

Division of Laboratory Systems



Diagnostic Excellence: A New Quality Tool to Prevent Adult Blood Culture Contamination

Jake Bunn, MBA, MLS(ASCP)CM

12/13/2023



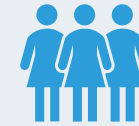
Agenda

- Introduction
 - *New and relevant OneLab™ Resources*
 - *Today's Presenters*
- Diagnostic Excellence: A New Quality Tool to Prevent Adult Blood Culture Contamination
- Q&A
- Upcoming Events

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Ready? Set? Test! Job Aids



Blood and Body Fluid Exposure Job Aid

This job aid is a quick reference guide outlining steps if exposed to blood or body fluids.



PDF

Check
Out the
Job Aid



Glove Removal Job Aid

This job aid provides a step-by-step guide for safely removing disposable gloves.



PDF

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Hand Hygiene Job Aid

This job aid serves as a quick reference guide for the steps to wash hands properly.



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NEW



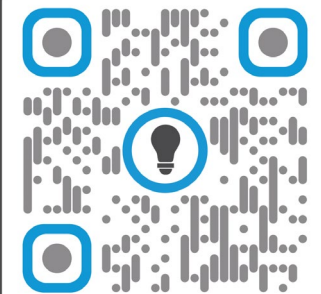
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Presenter



Jake Bunn

Clinical Laboratory Scientist

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U.S. Centers for Disease Control and Prevention



Diagnostic Excellence: A New Quality Tool to Prevent Adult Blood Culture Contamination

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Clinical Laboratory Scientist

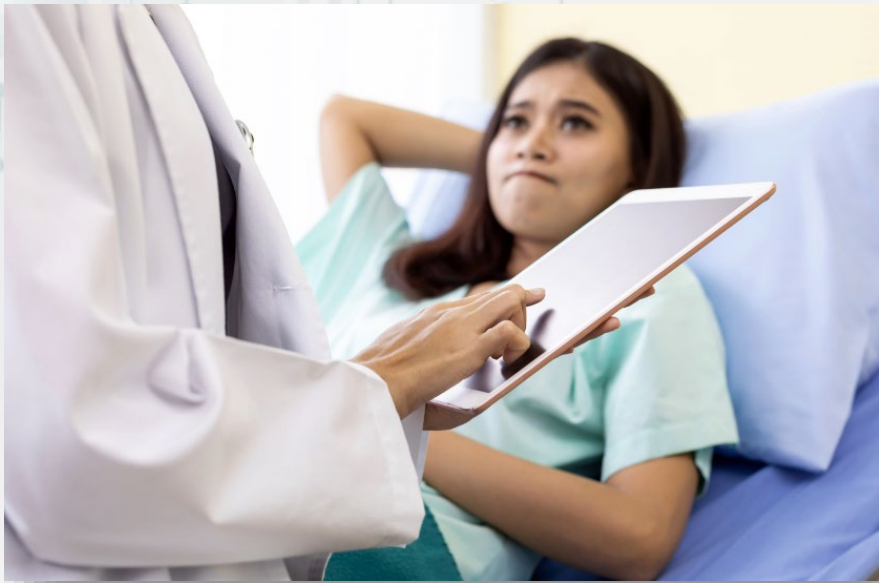




Blood Cultures



False Negatives Could lead to Misdiagnosis



False Positives Could lead to Mistreatment





Clinical Microbiology
Reviews®

PRactical GUIDANCE FOR
CLINICAL MICROBIOLOGY



A Comprehensive Update on the Problem of Blood Culture Contamination and a Discussion of Methods for Addressing the Problem

Gary V. Doern,^a Karen C. Carroll,^b Daniel J. Diekema,^c Kevin W. Garey,^d Mark E. Rupp,^e Melvin P. Weinstein,^f Daniel J. Sexton^g

“...organizations concerned with patient safety and health care quality control such as The Joint Commission, the Centers for Disease Control and Prevention, and the Agency for Healthcare Research and Quality should assume a leadership role.”

CLIA and the Blood Culture Contamination Rate



Code of Federal Regulations

A point in time eCFR system

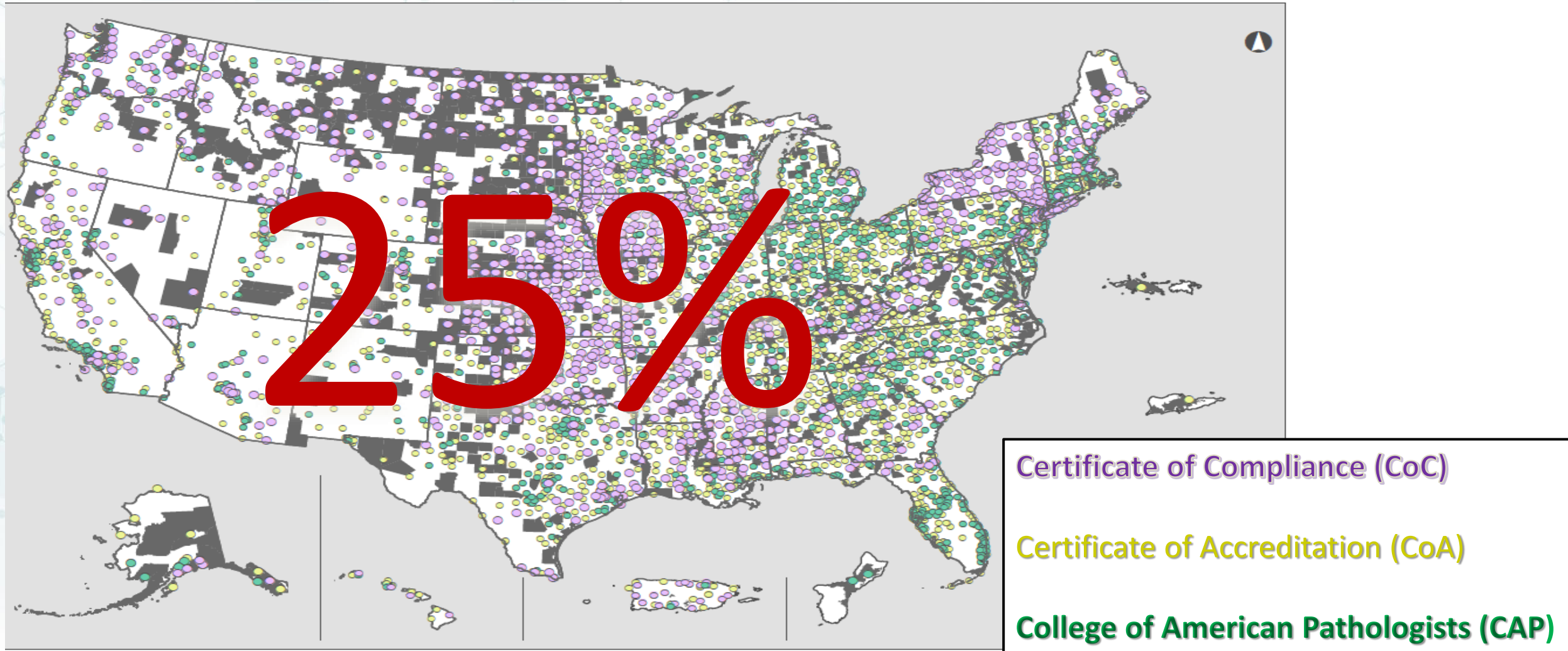


Title 42

PART 493—LABORATORY REQUIREMENTS



Current State of Blood Culture Contamination Assessment and Reporting



Decades of Evidence

State of the Science Review

Economic health care costs of blood culture contamination: A systematic review

Trends in Blood Culture Contamination

A College of American Pathologists Q-Tracks Study of 356 Institutions

Effectiveness of practices to reduce blood culture contamination: A Laboratory Medicine Best Practices systematic review and meta-analysis ☆

Blood Culture Metrics Are Human Metrics: The Missed Opportunity for Clinical Laboratory Quality Measures to Improve the Overall Blood Culture Process

A Quality Improvement Initiative to Reduce Blood Culture Contamination in the Neonatal Unit

Detection of bacteremia in adults: consequences of culturing an inadequate volume of blood

Blood Cultures: Issues and Controversies

Reducing Blood Culture Contamination Rates: Experiences of Four Hospital Systems

A national survey of interventions and practices in the prevention of blood culture contamination and associated adverse health care events

Blood culture contamination in the emergency department: An integrative review of strategies to prevent blood culture contamination

Congressional Action

Military Construction, Veterans Affairs, and Related Agencies Appropriations (MILCON) Act, 2022

July 2021

Reducing Blood Contamination.—The Committee is aware that blood culture contamination leads to enormous clinical implications, laboratory ramifications, and economic costs. The Committee directs VA to prioritize the development and implementation of a specific quality measure for blood contamination based on a recommendation of less than 1% blood culture contamination rate within 6 months of enactment. VA is directed to report to the Committees on Appropriations of both Houses of Congress within 180 days of the enactment of this Act detailing the implementation of this standard of care across the VA medical system.

[CRPT-117hrpt81.pdf \(congress.gov\)](#) Page #63

Correspondence to HHS Agencies

November 2021

We are appreciative of CMS' ongoing efforts to address the growing burden of sepsis for the Medicare population. In light of new clinical evidence and the advent of technologies capable of significantly reducing overall blood culture contamination rates, we strongly encourage CMS to:

- Prioritize the development and implementation of a specific quality measure for blood culture contamination based on an allowable standard of <1% blood culture contamination rates for individual hospitals;
- Collaborate with the Centers for Disease Control and Prevention and National Quality Forum on the development, testing and implementation of the quality measure, with regular reporting to be conducted via the National Healthcare Safety Network in the same manner as other similar quality measures;
- Establish appropriate tracking mechanisms to quantify the impact of blood culture contamination on inappropriate antibiotic use nationwide and potential impacts on the problems of antimicrobial resistance and the emergence and persistence of multi-drug resistant organisms; and
- Evaluate programs and/or other innovative approaches to incentivize adoption and implementation of best practices to minimize blood culture contamination in hospitals nationwide.

We urge CMS to take meaningful action to reduce the preventable error of blood culture contamination which represents an immense and avoidable economic and public health burden. By prioritizing the development and implementation of a specific quality measure for blood culture contamination and appropriately incentivizing the use of clinical practices and technologies that are

[2021.11.30 False Positive Sepsis Tests Letter to CMS.pdf \(house.gov\)](#)

Our Summary of the Current State



Can confirm poor blood culture collection processes may lead to adverse patient safety events



There is a need to standardize blood culture collection and establish quality monitors across the United States to:

- Ensure every patient has local access to equal quality healthcare
- Be able to compare studies and data among institutions

National Patient Safety Measure



CMS Consensus-Based Entity (CBE)
Endorsement and Maintenance

Adult Blood Culture Contamination Rate; A national measure and standard for clinical laboratories and antibiotic stewardship programs

CBE ID: 3658 **Steward:** [Centers for Disease Control and Prevention](#) **Status:** [Endorsed](#) **Status Last Updated:** 12 December, 2022

Measure Timeline



Measure Evaluation Criterion



Importance

Question to Consider when Addressing the Criterion

Is this measure meaningful and important to patients? Does it address an aspect of healthcare where there is a gap in performance or measurement?



Feasibility

Do the benefits of this measure outweigh the potential burdens associated with reporting on it?



Scientific Adaptability

Does the measure produce consistent results that accurately distinguish good care from poor quality care? Does it measure what it purports to measure?



Usability and Use

To what extent can patients, clinicians, hospitals, or other stakeholders use information from the measure to inform performance or improve accountability in care delivery?



Harmonization (Comparison to related or competing measures)

Are there existing measures that have data elements in common with this measure? To what extent can this measure leverage those data elements to reduce the burden associated with implementation and reporting?

Blood Culture Contamination – Preanalytic Issue



Blood Culture Contamination Rate

The total number of blood culture sets with growth of skin commensals without the same organism in other sets collected within 24 hours

The total number of eligible blood culture sets collected*

*Eligible at least two blood culture sets collected within 24 hours

Single-Set Blood Culture – Preanalytic Issue



In adults with a suspicion of a blood stream infection, two - three blood culture sets should be obtained in the evaluation of each septic episode (defined as a 24-hour period).
Target volume 40 – 60 mL



When only one blood culture set is collected out of the two - three recommended sets this is called a single-set blood culture.

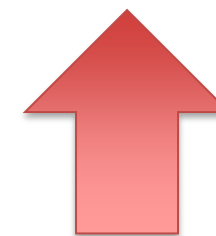
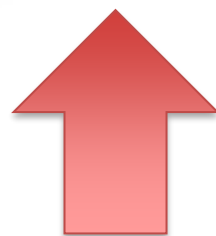
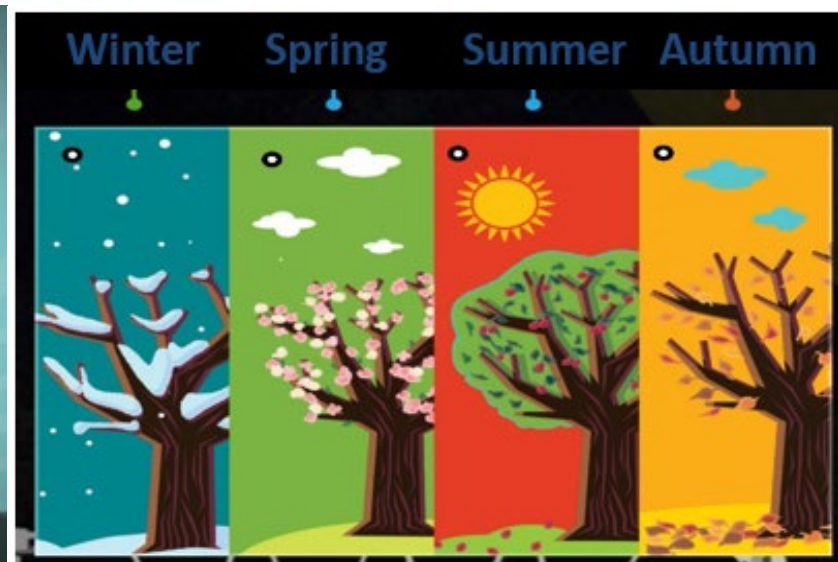
A single-set blood culture in a 24-hour period is not an adequate volume of blood to make a bacteremia diagnosis. (May lead to false negatives).

Single-Set Blood Culture Rate

The total number of single-set blood cultures without another set collected within 24 hours

$$\frac{\text{The total number of single-set blood cultures without another set collected within 24 hours}}{\text{The total number of blood culture sets collected}}$$

Facility Characteristics - Gaps in Care/Disparities



Patient Characteristics - Gaps in Care/Disparities

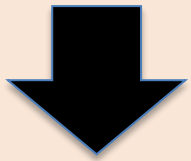


Health Equity and the Clinical Laboratory



Laboratory Collaboration ↔ Antibiotic Stewardship Teams

Collaboration Platform



Antibiotic Stewardship
Teams required by The
Centers for Medicare &
Medicaid Services (CMS)



Diagnostic Stewardship

Ordering the **right tests** for the **right patient** at the **right time** to provide information necessary to optimize clinical care with an emphasis on improved outcomes and patient safety.



[Morgan DJ, Malani PN, Diekema DJ. Diagnostic Stewardship to Prevent Diagnostic Error. JAMA. 2023;329\(15\):1255–1256. doi:10.1001/jama.2023.1678](https://doi.org/10.1001/jama.2023.1678)

Blood Culture Contamination: An Overview for Infection Control and Antibiotic Stewardship Programs Working with the Clinical Laboratory



Blood Culture Contamination: An Overview for Infection Control and Antibiotic Stewardship Programs Working with the Clinical Laboratory

Purpose

Blood culture contamination can compromise quality of care and lead to unnecessary antibiotic exposure and prolonged length of hospitalization. Microbiology laboratories typically track blood culture contamination rates and can provide data to assist in reducing c control programs and microbiology laboratories might participate in des interventions to decrease contamination rates, and antibiotic stewardshd be engaged to optimize multidisciplinary quality improvement efforts to contamination and improve the collection of blood culture specimens.

Background

Blood cultures are important diagnostic tools for identifying the pathogen(s) responsible for a patient's infection. This is especially true of patients with suspected sepsis or septic shock and for patients with suspected infective endocarditis^{1,2}. When indicated, blood cultures should be obtained prior to starting antimicrobial therapy^{1,2}. A conventional blood culture set consists of an aerobic and an anaerobic bottle. For adults, 20-30 mL of blood per venipuncture (depending on the instrument manufacturer) is recommended and may require >2 bottles depending on the system³. At least two blood culture sets should be obtained within a few hours of each other via peripheral venipuncture when obtaining blood cultures for a total volume of 40-60 mL of blood to optimize detection of pathogens⁴. The College of American Pathologists laboratory accreditation program states that clinical laboratories have a written policy and procedure for monitoring blood cultures from adults for adequate volume and provide feedback on the resu the monitoring and reporting of blood culture contamination rates is a laboratory c Because blood is a normally sterile body site, positive blood cultures with a know overall high positive predictive value for infection. However, blood culture contami In the era of modern blood culturing techniques, virtually all blood culture contami the source of contaminants is usually the patient's skin or the hub or cannula of an an existing catheter is used to obtain the specimen). Frequent causes include poo insufficient skin disinfection. Typical organisms include coagulase-negative staphy spp., *Bacillus* spp. other than *Bacillus anthracis*, *Micrococcus* spp., and *Cutibacte* Consequences include unnecessary antibiotic exposure with the potential for dow consequences (e.g., possible allergic reactions and *Clostridioides difficile* infectio include the unnecessary removal of intravenous catheters and other devices, an inc increased costs⁵. One study found that the average length of stay was 2 days long blood cultures compared to patients with negative cultures⁶. That same study four costs of a contaminated blood culture were \$12,824 compared to \$8,286 for a ney \$4,538 for preventing a contaminated blood culture⁶.



Example of a ba an aerobic bott



Tracking and Reporting

It can be useful to track the blood culture contamination rate to ensure high quality blood culture collection techniques are in place and effective. The College of American Pathologists recommends that the laboratory director should regularly review blood culture contamination rates as tracking the contamination rate and providing feedback to units and persons drawing blood cultures is one method that has been shown to reduce contamination rates⁷. Regularly reporting the rate to facility committees and leaders (e.g., infection prevention and control committee or an antimicrobial stewardship committee) can help ensure broad engagement. The American Society for Microbiology (ASM) and the Clinical Laboratory Standards Institute (CLSI) have recommended that an overall blood culture contamination rate should not exceed 3%⁸. However, many facilities have been able to drive this to less than 1%. Therefore, it should be possible to achieve blood culture contamination rates substantially lower than 3% even if 0% is not reached; when best practices are followed, a target contamination rate of 1% is achievable. Such thresholds can provide a method to benchmark unit or between facilities⁹.

Tracking the Blood Culture Contamination Rate

Blood culture contamination rates should be monitored by the laboratory. A contaminated blood culture is generally defined by one set out of multiple sets being positive for a commensal organism. A list of skin commensals can be found here: [An example of calculating a blood culture contamination rate](#) includes dividing the total number of contaminated blood culture sets by the total number of blood culture sets collected during the evaluation period.

Number of blood culture sets with growth of skin commensals within the same organism in other sets collected within 24 hours
Total number of all eligible blood culture sets collected

Exclusion criteria could include a lack of two blood culture sets drawn within a 24-hour period. As an example of the above calculation, if an institution has 200 blood culture sets drawn on 100 patients (each patient has 2 sets drawn within 5 minutes of each other) in one month, and one set grows *Staphylococcus epidermidis* and the patient's other set drawn within 24 hours of the positive one is negative, then the institution's contamination rate is 0.5%.

Using Blood Culture Contamination Rate for Quality Improvement

Many clinical laboratories routinely calculate and report the blood culture contamination rate as a quality metric at the beginning of the month to evaluate the previous month's rate. In addition to reporting i infection prevention and antibiotic ste specialized reporting of rates stratifie care locations and collection staff (e.g phlebotomy teams), can be undertake improvement efforts.

Prevention/Actions⁹

An in-depth discussion of the ways to problem of the blood culture contami found in the review article by Doern e of the article follows.

Full article [here](#).

1. Diagnostic Stewardship

Clinicians should strive to obtain the right patients, in the right set right time. Blood cultures can be and overused. An example of un be not obtaining blood cultures i antibiotics for a patient with susg Without a blood culture collecte antibiotics, it can be more difficu de-escalate antibiotic therapy gti causative organism is more likely unknown. Also, blood cultures of the appropriate volume is less th (i.e., two to three 20 mL volumes initial evaluation of the patient fo as this can decrease the sensitiv detection. Cultures can also be c example, obtaining repeat cultu with fever for whom an alternati than bloodstream infection is mu in patients with a very low pretes bloodstream infection, a positive likely to represent contamination

2. Proper Skin Antisepsis

Improper skin antisepsis can lea in blood culture contamination r recommended that the skin be d alcohol containing disinfectant a prior to drawing blood cultures¹⁰.

3. Blood Culture Bottle Disinfect

It is standard blood culture pract the blood culture bottle tops p

4. Blood Culture Collection Site

Peripheral venipuncture has consistently been associated with lower rates of blood culture contamination than draws collected through existing central venous catheters¹¹. Thus, peripherally drawn blood cultures are preferred over catheter drawn cultures except when the diagnosis of catheter-associated bloodstream infection is suspected¹². In these cases, both peripheral and catheter draws are indicated.

5. Hand Hygiene

Hand hygiene is recommended prior to interacting with patients and donning gloves prior to drawing blood cultures¹³.

6. Phlebotomy Teams and Education on Proper Technique

Blood cultures drawn by phlebotomy teams are less likely to be contaminated compared with blood cultures collected by non-phlebotomy staff in hospital settings¹⁴.

7. Surveillance and Feedback

Studies have demonstrated that providing feedback to those performing blood cultures regarding their contamination rates can decrease blood culture contamination rates^{15,16}. Antibiotic stewardship programs can also consider tracking and evaluating the impact of contamination rates on unnecessary vancomycin use.

8. Diversion Devices

There are devices that are commercially available that have shown promise in further reducing blood culture contamination rates. These devices initially divert a small amount of potentially contaminated blood and then collect blood for the blood culture¹⁷.

Next Step Considerations for Tracking and Preventing Blood Culture Contamination Events

- Antibiotic stewardship and infection prevention personnel should meet with laboratory personnel to learn how tracking and reporting of blood culture contamination events is being performed at their facility
- Understand locations in the facility where blood culture contamination events occur more commonly, the type of staff who collect blood cultures, and how the collector is identified in the laboratory information system

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Preventing Adult Blood Culture Contamination: A Quality Tool for Clinical Laboratory Professionals



[Preventing Adult Blood Culture Contamination: A Quality Tool for Clinical Laboratory Professionals | CDC](#)

CDC Division of Laboratory Systems
EXCELLENT LABORATORIES, OUTSTANDING HEALTH.

**Preventing Adult Blood Culture Contamination:
A Quality Tool for Clinical Laboratory Professionals**

Protect Patients during the Diagnostic Process by Monitoring Adult Blood Culture Contamination (BCC) Rates

Laboratory analysis of blood cultures is vital to the accurate and timely diagnosis of bloodstream infections. However, the reliability of your testing depends on clinical compliance with collection procedures that limit the risk of inconclusive or incorrect results. False negative blood culture results due to inadequate volumes of blood can result in misdiagnosis, delay therapy, and put patients at heightened risk of morbidity and mortality from bacteremia. Likewise, the presence of commonly occurring bacteria or fungi on human skin (i.e., commensal organisms) can increase the risk of false positives, compromising care by leading to unnecessary antibiotic therapy and prolonged hospitalization.

In December 2022, a Centers for Medicare & Medicaid Services (CMS) consensus-based organization endorsed a CDC proposal for a new patient safety measure to address these concerns (see Quality Measures | CMS for more on this topic). CDC developed this quality measure to promote blood culture best practices and improve the laboratory diagnosis of bloodstream infection.

The Clinical Laboratory Improvement Amendments of 1988 (CLIA) state that laboratories must monitor, assess, and when indicated, correct problems identified in their preanalytic systems. Using the methods provided in this quality tool to calculate the BCC and single-set rates will help meet this standard and ensure optimal blood culture collection. In addition, this quality measure incorporates best practices on blood culture collection from the Clinical Laboratory Standards Institute (CLSI) and the Infectious Disease Society of America (IDSA). These best practices are already in place at many laboratories across the nation and have shown to improve the laboratory diagnosis of bacteremia, significantly reduce incidence of BCC, and limit unnecessary antibiotic therapy. CDC strongly encourages you to adopt these practices into your laboratory's standard operating procedures (SOPs), to integrate this measure into your quality management system, and to work with infection control and antibiotic stewardship programs to educate and train clinical staff on their use.

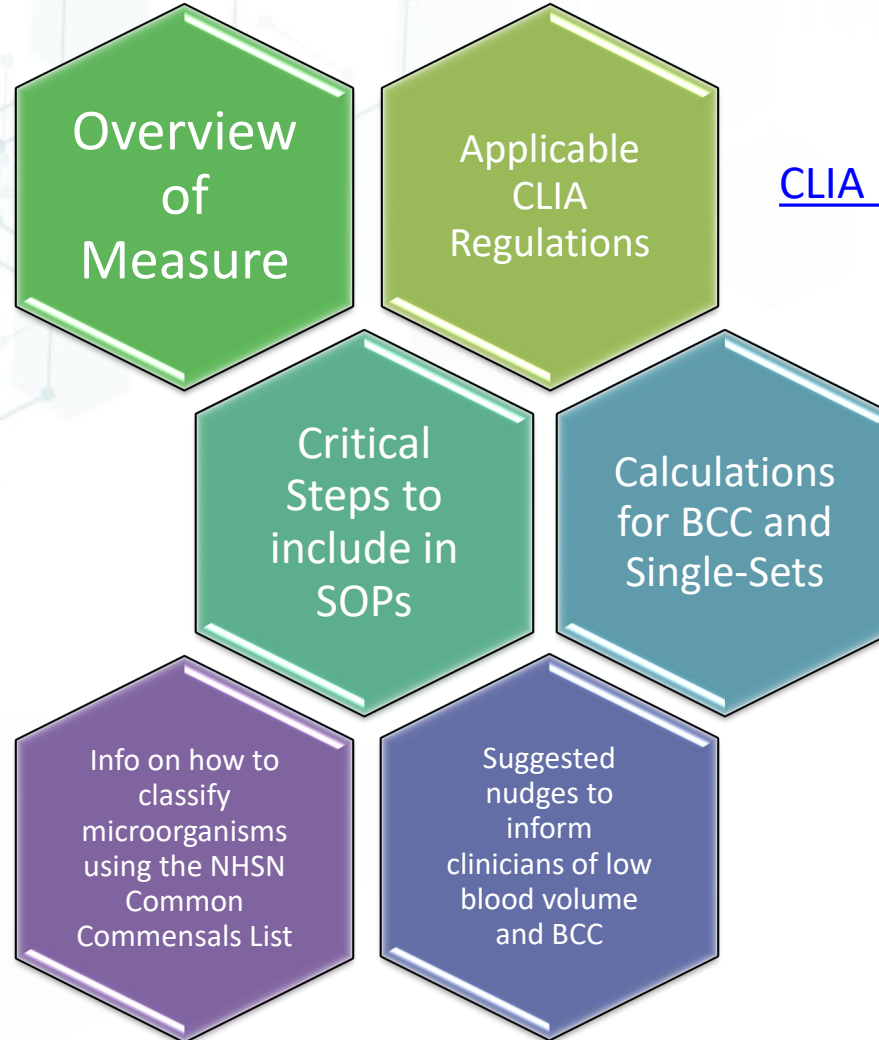
Follow CLIA Regulations
Laboratory Requirements, Code of Federal Regulations, Title 32 (2023): Chapter IV, Part 493 Subpart K – Quality System for Non-Waived Testing – § 493.1249 Standard: Preanalytic systems quality assessment.
The laboratory must establish and follow written policies and procedures for an ongoing mechanism to monitor, assess, and when indicated, correct problems identified in the preanalytic systems specified at §§ 493.1241 through 493.1242.

Collecting Adult Blood Culture Sets
A blood culture set from an adult patient should consist of 20–30 mL of blood collected through venipuncture. This may require more than two bottles, depending on the blood culture system and the institutional policy.

Collect Multiple Sets to Achieve the Optimal Volume
The volume of blood collected is critically important to the laboratory diagnosis of bloodstream infection, which generally requires two or more sets to achieve. In addition, two sets are required to determine whether the presence of a commensal organism can be classified as a possible contaminant.

To achieve an optimal volume, the blood culture collection standard of practice is to collect two to four blood culture sets from adult patients with a suspected blood stream infection in the evaluation of each septic episode (i.e., 24 hours). Your hospital or clinical setting should instruct healthcare staff to collect at least two blood culture sets (total volume of 40–60 mL) within a 24-hour period by peripheral venipuncture prior to antibiotic administration, if possible.

Preventing Adult Blood Culture Contamination: A Quality Tool for Clinical Laboratory Professionals Contents



[CLIA Law & Regulations \(cdc.gov\)](https://www.cdc.gov/ncidod/dlqp/cclia/)

<https://www.cdc.gov/nhsn/xls/master-organism-com-commensals-lists.xlsx>



Suggested Comments to Support Diagnostic Stewardship Practice

Blood Culture Contamination “Nudge”

“Single-set positive out of two sets [or more, if this is the laboratory policy] may indicate the presence of possible skin contaminant, clinical correlation required. Please call the laboratory if further work-up is needed.”

Single-Set Blood Cultures “Nudge”

“Single-set blood culture received; at least two sets needed to achieve the optimal volume (40-60 mL) for diagnosis of bacteremia, or false negatives may occur. Recommend drawing additional blood culture sets if clinically indicated.”



Hospital Sepsis Program Core Elements



Hospital Sepsis Program Core Elements: 2023



Table 1: Examples of tracking sepsis epidemiology, management, and outcomes (continued)

CATEGORY	PRIORITY	CONCEPT	EXAMPLE
Sepsis management	Additional	Antimicrobial narrowing	<p>Numerator: Hospitalizations with anti-MRSA treatment stopped within 3 calendar days of initiation</p> <p>Denominator: Hospitalizations meeting criteria for sepsis, initiated on anti-MRSA antimicrobial treatment, and with no MRSA identified in culture or microbial testing</p>
Sepsis management	Additional	<u>Blood culture contamination</u>	<p>Numerator: Number of blood culture sets with growth of skin commensals without the same organism in other sets collected within 24hrs</p> <p>Denominator: Total number of all eligible blood culture sets collected</p>
Sepsis management	Additional	Single Blood Culture	<p>Numerator: Number of single blood culture sets collected among adult patients</p> <p>Denominator: Total number of all blood culture sets collected among adults</p>
Sepsis management	Additional	Sepsis documentation	<p>Numerator: Hospitalizations with specific aspects of sepsis diagnosis and management documented during transitions of care (e.g., continuity or sepsis diagnosis, antimicrobial therapy plan)</p> <p>Denominator: Hospitalizations with a transition of care (e.g., ED-to-ward; ICU-to-ward transfer)</p>
Sepsis management	Additional	Timely post-hospital follow-up visit	<p>Numerator: Hospitalizations with a primary care follow-up visit scheduled prior to discharge, to occur within 14 days of discharge</p> <p>Denominator: Hospitalizations meeting criteria for sepsis, discharged to home or assisted living</p>
Sepsis management	Additional	Post-hospital follow-up call	<p>Numerator: Hospitalizations with post-discharge follow-up call attempted within three calendar days of discharge</p> <p>Denominator: Hospitalizations meeting criteria for sepsis, discharged to home or assisted living</p>



HOSPITAL SEPSIS PROGRAM CORE ELEMENTS 18



Multi-Professional Expertise

- Having availability of ad hoc domain expertise: Hospital sepsis programs should have at least ad hoc involvement of case management, microbiology, laboratory medicine, phlebotomy, outpatient clinicians, hospital epidemiologists, infection preventionists, patients, families, caregivers, and community members.

Next Steps

Promotional Efforts

Training Tool Kit

Data Collection



Promotional Efforts

- ✚ Accreditation Organizations and Professional Societies
- ✚ Hospital Administrators
- ✚ Antibiotic and Diagnostic Stewardship Committees
- ✚ Patient Safety and Quality Leaders
- ✚ Laboratory Directors and those who contribute to the blood culture total testing process
- ✚ Nurses and Phlebotomists and those who participate in the blood culture collection process
- ✚ Value Analysis Professionals (materials management)

Training Tool Kit

Goal to develop a suite of training tools such as:

- Training Infographics
- Bite Sized Learning



Data Collection

National Healthcare Safety Network (NHSN)

CDC's domestic tracking and response system to identify emerging and enduring threats across healthcare, such as COVID-19, healthcare-associated infections (HAIs), and antimicrobial-resistant (AR) infections



[National Healthcare Safety Network \(NHSN\). \(cdc.gov\)](https://www.cdc.gov/nhsn)

Special Thanks!

- OneLab Network
- Gary Doern and writing team *A Comprehensive Update on the Problem of Blood Culture Contamination and a Discussion of Methods for Addressing the Problem*
- CLSI M47 Principles and Procedures for Blood Cultures, 2nd Edition writing team
- Robert Sautter and the ASM Systematic Review Team for Blood Culture Contamination
- National Quality Forum (NQF) Patient Safety Team and Standing Committee
- Members of our expert panel leveraged for measure development
- Center for Clinical Standards and Quality – Centers for Medicare & Medicaid Services (CMS)
- Cliff McDonald, Ray Dantes, Joe Lutgring and the Division of Healthcare Quality Promotion, CDC
- Nancy E. Cornish, Senior Advisor, Quality and Safety Systems Branch, Division of Laboratory Systems, CDC
- Víctor R. De Jesús, Branch Chief, Quality and Safety Systems Branch, Division of Laboratory Systems, CDC
- Our entire Division of Laboratory Systems, CDC



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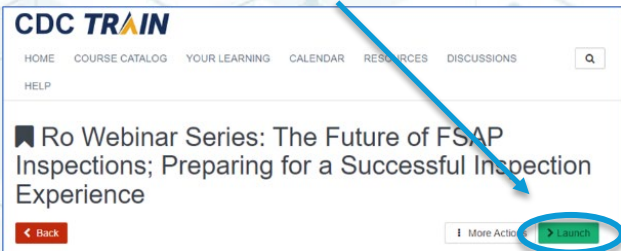
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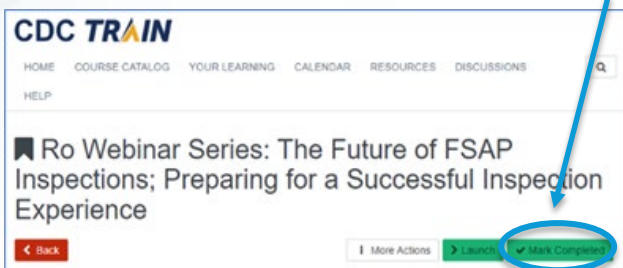
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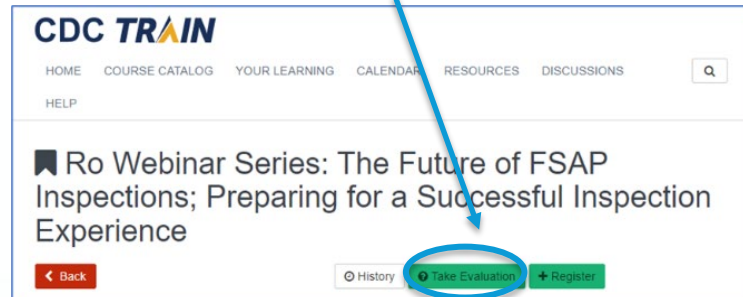


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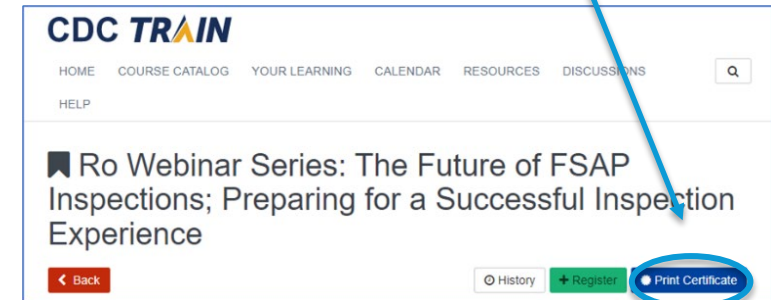
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Upcoming OneLab Network Events



Laboratory Onboarding Template Pilot Test by the Guam Public Health Laboratory

January 17th, 12:00 PM ET

GPHL pilot tested the CDC Laboratory Onboarding Template (LOT) to develop a New Employee Standard Operating Procedure (SOP) to provide a structured and streamlined process to onboard new employees into the laboratory, explain in detail the objectives of working in a public health laboratory, and provide a road map to navigate the day-to-day activities.

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