Best Practices for Detection of Bloodstream Infection

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Each year in the US and Europe, an estimated 750,000 and 1,200,000 patients, respectively, develop a bloodstream infection (BSI) with a bacterial or fungal pathogen (1, 2). Given the high mortality associated with sepsis, detection of BSIs is one of the most important functions of the clinical microbiology laboratory.

A delay in therapy for a BSI is independently associated with worse outcomes (1, 2). In the setting of BSI, it is essential to establish the etiology of infection and the antimicrobial resistance profile of the infecting agent to optimize antimicrobial therapy. Given the clinical need for rapid and accurate identification of pathogens in the setting of BSI, there is great interest in diagnostic methods that can be performed directly from peripheral blood. However, these efforts have been hampered by the low number of organisms circulating in blood (typically ≤1 to 10 colony forming unit per milliliter (CFU/mL)). Thus, blood cultures remain the gold standard for detection of BSIs because larger volumes of blood can be processed than with direct diagnostic methods.

Many factors contribute to successful detection of a pathogen in blood culture, including a number of key preanalytical factors (Table 1) (1–3). Given the high sensitivity of the method, avoidance of contamination is essential. This includes strict attention to hand hygiene and skin antisepsis during the collection process. In addition, the volume of blood collected is the single most important variable in the detection of an organism in the bloodstream. In adults, 20–30 mL of blood should be obtained for each blood culture set collected. A minimum of 2 blood culture sets should be collected per episode to increase the sensitivity of detection and to help distinguish contaminants from BSI. Three to 4 sets are recommended for certain indications, such as suspected endocarditis. Blood should be collected into a specialized blood culture medium that is incubated with a continuously monitored blood culture system, and a blood culture set should include both aerobic and anaerobic media. Blood should be collected via venipuncture rather than through an intravascular device whenever possible because venipuncture collection is associated with a lower rate of contamination. If blood is being collected for multiple types of laboratory testing, blood cultures should be the first specimen obtained. Ideally, blood cultures should be collected before initiation of antimicrobial therapy. On collection, blood cultures should be transported at room temperature (never refrigerated or frozen) to the laboratory for incubation as quickly as feasible.

Blood culture contamination is costly and can result in inappropriate antimicrobial therapy, prolonged length of stay, and increased healthcare costs. Blood culture contamination rates should be monitored, with feedback given to the teams.

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collecting the cultures. In the hospital setting, it has been demonstrated that the use of phlebotomy teams is associated with lower blood culture contamination rates (4).

Once blood culture specimens arrive in the laboratory, they should be loaded into the blood culture instrument as soon as possible. Blood culture specimens should be incubated for 4 to 5 days. Given the severity of BSIs, blood cultures should be processed 24 h a day, 7 days per week. This includes loading the bottles into the blood culture instrument and processing bottles that have flagged positive.

A Gram stain should be prepared and the results conveyed to a healthcare provider via an active reporting method, such as the telephone within 1 h of the blood culture signaling positive. Given the importance and severity of BSIs, this active notification is essential to expedite appropriate antimicrobial therapy. Positive blood culture broth is then subcultured to solid media for additional testing, including organism identification and antimicrobial susceptibility testing.

To reduce the interval between blood culture positivity and results that facilitate targeted therapy, there are a growing number of diagnostic assays available that can be performed directly on positive blood culture broth (5). These assays may expedite organism identification and/or provide genotypic or phenotypic antimicrobial resistance information. As these assays result in an increase in cost for processing blood cultures, the laboratory must work closely with the healthcare team to ensure that the faster result actually translates to changes in patient management. A growing number of studies have demonstrated the importance of involving the antimicrobial stewardship team in the notification chain to expedite action based on the results of this testing.

Accurate and expedient detection of microorganisms in the blood of patients with symptoms of sepsis is an important factor contributing to improved clinical outcomes. Blood culture remains the mainstay of pathogen detection, and successful outcome of blood culture relies on a number of preanalytical, analytical, and postanalytical factors.

Table 1. Factors affecting the yield of blood cultures.

| • Hand hygiene and skin antisepsis |
| • Volume of blood cultured |
| • Number of blood cultures obtained |
| • Collection of aerobic and anaerobic blood culture bottles |
| • Specimen transport conditions and transport time |
| • Composition of blood culture medium |
| • Use of continuously monitored blood culture system |

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REFERENCES


