Division of Laboratory Systems

The Adult Blood Culture Contamination National Patient Safety Measure

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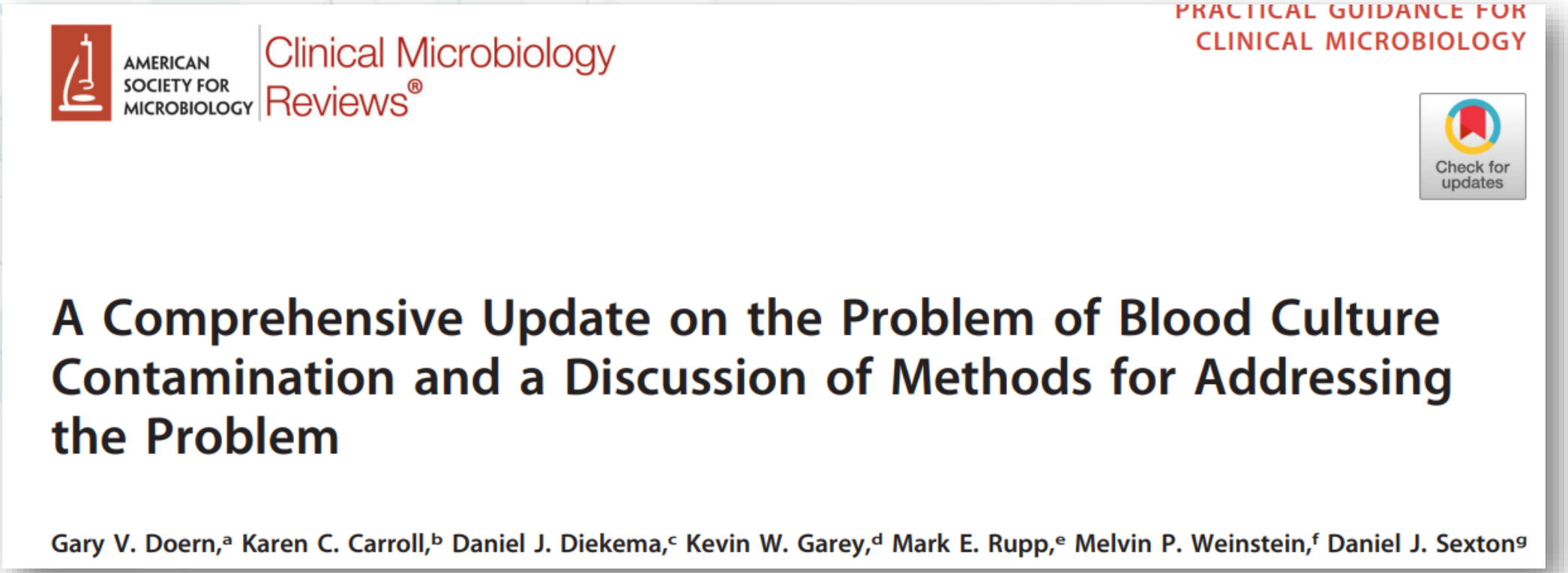
Blood Cultures



"…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."

Doern GV, et al. A comprehensive update on the problem of blood culture contamination and a discussion of methods for addressing the problem. Clinical Microbiology Reviews. January 2020.

CLIA and the Blood Culture Contamination Rate

NATIONAL ARCHIVES

Code of Federal Regulations

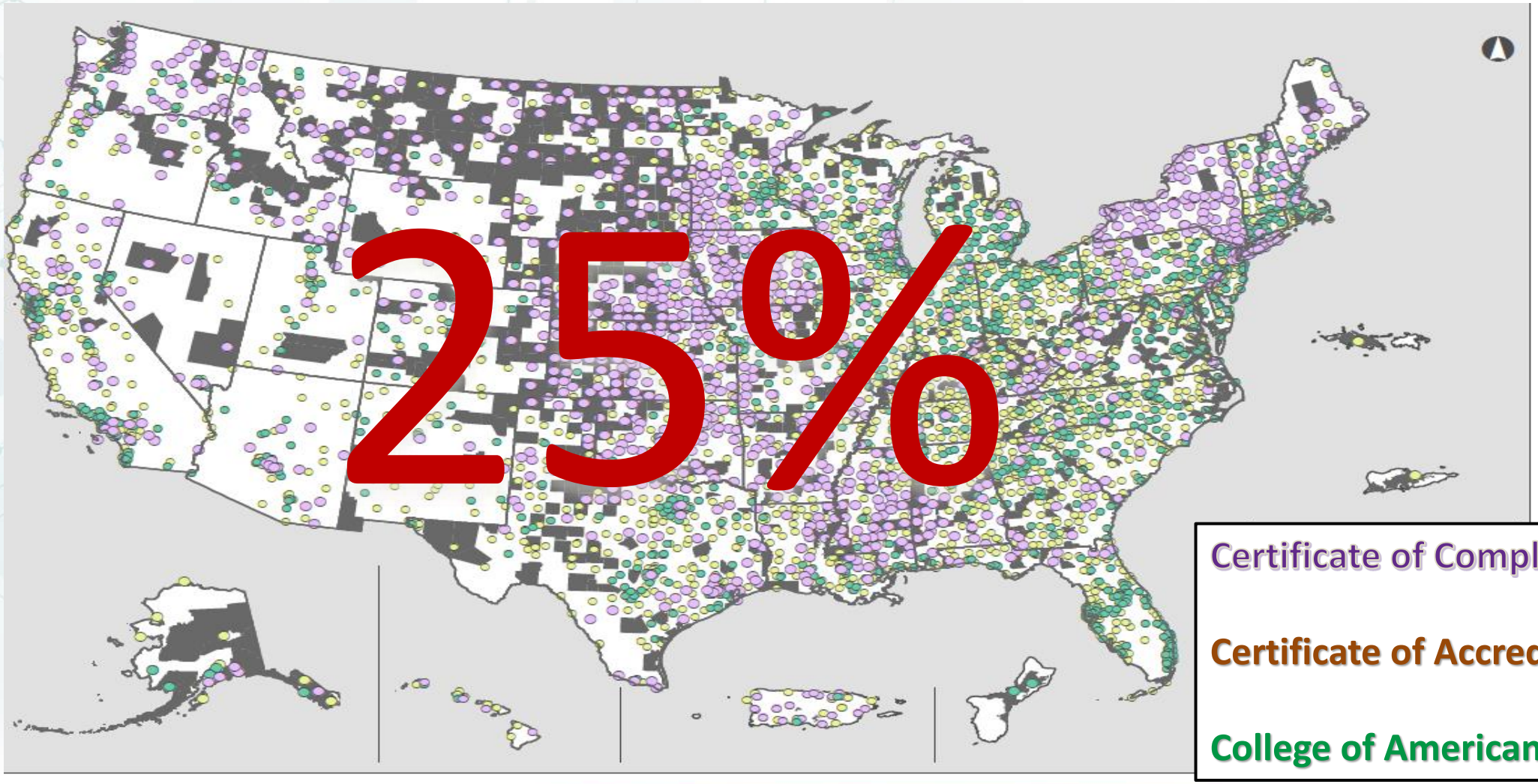
A point in time eCFR system

Title 42

PART 493—LABORATORY REQUIREMENTS

[CLIA Law & Regulations (cdc.gov)]

Current State of Blood Culture Contamination Assessment and Reporting



Certificate of Compliance (CoC)

Certificate of Accreditation (CoA)

College of American Pathologists (CAP)

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

References available on slide #24

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

https://p4qm.org/measures/3658

Measure Evaluation Criterion

Evaluation Criterion	Question to Consider when Addressing the Criterion
Importance	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?

NQF Conference 2021: *Evolution of the Measurement Applications Partnership*: Michelle Block Schreiber (CMS)

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

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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

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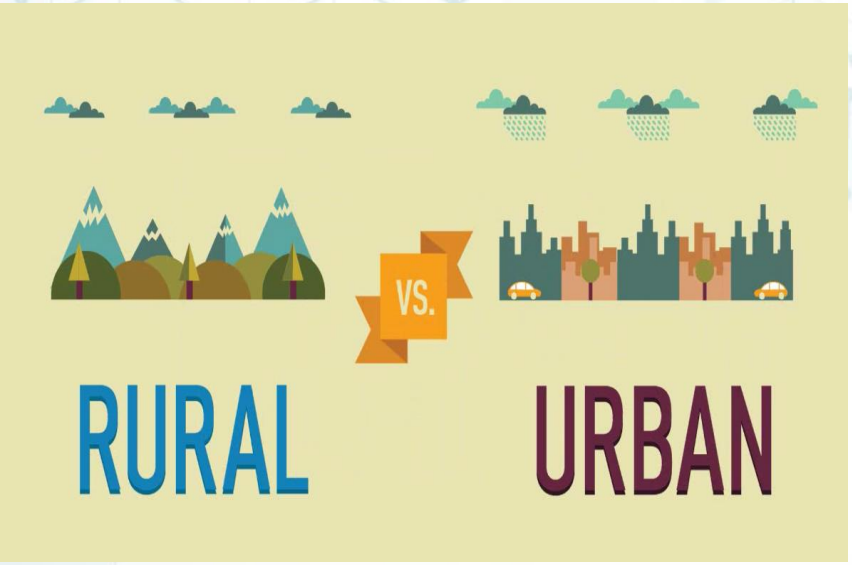
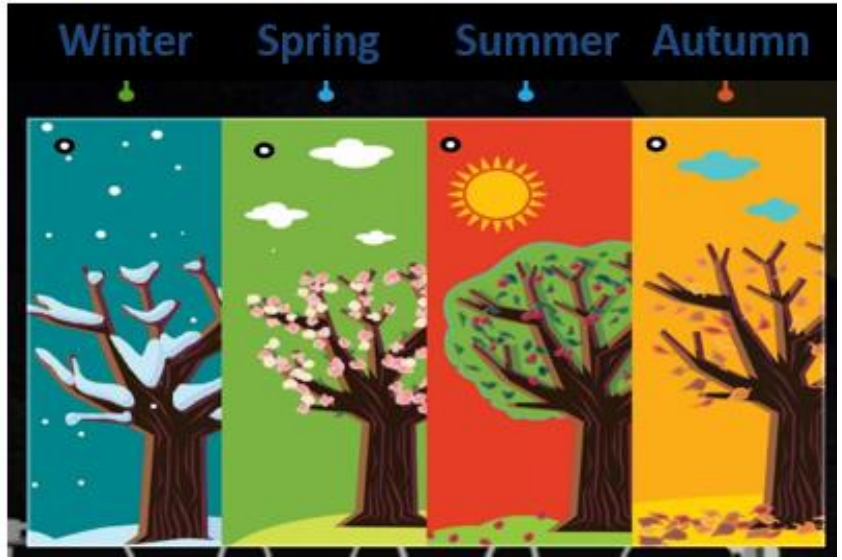
The total number of blood culture sets collected

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

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 stewardsh
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 system[2]. 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 pathogens[2]. 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

Example of a bl
an aerobic bottl

Because blood is a normally sterile body site, positive blood cultures with a known
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 ar
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* infectior
include the unnecessary removal of intravenous catheters or other devices, an inc
increased costs[3]. One study found that the average length of stay was 2 days long
blood cultures compared to patients with negative cultures[4]. That same study fou
costs of a contaminated blood culture were $12,824 compared to $8,286 for a ne
$4,538 for preventing a contaminated blood culture)[5].

U.S. Department of Health and Human Services
Centers for Disease Control and Prevention

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 rates[3]. 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%[3]. 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 within or between facilities[4].

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.

$$\frac{\text{Number of blood culture sets with growth of skin commensals without the same organism in other sets collected within 24 hours}}{\text{Total number of all eligible blood culture sets collected}}$$

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
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/Actions[5]

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
antibiotics for a patient with susp
Without a blood culture collectec
antibiotics, it can be more difficu
de-escalate antibiotic therapy gi
causative organism is more likely
unknown. Also, blood cultures c
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 cultur
with fever for whom an alternativ
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 ra
recommended that the skin be d
alcohol containing disinfectant a
prior to drawing blood cultures[5].
3. **Blood Culture Bottle Disinfec**
It is standard blood culture pract
the blood culture bottle tops prio

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 catheters[2]. Thus, peripherally drawn blood cultures are preferred over catheter drawn cultures except when the diagnosis of catheter-associated bloodstream infection is suspected[2]. 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 cultures[6].
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 settings[7].
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[8,19]. 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 culture[9].

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
- Review with the laboratory staff the blood culture collection procedures used in the facility and the training received by those responsible for collecting blood cultures
- Explore with laboratory staff how the site where blood cultures are collected is labeled (e.g., venipuncture or central venous catheter) and consider how to encourage collecting blood cultures from preferred sites
- Think about future tracking and facility benchmarking of blood culture utilization (e.g., blood cultures per admissions and patient days) as further data and guidance becomes available

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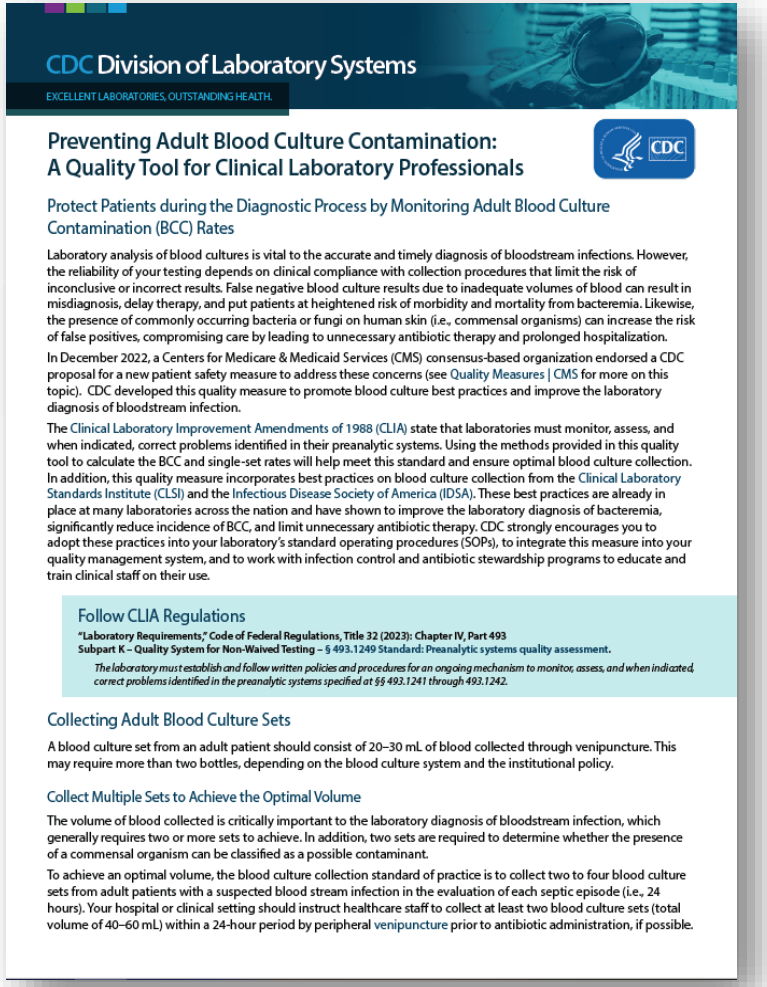
Preventing Adult Blood Culture Contamination: A Quality Tool for Clinical Laboratory Professionals



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.

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

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

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

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)]

Special Thanks!

- Clinical Laboratory Improvement Advisory Committee (CLIAC)
- 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
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- 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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