

# PREANALYTICAL CONSIDERATIONS

## CHAPTER 9

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### overview

*The **preanalytical** (prior to analysis) phase of the testing process begins when a test is ordered and ends when testing begins. Numerous factors associated with this phase of the testing process if not properly addressed can lead to errors that can affect specimen quality, jeopardize the health and safety of the patient, and ultimately increase the cost of medical care. Since each blood collection situation is unique, in addition to possessing the technical skills needed to perform a blood draw, a phlebotomist must be able to recognize and address these factors when necessary to avoid or reduce any negative impact.*

### ADDRESSING THE CHAPTER OBJECTIVES

The learning objectives listed below cover key topics discussed in this chapter. Write an answer to each objective. All of the answers can be found in the textbook.

1. Define the key terms and abbreviations listed at the beginning of this chapter

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2. List and describe the physiologic variables that influence laboratory test results and identify the tests most affected by each one

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3. List problem areas to avoid in site selection, identify causes for concern, and describe procedures to follow when encountering each

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4. Identify and describe various vascular access sites and devices and explain what to do when they are encountered

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5. Identify, describe, and explain how to handle patient complications associated with blood collection

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6. Identify, describe, and explain how to avoid or handle procedural error risks, specimen quality concerns, and reasons for failure to draw blood

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## KEY TERM MATCHING

Match the key term with the best description.

### Key Terms

1. \_\_\_\_ A-line
2. \_\_\_\_ AV shunt/fistula/graft
3. \_\_\_\_ Basal state
4. \_\_\_\_ Bilirubin
5. \_\_\_\_ CVAD
6. \_\_\_\_ CVC
7. \_\_\_\_ Diurnal/circadian
8. \_\_\_\_ Edema
9. \_\_\_\_ Exsanguination
10. \_\_\_\_ Hematoma
11. \_\_\_\_ Hemoconcentration
12. \_\_\_\_ Hemolysis
13. \_\_\_\_ Hemolyzed
14. \_\_\_\_ Heparin/saline lock
15. \_\_\_\_ Iatrogenic
16. \_\_\_\_ Icteric

### Descriptions

- a. Abnormal accumulation of fluid in the tissues
- b. Blood loss to the point where life cannot be sustained
- c. Catheter located in artery, most commonly the radial
- d. Catheter with a stopcock or cap for administering medication or drawing blood
- e. Central vascular access device or indwelling line
- f. Central venous catheter or central venous line
- g. Decrease in blood fluid content with an increase in nonfilterable components such as like RBCs
- h. Destruction of RBCs and release of hemoglobin into the fluid portion of a specimen
- i. Happening daily, or having a 24-hour cycle
- j. Product of the breakdown of red blood cells
- k. Resting metabolic state of the body early in the morning after a 12-hour fast
- l. Surgical joining of an artery and vein
- m. Swelling or mass of blood caused by blood leaking from a blood vessel
- n. Term used to describe a specimen affected by hemolysis
- o. Term used to describe a specimen marked by jaundice
- p. Term used to describe an adverse condition due to the effects of treatment

**Key Terms**

1. \_\_\_\_ Implanted port
2. \_\_\_\_ IV
3. \_\_\_\_ Jaundice
4. \_\_\_\_ Lipemia
5. \_\_\_\_ Lipemic
6. \_\_\_\_ Lymphostasis
7. \_\_\_\_ Mastectomy
8. \_\_\_\_ Petechiae
9. \_\_\_\_ PICC
10. \_\_\_\_ Preanalytical
11. \_\_\_\_ Reference ranges
12. \_\_\_\_ Sclerosed
13. \_\_\_\_ Syncope
14. \_\_\_\_ Thrombosed
15. \_\_\_\_ Vasovagal syncope
16. \_\_\_\_ Venous stasis

**Descriptions**

- a. Breast excision/removal
- b. Clotted, or denoting a vessel that contains a clot
- c. Condition of increased lipid content in the blood
- d. Fainting
- e. Hard, cordlike, and lacking resilience
- f. Icterus, condition characterized by increased bilirubin
- g. Normal laboratory test values for healthy individuals
- h. Of, within, or pertaining to the inside of a vein
- i. Peripherally inserted central catheter
- j. Prior to analysis
- k. Sudden fainting due to a nervous system response to abrupt pain, stress or trauma
- l. Surgically implanted chamber attached to an indwelling line
- m. Stagnation or stoppage of the normal blood flow
- n. Stoppage or obstruction of normal lymph flow
- o. Term used to describe serum or plasma that is cloudy white due to lipid content
- p. Tiny, nonraised red spots appearing on patient's skin

## CHAPTER REVIEW QUESTIONS

- 1. The medical term for fainting is**
  - a. Edema
  - b. Exsanguination
  - c. Reflux
  - d. Syncope
- 2. It is best if drugs that interfere with blood tests are stopped**
  - a. 1 to 4 hours before the test
  - b. 4 to 24 hours prior to the test
  - c. 24 to 48 hours prior to the test
  - d. 48 to 72 hours prior to the test
- 3. Which of the following tests is most affected if collected from a crying infant?**
  - a. Bilirubin
  - b. Cholesterol
  - c. Lead level
  - d. White blood count
- 4. A hematoma may result from all of the following *except***
  - a. Inadequate pressure applied to the site following venipuncture
  - b. Penetration of the needle through the back wall of the vein
  - c. Releasing the tourniquet before needle withdrawal
  - d. Using a needle that is too big for the size of the vein
- 5. Results of this test have a direct correlation with the patient's age**
  - a. Blood culture
  - b. Creatinine clearance
  - c. Glucose
  - d. Hemoglobin
- 6. Which of the following specimen conditions would lead you to suspect that the patient was not fasting when it was collected?**
  - a. Cloudy serum
  - b. Pale yellow plasma
  - c. Reddish plasma
  - d. Yellowish brown serum
- 7. A phlebotomist needs to collect a plasma specimen for a coagulation test. The patient has an IV in the left arm near the wrist and a hematoma in the antecubital area of the right arm. Where should the phlebotomist collect the specimen?**
  - a. Above the IV
  - b. From the IV after it has been shut off for 2 minutes
  - c. Distal to the hematoma
  - d. All of the above are acceptable collection sites
- 8. A patient's arm is in anatomic position. There appears to be a loop under the skin between the wrist and the elbow. You feel a buzzing sensation when you touch it. What you are feeling is a**
  - a. Fistula
  - b. Implanted port
  - c. PICC
  - d. Sclerosed vein

- 9. While in the middle of drawing a blood specimen, your patient starts to faint. The first thing you should do is**
- Apply a cold compress to the patient's forehead
  - Grab the ammonia inhalant and wave it in front of the patient's nose
  - Have the patient lower the head and breathe deeply
  - Release the tourniquet and remove the needle
- 10. A patient has had a mastectomy on the left arm and has an IV midway down the right arm. Where is the best place to perform a venipuncture?**
- Above the IV on the right arm
  - Below the IV on the right arm
  - In the left antecubital area
  - In the left hand
- 11. Blood loss to a point where life cannot be sustained is called**
- Diurnal variation
  - Exsanguination
  - Iatrogenic anemia
  - Vasovagal syncope
- 12. Which of the following specimens would most likely be rejected for testing?**
- A hemolyzed potassium specimen
  - An icteric bilirubin specimen
  - A nonfasting glucose specimen
  - An underfilled serum tube
- 13. Which of the following would be a clue that you have accidentally punctured an artery instead of a vein?**
- The blood is dark bluish red
  - The patient complains of great pain
  - The specimen spurts into the tube
  - All of the above
- 14. The serum or plasma of a hemolyzed specimen would most likely look**
- Cloudy or turbid
  - Pale yellow
  - Pink to red
  - Yellowish brown
- 15. Underfilling this tube will most likely result in a hemolyzed specimen**
- EDTA tube
  - Light blue top
  - Gray top
  - SST
- 16. Which activity can contaminate a blood specimen?**
- Cleaning the site with alcohol before collecting an ethanol specimen
  - Collecting blood cultures before the povidone-iodine is dry
  - Using povidone-iodine to clean a skin puncture site
  - All of the above
- 17. Which activity is *least* likely to lead to failure to draw blood?**
- Choosing a vein that has patency
  - Leaving the tourniquet on too long
  - Loosely anchoring the vein
  - Using a tube that was dropped

- 18. The best way to keep a vein from rolling is to**
- a. Insert the needle at a fairly steep angle
  - b. Make certain to anchor it well
  - c. Tie the tourniquet as tight as you can
  - d. Use a large-diameter needle
- 19. You insert the needle in a patient's arm and properly advance the collection tube onto the needle in the tube holder. No blood flows into the tube. You make several needle adjustments and still no blood flow. Which of the following is the best thing to do next?**
- a. Discontinue the draw and try somewhere else
  - b. Keep redirecting the needle until you hit a vein
  - c. Lift up on the needle to create a steeper angle
  - d. Try a new tube in case it's a vacuum problem
- 20. Which of the following is most likely to affect test results?**
- a. Edema
  - b. Petechiae
  - c. Reflux
  - d. Syncope

## CASE STUDY 9-1

### Problem Sites, Complications, and Procedural Errors

Erica is a recent phlebotomy program graduate who was hired less than a month ago by a major hospital in her first job as a phlebotomist. Her first 3 months of employment are a probationary period, and she is determined to do a good job. This morning she has been asked to collect a stat CBC and electrolytes from a patient in an intensive care unit. The patient is responsive and cooperative but has difficulty breathing. The patient's nurse mentions that she will hook up the patient's oxygen therapy as soon as the phlebotomist is finished with him. He has an IV in his left hand. Erica palpates the right antecubital area. She can feel the median cubital vein but it is deep. The basilic vein is visible and prominent so she decides to use it to collect the specimen. When she inserts the needle into the arm, the vein rolls and her needle ends up beside the vein and slightly under it. She redirects the needle and the vein rolls again. The patient winces in pain but says nothing. Noticing the look of pain on the patient's face Erica asks him if it hurts. The patient says yes and tells her that the pain is radiating down his arm and his fingers are tingling. Erica asks him if he would like her to remove the needle. The patient replies "No, you've got to get the specimen," so Erica tries again to redirect the needle. Finally, blood spurts into the tube and a hematoma starts to form quickly. At first Erica thinks that she may have hit an artery, but the specimen is normal in color so Erica dismisses the thought. She quickly collects the specimens, covers the site with gauze and asks the patient to hold pressure while she labels the tubes. When finished she thanks the patient and delivers the stat specimens to the laboratory.

#### Questions

1. What site selection issues were associated with the collection of this specimen?
2. Were site selection issues handled properly? Explain why or why not.
3. What complications and procedural error risks were involved?
4. Were complications and procedural errors handled properly? Explain why or why not.

## CASE STUDY 9-2

### Specimen Quality Concerns

Ray, a newly hired phlebotomist who just recently finished phlebotomy training, is preparing to draw the last GTT specimen on an outpatient. This is the first GTT he has performed without supervision, and he is proud of how well he has done. The patient has good veins in both arms so he has been alternating arms for the blood draws. The patient is anxious to go home, and Ray is in a hurry to go on break, so he quickly selects a vein, performs a successful venipuncture, and collects the required gray top tube. He finishes the draw and quickly shakes the tube. Later, as he starts to label it he notices that the tube is only half full. He has been allowed to submit other partial tubes without a problem, so he shrugs his shoulders and proceeds to bandage and then dismiss the patient. He submits the specimen to the lab and goes on break. When he returns he is informed that the last GTT specimen was hemolyzed and unsuitable for testing, and the test will have to be repeated. Ray is completely

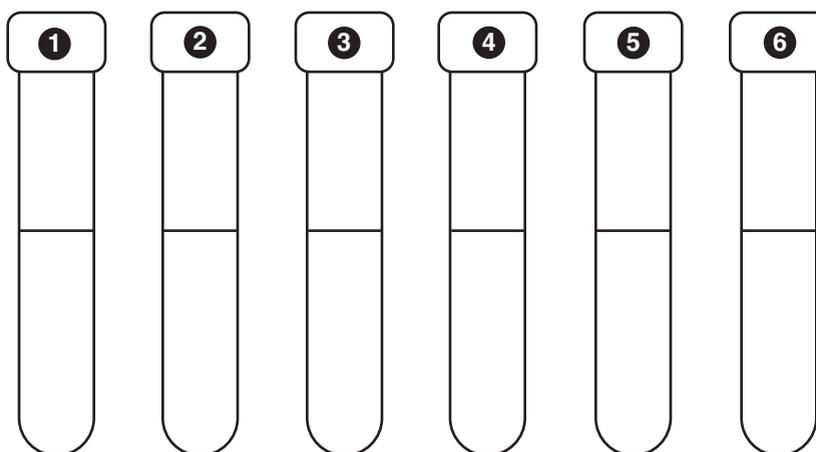
surprised by this because there were no problems with the draw. Ray has to call the patient and reschedule the test. The patient is understandably upset.

### Questions

1. What errors did Ray make that could have caused the specimen to be hemolyzed?
2. What could Ray have done differently that might have prevented the hemolysis?
3. What other error did Ray make?
4. What could Ray have done differently to prevent the error in number 3 above?

### COLORING ACTIVITY

Color the serum in the numbered aliquot tubes according to the appearance listed by tube number on the left.



### Serum Appearance

1. Icteric
2. Lipemic
3. Mild hemolysis
4. Moderate hemolysis
5. Gross hemolysis
6. Normal

## MATCHING ACTIVITIES

Match the physiologic effect to the test.

### Physiologic Effect

1. \_\_\_\_ Crying increases levels markedly
2. \_\_\_\_ Decreases with age
3. \_\_\_\_ Dehydration increases levels
4. \_\_\_\_ Elevated levels are related to jaundice
5. \_\_\_\_ Fatty foods increase levels
6. \_\_\_\_ Fever causes levels to increase
7. \_\_\_\_ Increases with altitude
8. \_\_\_\_ Levels normally peak around 0800
9. \_\_\_\_ Pancreatitis from steroid use increases levels
10. \_\_\_\_ Requires documentation of patient's position during collection
11. \_\_\_\_ Smoking decreases levels
12. \_\_\_\_ Stays elevated for 24 hours or more after exercise

### Test

- a. Amylase
- b. Bilirubin
- c. CK
- d. Coagulation factors
- e. Cortisol
- f. Creatinine clearance
- g. IGA
- h. Insulin
- i. Lipids
- j. Plasma renin
- k. RBC counts
- l. WBC counts

Match the risk to the procedural error.

### Risk

1. \_\_\_\_\_ Hematoma formation
2. \_\_\_\_\_ Iatrogenic anemia
3. \_\_\_\_\_ Inadvertent arterial puncture
4. \_\_\_\_\_ Infection
5. \_\_\_\_\_ Nerve damage
6. \_\_\_\_\_ Reflux
7. \_\_\_\_\_ Vein damage

### Procedural Error

- a. A patient is a difficult draw so the phlebotomist draws from the exact same site each time.
- b. Blood fills the stopper end of the tube first.
- c. Blood spurts into the tube after the needle is redirected several times.
- d. The needle goes through the vein and a hematoma forms.
- e. The patient complains of great pain during a missed attempt to draw from the basilic vein.
- f. The phlebotomist always wipes the alcohol dry before performing a venipuncture.
- g. Three 5-mL tubes of blood are drawn from an infant at one time.

Match the beginning of the sentence concerning causes of hemolysis with the letter of the correct ending.

### Sentence Beginning

1. Drawing blood from a vein \_\_\_\_\_
2. Failure to wipe away the first drop of blood \_\_\_\_\_
3. Forcing the blood \_\_\_\_\_
4. Frothing of the blood \_\_\_\_\_
5. Mixing additive tubes too vigorously \_\_\_\_\_
6. Pulling back \_\_\_\_\_
7. Squeezing the site \_\_\_\_\_
8. Using a needle with \_\_\_\_\_
9. Using too large a tube \_\_\_\_\_

### Sentence Ending

- a. Caused by improper fit of the needle on a syringe
- b. During capillary puncture
- c. During capillary specimen collection
- d. From a syringe into an evacuated tube
- e. Or using rough handling during transport
- f. That has a hematoma
- g. The plunger on a syringe too quickly
- h. Too small a bore for venipuncture
- i. When using a small-diameter butterfly needle

Match the venipuncture problem with a possible corrective action.

### Problem

1. \_\_\_\_ Bevel against the vein wall
2. \_\_\_\_ Collapsed vein
3. \_\_\_\_ Needle beside the vein
4. \_\_\_\_ Needle not deep enough
5. \_\_\_\_ Needle too deep
6. \_\_\_\_ Tube isn't in proper position
7. \_\_\_\_ Tube vacuum lost
8. \_\_\_\_ Undetermined needle position

### Corrective Action

- a. Gently push the needle forward
- b. Palpate the arm above the point of needle insertion
- c. Put on a new tube
- d. Remove the tube from the holder needle and pull the needle back slightly
- e. Reseat the tube to make certain the needle sleeve is not pushing the tube off the needle
- f. Try using a smaller-volume tube
- g. Withdraw the needle slightly, anchor the vein securely, and redirect the needle into it
- h. Withdraw the needle slightly

Match the type of equipment described in the following scenarios with the list of vascular access devices.

### Scenario

1. \_\_\_\_ A nurse is collecting a blood gas specimen from tubing inserted in the underside of a patient's left wrist on the thumb side.
2. \_\_\_\_ A nurse is palpating an area in the patient's upper chest. She tells the patient that she is looking for the "chamber."
3. \_\_\_\_ A patient in the dialysis unit has what appears to be a loop under the skin on the back of his arm in which the large needles connected to the dialysis tubing have been inserted.
4. \_\_\_\_ There are several short lengths of capped tubing protruding from a patient's left arm, just above the antecubital area.
5. \_\_\_\_ There is a device inserted on the back of a patient's arm just above the wrist. The device has a thin rubberlike cover through which a nurse is administering fluid from a syringe.
6. \_\_\_\_ Your patient is a line draw. He has three short lengths of capped tubing protruding from his chest. The nurse draws the specimen for you from one of the lengths of tubing.

### Vascular Access Devices

- a. Arterial line (A-line)
- b. Arteriovenous (AV) shunt
- c. Central venous catheter (CVC)
- d. Heparin lock
- e. Implanted port
- f. Peripherally inserted central catheter (PICC)

## KNOWLEDGE DRILLS

### Hematoma Formation

The following are six situations that can trigger hematoma formation. Fill in the blanks with the missing information.

1. The vein is \_\_\_\_\_ for the needle size.
2. The needle penetrates \_\_\_\_\_.
3. The needle is \_\_\_\_\_ into the vein.
4. Excessive or \_\_\_\_\_ is used to locate the vein.
5. The needle is removed while the \_\_\_\_\_.
6. \_\_\_\_\_ is not adequately applied following venipuncture.

### Iatrogenic Blood Loss

List three ways to minimize iatrogenic blood loss.

1. \_\_\_\_\_
2. \_\_\_\_\_
3. \_\_\_\_\_

### Hemoconcentration

Place a “C” in front of each sentence that describes an action that causes hemoconcentration. Place a “P” in front of each sentence that describes an action that prevents hemoconcentration.

1. \_\_\_\_ Allowing the patient to pump the fist
2. \_\_\_\_ Asking the patient to release the fist upon blood flow
3. \_\_\_\_ Choosing an appropriate patent vein
4. \_\_\_\_ Excessively massaging the area when locating a vein
5. \_\_\_\_ Redirecting the needle multiple times in search of a vein
6. \_\_\_\_ Releasing the tourniquet within 1 minute

## SKILLS DRILLS

### Venipuncture below an IV (text Procedure 9-1)

Fill in the blanks with the missing information.

Purpose: To obtain a blood specimen by venipuncture below an IV

Equipment: Applicable ETS or syringe system supplies and equipment

STEPS	EXPLANATION/RATIONALE
1. Ask the patient's nurse to turn off the IV for at least (A) _____ prior to collection	A phlebotomist is not qualified to (B) _____. Turning off the IV for (C) _____ allows IV fluids to dissipate from the area.
2. Apply the tourniquet (D) _____ to the IV	Avoids (E) _____ the IV
3. Select a venipuncture site (F) _____ to the IV	Venous blood flows (G) _____. Drawing (H) _____ an IV affords the best chance of obtaining blood that is free of (I) _____.
4. Perform the venipuncture (J) _____ if possible	IV fluids can be present (K) _____ due to (L) _____ and may still be present after the IV is shut off due to poor venous circulation
5. Ask the nurse to (M) _____ after the specimen has been collected	IV flow rates must be (N) _____ and starting or adjusting them is not part of a phlebotomist's (O) _____.
6. Document that the specimen was collected (P) _____, indicate (Q) _____, and identify (R) _____	This aids (S) _____ and the patient's physician in the event (T) _____.

## Fainting Procedure (text Procedure 9-2)

Fill in the blanks with the missing information.

Purpose: To properly handle a patient who feels faint or shows symptoms of fainting during a blood draw

Equipment: NA

STEPS	EXPLANATION/RATIONALE
1. (A) _____ and remove and discard the needle as quickly as possible	Discontinuing the draw and discarding the needle (B) _____ from (C) _____ should the patient faint
2. Apply pressure to the site while having the patient (D) _____ and breathe deeply	Pressure must be applied to prevent bleeding and bruising. (E) _____ and breathing deeply helps get oxygenated blood (F) _____
3. (G) _____ the patient	Diverts patient's attention, helps keep the patient (H) _____, and aids in assessing the patient's (I) _____
4. (J) _____ the patient	Prevents (K) _____ in case of (L) _____
5. (M) _____ and explain what you are doing if it is necessary to loosen a tight collar or tie	Avoids (N) _____ that are (O) _____ to hasten recovery
6. Apply a (P) _____ compress or washcloth to the (Q) _____	Part of the (R) _____
7. Have someone stay with the patient until (S) _____	Prevents patient from (T) _____ and causing (U) _____
8. Call (V) _____ if the patient does not respond	Emergency medicine is not in the phlebotomist's (W) _____.
9. (X) _____ the incident according to facility protocol	(Y) _____ could arise and further (Z) _____ is essential at that time

## CONCEPT MAPPING

Create a concept map of physiologic variables and the tests they affect.

