The Golden Rule of Specimen Collection: The Patient Test Result is Only as Good as the Sample We Get
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Importance of Phlebotomist on the Health Care Team
• Phlebotomists are the “face of the clinical laboratory” to most patients
• Most pre-analytical errors are NOT detected by the testing process!
• How can the phlebotomist prevent pre-analytical errors?
  – By following the standards!

Self Quiz:
• Is it acceptable to draw blood without orders?
• What are the effects of underfilling anticoagulated tubes?
• How long after a blood transfusion should you wait to obtain blood for routine testing?
• Have you drawn blood above an IV site?
Self Quiz:

• Left the tourniquet on for more than 60 seconds?
• Asked a patient to pump his/her fist?
• Poured two tubes together?
• Misidentified a patient?
• Drawn blood from a foot or ankle without permission?
• What does CLSI stand for?

Common Sources of Pre-analytic Error:

• Patient Identification
• Inappropriate site – hematoma, fistula, mastectomy, ankle or foot (without doctor permission)
• Infection control – contaminated samples
• Procedural errors
  – Incorrect order of draw
  – Not mixing anti-coagulated tubes immediately after collection
  – Leaving tourniquet on too long
  – Improper equipment

Common Sources of Pre-analytic Error:

• Age
  – Pediatric patients
  – Neonates
  – Geriatric patients
• Exercise and activity
• Food
• Sex
• Menstrual cycle
• Previous procedures
• Failure to follow special handling when required
• Obesity
• Drugs
• Pregnancy
• Smoking
• Posture
• Circadian rhythms
Case #1:

- You are doing morning draws on a pediatric floor. When you walk up to the nurses’ station, you observe a staff member popping the top off 2 lavender tubes and pouring them together. When you explain this is unacceptable, the nurse gets angry and tells you that the child is a hard stick and “you just don’t understand pediatrics. What do you do? – group discussion

Tubes fail to fill:

- Amount of anti-coagulant used by manufacturers is calculated to give the proper blood/anti-coagulant ratio when completely filled
- Underfill and the patient may not get an accurate result
- CLSI states, you NEVER combine two tubes even if they contain the same anti-coagulant!

Tubes fail to fill:

- All tubes should be filled to stated volume
- Which tube is most sensitive to under filling?
  - Citrate – can lead to falsely elevated PTT and doctors adjusting anti-coagulant dose that puts patients at risk
- What about patients who are hard sticks?
  - Do finger stick if possible (CBC)
  - Stock tray with smaller volume tubes
Tubes fail to fill:

- How are heparinized tubes affected by underfilling?
  - Excess heparin may interfere with some chemistry analytes
- How are EDTA tubes affected by underfilling?
  - When ratio of EDTA/blood is too high, red cells shrink. This will affect the hematocrit, and mean cell volume (MCHC)

Case #2:

- You have a patient with small veins that collapse when using an evacuated tube system. You decide the appropriate equipment to use is a butterfly (winged infusion set) and syringe. You insert the needle and pull back on the syringe plunger. The blood drips very slowly into the syringe and it takes several minutes to collect sufficient volume for all the tests ordered.

Case #2:

- Since it took so long to collect enough blood, you decide to hurry so you fill the EDTA tube first, followed by the chemistry tube. What procedural errors did the phlebotomist make? How will the samples be affected?
Clots Happen:

- Testing personnel cannot always tell if there are small clots in the specimen. This can lead to erroneous results.
- Syringe draws are especially vulnerable to clotting.
- Any delay in transferring blood to anticoagulated tubes can cause clot formation.

Clots Happen:

- Why does clotting during collection occur?
  - Needle not properly positioned in vein, it takes a long time to collect blood into syringe
  - Can also occur using an evacuated tube system if anti-coagulated tubes are not mixed 5-10 times immediately after collection
  - Also necessary to mix when using tubes with clot activators
  - Capillary tubes are especially vulnerable to clotting, they should be mixed periodically during collection.

What about the Order of Draw?

- Filling EDTA tube first
  - Falsely elevated potassium or sodium
  - Chelates and decreases calcium and iron levels
  - Elevates PT and PTT
Hemolyzed samples:

- If red cells burst during collection, the blood being tested is not the same as circulating blood.
- Red blood cells contain 23 times more potassium as the liquid portion of the blood.
- Other tests affected by hemolysis – LDH, AST, ALT, phosphorus, magnesium, ammonia, RBC, hemoglobin and hematocrit

Avoiding Hemolysis:

- Avoid line draws – VADs, central venous catheters, PICC lines are designed for infusing fluids, not drawing blood
- Be prepared to do a venipuncture anyway, even the best technique cannot prevent hemolysis during line draws
- Avoid vigorous mixing
- Make sure alcohol dries

Avoiding Hemolysis:

- Don’t rim clots
- Place the needle properly
  - If needle rests halfway through the wall of the vein, vacuum can partially collapse vein
  - Remember – CLSI recommends the only needle adjustment is to insert further into vein, or withdraw slightly – NO probing!
- Pre-warm skin puncture sites
- Fill tubes to stated volume
Case # 3:

- You have an order for a blood culture x 2 on an adult patient with very difficulty veins. Your obtain only 12 ml of blood from the first site. What is the appropriate action?

Blood Cultures:

- Organisms in blood stream that cause septicemia can be in concentrations as low as one organism/ml of blood.
- Blood culture bottles should be filled to manufacturer’s recommendation.
- Most manufacturers recommend 20 ml of blood be distributed between 2 bottles – what happens when you only get 10 ml?

Blood Cultures:

- Correct action –
  - Place 10 ml in the AEROBIC bottle, not dividing the amount between the two bottles.
  - 98% of organisms that cause septicemia are a result of aerobic organisms or facultative anaerobes (can tolerate some aerobic environment).
How long after a blood transfusion should you wait to draw blood?

- Each healthcare facility should have an established policy that requires the laboratory to be informed when a patient has a transfusion.
- Several factors need to be considered – type and amount of blood product given, purpose of lab test ordered, and clinical setting.

- Generally it is best to perform phlebotomy when the patient's circulatory system is back in homeostasis.
- A patient who is bleeding is not in steady-state.
- Whenever possible postpone blood draws until bleeding has stopped.
- Exception – during massive transfusion monitoring cells counts and coagulation tests are an essential part of therapy.

- For evaluation of post-transfusion hemoglobin, hematocrit and platelet count – draw blood within 10-60 minutes post-transfusion.
- Alterations in chemistry tests post-transfusion are not usually a concern in a low-volume transfusion setting.
How long after a blood transfusion should you wait to draw blood?

- Following transfusion of large amounts of blood products the following may be seen:
  - Banked red cells show increases in hemoglobin, potassium LDH, and iron
  - Citrate may cause transient hypocalcemia
  - Following large volume transfusion – wait 12-24 hours before drawing chemistry tests
  - Know and follow your institution’s policy!

Following the Standards:

- Is it acceptable to draw above an IV site?
- According to CLSI standards
  - Whenever possible draw from opposite arm
  - For distal (below IV site collections
    - Ask authorized caregiver to turn off IV for at least 2 minutes
    - Apply tourniquet between IV and puncture site
    - Perform venipuncture
  - Drawing above (proximal) to an IV is not recommended and only attempted when all other possibilities have been exhausted – you risk contaminating the sample with IV fluids

Following the Standards:

- CLSI also recommends phlebotomists avoid drawing through IV lines infused with heparin
- If not possible, the line should be flushed with 5 ml of saline followed by the withdrawal and discarding of twice the dead space volume of the VAD for non-coagulation tests and six times the dead space volume for coagulation tests
Following the Standards:

- Precautions when using a tourniquet - According to CLSI, tourniquet application should not exceed more than one minute.
- Apply 3-4 inches above venipuncture site
- If tourniquet in place longer than two minutes – release and reapply just before performing puncture

Effect of Prolonged Tourniquet Application: Hemoconcentration

- A decrease in plasma volume which causes a simultaneous increase in RBC and other analytes
- Fist pumping – also not recommended by CLSI – can elevate potassium and ionized calcium

Order of Draw:

- Use for both plastic and glass tubes. All additive tubes must filled to their stated volume. Purpose is to prevent erroneous results due to additive carry-over.
Order of Draw:

- Blood culture
- Coagulation tube (blue)
- Serum tubes with or without gel (red or gold)
- Heparin tubes with or without gel (green and light green)
- EDTA tube with or without gel (lavender)
- Glycolytic inhibitor (e.g., gray)

Order of Draw:

- Note – when using a butterfly (winged infusion set) and a coagulation tube is the first needed, first draw a discard tube
- Discard tube is used to prime the tubing of the collection set to maintain proper blood/anti-coagulant ratio.
- Discard tube should be either a coagulation tube or non-additive tube

Site Selection According to CLSI:

- Preferred site is the antecubital fossa.
- When antecubital veins are not acceptable or unavailable, veins on back of hand also acceptable
- Sites to avoid:
  - Foot and ankle
  - Sclerosed or thrombosed veins
  - Site of previous hematoma
  - Side on which mastectomy has been performed
  - Arm with fistula, cannula or vascular graft
Questions?

[Image of a crowded stadium with a large "IOWA" banner]

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