the medical assistant must consider other necessary supplies, such as tourniquets and adhesive bandages, that may have to be exchanged for versions that do not contain latex. Many facilities stock only latex-free supplies because of the potential for allergic responses in workers and patients.

The Occupational Safety and Health Administration (OSHA) requires healthcare workers to wear gloves during venipuncture; however, the agency does not specify when during the course of the procedure the gloves must be put on. Because veins can be difficult to locate with gloved fingertips, the site may be palpated before putting on gloves. The standard procedure for venipuncture established by the Clinical and Laboratory Standards Institute (CLSI) states that gloves should be put on after vein palpation but before preparation of the site. Those who need the final assurance of one last palpation before the needle is inserted must remember that touching the prepared site, even with gloves, contaminates the area. To help find the vein after cleansing the area, make note of certain skin markers, such as creases, freckles, or scars. If the area is touched, it must be cleansed again. Keep in mind that the tourniquet should be tied for no longer than 1 minute at a time.

Tourniquets

Before blood can be drawn, a vein must be located. Application of a tourniquet (Figure 53-3) is the most common way to do this; it prevents venous flow out of the site, causing the veins to bulge. The tourniquet is tied around the upper arm so that it is tight but not uncomfortable and can be released easily with one hand. Latex tourniquets are inexpensive, but they may become contaminated, and some patients are allergic to latex. Other tourniquets with Velcro closures are available and may be more comfortable for the patient, but they are difficult to release. Single-use, nonlatex tourniquets are available and are recommended for reducing cross-contamination between patients and healthcare workers, preventing nosocomial infection, and preventing latex exposure.

Tourniquets are tied 3 to 4 inches above the elbow immediately before the venipuncture procedure begins. Because a tourniquet impedes blood flow, leaving it on for longer than 1 minute greatly increases the possibility of hemoconcentration and altered test results. The tourniquet should not be tied so tightly as to impede arterial blood flow; this restricts venous blood return, resulting in poor venous distention. Checking the pulse at the wrist ensures that arterial flow is not restricted. Tourniquets also are used when drawing blood from hand and foot veins and are tied on the wrist or ankle, respectively.

Tourniquets can be uncomfortable for patients, especially those with heavyset or hairy upper arms, if they are not applied correctly. Make sure the tourniquet is flat against the skin, and if necessary, tie it over the clothing if it is causing the patient
and the more likely it is the blood will hemolyze if a high-gauge needle with a small lumen is used.

The size of the tube to be used depends on several factors. Each test performed in the laboratory requires a specific amount of blood. Consult the manual provided by the laboratory to make sure you are drawing the right amount of blood for the test. Tests can often be combined, which reduces the number of tubes that must be drawn. For example, both a complete blood count and an erythrocyte sedimentation rate test (discussed in Chapter 54) are performed on a sample from a lavender-topped tube; you need not draw two tubes, because the 7-mL volume is sufficient for both tests. When in doubt, call the laboratory. Keep in mind that blood is approximately half cells and half liquid. If a test requires 3 mL of serum, 6 mL of blood must be collected.

Patients often express great concern when several tubes of blood must be drawn. You can allay their fears by explaining that the average adult has a little less than 10 pints of blood (5 L). Most adults can relate to donating a unit of blood, which is around a pint (400 to 500 mL). Because the red-topped tube contains 10 mL, you would have to draw 40 to 50 tubes before you have removed a pint.

**Tube Additives**

All tubes except the red-topped one contain an additive. Anticoagulants are added to prevent blood from clotting. Tubes may be glass or plastic, and the additive may be a powder, a liquid visible in the tube, or a liquid sprayed inside the tube by the manufacturer and allowed to dry. The choice of anticoagulant depends on the test to be done.

Ethylenediamine tetracetic acid (EDTA), found in the lavender-topped tube, prevents platelet clumping and preserves the appearance of blood cells for microscopic examination; however, it is incompatible with the testing reagents used in coagulation studies. Consult the manual provided by the laboratory before obtaining a specimen from the patient.

Clot activators promote blood clotting. Silica particles enhance clotting, for example, by providing a surface for platelet activation. Thrombin quickly promotes clotting and is used in tubes drawn for coagulation testing or in the event a sample is needed from a patient taking a prescribed anticoagulant, such as heparin.

Anticoagulants prevent blood from clotting which allows the contents of the tube to be used in two ways. First, the sample can be used as whole blood; second, the sample can be centrifuged, and the liquid portion, called plasma, can be retrieved. Whole blood is used for tests such as complete blood counts and blood typing, whereas plasma is used for coagulation testing and coagulation studies.

If blood is allowed to clot and then is centrifuged, the liquid portion is referred to as serum. Without a clot activator, blood clots in 30 to 60 minutes, after which it must be centrifuged. The serum must be separated from the cells quickly, because cells may continue to metabolize substances such as glucose or may release metabolites that interfere with testing. Thixotropic gel can be found in some tubes, including the serum separation tube (SST) red-gray and the plasma separation tube (PST) green-gray (marbled)-topped tubes by Becton, Dickinson (Franklin Lakes, New Jersey). This synthetic gel has a density between that of red cells and plasma or serum, and it settles between the two during
TABLE 53-1 Common Stoppers and Additives and Their Laboratory Uses

<table>
<thead>
<tr>
<th>VACUETTE COLOR</th>
<th>COLOR</th>
<th>HEMOGARD COLOR</th>
<th>ADDITIVE AND ITS FUNCTION</th>
<th>LABORATORY USE</th>
<th>OPTIMUM VOLUME/ MINIMUM VOLUME</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adult Tubes</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yellow</td>
<td>Yellow</td>
<td>Yellow</td>
<td>SPS prevents blood from clotting and stabilizes bacterial growth</td>
<td>Blood or body fluid cultures</td>
<td>5 mL/NA</td>
</tr>
<tr>
<td>Red</td>
<td>Red</td>
<td>Red</td>
<td>None</td>
<td>Serum tests; chemistry studies, blood bank, serology</td>
<td>10 mL/NA</td>
</tr>
<tr>
<td>Red-gray (marbled)</td>
<td>Gold</td>
<td>Gold</td>
<td>None, but contains silica particles to enhance clot formation</td>
<td>Serum tests</td>
<td>10 mL/NA</td>
</tr>
<tr>
<td>Light blue</td>
<td>Light blue</td>
<td>Light blue</td>
<td>Sodium citrate; removes calcium to prevent blood from clotting</td>
<td>Coagulation testing</td>
<td>4.5 mL/4.5 mL</td>
</tr>
<tr>
<td>Green</td>
<td>Green</td>
<td>Green</td>
<td>Heparin (sodium/lithium/ammonium); inhibits thrombin formation to prevent clotting</td>
<td>Chemistry tests</td>
<td>10 mL/3.5 mL</td>
</tr>
<tr>
<td>Green-gray (marbled)</td>
<td>Light green</td>
<td>Light green</td>
<td>Lithium heparin and gel for plasma separation</td>
<td>Plasma determinations in chemistry studies</td>
<td>2 mL/2 mL</td>
</tr>
<tr>
<td>Yellow-gray (marbled)</td>
<td>Orange</td>
<td>Orange</td>
<td>Thrombin</td>
<td>Stat serum demonstrations in chemistry studies</td>
<td>2 mL/2 mL</td>
</tr>
<tr>
<td>Lavender</td>
<td>Lavender</td>
<td>Lavender</td>
<td>EDTA; removes calcium to prevent blood from clotting</td>
<td>Hematology tests</td>
<td>7 mL/2 mL</td>
</tr>
<tr>
<td>Gray</td>
<td>Gray</td>
<td>Gray</td>
<td>Potassium oxalate and sodium fluoride; removes calcium to prevent blood from clotting; fluoride inhibits glycolysis</td>
<td>Chemistry testing especially glucose and alcohol levels</td>
<td>10 mL/10 mL</td>
</tr>
<tr>
<td>Royal blue</td>
<td>Royal blue</td>
<td>Royal blue</td>
<td>Sodium heparin (also sodium EDTA); inhibits thrombin formation to prevent clotting</td>
<td>Chemistry trace elements</td>
<td>7 mL</td>
</tr>
<tr>
<td>Pediatric Tubes</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Red</td>
<td>Red</td>
<td>Red</td>
<td></td>
<td>2 mL/NA; 3 mL/NA; 4 mL/NA</td>
<td></td>
</tr>
<tr>
<td>Lavender</td>
<td>Lavender</td>
<td>Lavender</td>
<td></td>
<td>2 mL/0.6 mL</td>
<td></td>
</tr>
<tr>
<td>Green</td>
<td>Green</td>
<td>Green</td>
<td></td>
<td>3 mL/0.9 mL</td>
<td></td>
</tr>
<tr>
<td>Light blue</td>
<td>Light blue</td>
<td>Light blue</td>
<td></td>
<td>4 mL/1 mL</td>
<td></td>
</tr>
</tbody>
</table>


EDTA, ethylenediaminetetraacetic acid; SPS, sodium polyanethol sulfonate.
*Stopper colors are based on Becton-Dickinson Vacutainer tubes.
*Hemogard closures provide a protective plastic cap over the rubber stopper as an additional safety feature.
*Additives, additive functions, and laboratory uses are the same for both pediatric and adult tubes.

Centrifugation, forming a barrier that facilitates retrieval of the liquid portion without cellular contamination.

It is important to mix the contents of the tube well after collection by inverting it several times (do not shake the tube) and also to avoid a short draw (i.e., a tube that is not completely filled) (Table 53-2). Having the proper ratio of blood to additive is crucial. Always be sure to check the tube for an expiration date. Outdated tubes may have diminished vacuum, or the additive may have degraded.

CRITICAL THINKING APPLICATION 53-1

- Melissa Mochan has been assigned to orient Leah to the clinic and her duties as a certified medical assistant. Melissa takes Leah to the laboratory in the clinic, which has a small room with a blood collection chair and a table. What supplies should be on the table for performing venipuncture?
- What else might Leah find in this room?
TABLE 53-2 Effects of Underfilling Collection Tubes

<table>
<thead>
<tr>
<th>STOPPER COLOR</th>
<th>EFFECT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yellow</td>
<td>Reduces possibility of bacterial recovery</td>
</tr>
<tr>
<td>Red</td>
<td>Insufficient sample</td>
</tr>
<tr>
<td>Red-gray</td>
<td>Poor barrier formation; insufficient sample</td>
</tr>
<tr>
<td>Light blue</td>
<td>Coagulation test results falsely prolonged</td>
</tr>
<tr>
<td>Green</td>
<td>False results because of excess heparin</td>
</tr>
<tr>
<td>Green-gray</td>
<td>False results because of excess heparin</td>
</tr>
<tr>
<td>Lavender</td>
<td>Falsely low blood cell counts and hematocrits; morphologic changes to red blood cells; staining alteration</td>
</tr>
<tr>
<td>Yellow-gray</td>
<td>False results</td>
</tr>
<tr>
<td>Gray</td>
<td>False results</td>
</tr>
<tr>
<td>Royal blue</td>
<td>False results</td>
</tr>
</tbody>
</table>

Order of Collection

If samples for more than one tube must be drawn during a venipuncture, a specified order must be followed so that material from a previous tube is not transferred to the next tube. Carry-over of additives from one tube to the next could cause sample alteration and erroneous results. The CLSI (formerly the National Committee for Clinical Laboratory Standards [NCCLS]) developed a set of standards outlining the order of draw for a multtube draw. The same order applies to the filling of tubes when blood is collected in a syringe and takes into account the use of newer plastic tubes.

1. **Yellow** blood culture tubes are filled first, because they are sterile.

2. **Light blue**-topped tubes with sodium citrate are next, because other anticoagulants might contaminate the sample collected for coagulation studies. If no blood culture has been ordered, CLSI recommends that blood for the light blue–topped tube should be drawn first if routine coagulation testing has been ordered (i.e., prothrombin time [PT] and activated partial thromboplastin time [APTT]; see Chapter 54). For testing other than routine PT and APTT, a red-toped “waste” tube may be filled. When a winged infusion set is used, CLSI currently recommends that blood be drawn into a red-toped tube even if the order does not call for it. This is done to fill the tubing’s dead space with blood and to prevent any thromboplastin released during venipuncture from contaminating the light blue–topped tube and interfering with coagulation testing. It is not necessary to fill the tube to be discarded.

3. **Red** serum tubes without clot activator (red stopper) or with clot activator (red-gold or speckled stopper) are filled next. Although CLSI notes that glass, nonadditive serum tubes can be drawn before the light blue–topped tubes, the draw order has been simplified to function for all serum tubes, regardless of their composition.

4. **Green**-topped tubes are next, because heparin is less likely to interfere with EDTA than vice versa.

5. **Lavender**-topped tubes follow. Because EDTA binds with calcium, blood for this tube is drawn near the end.

6. The **gray**-topped tube is last, because the contents can elevate electrolyte levels or damage cells if passed into another tube (Table 53-3).

**TABLE 53-3 Stopper Color and Inversion Mixing**

<table>
<thead>
<tr>
<th>STOPPER COLOR</th>
<th>MIX BY INVERSION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yellow</td>
<td>8-10 times</td>
</tr>
<tr>
<td>Light blue</td>
<td>3-4 times</td>
</tr>
<tr>
<td>Red or red speckled</td>
<td>5 times</td>
</tr>
<tr>
<td>Green</td>
<td>8-10 times</td>
</tr>
<tr>
<td>Lavender</td>
<td>8-10 times</td>
</tr>
<tr>
<td>Gray</td>
<td>8-10 times</td>
</tr>
</tbody>
</table>

**Needles**
A critical part of phlebotomy is the knowledge of which needle and which tube or syringe to use in each situation. All needles used in phlebotomy are sterile, disposable, and used only once. Each is housed in a cover, which should be inspected before use to ensure that sterility has not been compromised (i.e., the seal should be intact) and that the needle has no manufacturing defects, such as burrs or nicks. Needles have two parts: the hub and the shaft. Shafts differ in length, ranging from ¾ to 1½ inches. The length of the shaft has no bearing on the venipuncture procedure, but some prefer a longer needle because it is less likely to slip out of the vein, whereas others prefer a shorter needle because it makes patients less uneasy. One end of the shaft is cut at an angle and forms the bevel, which creates a very sharp point. The hole in the bevel is called the lumen.

Lumen size is important in venipuncture and is referred to as the gauge. The gauge is designated by a numeric value; the higher the number, the smaller the lumen. A blood bank uses a 16-gauge needle to collect pints of blood for transfusions, because the lumen is wide, which reduces the chance of hemolysis. The smallest gauge needles (23 gauge) are used to collect blood from small or fragile veins, such as in elderly and very young patients. Routine adult venipuncture requires a 20- to 21-gauge needle. The hub is the point where the needle attaches to the syringe or the needle holder.

**Multisample Needles**
Multisample needles are commonly used in routine adult venipuncture. They are so called because they are used when several tubes are to be drawn during a single venipuncture. These needles are double-pointed (Figure 53-5). One point enters the patient's vein, and the other punctures the rubber stopper of the collection tube. The point that enters the tube is sheathed with a retractable rubber sleeve that allows tubes to be changed without blood leaking into the needle holder or tube holder.

**Syringes**
Syringes are used when there is concern that the strong vacuum in a stoppered tube might collapse the vein. The syringe needle
fits on the end of the barrel and comes in different gauges. The amount of blood drawn into the barrel depends on how much is to be transferred to stoppered tubes. When blood is drawn into a syringe, it must be transferred immediately to another tube, because the blood will clot in the syringe barrel. In these situations a syringe with an engineered sharps injury prevention feature and safe work practices should be used. The blood must be transferred from the syringe to the test tube with a needleless blood transfer device, as required by OSHA. A special transfer tube adapter is used to transfer the blood to the Vacutainer tube. The adapter connects to the top of the syringe once the needle cover is in place and the needle is removed. The adapter contains an enclosed needle that punctures and delivers the blood into the Vacutainer tube (Figure 53-6).

**Winged Infusion Sets (Butterfly Needles)**

Butterfly needles (Figure 53-7) are designed for use on small veins, such as those in the hand or in pediatric patients. The most common needle size is 23 gauge; the needle is 1/2- to 3/8-inch long and has a plastic, flexible, butterfly-shaped grip attached to a short length of tubing. One end is fitted into the syringe or the vacuum tube adapter. Often a syringe is used, because the vacuum can be controlled more easily. Smaller evacuated tubes, with a less powerful vacuum, are preferable when a butterfly set is used.

**Figure 53-5** Multipurpose needles.

**Figure 53-6** BD Vacutainer blood transfer device. (Courtesy Becton, Dickinson, Franklin Lakes, New Jersey.)

**Figure 53-7** Winged infusion set attached to an evacuated tube holder with a Luer needle holder. (Courtesy Becton, Dickinson, Franklin Lakes, New Jersey.) (Courtesy and © Becton, Dickinson and Company, Franklin Lakes, N.J.)

**Needle Holders**

Double-pointed needles must be firmly placed into a needle adapter or tube holder (Figure 53-8). Usually they are translucent cylinders, and they come in different sizes to accommodate the tube used. The cylinders often have a ring that indicates how far the tube can be pushed onto the needle without losing the vacuum. OSHA requires that, to prevent accidental needle sticks, needle holders must be discarded after a single use. In most cases the entire needle and holder are disposed of simultaneously; needles are not removed from the needle holder, and the safety feature on the needle must be activated before disposal.

**Needle Safety**

Healthcare workers who use or may be exposed to needles are at increased risk of needle-stick injury. Such injuries can lead to serious or fatal infections with blood-borne pathogens such as hepatitis B virus (HBV), hepatitis C virus (HCV), or human immunodeficiency virus (HIV). An estimated 600,000 needle-stick injuries occur each year, and nursing staff members are most frequently injured. Needle-stick injuries account for up to 80% of accidental exposures to blood. As discussed in Chapter 27, used needles should never be recapped.

According to OSHA, the best practice for preventing needle-stick injuries after phlebotomy is to use a sharp with engineered sharps injury protection (SESIP) attached to a needle holder. SESIPs, or safety needles, eliminate the need to remove the needle from the needle holder and in some way shields the needle immediately after use. The U. S. Food and Drug Administration (FDA), which is responsible for approving medical devices marketed and sold in the United States, recommends devices that provide a barrier between the hands and the needle after use in which the phlebotomist's hands remain behind the needle at all times. Safety shields that can be activated before or immediately after removal of the needle from the vein and that remain in effect after disposal.
also should be an integral part of the device. Finally, these devices should be as simple as possible, requiring little or no training to use. Some examples of SESIPs include the following:

- **Self-sheathing safety devices** (Figure 53-9): These devices have sliding needle shields attached to disposable syringes and vacuum tube holders. Before activation, the sleeve is positioned over the barrel of the syringe. After the procedure, the phlebotomist slides the sleeve forward over the needle, where it locks into place, protecting the needle.
- **Retractable safety devices** (Figure 53-10): After the needle has been used and removed from the vein, a plunger is pushed to retract the needle into the syringe or needle holder. The entire unit is disposed of in the sharps container.
- **Needle-blunting safety mechanisms** (Figures 53-11 and 53-12): After the venipuncture a blunt tube is moved through the needle, covering the sharp point. With the needle in the needle holder, the vacuum tube is removed and then pushed forward again while the needle is still in the vein. This moves the blunt-tipped needle forward through the needle, past the sharp needle point. The blunt point tip of the needle can be activated before it is removed from the patient.

When a butterfly set is used, a third "wing" is rotated after collection and before removal of the needle from the vein. As the third wing is rotated, it moves the blunt needle down the shaft before it is removed from the patient.

- **Hinged or sliding safety mechanisms** (Figure 53-13): These devices, which are attached to the phlebotomy needle or a winged infusion needle, are manually engaged after the needle has been removed from the vein. The plastic sheath covers the needle, and the entire unit is disposed of in the sharps container.

The following steps should be taken to protect against needlestick injuries:

- Do not use needles when safe, effective alternatives are available.
- Help your employer select and evaluate devices with safety features.
- Use devices with safety features provided by your employer.
- Never recap a contaminated needle.
- Plan for safe handling and disposal before beginning any procedure using needles.
- Dispose of used needles and needle holders promptly in appropriate sharps disposal containers.
- Report all needle-stick and other sharps-related injuries promptly to ensure that you receive appropriate follow-up care.
- Tell your employer about hazards from needles that you observe in your work environment.
- Participate in blood-borne pathogen training and follow recommended infection prevention practices, including obtaining hepatitis B vaccination.
As detailed in Chapter 27, OSHA requires employers to establish and maintain a sharps injury log for recording injuries from contaminated sharps. This log should contain information about the device involved in the incident, the department or work area where the incident occurred, and an explanation of the incident. Employee confidentiality must be maintained.

**Postexposure Management of Needle Sticks**

An accidental needle stick is a medical emergency. (OSHA-recommended management procedures are discussed in detail in Chapter 27.) Effective management of an accidental sharps exposure includes the following:

- **Immediately after injury,** the wound is inspected for foreign material, which is removed. The site is washed for 10 minutes with an antimicrobial soap, 10% iodine solution, or chlorine-based antiseptic.
- **The injury is reported to the supervisor and an incident report is completed.**
- **The employee is referred to a physician for confidential assessment and follow up,** baseline testing for HBV, HCV, and HIV is recommended for both the employee and the source individual. If the employee has been immunized for HBV and has a positive postimmunization titer, there is no risk of acquiring HBV and no source testing is needed. If the worker has not been immunized, source testing for infection with HBV is recommended if the source is known and can be located. If the source patient tests positive for HBV, the employee should receive HBV immune globulin (HBIG) and the series of HBV immunizations should be initiated. If the source tests negative, no treatment is indicated. If the source patient cannot be tested, the employee should be treated as if the source patient were positive for HBV. The source should also be tested for HCV. If positive, the employee should be monitored for signs and symptoms of hepatitis for 6 months. No postexposure prophylaxis is recommended for HCV infection. For HIV exposure, most employers recommend a 4-week regimen of antiretroviral drugs. To best protect the victim, antiretroviral therapy should be administered within hours of exposure. HIV treatment involves potential serious side effects; therefore, the employee decides whether medications are started. If the source is found to be negative, antiretroviral therapy can be discontinued.
- **Interim testing may be performed if the healthcare worker experiences symptoms of acute HIV exposure or hepatitis.** For HBV, antibody testing should be repeated at 6 weeks, 12 weeks, and 6 months if either the source was HIV positive or the source’s status remains unknown. Confidential follow-up care must include provisions for emotional support and counseling for the healthcare worker.

**CRITICAL THINKING APPLICATION 53-2**

- **During her lunch break, Leah meets some of her co-workers. The conversation in the lunchroom involves an accident that occurred several years ago when a former employee was performing venipuncture on a recovering intravenous drug addict and was accidentally stuck with the needle. Describe the procedure for follow up of an accidental needle stick incident.**
- **What measures are available to prevent accidental needle sticks?”**
**ROUTINE VENIPUNCTURE**

Your appearance and actions reflect your laboratory or facility. A patient’s first impression of the facility often comes from you. Clean laboratory coats or scrubs tell the patient the facility is clean; wearing gloves tells the patient you will treat him or her with care; and speaking knowledgeably provides the impression that the facility is staffed with professionals.

Venipuncture involves several important steps with which the medical assistant must be thoroughly familiar before attempting the procedure. The first step is to select the proper method for venipuncture (syringe or evacuated tube). Next, the patient must be prepared for the procedure. Patient preparation is followed by the actual venipuncture and specimen collection. The final step is care of the puncture site before the patient is discharged.

**Patient Preparation**

All blood collections begin with a requisition, a form from the patient’s physician requesting a test. Requisitions may be computer generated or handwritten and at minimum must have the following information:

- Patient’s name
- Date of birth
- Identification number
- Name of the physician making the request
- Type of test requested
- Test status (timed, fasting, stat, and so forth)

Venipuncture begins with greeting and identifying the patient. According to CLSI, proper identification includes asking outpatients to provide their full name, address, and an identification number or birth date. This information must be compared with the written information on the requisition. With inpatients, CLSI recommends asking for the same information and comparing it with the information on the requisition and the identification bracelet. If the patient speaks a different language, has limited language skills (such as a child) or is otherwise unable to communicate, a family member or caregiver must provide the information. The name of this person should be documented.

Introduce yourself and briefly explain the purpose and procedure of the venipuncture. If the patient has questions about the ordered tests, politely request that the patient speak to the physician and ask whether the individual would like to do so before you collect the sample. Obtain verbal consent to perform the procedure simply by asking whether you have permission to take some blood from the patient’s arm. Always ask the patient whether he or she has experienced problems during routine venipuncture in the past and take steps to prevent such problems. Your self-confidence in the procedure will be evident to the patient and will help allay any fears. Instilling confidence in your patients means acting and speaking professionally. Refer to the patient as “sir” or “ma’am” or Mr. Jones or Ms. Smith, not “honey,” “sweetie,” Bill, or Margaret. Being friendly is important, but make sure your patients feel respected and understand that you take your role in their care seriously.

**Preparing for the Venipuncture**

Seat the patient in a chair, or have the person lie down on an examination table if the patient has a history of syncope, and ask the patient to extend the arm. Inspect both arms and ask whether the patient has a preference. Generally, veins in the forearm or the elbow (antecubital area) are used for venipuncture (Figure 53-14). The puncture site should be carefully selected after both arms have been inspected. Alternative sites may be indicated if the area is cyanotic, scarred, bruised, edematous, or burned. You may use veins on the lower forearm, the back of the hand, or the wrist. Use foot or ankle veins only if the patient has good circulation in the legs and you have received permission from your supervisor or the physician. Never draw blood from this area if the patient is diabetic.

To apply a tourniquet, place the tourniquet 3 to 4 inches above the patient’s elbow, making sure it is not twisted (Figure 53-15). Grasp the tourniquet ends, one in each hand, at the part of the tourniquet that is closest to the patient’s skin. Pull the ends apart to stretch the rubber material, then cross one end over the other while maintaining the tension. Tuck the top end of the tourniquet underneath the bottom piece, creating a loop with the upper flap free so it can be released with one hand. The tourniquet should be tight without being twisted or pinching the patient’s skin. Both ends of the tourniquet should be
pointing upward so that they do not contaminate the blood draw site.

When the tourniquet is in place, ask the patient to make a fist and palpate for an acceptable vein using your ungloved index finger. If you are able to palpate the vein through gloved fingers you can continue with the phlebotomy process. A thorough survey of both arms should be done before the venipuncture site is chosen. Veins bounce lightly when palpated. The medial veins generally run parallel or at a slight angle to the fold in the antecubital area, whereas the cephalic veins run lateral or to the outside of the antecubital area. These veins are the veins of choice. The basilic vein, which lies on the inside part of the antecubital area, is very close to the brachial artery and median nerves and should be used only if the medial or cephalic veins are inaccessible. The most common injury patients suffer from phlebotomy is nerve injury. If the patient complains of tingling, numbness, or a shooting pain, discontinue the procedure and choose another site before continuing. Do not probe with the needle under this condition; any attempt at relocating the needle puts the patient at great risk of nerve injury.

## Performing the Venipuncture

When you have located a vein, remove the tourniquet. A tourniquet can remain in place for 1 minute. After its removal, you must wait 2 minutes before reapplying it. Assemble the appropriate equipment, making sure everything is within easy reach, that the sterile packets are torn open, and that the contents are easily accessible. Sanitize your hands.

Reapply the tourniquet and quickly relocate the vein. Put on your gloves and cleanse the antecubital area with the alcohol, working outward in a circular motion. Do not touch this area after cleansing. Ask the patient to clench the hand into a fist. Do not have the patient pump the fist, because this may temporarily increase the level of potassium and ionized calcium in the blood. Anchor the vein by stretching the skin downward below the collection site with the thumb of the nondominant hand and swiftly insert the needle into the vein at a 15-degree angle. The bevel should be facing up. If the needle is inserted at an angle greater than 15 degrees, it quickly penetrates the other side of the vein and enters other structures, such as nerves or the brachial artery, and very likely will cause a hematoma or an injury. Pull back on the syringe plunger or push the evacuated tube into the double-pointed needle. When blood enters the tube or barrel, ask the patient to unclench the fist.

## Completing the Venipuncture

Continue to draw the specimen, checking periodically on the patient’s condition. As you remove each tube from the needle holder, gently invert it several times before you place it in the rack. Tubes with clot activator should be inverted five times, light-blue-topped tubes for coagulation studies should be inverted three or four times, and all other anticoagulant tubes should be inverted 8 to 10 times. If the tubes are not inverted immediately after collection, small clots can form in specimens. When you near the end of the draw and the last tube to be collected fills, carefully release the tourniquet without jarring the needle and remove the final vacuum tube. Remove the needle quickly and apply the gauze with pressure to the puncture site.

Ask the patient to apply direct pressure to the gauze but not to bend the arm. Immediately activate the safety device to cover the needle and dispose of the entire needle/needle holder unit into a sharps container. Before putting on the bandage, perform a two-point check to make sure the vein is not leaking. Observe the site for 5 to 10 seconds after releasing pressure and removing the gauze. If visible bleeding occurs or if the tissue around the puncture site rises, continue applying pressure until the bleeding has stopped. Special precautions must be taken for patients receiving anticoagulants, because the phlebotomy site will bleed longer than the norm. Put on a bandage and dispose of the gauze in a biohazard waste container. Clean gauze, not a cotton ball, can be taped over the site in lieu of a bandage. Label all tubes by the patient’s side. Never leave the room or release an outpatient until the tubes have been labeled. Assess the patient’s status one last time, then dismiss the patient or leave the room.

Procedures 53-1 and 53-2 outline the proper procedures for venipuncture using a syringe and the evacuated tube method. Certain patients, such as those with narrow veins, young children, and aging adults, may require a winged infusion set (butterfly needle) rather than the previously mentioned methods. Butterfly units also can be used to draw blood from the hands of adults. As mentioned, the needle in a winged infusion unit is shorter, and the wings help you grasp and guide the needle more easily. The tubing also maximizes the strength of the vacuum, thus preventing the collapse of fragile veins, which is a common problem in phlebotomy on elderly patients (Procedure 53-3).

## PROBLEMS ASSOCIATED WITH VENIPUNCTURE

Failure to obtain blood can occur because of a number of factors. Determining the cause of the problem may help you decide whether a second attempt would be successful. The first rule is to remain calm so that you can think clearly and systematically determine the possible cause of the problem.

A hemATOMA is a large, painful, bruiselike area at the puncture site caused by blood leaking into the tissue, which causes the tissue around the puncture site to swell. The most common causes of hematoma formation during the draw are excessive probing with the needle to locate a vein, failure to insert the needle far enough into the vein, and a needle that goes through the vein. A hematoma also can form after a draw if you fail to remove the tourniquet before removing the needle, fail to withdraw the vacuum tube before the needle is withdrawn, fail to apply adequate pressure on the puncture site, or if the elbow is bent while pressure is applied. If a hematoma forms, discontinue the procedure, apply pressure to the area for a minimum of 3 minutes, and then apply an ice pack to the area. Notify the physician and observe the site to determine whether the bleeding has stopped. Depending on the facility's policy, an incident report may have to be completed and recorded in the patient's record.

Fainting, or syncope, can have serious consequences, and the phlebotomist must always be prepared. Securing the patient in a blood collection chair prevents bodily injury if the person faints. Constant conversation with the patient during the procedure can help identify an impending episode, as can observing the patient's face and breathing rate.
PROCEDURE 53-1

Perform Venipuncture: Collect a Venous Blood Sample Using the Syringe Method

GOAL: To collect a venous blood specimen using the syringe technique.

EQUIPMENT and SUPPLIES
- Needle, syringe with 21- or 22-gauge safety needle
- Vacutainer tubes appropriate for tests ordered
- 70% isopropyl alcohol pads
- Sterile gauze pads
- Tourniquet
- Syringe adaptor for transfer to Vacutainer tubes
- Hypoallergenic tape or bandage
- Permanent marking pen
- Biohazard waste container
- Disposable gloves
- Patient’s record

PROCEDURAL STEPS

1. Check the requisition form to determine the tests ordered. Gather the appropriate tubes and supplies.
   PURPOSE: To collect the specimen properly.
2. Sanitize your hands and put on nonsterile gloves.
   PURPOSE: To ensure infection control.
3. Identify the patient, explain the procedure, and obtain permission to perform the venipuncture.
   PURPOSE: To make sure you have the right patient; explanations help to gain the patient’s cooperation.
4. Assist the patient to sit with the arm well supported in a slightly downward position.
   PURPOSE: The veins of the antecubital fossa are more easily located when the elbow is straight.
5. Assemble the equipment. The choice of syringe barrel size and needle size depends on your inspection of the patient’s veins and the amount of blood required for the ordered tests. Attach the needle to the syringe. Pull and depress the plunger several times to loosen it in the barrel. Keep the cover on the needle.
   PURPOSE: Using the smallest syringe possible minimizes the chance of hemolysis. Engaging the plunger ensures that you will not have to use as much force to pull the blood into the barrel, thereby minimizing the chance of hemolysis.
6. Apply the tourniquet around the patient’s arm 3 to 4 inches above the elbow. The tourniquet should never be tied so tightly that it restricts blood flow in the arter/ (Figure 1). The tourniquet should remain in place no longer than 1 minute.
   PURPOSE: The tourniquet is used to make the veins more prominent. A quick check of the radial pulse ensures that the tourniquet has not been applied too tightly.
7. Ask the patient to make a fist.
   PURPOSE: Clenching the fist produces engorgement of the vein.
8. Select the venipuncture site by palpating the antecubital space (if you have difficulty palpating the vein with gloves, you can remove the gloves, palpate the vein and visibly mark its location, then put on new gloves before continuing); use your index finger to trace the path of the vein and to judge its depth. The vein most often used is the median cephalic vein, which lies in the middle of the elbow (Figure 2).
   PURPOSE: The index finger is most sensitive for palpating. Do not use the thumb, because it has a pulse of its own, which may confuse you.

FIGURE 1 (From Garrels M, Oatis C: Laboratory testing for ambulatory settings, ed 2, St Louis, 2011, Saunders.)

FIGURE 2 (From Garrels M, Oatis C: Laboratory testing for ambulatory settings, ed 2, St Louis, 2011, Saunders.)
9. Cleanse the site, starting in the center of the area and working outward in a circular pattern with the alcohol pad (Figure 3). Allow the area to dry before proceeding.  
**PURPOSE:** The circular pattern helps prevent recontamination of the area. Puncturing a wet area stings and can cause hemolysis of the sample.

10. Hold the syringe in your dominant hand. Your thumb should be on top and your fingers underneath. Remove the needle sheath.

11. Grasp the patient’s arm with the nondominant hand and anchor the vein by stretching the skin downward below the collection site with the thumb of the nondominant hand.  
**PURPOSE:** Failure to anchor the vein makes puncturing more difficult and painful and may result in a missed vein.

12. With the bevel of the needle up, aligned parallel to the vein, and at a 15-degree angle, insert the needle through the skin and into the vein rapidly and smoothly (Figure 4). Observe for a “flash” of blood in the hub of the syringe. Ask the patient to release the fist.  
**PURPOSE:** The sharpest point of the needle is inserted first. The angle ensures that the needle does not penetrate through the vein. The appearance (“flash”) of blood in the hub ensures that the needle is in the vein.

13. Slowly pull back the plunger of the syringe with the nondominant hand. Do not allow more than 1 mL of head space between the blood and the top of the plunger. Make sure you do not move the needle after entering the vein. Fill the barrel to the needed volume (Figure 5).

14. Release the tourniquet when venipuncture is complete. It must be released before the needle is removed from the arm (Figure 6).  
**PURPOSE:** Removal of the tourniquet releases pressure on the vein and helps prevent blood from getting into adjacent tissues and causing a hematoma.

15. Place sterile gauze over the puncture site at the time of needle withdrawal (Figure 7). Immediately activate the needle safety device.  
**PURPOSE:** Direct pressure is the best method to stop bleeding. Elevating the arm above the heart also stops bleeding.

16. Instruct the patient to apply direct pressure on the puncture site with sterile gauze. The patient may elevate the arm but should not bend it.

17. Transfer the blood immediately to the required tube or tubes using a syringe adapter. Do not push on the plunger during transfer. Discard the entire unit when transfer is complete. Invert the tubes after the addition of blood and label them with the necessary patient information (Figure 8).  
**PURPOSE:** The syringe adapter protects against accidental needle sticks and allows the correct amount of blood to be delivered.
into the tube by vacuum. Pleshing the plunger hemolizes the blood. Blood begins to clot shortly after collection, so it must be transferred into the vacuum tube and mixed with anticoagulant immediately after collection. Inverting the tubes ensures anticoagulation.

18. Inspect the puncture site for bleeding or hematoma.
19. Apply a hypoallergenic bandage (Figure 9).

20. Clean the work area, remove your gloves, and sanitize your hands.

Dispose of any blood-contaminated materials (e.g., gauze) in the biohazard container.

PURPOSE: To ensure infection control.

21. Complete the laboratory requisition form and route the specimen to the proper place. Record the procedure in the patient’s record.

PURPOSE: A procedure is not considered complete until it is recorded.
PROCEDEUR 53-2

Perform Venipuncture: Collect a Venous Blood Sample Using the Evacuated Tube Method

GOAL: To collect a venous blood specimen by the evacuated tube technique.

EQUIPMENT and SUPPLIES
- Vacutainer needle, needle holder, and proper tubes for requested tests
- 70% isopropyl alcohol pads
- Sterile gauze pads
- Tourniquet
- Hypoallergenic tape or bandage
- Permanent marking pen
- Biohazard bag or disposal container
- Disposable gloves
- Patient's record

PROCEDURAL STEPS

1. Check the requisition form to determine the tests ordered. Gather the appropriate tubes and supplies.
   PURPOSE: To perform specimen collection properly.
2. Sanitize your hands and put on nonsterile gloves.
   PURPOSE: To ensure infection control.
3. Identify the patient, explain the procedure, and obtain permission for the venipuncture.
   PURPOSE: To make sure you have the right patient; explanations help gain the patient's cooperation.
4. Assist the patient to sit with the arm well supported in a slightly downward position.
   PURPOSE: The veins of the antecubital fossa are more easily located when the elbow is straight.
5. Assemble the equipment. The choice of needle size depends on your inspection of the patient's veins. Attach the needle firmly to the Vacutainer holder. Keep the cover on the needle.
   PURPOSE: If the needle is loose, air can enter the tube, causing frothing and subsequent hemolysis.
6. Apply the tourniquet around the patient's arm 3 to 4 inches above the elbow. The tourniquet should never be tied so tightly that it restricts blood flow in the artery (Figure 1). Tourniquets should remain in place no longer than 60 seconds.
   PURPOSE: The tourniquet is used to make the veins more prominent. A quick check of the radial pulse ensures that the tourniquet has not been applied too tightly.
7. Ask the patient to make a fist.
   PURPOSE: Clenching the fist produces engorgement of the vein. Do not ask the patient to pump the fist, because this may disrupt the blood's electrolyte balance.
8. Select the venipuncture site by palpating the antecubital space and use your index finger to trace the path of the vein and to judge its depth. The vein most often used is the median cephalic vein, which lies in the middle of the elbow (Figure 2).
   PURPOSE: The index finger is most sensitive for palpating. Do not use the thumb, because it has a pulse of its own, which may confuse you.
9. Cleanse the site, starting in the center of the area and working outward in a circular pattern with the alcohol pad (Figure 3).
10. Dry the site with a gauze pad.
    PURPOSE: The circular pattern helps prevent recontamination of the area. Puncturing a wet area stings and can cause hemolysis of the sample.
11. Hold the Vacutainer assembly in your dominant hand. Your thumb should be on top and your fingers underneath. You may want to position the first tube to be drawn in the needle holder, but do not push it onto the double-pointed needle past the marking on the holder. Remove the needle sheath.

FIGURE 1 (From Garrels M, Oetis C: Laboratory testing for ambulatory settings, ed 2, St Louis, 2011, Saunders.)

FIGURE 2 (From Garrels M, Oetis C: Laboratory testing for ambulatory settings, ed 2, St Louis, 2011, Saunders.)
PURPOSE: Positioning the hand in this manner provides the best visibility of the needle entering the site. Pushing the tube onto the double-pointed needle causes air to rush into the tube, destroying the vacuum.

12. Grasp the patient’s arm with the nondominant hand and anchor the vein by stretching the skin downward below the collection site with the thumb of the nondominant hand.
PURPOSE: Failure to anchor the vein makes puncturing more difficult and painful and may result in a missed vein.

13. With the bevel of the needle up, aligned parallel to the vein, and at a 15-degree angle, insert the needle through the skin and into the vein rapidly and smoothly (Figure 4).
PURPOSE: The sharpest point of the needle is inserted first. Inserting the needle quickly minimizes pain.

14. Place two fingers on the flanges of the needle holder and use the thumb to push the tube onto the double-pointed needle. Make sure you do not change the needle’s position in the vein. When blood begins to flow into the tube, ask the patient to release the fist.
PURPOSE: The thumb has the strength necessary to push the needle swiftly through the stopper. However, if you are not careful, the needle can easily be pushed further into the site when the tube is pushed.

15. Allow the tube to fill to maximum capacity. Remove the tube by curling the fingers underneath and pushing on the needle holder with the thumb. Take care not to move the needle when removing the tube.
PURPOSE: Tubes must be full to ensure the proper anticoagulant-to-blood ratio. Moving the needle may result in inadvertent penetration of the other side of the vein or slipping of the needle out of the vein.

16. Insert the second tube into the needle holder, following the instructions in the previous steps. Continue filling tubes until the order on the requisition has been filled. Gently invert each tube immediately after removing from the needle holder to mix anticoagulants and blood. As the last tube is filling, release the tourniquet.
PURPOSE: The tourniquet should remain in place for no longer than 1 minute to prevent hemocoagulation. Gentle inversion prevents clotting of blood, whereas vigorous mixing may cause hemolysis.

17. Remove the last tube from the holder. Place gauze over the puncture site (Figure 5) and quickly remove the needle, engaging the safety device. Dispose of the entire unit in the sharps container.
PURPOSE: To ensure infection control.

18. Apply pressure to the gauze or instruct the patient to do so. The patient may elevate the arm but should not bend it.
PURPOSE: Direct pressure is the best method to stop bleeding. Elevating the arm above the heart also stops bleeding.

19. Label the tubes with the patient’s name, the date, and the time (Figure 6).
PROCEDURE 53-2—cont’d

20. Check the puncture site for bleeding and hematoma formation.
21. Apply a hypoallergenic bandage (Figure 7).
22. Clean the work area, remove your gloves, and sanitize your hands.
   Dispose of any blood-contaminated materials (e.g., gauze) in the biohazard container.
   PURPOSE: To ensure infection control.

23. Complete the laboratory requisition form and route the specimen to the proper place. Record the procedure in the patient’s record.
   PURPOSE: A procedure is considered not done until it is recorded.

PROCEDURE 53-3

Performing Venipuncture: Obtain a Venous Sample with a Winged Infusion Set (Butterfly Needle)

GOAL: To obtain a venous sample accurately from a hand vein using a winged infusion set.

EQUIPMENT and SUPPLIES
- Tourniquet
- Alcohol pads or other antiseptic prep
- Sterile gauze pads
- Winged infusion (butterfly) needle set
- Appropriate tubes with a needle and needle adapter
- Syringe with needle
- Sharp's disposal container
- Hypoallergenic bandage
- Permanent marking pen
- Biohazard waste container
- Disposable gloves
- Patient record

PROCEDURAL STEPS

1. Check the requisition and gather the appropriate tubes for the needed tests. Assemble the balance of your supplies.
   PURPOSE: For efficiency in preparation.

2. Sanitize your hands and put on gloves.
   PURPOSE: To ensure infection control.

3. Identify the patient, and explain the procedure.
   PURPOSE: To make sure you have the right patient; explanations help to gain the patient’s cooperation.

4. Remove the butterfly device from the package and stretch the tubing slightly. Take care not to activate the needle-retracting safety device accidentally.
   PURPOSE: To keep the tube from recoiling.

5. Attach the butterfly device to the syringe (Figure 1) or needle holder.

6. Seat the first tube in the evacuated tube holder and place the unit carefully where it will not roll away.

7. Apply a tourniquet to the patient’s wrist just proximal to the wrist bone. Do not apply the tourniquet so tightly that blood flow in the arteries is impeded.

8. Hold the patient’s hand in your nondominant hand with the fingers lower than the wrist.
   PURPOSE: This position aids the identification of the veins and draw site.
9. Select a vein and cleanse the site at the bifurcation (forking) of the veins.
10. Using your thumb, pull the patient's skin taut over the knuckles.
   PURPOSE: Stretching the skin prevents the veins from rolling underneath.
11. With the needle at a 10- to 15-degree angle, bevel up, align it with the
    vein.
12. Insert the needle by holding the wings or the rear of the set. After
    insertion the wings are never touched again. Make sure the safety
    device is not activated.
   PURPOSE: Inserting the needle by holding the wings gives a greater
   sense of control. If the sides are held, the safety shield slides forward
    over the needle when the point of the needle makes contact with the
    skin.
13. Draw blood into the syringe or push the blood collecting tube onto the
    end of the holder (Figure 2). Note the position of the hands while
    drawing the blood. When drawing blood into the syringe, make sure
    the vacuum you create is slow and steady and that no more than 1 mL
    of head space exists between the blood and the plunger.
   PURPOSE: Drawing blood too forcefully into the syringe may collapse
    the vein or hemolyze the blood.
14. Release the tourniquet when the blood appears in the tube or a “flash”
    of blood is seen in the hub of the syringe.
   PURPOSE: To prevent hemocoagulation, the tourniquet should remain
    in place no longer than 1 minute.
15. Always keep the tube and the holder in a downward position so that
    the tube fills from the bottom up.
16. Place a gauze pad over the puncture site and gently remove the needle
    (Figure 3).
17. Complete the procedure as you would for an antecubital draw (see
    Procedure 53-2, steps 19 through 23).

FIGURE 1 (From Garrels M, Oatis C: Laboratory testing for ambulatory settings, ed 2, St
Louis, 2011, Saunders.)

FIGURE 2 (From Garrels M, Oatis C: Laboratory testing for ambulatory settings, ed 2, St
Louis, 2011, Saunders.)

FIGURE 3 (From Garrels M, Oatis C: Laboratory testing for ambulatory settings, ed 2, St Louis, 2011, Saunders.)
If the patient begins to faint, quickly remove the tourniquet and needle from the arm and immediately dispose of the needle in a sharps container to prevent an accidental exposure. An ammonium carbonate, or smelling salts, capsule can revive the patient. Hold the capsule away from the face as you crush it between your fingers; then hold it approximately 4 inches from the patient’s nostrils until the person regains consciousness. The ammonia fumes irritate the membranes of the nose and lungs, which triggers a reflex that causes the muscles that control breathing to work faster. Do not allow the contents of the capsule to drip onto the patient’s skin or into the mouth, nose, or eyes, because they can cause caustic burns.

Nerve damage can be a consequence of venipuncture, albeit an unlikely one. Preventive measures include avoiding the basilic vein and refraining from blind probing if the vein is missed.

Table 53-4 lists some probable solutions to complications. As a general rule, it is wise to limit yourself to two attempts to obtain blood from any one patient. If you fail on the second attempt, ask the patient whether he or she would prefer having someone else try or whether it would be better to come back at another time. This maneuver lets the patient feel that he or she is in control of the situation. At one time or another everyone is unsuccessful at obtaining a needed blood sample, so do not feel that you are a failure.

**CRITICAL THINKING APPLICATION 53-3**

Leah is in her second week at the clinic, and she is confident she can perform phlebotomy on her own. Melissa has been a good mentor, and Leah has done quite a few successful “sticks” without any problems. Today, however, she is just having a bad day. Mr. Godfrey Lawrence has come to the clinic with numerous problems, and Dr. Gupta has ordered several blood tests. Mr. Lawrence is uncooperative when he sees that Leah must draw four tubes of blood. He angrily tells her that she cannot take that much blood out of him; she is a vampire and she will drain him. How should Leah deal with this problem?

**SPECIMEN RECOLLECTION**

Sometimes problems with a sample cannot be determined until the specimen is analyzed in the laboratory. Rejected specimens must be recollected. The laboratory may reject a specimen for reasons that include the following:

- Unlabeled or mislabeled specimen
- Insufficient quantity
- Defective tube
- Incorrect tube used for the test ordered
- Hemolysis
- Clotted blood in an anticoagulated specimen
- Improper handling

Hemolysis is the major cause of specimen rejection. Because it cannot be detected until the blood cells separate from the plasma or serum, it is crucial to take steps to prevent red cell damage during collection. Hemolyzed serum or plasma appears rosy to bright red in color because of the release of hemoglobin from the cells. Some of the more routine tests that are adversely affected by hemolysis are chemistry tests for electrolytes (e.g., potassium and sodium), bilirubin, total protein, and numerous liver enzymes (e.g., alkaline phosphatase and gamma glutamyl transferase). Table 53-5 reviews the major causes of hemolysis during collection.
### TABLE 53-5  Major Causes of Hemolysis During Collection

<table>
<thead>
<tr>
<th>CAUSE OF HEMOLYSIS</th>
<th>EXPLANATION</th>
<th>PREVENTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alcohol preparation</td>
<td>Transfer of alcohol into the specimen causes hemolysis.</td>
<td>Allow venipuncture site to dry completely.</td>
</tr>
<tr>
<td>Incorrect needle size</td>
<td>A high-gauge needle causes the blood to be forced through a small lumen with great force, shearing the cell membranes; a very-low-gauge needle allows a large amount of blood to suddenly enter the tube with great force, causing frothing.</td>
<td>Choose the correct needle for the job, aiming for a 19- to 23-gauge needle.</td>
</tr>
<tr>
<td>Loose connections on the</td>
<td>If the connection between the needle holder and the double-pointed needle or the syringe and needle is loose, air can enter the sample and cause frothing.</td>
<td>Make sure all connections are tight before beginning the venipuncture.</td>
</tr>
<tr>
<td>vacuum tube assembly</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Removing the needle from</td>
<td>The remaining vacuum in the tube can cause air to be drawn forcefully into the tube, causing frothing.</td>
<td>Remove the final tube from the needle holder before withdrawing the needle from the patient's vein.</td>
</tr>
<tr>
<td>the vein with the tube</td>
<td></td>
<td></td>
</tr>
<tr>
<td>intact</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Underfilled tubes</td>
<td>Underfilling tubes leads to an improper blood/additive ratio. Certain additives in disproportionate amounts (e.g., sodium fluoride) can cause hemolysis.</td>
<td>Permit blood to flow into the tubes until no more movement can be seen.</td>
</tr>
<tr>
<td>Syringe collections</td>
<td>Pulling back forcibly on the plunger draws blood too quickly through the needle, shearing cell membranes; transferring blood into a vacuum tube further traumatizes red blood cells.</td>
<td>Pump the plunger several times before use to loosen it in the barrel. Use the smallest syringe possible. Place the aspiration rate so that no more than 7 mL of air space is present at any time. Transfer blood into the vacuum tube immediately, preferably using a transfer device. Never push on the plunger when transferring to a vacuum tube. Angle the syringe so that the blood runs gently down the side of the tube, preventing the cells from hitting the bottom of the tube with force.</td>
</tr>
<tr>
<td>Mixing tubes too vigorously</td>
<td>All tubes except the red-topped tube must be mixed.</td>
<td>Gently invert tubes immediately after the draw. Anything other than gentle inversion (e.g., shaking) can hemolyze cells.</td>
</tr>
<tr>
<td>Temperature and transport</td>
<td>Trauma and temperature extremes can damage cells. Freezing results in ice crystals that puncture cell membranes.</td>
<td>Tubes should be transported in the upright position with as little trauma as possible. Temperature should be controlled; not too hot and not too cold.</td>
</tr>
<tr>
<td>problems</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Separation of plasma or</td>
<td>Removing the serum or plasma from the cells minimizes the risk of contaminating the specimen with red cell contents.</td>
<td>Blood samples should be centrifuged, when applicable, as soon as possible and serum or plasma removed from the cells.</td>
</tr>
<tr>
<td>serum from red cells</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prolonged tourniquet time</td>
<td>While the tourniquet restricts blood flow, interstitial fluid can leak into the veins and hemolyze red cells.</td>
<td>Adhere to the 1-minute rule for tourniquet application.</td>
</tr>
<tr>
<td>Poor collection; blood</td>
<td>The needle lumen may be blocked because it is too close to the inner wall of the vein.</td>
<td>Withdraw the needle slightly to center it in the vein.</td>
</tr>
<tr>
<td>flowing too slowly into the</td>
<td></td>
<td></td>
</tr>
<tr>
<td>tube</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### CRITICAL THINKING APPLICATION 53-4

- Leah next must draw a sample from Ms. Danielle Rollins. Ms. Rollins indicates that she has a history of bruising after venipuncture, and sure enough, a hematoma begins to rise shortly after Leah inserts the needle. She then notices that Ms. Rollins has become pale and is perspiring. What should Leah do first?
  - What other steps should Leah take? Can she still obtain the sample?

### CAPILLARY PUNCTURE

Capillaries are small blood vessels that connect small arterioles to small venules. A capillary, or dermal, puncture is an efficient means of collecting a blood specimen when only a small amount of blood is required or when a patient's condition makes venipuncture difficult. Because the requisition will not indicate that the collection is to be made in this manner, you must be familiar with the advantages, limitations, and appropriate uses of this technique. Capillary puncture is warranted in the following situations:
- Older patients
- Pediatric patients (especially under age 2)
- Patients who require frequent glucose monitoring
- Patients with burns or scars in venipuncture sites
- Obese patients
- Patients receiving intravenous therapy
• Patients who have had a mastectomy
• Patients at risk for venous thrombosis
• Patients who are severely dehydrated
• Tests that require a small volume of blood

Because capillaries are bridges between arteries and veins, capillary blood is a mixture of the two. Small amounts of tissue fluid also are present in capillary blood, especially in the first drop. Analyte levels are usually the same in capillary and venous blood, with a few exceptions. Hemoglobin and glucose values are higher in capillary blood; potassium, calcium, and total protein are higher in venous blood.

§ Equipment

Skin Puncture Devices
The device used to perform a dermal puncture is the lancet, which delivers a quick puncture to a predetermined depth (Figure 53-16). OSHA has directed that lancets must have retractable blades; they also must have locks that prevent accidental puncture after use and that also prevent the device from being reused (Table 53-6). Skin puncture devices should always be discarded in a sharps container.

Collection Containers
Different types of collection devices and containers are available, and the ones used depend on the test to be performed (Figure 53-17). Microcollection, or Microtainer, tubes hold up to 750 μL (0.75 mL) of blood and are available with a variety of anticoagulants and additives. The tops are color coded in the same fashion as evacuated tubes. Blood is collected drop-wise into these tubes through a funnel-like device. Capillary tubes are another means of collecting blood from a dermal puncture. These are glass or plastic tubes that draw blood by capillary action; that is, the blood fills into these narrow tubes without the need for suction. If the capillary tube is coated with the anticoagulant heparin, a red band will be seen at the top. A common, heparin-coated capillary tube is the microhematocrit tube used for determining the percentage of packed red blood cells in the microhematocrit test (Chapter 54).

Manufacturers also provide various collection devices for obtaining small amounts of blood for "point of care" testing, such as for glucose, hemoglobin A1c, and cholesterol (Chapter 54). The blood either is pulled into the collecting device by capillary action after puncture, or it is dropped onto a reagent strip, which is inserted into the instrument to be analyzed.

Blood from a capillary puncture also can be deposited on paper cards. One such card, the Guthrie card, is used to test

![Figure 53-16 Skin puncture devices include simple lancets and automated devices that control the depth and width of the incision. (Courtesy Becton, Dickinson and Company, Franklin Lakes, New Jersey.)](image1)

![Figure 53-17 Microsample containers: Microtainer tubes and a capillary tube in sealing clay.](image2)

<table>
<thead>
<tr>
<th>TABLE 53-6</th>
<th> </th>
<th>BLOOD VOLUME</th>
<th>APPLICATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>DEVICE DEPTH AND DIMENSION</td>
<td> </td>
<td> </td>
<td> </td>
</tr>
<tr>
<td>2.25-mm, 28-gauge needle</td>
<td> </td>
<td>Single drop</td>
<td>Finger sticks</td>
</tr>
<tr>
<td>2.25-mm, 23-gauge needle</td>
<td> </td>
<td>Single drop</td>
<td>Finger sticks, glucose test</td>
</tr>
<tr>
<td>1 × 1.5-mm blade</td>
<td> </td>
<td>Low blood flow</td>
<td>Finger sticks, microhematocrit tube, or drop of blood for glucose or cholesterol test</td>
</tr>
<tr>
<td>1.5 × 1.5-mm blade</td>
<td> </td>
<td>Medium blood flow</td>
<td>Finger sticks; to fill a single Microtainer tube</td>
</tr>
<tr>
<td>2 × 1.5-mm blade</td>
<td> </td>
<td>High blood flow</td>
<td>Finger sticks; to fill multiple Microtainer tubes</td>
</tr>
</tbody>
</table>

neonates for certain metabolic disorders, such as phenylketonuria (PKU). Blood is deposited into circles on biologically inactive filter paper and sent to a referral laboratory for analysis within 24 hours of sampling. Federal postal regulations for the mailing of biohazardous material must be followed (Figure 53-18).

## Routine Capillary Puncture

### Site Selection

In adults and children, the usual puncture site is the ring finger, but capillary blood can be obtained from the middle finger or heel (Figure 53-19). The thumb usually is too calloused, and the index finger has extra nerve endings that make the puncture more painful. The fifth finger has too little tissue for a successful puncture. The puncture is made at the tip and slightly to the side of the finger. Be sure to puncture a fleshy area closer to the center of the finger to prevent damage to underlying bone. Avoid areas that are calloused, scarred, burned, infected, cyanotic, or edematous.

For children younger than 1 year, dermal puncture is performed on the medial and lateral surfaces of the plantar surface (bottom) of the heel. Areas other than these are unsafe and may cause bone or nerve damage to an infant. Blood flow from an infant’s heel can be increased as much as sevenfold by applying a warm, moist towel (or other warming device) at a temperature no higher than 42° C (108° F) for 3 to 5 minutes. Never place bandages on the heel or anywhere on infants under age 2, because they may peel off and become a choking hazard.
Patient Preparation

Preparation for a capillary puncture is similar to that for venipuncture. Put on gloves and cleanse the finger well with an alcohol prep pad. If the patient's hands are excessively soiled, ask the person to wash them before the procedure. If the patient's hands are cold, warm them in warm water and dry them thoroughly, or ask the person to rub or shake them vigorously.

Generally, you must work very efficiently when performing a capillary puncture, because blood flow stops quickly. Be sure to have your supplies organized and within easy reach. Grasp the finger firmly and apply gentle, intermittent pressure but do not squeeze or "milk" it. Press the puncture device firmly against the skin and quickly depress the plunger.

Collecting the Specimen

After puncturing the dermis, it is important to wipe away the first drop of blood with sterile gauze. This drop contains tissue fluid that could interfere with test results. Fill the sampling containers according to the manufacturer's directions. Touch the container to the drop of blood as it is released from the puncture site, but do not touch the skin. If blood flow stops, wiping the site with sterile gauze may restart the flow. Be prepared for blood to contaminate your gloves or surfaces by having spare gloves, extra gauze pads, and disinfectant nearby. After the containers have been filled, ask the patient to apply pressure to the gauze you have placed over the puncture site if he or she is able. Seal containers as recommended by the manufacturer if necessary.

Specimen Handling

Capillary collection containers often are too small to apply a label. The most efficient way to transport capillary tubes is to remove the stopper from a red-topped tube, insert the capillary tubes, sealed-end down, replace the stopper, and label the tube. Micropincher tubes have plastic plugs that fit over the top. They may be placed in either a labeled tube or a labeled zipper-lock bag for transport. Always decontaminate collection containers before delivering them to the laboratory if blood was deposited on the surface during collection. The procedure for routine capillary collection is outlined in Procedure 53-4.

Critical Thinking Application

- Melissa calls Mrs. Cora Miatto into the room. Mrs. Miatto, who is 88, is seeing the doctor today to have coagulation studies done. She is a pleasant, talkative woman. Melissa begins to organize her supplies. She examines Mrs. Miatto's arms and decides that drawing from the right hand would be best. Why do you think she made this decision?
- What supplies will she need to draw from the hand? What tubes will she use to collect samples?

Pediatric Phlebotomy

Obtaining blood from children and infants may be difficult and potentially hazardous. The procedure should be performed only by personnel trained in the techniques for pediatric phlebotomy. Successfully obtaining blood from children requires skill and an understanding of pediatric psychological development, as well as appropriate communication skills. The phlebotomist must gain the child's confidence and often that of the parent as well. Parents often ask the phlebotomist to explain the tests being done and why. You should be very careful when divulging information; never tell the parents what disease or condition a specific blood test detects. Refer questions to the child's physician. A parent or guardian may or may not be an asset during the procedure. Ask the parent about the child's previous phlebotomy experiences and how cooperative the child is likely to be. Tactfully determine whether the parent is comfortable with assisting in restraining an uncooperative child. Parental behavior greatly influences the child's behavior during the procedure. Children should never be restrained in a way that might cause physical injury. If the parent is unable or unwilling to assist with necessary restraint, always refer to the office or laboratory policy on restraints and procedural holds. Table 53-7 provides information on the typical fears and concerns of children during the procedure and suggested parental involvement.

Removing large amounts of blood, especially from premature infants, may result in anemia (Table 53-8). The amount of blood withdrawn must be recorded in the child's chart. Puncturing deep veins in children may result in cardiac arrest, hemorrhage, venous
PROCEDURE 53-4
Perform Capillary Puncture: Obtain a Capillary Blood Sample by Fingertip Puncture

GOAL: To collect a capillary blood specimen suitable for testing using the fingertip puncture technique.

EQUIPMENT and SUPPLIES
- Sterile disposable safety lancet
- 70% alcohol prep pads
- Sterile gauze pads
- Nonallergenic tape
- Appropriate collection containers (e.g., capillary tubes or Microtainer devices)
- Sealing clay or caps for capillary tubes
- Permanent marking pen
- Biohazard waste container
- Disposable gloves
- Patient’s record

PROCEDURAL STEPS
1. Read the requisition and gather all needed supplies based on the physician’s requisition.
   PURPOSE: To perform the procedure efficiently. Once the skin has been punctured, the collection must proceed as rapidly as possible so that the blood does not clot before the entire specimen has been collected.
2. Sanitize your hands. Put on nonsterile gloves.
3. Identify the patient and explain the procedure.
   PURPOSE: To make sure you have the right patient; explanations help gain the patient’s cooperation.
4. Select a puncture site depending on the patient’s age and the sample to be obtained (side of middle or ring finger of nondominant hand, medial or lateral curved surface of the heel, or the great toe for an infant).
   PURPOSE: The nondominant hand may have fewer calluses. The side of the finger is less sensitive, and the skin usually is not as thick. Use great caution when performing capillary puncture on infants.
5. Gently rub the finger along the sides.
   PURPOSE: To promote circulation. If the finger is very cold, you may immerse it in warm water or moisten it with warm towels.
6. Clean the site with alcohol, allow it to air dry, or dry it with sterile gauze (Figure 1).
   PURPOSE: Puncturing skin that is wet with alcohol is painful and can hemolyze the specimen.
7. Grasp the patient’s finger on the sides near the puncture site with your nondominant forefinger and thumb.
   PURPOSE: Firmly holding the site allows control of the puncture.
8. Hold the lancet at a right angle to the patient’s finger and make a rapid, deep puncture on the side of the patient’s fingertip (Figure 2).
   PURPOSE: Lancets are designed to puncture at specific depths that permit the free flow of blood.

FIGURE 1 (From Garrels M, Oatis C: Laboratory testing for ambulatory settings, ed 2, St Louis, 2011, Saunders.)

FIGURE 2 (From Garrels M, Oatis C: Laboratory testing for ambulatory settings, ed 2, St Louis, 2011, Saunders.)
PROCEDURE 53-4—cont’d

9. Dispose of the lancet in the sharps container. Wipe away the first drop of blood with clean gauze (Figure 3).
   PURPOSE: The first drop of blood contains tissue fluid, which may alter test results.

10. Apply gentle pressure to cause the blood to flow freely.
    PURPOSE: Forceful squeezing liberates fluid that dilutes the blood and causes inaccurate results.

11. Collect blood samples.
    a. Express a large drop of blood, touch the end of the tube to the drop of blood (not the finger), fill the capillary tubes (Figure 4), place the finger over the blood-free end of the tube, and seal the other end of the tube by inserting it into the sealing clay. The tube should be approximately three quarters full before it is sealed.
    PURPOSE: Placing the finger over the capillary tube prevents the blood from dripping onto the sealing clay.
    b. Wipe the finger with a clean, sterile gauze pad, express another large drop of blood, and fill a Microtainer (Figure 5). Do not touch the container to the finger. If more blood is needed, wipe the puncture with clean gauze and gently squeeze another drop. Cap the tube when the collection is complete.
    PURPOSE: Touching the container to the finger irritates the puncture site and may cause infection.

12. When collection is complete, apply pressure to the site with clean sterile gauze (Figure 6). The patient may be able to assist with this step.

13. Select an appropriate means of labeling the containers. Capillary tubes can be placed in a red-topper tube, which is subsequently labeled. Microtainers can be placed in zipper-lock bags that are subsequently labeled.

14. Check the patient for bleeding, and clean the site if traces of blood are visible, and apply a nonallergenic bandage if indicated.

15. Dispose of used materials in the proper containers.

16. Clean the work area. Remove your gloves and sanitize your hands.
    Dispose of any blood-contaminated materials (e.g., gauze) in the biohazard container.
    PURPOSE: To ensure infection control.

17. Record the procedure in the patient’s record.
    PURPOSE: A procedure is considered not done until it is recorded.

FIGURE 3 (From Garrels M, Oatis C: Laboratory testing for ambulatory settings, ed 2, St Louis, 2011, Saunders.)

FIGURE 4 (From Garrels M, Oatis C: Laboratory testing for ambulatory settings, ed 2, St Louis, 2011, Saunders.)

FIGURE 5 (From Garrels M, Oatis C: Laboratory testing for ambulatory settings, ed 2, St Louis, 2011, Saunders.)
TABLE 53-7 Childhood Behavior and Parental Involvement During Phlebotomy

<table>
<thead>
<tr>
<th>AGE</th>
<th>TYPICAL MENTAL STATE</th>
<th>SUGGESTED PARENTAL INVOLVEMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Newborns (0-12 months)</td>
<td>Trust that adults will respond to their needs.</td>
<td>Parent should assist by cradling and comforting child.</td>
</tr>
<tr>
<td>Infants and toddlers (1-3 years)</td>
<td>Minimal fear of danger but fear of separation. Limited language and understanding of procedure.</td>
<td>Parent should assist by holding the child and providing emotional support.</td>
</tr>
<tr>
<td>Preschoolers (3-6 years)</td>
<td>Fearful of injury to body; still dependent on parent.</td>
<td>Parent may be present to provide emotional support and to assist in obtaining child’s cooperation.</td>
</tr>
<tr>
<td>School-aged children (7-12 years)</td>
<td>Less dependent on parent and more willing to cooperate; fear loss of self-control (crying).</td>
<td>Child may not want parent present.</td>
</tr>
<tr>
<td>Teenagers (13-18 years)</td>
<td>Fully engaged in the process; embarrassed to show fear and may show hostility to cover emotions.</td>
<td>Teen may not want parent present.</td>
</tr>
</tbody>
</table>

TABLE 53-8 General Guidelines for Pediatric Venipuncture

<table>
<thead>
<tr>
<th>WEIGHT (lb)</th>
<th>LIMIT DURING A SINGLE DRAW</th>
</tr>
</thead>
<tbody>
<tr>
<td>8-10</td>
<td>3.5 mL</td>
</tr>
<tr>
<td>10-15</td>
<td>5 mL</td>
</tr>
<tr>
<td>16-40</td>
<td>10 mL</td>
</tr>
<tr>
<td>41-60</td>
<td>20 mL</td>
</tr>
<tr>
<td>61-65</td>
<td>25 mL</td>
</tr>
<tr>
<td>66-80</td>
<td>30 mL</td>
</tr>
</tbody>
</table>

Thrombosis, damage to surrounding tissues, or infection. In addition, the child could be harmed during forceful restraint. To prevent these problems, blood should be collected only by dermal puncture from children under age 2 unless the procedure warrants venous collection (lead levels or blood culture). Venipuncture on children under age 2 should be performed only on surface veins, including the dorsal hand vein, using a 23-gauge winged infusion set coupled to a syringe or a pediatric vacuum tube collection set.

When the medical assistant is required to perform pediatric phlebotomy, wearing a colorful smock, being truthful about the discomfort the child will feel, and providing tokens and praise for bravery go a long way toward allaying the child’s fears. Topical anesthetic creams and disks may be prescribed to lessen pain at the puncture site, but they must be applied at least 1 hour before the procedure. In most cases a calm, professional phlebotomist who understands the developmental needs of the child and relates to the child on that level can gain the acceptance necessary to perform a successful venipuncture or dermal puncture with a minimum of restraint and frustration.

Postcollection Specimen Handling

It has been said that the results of laboratory testing are only as good as the specimen sent for testing. Specimens handled improperly after collection may provide erroneous results and
unnecessarily compromise the patient's health. From the moment
the specimen is collected, analytes in the blood begin to decay,
and it is a race against time to provide results that accurately
represent a patient's condition at the time of the blood collection.
After collection, blood may need to be processed before the
sample is sent to its final destination. For most samples, this
involves the separation of the plasma or serum from the red cells.
If the tube contains no anticoagulant, blood begins to clot when
it comes in contact with the glass tube. Plastic tubes require the
addition of a clot activator; the SST speckle-topped tube has
silica additives to accelerate clotting. "Clot" tubes should be
allowed to sit upright in a rack for 30 to 60 minutes at room
temperature while a solid clot forms. Tubes with clot accelerator
should form a dense clot within 30 minutes. The presence of
anticoagulants in the blood, such as warfarin (Coumadin) or
heparin, may delay clotting. Once the clot has formed, every
effort should be made to remove the clot from the serum within
2 hours.

Removal of the clot from the serum requires centrifugation.
For the thixotropic gel to form the barrier between the clot and
the serum, certain g-force, time, and temperature requirements
must be met. A minimum g-force of 1,000 g must be achieved
by centrifugation; the gel must be at 25°C (77°F), and the tube
must be centrifuged for 10 to 15 minutes. The serum does not
have to be removed from the tube after centrifugation, because
the gel has formed a barrier over the red blood cells. Once a tube
with thixotropic gel has been centrifuged, it cannot be centri-
fuged again. The serum, however, can be decanted and centri-
fuged in another tube.

For tests that require plasma, the plasma should be removed
from the cells as soon as possible. This can be accomplished
with centrifugation followed by aspiration of the plasma and
transfer to another tube using a disposable pipet. The green-gray
marbled-topped tube, with lithium heparin anticoagulant, has
a thixotropic gel, which forms the necessary barrier when cen-
trifuged as described previously. Certain blood tests, such as the
complete blood count, require whole blood. It is wise to check
the requirements of the laboratory that will perform the test as
to how the specimen should be transported and stored. The
College of American Pathologists recommends that whole blood
for automated blood counts be refrigerated and tested within
72 hours.

Often specimens must be transported by courier to other
facilities. The Hazardous Materials Shipping Regulations es-
ablished by the Department of Transportation apply to the pack-
ing or shipping of hazardous materials by ground transportation.
Those who ship human specimens must be trained in all
aspects of the handling, packing, and shipping of biohazardous
materials.

**CHAIN OF CUSTODY**

As discussed in Chapter 52, blood samples may be collected as
evidence in legal proceedings. Blood may be drawn for drug and
alcohol testing, DNA analysis, or parentage testing. These samples
must be handled according to special procedures to prevent tam-
pering, misidentification, or interference with the test results.

**Chain of custody** is a legal term that refers to the ability to
guarantee the identity and integrity of the specimen from collec-
tion to reporting of the test results. It is a process used to main-
tain and document the chronologic history of a specimen.
(Documents should include the name or initials of the individual
collecting the specimen, each person or entity subsequently
having custody of it, the date the specimen was collected or
transferred, the employer or agency, the specimen number, the
patient's or employee's name, and a brief description of the
specimen.)

Collection kits are available that contain everything needed
for the venipuncture, including the tube, the needle, the chain
of custody forms and seals, the antiseptic, and even the tourni-
quet. Familiarize yourself with these kits before you are required
to use them. You may be required to testify at a legal proceeding
if you are involved in the collection or testing of a sample involved
in a legal proceeding.

**CLOSING COMMENTS**

**Patient Education**

Medical assistants who work as phlebotomists must maintain a
professional attitude, yet remain sympathetic to the patient's fears
and anxiety about being "stuck with a needle." Establishing an
environment that encourages the person to relax can minimize
the patient's pain and discomfort during the procedure.

Always remember to identify your patient and explain what
you are going to do. Answer any questions the patient may have
and perform the procedure skillfully before anxiety has time to
set in.

Provide as much explanation as needed to ease the patient's
anxiety. Often the patient can help by identifying the site of the
last successful blood draw. Follow the patient's suggestion in
choosing the site for obtaining a blood specimen. When a patient
is allowed to become an active participant in the procedure, he
or she remains more relaxed, talkative, and confident in your
expertise as a phlebotomist.

The atmosphere can change dramatically if the patient has had
an unpleasant experience and associates pain and discomfort with
venipuncture. Such a patient usually is ill at ease and apprehen-
sive. In this case, you need to make every effort to perform the
procedure quickly, efficiently, and effectively. Once the blood has
been drawn and the patient has relaxed, you can help the patient
develop a positive attitude.

If your patient has a history of syncope when blood is drawn
or if you suspect the patient may faint during the procedure, have
the person lie down. Assemble your equipment and alert the
physician before beginning the procedure. This type of profes-
sional care may help the patient get through the procedure
without a traumatic effect.

**CRITICAL THINKING APPLICATION 53-6**

- As much as Leah likes children, performing capillary puncture on little
  fingers is not one of her favorite things to do. Mrs. Spix brings her
  son, Garrett, in for a hemoglobin and hematocrit test: Garrett is 3
years old. Mrs. Spix nervously asks Leah about the procedure and the tests Garrett must have. How can Leah adequately answer Mrs. Spix’s questions and make Garrett and his mother feel at ease about this procedure?
- What supplies will Leah need? Explain how she will perform the capillary puncture.

## Legal and Ethical Issues
Venipuncture and microcapillary blood collection are invasive procedures in which a sterile needle or a lancet is inserted through the skin. Because the skin is penetrated, drawing blood becomes a surgical procedure and is subject to the laws and regulations of surgery. When venipuncture is performed, the rules and regulations must be followed with no deviations. Be sure to follow the procedures as written and become familiar with the regulations and standards established by local and state agencies as well as the CLSI and OSHA. Deviations leave the medical assistant open to accusations of malpractice. Document any situations that arise in which observation of the standard of care comes into question.

On rare occasions, patients who have scarred veins as a result of intravenous drug use may ask to draw their own blood. You should never permit this and should always take precautions that your supplies are protected.

## SUMMARY OF SCENARIO
Leah has learned that phlebotomy is truly an art. Although she was nervous at first, she has become quite proficient with this new skill. She discovered that her nervousness was “contagious” and that if she remains calm and organized, her patients are more likely to feel at ease with the procedure. She has learned that it is necessary to talk with patients before drawing their blood, not only to allay their fears, but also to get clues about past problems or the best site for the draw. She has learned that she is responsible for explaining the tests ordered and how much blood she will draw, but that she is not responsible for explaining the reasons the tests are being done. Effective communication is the most important aspect of phlebotomy.

Through practice and careful attention, Leah has come to recognize the proper equipment to use in phlebotomy, and she never hesitates to call the referral laboratory used by her employer if she has a question about proper collection of a specimen. Communicating with children and adults is as different as the equipment she uses for venipuncture; the small veins of children and the elderly require special care, and she has become proficient in the use of winged infusion sets and syringes to prevent vein collapse. Leah is well aware of the dangers of phlebotomy, and through education and the use of approved safety devices, she is confident that she can provide excellent care for her patients at the Health Alliance Medical Clinic.

## SUMMARY OF LEARNING OBJECTIVES

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

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

3. List the equipment needed for venipuncture. Venipuncture requires a double-pointed safety needle, evacuated collection tubes, needle holder or a syringe fitted with a safety needle, tourniquet, alcohol prep pad, gauze or cotton, sterile bandage, latex gloves, and a biohazard disposal container.

4. Explain the purpose of a tourniquet. A tourniquet is used to prevent venous flow out of the site, which causes the veins to bulge. The tourniquet makes veins easier to locate and puncture.

5. Explain how to apply a tourniquet and three consequences of improper application. Tourniquets are applied snugly around the upper arm (or wrist for a hand draw) in a fashion that permits easy release. Leaving the tourniquet on for a prolonged period results in hemoconcentration; applying the tourniquet too tightly results in unnecessary discomfort to the patient and the release of tissue fluid into the blood.

6. Explain why the stopper colors on evacuated tubes differ. The various colors of vacuum tube stoppers indicate the contents of the tube. Certain additives are compatible with certain laboratory tests. The phlebotomist must be knowledgeable about blood tests and the type of tube needed. Consulting literature provided by the manufacturer ensures the proper choice of a collection tube.

7. State the correct order in which samples for various types of tubes should be collected. (1) Sterile or SPS, (2) light blue, (3) red or red speckled, (4) green, (5) lavender, and (6) gray. Evacuated tubes should be collected in a specific order to prevent carryover of tube additives.

8. Describe the types of sharps used in phlebotomy. The venipuncture needle has a shaft with one end cut at an angle (bevel). The other end (the hub) attaches to the syringe or to a needle holder. The opening in the tip, the lumen, is measured in gauge numbers. Double-pointed needles are used for the evacuated tube method. Needles with special adapters are used with disposable syringes. Lancets are used for dermal puncture.

9. Explain why a syringe would be chosen for blood collection rather than an evacuated tube.
Syringes are more commonly used for blood collection from elderly patients, whose veins tend to be more fragile; from children, whose veins tend to be small; and from obese patients, whose veins tend to be deep. Using a syringe allows a more controlled draw. Syringes commonly are used with winged infusion sets.

10. Discuss the use of sharps with engineered sharps injury protection. OSHA requires all sharps used for phlebotomy to be engineered with safety devices, such as retractable needles, self-shielding needles, and blunting devices. Needle caps should never be recap and in most cases they are not removed from the venipuncture unit. All sharps must be disposed of in an approved sharps container.

11. Summarize postexposure management of needle sticks. OSHA requires employers to have a postexposure plan in place for accidental sharps exposures. These plans generally include a means to cleanse the wound with an appropriate antisepic cleanser; evaluation of the exposure to determine whether the employee is at risk for contracting HBV, HCV, or HIV, depending on the circumstance of the injury; gathering of information about the source of the blood involved; prophylactic care if necessary; confidential counseling for the injured; and follow-up on the exposure.

12. Detail patient preparation for venipuncture that shows sensitivity to the patient's rights and feelings. The medical assistant must be sensitive to the needs and concerns of patients both before and during the phlebotomy procedure. The procedure should be explained to the patient, and all questions should be answered. The patient should be observed for any problems during the procedure, and the medical assistant should use therapeutic communication techniques throughout the intervention.

13. Describe and name the veins that may be used for blood collection. The median cephalic vein is the vein of choice for phlebotomy, but blood can be drawn from the cephalic vein and the median basilic vein. The basilic vein should not be used if possible. The dorsal vein on the hand may be used.

14. List in order the steps of a routine venipuncture. A routine venipuncture begins with greeting and identifying the patient. The medical assistant then assembles the equipment, locates the vein, draws the blood, removes and properly disposes of the needle, tends to the puncture site, labels the tubes, and delivers them to the laboratory. Standard Precautions are followed during the procedure.

15. Collect a venous blood sample using the syringe method. Refer to Procedure 53-1.


17. Explain why a winged infusion set (butterfly needle) would be chosen over an evacuated tube. A winged infusion set (butterfly needle) is used on blood draws from the hand and from children. The needle is shorter, and the wings assist with holding and guiding the needle. The tubing minimizes the vacuum and prevents collapse of fragile veins. Using a syringe can control the vacuum to a greater extent than using vacuum tubes.


19. Summarize typical problems that may be associated with venipuncture. Refer to Table 53-4.

20. Identify the major causes of hemolysis during venous blood collection. Refer to Table 53-5.

21. List situations in which capillary puncture would be preferred over venipuncture. Capillary puncture is preferred over venipuncture for certain tests, such as hematocrit or hemoglobin analysis. It is routinely performed on children under age 2 years.

22. Discuss proper dermal puncture sites. The middle two fingers (the lateral sides of each) generally are used for capillary puncture. In infants, the heel is the site of choice. The center of the heel must be avoided.

23. Describe containers that may be used to collect capillary blood. Capillary blood can be collected in Microtainer devices, in capillary tubes, or on paper test cards. The Microtainer devices may contain anticoagulants and have stopper colors consistent with vacuum tubes.

24. Explain why the first drop of blood is wiped away when a capillary puncture is performed. The first drop of blood contains tissue fluid that could affect the test results.


26. Differentiate whole blood, serum, and plasma and give an example of a test performed with each. Whole blood coagulates unless mixed with an anticoagulant. The anticoagulant must be matched with the test so as not to interfere with the results. Whole blood is required for the complete blood count and differential. When clotted blood is centrifuged, the cells and liquid separate; the liquid portion is the serum. Most chemistry and serology testing is performed on serum. When anticoagulated blood is centrifuged, the liquid that remains is plasma. Plasma may be used for coagulation studies and blood glucose testing.

27. Describe handling and transport methods for blood after collection. Blood cells can easily hemolyze, which alters test results; therefore, serum or plasma should be separated from the cells as soon as possible after collection. This is done by centrifugation. Blood samples to be transported must be packaged securely and sent according to regulations set forth by governmental agencies.
Study Guide Connection: Go to the Chapter 53 Study Guide. Read and complete the activities.

Evolve Connection: Go to the Chapter 53 link at evolve.elsevier.com/kinn to complete the Chapter Review and Chapter Quiz. Peruse other resources listed for this chapter to increase your knowledge of Assisting in Phlebotomy.