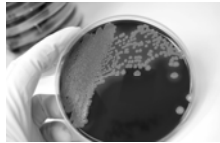


[We need blood cultures, STAT!]

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May 21, 2009



[Objectives]

Upon completion of the webinar, the professional will be able to:

1. Identify the purpose of blood culture collection.
2. Describe five preanalytical errors.
3. Describe specimen collection including site preparation and use of safe needle devices.
4. List equipment needed for blood culture collection.
5. Describe methods used to collect blood for blood cultures.
6. Identify the importance of minimizing preanalytical errors.

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[What is a blood culture?]

- A blood culture is a laboratory test where blood is placed in liquid culture media to determine if microorganisms, specifically bacteria or fungi, are present in the blood.
- If bacteria or fungi grow in the culture, more tests are performed to identify the type of bacteria/fungi present and specific types of antibiotics to use to eradicate the microorganism.
- Blood cultures will not detect infections caused by viruses or parasites.

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[What is a blood culture?]

- The presence of bacteria in the blood is called bacteremia.
- The presence of fungi in the blood is called fungemia.
- For our purposes today, I will use the term bacteremia for both the presence of bacteria and fungi in the blood.

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[Bacteremia & sepsis]

- A patient with bacteremia generally develops a systemic reaction to the infection; this is called sepsis.
- Sepsis may be called “blood poisoning”; however, this is a non-medical term.
- Sepsis is a potentially serious, life-threatening disease.

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[What is sepsis?]

- Sepsis is the body’s reaction to infection; this leads to a systemic inflammatory reaction and eventually organ dysfunction and/or failure.
- Annually, about 750,000 people in the U.S. develop sepsis; 215,000 of them die.

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What is sepsis?

- The incidence of sepsis is rising as the population ages.
- Sepsis can develop from any type of infection elsewhere in the body
 - Bronchopulmonary infections – 40%
 - Abdominal infections – 30%
 - UTIs – 10%

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Signs/symptoms of sepsis

- | | |
|--------------------|-----------------------|
| ■ Fever | ■ Severe headache |
| ■ Tachycardia | ■ Shortness of breath |
| ■ Rapid breathing | ■ Pain in abdomen |
| ■ Overall weakness | ■ Skin redness |
| ■ Confusion | ■ Draining wounds |

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Diagnosis of sepsis

- To be called septic, patient must have at least two of the following:
 - Tachycardia > 90 BPM at rest
 - Temperature of > 100.4 F or < 96.8 F
 - WBC >12,000/ μ L or < 4,000/ μ L, or >10% band neutrophils (a white blood cell that fights infection)
- Culture of blood or other tissue

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Who is at risk for sepsis?

- IVs for > 1 week
- Central IV lines
- Intra-abdominal or pelvic infections
- Splenectomy
- Meningitis
- Diverticulitis, Crohn's disease, cholecystitis
- Pyelonephritis, kidney stones, prostate enlargement
- Diabetes, alcoholism, chronic conditions
- > 65 years of age

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Treatment of sepsis

- Antibiotics to kill the bacteria
- IV fluids to maintain blood pressure
- Medications to increase blood pressure
- Ventilator, if needed to support pulmonary function
- Dialysis, if needed to support kidney function
- Feeding tube, if needed
- Drainage of fluids from infected areas such as a wound, lungs

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Blood culture specimen collection-preanalytical variables

1. Timing of collection
2. Number of blood cultures collected
3. Volume of blood added to bottles
4. Distribution of blood between aerobic and anaerobic bottles
5. Disinfection of skin

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**Blood culture specimen collection-
preanalytical variables**

- **Timing of collection**
 - Very few studies done
 - Data shows an influx of bacteria into the bloodstream about one hour before the onset of fever/chills
 - Blood cultures are generally collected when the patient has a temperature spike and at arbitrary intervals of 30 – 60 minutes or 2-3 sets per episode

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**Blood culture specimen collection-
preanalytical variables**

- **Number of blood cultures**
 - Studies have shown that the collection of at least three sets of blood cultures provides the best chance of identifying pathogenic bacteria in the blood
 - Single blood cultures should never be drawn from adult patients; exceptions may be made for pediatric patients and patients with bacterial endocarditis

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**Blood culture specimen collection-
preanalytical variables**

- **Volume of blood**
 - Probably the most important variable in detecting the presence of pathogenic bacteria in blood
 - For adults the recommended volume is 20 – 30 mL per venipuncture
 - For infants and younger children, the volume of blood drawn should be no more than 1% of the patient's total blood volume

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Blood culture specimen collection- preanalytical variables

- Volume of blood
 - The two most “popular” vendors of blood culture bottles are Becton Dickson (BD) and Biomiereux
 - BD
 - Adult: 8-10 mL blood per bottle
 - Pediatric: 0.5 – 5 mL per bottle
 - Biomiereux
 - Adult: up to 10 mL per bottle
 - Pediatric: up to 4 mL
 - The greater the volume, the better the chance of isolating pathogenic bacteria

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Blood culture specimen collection- preanalytical variables

- Volume of blood
 - Always follow manufacturer instructions
 - Use laboratory policy on maximum allowable amount of blood drawn at any one time from an infant/child; most labs have a chart listing weight and allowable blood volume
 - Always try to collect the maximum amount of blood to assure the highest quality specimen for testing.

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Blood culture specimen collection- preanalytical variables

- Distribution of blood between aerobic and anaerobic bottles
 - Studies recommend aerobic and anaerobic be collected with each draw
 - Some bacteria grow best in the presence of oxygen (air) = aerobic
 - Other bacteria grow best when no oxygen is present = anaerobic
 - If less than the recommended amount of blood is collected, inoculate the aerobic bottle first with the recommended volume, then put the remaining blood in the anaerobic bottle
 - Some labs opt to use only aerobic bottles; in this case, two aerobic bottles should be collected with each draw

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**Blood culture specimen collection-
preanalytical variables**

- Disinfection of skin
 - It is normal for our skin to have bacteria; called “normal flora”
 - Prior to the venipuncture for a blood culture, the patient’s skin must be disinfected to minimize the chance of the normal flora contaminating the blood specimen

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**Blood culture specimen collection-
preanalytical variables**

- Disinfection of skin
 - Most commonly used skin disinfection substances are povidone-iodine and chlorhexidine gluconate
 - Povidone-iodine “Frepp®/Sepp®”
 - Chlorhexidine “Chloroprep”
 - Both disinfect equally

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**Blood culture specimen collection-
preanalytical variables**

- Povidone-iodine “Frepp®/Sepp®”
 - Two step procedure
 - Step 1: Frepp
 - Sponge with wings; contains 70% isopropyl alcohol; wings of sponge are squeezed together to break the ampule containing the alcohol
 - Holding sponge by wings, the sponge is pressed on the skin until liquid appears
 - Gently rubbed back and forth over the skin for 30 seconds
 - Allow to dry until skin is no longer wet-at least one minute, may take longer

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**Blood culture specimen collection-
preanalytical variables**

- Povidone-iodine “Frepp®/Sepp®”
 - Two step procedure
 - Step 1: Frepp®-continued
 - Gentle friction created by going back and forth with the sponge, lifts up & removes dead cells, helps disinfect the area
 - Step 2: Sepp®
 - 10% povidone iodine in glass ampule with cotton gauze tip

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**Blood culture specimen collection-
preanalytical variables**

- Povidone-iodine “Frepp®/Sepp®”
 - Step 2: Sepp®
 - 10% povidone iodine in glass ampule inside another ampule with cotton gauze tip
 - Outer ampule squeezed until inner ampule breaks, releasing povidone iodine to the tip of the cotton gauze
 - Apply povidone iodine to the venipuncture site starting at the center and moving outward in concentric circles to the periphery



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**Blood culture specimen collection-
preanalytical variables**

- Step 2: Sepp®-continued
 - Sepp must be allowed to dry; at least one minute, may take longer
 - After collection is completed, use alcohol wipe to remove solution from the skin
- Chlorohexidine “Chloroprep®”
 - Sponge with wings; contains 2% chlorhexidine gluconate; wings of sponge are squeezed together to break the ampule containing the chlorhexidine
 - Holding sponge by wings, the sponge is pressed on the skin until liquid appears

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Blood culture specimen collection- preanalytical variables

- Gently rub back and forth over the skin for 30 seconds
- Allow to dry until skin is no longer wet; at least one minute, may take longer
- Many labs are moving to chlorhexidine gluconate as it is not associated with allergic reactions and does not need to be cleaned off the skin after the venipuncture is completed
- Disadvantage of chlorhexidine: cannot be used on infants less than two months of age

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Blood culture specimen collection- preanalytical variables

- Other important things regarding specimen collection for blood cultures
 - Arterial blood is not recommended
 - Blood collected from indwelling intravascular access devices have higher rates of contamination
 - Specimens should be received in the lab within two hours of collection
 - Specimens should never be refrigerated or frozen; kept at R

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Blood culture bottles



- Two basic types of bottles—long neck and short neck
- Bottles contain a nutrient broth to enable bacterial growth and an anticoagulant to prevent the blood from clotting

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Blood culture bottles

- Bottles have different color caps to distinguish:
 - aerobic from anaerobic,
 - pediatric from adult, and
 - the presence of other substances
 - resins/activated charcoal to absorb any antibiotics in the patient's blood
 - supplemental enrichment media for bacteria such as *Mycobacteria*

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Blood culture bottles

- Bottles draw blood with vacuum but the bottles can be easily overfilled; must allow to fill only to the volume marker on the bottle
- Overfilled bottles can lead to false positives
- Nutrient broth in bottle should not come in contact with the needle entered in the patient's vein; bottles must sit upright when blood is being added

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Filling blood culture bottles

- Blood is added to the bottles one of two ways
 - Direct draw using an winged infusion set (butterfly) and tube holder/adaptor cap
 - Blood collected into syringe then transferred to bottle using a blood transfer device

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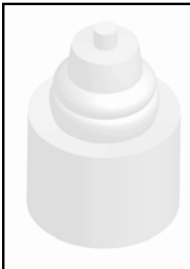
Filling blood culture bottles-
adapter caps



- Long neck blood culture bottles
 - Designed for use with regular “adapter” or tube holder

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Filling blood culture bottles-
adapter caps

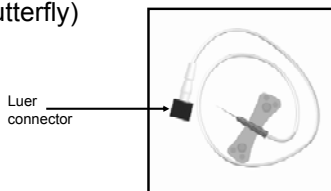


- Short neck blood culture bottles
 - Manufacturer designed a special adapter cap to fit the bottle top

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Filling blood culture bottles-
adapter caps

- Both adapters work the same
- Adapter is attached to the luer connector of a winged infusion set (butterfly)



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Filling blood culture bottles- adapter caps

- Venipuncture is performed with butterfly.
- Blood culture bottle is inserted into the tube holder/adapter cap
- Blood is allowed to flow into the bottle until the “fill to” line is reached

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Filling blood culture bottles- syringe

- A syringe can be used to collect blood for a blood culture if long neck bottles are used
- Transfer device must be used to transfer blood from the syringe to the bottle
- Transfer device looks like a tube holder/adapter but it has a needle inside of it

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Filling blood culture bottles- syringe

- After venipuncture is completed using a syringe, the safe needle device is activated & the needle removed
- Syringe is attached to the luer end of the tube holder



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Filling blood culture bottles-syringe

- The blood culture bottle is inserted into the transfer device (where the red top tube appears in this picture)
- Blood enters the bottle from the syringe



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Blood cultures in the lab

- Once blood culture bottles reach the lab, they are placed in an automated instrument
- The instrument constantly monitors the bottles for the production of CO_2 , a by-product of bacterial growth
- CO_2 is usually detected between 13.8 hr to 20.2 hours

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Blood cultures in the lab

- When a bottle has been determined to have bacterial growth, an aliquot of the blood/culture media is removed and placed on culture plates
- When bacteria grows on the plates, the CLS performs biochemical testing to determine what bacteria is present, i.e., *Staphylococcus aureus*, *Escherichia coli*, etc
- Once the identify of the bacteria is known, tests are performed to determine the best antibiotic to use to treat the infection

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Blood culture contamination

- A contaminated blood culture occurs when the bacteria found to be growing in the culture are from the patient's skin and are not the cause of the patient's illness.
- How does the lab tell if bacteria growing in the blood culture bottle came from the patient's blood (a "real" positive) or the patient's skin (a "false" positive or contamination)?
- The CLS in microbiology have their "ways"!

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Blood culture contamination

- Is blood culture contamination a big deal?
 - YES! It is such a big deal that CAP-accredited laboratories (and most other laboratories) monitor the percentage of contaminated blood cultures by the individual collecting specimens.
 - Example: I collected 50 blood cultures in April 2009 and 5 were determined to be false positives due to contamination. This equals 10% blood culture contamination rate.

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Blood culture contamination

- Most blood culture contamination comes from bacteria on the patient's skin.
- The skin bacteria can also cause septicemia; when the patient's blood culture comes up positive, the doctor must treat the patient as if he/she has septicemia.

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Blood culture contamination

- Studies show that treating a patient for a false positive blood culture
 - Extends his/her hospital stay by as much as 4.5 days
 - Increases the cost of treatment by as much as \$8,700
 - ↑ laboratory charges
 - ↑ pharmacy charges
 - ↑ hospital stay

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Blood culture contamination

- Therefore, both CAP and ASM recommend that blood culture contamination rates be monitored by individual on a monthly basis.
- The accepted threshold of contamination is 3%; some laboratories tighten the threshold to 2 – 2.5%.

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Blood culture contamination

- All quality assurance monitors must have a plan of action should the acceptable threshold be exceeded.
- For blood culture contamination, documented retraining is indicated when a phlebotomist (or other healthcare provider) exceeds the acceptable number of contaminated blood cultures.

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Blood culture specimen collection-equipment

- Gloves
- Tourniquet
- Alcohol wipes
- Gauze
- Bandage/Coban® wrap
- Winged infusion set (butterfly) or syringe/safety needle/transfer device
- Blood culture bottles
- Disinfection kit (povidone iodine or chlorhexidine gluconate)
- Tube holder, if using long neck blood culture bottles; adapter cap if using short neck bottles
- Biohazard waste container

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Blood culture collection procedure

1. Identify patient per facility protocol.
2. Explain procedure to patient.
3. Wash hands per facility protocol.
4. Gather needed equipment and items.
5. Don gloves.
6. Locate venipuncture site. Note a "landmark" by the site as you will not be able to repalpated. Release the tourniquet.

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Blood culture collection procedure

7. Prepare the skin using either a two-step or one-step method, as previously discussed. Allow each step to dry. Do not blot, wipe, fan, or blow on the site.
8. While site is drying, remove the protective caps on the blood culture bottles and cleanse the septum with 70% alcohol wipe. Use a separate wipe for each bottle. Do not use iodine or Betadine.
9. Connect the blood culture bottle adapter cap to the luer connector of the butterfly.

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Blood culture collection procedure

10. Retie the tourniquet and perform the venipuncture. Do not repalpate the cleansed venipuncture site.
11. Perform the puncture.
12. Place the adapter cap on the aerobic bottle and push the needle through the septum of the bottle. Keep the bottle in an upright position. Blood culture liquid should not come into contact with the butterfly tubing or needle.

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Blood culture collection procedure

13. Using the fill indicator line on the bottle label, collect the appropriate amount of blood.
14. Remove the bottle from the adapter cap and repeat the procedure for the anaerobic bottle.
15. Gently mix the blood with the culture fluid.

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Blood culture collection procedure

16. Collect other lab tests, if needed.
17. Release the tourniquet and remove the needle from the patient.
18. Provide appropriate post-puncture care for the patient. Remove gloves and wash hands.

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Blood culture collection procedure

19. Appropriately discard used equipment.
20. Remove gloves and wash hands.
21. Label the blood culture bottles per facility protocol. Do not place the label over the bottle bar codes.

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Blood culture collection procedure-SPS tubes

- SPS tubes
 - Yellow top tube containing sodium polyanethol sulfonate (SPS)
 - When certain bacteria/fungi (and even some viruses) are anticipated, collection in SPS tubes may be requested
 - Evacuated tube draws 8.3 mL; pediatric 1.5 mL
 - Site preparation is same as for blood culture bottles; top of tube should be cleansed with alcohol wipe. Do not use iodine or Betadine.
 - Tube should be gently inverted to mix blood with SPS.

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Blood culture collection-specimen rejection criteria

- Incorrectly labeled or unlabeled bottles
- Broken, damaged, or leaking bottles
- Clotted bottles
- Tubes containing anticoagulants other than SPS

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Blood culture specimen collection- preanalytical variables – review

1. Timing of collection
2. Number of blood cultures collected
3. Volume of blood added to bottles
4. Distribution of blood between aerobic and anaerobic bottles
5. Disinfection of skin

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Questions?



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[_____]

Thank You!

And—don't forget to take the online CE test to receive recertification credit.

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