QUALITY ASSURANCE IN PHLEBOTOMY

- PREANALYTIC CONSIDERATIONS
- SPECIMEN HANDLING
- SPECIMEN PROCESSING

PREANALYTIC CONSIDERATIONS

- In addition to the technical skills necessary to collect a blood specimen, anyone who collects blood specimens must be able to recognize
- problem sites,
- identify procedural error risks,
- address certain patient conditions, and
- handle patient complications associated with blood collection to avoid or minimize any negative impact

Problem Sites

- Burns, Scars, and Tattoos area should be avoided
- **Damaged Veins:** Sclerosed (hardened) or thrombosed (clotted) viens
- **Edema**, swelling caused by the abnormal accumulation of fluid in the tissues, makes veins harder to locate
- **Hematoma** A swelling or mass of blood that escaped from a vein during or following venipuncture is called a hematoma
- **Mastectomy** Lymph node removal, typically part of the procedure, can cause lymphostasis (stoppage of lymph flow), which makes the arm susceptible to swelling and infection

Vascular Access Devices (VAD)

- Only specially trained personnel should draw blood from a VAD (ventricular access device), although a phlebotomist may assist by transferring the blood to the appropriate tubes.
- Each of the following is a type of VAD that a phlebotomist may encounter
- **Arterial line:** located in the radial artery and used to provide continuous blood pressure measurement.
- may also be used to collect blood gases and other blood specimens

- **Arteriovenous (AV) shunt or fistula**: created by a surgical procedure that permanently fuses a vein and artery together to provide access for dialysis.
- The connection forms a loop that can usually be easily seen.
- A vibration called a “thrill” is felt when it is palpated.
- **Heparin or saline lock:** a catheter connected to a stopcock, or a cap with a diaphragm, through which medication is given or blood drawn.
- typically placed in a lower forearm vein.
- Either type may be flushed with heparin to keep it from clotting.
- Heparin can adhere to the tubing, so a 5-mL discard tube should be collected first if drawing blood from either type.

- **Intravenous line:** Tubing connected to a catheter inserted in a vein and used to administer fluids.
- It is best not to draw blood specimens from an arm with an IV line, especially above the IV access site, because IV fluid can contaminate the specimen and affect test results.
- A previous IV access site also should not used for venipuncture within 24 to 48 hours of when an active IV line was removed, because it also is a potential source of error in testing.
- If no other site is available, draw the specimen below the IV access site. Follow facility protocol.

- **Central vascular access device (CVAD) or indwelling line:**
- a line inserted into a main vein or artery that is used primarily to administer fluids and medications, monitor blood pressure, and draw blood.
- Most CVADs are routinely flushed with heparin or saline to prevent clotting, so a small amount of blood must be drawn from the line and discarded prior to collecting blood specimens.
- Drawing coagulation specimens from CVADs is not recommended.

Procedural Error Risks

- **Hematoma formation:** rapid swelling at or near the venipuncture site due to blood leaking into the tissues
- **Iatrogenic anemia:** anemia as a result of treatment (e.g., frequent blood draws or removing large quantities at a time). Only minimum amounts of blood should be drawn from infants
- **Inadvertent arterial puncture:** accidentally sticking an artery
- **Infection of the site:** adverse effects of bacterial multiplication, use aseptic techniques
- **Nerve injury:** results from poor site selection, inserting the needle too deeply or quickly, patient movement on needle insertion, excessive or lateral needle redirection or blind probing

- **Reflux:** backflow of blood from the tube into the patient's vein that can occur if blood in the tube is in contact with the needle during a blood draw.
- To prevent reflux, the patient's arm must be in a downward position so that the collection tube fills from the bottom up.

- **Vein damage:** scar buildup that can result from many venipunctures in the same area for an extended period, improper redirection of the needle, or probing.
- Vein damage can impair vein **patency and make it difficult** to perform subsequent venipunctures

Patient Conditions and Complications

- Allergies to supplies or equipment
- Excessive bleeding
- Fainting
- Nausea or vomiting
- Obese patients:
- **Pain:** A slight amount of pain is expected during a routine venipuncture or capillary puncture.

- **Petechiae:** When a tourniquet is applied to certain individuals, tiny red spots called petechiae appear on the arm below it. The spots are actually minute amounts of blood that escape from the capillaries and come to the surface of the skin as a result of platelet abnormalities or a defect in the capillary walls

- **Seizures/convulsion:** Discontinue blood collection immediately if a patient has a seizure or goes into convulsions.
- Hold pressure over the site, if possible

CAPILLARY SPECIMEN COLLECTION

- Drops of blood for testing can be obtained by puncturing the capillary bed of the skin with a lancet or other sharp device.
- especially useful in pediatrics where removal of larger quantities of blood can have serious consequences.
- Collection sites include the fingers of adults and children over the age of 2 and the heels of infants

- **Alcohol, Gauze, Bandages**
- Lancets

Warming Devices

- Warming the site increases blood flow up to seven times and is especially important when performing heel sticks.
- A towel or diaper dampened with warm water can be used; however, water temperature must not exceed 42°C or it could scald the patient.
- **Microcollection Tubes**
- **Sealants:** Sealants are claylike substances used to seal one end of microhematocrit tubes

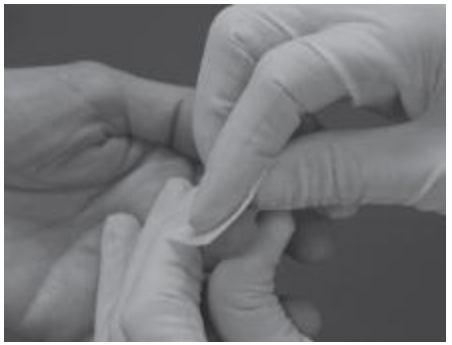
Capillary Order of Draw

- 1. EDTA specimens
- 2. Other additive specimens
- 3. Serum specimens

Indications for Capillary Puncture

- practical alternative to venipuncture (Small volume required)
- not appropriate for dehydrated patients with poor circulation to the extremities
- Capillary puncture can be appropriate under circumstances
  - There are no accessible veins.
  - Available veins are fragile or must be saved for other procedures such as chemotherapy.
  - The patient has thrombotic or clot-forming tendencies.
  - Blood is to be obtained for POCT procedures such as glucose monitoring
  - Infants have a small blood volume, so capillary puncture preferred
  - Infant or child venipuncture is difficult and can damage veins
  - An infant or child can be injured by the restraining method used during venipuncture.
  - Capillary blood is the preferred specimen for some tests, such as newborn screening tests

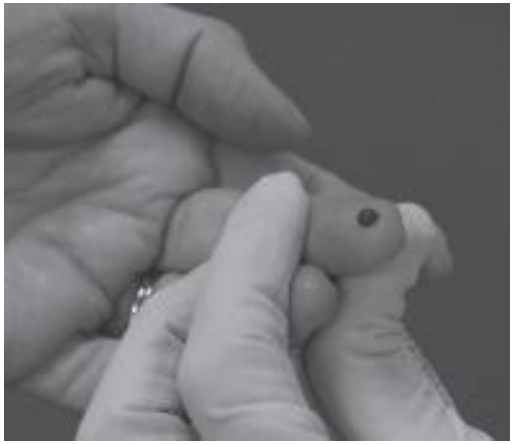
CAPILLARY PUNCTURE PROCEDURES
(finger sticks & Heel sticks)

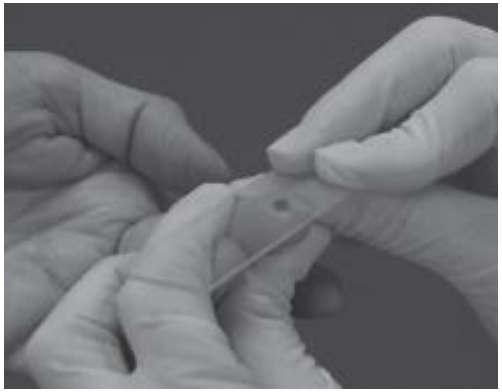


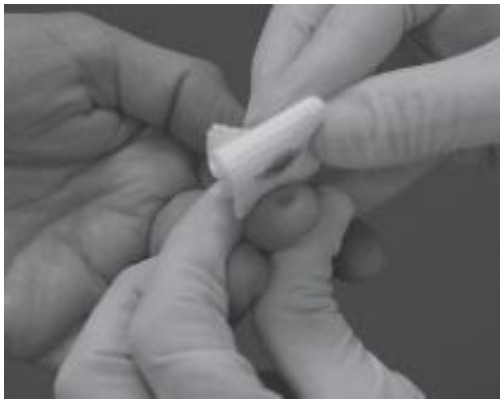
PROCEDURE 2-4. FINGERSTICK PROCEDURE

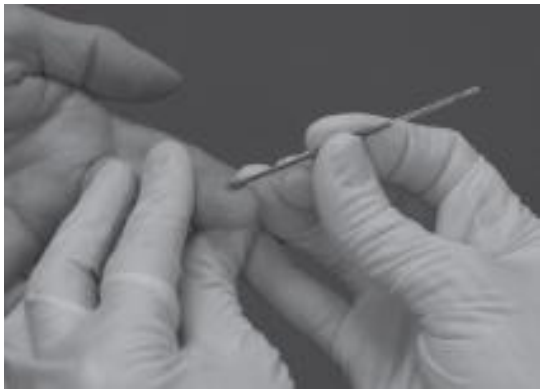
- Step 1: Review and Accession Test Request
- Step 2: Approach, Identify, and Prepare Patient
- Step 3: Verify Diet Restrictions and Latex Sensitivity
- Step 4: Sanitize Hands and put on gloves
- Step 5: Position Patient
- Step 6: Select the Puncture/Incision Site
- Step 7: Warm the Site if Applicable
- Step 8: Clean and Air Dry Site
- Step 9: Prepare Equipment
- Step 10: Puncture the Site and Discard Lancet/Incision Device

- Step 11: Wipe Away the First Blood Drop
- Step 12: Fill and Mix Tubes/Containers in the Order of Draw
- Step 13: Place Gauze and Apply Pressure
- Step 14: Label Specimen and Observe Special Handling Instructions
- Step 15: Check the Site and Apply Bandage
- Step 16: Dispose of Used Materials
- Step 17: Thank Patient, Remove Gloves, and Sanitize Hands
- Step 18: Transport Specimen to the Lab



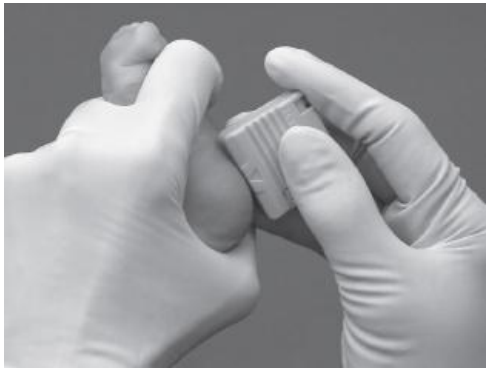






PROCEDURE 2-5. HEEL STICK PROCEDURE

- Step 1-8 (same as for finger stick)
- Step 9: Prepare Equipment
- Step 10: Puncture Site and Discard Lancet/Incision Device
- Step 11: Wipe Away the First Blood Drop
- Step 12: Fill and Mix Tubes/Containers in Order of Draw
- Step 13: Place Gauze and Apply Pressure
- Step 14: Label Specimen and Observe Special Handling Instructions
- Step 15: Check the Site
- Step 16: Dispose of Used and Contaminated Materials
- Step 17: Thank the Parent or Guardian, Remove Gloves, and Sanitize Hands
- Step 18: Transport Specimen to the Lab



Neonatal Bilirubin Collection

- Proper collection of infant bilirubin specimens is crucial to accuracy of test results.
- Specimens must be collected carefully to avoid hemolysis, which can falsely decrease results
- **Light breaks down bilirubin** and also falsely decreases results.
- To minimize light exposure, UV lights must be turned off and specimens collected as quickly as possible in amber microtubes.
- Protection from light is also required during transportation and handling

SPECIMEN HANDLING AND PROCESSING

- Proper handling and processing is critical for testing process

- Improper handling or processing can negatively affect test results and cause delays in patient care

- **Routine Handling**
  - Mixing Tubes
  - Transporting Specimens
  - Delivery Time Limits

- **Special Handling**
  - Analyte Protection
  - Chain of Custody

Routine Handling

Mixing Tubes

- Additive tubes must be mixed immediately after collection by inverting them from three to eight times depending on the additive type.

- Gentle inversion is essential, as vigorous mixing can cause hemolysis.

- Some tests, including potassium, magnesium, and most enzyme tests, cannot be performed on hemolyzed specimens

Transporting Specimens

- According to CLSI and Occupational Health and Safety Administration (OSHA) guidelines, blood specimen tubes must be transported to the laboratory in a plastic bag with a biohazard logo, a liquid-tight closure, and a slip pocket for paperwork
- Specimens sent via pneumatic tube system must be in zipper-type plastic bags to contain spills and protected from shock
- Specimens should be transported stopper up to reduce agitation, allow serum tubes to clot properly, and keep blood away from the stopper for safety reasons.
- Agitation or rough handling can cause hemolysis or lead to platelet activation that can affect coagulation tests.

Delivery Time Limits

- Stat specimens must be transported, processed, and tested immediately.
- Routine blood specimens, however, should ideally be delivered to the laboratory within 45 minutes of collection and centrifuged within 1 hour of arrival if serum or plasma is needed.
- (The maximum time limit for serum or plasma separation according to CLSI standards is 2 hours after collection.)
- Specimens for some tests such as cortisol and potassium must be separated sooner.

- Prompt separation is essential to minimize the effects of metabolic processes such as glycolysis.
- Unless an additive such as sodium fluoride chemically prevents it, cellular glycolysis lowers glucose levels in a specimen at a rate of up to 200 mg/L per hour until the serum or plasma is physically separated from the cells.
- Glucose specimens collected in sodium fluoride tubes are stable at room temperature for 24 hours and up to 48 hours if refrigerated.
- Other analytes affected by cellular metabolism include aldosterone, calcitonin, enzymes, and phosphorus

Special Handling

Analyte Protection

- Some analytes are significantly affected by exposure to light or certain temperatures and require special specimen handling to protect them.
- For example, cooling below body temperature (37°C) can cause precipitation or agglutination in some specimens.
- These specimens are typically collected in prewarmed tubes and transported in 37°C heat blocks or wrapped in special warming material.
- Other specimens require chilling to slow down metabolic processes that can negatively affect an analyte.
- These specimens must be transported in crushed ice and water slurry

- A number of analytes can be broken down by light, resulting in false low values.
- Bilirubin, for example, can decrease by up to 50% after 1 hour of light exposure.
- Specimens for these analytes must be protected from light by
  - being wrapped in foil,
  - being collected in amber microtubes (e.g., infant bilirubin),
  - or being placed in a light-blocking transport container.
- Required conditions must be maintained upon arrival in the laboratory.

Chain of Custody

- Specimens collected for forensic or legal reasons require a special documentation protocol called chain of custody.
- A special form accompanies the specimen from collection to reporting of test results.
- The form identifies and is signed by the individual submitting to the test, a witness (if applicable), and all who handle it including those who collect, process, and test it.
- The date and time of receipt and the condition specimen must also be documented by all who handle it.
- Anyone participating in the chain of custody of a specimen can be summoned to participate in a related legal proceeding

SPECIMEN PROCESSING

- Large laboratories typically have a specific area (often called central processing) where specimens are received, **accessioned (identified and logged), and prepared for** testing.
- This includes evaluating specimen suitability for testing and sorting by department and type of processing required.

Processing Safety

- Occupational Health and Safety Administration (OSHA) regulations require the use of PPE including
- gloves, fully closed fluid-resistant lab coats or aprons, and protective face gear such as mask and goggles with side shields, or chin-length face shields, by specimen processors.
- In addition, all procedures involving blood must be performed in a manner that minimizes splashing, spraying, splattering, and generation of droplets

Specimen Suitability

- Properly identified, quality specimens are required for valid test results.
- Poor-quality or improperly identified specimens are normally rejected for testing, and new specimens are requested.
- Chemistry specimens are most frequently rejected for hemolysis.
- Other reasons include collection in the wrong tube, failure to follow special timing or handling requirements, QNS (quantity not sufficient), and clotting in whole blood or plasma specimens.
- Rejection criteria, such as hemolysis, may not be identified until processing has begun or even completed.

Centrifugation

- Unless the test is performed on whole blood, a blood specimen must be centrifuged to separate the serum or plasma from the cells.
- For serum testing specimen must be completely clotted before centrifugation.
- Incomplete clotting results in latent fibrin formation
- At room temperature, complete clotting takes 30 to 60 minutes.
- Chilled specimens or patients with high white blood cell counts or are on anticoagulant medication may take longer to clot.
- Anticoagulated specimens can be centrifuged right away.
- After centrifugation, specimens should be visually checked.
- The presence of hemolysis, **icterus (yellow bilirubin pigment),** and cloudiness or turbidity that could indicate **lipemia** (increased lipids), or any abnormality, should be noted

Stopper Removal

- When tube stoppers are removed to obtain the serum or plasma, stopper removal devices or robotics should be used,
- the processor should be wearing a full-length face shield, or the tube should be held behind a splash shield.
- Stoppers should be covered with gauze or tissue to catch blood drops or aerosol that may be released during removal and pulled straight up and off;
- they should not be popped off by a thumb roll technique

Aliquot Preparation

- An **aliquot (portion of a specimen) is often created** when multiple tests are ordered on a single specimen.
- An aliquot is prepared by transferring a portion of the specimen into one or more tubes labeled with the same ID information as the specimen tube.
- Aliquot preparation has an inherent risk of error, and each specimen must be carefully matched with the corresponding aliquot tube to avoid misidentified samples.
- Once transferred into an aliquot tube, serum and plasma are virtually indistinguishable.
- Because there can be both types of specimens for the same patient, it is important to match the correct specimen with the aliquot tube of the requested test as well with the patient.

Aliquot Preparation

- Aliquot tubes should be capped as soon as they are filled to prevent evaporation and protected from heat and light.
- If testing is to be delayed, most samples can be refrigerated at 4°C for up to 8 hours.
- Samples that are not stable at 4°C may need to be frozen at -20°C. For example, alkaline phosphatase levels increase and lactate dehydrogenase levels decrease at higher temperatures.