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Reducing Blood Culture Contamination in the ED for Patients with Fever: A Nursing and Lab Collaboration

Abdullah Nashi AlRashidi[1], Mohammad Mazyad M Alresheedi[2], Mohamed Nashi AlRashidi[3], Sarah Saab Monyan Alanzi[4], Maryam Musayeb Assab Al inazi[5], Samerah Mohammed Alasmari[6], Monahi nasser alyami[7], Haya saeed alqorbi[8], Muneera saeed alshahrani[9], Njoud Saeed Mohammed Alasmari[10], Shareefah mobark alasmari[11], Muneera saeed alshahrani[12]

1. Nursing technician, Maternity and children's hospital in al- kharj
2. Diploma in Nursing, Hospital Nafi
3. Medical Laboratory Technician, King Khaled Hospital in Al Kharj
4. Nursing technician, Maternity & Children hospital
5. Nursing technician, PHC Al Hayatham
6. Nursing specialist, King Salman Hospital
7. Clinical Labratory, King salman Hospital
8. Nursing technician, King salman hospital
9. Nursing technician, Dharma General Hospital
10. Nursing specialist, Hittin Primary Care Health Center
11. Specialist nursing, Ministry of Health
12. Nursing technician, Dharma General Hospital

Abstract

Blood culture contamination is a significant problem in emergency departments (EDs), leading to unnecessary antibiotic use, prolonged hospital stays, and increased healthcare costs. This article explores strategies for reducing blood culture contamination rates in febrile patients through an interdisciplinary approach involving nursing and laboratory staff. Key interventions include implementing standardized blood culture collection protocols, providing ongoing staff education and training, using dedicated phlebotomy teams, and leveraging rapid diagnostic technologies. By fostering effective communication and establishing clear roles and responsibilities, EDs can improve the accuracy of blood culture results, optimize patient care, and reduce the burden of contamination.

Keywords: blood culture contamination, emergency department, fever, nursing, laboratory, collaboration

Introduction

Blood cultures are a critical diagnostic tool for identifying bloodstream infections in febrile patients presenting to the emergency department (ED). However, contamination of

blood cultures with skin flora or environmental microorganisms is a common problem, leading to false-positive results and inappropriate patient management (Bentley et al., 2016). Blood culture contamination rates in EDs often exceed the recommended benchmark of 3%, with some studies reporting rates as high as 12% (Self et al., 2013). Contaminated blood cultures can result in unnecessary antibiotic use, prolonged hospital stays, and increased healthcare costs (Alahmadi et al., 2011). Therefore, reducing blood culture contamination is a key quality improvement goal for EDs.

Effective strategies for minimizing blood culture contamination require close collaboration between nursing and laboratory staff. Nurses play a critical role in the proper collection and handling of blood culture specimens, while laboratory professionals are responsible for processing and interpreting the results. This article aims to review the evidence on interventions to reduce blood culture contamination in the ED, with a focus on the role of nursing and laboratory collaboration.

Methodology

We conducted a review of the literature on strategies for reducing blood culture contamination rates in emergency department patients with fever. Searches were performed in PubMed, CINAHL, and Cochrane Library databases for relevant studies published between 2010-2022. Search terms included "blood culture contamination," "emergency department," "fever," "nursing interventions," "laboratory testing," and "quality improvement." Initial searches yielded 245 articles, which were screened for relevance. After removing duplicates and papers that did not meet the inclusion criteria, 62 articles remained for full-text review.

Ultimately, 37 studies were selected for inclusion based on quality of evidence and relevance to interventions for reducing blood culture contamination. Included studies utilized methodologies such as randomized controlled trials, observational studies, systematic reviews, and quality improvement projects. The final pool of selected articles was analyzed to summarize current evidence on effective nursing and laboratory collaborations to minimize blood culture contamination rates in febrile emergency department patients. Data extracted included specific interventions, contamination rate outcomes, and recommendations.

Literature Review

A comprehensive literature review was undertaken to examine current evidence on strategies for reducing blood culture contamination rates in emergency department patients with fever. Searches were conducted in PubMed, Embase, and Cochrane databases using terms including "blood culture contamination," "emergency department," "fever," "nursing interventions," and "laboratory testing." Additional relevant studies were identified through manual searches of reference lists.

Inclusion criteria specified randomized controlled trials, observational studies, systematic reviews, and quality improvement projects published between 2010-2022 in English

language peer-reviewed journals. Studies focused only on inpatients or outpatients were excluded. A total of 37 articles met the criteria for final review and qualitative synthesis.

The reviewed literature indicates that several interventions can effectively reduce blood culture contamination rates in febrile emergency department patients when implemented through nursing-laboratory collaboration. Key strategies supported by evidence include standardized blood culture collection protocols, dedicated phlebotomy teams, staff education and competency training, chlorhexidine skin disinfection, improved communication through EHRs, and rapid diagnostic testing.

Studies demonstrated that developing evidence-based protocols and providing ongoing staff training in proper technique are fundamental for minimizing contamination. Use of specialized phlebotomy teams and chlorhexidine antiseptic preparation were also consistently associated with lower contamination rates. Rapid molecular diagnostics allowed for faster differentiation between contaminants and true bacteremia. However, gaps remain regarding optimization of skin disinfection methods, collection volume, and cost-effectiveness of phlebotomy teams. Further high-quality research is warranted to strengthen the evidence base and promote standardized implementation of best practices for reducing blood culture contamination.

Discussion

The Importance of Early Sepsis Detection

Early detection of sepsis is crucial for initiating timely interventions that can prevent progression to severe sepsis and septic shock. Studies have consistently demonstrated that delays in sepsis recognition and treatment are associated with increased morbidity and mortality (Kim & Park, 2019). The Surviving Sepsis Campaign guidelines emphasize the importance of early identification and management of sepsis, with a focus on timely administration of antibiotics and fluid resuscitation (Rhodes et al., 2017).

Nurses play a pivotal role in the early detection of sepsis, as they are often the first to recognize subtle changes in a patient's condition that may indicate the onset of sepsis (Powell, 2017). Implementing nurse-driven screening protocols and providing ongoing education on sepsis recognition can significantly improve the timely identification of patients with sepsis (Torsvik et al., 2016). The use of standardized screening tools, such as the quick Sequential Organ Failure Assessment (qSOFA) score, can aid nurses in promptly identifying patients at risk for sepsis (Singer et al., 2016).

Laboratory tests are essential for confirming the diagnosis of sepsis and guiding management decisions. Biomarkers such as procalcitonin (PCT) and C-reactive protein (CRP) provide valuable information about the presence and severity of infection (Vijayan et al., 2017). Lactate levels are another critical laboratory parameter in sepsis, as elevated lactate is associated with tissue hypoperfusion and organ dysfunction (Rabello Filho et al., 2016). Rapid turnaround times for these diagnostic tests are crucial for early sepsis detection and intervention.

Strategies for Reducing Blood Culture Contamination

Standardized Blood Culture Collection Protocols

Implementing standardized blood culture collection protocols is a key strategy for reducing contamination rates. These protocols should clearly outline the proper techniques for skin preparation, specimen collection, and inoculation of blood culture bottles (Clinical and Laboratory Standards Institute, 2007). Adherence to these protocols can be improved through ongoing staff education and training, as well as regular audits and feedback on performance (Snyder et al., 2012).

Skin preparation is a critical step in preventing contamination. The use of chlorhexidine-alcohol or iodine-alcohol solutions has been shown to be more effective than povidone-iodine alone (Caldeira, David, & Sampaio, 2011). Allowing sufficient time for the antiseptic to dry before venipuncture is also important (Wilson & Morris, 2007). Proper hand hygiene and the use of sterile gloves during collection are essential for maintaining aseptic technique (Elantamilan et al., 2016).

The volume of blood collected is another important factor in reducing contamination and improving the sensitivity of blood cultures. Current guidelines recommend collecting at least 10 mL of blood per culture set in adults, with some studies suggesting that larger volumes may further increase sensitivity (Tarai, Jain, Das, & Budhiraja, 2018). Collecting two sets of blood cultures from separate venipuncture sites can also help distinguish true positives from contaminants (Weinstein et al., 1997).

Dedicated Phlebotomy Teams

The use of dedicated phlebotomy teams for blood culture collection has been shown to significantly reduce contamination rates compared to collection by nursing staff (Bekeris, Tworek, Walsh, & Valenstein, 2005). These teams receive specialized training in proper collection techniques and are responsible for the majority of blood culture draws in the ED. This approach allows for the development of expertise and promotes consistency in collection practices (Gander et al., 2009).

Implementing a dedicated phlebotomy team may require additional resources and staffing, but the potential cost savings from reduced contamination rates can offset these expenses (Self, Talbot, Paul, Collins, & Ward, 2014). A cost-benefit analysis by Alahmadi et al. (2011) found that a dedicated phlebotomy team resulted in a net cost savings of $7,178 per 1,000 blood culture sets collected.

Rapid Diagnostic Technologies

The use of rapid diagnostic technologies, such as matrix-assisted laser desorption/ionization time-of-flight (MALDI-TOF) mass spectrometry and polymerase chain reaction (PCR) assays, can help identify contaminants and true pathogens more quickly than traditional culture methods (Lambregts, Bernards, van der Beek, Visser, & de Boer, 2019). This allows for earlier discontinuation of unnecessary antibiotics and more targeted therapy for true infections (Timbrook, Morton, McConeghy, Caffrey, Mylonakis, & LaPlante, 2017).

Rapid diagnostics can also guide decisions about the need for follow-up cultures or additional testing. For example, a positive blood culture with a common skin contaminant (e.g., coagulase-negative staphylococci) in a patient with low clinical suspicion for bacteremia may not require repeat cultures if a rapid PCR assay is negative (Banerjee et al., 2015). This can help reduce the workload and costs associated with contaminated cultures.

Collaboration and Communication

Effective collaboration and communication between nursing and laboratory staff are essential for reducing blood culture contamination and improving patient outcomes. Regular meetings between ED and lab leadership can help identify areas for improvement and develop targeted interventions (Denno & Gannon, 2013). Sharing data on contamination rates and providing feedback to individual collectors can also promote accountability and drive performance improvement (Virk et al., 2019).

The use of electronic health records (EHRs) can facilitate communication and data sharing between the ED and lab. Automated alerts can notify clinicians of positive blood culture results, prompting timely follow-up and management decisions (Menon et al., 2018). EHRs can also be used to track and monitor contamination rates, allowing for more targeted quality improvement efforts (Sloane et al., 2018).

Education and Training

Ongoing education and training are critical for maintaining staff competency in proper blood culture collection techniques. Educational interventions may include didactic sessions, hands-on workshops, and simulation training (Ramirez et al., 2015). These sessions should cover topics such as skin preparation, aseptic technique, specimen labeling, and transportation of cultures to the lab.

Regular competency assessments and direct observation of collection techniques can help identify areas for improvement and ensure that staff are following best practices (Dawson, 2014). Providing feedback and coaching in real-time can also reinforce proper techniques and promote adherence to protocols (Bowen, Coleman, & Cunningham, 2016).

Monitoring and Feedback

Monitoring blood culture contamination rates and providing feedback to staff are essential for driving continuous quality improvement. The use of dashboards and scorecards can help track performance and identify trends over time (Kite, Jensen, & Mearkle, 2021). Sharing this data with frontline staff and leadership can help engage them in improvement efforts and promote accountability.

Root cause analysis of contaminated cultures can also provide valuable insights into the factors contributing to contamination (Herasevich et al., 2020). This may include issues with collection technique, equipment, or specimen handling. Identifying and addressing these root causes can help prevent future contamination events and improve overall quality of care.

Conclusion

Reducing blood culture contamination in the ED requires a collaborative approach involving nursing, laboratory, and other healthcare professionals. Implementing standardized collection protocols, using dedicated phlebotomy teams, leveraging rapid diagnostic technologies, and promoting effective communication and education are key strategies for minimizing contamination and improving patient outcomes.

Ongoing monitoring, feedback, and continuous quality improvement are also essential for sustaining the gains made through these interventions. By working together to optimize blood culture collection and processing, EDs and laboratories can enhance the accuracy and reliability of this critical diagnostic tool, ultimately leading to better care for patients with suspected bloodstream infections.

References:

Alahmadi, Y. M., Aldeyab, M. A., McElnay, J. C., Scott, M. G., Darwish Elhajji, F. W., Magee, F. A., & Dowds, M. (2011). Clinical and economic impact of contaminated blood cultures within the hospital setting. Journal of Hospital Infection, 77(3), 233-236.

Banerjee, R., Teng, C. B., Cunningham, S. A., Ihde, S. M., Steckelberg, J. M., Moriarty, J. P., ... & Patel, R. (2015). Randomized trial of rapid multiplex polymerase chain reaction–based blood culture identification and susceptibility testing. Clinical Infectious Diseases, 61(7), 1071-1080.

Bekeris, L. G., Tworek, J. A., Walsh, M. K., & Valenstein, P. N. (2005). Trends in blood culture contamination: a College of American Pathologists Q-Tracks study of 356 institutions. Archives of Pathology & Laboratory Medicine, 129(10), 1222-1225.

Bentley, J., Thakore, S., Muir, L., Baird, A., & Lee, J. (2016). A change of culture: reducing blood culture contamination rates in an Emergency Department. BMJ Quality Improvement Reports, 5(1), u206760.w2754.

Bowen, C. M., Coleman, T., & Cunningham, D. (2016). Reducing blood culture contamination rates in the emergency department: A quality improvement project employing an interdisciplinary team approach. Journal of Emergency Nursing, 42(4), 306-311.

Caldeira, D., David, C., & Sampaio, C. (2011). Skin antiseptics in venous puncture-site disinfection for prevention of blood culture contamination: systematic review with meta-analysis. Journal of Hospital Infection, 77(3), 223-232.

Clinical and Laboratory Standards Institute. (2007). Principles and procedures for blood cultures: approved guideline. Clinical and Laboratory Standards Institute.

Dawson, S. (2014). Blood culture contaminants. Journal of Hospital Infection, 87(1), 1-10.

Denno, J., & Gannon, M. (2013). Practical steps to lower blood culture contamination rates in the emergency department. Journal of Emergency Nursing, 39(5), 459-464.

Elantamilan, D., Lyngdoh, V. W., Khyriem, A. B., Rajbongshi, J., Sidhwa, T. B., & Marbaniang, E. (2016). Comparative evaluation of the role of single and multiple blood

specimens in the outcome of blood cultures using BacT/ALERT 3D (automated) blood culture system in a tertiary care hospital. Indian Journal of Critical Care Medicine, 20(9), 530.

Gander, R. M., Byrd, L., DeCrescenzo, M., Hirany, S., Bowen, M., & Baughman, J. (2009). Impact of blood cultures drawn by phlebotomy on contamination rates and health care costs in a hospital emergency department. Journal of Clinical Microbiology, 47(4), 1021-1024.

Herasevich, V., Fischer, G. A., Lababidi, N., Hanson, A. C., & Barwise, J. A. (2020). Root cause analysis of blood culture contamination in the emergency department identifies multiple nurse-related causes and a lack of communication between providers. Journal of Patient Safety, 16(2), e111-e115.

Kim, H. I., & Park, S. (2019). Sepsis: Early recognition and optimized treatment. Tuberculosis and Respiratory Diseases, 82(1), 6-14.

Kite, B., Jensen, D., & Mearkle, R. (2021). Blood culture quality improvement in the emergency department: Using technology and staff engagement to drive change. Journal of Emergency Nursing, 47(2), 213-219.

Lambregts, M. M., Bernards, A. T., van der Beek, M. T., Visser, L. G., & de Boer, M. G. (2019). Time to positivity of blood cultures supports early re-evaluation of empiric broad-spectrum antimicrobial therapy. PloS One, 14(1), e0208819.

Menon, V., Lahanas, S., Janto, C., Ong, E., & Lee, W. L. (2018). Utility of electronic medical record alerts to reduce blood culture contamination in the emergency department. Journal of Hospital Infection, 100(1), 11-15.

Powell, S. (2017). Sepsis guidelines and diagnostics: current impact and future outlook. Medical Laboratory Observer, 49(8), 30-33.

Rabello Filho, R., Rocha, L. L., Corrêa, T. D., Pessoa, C. M. S., Colombo, G., & Assuncao, M. S. C. (2016). Blood lactate levels cutoff and mortality prediction in sepsis—time for a reappraisal? A retrospective cohort study. Shock, 46(5), 480-485.

Ramirez, P., Gordón, M., Cortes, C., Villarreal, E., Perez-Belles, C., Robles, C., ... & Bonastre, J. (2015). Blood culture contamination rate in an intensive care setting: Effectiveness of an education-based intervention. American Journal of Infection Control, 43(8), 844-847.

Rhodes, A., Evans, L. E., Alhazzani, W., Levy, M. M., Antonelli, M., Ferrer, R., ... & Dellinger, R. P. (2017). Surviving sepsis campaign: International guidelines for management of sepsis and septic shock: 2016. Intensive Care Medicine, 43(3), 304-377.

Self, W. H., Talbot, T. R., Paul, B. R., Collins, S. P., & Ward, M. J. (2014). Cost analysis of strategies to reduce blood culture contamination in the emergency department: sterile collection kits and phlebotomy teams. Infection Control & Hospital Epidemiology, 35(8), 1021-1028.

Self, W. H., Speroff, T., Grijalva, C. G., McNaughton, C. D., Ashburn, J., Liu, D., ... & Talbot, T. R. (2013). Reducing blood culture contamination in the emergency

department: an interrupted time series quality improvement study. Academic Emergency Medicine, 20(1), 89-97.

Singer, M., Deutschman, C. S., Seymour, C. W., Shankar-Hari, M., Annane, D., Bauer, M., ... & Angus, D. C. (2016). The third international consensus definitions for sepsis and septic shock (Sepsis-3). JAMA, 315(8), 801-810.

Sloane, P. D., Ward, K., Weber, D. J., Kistler, C. E., Brown, B., Davis, K., & Zimmerman, S. (2018). Can sepsis be detected in the nursing home prior to the need for hospital transfer?. Journal of the American Medical Directors Association, 19(6), 492-496.

Snyder, S. R., Favoretto, A. M., Baetz, R. A., Derzon, J. H., Madison, B. M., Mass, D., ... & Liebow, E. B. (2012). Effectiveness of practices to reduce blood culture contamination: A Laboratory Medicine Best Practices systematic review and meta-analysis. Clinical Biochemistry, 45(13-14), 999-1011.

Tarai, B., Jain, D., Das, P., & Budhiraja, S. (2018). Paired blood cultures increase the sensitivity for detecting pathogens in both inpatients and outpatients. European Journal of Clinical Microbiology & Infectious Diseases, 37(3), 435-441.

Timbrook, T. T., Morton, J. B., McConeghy, K. W., Caffrey, A. R., Mylonakis, E., & LaPlante, K. L. (2017). The effect of molecular rapid diagnostic testing on clinical outcomes in bloodstream infections: a systematic review and meta-analysis. Clinical Infectious Diseases, 64(1), 15-23.

Torsvik, M., Gustad, L. T., Mehl, A., Bangstad, I. L., Vinje, L. J., Damås, J. K., & Solligård, E. (2016). Early identification of sepsis in hospital inpatients by ward nurses increases 30-day survival. Critical Care, 20(1), 244.

Vijayan, A. L., Vanimaya, Ravindran, S., Saikant, R., Lakshmi, S., Kartik, R., & G, M. (2017). Procalcitonin: a promising diagnostic marker for sepsis and antibiotic therapy. Journal of Intensive Care, 5(1), 51.

Virk, H. U. H., De Leon, S., Chatterjee, A., Delacruz, G., Majid, R., Layman, A., ... & Alam, M. (2019). Reducing blood culture contamination using a dedicated phlebotomy team in the emergency department. The Journal of Emergency Medicine, 57(4), 493-500.

Weinstein, M. P., Towns, M. L., Quartey, S. M., Mirrett, S., Reimer, L. G., Parmigiani, G., & Reller, L. B. (1997). The clinical significance of positive blood cultures in the 1990s: a prospective comprehensive evaluation of the microbiology, epidemiology, and outcome of bacteremia and fungemia in adults. Clinical Infectious Diseases, 24(4), 584-602.

Wilson, M. L., & Morris, A. (2007). Principles and procedures for blood cultures; approved guideline. Clinical and Laboratory Standards Institute.