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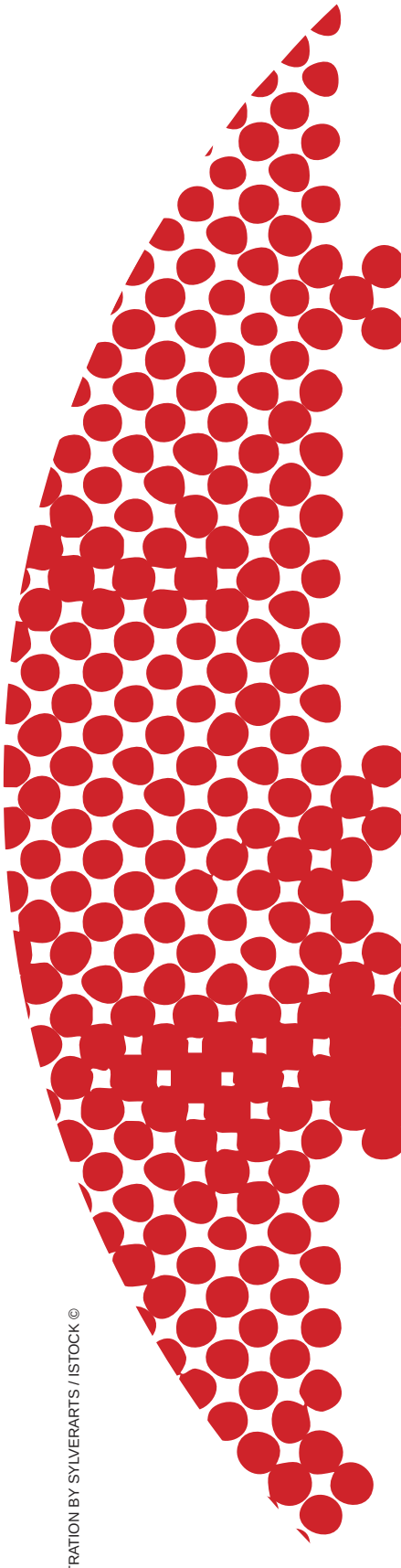
Phlebotomy basics

Nurses are increasingly expected to draw patients' blood for lab work, but what if you haven't been adequately trained?

By Sarah M. Billings-Berg, DC, MSN, RN, CNE



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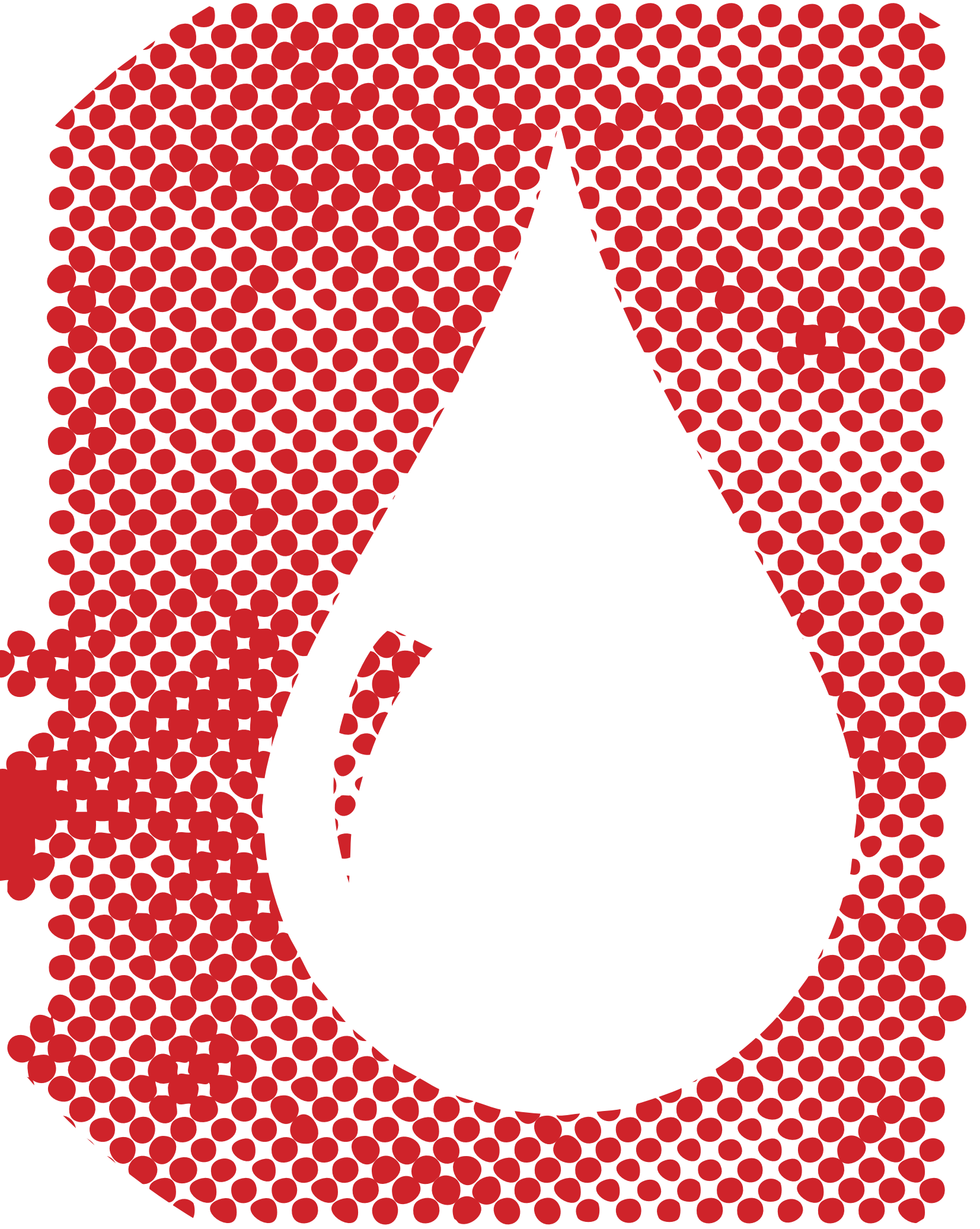
Has your ED patient ever needed a stat lab and there was no phlebotomist in sight? Have you ever gone to your home health patient's house to get a finger-stick international normalized ratio (INR) and the point-of-care machine stops working? Whether in acute care, long-term care, or home health, most nurses will inevitably find themselves in a position where they have to draw a patient's blood via peripheral venipuncture. Nursing schools across the country often include drawing blood from a central line or port in their curriculum, but very few include peripheral venipuncture and phlebotomy basics in the skills checklist.

In this article, you'll learn the do's and don'ts of phlebotomy, including drawing technique, equipment selection, tube additives, drawing order, blood transport, and nursing considerations.

The right equipment

Nurses are accustomed to working with sharps, performing hand hygiene, and using proper protective equipment for invasive procedures. Phlebotomy is no different. You should maintain sharps safety, protect yourself and your patient from blood-borne pathogens, and remember the chain of infection at all times. As you gather your supplies, you'll find that there's a variety of blood drawing equipment available. So how do you know what size needle and device are best to use?



The evacuated tube system is the standard equipment used for routine venipuncture.

A quick patient assessment should give you the information you need to make the appropriate equipment choices. Take a minute to inspect and palpate the patient's veins. Are they readily visible and close to the surface or are they deeper? Are the veins small and fragile or are they large and supple? The size and condition of the vein are what dictates your decisions when choosing equipment. Also consider that patients may have hardened or sclerotic veins due to I.V. chemotherapy treatment or I.V. drug use. These veins should be avoided because they're difficult to puncture and any attempt can lead to further patient injury.

Evacuated tube system vs. syringe

The evacuated tube system (ETS) is the standard equipment used for routine venipuncture. It consists of a needle device, a tube holder, and an air-evacuated tube. You attach the needle device to the tube holder, insert the needle into the vein, and engage the tube. The tube holder is a simple plastic appliance that connects the needle to the tube and allows for stabilization of tube engagement during the draw. Once penetrated by the needle, the tube will automatically fill with the correct amount of blood according to the amount of vacuum pressure within the tube. When the tube is manufactured, negative pressure is created within it by removing the air. Once the tube is punctured by engaging the tube onto the needle, the negative pressure causes suction to draw the blood into the tube. Easy, right? Not necessarily.

You must consider the size and condition of the vein before defaulting to an ETS. If the vein is small, thin, and fragile, a syringe draw may be the way to go. By using a syringe and needle to draw the patient's blood, you can control the pressure and speed at which the blood is removed by varying the rate that you pull back on the plunger. A syringe draw is a much more appropriate technique for you to use with veins that easily collapse. However, if multiple tubes are needed from a patient, you must also consider how many total milliliters of blood are needed to fill each tube and choose an appropriate size syringe. When you draw using a syringe, you complete the process by transferring the blood to the tubes with a Luer-lock transfer device.

Butterfly needle vs. straight multisample needle

When you've selected an ETS to perform a blood draw, you must also consider the size and condition of the vein. For veins that are small, difficult, and close to the surface, such as those on the back of the hand, your best choice is a butterfly or winged needle set. A butterfly needle is shorter with a smaller diameter (23 to 25 gauge) and easily controlled. Butterfly needles also have a length of small, clear tubing between the needle that accesses the vein and the needle that attaches to the tube holder and accesses the evacuated tube. When you insert the needle into the vein, a blood flashback will be visible in the tubing, making it easier to recognize that you've accessed the vein.

A straight multisample needle is typically 1 to 1.5 inches (2.5 to 3.8 cm) in length and the gauge ranges from 20 to 22. Multisample needles are the standard choice for routine venipuncture in a patient with normal, healthy veins. If a patient has veins that are particularly fragile, you can also use a butterfly needle that's designed to attach to a syringe. Some healthcare personnel choose to use a butterfly needle device with every patient because of its size and ease of use. However, this practice is costly because butterfly needles are expensive compared with multisample needles.

Tourniquet

Tourniquets vary in elasticity, width, and length. Ordinarily, a facility will use one or two types of tourniquets and you won't have much of a choice. Most facilities are now using latex-free tourniquets, but you should ask your patient about latex

sensitivity if the tourniquet isn't latex-free. There are tourniquets that are longer for obese patients and smaller for pediatric patients and petite adults. The Clinical and Laboratory Standards Institute recommends single-use tourniquets to avoid hospital-acquired infection transmission.

Site antiseptic

For routine blood draws, 70% isopropyl alcohol or 70% ethyl alcohol is recommended. For routine antisepsis, you can use a standard alcohol prep pad or alcohol-impregnated swabs. If you're drawing blood cultures, be sure to follow the policy and procedure at your facility. The procedure typically calls for the use of chlorhexidine or alcohol and povidone-iodine as the skin antiseptics. Other antiseptics can be used during a routine blood draw, such as chlorhexidine gluconate or benzalkonium chloride.

Tubes

Why are there so many different types of tubes and what do all of the colors mean? Venipuncture collection tubes are probably the least understood element of phlebotomy by nurses because venipuncture isn't included in nursing curricula. However, using the correct type of tube, filling it to the right level, and knowing how to handle the tube postdraw are essential for accurate test results.

Although it isn't vital to know the exact scientific nature of tube additives and types, it's important to have a general idea of what the additive does and why you're using it (see *Commonly used phlebotomy tubes*). Tube types are indicated by colors that are universally associated with a certain additive or tube property. There are two basic principles to consider: 1) Does this need to be a plasma sample? 2) Does this need to be a serum sample?

The difference between plasma and serum is that plasma contains clotting proteins and serum doesn't. If a test requires a whole blood or plasma sample, such as a complete blood cell (CBC) count, blood bank test, or stat chemistries, then the tube needs to contain an anticoagulant additive to prevent clotting. When obtaining a serum sample, such as serum electrolytes or blood urea nitrogen (BUN)/creatinine, the blood needs to clot within the tube before centrifugation and serum collection. In this case, the tube has no additive or contains a clot activator.

Centrifugation is when the tubes are placed in a machine that spins at a high number of revolutions per minute. The spinning action causes the heavier formed elements (blood cells, platelets) to consolidate at the bottom of the tube. The liquid portion of the sample (serum or plasma) is less dense and, therefore, pools in the upper part of the tube, making it easier to collect.

Whether your sample is plasma or serum, there are multiple tube types that also have separator gel present in the bottom of the tube. The separator gel migrates to a position between the formed elements and the plasma or serum during centrifugation. The gel creates a barrier that helps prevent whole cells from contaminating the serum or plasma sample.

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20 steps to successful venipuncture

Any nurse who's being introduced to a new skill should have a skills checklist and be aware of the rationale supporting each step. Use the following as your guide.

1. Review the order

It's best practice to check the provider's order before drawing the lab(s). If the lab test ordered doesn't seem appropriate for your patient, don't be afraid to double check with the provider.

2. Gather the supply tray/cart

If your facility has a phlebotomy tray available with an array of supplies, bring it with you. Many facilities don't have phlebotomy trays immediately available to nurses. In this case, be sure to assess your patient's veins before this step to ensure that you gather the appropriate supplies.

3. Approach, identify, and prepare the patient

Explain the procedure to the patient and ask if he or she has had any difficulty with needles or blood draws. It's best to identify a needle phobia ahead of time so that patients can position themselves as they prefer. Ask the patient if he or she has a history of fainting during blood draws. If yes, the patient should lie down for the procedure.

As with any procedure, medication, or treatment, it's imperative to accurately identify your patient before a blood draw. Ask your patient for at least two verbal identifiers and check them against the lab requisition and patient wristband. The most common verbal identifiers are full

Commonly used phlebotomy tubes

Color/Indicator	Additive and/or property	Example lab test	Considerations
Blood culture bottles (may have different color indicators: one is aerobic, one is anaerobic)	• Culture broth medium to encourage microbial growth	• Blood cultures	• Usually collected in two sets of two from different sites • Use aseptic technique for skin prep • Cleanse top of bottles after protective cap is removed
Light yellow (sterile)	• Sodium polyanethol sulfonate • Anticoagulant • Reduced bacterial breakdown	• Blood cultures	• Eight inversions to mix
Light blue	• Sodium citrate • Anticoagulant	• Coagulation studies (prothrombin time, INR, partial thromboplastin time) • D-dimer	• Must be filled within 90% of indicated volume for 9:1 blood to anticoagulant ratio • Three to four inversions to mix
Red	• None if glass tube • Blood will clot naturally • Clot activator if plastic	• Serum chemistry • Blood type and screen	• Often used as as waste tube • Blood must clot for a minimum of 30 minutes • Five inversions to mix
Gold (serum separating tube [SST])	• Gel separator • When centrifuges, gel migrates to form a barrier between plasma/serum and cells	• Serum chemistry (basic metabolic panel, BUN) • Amylase • Creatine kinase	• Blood must clot for a minimum of 30 minutes • Five inversions to mix
Green	• Heparin • Anticoagulant	• Stat electrolytes • Plasma tests • Creatinine • Troponin	• Deliver immediately for processing • Eight inversions to mix • Gently mix to prevent hemolysis
Lavender/purple	• EDTA • Anticoagulant	• Hematology (CBC count) • Erythrocyte sedimentation rate • Ammonia	• Place ammonia sample in ice slury immediately • Eight inversions to mix
Gray	• Sodium fluoride • Antiglycolytic • Potassium osalate • Anticoagulant	• Glucose • Lactic acid • Blood alcohol	• Eight inversions to mix

name and date of birth. Patient identification may also be verified via medical record number or a unique personal identification number. Some facilities may use wristband barcode scanning as a method of patient identification.

This is also a good time to verify latex allergies and if your patient followed any prelab instructions such as fasting.

4. Hand hygiene

You should always perform hand hygiene immediately before performing any invasive procedure. You may use soap and water or an alcohol-based hand sanitizer.

5. Apply the tourniquet, ask the patient to make a fist, and assess the antecubital space

Most lab draws are performed in the antecubital space of the patient's arm. If there isn't a suitable vein in the antecubital space, the back of the patient's hand is also acceptable. When drawing from the antecubital space, it's important to palpate each vein to assess how it feels and the vein's position. Once the tourniquet is in place, ask the patient to make a fist and hold it. Don't have the patient pump his or her fist because this may cause a change in the blood composition and lead to erroneous results.

6. Select a vein, release the tourniquet, and ask the patient to relax his or her fist

The median cubital vein is the first choice for blood draws because it has a decreased proximity to arteries and nerves in the arm. The more lateral cephalic vein is the second choice and the basilic vein in the medial arm is the last choice. The basilic vein lies over a major artery and a nerve in the arm, which increases the risk of patient injury.

7. Cleanse the site

Just as when prepping a site for an I.V. or injection, you want to use friction and apply 70% isopropyl or ethyl alcohol in concentric circles, moving outward for a total prep area of 2.5 to 3 in (6.4 to 7.6 cm). You may also use benzalkonium or chlorhexidine to prepare the site, using the same technique. Let the site air-dry completely before venipuncture and be careful not to recontaminate. Don't blow air onto the site, wave your hand over it, or blot it with dry gauze. The air-drying action is what helps decontaminate the site.

8. Apply clean gloves and prepare your equipment

At this point, you've assessed the patient's arm and selected the best vein for venipuncture. Now you need to decide which technique and equipment are most suitable for your patient (ETS or syringe, butterfly needle or straight multisample needle). Prepare the equipment by attaching the tube holder to the needle and selecting the correct tube(s) for the test(s) ordered. Don't uncap the needle at this point. It's a good idea to have extra tubes available in case there's a faulty tube. You should also have a piece of gauze and some tape available for immediately after the draw. By the time you've collected and prepared your equipment, the site should be dry.

9. Reapply the tourniquet, have the patient make a fist, and uncap the needle

Be sure to carefully reapply the tourniquet so that you don't contaminate the cleansed site. If contamination does occur, you'll need to resanitize the site. When you uncap the needle, inspect the bevel for any barbs or defects. If the needle is faulty, replace it.

10. Anchor the vein and insert the needle

Anchor the vein with the thumb of your nondominant hand 1 to 2 in (2.5 to 5.1 cm) below the insertion site, being careful not to touch it. If you touch the insertion site, it must be resanitized. Insert the needle at a 30°-angle for antecubital veins and a 10°-angle for hand veins. If the vein is deeper in the tissue, you should increase your angle of insertion slightly. If the vein

The median cubital vein is the first choice for blood draws because it has a decreased proximity to arteries and nerves in the arm.

is more superficial, then use a shallower angle of insertion. Rest the first tube to be filled in the tube holder at this point, but don't puncture it.

11. Establish blood flow, have the patient open his or her fist, and release the tourniquet

If you're using a butterfly needle, you'll see blood flashback in the tubing when you've accessed the vein. If you're using a straight multisample needle, there's no way to see a flashback of blood when you enter the vein; your judgment on vein access is more by feel and depth of needle insertion. When you feel that the vein has been accessed, engage the tube onto the needle and turn the tube a quarter turn to keep it in place. Once blood flow is established, you may release the tourniquet. Remember that the tourniquet shouldn't be on for more than 1 minute because it can change the blood composition. If you're drawing multiple tubes, it's acceptable to keep the tourniquet on when you place a new tube as long as the total tourniquet time remains less than 1 minute.

memory jogger

To remember the order of draw, think "Stop light red stay, green light go."

- STOP (sterile)
- LIGHT (light blue, citrate)
- RED (red)
- STAY (SST, gold)
- GREEN (green, heparin)
- LIGHT (lavender, EDTA)
- GO (gray, oxalate)

12. Fill tubes using the correct order of draw and mix tubes

Tubes should fill to the appropriate amount automatically because of the vacuum in each tube. Be sure not to remove the tube before it's full because it can throw off the additive-to-blood ratio in the tube. When you switch tubes, stabilize the tube holder with your nondominant hand, making sure that you don't change the needle insertion depth. This takes practice. When you're removing the filled tube and placing the new tube, use the two flanges on the side of the tube holder to stabilize it and push the new tube onto the needle. ETS tubes are filled in a specific order to avoid additive contamination from tube to tube. Depending on the lab tests being collected, as well as facility protocol, you may be required to collect a "waste" or discard sample as your first tube. This tube is typically white or clear and collects approximately 3 to 5 mL of blood to prevent contamination of the sample. A nonadditive red-top tube may also be used as a discard sample tube.

The order of draw is as follows:

- light yellow—sterile tubes (blood cultures)
- light blue—coagulation tubes
- red—serum tubes with or without clot activator
- gold—serum tubes with or without separator gel
- green—heparin tubes with or without separator gel
- lavender, purple, pink—ethylenediamine tetraacetic acid, or EDTA, tubes
- gray—glycolytic inhibitor tubes.

Each tube needs to be mixed by inverting it a certain number of times. It's important not to invert tubes too quickly or you may cause hemolysis of the blood cells, which can lead to erroneous lab results. Most tubes are inverted eight times. Red and gold tubes are inverted five times and light blue tubes are inverted four times.

13. Place gauze, remove the needle, and apply pressure to the site

Place gauze lightly over the site just before withdrawing the needle so that when you remove the needle, you can apply immediate pressure. At this point, you may ask the patient to hold pressure with the gauze. If the patient is unable, then you must complete this step. Hold the pressure for at least 2 minutes. If the patient is

receiving anticoagulant therapy, such as heparin or warfarin, hold the pressure for 5 minutes.

14. Discard the collection unit

Engage the needle's safety device immediately after withdrawing it from the patient's arm and place the needle/tube holder unit in the sharps container. Under no circumstances should you remove the needle from the tube holder before disposal because it increases your risk of a needle stick.

15. Label the tubes

Many facilities have computer-generated labels for tubes. If this is the case at your facility, verify the label information, place your initials/time/date on the label, and apply the label to the tube. If you're filling out the entire label, include the patient's last name and first initial, his or her date of birth, your initials, the time, and the date.

16. Implement special handling

If the lab you drew requires special handling, such as placing the tube in an ice slurry or wrapping it in foil to protect it from light, now's the time to do so. If you aren't sure of special handling for a sample, call the lab and ask. It's better to clarify than to repeat a blood draw because of mishandling a sample.

17. Check the patient's arm and apply a bandage

Assess the insertion site for continued bleeding or bruising. If the site isn't actively bleeding, then apply a pressure bandage with gauze and tape. If the site is still bleeding, continue to hold pressure and recheck the site in a few minutes.

18. Dispose of materials and clean up

Follow your facility's policy for disposal of items with blood on them. Also throw away the tourniquet and any other used materials.

19. Remove your gloves, perform hand hygiene, and thank the patient

Remove and throw away your gloves, and then perform hand hygiene with soap and water or sanitizing gel. You should also thank your patient, communicate any symptoms to report, and let him or her know that the provider will discuss any abnormal lab values. If you used a phlebotomy tray or cart, remove it from the room and sanitize it per facility policy.

20. Transport specimens to the lab

Follow your facility's policy for lab sample transport. If this is a stat lab or the sample requires special handling, it may be most efficient to bring the sample to the lab yourself. Be sure to keep the tubes upright and away from excessive movement during transport to reduce the risk of cell hemolysis.

20 steps to a successful blood draw checklist

cheat sheet

- Review the order
- Gather the supply tray/cart
- Approach, identify, and prepare the patient
- Perform hand hygiene
- Apply the tourniquet, ask the patient to make a fist, and assess the antecubital space
- Select a vein, release the tourniquet, and ask the patient to relax his or her fist
- Cleanse the site
- Apply clean gloves and prepare your equipment
- Reapply the tourniquet, have the patient make a fist, and uncap the needle
- Anchor the vein and insert the needle
- Establish blood flow, have the patient open his or her fist, and release the tourniquet
- Fill tubes using the correct order of draw and mix tubes
- Place gauze, remove the needle, and apply pressure to the site
- Discard the collection unit
- Label the tubes
- Implement special handling
- Check the patient's arm and apply a bandage
- Dispose of materials and clean up
- Remove gloves, perform hand hygiene, and thank the patient
- Transport specimens to the lab

Facilitating accurate results

The preanalytical phase of blood specimen collection and lab value determination is everything that happens from the time the test is ordered to the time the sample is analyzed. There are multiple considerations during this phase. Granted, nurses don't have control over all preanalytical risks and concerns, but there's a lot you can do to minimize erroneous lab results and help decrease the likelihood of a second blood draw. After the results are obtained, it's

imperative to ensure provider communication of their significance to the patient.

Timing

Depending on what lab test is ordered, you need to verify that it's the correct time to draw the lab. For example, when a drug's peak and trough levels are tested, make sure that you're drawing the peak level after the correct dosage and at the high point of the drug's pharmacologic peak. You should verify the peak time in a drug reference before the draw. The trough is drawn just before a dose administration; usually, the third or fourth because this is when serum drug levels are at their lowest.

Burns, scars, tattoos, and damaged veins

You should avoid these areas for several reasons. Any area of the skin that's newly burned or injured may be painful for the patient and there's an increased risk of infection. Areas that have healed after an injury, including tattoos, may have significant scar tissue and impaired circulation that can cause erroneous results. Tattoos can also hide underlying bruising or hematomas and often patients don't want a blood draw through a tattoo. Damaged veins from frequent blood draws, I.V. drug use, or frequent I.V. placement can become hardened (sclerosed) and difficult to puncture.

Mastectomy or chest and upper extremity surgeries

The removal of lymph nodes or impaired lymph circulation can cause not only an imbalance in blood composition, but also put a patient at increased risk for infection and lymphedema. Performing venipuncture on a patient's mastectomy side is the last resort and you should consult the patient's healthcare provider first.

on the web

Center for Phlebotomy Education:
www.phlebotomy.com

Clinical and Laboratory Standards Institute:
www.CLSI.org

Mayo Clinic:
www.mayomedicallaboratories.com/index.html

National Phlebotomy Association:
www.nationalphlebotomy.org/

I.V. sites or venous access devices

You should avoid venipuncture on the extremity with an established I.V. or other venous access device, such as a peripherally inserted central catheter (PICC) line. I.V. fluids and saline locks can lead to erroneous lab results, and you also run the risk of damaging or dislodging the device with tourniquet placement. If a patient has an I.V., saline lock, or PICC line that can't be used for blood draws, the best choice is to perform the venipuncture on the opposite extremity. If the patient has I.V. access in both arms, turn off any I.V. fluids for a minimum of 2 minutes and draw the sample from a site below the level of the I.V.

Edematous sites and obesity

Sites that are swollen from an injury or I.V. infiltrate may be contaminated with increased tissue fluid or have altered blood composition. Swelling in the arm or obesity can make it difficult to locate a viable vein for venipuncture. If the patient is obese, use a longer tourniquet or extra-large BP cuff too avoid patient discomfort.

Tourniquet application

Believe it or not, tourniquet application is one of the most important steps in proper venipuncture. You should place a tourniquet 3 to 4 in (7.6 to 10.2 cm) above the site, tying it tight enough to slow venous blood flow and loose enough not to impede arterial blood flow. Tie the tourniquet using a quick release knot, with the ends pointed away from the venipuncture site and the loop pointed toward the site. If the ends are pointing toward the insertion site, they can easily get in the way and cause contamination. Remember, you shouldn't leave the tourniquet in place for more than 1 minute. Also, never place a tourniquet over a wound or acute injury. It's perfectly acceptable to place a sleeve or towel under

the tourniquet to protect the patient from skin tears and discomfort. This should be a key nursing intervention when you're drawing blood from an older adult patient with frail skin.

Learning curve

As hospitals and other care centers decentralize ancillary services, nurses are being called on more frequently to draw blood. Transitional and home care nurses often perform phlebotomy procedures, but rarely receive adequate education to do so. Procedural errors during the preanalytical phase are largely responsible for inaccurate lab results that lead to the need for additional blood draws or improper treatment. However, there's little room in nursing curricula to add more skills content. This leaves phlebotomy as a topic for continuing education. Take the initiative to educate yourself about proper phlebotomy techniques and equipment before you're asked to draw blood. ■

REFERENCES

Appold K. Drawing blood from drug addicts. *Journal of Continuing Education Topics and Issues*. 2014;16(3):96-98.

Daugherty K. Best practices in phlebotomy...in an ACO environment. *MLO Med Lab Obs*. 2012;44(4):20-22.

Downing J, Yoder LH, Kirksey KM. A qualitative study of phlebotomy device selection. *Medsurg Nurs*. 2011;20(6):291-295.

E-Phlebotomy Training. Order of draw explained: clearing out any confusion. www.ephlebotomytraining.com/phlebotomy-order-draw-explained/.

Garza D, Becan-McBride K. *Phlebotomy Handbook*. 9th ed. Upper Saddle River, NJ: Pearson; 2014.

McCall RE, Tankersley CM. *Phlebotomy Essentials*. 6th ed. Philadelphia, PA: Wolters Kluwer; 2016.

Ropp P. Steps to lowering blood culture contamination rates in the ED. *Nurs Manag*. 2012;43(2):10-12.

Vincent E. Issues of infection prevention and control in phlebotomy. *Practice Nursing*. 2015;26(8):402-406.

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