Phlebotomy Fundamentals for Clinical Laboratory Scientist

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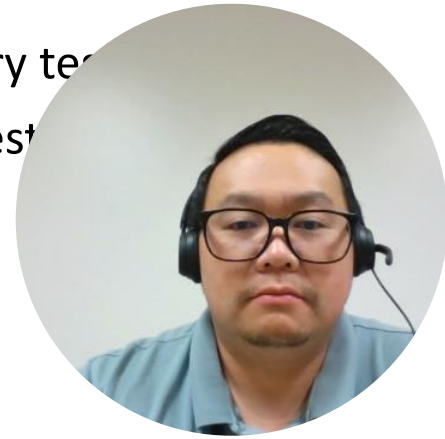
Health Services
LOS ANGELES COUNTY

Learning Objectives

At the end of this presentation, trainee will

- Identify the organs in the circulatory system, and distinguish between artery and vein
- Differentiate between arterial, venous and capillary draw and indicate situation when each is utilized
- Categorize and summarize the component of blood and the functions and composition of each component
- Describe the collection procedure, methods, and workflow.
- Indicate the common veins utilized for blood draw.
- Recall the order of draw and the types of anticoagulants associated with each specimen tubes.
- List the equipment required for phlebotomy
- Demonstrate proper technique of phlebotomy, and accessioning. (During practicum)
- Evaluate specimen acceptance criteria and indicate effect of specimen quality on laboratory te
- Understand the laws, regulations and standards associated with phlebotomy, laboratory test safety.
- Describe the basic infection control strategies associated with phlebotomy.



Blood Specimen Collection

The process and procedures detailed in this standard are intended to prevent specimen collection errors that threaten specimen quality, protect health care professionals from accidental exposure, and prevent patients from the injuries, complications, and medical mistakes that can result from improperly collected specimens. (CLSI, 2017)

Pre-Analytical factors affecting Lab Results:

- Hemolysis – cancelation of some tests such as:
  - Potassium
  - LDH
  - INR
- Insufficient amount of blood drawn – cancelation and delay in result reporting
  - Blue top for coagulation tests – must be full, less than full is canceled
  - Gold top – insufficient volume requires manual processing, causes delay in reporting of result
  - Lavender top – minimum volume required is 2 mL, less than 2mL is canceled
- Clotted specimen - cancelation
  - Blue top – coagulation tests are canceled
  - Lavender top – CBC and all parameters included in the panel are canceled

Pre-Analytical factors affecting Lab Results:

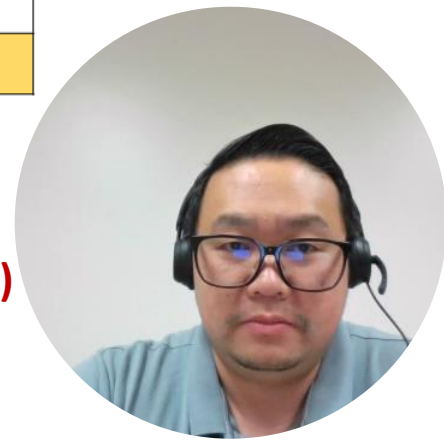
Contamination – may be due to carry-over of additive, pouring of specimen from one tube type to a different tube type, IV fluid or improper/insufficient cleaning preparation for blood culture

Analyte	5/9/2015 7:16	5/9/2015 17:35	5/9/2015 20:50
Na	135	134	138
K	3.7	8.0	3.3
Cl	102	108	105
ALP	NA	NA	NA
Ca	7.8	6.7	8.0
Mg	2.1	1.4	1.7
BMP with Slight EDTA* Contamination			

Analyte	5/9/2015 7:16	5/9/2015 17:35	5/9/2015 20:50
Na	136	135	137
K	4.0	>10.0	3.4
Cl	90	83	90
ALP	85	19	82
Ca	9.2	<0.8	9.1
Mg	2.4	<0.1	2.1
CMP with Gross EDTA* Contamination			

*K2 EDTA – Dipotassium Ethylenediaminetetraacetic acid.

The specimen was collected into a lavender (EDTA) tube and transferred to a gold (clot activated)



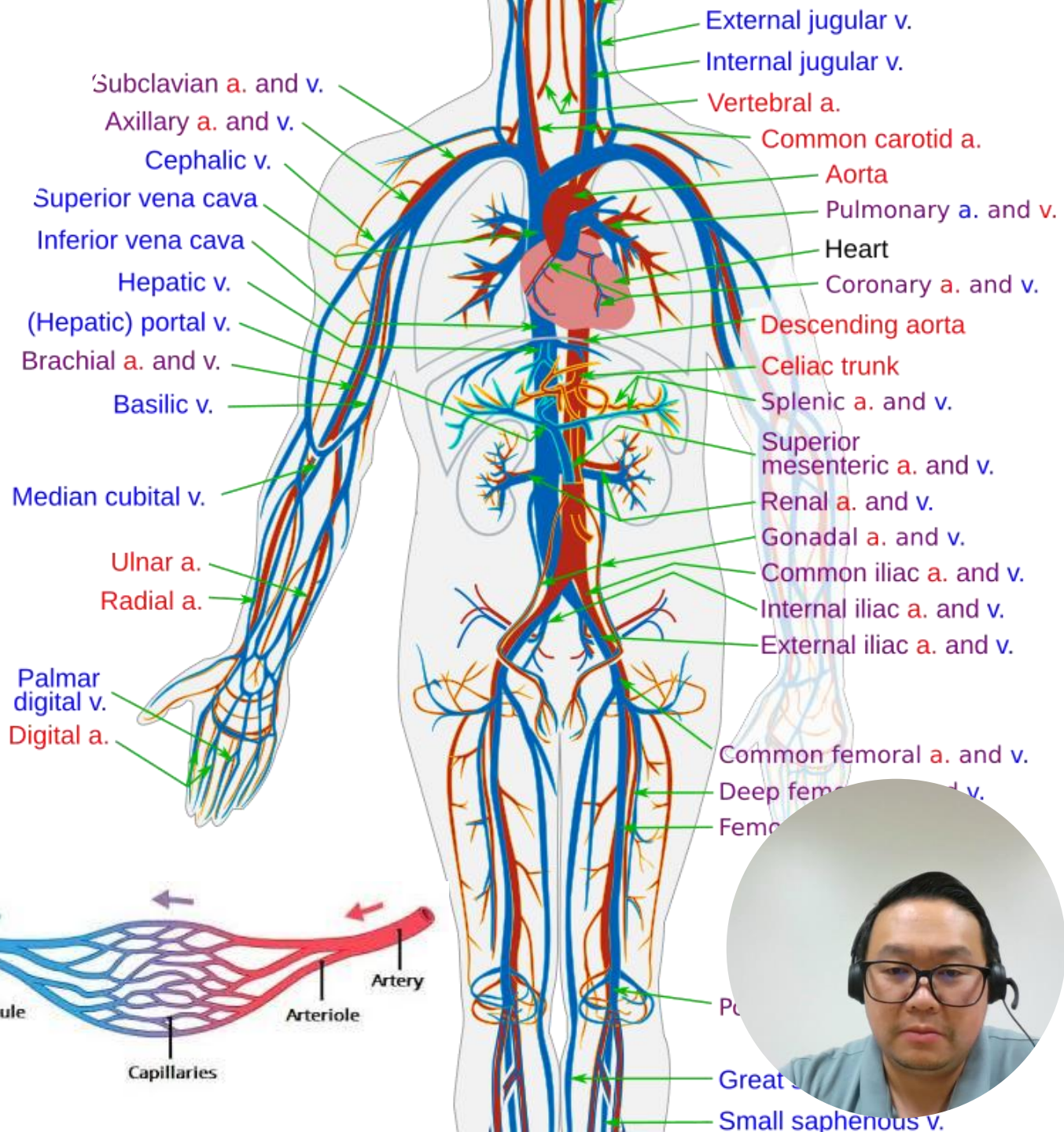
Pre-Analytical factors affecting Lab Results:

Improper labeling – delay in processing, delay in result reporting

Mislabeling – cancelation, wrong results reported, Patient transfused with wrong ABO/RH type blo

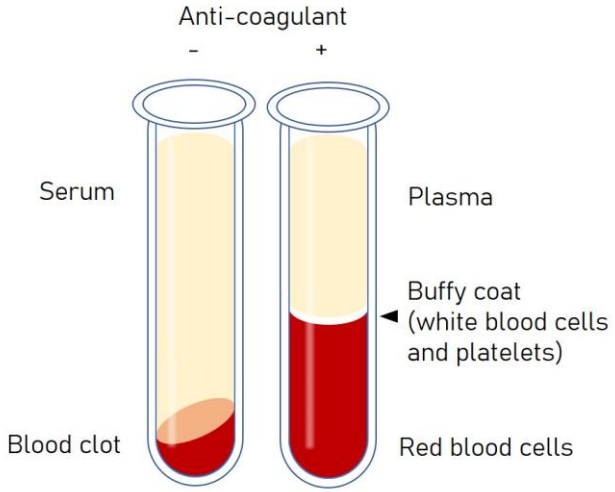
The Human Circulatory System

- Organs
  - Heart
  - Aorta
  - Arteries
  - Arterioles
  - Capillaries
  - Venules
  - Veins
  - Vena Cava (Superior and Inferior)

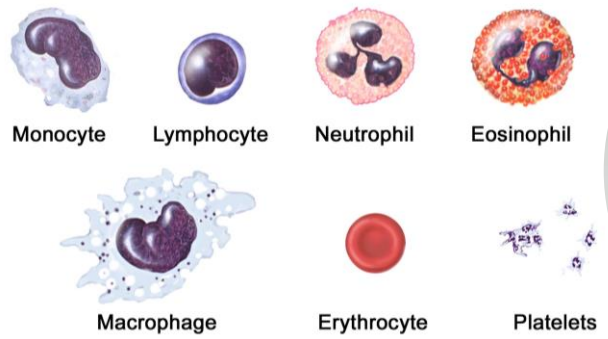


Blood Composition and Component

- Plasma vs Serum
  - Plasma:
    - Anticoagulated, Contains clotting factors
  - Serum
    - Clotted blood, without clotting factors



- Cellular Components
  - Red Blood Cell (Erythrocytes)
    - Oxygen transport
  - White Blood Cells (Leukocytes)
    - Immune response
    - Granulocytes vs Agranulocytes
  - Platelets (Thrombocytes)
    - Clotting and hemostasis



Infection Control

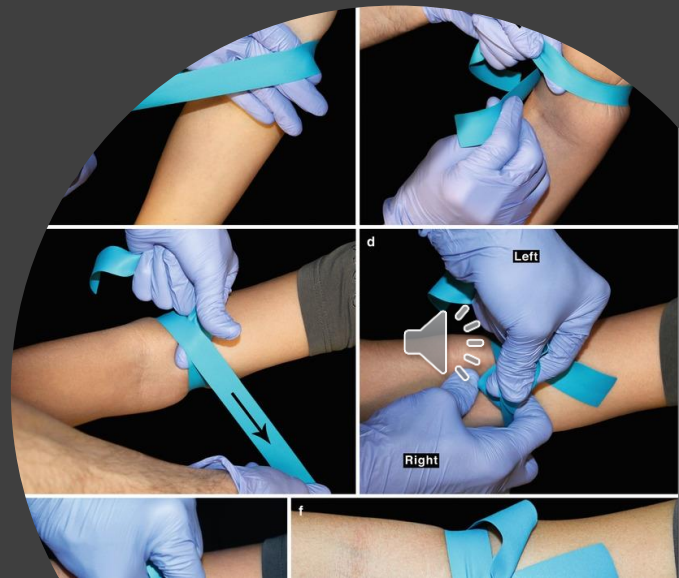
- Route of transmissions
  - Droplet, Aerosol, Contact
- Standard precautions
  - Lab Coats/Gowns, Clean Gloves
- Read signs and labels for patients in isolation.
  - PPE: Mask, Goggles
- Hand Hygiene
  - Sanitizer in
  - Wash hand out
- Sharps Safety
  - Discard used needles and devices in proper containers

Phlebotomy Equipment

Equipment at-a-glance

Phlebotomy Equipment

- Specimen Tubes
- Needles (Gauges)
  - 17: Blood Donation
    - Fast, Minimize mechanical hemolysis
    - Most Discomfort
  - 19: Standard Gauge
  - 21/ 23: Butterfly
    - Least Discomfort
    - Slow, Increase risk of mechanical hemolysis
    - 25 gauge will cause hemolysis.
- Tourniquet
- Lancet
- Syringes: make sure the needed is fitted securely
  - Excess pulling pressure will induce hemolysis

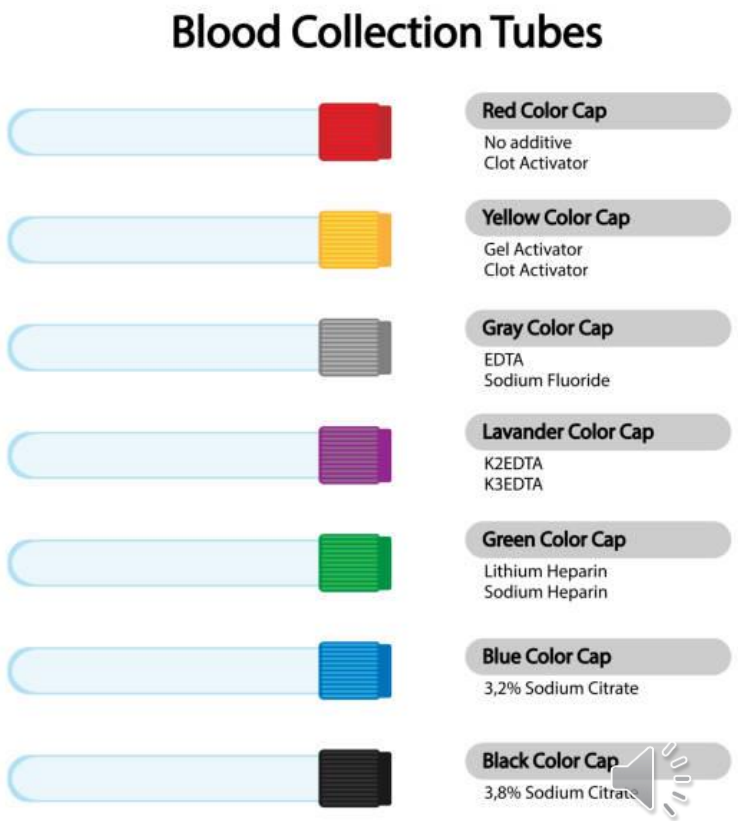


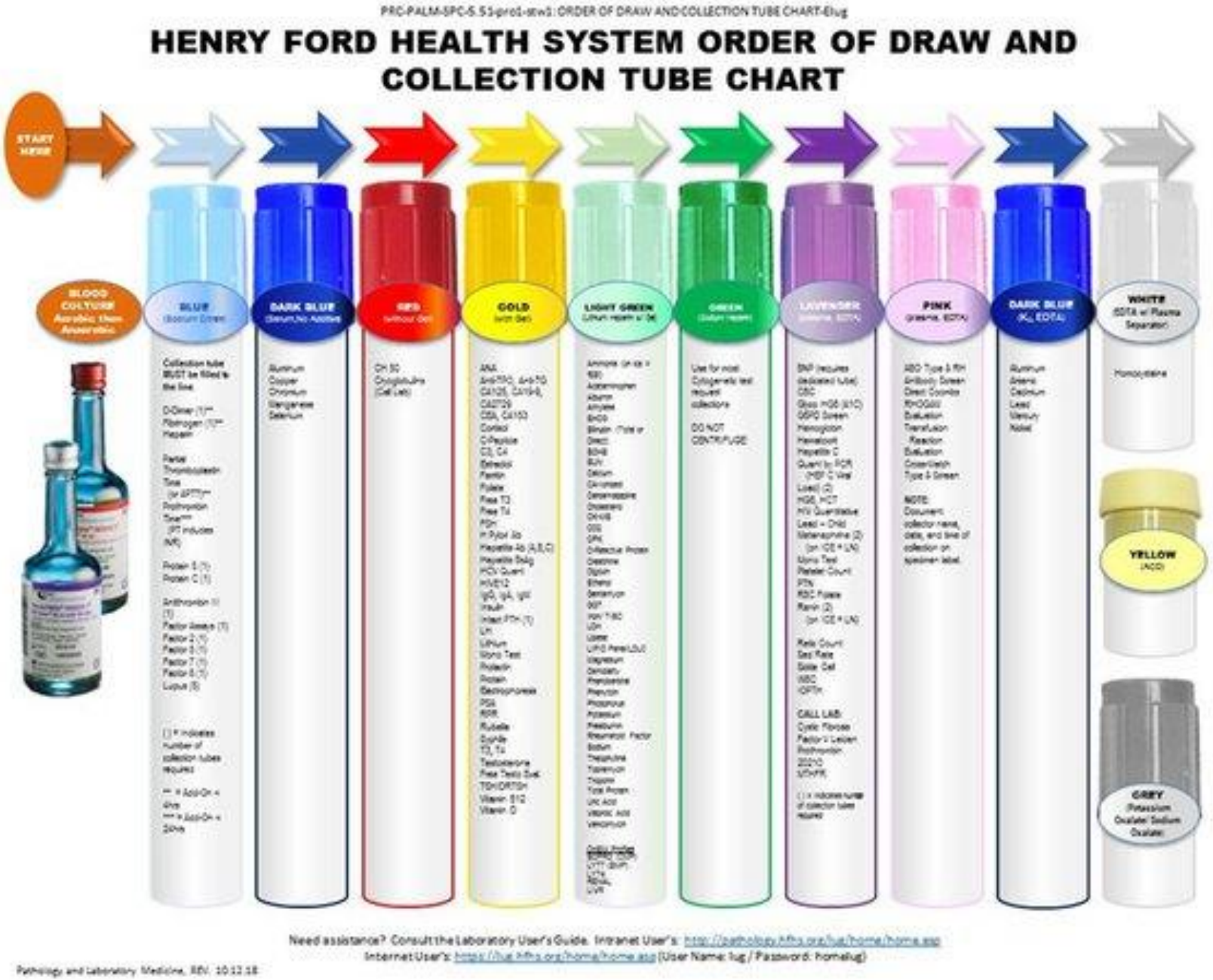
Specimen Tubes

Phlebotomy Tube Colors and Their Additives

Color	Additive	Sample Type	Department(s)
	Sodium citrate	Plasma	Coagulation
	None or clot activator	Serum	Chemistry Blood bank Serology
	Clot activator and gel separator	Serum	Chemistry
	Lithium heparin or sodium heparin	Plasma Whole blood	Chemistry
	EDTA	Whole blood	Hematology
	EDTA	Whole blood	Blood bank
	Sodium fluoride and potassium oxalate	Whole blood Plasma	Chemistry
	None or EDTA	Serum Whole blood Plasma	Chemistry
	SPS or ACD	Whole blood Plasma	Microbiology Blood bank

@phlebotomyusa





Order of Draw

- CLSI Guideline
  1. Blood Culture
  2. Sodium Citrate
  3. Serum tube
     1. Separators with clot activators and gels
  4. Heparin
     1. With or without Gel
  5. EDTA
     1. With or without Gel separator
  6. Sodium Fluoride / Potassium Oxalate

Blood collection process

Follow the Order of Draw to Prevent Contamination: Carry-over of additive from one tube to the next

Order and Additive	Tube Type		
1st None, Blood Culture			
	Yellow		
2nd Citrate			
	Light Blue	Black	
3rd Clot Activator			
	Gold	Red	Royal Blue

Blood collection process

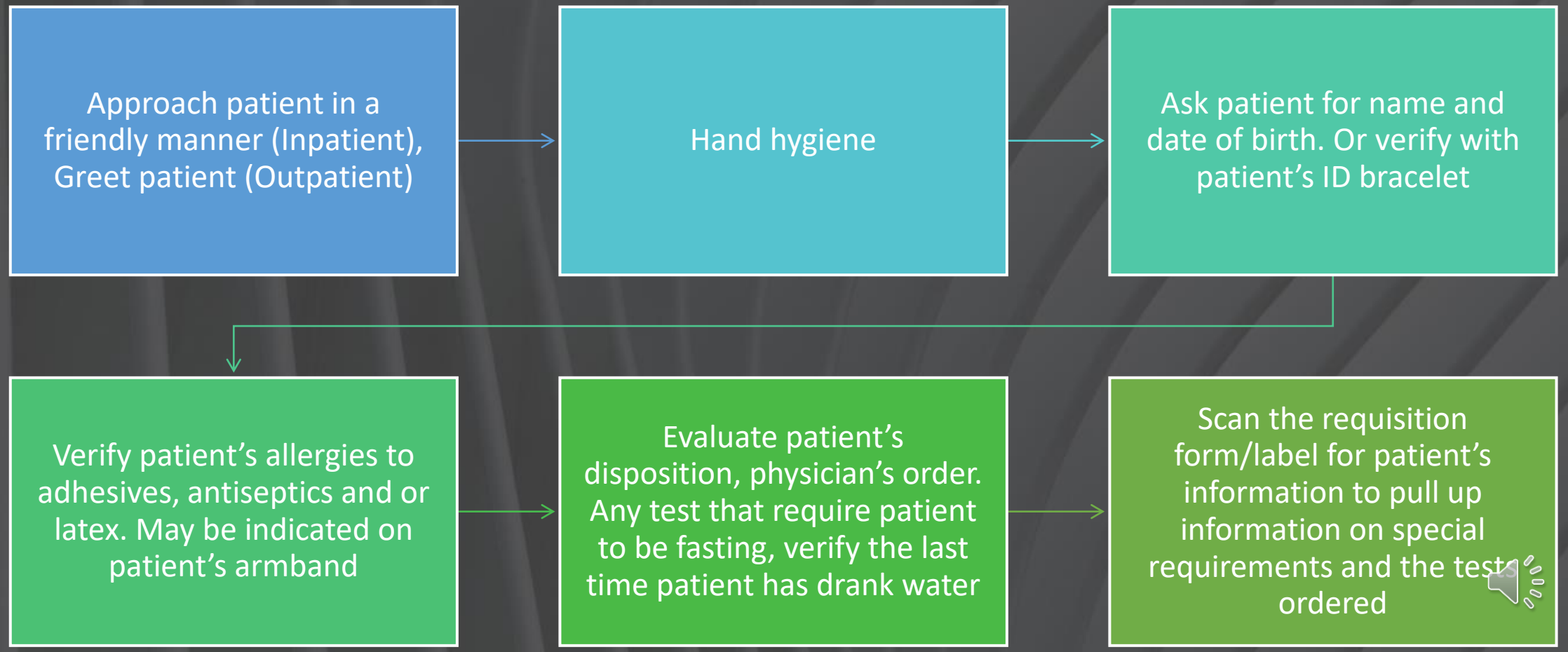
Follow the Order of Draw to Prevent Contamination: Carry-over of additive from one tube to the next

4th Heparin			
	Light Green	Green	
5th EDTA			
	Lavender	Pink	Royal Blue
6th Sodium Flouride or Potassium Oxalate			
	Grey		
7th ACD A/B			
	Yellow		

Phlebotomy workflow (Registration)

Once patient arrives at the clinic (Outpatient)	Customer service begin with registration at the front desk This is a critical step to identify the patient
Lab request is ordered (In or Outpatient)	Nurse collected indicate drawn by nursing Lab collect indicate drawn by lab phlebotomist.

Phlebotomy Workflow (Before Venipuncture)



Phlebotomy Workflow (Before Venipuncture)

Put on gloves

Hyperextend arm to select appropriate venipuncture site

Prepare equipment, the patient and chosen site

Place tourniquet 3-4 inches higher than the puncture site.

- Avoid applying tourniquet too tight, and for longer than 1 minute to avoid hemoconcentration.
- If Tourniquet is removed, must wait 2 minutes before you can apply it again.

Ask the patient to make a fist without pumping his hand

Select the vein and apply appropriate antiseptic

Phlebotomy Workflow (Before Venipuncture)

Perform venipuncture

- Hold patient's arm firmly, pull the skin up and anchor the vein
- Insert the needle at 15-30 degree angle.
- Avoid excessive probing

Collect samples in the proper tubes in the correct order of draw

Remove tourniquet while the final tube fills.

Gently place the gauze over the puncture site and swiftly withdraw needle using backward motion. Apply pressure at puncture site.

- Adequate pressure prevent/minimize hematoma

Phlebotomy Workflow (After Venipuncture)

Engage safety device on the needle and discard in sharps container.

Dispose any other contaminated supplies in proper containers

Mix specimens with additives by gentle rocking back and forth per manufacturer guideline

Appropriately label all the tubes while you are still with the patient

Verify patient information on the specimen label and tube with the patient.

Remove your gloves and dispose them in biohazard container

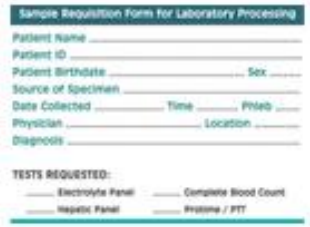
Wash your hands

Deliver labeled specimen to testing areas promptly.

Phlebotomy (Heel stick/Finger stick)

The Equipment for Fingersticks or Heel Sticks

Gloves



Requisition Form

Alcohol Wipes

Lancet

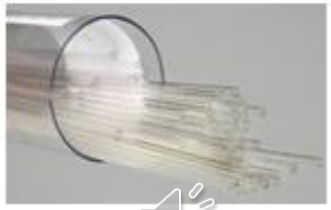
Gauze Sponges

Microtainer collection tubes

Glucometer

Sharps Container

Neonatal Screen



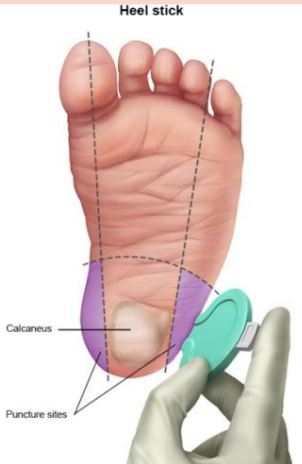
Capillary Tubes

Phlebotomy TRAINING GROUP

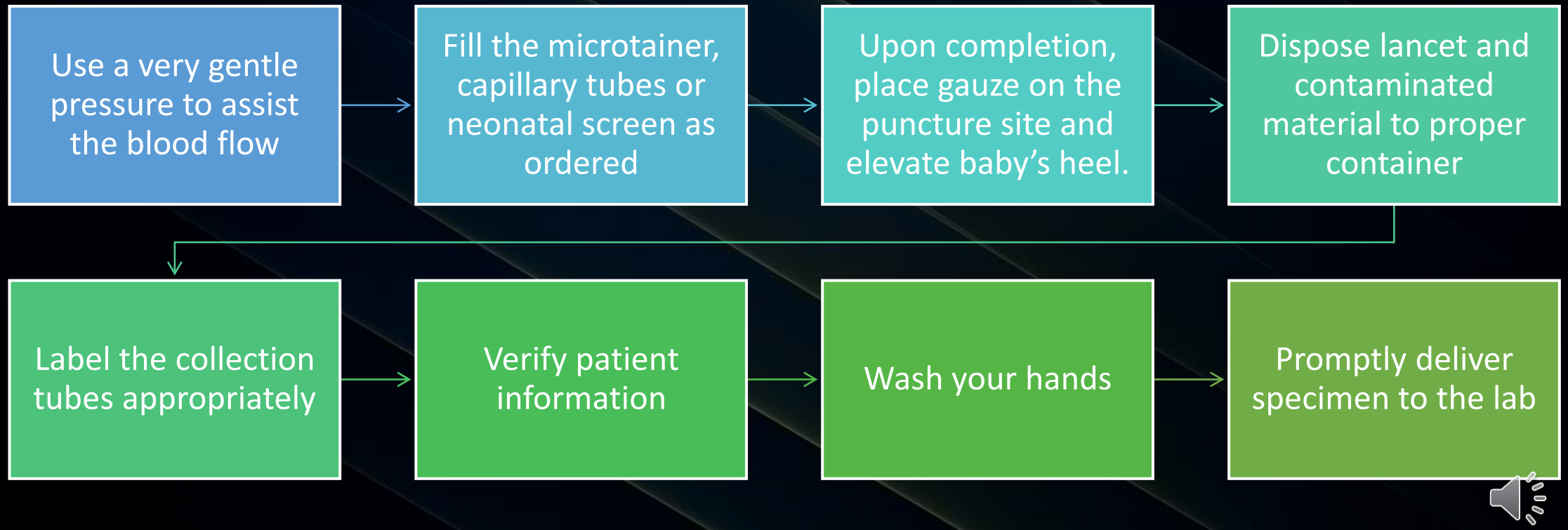
http://PhlebotomyTrainingGroup.com
The #1 website for phlebotomy training and certification

Phlebotomy Workflow (Heel stick)

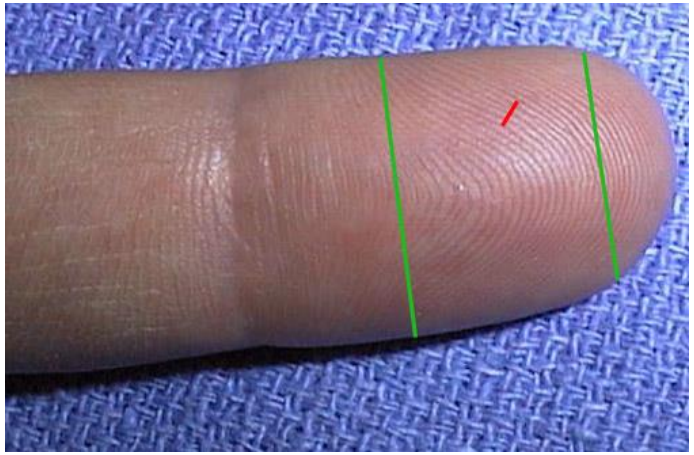
- Follow the same greeting and preparation procedure. This procedure is utilized to collect blood from newborns or infants
- Pre-warm the heel, but be sure not to burn the baby
- Hand hygiene
- Put on gloves
- Sanitize puncture site
- Use sterile lancet to cut across the heel print line
- Wipe off first drop with gauze



Phlebotomy Workflow (Heel stick)



Phlebotomy (Finger Stick)



Hand Hygiene and put on glove → Select the ideal finger, usually middle or ring finger of the non-dominant hand.

↓

Apply antiseptic to finger. → Using sterile lancet to make a skin puncture next to the center of the finger pad, perpendicular to the finger tip's ridges

↓

Discard lancet in to sharps → Wipe away first drop with gauze

↓

Collect drops of blood into proper collection device → Gently massage the finger to promote blood flow but avoid excessive pressure

Phlebotomy (Finger Stick)

Cap and rotate the collection device back and forth if any additives are in the collection tube.

Ask patient to hold gauze over puncture site for a few minutes until bleeding subsides or stops.

Dispose contaminated material in appropriate containers.

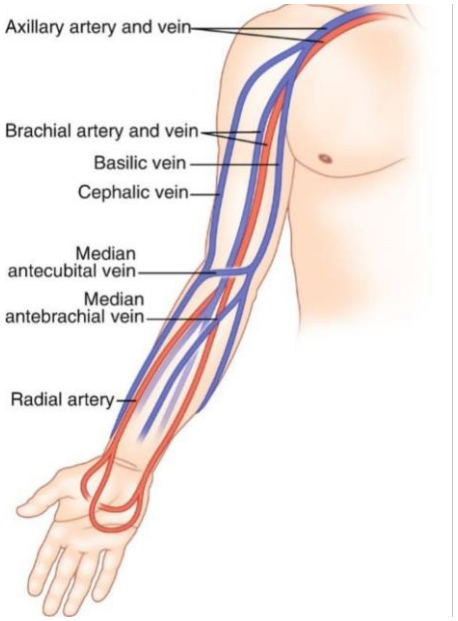
Properly label tubes in the presence of the patient.

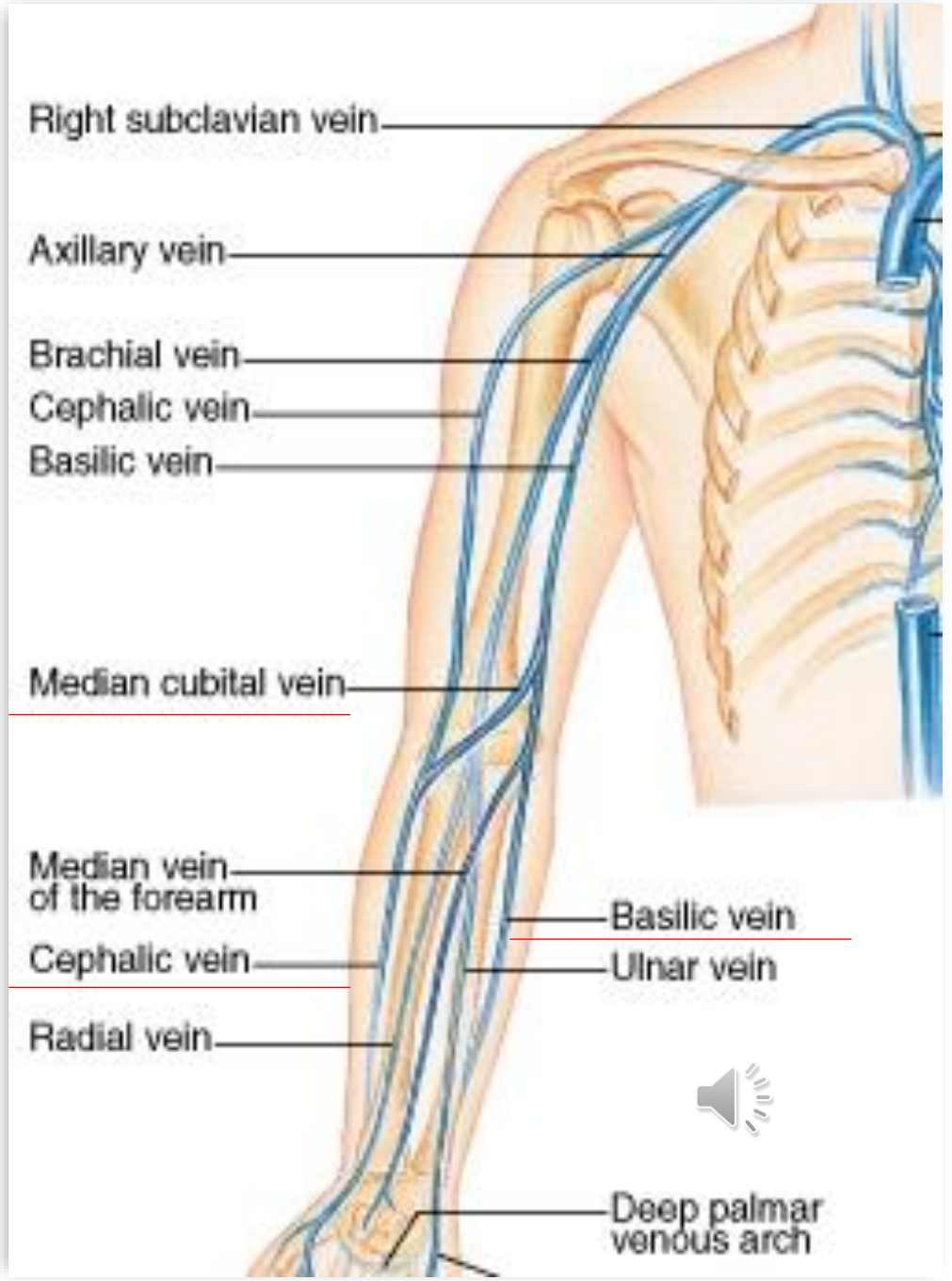
Verify patient information again, and check patient's puncture site that bleeding has ceased.

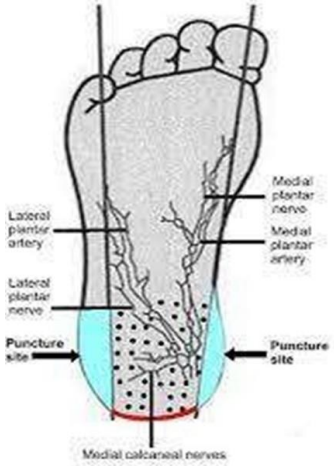
Remove gloves, hand hygiene and promptly deliver specimen to the lab.

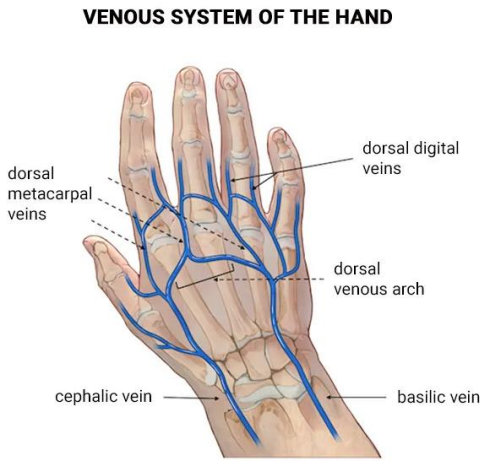
Site Selection

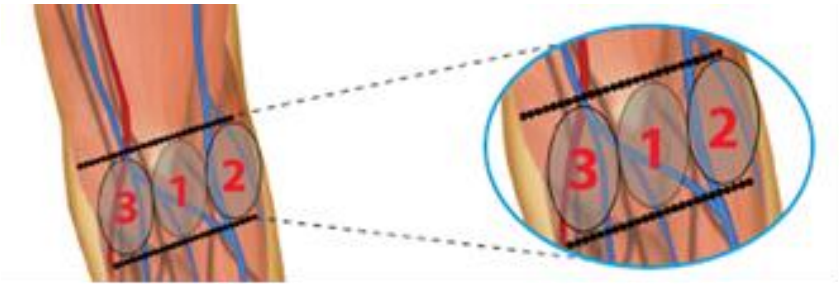
- Arms, or hand
- Select proper site to minimize risks such as hematoma or nerve damage.
- Avoid IV site, draw the opposite arm or below the IV site
- Avoid Mastectomy Side of the body or near the upper arm due to lymphoedema
- Avoid Edematous extremities, area with excessive scars











Selection of Puncture Site

Selection of Venipuncture site:

Antecubital veins, prioritize as follows:

1st Median aspect (center)

2nd Lateral aspect (outer)

3rd Medial aspect (inner)

When antecubital veins are not acceptable or are unavailable, veins on the **back of the hand** are also acceptable for venipuncture.

Selection of Puncture Sites

<u>Do not draw from the following sites or certain conditions mentioned below</u>:

- Artery
- Foot
- Femoral area
- Shunt
- Heparin lock
- A-line
- I.V. line
- Midline catheter
- Arm with I.V. ** (see Notes)
- Patient undergoing dialysis procedure
- Arm receiving blood transfusion
- Patient with PICC line
- Mastectomy

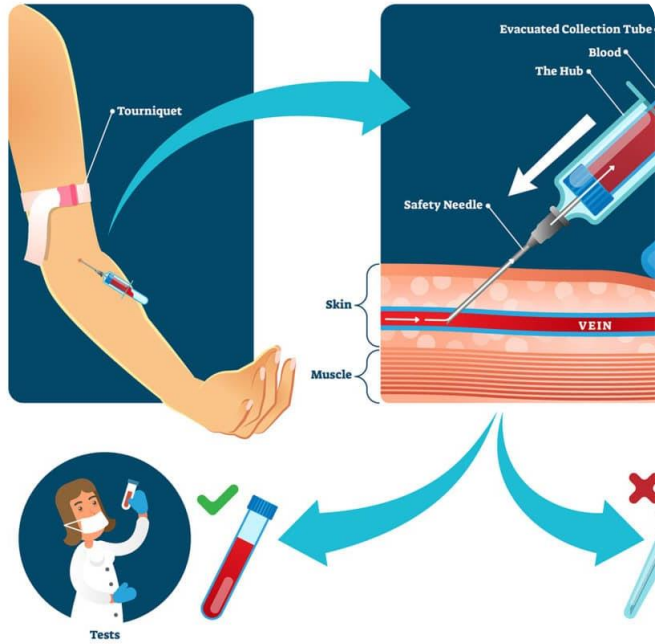
****Puncture site must be below (distal to) the point of IV infusion, and the IV must be paused for at least 2 minutes prior to draw. Notify the nurse in charge of the patient after the procedure.**

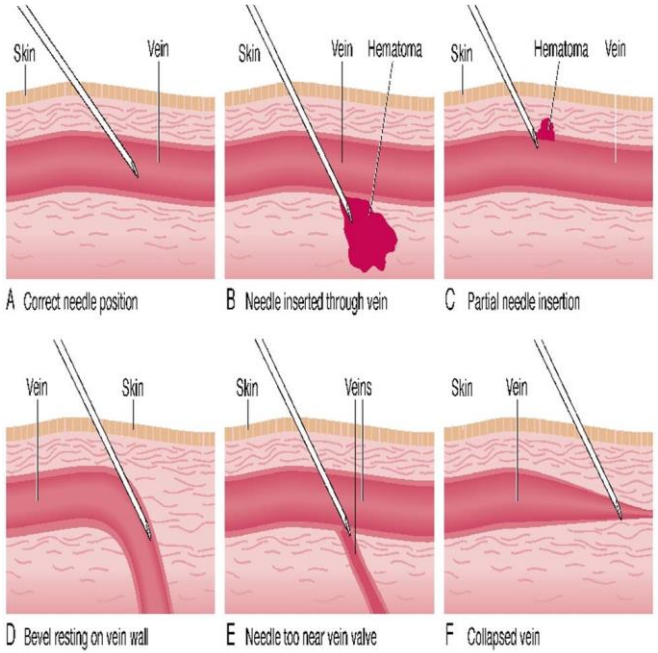
Selection of Puncture Sites

Other considerations:

- No hematoma
- No extensive scarring
- Avoid inflamed sites
- Avoid edematous sites
- Extremity affected by stroke, injury and surgery

Possible impact if not followed: Contamination or altered laboratory results.





Technique of Draw

- Set up your needle
- Apply Tourniquet
- Prepare skin surface with Anti-septic
  - Alcohol
  - Iodine or Chlorohexidine
- Locate a vein
- Venipuncture
- Release Tourniquet
- Remove needle and simultaneously engage safety feature
  - Apply gauges to venipuncture site and apply pressure
- Mix specimen tube
- Apply Gauzes
- Apply specimen label in front of patient and verify identification information with patient.

Blood collection process

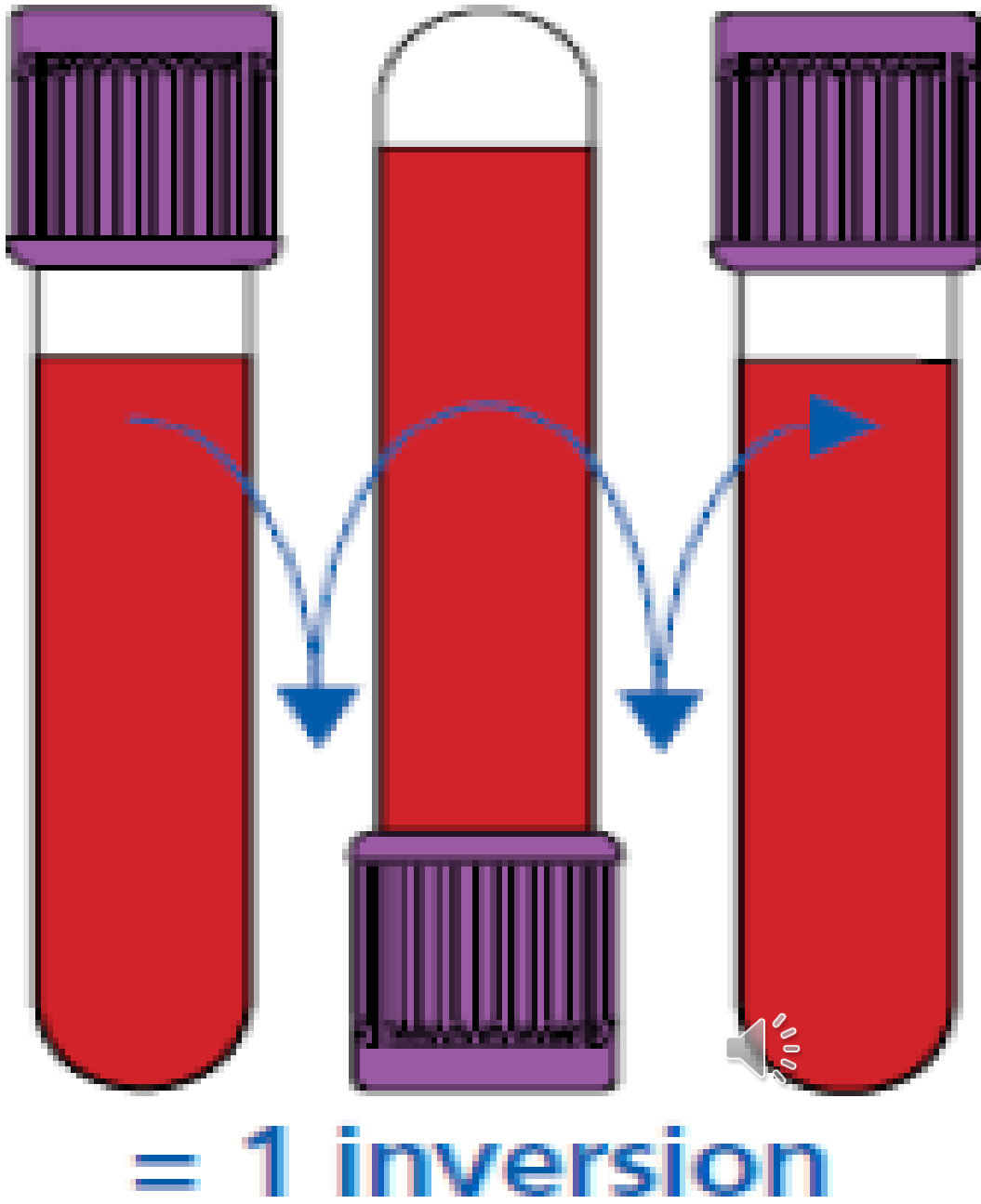
Required volume for each tube:

- Blue top - less than full is canceled
- Lavender – minimum is 2 ml; less than 2 ml is canceled
- Gold - insufficient volume requires manual processing; delays processing

Blood collection process

Invert/mix tube immediately after filling – follow the number of inversions indicated on the for Order of Draw

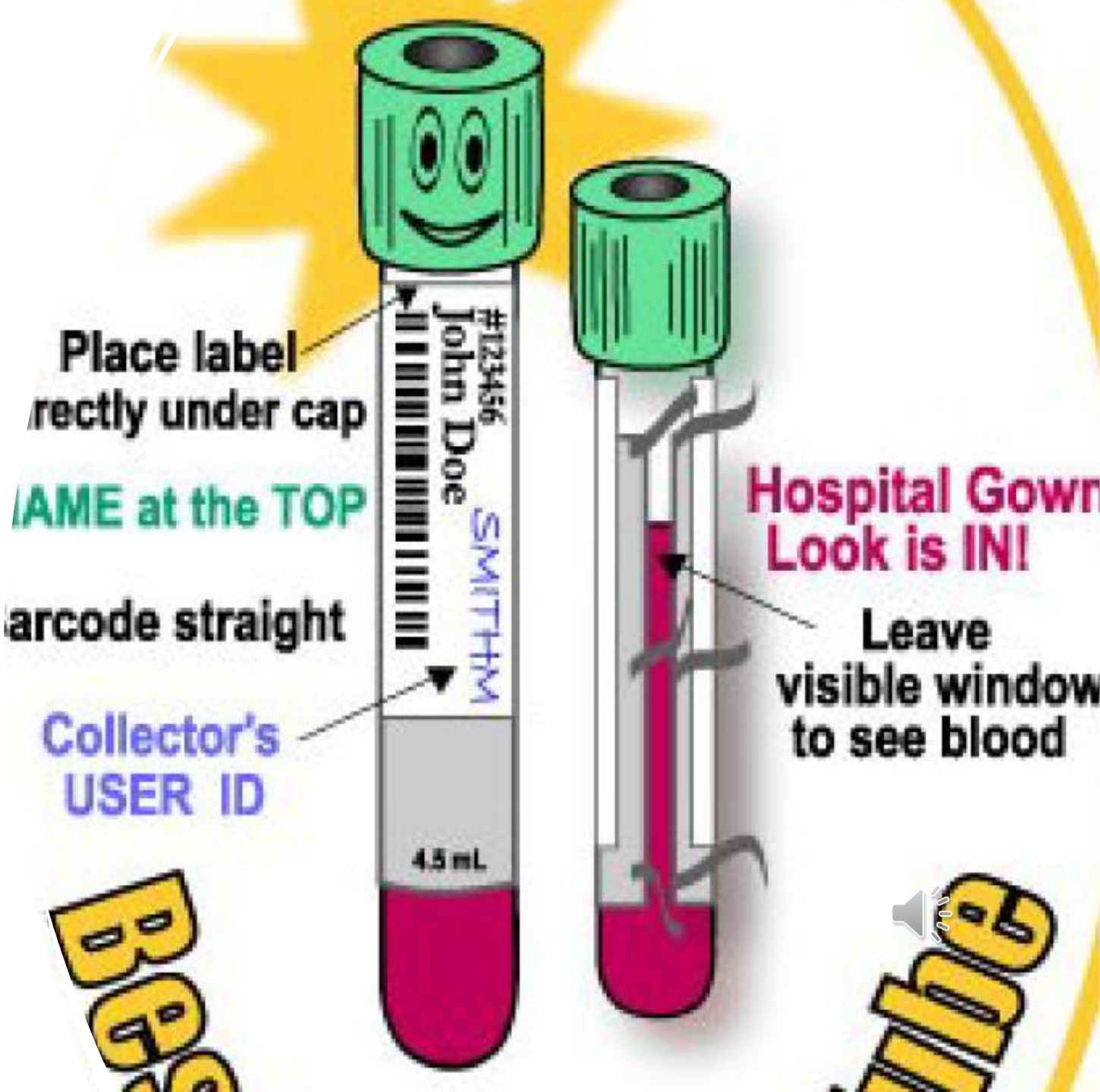
- Incomplete or insufficient inversion causes anticoagulated specimens to clot leading to cancelation of lab results.
- Examples of anticoagulated tubes: blue top (citrate), lavender top (EDTA) & green top (heparin)



Blood collection process

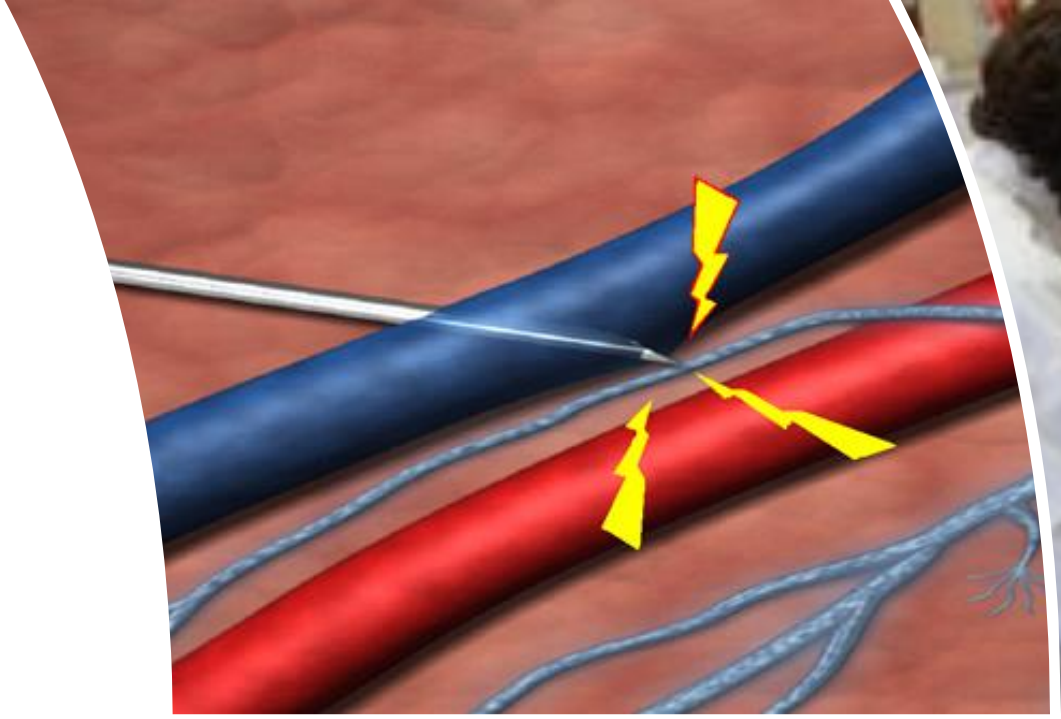
Label tubes accurately and properly

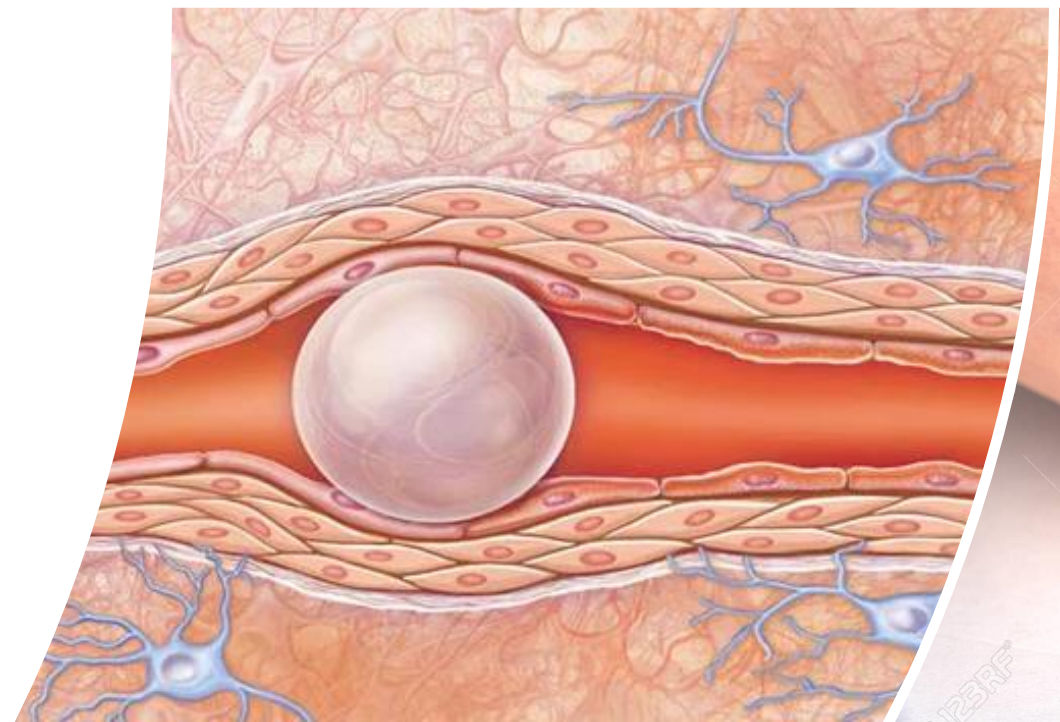
- Leave a window
- Do not write along the barcode
- Avoid wrinkles on labels especially on the barcode



Complications

- Hematomas
- Nerve damage
- Artery Puncture
- Fainting
- Air embolism
- Allergy
- Hyperventilation
- Anemia (Iatrogenic)





Collecting Blood Culture Bottles

New Blood Culture Bottles:

Blood culture Specimen Collection

Supplies Needed:

- BACTEC Culture Vials
  - PLUS Aerobic
  - Lytic/10 Anaerobic
  - Peds PLUS - for Pediatric or blood draws less than 3ml
- Butterfly Blood collection set or syringe
- Vacutainer holder
- Swab with chlorhexidine-gluconate or 1 to 10% povidone - iodine solution
- Alcohol prep
- Gauze
- Adhesive bandage
- Tourniquet

Blood culture Specimen Collection

Prior to use:

- Inquire if patient has a history of adverse reaction to iodine.
- Inspect all vials and discard any vials showing evidence of contamination, damage or deterioration.
- BACTEC vial septa contains natural rubber

Blood culture Specimen Collection

Preparation of the puncture site:

- Cleanse the venipuncture site with 70% isopropyl alcohol.
- Swab with chlorhexidine-gluconate or 1 to 10% povidone- iodine solution according to Manufacturer's instructions.

Notes:

- Chlorhexidine-gluconate is recommended for infants two months and older and patients with iodine sensitivity.
- If povidone iodine is used, the site should be cleansed after phlebotomy is performed
- Allow site to air dry.
- If the venipuncture proves difficult and the vein must be re-palpated, the site must be re-cleansed.

Blood culture Specimen Collection

Blood culture Specimen Collection

Using the media meniscus as a guide, mark BACTEC culture vial label(s) at desired fill level. (each hatch mark on label is approximately 5ml)

Blood culture Specimen Collection

Remove flip-off caps from BACTEC culture vial(s). **Wipe the top of each vial with a single alcohol swab and allow to dry.**

Blood culture Specimen Collection

Prepare blood collection set:

- Butterfly
- Vacutainer holder

Blood culture Specimen Collection

- Perform venipuncture by holding wings of butterfly device.
- DO NOT hold by grasping the yellow safety shield

Blood culture Specimen Collection

- Select aerobic vial first. (blue band on vial)
- Maintain vial in an **upright position.**
- Push and hold Vacutainer holder over top of vial to puncture septum.
- Hold in place on vial and collect blood to desired fill level.
- Monitor to ensure proper flow and fill level.

Blood culture Specimen Collection

- Once desired fill level is achieved, remove holder from vial.
- Immediately transfer holder to second vial and push needle into vial.
- Hold in place on vial and collect blood to desired fill level.
- Remove holder from vial.

Blood culture Specimen Collection

Recommended Fill Volumes for Needle and Syringe Draw:

- Children: 0.5 to 5 mL of blood per venipuncture. Transfer the entire amount to a **BACTEC™** PEDS PLUS/F vial. (Pink label)
- Adult: 16 to 20 mL of blood per venipuncture. If it is impossible to draw the required amount, aliquot as follows:

Venipuncture	Amount in BACTEC Plus Aerobic Vial (silver label)	Amount in BACTEC Lytic/10 Anaerobic Vial (purple label)
16-20mL	Split equally between aerobic and anaerobic vials	
13-16mlL	8mL	5-8mL
10-12mL	5-7mL	5mL
5-9mL	Entire blood amount	0mL

Blood Culture Specimen Collection

- **Factors contributing to Blood Culture Contamination:**
- **Personnel** – must be properly trained to perform the procedure
- **Skin preparation** - Skin normal flora is #1 cause of percutaneous contamination
- **Vascular Access Device (VAD)** – Higher rate of contamination vs direct venipuncture
  - General recommendation is to **collect blood culture by venipuncture whenever possible**
- **Blood culture bottle preparation**
  - Rubber stoppers are not sterile, cleanse with alcohol pad and let dry
  - Discard bottles showing any evidence of contamination, deterioration, damage or expired
- **Supplies**
  - Ensure that all collection supplies are free of damage and within the expiration date

Quality Assurance and Improvement

Quality Assurance

- Competency assessment with direct observation
- Equipment expiration date check and quality check before collecting specimen

Quality Improvement

- Incident reporting and investigation
- Corrective action and preventive action plan
- Turn around time improvement
  - From patient check in to blood draw completion

Customer Service

External Customers

- Patients
- Patient's family member

Internal Customers

- Nurses, RN, NA, OR Circulars
- Providers, MD, DO, NP, CRNAs, Pharmacists,
- CLSs

Ethics

- HIPPA Compliant
- Patient confidentiality
- Consent verifications
- Standard of care
- Malpractice
- Negligence
- Chain of custody

Regulatory and Accreditation Organizations

ADA, CDC, CLIA, CMS, FDA, OSHA

AABB, CAP, CLSI, TJC (JACHO)

Assignments and Practicum

- Watch the Videos in the attached Video Library
- Complete your assignments in MTS and/or Media Lab
- Report to Phlebotomist Supervisor for Hands on training
- Practice on each other
- Report to your assigned phlebotomist trainer to complete your 50 draws

References

- Introduction to Phlebotomy- Kiechle
- Phlebotomy Textbook- Strasinger
- Blood collection, a Short Course- Strasinger
- Applied phlebotomy-Ernst
- Handbook of phlebotomy and patient service technique- Pendergraph
- CLSI Guideline
- https://phlebotomytraininggroup.com/venipuncture/
- https://clinlab.ucsf.edu/specimen-collection
- https://www.phlebotomyusa.com/blog/phlebotomy/which-color-tube-for-what-test/
- https://proceduralist.org/us-guided-iv/us-iv-technique/
- BD Manufacturer package insert