Blood Culture Contamination

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Medical Grand Rounds
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The Impact of Confusing Skin Contamination & Device Colonization with Clinical Infection

The Blood Culture Growing Coagulase-Negative Staphylococci, diptheroids, corynebacteria: *Infection or Not?*
Overview

• Bacteriology of the skin
• Factors that affect contamination of blood cultures
• Interpretation of blood cultures
• Incidence of blood culture contamination
• Pathogenesis of central venous catheter colonization
• Incidence of catheter colonization
• Impact of contaminated blood cultures
• Technique to minimize blood culture contamination
• Conclusion
Question 1

• Coagulase negative staphylococci are a common skin commensal and a common cause of blood culture contaminations.
  – True or False?
Question 2

• 2nd generation CVCs impregnated with antiseptics do not have issues with bacterial colonization or infection.
  – True or False?
Question 3

- 2 Positive blood cultures from the same patient separated in time by multiple negative blood cultures is suggestive of a blood culture contamination.
  - True or False?
Skin Flora

• Price classified skin organisms:
  – Transient flora:
    • relatively scarce on clean, unexposed skin; abundant on exposed skin
    • non-reproducing
    • loosely attached; easily removed
  – Resident flora:
    • permanent inhabitants of the skin
    • growing and reproducing
    • firmly attached; relatively difficult to remove

Price PB. J Infect Dis 1938;63:301.
## Resident Skin Flora

<table>
<thead>
<tr>
<th>Category</th>
<th>Organism(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Micrococaceae</td>
<td><em>Staphylococcus</em> spp</td>
</tr>
<tr>
<td></td>
<td><em>Micrococcus</em> spp</td>
</tr>
<tr>
<td>Coryneforms</td>
<td><em>Corynebacterium</em> spp</td>
</tr>
<tr>
<td></td>
<td><em>Propionibacterium</em> spp</td>
</tr>
<tr>
<td>Gram-negative bacilli</td>
<td><em>Acinetobacter calcoaceticus</em></td>
</tr>
<tr>
<td></td>
<td><em>Alcaligenes</em></td>
</tr>
<tr>
<td></td>
<td><em>Pseudomonas</em> spp</td>
</tr>
<tr>
<td>Pityrosporum</td>
<td></td>
</tr>
</tbody>
</table>

Multiple organisms serve as potential contaminants.

Density of Bacterial Colonization
(mean count/cm²)

Noble WC. Microbiology of Human Skin, 1981.
Factors Affecting Contamination of Blood Cultures

- Anatomic site- varied organism concentration
  - Higher contamination rates from femoral vein or areas of dermatitis
- Operator technique
- Number of cultures obtained
- Catheter draw vs. venipuncture

### Nosocomial Bloodstream Infections, 1995-2001

<table>
<thead>
<tr>
<th>Rank</th>
<th>Pathogen</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Coagulase-negative Staph</td>
<td>30%</td>
</tr>
<tr>
<td>2</td>
<td>S. aureus</td>
<td>17%</td>
</tr>
<tr>
<td>3</td>
<td>Enterococci</td>
<td>12%</td>
</tr>
<tr>
<td>4</td>
<td>Candida spp</td>
<td>8%</td>
</tr>
<tr>
<td>5</td>
<td>E. coli</td>
<td>6%</td>
</tr>
<tr>
<td>6</td>
<td>Klebsiella</td>
<td>5%</td>
</tr>
<tr>
<td>7</td>
<td>Pseudomonas</td>
<td>4%</td>
</tr>
<tr>
<td>7</td>
<td>Enterobacter</td>
<td>4%</td>
</tr>
<tr>
<td>8</td>
<td>Serratia</td>
<td>2%</td>
</tr>
<tr>
<td>9</td>
<td>Acinetobacter</td>
<td>1%</td>
</tr>
</tbody>
</table>

N= 23,655

Increasing Role of CNS in NBSIs

How does one interpret a positive blood culture with coagulase negative staphylococci or other potential contaminants?
Interpretation of Blood Cultures

• Blood culture is the only test used to define bacteremia in routine clinical practice
  – No gold standard against which to compare; precludes direct determination of clinical utility

• Pattern of positivity
• Time to positivity
• Organism
• Venipuncture vs. catheter draw

Various factors are at play in the clinical interpretation of a positive blood culture
Patterns of Blood Culture Positivity


Blood culture positivity decreases with repeat cultures given contamination.

- **Endocarditis**
- **True bacteremia**
- **Contaminants**
Number of Positive Cultures

Blood culture positivity decreases with repeat cultures given contamination

% representing contamination

Impact of Inoculum Size on Time to Positivity

- In vitro study
- Serial 10-fold dilutions of an initial inoculum of $3 \times 10^7$ CFU/mL of *S. epidermidis* prepared
- 0.1 mL of each dilution injected into aerobic blood culture bottle of an automated detection system
- **Each 10-fold dilution added ~2.5 hours to time to positivity**

# Classification of Contamination Based on Organism

<table>
<thead>
<tr>
<th>Probability of contamination</th>
<th>High (&gt;90%)</th>
<th>Intermediate</th>
<th>Low (&lt;10%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corynebacterium spp</td>
<td>Viridans strep (49%)</td>
<td>S. aureus</td>
<td></td>
</tr>
<tr>
<td>Propionibacterium spp</td>
<td>Enterococci (22%)</td>
<td>S. pneumoniae</td>
<td></td>
</tr>
<tr>
<td>Bacillus spp</td>
<td>CNS (82%)</td>
<td>E. coli</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ps. aeruginosa</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>C. Albicans</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Acinetobacter spp</td>
<td></td>
</tr>
</tbody>
</table>

Situations Predicting CNS Contamination

• A single positive blood culture followed by multiple negative blood cultures
• Only 1 of 2 simultaneously-drawn blood cultures grow CNS
• 2 positive cultures from the same patient separated in time by multiple negative cultures
• Growth in only the aerobic or anaerobic bottle of a simultaneously inoculated pair

Number of Positive Cultures: Coagulase-Negative Staphylococci

Multiple positive cultures suggests clinical significance

Positive Predictive Value of Blood Cultures Positive for CNS

• Retrospective evaluation of 227 episodes of CNS bacteremia

• Infection defined as ≥1 positive blood culture in patient with fever, treated by MD, have ≥1 clinical or laboratory sign of infection (e.g., hypotension, leukocytosis, DIC markers)

• 26% of positive CNS blood cultures represented true infection (positive predictive value)

# Role of Contaminants in Blood Cultures

Evaluation of 37,156 blood cultures yielding 2,333 isolates over a 3-year period from a 1,000-bed hospital

<table>
<thead>
<tr>
<th>Organism</th>
<th>Clinically Significant</th>
<th>Transient</th>
<th>Contaminant</th>
<th>Indeterminate</th>
</tr>
</thead>
<tbody>
<tr>
<td>CNS (n=683)</td>
<td>20%</td>
<td>10%</td>
<td>64%</td>
<td>6%</td>
</tr>
<tr>
<td>Viridans strep (n=114)</td>
<td>31%</td>
<td>38%</td>
<td>28%</td>
<td>3%</td>
</tr>
<tr>
<td>Enterococci (n=110)</td>
<td>92%</td>
<td>4%</td>
<td>2%</td>
<td>2%</td>
</tr>
<tr>
<td>Diphtheroids (n=77)</td>
<td>16%</td>
<td>8%</td>
<td>71%</td>
<td>5%</td>
</tr>
<tr>
<td>ALL Organisms (n=2,333)</td>
<td>64%</td>
<td>8%</td>
<td>25%</td>
<td>3%</td>
</tr>
</tbody>
</table>

Blood Culture Contamination Rates

- Multicenter study (640 institutions)
- Each center collected data on positive blood cultures for 120 days or until a total of 1,000 positive and 1,000 negative cultures had been processed
- 497,134 cultures from adults were evaluated; largest study ever performed
- Median contamination rate = 2.5%
  - Represents 30% of all positive results

## Summary: Blood Culture Contamination Rates

<table>
<thead>
<tr>
<th>Author/year</th>
<th>Cultures evaluated</th>
<th>% contaminated</th>
<th>Of contaminated, % CNS</th>
</tr>
</thead>
<tbody>
<tr>
<td>MacGregor/1972</td>
<td>1,707</td>
<td>8.9</td>
<td></td>
</tr>
<tr>
<td>Roberts/1980</td>
<td>18,132</td>
<td>0.8</td>
<td>NR</td>
</tr>
<tr>
<td>Shahar/1990</td>
<td>181</td>
<td>3.9</td>
<td>29</td>
</tr>
<tr>
<td>Roberts/1991</td>
<td>37,156</td>
<td>3.3</td>
<td>76</td>
</tr>
<tr>
<td>Thamlikitkul/1992</td>
<td>1,619</td>
<td>8.0</td>
<td>11</td>
</tr>
<tr>
<td>Schifman/1993</td>
<td>1,546</td>
<td>3.4</td>
<td>NR</td>
</tr>
<tr>
<td>Strand/1993</td>
<td>8,467</td>
<td>5.0</td>
<td>80</td>
</tr>
<tr>
<td>Gibb/1997</td>
<td>17,744</td>
<td>2.0</td>
<td>55</td>
</tr>
<tr>
<td>Souvenir/1998</td>
<td>1,433</td>
<td>4.1</td>
<td>NR</td>
</tr>
<tr>
<td>Miroz/1999</td>
<td>2,041</td>
<td>2.4</td>
<td>98</td>
</tr>
<tr>
<td>Little/1999</td>
<td>3,851</td>
<td>3.1</td>
<td>87</td>
</tr>
<tr>
<td>Segal/2000</td>
<td>8,306</td>
<td>3.0</td>
<td>49</td>
</tr>
<tr>
<td>Waltzman/2001</td>
<td>9,465</td>
<td>0.9</td>
<td>63</td>
</tr>
</tbody>
</table>
Predictors of Contamination
Predictors of Contamination

- MDs drawing blood cultures
  - 3.9% vs. 2.2% [P<.001]
- Use of iodophor (e.g., Betadine) for skin prep
  - 2.6% (iodophor) vs. 2.1% (tincture of iodine), [P=.036]
    - In hospitals with MDs drawing cultures: 2.9% (iodophor) vs. 2.3% (tincture), [P=.042]
    - In hospitals with phlebotomy teams: no difference between iodophor & tincture
- Lack of antiseptic application to bottles prior to inoculation
  - 3.4% (no antiseptic) vs. 2.3% (antiseptic), [P=.018]
- Lack of phlebotomy team
  - 2.7% vs. 2.3% [P=.039]

## Predictors of Contamination

### Trends in Blood Culture Contamination: A College of American Pathologists Q-Tracks Study of 356 Institutions

<table>
<thead>
<tr>
<th>Design</th>
<th>• Longitudinal cohort study of 356 clinical laboratories that provided quarterly data about blood culture results</th>
</tr>
</thead>
</table>
| Results | • Contamination was higher in institutions that used nonlaboratory personnel to collect blood \( (P = .03) \)  
• Contamination was lower in facilities that used a dedicated phlebotomy team \( (P < .001) \).  
• Higher volume of blood collection was associated with lower contamination rates \( (P < .001) \) |
| Conclusion | Institutions using decentralized patient-centered personnel rather than dedicated phlebotomy teams to collect blood cultures experience significantly higher contamination rates. |
What about Central Venous Catheters as Sources for Blood Cultures?
Central Venous Catheters

- Estimated that 5 million central venous catheters are used in the US yearly
- Incidence of catheter-related bloodstream infection is estimated at 250,000-400,000 per year
- Of catheters in place on average for 8 days, 25% develop colonization & 5% BSI
Pathogenesis of Catheter Colonization

- Migration of organisms from the catheter-skin interface over the external surface of the catheter
- Migration of organisms from the catheter hub down the internal surface of the catheter
- Hematogenous seeding of the catheter tip
- Contamination on insertion
- Contaminated infusates

Catheter Colonization

Cocci embedded in vascular catheter biofilm

Catheter Colonization & Infection Rates

Pooled data from 14 clinical trials of central venous catheters

<table>
<thead>
<tr>
<th>Catheter type</th>
<th>1st generation</th>
<th>2nd generation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Non-impregnated</td>
<td>Antiseptic impregnated</td>
</tr>
<tr>
<td>Colonized</td>
<td>481/1641 29.3%</td>
<td>396/2412 16.4%</td>
</tr>
<tr>
<td>Infected</td>
<td>79/1602 4.9%</td>
<td>54/2338 2.3%</td>
</tr>
</tbody>
</table>

Despite antiseptic impregnation of catheters-contamination and infection still occurs
Contaminated Blood Cultures: Catheter Draws vs. Venipuncture

- Retrospective evaluation of 3,276 blood cultures from 2 hospitals (900 beds total)
- 89/3,276 positive for skin flora
  - 59/89 determined to be contaminants
- Rate of contamination:
  - Overall: 1.8%
  - Venipuncture specimens: 1.7%
  - Central line specimens: 2.0%

Contaminated Blood Cultures: Catheter Draws vs. Venipuncture

- Evaluated 1,516 episodes of blood cultures (3,395 sets)
- Contamination determined by 2 independent reviewers; disagreements referred to a panel of 3 ID experts
- Contamination rate
  - Via intravascular line: 6%
  - Via venipuncture: 3%
- Of CNS (+) cultures, 86% were deemed contaminants

# Contaminated Blood Cultures: Catheter Draws vs. Venipuncture

## Interpretation of Paired Blood Culture Results

<table>
<thead>
<tr>
<th>Venipuncture</th>
<th>Intravascular Catheters</th>
</tr>
</thead>
<tbody>
<tr>
<td>+</td>
<td>-</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>True Positive</th>
<th>Discordant</th>
<th>Discordant</th>
</tr>
</thead>
<tbody>
<tr>
<td>True negative</td>
<td>-</td>
<td>True negative</td>
</tr>
</tbody>
</table>

Catheter Draws vs. Venipuncture

The analysis of discordant, paired cultures

(1) Evidence of sepsis (fever, high or low neutrophil count) and a localizing site;

(2) Presence of organisms unlikely to be contaminants in the culture, including *Staphylococcus aureus*, *Candida* spp. and *Streptococcus pneumoniae*; or

(3) The same organism found in other blood cultures (in addition to the pair being analysed) taken from a separate site during the same episode of sepsis.

Clinical Utility of Blood Cultures: Catheter Draws vs. Venipuncture

• Study aim was to assess the sensitivity and specificity of catheter-drawn and peripheral blood cultures.
• 8444 paired blood culture samples collected over a 44-month period from a 280 bed metropolitan hospital.
• Catheter-collected cultures had a specificity of 85% compared with 97% for peripheral cultures.
• In only two instances (0.2%) was the diagnosis of clinically significant bacteraemia made on the basis of catheter culture alone.

Clinical Utility of Blood Cultures: Catheter Draws vs. Venipuncture

• Retrospective cohort study of inpatients in whom paired cultures (peripheral & through central line) were performed (n=551)

• Gold standard: Blinded assessments of culture results by infectious disease experts

• Negative predictive value:
  – Catheter draw: 99% (CI_{95} 97-100%)
  – Venipuncture: 98% (CI_{95} 96-100%)

• Positive predictive value:
  – Catheter draw: 63% (CI_{95} 50-75%)
  – Venipuncture: 73% (CI_{95} 60-86%)

Impact of Contaminated Blood Cultures
Impact of Contaminated Blood Cultures

• Unnecessary antimicrobial therapy
  – Adverse effects
  – Resistance

• Additional testing

• Consultation

• Increased length of stay

• Increased cost
Impact of Contaminated Cultures

- 4-year retrospective study at Children’s Hospital in Boston
- Evaluated 9,465 blood cultures from children 3-36 months old with rectal temperature \(\geq 39^\circ\text{C}\) without focal bacterial infection (except otitis media)
- Pathogens defined as Group A strep, Group B strep, \textit{H. influenzae}, \textit{N. meningitidis}, \textit{Salmonella}, \textit{S. aureus}, \textit{S. pneumoniae}; all others were considered nonpathogens

Impact of Contaminated Cultures

- 9,465 children cultured at Children’s Hospital, Boston
  - 242 (2.6%) had positive cultures
    - 155 true pathogens
    - 87 contaminants
  - 7/87 children hospitalized

<table>
<thead>
<tr>
<th>Contaminating Organisms</th>
<th>N (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CNS</td>
<td>54 (63)</td>
</tr>
<tr>
<td>Viridans strep</td>
<td>12 (14)</td>
</tr>
<tr>
<td>Micrococcus spp</td>
<td>6 (7)</td>
</tr>
<tr>
<td>Bacillus spp</td>
<td>5 (6)</td>
</tr>
<tr>
<td>Enterococcus spp</td>
<td>2 (2)</td>
</tr>
<tr>
<td>Others</td>
<td>8 (9)</td>
</tr>
</tbody>
</table>

## Impact of Contaminated Blood Cultures

87 patients

<table>
<thead>
<tr>
<th>Item</th>
<th>Charges</th>
</tr>
</thead>
<tbody>
<tr>
<td>Outpatient Facility</td>
<td>8,462</td>
</tr>
<tr>
<td>Laboratory studies</td>
<td>2,682</td>
</tr>
<tr>
<td>Antibiotics</td>
<td>308</td>
</tr>
<tr>
<td>Inpatient Facility</td>
<td>18,000</td>
</tr>
<tr>
<td>Laboratory studies</td>
<td>1,284</td>
</tr>
<tr>
<td>Antibiotics</td>
<td>943</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>$32,229</strong></td>
</tr>
</tbody>
</table>

$32,229 / 87 patients = $371/patient

Impact of Contaminated Cultures

- 8,306 children cultured at Children's National Medical Center
  - 491 (5.9%) had positive cultures
    - Excluded 276, including all patients admitted (n=139)
    - Of 209 analyzed cases, 85 contaminants

<table>
<thead>
<tr>
<th>Organism</th>
<th>N</th>
<th>(%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CNS</td>
<td>42</td>
<td>(49)</td>
</tr>
<tr>
<td>Viridans strep</td>
<td>5</td>
<td>(6 )</td>
</tr>
<tr>
<td><em>Micrococcus</em> spp</td>
<td>3</td>
<td>(3 )</td>
</tr>
<tr>
<td>Others</td>
<td>35</td>
<td>(42)</td>
</tr>
</tbody>
</table>

Impact of Contaminated Blood Cultures

85 patients

<table>
<thead>
<tr>
<th>Item</th>
<th>Charges</th>
</tr>
</thead>
<tbody>
<tr>
<td>Facility + MD</td>
<td>$72,700</td>
</tr>
<tr>
<td>Laboratory studies</td>
<td>$6,204</td>
</tr>
<tr>
<td></td>
<td>$78,904</td>
</tr>
</tbody>
</table>

$78,904 / 85 patients = $928/patient

## Resource Utilization Due to Contaminated Blood Cultures

<table>
<thead>
<tr>
<th></th>
<th>Contaminant episode (n=94)</th>
<th>Negative episode (n=1097)</th>
<th>Univariate P</th>
<th>Multivariate*: % increase (CI&lt;sub&gt;95&lt;/sub&gt;)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Laboratory charges</td>
<td>$2,057</td>
<td>$1,426</td>
<td>.0003</td>
<td>20 (2-50)</td>
</tr>
<tr>
<td>Pharmacy charges</td>
<td>$1,456</td>
<td>$798</td>
<td>.02</td>
<td>21 (-6-56)</td>
</tr>
<tr>
<td>Total charges</td>
<td>$13,116</td>
<td>$8,731</td>
<td>.004</td>
<td>12 (-7-33)</td>
</tr>
<tr>
<td>Length of stay, d</td>
<td>12.5</td>
<td>8</td>
<td>.003</td>
<td>14 (-3-34)</td>
</tr>
</tbody>
</table>

All results are medians

*Controlling for altered mental status, age, intravascular device, severity of underlying disease, major comorbidity

Impact Analysis of Contaminated Blood Cultures

Assumptions:
- 250,000-400,000 bloodstream infections/year in US
- CNS account for 30% of bloodstream infections using current definitions
- 10-40% of CNS BSIs are misclassified (i.e., represent contamination)
- Contaminated blood culture misclassified as infection generates $4,300 in charges
Impact of Contaminated Blood Cultures

Depending on the number of NBSI per annum and the rate of CNS contamination charges range between $32-$206 million.
Technique to minimize contamination of blood cultures by venipuncture
Principles for Collection

- Gloves are worn in accordance with standard precautions.
- Cultures should be drawn before administration of antibiotics, if possible.
- If at all possible, blood cultures should not be drawn from lines, but should be drawn via venipuncture.
Materials

- Chlorhexidine swabs (1-2 packages)
- Alcohol swabs
- Blood culture bottles (2 bottles per set)
- 2 syringes (adult: 20 cc, pediatric: 5 cc)
- 2 needles (adult: 22 gauge or preferably larger butterfly or standard needle; pediatric: 25 or 23 gauge butterfly or standard needle)
- Gloves (sterile & nonsterile)
- Tourniquet
- Sterile gauze pad
- Adhesive strip or tape
- Self-sticking patient labels
- Plastic zip lock specimen bags
Steps

1. Identify the patient by checking the arm band or area-specific procedure.
2. Explain the procedure to the patient.
3. Wash hands with soap and water with friction for 15 seconds or use alcohol-based hand rub.
Steps

4. Prep the rubber cap of the blood culture bottles with an alcohol pad in a circular motion. Allow the alcohol to dry.

Place cursor over image & click to view video
5. Prep the puncture site with chlorhexidine:

- Using aseptic technique, remove the applicator from its package.
- Holding the applicator downward, gently squeeze the wings to release the solution.
- Scrub with a back & forth motion using friction for 30 seconds on dry skin or 2 minutes on wet skin.
- Do not wipe the site after cleansing the skin with chlorhexidine.
Steps

5. Prep the puncture site with chlorhexidine:
   - Using aseptic technique, remove the applicator from its package.
   - Holding the applicator downward, gently squeeze the wings to release the solution.
   - Scrub with a back & forth motion using friction for 30 seconds on dry skin or 2 minutes on wet skin.
   - Do not wipe the site after cleansing the skin with chlorhexidine.
Steps

5. Prep the puncture site with chlorhexidine:
   • Using aseptic technique, remove the applicator from its package.
   • Holding the applicator downward, gently squeeze the wings to release the solution.
   • Scrub with a back & forth motion using friction for 30 seconds on dry skin or 2 minutes on wet skin.
   • Do not wipe the site after cleansing the skin with chlorhexidine.
Steps

6. Apply gloves:

If palpation of site prior to puncture is anticipated, wear **sterile** gloves.

If palpation of site prior to puncture is not anticipated, wear **nonsterile** gloves.
Steps

7. Draw blood. Note the appropriate volume to obtain:

<table>
<thead>
<tr>
<th></th>
<th>Total volume</th>
<th>Aerobic bottle</th>
<th>Anaerobic bottle</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adult</td>
<td>20 ml</td>
<td>10 ml</td>
<td>10 ml</td>
</tr>
<tr>
<td>Pediatric</td>
<td>5 - 20 ml</td>
<td>2.5 - 10 ml</td>
<td>2.5 - 10 ml</td>
</tr>
<tr>
<td>Infant</td>
<td>1-2 ml</td>
<td>0.5 -1 ml</td>
<td>0.5-1 ml</td>
</tr>
<tr>
<td>Adult (low volume)*</td>
<td>4-10 ml</td>
<td>All</td>
<td>None</td>
</tr>
</tbody>
</table>

Do not overfill bottles  (do not add more than 10 ml of blood to each bottle)

*In some cases, it may not be possible to obtain 20 ml blood from an adult. If 10 ml or less is obtained, place all of the blood in the aerobic bottle.
Steps

8. Gently rotate the bottles to mix the blood & the broth (do not shake vigorously).
Steps

9. Place the patient label on each bottle & label each culture bottle with the site of specimen collection.

10. Send the blood cultures to the Clinical Microbiology receiving area as soon as possible.
Steps

12. If 2 sets of blood cultures have been ordered, obtain the second set in the same manner as the first, making a new venipuncture at a different site.
Summary

• Interpreting blood cultures growing CNS remains difficult
  – Lack of gold standard
  – CNS increasingly important as contaminants & pathogens

• Positive Blood cultures drawn through CVCs can be difficult to interpret given high rates of colonization and contamination
  – Catheter colonization & infection rates are significantly lower with 2nd generation catheters

• Impact of contaminated blood cultures is not well elucidated, but given the number of blood cultures drawn, is likely to be significant

• Avoidance of CVC blood draws, proper technique, and trained phlebotomy teams will likely decrease the frequency of blood culture contamination.
Question 1

- Coagulase negative staphylococci are a common skin commensal and a common cause of blood culture contaminations.
  - True or False?

  TRUE
• 2nd generation CVCs impregnated with antiseptics do not have issues with bacterial colonization or infection.
  – True or False?

  FALSE
Question 3

• 2 Positive blood cultures from the same patient separated in time by multiple negative blood cultures is suggestive of a blood culture contamination.
  – True or False?

TRUE