Estimated Clinical and Economic Impact of Reducing Blood Culture Contamination
Three important papers to help with the economic decision

Economic health care costs of blood culture contamination: A systematic review
Casey Dempsey PharmD, Erik Skoglund PharmD, Kenneth L. Muldrew MD, MPH, Kevin W. Garey PharmD, MS

State of the Science Review

Estimated Clinical and Economic Impact through Use of a Novel Blood Collection Device To Reduce Blood Culture Contamination in the Emergency Department: a Cost-Benefit Analysis
Erik Skoglund, Casey J. Dempsey, Hua Chen, Kevin W. Garey

A Comprehensive Update on the Problem of Blood Culture Contamination and a Discussion of Methods for Addressing the Problem
Gary V. Doern, Karen C. Carroll, Daniel J. Diekema, Kevin W. Garey, Mark E. Rupp, Melvin P. Weinstein, Daniel J. Sexton
We draw a lot of blood cultures in the USA (40,000,000+)! …and a few definitions and numbers to get us started.

Positive rate: <5-10%

Negative: 90-95%

True pathogens

Contaminants

Positivity rate

Microbiology lab consequences of blood culture contamination

<table>
<thead>
<tr>
<th>Event</th>
<th>Micro lab consequence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blood culture drawn</td>
<td>Disrupt laboratory efficiency</td>
</tr>
<tr>
<td>Empiric antibiotic</td>
<td>Tech work up of contaminated blood cultures and divert away from more critical samples.</td>
</tr>
<tr>
<td>started</td>
<td>Time spent in phoning false positive blood cultures as critical action values to care providers.</td>
</tr>
<tr>
<td></td>
<td>Negative impression of clinical laboratory services</td>
</tr>
<tr>
<td></td>
<td>Unnecessary and costly additional laboratory testing</td>
</tr>
<tr>
<td></td>
<td>Repeat blood cultures, cultures of ancillary sites, and vancomycin TDM (20)</td>
</tr>
<tr>
<td></td>
<td>Rapid diagnostics used for speciation (17).</td>
</tr>
</tbody>
</table>

Clinical consequences of blood culture contamination

Event

Blood culture drawn
Empiric antibiotic started

Blood culture contaminant

Time

Clinical consequence

• Continued use of empiric antibiotics
• New start antibiotics (vanco)
• Repeat blood cultures and other diagnostic tests (TEE)
• Delay in diagnosis of actual reason for hospitalization

Toxicities associated with antibiotic use (CDI)

Increased length of stay

Each additional night in a hospital increases a patient’s risk for adverse drug reaction by 0.5%, for hospital-acquired infection by 1.6%, and for pressure ulcer of 0.5%.

Bottom line: There are a lot of clinical and laboratory consequences of blood culture contamination

Possible/Probable Contaminant
- CoNS
- Aerobic Diphtheroids
- Anaerobic Diphtheroids
- Bacillus Species

**CLINICAL DILEMMA:**
CONTINUE ANTIBIOTICS OR DE-ESCALATE?

**EXTENDED LENGTH OF STAY**
- HOLD & OBSERVE OR ADMIT?
- ADDITIONAL TESTING (LAB TESTS, BLOOD CULTURES, OTHER DIAGNOSTIC & THERAPEUTIC PROCEDURES)
- TRANSFER TO STEP DOWN OR ACUTE CARE UNIT

**RISK OF C-DIFF, MDRO & ADRS**
RISK OF HAIS/HACs (1.4% INCREASED RISK PER PATIENT PER DAY)

**CULTURE RESULT:**
- NEGATIVE
  - ASYMPTOMATIC
- POSITIVE
  - HOLD OR READMIT

15-40% of the time possible or probable contaminants = true bacteremia*
- Even after Rapid Organism Identification

*data on file

Estimated Clinical and Economic Impact of Reducing Blood Culture Contamination
We recently completed a systematic review of the costs of blood culture contamination

Dempsey et al. Amer J Infect Contr 2019;
<table>
<thead>
<tr>
<th>Publication</th>
<th>Estimated Incremental Charges</th>
<th>Adjusted for 40% Cost-to-Charge Ratio</th>
<th>Extended Length of Stay</th>
</tr>
</thead>
<tbody>
<tr>
<td>Journal of Hospital Infection</td>
<td>$8,210^1*$</td>
<td>$3,284^1$</td>
<td>5.4</td>
</tr>
<tr>
<td>Journal of Clinical Microbiology</td>
<td>$9,665^2*$</td>
<td>$3,866^2$</td>
<td>1+$</td>
</tr>
<tr>
<td>Journal of Hospital Medicine</td>
<td>$10,692^3*$</td>
<td>$4,277^3$</td>
<td>3.0</td>
</tr>
<tr>
<td>Clinical Performance Quality Healthcare</td>
<td>$9,226^4*$</td>
<td>$3,690^4$</td>
<td>8.4</td>
</tr>
<tr>
<td>Journal of American Medical Association</td>
<td>$7,682^5*$</td>
<td>$3,073^5$</td>
<td>4.5</td>
</tr>
<tr>
<td>The American Journal of Medicine</td>
<td>$10,331^6*$</td>
<td>$4,132^6$</td>
<td>4.2</td>
</tr>
<tr>
<td><strong>Average</strong></td>
<td><em><em>$9,301</em>$</em>*</td>
<td><strong>$3,720</strong></td>
<td><strong>4.42</strong></td>
</tr>
</tbody>
</table>

**SOURCES:**

* - CPI adjusted to 2015 $
How to Prevent Blood Culture Contamination
Initial Specimen Diversion Device vs. Phlebotomists

- Prospective evaluation of n=904 patients in ED
- 2 BCx set per patient (1 set diversion, 1 set standard)

*ISDD=Initial specimen diversion device
Does Diversion Device Pay for Itself?

Specific Aims

1) Do direct microbiology and pharmacy cost-savings (including opportunity labor costs) off-set the purchase costs of the device?

2) Is it necessary to consider “soft” cost-savings (e.g. LOS, HAIs) before diversion device is economical?

3) Does institutional use of rapid diagnostic testing influence economic feasibility?
Economic Framework for Blood Culture Contamination

Economics of blood culture contamination is based on the likelihood of these downstream events to occur.
Decision Tree Structure

BCx drawn in ED

- Conventional draw
  - Growth
  - No growth

- ISDD draw

- Contaminant
  - True BSI

- Micro. variables
  - Repeat BCx’s
  - ID/AST costs

- Pharmacy variables
  - Empiric abx
  - Abx DOT

- Indirect variables
  - LOS
  - ADRs
  - HAI’s
  - Dx costs
### Steripath Cost Effectiveness Study

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**Total Estimated Net Cost-Savings per Blood Culture Collection Associated with the Routine Steripath Implementation in the ED**

<table>
<thead>
<tr>
<th>Baseline Blood Culture Contamination Rate Prior to Steripath Implementation</th>
<th>Expected Microbiology Cost-Savings per Blood Culture ($)</th>
<th>Expected Pharmacy Cost-Savings per Blood Culture ($)</th>
<th>Expected Indirect Hospital Cost-Savings per Blood Culture ($)</th>
<th>Total Estimated Cost-Savings per Blood Culture ($)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>with RDT</td>
<td>without RDT</td>
<td>with RDT</td>
<td>without RDT</td>
</tr>
<tr>
<td>2%</td>
<td>$6</td>
<td>$3</td>
<td>$2</td>
<td>$74</td>
</tr>
<tr>
<td>3%</td>
<td>$10</td>
<td>$4</td>
<td>$3</td>
<td>$117</td>
</tr>
<tr>
<td>4%</td>
<td>$13</td>
<td>$6</td>
<td>$4</td>
<td>$160</td>
</tr>
<tr>
<td>6%</td>
<td>$21</td>
<td>$9</td>
<td>$7</td>
<td>$244</td>
</tr>
<tr>
<td>8%</td>
<td>$28</td>
<td>$12</td>
<td>$10</td>
<td>$330</td>
</tr>
</tbody>
</table>

- Use of Steripath ISDD for blood culture collection in the ED is a cost-beneficial strategy to reduce the clinical and economic effect of blood culture contamination in terms of microbiology, pharmacy and indirect hospital implications.

My conclusions

• Blood culture contamination is a frequent and costly event from a clinical and economic perspective

• There are a host of best practice guideline suggestions to prevent blood culture contamination
  – Many of these recommendations contain human factors that are hard to teach/maintain

• Specimen Diversion Device have been shown in clinical trials to reduce blood culture contamination rates to <1%
  – (will this become the new CLSI standard?)

• A Decision analytic model confirmed that use of Steripath ISDD for blood culture collection in the ED would be a cost-beneficial strategy to reduce the clinical and economic effect of blood culture contamination