

Blood Specimen Collection: Venipuncture Vacuum-Extraction Method (Home Health Care) - CE

ALERT

Strictly adhere to guidelines for hand hygiene, standard precautions, and site preparation to minimize the risk for a health care-associated infection.¹²

Obtain appropriate laboratory tubes before the home visit. Contact the laboratory to validate the proper tubes and the volume required to process the specimens, if needed.

Carefully assess a patient who is at risk for venous collapse from the vacuum-extraction system. Consider that young children, older adults, and those who have received treatments damaging to the veins may not be able to withstand the vacuum system pressure or may require a smaller tube. Pressure from a larger tube may cause vein wall damage, leading to infiltration.

Don appropriate personal protective equipment (PPE) based on the patient's signs and symptoms and indications for isolation precautions.

OVERVIEW

Observing infection control standards is essential when obtaining a blood specimen. Appropriate safety devices should always be used. Standards should be followed to minimize the risk of exposure to blood-borne pathogens, including use of safer medical devices, such as needleless devices and shielded-needle devices.⁴ Venipuncture requires an aseptic no-touch technique.⁶ Veins used for venipuncture should be repeatedly assessed for infiltration, extravasation, infection, or phlebitis using standardized scales.⁹ Pain, burning, stinging, erythema, warmth, and subcutaneous swelling should be reported to the practitioner.

A vacuum-extraction blood sampling system uses vacuum force to draw blood into vacuum-sealed test tubes. Venipuncture with these systems involves inserting a hollow-bore needle into the lumen of a vein to obtain a specimen. A hollow-bore straight needle or winged-butterfly needle with a short length of tubing is connected to a collection barrel housing a rubber-sheathed needle with a Luer lock. The rubber-sheathed needle housed in the collection barrel is used to puncture the rubber top of a vacuum test tube after the connecting hollow-bore needle rests in the vein's lumen. Once the rubber top is punctured, the vacuum is initiated within the tube, and a set volume of blood is extracted from the patient's vein.

Test tubes used with these systems require special care and storage and should be maintained in an upright rack. Some tubes contain fixative agents that require an exact amount of blood to be drawn into the tube. Tubes without fixative agents allow variable amounts of blood to be drawn. Some tests require less blood than others; therefore, the correct volume must be drawn using the correct size tube so the patient has less risk of anemia⁸ and venous injury. Some fixatives are more likely to contaminate other specimens when tubes are sequentially engaged in the rubber-sheathed needle. The laboratory should be contacted to find out the correct order for insertion of collection tubes into the vacuum system needle. Some specimens have special requirements before or after specimen

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collection (e.g., the tube must be chilled, or the specimen must be placed in a mixture of ice and water after the blood draw).

Because limited venous access may be a life-threatening complication of venipuncture, maintaining the vein's integrity is essential. A patient with veins that may collapse or become injured from the vacuum pressure may require an alternate method of venous sampling. In addition, a patient's veins may be difficult to locate because of unusual anatomy, trauma from repeated phlebotomy, or edema.

Tourniquets should be used with caution. Prolonged tourniquet application may cause stasis, changes in blood components, and hemoconcentration. Infection control standards require that tourniquets be single use.⁶ Bacterial contamination of reused tourniquets, including with multidrug-resistant organisms, is a common finding.²

When preparing a specimen label, the health care team member should confirm the patient's identifying information. A laboratory cannot process a mislabeled specimen or one that does not arrive in a timely manner. Errors in any aspect of blood sampling may require repeat samples, placing the patient at risk for blood loss and venous injury.

Venipuncture can be painful, and a patient may experience anxiety or fear before the procedure. A calm approach and skilled technique may help limit a patient's aversion to venipuncture. Anxiety may be assuaged by communicating with the patient about how to help relieve his or her concerns.

PATIENT AND CAREGIVER TEACHING

- Explain the purpose of collecting the blood specimen and the method to be used.
- Explain how a tourniquet, antiseptic swab, and venipuncture may feel.
- Explain that pressure is applied to the venipuncture site after the needle is withdrawn, without bending the arm.
- Instruct the patient to apply pressure to the site if he or she is able. For a patient who has a bleeding disorder or who is undergoing anticoagulant therapy, explain that holding pressure for a longer time may be required to achieve clotting.
- Instruct the patient and caregiver on the signs and symptoms of a vasovagal response.
- Instruct the patient and caregiver on the signs and symptoms of complications to report to the health care team member or practitioner.
 - Persistent or recurrent bleeding or expanding hematoma at the venipuncture site after initial hemostasis is achieved
 - Infection
 - Phlebitis
- Encourage questions and answer them as they arise.

PROCEDURE

1. Perform hand hygiene and don PPE as indicated for needed isolation precautions.
2. Introduce yourself to the patient.
3. Verify the correct patient using two identifiers.
4. Explain the procedure to the patient and ensure that he or she agrees to treatment.
5. Verify the practitioner's order and assess the patient for pain.

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6. Consult with the practitioner to minimize venipuncture and conserve blood by substituting point-of-care testing for venipuncture, using low-volume collection tubes, performing all daily tests during one venipuncture, and eliminating routine testing.⁸
7. Assess the patient's history for risks associated with venipuncture.

- a. Anemia
- b. Anticoagulant therapy
- c. Low platelet count
- d. Bleeding disorder
- e. Venous collapse
- f. Traumatic venipuncture
- g. Phlebitis

8. Determine the patient's ability to cooperate with the procedure, his or her experience with blood specimen collection, and the need for caregiver assistance.
9. Review the patient's history for adverse reactions to previous venipuncture, including a vagal or seizure response.² Ask the patient if such reactions have occurred.
10. Assess the patient for anxiety or fear related to the procedure. Provide reassurance and ask how to make the patient more comfortable.²
11. Assess the patient for an allergy or sensitivity to antiseptic or analgesic agents or latex, if latex is used in any equipment (e.g., collection barrels, sheathed needles, tourniquets, bandages, specimen tube tops, gloves)³ Assess the patient for a seafood sensitivity if an iodine skin preparation is to be used.
12. Assess the patient for contraindicated venipuncture sites, such as sites affected by IV access, hematoma, signs of phlebitis or previous infiltration, radiation, tissue injury or infection, or current or planned hemodialysis access.⁵ Other contraindicated sites include an upper extremity on the side of a mastectomy or another lymphatic system compromise and an upper extremity on the affected side of a cerebrovascular accident.
13. Assess the patient's hydration and perfusion status.
14. Review the anatomy of the venous system and the organization's practice for the preferred veins for venipuncture.
15. Review the manufacturer's instructions for using a vacuum-extraction system.
16. Determine whether cautions or preconditions must be met before the specimen can be collected.

Rationale: Specimen timing can be related to medication administration, nutritional intake, procedures, or diagnostic testing.

17. Plan to aspirate only the amount needed to avoid blood loss.⁸
18. Identify special requirements for the laboratory specimen, such as whether the specimen must be placed on an ice pack.
19. Review the laboratory's requirements for labeling and handling the specimens.
20. Prepare an area in a clean, convenient location and assemble the necessary supplies. Replace equipment with nonlatex equipment if the patient has a latex allergy.

Ensure that all work surfaces used to hold blood-drawing equipment have been disinfected to protect the patient and the specimen from contamination.¹⁵

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Ensure that tube expiration dates have not passed, that tube labels allow the blood to be clearly visible when aspirated (except for tubes that shield light-sensitive specimens), that tubes have no breaks or sharp edges, and that tubes have been stored upright at the correct temperature (e.g., some fixative agents require refrigeration).

21. Provide privacy for the patient.
22. Ensure proper lighting to aid observation of vein contours and colors.
23. Assist the patient to a comfortable position and have him or her remove food as well as gum and mints from his or her mouth.

Rationale: An empty mouth reduces the risk of injury to the patient if he or she experiences lightheadedness or a seizure or faints from vagal stimulation.

Be prepared to manage a vasovagal response or a seizure if the patient is at risk.²

24. Support the patient's selected upper extremity and extend it to form a straight line from the shoulder to the wrist. Place a small pillow or towel under the upper extremity, if needed.

Rationale: Proper patient positioning helps stabilize the extremity.

25. Place a clean cloth or paper drape under the patient's upper extremity.¹⁵
26. Identify the best sites for venipuncture per the organization's practice, avoiding contraindicated sites.

a. Choose a vein that is easily visible without applying a tourniquet; is straight and does not divert into another branch;¹⁵ has no swelling, hematoma, phlebitis, infection, or infiltration; and has not had recent venous access or venipuncture. Typically, the median cubital vein is the easiest to puncture because it lies between the muscles.¹⁵

Obtaining blood samples from an extremity with a peripheral access device in place may cause specimen contamination or hemolysis. Obtain the sample distal to the peripheral access device, if applicable.⁸

Venipuncture where a vein branches increases the risk of a hematoma. Puncturing the basilic vein is associated with damage to an underlying artery or nerve and is typically more painful.¹⁵

Consider that a vein in the antecubital region yields less hemolysis.

- b. If needed, apply a single-use tourniquet⁸ approximately 7.5 to 10 cm (3 to 4 in)¹³ above the selected venipuncture site. Encircle the extremity and pull one end of the tourniquet tightly over the other, looping one end under the other. Apply the tourniquet so it can be removed by pulling one end with a single motion.

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Rationale: A tourniquet blocks venous return to the heart from the extremity, causing the veins to dilate for easier assessment.

Ensure that the tourniquet is not so tight that it impedes arterial blood flow.⁶

Apply a tourniquet loosely or do not use a tourniquet with a patient who has a history of bleeding, is easily bruised, has fragile skin, or has diminished circulation.⁶

Do not keep the tourniquet on the patient longer than 1 minute² before the procedure is performed. Prolonged tourniquet application causes stasis, changes in blood components, and hemoconcentration.

If a blood pressure cuff is used as a substitute for a tourniquet, inflate the cuff less than 60 mm Hg² and leave it inflated for 1 minute or less.⁸

c. Instruct the patient to make a fist without vigorously opening and closing it.

Rationale: Making a fist facilitates the distention of veins by forcing blood up from the distal veins. Vigorously opening and closing the fist may cause erroneous laboratory test results from hemoconcentration and changes to the blood components.¹³

d. Quickly inspect the vein distal to the tourniquet to confirm the selected venipuncture site.

Do not select a vein on the underside of the wrist.

e. Palpate the selected vein and consider a firm vein that rebounds. Do not select a vein that feels rigid or cordlike or that rolls when palpated.

Rationale: A patent, healthy vein is elastic and rebounds on palpation. A thrombosed vein is rigid, rolls easily, and is difficult to puncture.¹⁵

f. If the selected vein cannot be palpated or viewed easily, remove the tourniquet and apply a warm compress over the upper extremity or instruct the patient to turn his or her hand downward to make observation of the veins easier. Wait for at least 2 minutes¹ after removing the tourniquet. Then reapply it to assess the area for increased local dilation or to select a more appropriate alternate vein.

Rationale: Removing the tourniquet if a vein cannot be palpated or viewed minimizes discomfort to the patient and prevents inaccurate test results. Warming increases arterial blood flow, making veins more prominent.⁶

g. Release the tourniquet.

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If unable to locate an acceptable vein after reapplying the tourniquet, contact the practitioner for further instructions.

27. To prevent equipment incompatibility, prepare the collection equipment using tubes, holders, and needles from the same system and manufacturer.¹⁵

Rationale: Combining systems may injure the patient or yield incorrect test results through hemolysis, needle disengagement, or inadequate tube filling.

a. Choose an appropriate-size needle (21- to 23-G²) that is small enough to fit in the vein but does not cause hemolysis.

Rationale: Needles that are 23-G or smaller increase the risk of hemolysis.² Needles that are 25-G or smaller are more likely to cause clotting.¹⁵ Needles larger than 19-G may cause hemolysis related to increased blood flow turbulence.¹⁵

b. Ensure that a double-ended straight or winged-butterfly venipuncture needle² equipped with a safety device is securely attached to the vacuum-extraction system collection barrel. Alternatively, and if required, remove the sterile cap from the rubber sheathed end of the double-ended straight or winged-butterfly needle and attach the needle to the collection barrel. If a single-ended straight or winged-butterfly needle is used, attach the needle securely to a collection barrel housing a sheathed needle. Keep the needle hub and the connection sites sterile.

Rationale: Safety devices can decrease the risk of needlestick injury by 75%.¹⁵

Vacuum-extraction system sheathed needles are considered sharps that are associated with needlestick injuries, and they must be disposed of in a sharps container that is within arm's reach and is large enough to allow disposal of the entire device without detaching the needle.⁴ The sheathed needle's flexible cover prevents blood from flowing when the needle is not engaged in a vacuum tube; however, the sheath does not prevent a needlestick injury if a finger inadvertently enters the collection barrel.

Use a new collection barrel for each patient. Do not detach the needle from the collection barrel for disposal after use.¹⁵

c. Rest the proper blood specimen tube inside the collection barrel. Wait to puncture the rubber stopper with the sheathed needle.

Rationale: Puncturing the stopper before the needle is in the vein causes the tube to lose its vacuum.

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Use the order of draw specified by the laboratory that processes the specimens. Some laboratories vary the order from national recommendations.

Collect specimens for coagulation studies before collecting specimens that require a tube containing a clot activator or other additive. If using a butterfly needle with tubing, use a nonadditive tube to collect the air from the tubing before engaging a coagulation tube.⁸

28. Find the selected venipuncture site again.
29. Perform hand hygiene and don gloves and appropriate PPE based on the patient's signs and symptoms and indications for isolation precautions.
30. Prepare the venipuncture site.

- a. If the skin needs cleansing, use soap and water first, then allow to dry completely.⁷
- b. Use an organization-approved antiseptic for routine venipuncture. A solution of chlorhexidine is preferred.¹⁰

- i. Prepare the insertion site with greater than 0.5% chlorhexidine in alcohol solution^{6,14} using a back-and-forth motion for a minimum of 30 seconds¹¹ and allow to dry completely.
- ii. If chlorhexidine is contraindicated, use tincture of iodine or an iodophor. Allow iodophors to dry a minimum of 90 to 120 seconds.^{7,10}

- c. Do not touch the site after preparation.

31. Obtain the blood sample.

- a. Reapply the tourniquet and find the vein again.
- b. Remove the cap from the venipuncture needle, maintaining the needle's sterility. Warn the patient to expect to feel a stick.

Discard the needle and the collection barrel in a sharps container and prepare a new venipuncture set if contamination occurs.

- c. Place the thumb or forefinger of the nondominant hand distal to the venipuncture site and gently pull and stretch the patient's skin until it is taut and the vein is stabilized.

Rationale: Gently pulling and stretching the patient's skin helps stabilize the vein and prevent rolling during needle insertion.

- d. Hold a butterfly needle, if used, by the wings; hold a straight needle, if used, at the hub. Insert the needle at a 30-degree angle¹⁵ from the patient's upper extremity with the bevel facing upward, just distal to the exact site selected for vein penetration.

Rationale: The smallest and sharpest point of the needle should puncture the skin first to reduce the chance of penetrating the sides of the vein during insertion. Keeping the bevel up causes less trauma to the vein. Entering the

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skin distal to the vein prevents unanticipated vein puncture, which may result in inadequate blood specimen retrieval and hematoma.

e. Slowly insert the needle into the vein.

Rationale: Inserting the needle slowly prevents puncture through the opposite side of the vein.

Look for blood return in the tubing of a butterfly needle, if used.

f. Grasp the collection barrel securely and advance the first specimen tube into the sheathed needle inside the barrel so the needle pierces the tube's rubber top. Use caution not to advance the needle farther into the patient's vein.

Rationale: Pushing the sheathed needle through the rubber top breaks the vacuum, pulling blood into the tube. If the needle advances too far, it may transverse the vein through the opposite wall into the subcutaneous tissue.

Improper needle insertion can result in incomplete puncturing of the rubber top.

g. Look for the rapid flow of blood into the tube.

Rationale: Failure of blood to appear indicates that the vacuum is lost or that the needle is not in the vein.

h. After the specimen tube is filled to the correct level for the ordered tests (indicated by the marking on the tube or by the laboratory's practice), grasp the collection barrel firmly and remove the specimen tube, using caution not to disrupt the venipuncture needle's location in the vein.

Rationale: Insufficient blood draw volume may lead to inaccurate results.

Rationale: Grasping the collection barrel prevents the venipuncture needle from advancing or dislodging. The tubes should be filled to the correct level because additives in certain tubes are measured in proportion to the filled tube.

i. Insert and remove additional specimen tubes in the laboratory-directed order into the collection barrel, engaging the sheathed needle, as needed.

j. If the tubes contain additives, gently invert them back and forth immediately after they are filled with blood. Do not shake them.

Rationale: Inverting the tube gently ensures the additives are properly mixed to prevent erroneous test results. Shaking may cause lysis of cells, resulting in inaccurate test results. Tubes must be inverted three to eight times (depending on the additives) to ensure proper mixing.¹⁵

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k. If the blood is flowing sufficiently into the tubes, release the tourniquet just before filling the last specimen tube. Wait to release the tourniquet until the last tube is almost full if blood flow is slow. Fill the last tube and remove it from the collection barrel.

Rationale: Releasing the tourniquet before filling the last specimen tube reduces bleeding at the site when the needle is withdrawn.

l. Apply a sterile gauze pad over the venipuncture site without applying pressure. Disconnect the collection tube to break the vacuum and quickly but carefully withdraw the needle from the vein, activating safety mechanisms to protect from accidental needlesticks.

Rationale: Applying pressure before removing the needle can cause discomfort and injury. Breaking the vacuum and carefully removing the needle minimizes discomfort and vein trauma.

m. Immediately apply pressure over the venipuncture site with gauze until the bleeding stops. Observe the site for hematoma or bleeding. Instruct the patient to help apply pressure if he or she is able.

Rationale: Direct pressure minimizes bleeding and prevents hematoma formation. A hematoma may cause compression and nerve injury.

A patient who has a bleeding disorder or who is undergoing anticoagulant therapy may require holding pressure for several minutes until the bleeding stops.

32. Immediately discard the collection barrel, needle, and tubing in a sharps container. Do not recap needles or attempt to remove the needle from the collection barrel.

Rationale: Discarding collection barrel, needle, and tubing prevents cross-contamination from needlesticks and contact with blood.

33. Inspect the venipuncture site for bleeding. If no bleeding is detected, apply gauze with tape or an adhesive bandage.

Rationale: Applying gauze with tape or an adhesive bandage keeps the venipuncture site clean and controls any final bleeding or oozing.

Instruct the patient not to bend his or her arm.

34. Check the collection tubes for any sign of external contamination with blood. Decontaminate the tubes, if necessary, per laboratory standard.

Rationale: Decontamination prevents cross-contamination and reduces the risk of exposure to pathogens present in blood.

35. Assist the patient to a comfortable position for several minutes.

36. In the presence of the patient, label the specimen per the organization's practice.¹²

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37. Prepare the specimen for transport.

- a. Place the labeled specimen in a biohazard bag.
- b. If the specimen requires ice for transport, place the specimen in a biohazard bag, then place the bag with the specimen into a second biohazard bag filled with ice slurry.

Rationale: Placing the specimen in a separate bag protects the label from being damaged.

38. Reassess the venipuncture site to determine whether bleeding has stopped or a hematoma has formed.

39. Assess the patient for tolerance of the venipuncture, including signs of anxiety or fear.

Rationale: A patient may require more venipunctures in the future. Addressing concerns and letting the patient express emotions may reduce any aversion to future venipunctures. Documenting the patient's response allows for improved care planning for future venipunctures.

40. Assess the patient for infection or phlebitis using standardized scales.⁹ Report pain, burning, stinging, erythema, warmth, or subcutaneous swelling to the practitioner.

41. Report adverse events in an incident-reporting system.¹⁵

42. Discard supplies, remove PPE, and perform hand hygiene.

43. Document the procedure in the patient's record.

44. Transport the specimen to the laboratory immediately after leaving the patient's home.

Rationale: Sending the specimen immediately to the laboratory helps ensure accurate results.

EXPECTED OUTCOMES

- Vein accessed successfully
- Hemostasis achieved
- Adequate laboratory specimen obtained for testing
- Aseptic technique achieved
- Insertion site remains free of bruising or hematoma
- Sample appropriately labeled and transported immediately after home visit

UNEXPECTED OUTCOMES

- Hematoma formation at venipuncture site
- Needle insertion through vein
- Ecchymosis
- Fainting
- Development of infection or phlebitis at venipuncture site
- Injury of nerve or adjacent tissue
- Vasovagal response, including dizziness or fainting
- Loss of consciousness and subsequent seizure
- Inability to achieve hemostasis
- Inadequacy of laboratory specimen for testing

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- Hemolyzed laboratory specimen
- Failure to maintain aseptic technique
- Failure to obtain blood specimen
- Blood spill
- Needlestick injury

DOCUMENTATION

- Patient and caregiver teaching
- Patient's progress toward goals
- Assessment of pain, treatment if necessary, and reassessment
- Date and time of venipuncture
- Number and location of attempts
- Samples obtained and disposition of specimens
- Location and description of venipuncture site
- Abnormal laboratory test results and related interventions
- Communication of laboratory results to practitioner
- Orders received from practitioner
- Inability to obtain sample
- Patient's tolerance of venipuncture
- Complications and related interventions
- Emergency measures

OLDER ADULT CONSIDERATIONS

- Older adults have fragile veins that are easily traumatized during venipuncture. Applying a warm compress may help with obtaining a blood sample. Using a small-gauge needle may also be beneficial.
- The appropriate-size vacuum tube should be used. Large tubes may exert too much pressure on an older adult's veins.

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ADDITIONAL READINGS

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*In these skills, a "classic" reference is a widely cited, standard work of established excellence that significantly affects current practice and may also represent the foundational research for practice.

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Elsevier Skills Levels of Evidence

- Level I - Systematic review of all relevant randomized controlled trials
- Level II - At least one well-designed randomized controlled trial
- Level III - Well-designed controlled trials without randomization
- Level IV - Well-designed case-controlled or cohort studies
- Level V - Descriptive or qualitative studies
- Level VI - Single descriptive or qualitative study
- Level VII - Authority opinion or expert committee reports

Supplies

Ensure that all necessary supplies and durable medical equipment are available before the home visit.

- Adhesive bandage or tape
- Antiseptic agent for skin preparation (per the organization's practice)
- Appropriate-size sterile double-ended straight or winged-butterfly needle or single-ended needle with collection barrel with sheathed needle (with safety devices)
- Collection barrel with Luer lock adapter (for Luer lock syringe)
- Gloves, sterile gloves, and PPE, as indicated
- Ice pack and additional occlusive bag, if needed
- Identification labels with proper patient identifiers
- Laboratory requisition (appropriate patient identification, date, time, and name of test)
- Occlusive biohazard bag
- Approved container for delivery of specimen to laboratory
- Single-use tourniquet
- Small pillow or folded towel, or chair with special arm extension
- Sterile gauze pads
- Vacuum blood tubes
- Warm compress, if needed
- Sharps container

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