Reducing Blood Culture Contamination Rates Through Staff Education: A Quality Improvement Initiative

Kirsten M. Mutuberria

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Reducing Blood Culture Contamination Rates Through Staff Education: A Quality Improvement Initiative

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Abstract

BACKGROUND: Blood cultures are a widely utilized tool that aids in diagnosis and treatment plans. Contaminated cultures are incredibly costly, resulting in increased length of stay, opportunistic infections, pharmacy costs, repeated laboratory tests, and decreased reimbursements. Evidence suggests higher incidence rates of blood culture contaminations (BCCs) are seen in emergency departments (ED) compared to any other unit within a hospital system. The internationally accepted threshold of 3% is not often met, although recent studies suggest a lower rate is possible, even in critical care environments. A literature review resulted in data showing that educational-based interventions focusing on adherence to facility policy, standardization, and evidence-based practice successfully decreased BCC rates. This quality improvement initiative aimed at reducing BCC in a rural emergency department to under 2% following one month of educational interventions.

LOCAL PROBLEM: This project was conducted in a 45-bed (25 hospital rooms, ten hallway beds, six overflow beds, and six additional rooms in the annex for psychiatric holds) rural emergency department. Inconsistent BCC rates ranged from 0.7% to 3.9% in a year. A previous quality improvement project conducted in the same microsystem in 2022 displayed an information graphic for staff reeducation. Rates initially reduced; however, the decrease did not continue. After partnering with key stakeholders, it was decided that additional interventions were warranted to create sustainable change and promote better healthcare outcomes.

METHODS: This quality improvement initiative utilized a Plan-Do-Study-Act model to evaluate a previous quality improvement project conducted in the same microsystem and adjust the intervention to promote sustainability. This current project utilized a before and after study design to assess for decreased BCC rates following an adjusted educational intervention.

INTERVENTION: To promote adherence to facility protocols and best practices, informational graphics were created and displayed throughout the ED. They were placed on intravenous (IV) supply carts where collection supplies are kept, and areas like staff bathrooms and highly trafficked lounges. A poster detailing the current state of the microsystem and costs associated with increased BCC rates was created to offer feedback and displayed in the main breakroom. Site visits were made weekly to assess for damaged materials and to answer any questions from staff.

RESULTS: The goal of decreasing BCC rates below 2% was achieved. Following the month-long interventions in June 2023, the BCC rate fell to 1.7% from a high of 3.9% at the beginning of the year.

CONCLUSIONS: Many factors affect BCC rates in a microsystem. Very little time and resources can be devoted to learning in critical care environments like an ED. It is essential to bring education to staff to promote participation. Consistent and recurring reinforcement of education and real-time feedback is crucial in creating change and ensuring sustainability.

KEYWORDS: Blood Cultures, Blood Culture Contamination (BCC), Emergency Department (ED), facility protocol, re-education, quality improvement
Introduction

Blood cultures are a highly effective tool that healthcare providers use, directly contributing to developing care plans. They are commonly utilized to assess sepsis, bacteremia, and systemic inflammatory response syndrome (SIRS) caused by infection (Garcia et al., 2015; Halstead et al., 2020). Unfortunately, errors in collecting or processing can introduce bacteria into the sample through the skin, environment, or materials used, leading to contaminated blood cultures (Garcia et al., 2015). Some studies have shown that blood culture contamination (BCC) and false positives are seen more in the emergency department setting than in other areas of the hospital (Dempsey et al., 2019). The Clinical and Laboratory Standards Institute, a reputable global nonprofit that creates clinical and laboratory standardization, classifies blood cultures as contaminated when there is a “microorganism isolated from a blood culture during specimen collection or processing that was not pathogenic for the patient from whom the blood was collected” (Bool et al., 2020, p. 157). Improper technique, nonadherence to facility protocols, and abandoning evidenced-based practice are often cited as primary roots of this endemic problem (Hughes et al., 2018). These lapses often lead to improper cleansing of the skin, inadequate disinfection of the blood culture bottles, incorrect order of collection, and inability to maintain an aseptic technique (Doern et al., 2019). To treat infection adequately, it is critical to correctly identify and discriminate between true pathogens and contaminated blood cultures (Ramirez et al., 2015).

The Clinical Laboratory Standards Institute has set the recommended BCC level to be less than three percent. A recent push has been to lower the benchmark further to ensure the best possible patient care (Weinstein & Lewis, 2020). Despite these globally accepted guidelines, literature and studies have encountered over 50% contamination rates in some instances (Corboy
Contaminated blood cultures negatively affect both the patient and healthcare facilities. Contaminated blood cultures can lead to repeated testing, unnecessary antibiotic administration, extended hospital stays, and compromised patient care. The administration of unnecessary antibiotics can lead to adverse health outcomes, including but not limited to allergic reactions and an increased risk of opportunistic infections like *Clostridium difficile* (Corboy & Attridge, 2019). There are profound financial implications for both patient and facility, such as issues with Medicare reimbursement, waste of human and material resources, expensive tests, and other downstream economic costs (Corboy & Attridge, 2019; McNab et al., 2022). BCCs have a direct implication for the nursing profession and have the potential to cause more strain on healthcare workers, especially in the emergency department, where resources like laboratory workers and dedicated phlebotomy teams are typically unavailable. Improving BCC rates is necessary to ensure proper care and better healthcare outcomes for some of the most vulnerable patients.

**Problem Description**

When assessing the microsystem in a rural emergency department in New England, quality improvement (QI) opportunities were identified concerning BCC rates. A 45-bed emergency department, this microsystem attends to emergent and critical patients, patients awaiting transfer to other facilities, and admitted patients waiting for space in the central part of the hospital. The unit treats various ailments such as chest pain, shortness of breath, trauma, stroke, heart attacks, nausea/vomiting/diarrhea, and infection. The department often encounters patients who present with untreated bacterial or viral infections. Depending on the severity of the disease, sepsis may result. The staff surveyed during conversations point to sepsis as a top five diagnosis for their microsystem and one of their most concerning issues (J. Woods, Personal
communication, February 2023). According to the CDC, one in three people who die in a hospital setting had sepsis during that stay. In 87% of cases, sepsis starts before the patient enters the hospital doors (CDC, 2022). Because of this, it is critical to identify untreated infections, diagnose the cause, and treat patients quickly.

Blood cultures are regularly ordered in this ED when the patient presents with infection-like symptoms such as fever, vomiting, chills, stiff neck, leukocytosis, or difficulty breathing (Chela et al., 2019; J. Woods, Personal Communication, March 2023). Blood cultures are an integral part of the microsystem’s sepsis protocol, as the results often dictate treatment decisions, including the rapid administration of antibiotics. Unfortunately, this unit has a trend of high staff turnover, causing the need for temporary employees like travel nurses and employees with different disciplines and education, all of which can lead to a breakdown of procedures (J. Woods, Personal correspondence, March 2023). Best practice guidelines for collection include several steps. Specimens should be collected using an aseptic or sterile technique before antibiotic treatment. Direct venipuncture or a newly placed intravenous catheter is preferred. Collecting the samples in the correct order is essential. A second round of cultures from a different venipuncture site within 15-30 minutes following the initial collection is typically indicated to confirm the bacteria. Best practice recommends collecting samples utilizing laboratory staff or a dedicated phlebotomy team to minimize risk (Andrews et al., 2023; Bool et al., 2020). Due to a lack of resources, emergency department personnel routinely collect the samples in this microsystem. Care must be taken at every level. A misstep at any of these stages can result in a contaminated sample. Standardization and protocol compliance are crucial in promoting proper procedures. In a time-sensitive environment such as an emergency department,
the patient could be incorrectly treated, incurring costs to the facility and client while leading to poorer healthcare outcomes.

The microsystem tracks its BCC rates monthly to ensure proper patient care. The monthly rates vary widely, while the patient numbers remain relatively similar. In 12 months from January 2022 to January 2023, the contamination percentages ranged from 0.73% at the lowest to a staggering 3.9% at its highest (Andrews et al., 2023). A quality improvement project initiated in 2022 in this microsystem showed a significantly decreased blood culture contamination rate following the utilization of visual aids and staff engagement (McGuire, 2022). Over time, contamination rates began to rise again. Despite this, the initial results showed a willingness on behalf of the staff for compliance and indicated opportunities for adjustments to promote future improvements.

**Available Knowledge**

A literature review was conducted to identify current research for patterns and themes that can best guide future quality improvements in reducing blood culture contamination rates. The studies were searched for and located in March and April of 2023 using the University of New Hampshire Nursing Research Guide. The databases used to search for eligible studies included the Cumulative Index to Nursing and Allied Health Literature (CINAHL), Medical Literature Analysis and Retrieval System Online (MEDLINE), and PubMed. Numerous keywords and Boolean phrases were used to filter and refine the search. These included “blood culture,” “emergency department OR emergency room,” “education OR educational intervention OR intervention,” “contamination,” “reduction,” and “systematic review”. A total of seven articles were chosen for the final review. These included an integrative review, prospective observational studies, cohort studies, and evaluations of facility-specific quality improvement
projects. Please see Appendix A for a detailed flow chart using the Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA).

Evidence shows that supporting educational interventions for staff collecting blood cultures can decrease blood culture contamination rates. The literature evaluated was the most up-to-date research on lowering BCC rates as of April 2023. All articles were published within the last eight years, and over half of the research assessed was published within the previous three years. Several themes were woven throughout the studies and quality improvement projects to inform and develop future practice.

Planning

Some of the most successful studies and quality improvement projects focused on the planning stage. These projects were focused on assessing the current state of their department or hospital. Pre-intervention BCC rates were evaluated in all studies or quality improvement initiatives, but the authors assessed the root causes of their problems before developing solutions. Through a quality improvement initiative, Al-Hamad et al. (2016) collected surveys from their staff to evaluate knowledge gaps and areas for educational opportunities. The authors then tailored education based on the data collected, resulting in better outcomes for their facility. He et al. (2020) established a Quality Control Group that observed over 80 blood culture collection instances to assess where facility protocol breaks may be. Interviews and surveys were conducted to identify the most significant areas of concern regarding policy and procedure. The authors then analyzed cause-and-effect data and reviewed current literature to create educational interventions. Park et al. (2015) administered questionnaires to assess competency, misconceptions, and technical skills. A comprehensive training session was then developed based on those results. The authors of a different quality improvement initiative formed a task
force of postgraduate students and a senior microbiology resident to observe the practice of blood culture collection (Shaji et al., 2022). The authors then created a fishbone diagram and a chart identifying breaks in protocols and areas of training and re-education opportunities. From this, they developed new standards of practice for their facility and formulated training sessions to disseminate this information. Understanding the root causes of the problem and allowing that to inform how their interventions would be implemented enabled the authors of these studies to develop plans that created meaningful change.

**Sustainability**

Creating meaningful change is critical in any quality improvement. Ensuring the sustainability of that change is paramount in guaranteeing continued success. The studies and quality improvement projects that proved longevity in their successful decrease of BCC rates concentrated on ongoing interventions and education. Single educational sessions proved beneficial, but projects that continued to adjust and implement changes with long periods of interventions were the most successful in maintaining low BCC rates. For example, while conducting an integrative literature review, Bool et al. (2020) found that a 70% reduction in BCC rates in one facility was only interrupted during periods when education ceased. The authors found that when feedback was not given monthly to staff, education sessions were paused, or posters were not displayed, BCC rates began to increase slowly. While conducting a quality improvement initiative, Halstead et al. (2020) found that hospitals with quarterly re-training, transparent feedback of successes and failures, and specific re-training for individuals that needed supplemented education successfully kept BCC rates below 3% for a sustained period, some for up to ten years. A quality improvement project conducted in an intensive care unit (ICU) found that continued direct observation and individual retraining led to contamination
rates below 1% for months at a time (He et al., 2020). The authors of this project emphasize continued monthly feedback and adjusting training sessions based on successes and failures in their long-term plan to create sustainable change. They recruited team members from the ICU to develop and implement changes, creating staff buy-in and motivation to continue with the changes recommended (He et al., 2020). Park et al. (2020) conducted a quality improvement project over a year and found that adherence to facility protocol improved more the longer the interventions were in place. Sustainability is essential in creating meaningful change. A reduction in BCC rates over a long period creates better healthcare outcomes. To promote this, it is imperative to assess and adjust interventions, continue to educate, and be diligent in efforts to improve.

**Bundled Approach**

A strong theme seen in most studies was the success of bundled approaches in decreasing BCC rates. Studies and quality improvement projects with single interventions decreased contamination rates, but those that used a multimodal approach were more impactful and had greater sustainability. Promotion of standardization, using various methods to disseminate information, and consistent staff feedback proved to help maintain lower rates. Workshops that included visual aids, PowerPoint presentations, and live demonstrations decreased the hospital-wide contamination rate by 36% in one project (Al-Hamad et al., 2016). The authors of an integrative review concluded that a bundle approach, including education, stakeholder involvement, and transparent feedback on BCC rates, was the most impactful (Bool et al., 2020). They found that studies doing so had upwards of a 67% reduction in contamination rates. The authors insisted that as the problem is multifaceted, the solution must also be (Bool et al., 2020). He et al. (2020) initially only used a single educational approach to decrease BCC rates and
failed to produce adequate results. When they reassessed the needs of staff, the authors incorporated mobile applications, PowerPoint presentations with step-by-step instructions, checklists, feedback, phlebotomy training, and supplemental online learning into their quality improvement project. This led to a BCC of 0.59% within ten months (He et al., 2020).

Team members are likely to have different learning styles. They work various shifts. Many hospitals have temporary workers or per diem employees. Educating these individuals using a single type of intervention at one time would prove extremely difficult. Assessing the needs of one’s team and developing a bundled approach can reach more staff and create a lasting and sustainable impact. A layered educational approach incorporating different modalities has proved most effective in addressing knowledge gaps and creating impactful change.

*Adherence to Facility Protocol*

The most striking pattern seen in every study evaluated was the importance of adherence to facility protocol. These studies all found that the most significant reason behind their facility’s unacceptable contamination rates was the failure to follow guidelines. Proper skin disinfection before catheter placement, maintaining an aseptic technique, cleaning the tops of the blood culture bottles, and refraining from palpating the skin following cleansing is generally accepted as best practice for collecting blood samples for cultures. However, the authors of each study encountered a failure to comply. To ensure success, the authors surmised, staff must be informed of the policies and educated on the importance of following guidelines. Through surveys and observation, Al-Hamad et al. (2016) and Shaji et al. (2020) found that failure to comply with facility guidelines mainly stemmed from a lack of awareness. They cited that staff often failed to clean the top of blood culture bottles and frequently palpated the skin following disinfection. Clear protocols were established and incorporated into their new training. He et al. (2020)
formed a Quality Control Group that observed staff not washing hands before the procedure, which is standard practice in any healthcare facility. The authors evaluated knowledge gaps and trained their staff accordingly. Following staff observation, the authors of a quality improvement initiative found a high degree of variation in collecting samples for the culture (Shaji et al., 2022). They created and implemented new protocols and promoted the standardization of the process, successfully reducing BCC rates. The authors of a separate quality improvement project found that a two-hour education session on their hospital's proper policies and procedures decreased their BCC rate by 10% (Ramirez et al., 2015). Park et al. (2015) observed a more significant impact on BCC rates following an educational program focused on policy adherence instead of a new nationwide clinical skills test in the licensure examination. Commitment to facility policy and best practices is critical to decreasing BCC rates. Guidelines are essential in standardization, but if they are not followed, then change is impossible.

**Conclusion**

Blood cultures are a highly utilized diagnostic test. Unfortunately, contaminated blood cultures can be costly to patients and the healthcare system, lead to extended hospital stays, and potentially contribute to worse healthcare outcomes (Bowen et al., 2016a). The authors of these studies and quality improvement initiatives demonstrated that developing and implementing a plan for educational interventions to decrease BCC rates is possible, even in critical care environments with high staff turnover and no dedicated phlebotomist teams. The studies evaluated show a direct correlation between educational interventions and decreased BCC rates in healthcare facilities. Planning, assessing, implementing, studying the results, and adjusting interventions are necessary to ensure the best possible results. These articles have outlined that continued training and reeducation help shrink the knowledge gap that many hospital
departments face. Adherence to facility protocols and evidence-based practice is essential in creating sustainable change. A layered educational approach incorporating different modalities will best guide future practice and contribute to better healthcare outcomes.

**Rationale**

This QI project followed the Plan-Do-Study-Act (PDSA) framework to implement the proposed interventions. PDSA is a four-step process and a valuable model for improvement. It includes developing a change, implementing an intervention, assessing its outcome, and refining the intervention based on what was learned (*Science of Improvement*, n.d.). This model allows modifications to be implemented on a small scale and quickly adjusted based on collected data (Connelly, 2021). The PDSA structure for quality improvement seems most appropriate for this particular microsystem, as multiple changes can be made quickly to assess the most successful intervention. This project is the second cycle of a previous quality improvement initiative performed in 2022 (McGuire, 2022). That initiative was an infographic placed in the staff lounge outlining proper policy and procedure of blood culture collection. The results of that quality improvement project have been assessed, and interventions adjusted to promote change.

This quality improvement initiative's “planning stage” involved drafting a proposal outlining the problem description of the methods employed during the “do” stage. This included reviewing the most up-to-date literature on the project, assessing the microsystem involved in this quality improvement project, partnering with the key stakeholders, performing a cost-benefit analysis, and assessing which intervention would best suit the department. During the “Do” stage, the author spent considerable time implementing the proposed interventions in the department. This began in late May 2023 and concluded at the beginning of July. Following this stage, the “Study” portion involved assessing the data and identifying the efficacy of the
interventions. BCC rate data is typically released one to two weeks following a month’s end. The data for June was received on July 15th.

**Specific Aim**

The specific aim of this project was to reduce the BCC rate from the high of 3.9% to below 2% by the end of June 2023, following one month of educational interventions. By promoting facility policy and best practice guidelines across all disciplines within the department through education and feedback, this initiative aimed at increasing standardization in practice and decreasing blood culture contamination rates. This goal was closely related to the mission and vision of the microsystem in serving patients and their families by providing a safe and optimal healing environment.

**Methods**

**Context**

The microsystem attends to emergent and critical patients 24 hours a day, seven days a week. The healthcare providers within the department often treat patients suspected of having sepsis and utilize blood cultures as a top diagnostic tool. The hospital has set guidelines for blood collection to perform blood cultures based on ample evidence-based research (Bool et al., 2020; McNab et al., 2022). Unfortunately, there is a trend of high staff turnover, causing the need for temporary employees like travel nurses and per diem workers, possibly contributing to a decrease in compliance. Additionally, the department utilizes employees with different disciplines, experience, and education. This includes Physicians, mid-level providers (Physician Assistants, Advanced Practicing Registered Nurses), Registered Nurses, Clinical Nurse Leaders, Laboratory Technicians, Imaging Technicians, Emergency Department Technicians, Registered Paramedics (RP), Licenses Nurses Assistants (LNA), Health Unit Coordinators (HUC),
receptionists, and security officers. Education ranges from certificate program-based (RP, LNAs), associate degree prepared (RNs), bachelor’s degree prepared (RNs), master’s prepared (RNs), and doctorate education. Although different experiences are valuable, these factors can cause a breakdown of policies and procedures and decrease adherence to facility protocols (J. Woods, Personal correspondence, March 2023). Educational interventions must be focused on all team members collecting blood culture samples to ensure success. Visual infographics and poster presentations with feedback on previous performance will be able to reach more staff during all shifts. They can be helpful in continuous reminders to adhere to best practices.

The microsystem has set its acceptable BCC rate to under three percent but has had varying rates over the last two years and often exceeds that benchmark. Previous quality improvement efforts that displayed infographics in the nurses’ staff lounge decreased BCC rates, but only for small periods, and have not yielded sustained results. The current quality improvement initiative enhanced and relocated infographics to more visible areas with higher traffic. This ensured exposure to the information regardless of discipline, shift schedule, or whether they frequent the staff lounge.

**Cost Benefit Analysis**

The costs associated with this quality improvement initiative were minimal and close to cost-neutral. The feedback and education regarding facility-specific protocols utilized materials found within the hospital. The macrosystem has already developed protocols based on globally accepted guidelines and evidence-based practice; thus, no additional costs were associated with formulating new policies. Currently, processes are already in place to gather data and track BCC rates within the hospital, thereby incurring no additional costs. The only costs associated with this initiative were the labor costs of the Sepsis Champion assisting with implementing this
project, the materials required for printing and laminated educational cards, and a poster displaying previous BCC rates and offering feedback on costs associated with high BCC rates.

The breakdown of these costs can be seen in Table 1.

**Table 1**

*Quality Improvement Project Cost Breakdown*

<table>
<thead>
<tr>
<th>Item</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sepsis Champion’s Involvement (20 hours)</td>
<td>$720</td>
</tr>
<tr>
<td>• Based on the average hourly wage of a registered nurse in an emergency department with 2 years’ experience <em>(Salary, n.d.)</em></td>
<td></td>
</tr>
<tr>
<td>Office Supplies</td>
<td>$30</td>
</tr>
<tr>
<td>• Card stock</td>
<td></td>
</tr>
<tr>
<td>• Ink for printer</td>
<td></td>
</tr>
<tr>
<td>• Lamination materials</td>
<td></td>
</tr>
<tr>
<td>• Thumb tacks</td>
<td></td>
</tr>
<tr>
<td>• Poster board for feedback poster</td>
<td></td>
</tr>
</tbody>
</table>

Contaminated blood cultures cause additional expenses to the patient and healthcare facility and can lead to direct and indirect costs. A systematic review published in 2019 found that per patient there were additional pharmacy costs (between $210 to $12,611), higher laboratory charges (between $2,397 and $11,152), and increased hospital stays of upwards of 22 days *(Dempsey et al., 2019)*. The same systematic review found increased hospital costs of between $2,923 and $5,812 and pharmacy and laboratory costs of around $305 to $1,389 per patient *(Dempsey et al., 2019)*. Contaminated blood cultures and the resulting treatments and charges can also cause issues with Medicare reimbursement *(McNab et al., 2022)*. In this respect, continuing with high BCC rates within the emergency department would be highly costly.

**Interventions**
The proposed intervention dealt with staff feedback and the promotion of facility policy. It was decided that infographics outlining best practices would be created and placed on the carts (known as “IV carts”) that contain the necessary materials used for the collection of samples for blood cultures. There are approximately a total of 15 carts located in rooms and in the hallways. The infographics created measured five inches by eight inches in size, were printed on card stock, and were laminated (See Appendix C for a copy of the infographic). They were attached flush to the top of the IV carts for easy viewing. The tops of the IV carts are routinely used as a workspace when inserting catheters and collecting blood samples, giving this location high visibility. The microsystem’s Sepsis Champion and lead nurse educator were vital stakeholders. They were consulted on the final design of the infographics to enhance their impact. These infographics had the following information on them taken from the microsystem’s policies (See Appendix B for specifics on policies. Some items were redacted to protect anonymity) (Andrews & Champagne, 2022):

1. **Specimen Preparation**
   a. Remove the caps of the blood culture bottles and clean them with 70% isopropyl alcohol pads.
   b. Allow to fully dry before collection
   c. Fill the blue (aerobic) and then the purple (anaerobic) blood culture bottle
   d. Collect two sets of blood cultures BEFORE antibiotic administration

2. **Skin Preparation**
   a. Clean skin with a Chloraprep applicator for 30 seconds using back-and-forth motions
   b. Allow skin to fully dry
c. **DO NOT PALPATE THE SKIN ONCE CLEANED**

d. If drawing blood cultures from an existing catheter, use the chloraprep swab provided in the blood culture kit

In addition to infographics in the ED, staff feedback was utilized to promote re-education. A larger display that illustrated the last year of data regarding BCC rates and costs associated with high rates was posted in the staff breakroom (See Appendix D for a copy of the poster). Names of those who had contaminated blood cultures were not used to protect anonymity. To ensure optimal visibility, the Clinical Lead had agreed to highlight this data and quality improvement project in their daily huddle meetings before shift changes.

**Study of the Interventions**

The microsystem already tracks BCC rates through its information and technology (IT) department. After collection, each blood culture is scanned into its electronic medical record (EMR). Following processing in the lab, data regarding any contaminated blood cultures are sent to the Section Head of Microbiology and Pathology. The results are assessed every month, and a report is generated that provides the overall monthly contamination rate, the method of collection, the employees responsible, the job title, the discipline of the employees, the number of occurrences per employee, and the collection site. A spreadsheet compiling the information is then sent to the Sepsis Champion for analysis and use for improvement. The data is reliable and has a high degree of validity due to its repetitive nature.

The Sepsis Champion had agreed to partner with the author and sent information as it became available. Data is typically available between one to two weeks following the end of the month. Studies have shown that reminders and re-education of facility protocol are highly effective in promoting adherence (Bool et al., 2020). It was predicted that if the BCC rates
dropped from their previous state, the interventions would be considered impactful as no other interventions were being implemented to address this issue.

**Measures**

The operational definition of blood culture contamination is a microorganism identified after collection that was not pathogenic for the patient (Bool et al., 2020). The microsystem aligns itself with evidenced-based research and identifies a contaminated culture if there is a presence of normal skin flora such as coagulase-negative staphylococci, *Bacillus* spp. (not *B. anthracis*), viridian group streptococci, *Corynebacterium* spp., *Propionibacterium* spp., *Micrococcus* spp. (Bool et al., 2020; Ramirez et al., 2015). The hospital currently collects information on all blood cultures collected. Each month, a tally of the total number of contaminated cultures is compared to the total overall blood cultures collected to calculate the contamination rate. As the collection of BCC rates is a routine measure already implemented within the microsystem, this method was chosen to evaluate the outcome of the intervention. Because it is already in use, there were no additional costs directly or indirectly in capturing this data. The intervention was implemented at the end of May 2023, and the data was evaluated in mid-July 2023.

**Analysis**

A descriptive statistical analysis assessed the categorical data. The overall monthly contamination rate is expressed as a percentage. The percentage of blood culture contaminations is calculated by comparing the number of contaminated blood cultures to the total overall blood cultures collected during the month. Data was evaluated before and after the interventions, and particular attention was paid to the month the initiative was implemented. The mean, standard deviation, and range were collected and analyzed using Microsoft Excel (See Table 2 for
specifics). A paired t-test was conducted to determine if there was statistical significance to the BCC rate change from pre-intervention to post-intervention periods. Graphs were created to evaluate any trends in BCC rates for the last year (See Figure 1). The timely collection of available data and high visibility of the infographics will help promote the success of this project.

**Ethical Considerations**

There were a few ethical considerations that needed to be addressed. There was no patient involvement, and thus did not breach any confidentiality. The intervention focused on educating healthcare workers tasked with collecting samples for blood cultures and did not require mandatory participation. Staff were informed of the intervention before implementation. The team included registered nurses and emergency medical technicians. Names of those who collected contaminated blood cultures are included in the data given to the Sepsis Champion and were viewed by the author. Still, demographic data was not used when displaying BCC rates to protect employees' identities. Studies show that interventions with a punitive overtone are less successful than those that promote and celebrate successes (Bool et al., 2020; Halstead et al., 2020; McNab et al., 2022). The interventions themselves posed no physical or emotional harm to anyone involved. Bias was minimal as the data being gathered was strictly quantitative and was collected by the hospital using IT resources. The only conflict of interest was the author’s acceptance of a job in the organization, but it did not affect the data collected, as the microsystem is responsible for this. The University of New Hampshire’s Quality Review Committee reviewed this quality improvement project proposal for approval, and a QI determination letter was given.

**Results**

**Implementation: Initial Steps and Evolution**
The implementation timeline for this quality improvement project had been planned for three phases. Unfortunately, due to data availability, minor adjustments had to be made to the project. The initial creation phase ran from May 22nd until May 31st. During this time, an informational graphic card (infographic) measuring 5 inches by 7 inches was designed, printed, and laminated (See Appendix C for a copy of the infographic). The content of the infographics outlined facility protocols and focused on procedures and steps that recent quality improvement projects and studies have noted as being typically missed or performed incorrectly (Bool et al., 2020; He et al., 2020; Shaji et al., 2022). On June 1st, informational graphic cards were placed on every intravenous supply card (IV cart) in the main emergency room, overflow areas, staff bathrooms, and the staff lounge.

The second phase entailed designing and displaying an 18-inch by 24-inch poster placed in the staff lounge in the emergency department's main section (See Appendix D for a copy of the poster). The poster outlined the emergency department’s blood culture contamination rates for the past year. Other included information focused on the associated costs of an increased contamination rate. Originally, the poster was to be displayed the first week of June.

Unfortunately, the data for May 2023 was unavailable until the second week of June. The poster was completed and displayed on the 16th of June. Phase two also included evaluating the status of the infographics placed earlier in the month. The state of the infographics (damaged or missing) could indicate whether this type of intervention could be sustainable. Due to the delay of the poster, this evaluation happened mid-month, on June 16th. Upon assessment, no cards were damaged or removed from where they were initially placed. A final walkthrough was conducted on Friday, June 30th, to identify any damaged or missing infographic cards and posters. All materials remained present and intact.
Phase three, the final phase, focused on evaluating data received for June. BCC rate data was received from the Sepsis Champion on July 15th. Statistical analysis was conducted to assess for any significant change in BCC rates and any trends associated with the microsystem.

**Process Measures and Outcomes**

This quality improvement initiative focused on promoting adherence to best practices and facility protocol through education to decrease blood culture contamination rates. The designed infographics and poster attempted to utilize different forms of education to reach the most people. The infographic cards outlined the proper steps in cleaning and collecting samples, while the poster concentrated on giving feedback to the staff. This type of re-education is effective in facilities with high staff turnover and different disciplines working together during different shifts (Al-Hamad et al., 2016; Bool et al., 2020; Halstead et al., 2020; He et al., 2020). The outcome was measured by assessing the blood culture contamination rate post-intervention and comparing that to pre-intervention statistics.

BCC rates at this rural emergency department are calculated at the end of each month and assessed again after each quarter by the Microbiology and Pathology Department. The results are released to the Sepsis Champion approximately one to two weeks following the end of the month. BCC rates were evaluated for this quality improvement project from Quarter 2 2022 through the end of Quarter 2 2023. In that time, the rates have been unpredictable, the lowest being 0.73% in July 2022 and the highest of 3.9% in January 2023. The BCC threshold goal for this quality improvement initiative was 2%. The current facility threshold is 3%. Following the interventions implemented in the microsystem in June 2023, a 1.7% contamination rate resulted. Figure 1 illustrates the year-long progression of contamination rates from April 2022 through June 2023.
Although June’s rate had increased compared to the previous three months (March, April, and May), the resulting BCC rate was still successful. The BCC rate for June at 1.7% was below the 2% threshold goal and the yearly average of 1.9%. The entire second quarter of 2023 was below the facility threshold of 3% and the goal threshold. Descriptive statistical analysis was conducted on the available data. Table 1 outlines Q2 2022 through Q3 2022.

**Table 1**

*Descriptive Analysis from Q2 2022 Through Q3 2023*

<table>
<thead>
<tr>
<th>N</th>
<th>Range</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Variance</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.1%</td>
<td>2.7%</td>
<td>1.8%</td>
<td>4.5%</td>
<td>2.4%</td>
<td>2.8%</td>
<td>2.6%</td>
</tr>
</tbody>
</table>
Quarterly BCC rates have also been assessed for Q1 and Q2, from 2020 to 2023, to evaluate any trends in BCC rate percentage. Figure 2 shows that contamination rates in the first quarter are typically lower than in the second quarter. In 2023, Q2 was lower than Q1 and decreased by 0.9%. In addition, the reduced BCC rate of Q2 2023 of 1.7% was statistically significant to the Q2 2022 rate of 2.5% ($P=0.041$).

**Figure 2.**

*Blood Culture Contamination Rates by Quarter*

| BCC Rate | 18 | 3.3 | .6 | 3.9 | 1.878 | .8916 | .795 |

**Observed Association: Contextual Element and Unintended Consequences**

During this quality improvement study and planning phase, the author identified an opportunity to utilize education to decrease blood culture contamination rates. BCC rates have varied tremendously from 2022 until now and lack consistency. When the author initially reviewed data, the emergency department had seen a contamination rate of 3.9% in June of 2023, the highest in over two years. The second quarter of 2023 showed a great reduction in BCC rates, pre-intervention. Q1 had an average contamination rate of 2.6%. Q2 had a 1.7% average
contamination rate. This is uncharacteristic of the trends previously seen in this department, as Q2 rates have typically increased over Q1. A visualization of this structure can be seen in Figure 2. According to the Sepsis Champion, staffing may have contributed to this unexpected pre-intervention decrease in contamination rate. The microsystem is utilizing traveling nurses and other part-time workers less. Most workers are seasoned full-time employees. This could have led to increased adherence to facility protocol and a decreased rate in the two months preceding the intervention.

Discussion

Summary

Key Findings

This quality improvement initiative aimed to reduce the blood culture contamination rate in a rural emergency department setting to below 2% following re-education of staff members on best practices of blood culture sample collection. Recent studies have shown that using educational tools to promote facility protocols and standardization of practice successfully lowers rates, and this tactic was adapted for this project (Bool et al., 2020; Shaji et al., 2022). Pre-intervention assessment in January and February found that BCC rates had been trending up during Q1 of 2023 and had exceeded the accepted 3%. BCC rates in this microsystem have been traditionally unpredictable, ranging from as little as 0.73% to a high of 3.9% from January 2022 to February 2023. When partnering with key stakeholders of the microsystem, like the Sepsis Champion and Lead Educator, the need for intervention was identified due to the costly nature of contaminated blood cultures and historically inconsistent rates.

A previous quality improvement initiative utilized staff re-education to reduce BCC rates in the same department in 2022. Utilizing a Plan-Do-Study-Act (PDSA) model, the original QI
intervention was assessed and adjusted to increase visibility, heighten exposure, and promote adherence to facility protocol (Connelly, 2021; *Plan-Do-Study-Act (PDSA) Directions and Examples*, n.d.). The PDSA model was chosen for this initiative as this technique allows for multiple cycles of change with small adjustments. This model enables learning about the impact of a particular intervention and assessing whether or not it works in a particular setting (Reed et al., 2016). Evaluating cycles of the intervention then allows for continued adjustments to promote more sustainable results. The previous quality improvement project was successful but did not produce sustainable results. Following the adjustment to the content and location of the information and adding a poster with feedback for the staff, the goal threshold for this project was reached. Continued evaluation of monthly BCC rates would allow for an assessment of the sustainability of the intervention and would inform future adjustments if indicated.

**Project Strengths**

Because of the 24-hour-a-day, 7-days-a-week emergency department schedule, multiple shifts, different disciplines, and various temporary workers fill in where needed. This creates difficulty when attempting any standard re-education. To mitigate this issue, infographic cards were developed and displayed where blood culture collection supplies were located, in addition to frequented areas such as the staff lounge and bathroom boards. The interventions implemented in this quality improvement project brought education to the staff, rather than attempting to bring the staff to the education. In this regard, there was a high degree of exposure to the step-by-step instructions for sample collection based on existing facility protocol and best practices. Any time anyone accessed the contents of the supply carts, these infographics were seen. When asked, staff mentioned they were aware of these cards, had noticed them, and read them after they were displayed (Personal Correspondence, Emergency Room Staff, 2023).
In addition to being highly visible, this project was inexpensive and easy to replicate. Twenty-two infographics and one poster remained intact and in place for the full month of June. This type of educational intervention can also be adjusted depending on the individual settings. This lends itself to a high degree of transferability to other microsystems and macrosystems.

**Interpretation**

**Interventions and Outcomes**

This quality improvement project aimed at using educational reminders to promote standardization and adherence to facility protocols, thereby decreasing blood culture contamination rates to under 2%. The summer months are typically difficult within this emergency department as there is an increased patient census, limited staff, and high demand for blood cultures. Despite these challenges, the interventions implemented during this initiative directly impacted the blood culture contamination rates. The BCC rate for June was 1.7%, below the 2% threshold goal and well below the internationally accepted 3% benchmark. Trends have shown a typical increase in contamination rates from Quarter 1 (Q1) to Quarter 2 (Q2) in this microsystem in past years (see Figure 2). This was not the case in 2023, as the BCC rate decreased by 0.9% from Q1 (2.6%) to Q2 (1.7%).

**Relevance to Current Literature**

Many factors can influence contamination, including a break in facility protocols, inadequate staffing, and a misunderstanding of the proper procedure and best practices for sample collection. Recent literature has shown that blood culture contamination rates can be decreased by promoting standardization and adherence to facility protocols through staff education and feedback (Al-Hamad et al., 2016; Bool et al., 2020; He et al., 2020; Shaji et al., 2022). Various approaches have proven successful, including informational graphics, monthly
training sessions, posters, mobile applications, and individual one-on-one sessions. This quality improvement project initiative adopted some of these techniques. Although they were used on a small scale, the interventions proved impactful. The informational graphic cards used during this project were on display for the entire month of June in high-traffic places so that those who drew blood culture samples would be exposed to the step-by-step instructions each time. Consistent and real-time educational reminders are more effective and impactful in creating sustainable change than single educational training sessions (Bool et al., 2020).

This quality improvement project also utilized a poster to provide staff feedback, showing the microsystem's current system, the explanation behind the goal threshold of 2%, the current facility endorsed threshold of 3%, and the costs associated with BCCs. Recent studies highlight that providing feedback to the staff on the unit’s or facility’s performance using a non-punitive approach is more successful in impacting behavior than using punishment or more corrective action (Halstead et al., 2020). Staff must understand the cause and effect regarding BCC rates and how their actions can lead to improvement. Using this approach is more likely to result in a positive change. Combining the graphic cards and poster allowed for more in-depth education, and this bundled approach to reeducation aligns with the most recent literature showing the efficacy of a multi-modal tactic (Al-Hamad et al., 2016; Bool et al., 2020).

**Impact of the Project**

In Q1 2023, the microsystem had 21 contaminated blood cultures, 11 of which occurred in January during the planning phase of this project. In Q2 2023, there were 14 contaminated cultures, seven in June following the intervention. The use of education to reduce BCC rates impacts staff, patients, and the facility on not only a microsystem level but a macrosystem level as well. Contaminated blood cultures are costly in time, physical resources, and finances. BCCs
increase laboratory costs, patient stays, put additional strain on healthcare workers, and affect how a hospital is reimbursed. One systematic review found that a single contaminated blood culture can cost thousands (McNab et al., 2022). Reducing just one contaminated culture could save $30,000 in laboratory costs, pharmacy costs, and extended hospital admissions (McNab et al., 2022). In addition, there is less demand on healthcare workers regarding the time required to rerun tests, medication administration, and continued patient care. In this respect, promoting best practices and proper protocols through staff education can have a significant effect.

**Influence of Context**

During the planning phase of this quality improvement initiative in January of 2023, the emergency department had a BCC rate of 3.9%, the highest percentage in over a year. Following the implementation of interventions, the BCC rate was 1.7%. Although a significant reduction and was considered successful, June's lower contamination rate increased from the previous months. In April and May 2023, the contamination rates were 1.3% and 0.8%, respectively. These rates were uncharacteristically low in comparison to the year preceding (See Figure 1). There may have been some external factors influencing the rate directly before the rollout of the intervention, such as staffing turnover and a decrease in the use of temporary workers. Despite this, the rate for June 2023 stayed below the 2% threshold goal, at least partly due to the interventions implemented in addition to other contextual influences.

**Cost**

The resulting cost of the quality improvement project was less than anticipated. The initial budget projected the need to reprint damaged or inadvertently taken down materials. This was unnecessary as every informational graphic and poster remained intact throughout the interventional period. The intervention succeeded in decreasing BCC rates and, thus, potentially
saved money regarding supplies, repeated tests, extended stays, and human costs such as the time and resources of the healthcare workers on the unit. In this way, the potential benefits outweighed any costs associated with this project.

**Limitations**

Despite being easily replicable, this type of intervention is limited in its generalizability regarding the setting in which it would be conducted. The emergency department chosen for this quality improvement project has specific resources that other units may not have, such as an in-facility laboratory that processes blood culture samples. It is unknown if contamination rates would increase due to handling issues if specimens needed to be transferred and processed in a different facility. Additionally, nurses and registered paramedics collect most of the blood culture samples in this facility, and the type of intervention was directed toward those professions. Other institutions utilize laboratory technicians for collection, and it is unknown if these specific educational interventions would be successful with this population. Finally, more study is needed to assess the generalizability of these interventions in an ambulatory setting. Much evidence indicates the success of educational interventions in decreasing blood culture contamination rates in hospital settings (Al-Hamad et al., 2016; Bool et al., 2020; He et al., 2020). Still, there is a lack of knowledge on whether it can be applied to an ambulatory setting such as an Urgent Care or other outpatient facilities.

**Factors Limiting Validity**

Several limiting factors associated with this intervention should be acknowledged to inform future PDSA cycles. Some concerns centered around the design of the initiative. The quality improvement project was not a randomized control trial. The intervention was
implemented in one emergency department and lacked a control group. These issues could decrease its generalizability in other microsystems.

Other factors centered around timing. For example, the project was conducted during a condensed timeframe. Only one month of data was assessed for results following the implementation of the intervention. Extending the timeline to include data from six months to a year would allow for a greater understanding of trends and help offset any short-term contextual issues, such as staffing changes or staffing numbers during shifts. Clear evidence points to the need for continuous education and feedback to ensure sustained adherence to facility protocols (Bool et al., 2020; Ramirez et al., 2015). A longer timeframe would allow for more adjustment cycles following the Plan-Do-Study-Act model. Additionally, the interventions were implemented during the summer. The rural emergency department where the interventions were conducted is located in a popular tourist destination, and the summer months are typically busier with higher patient numbers. Staffing is commonly decreased during this season, leading to an increased time strain on employees. Blood culture sample collections require adherence to a particular order of procedure, and a lack of time has been cited as a significant contributing factor to increased contamination rates (Al Zamel et al., 2020; Al-Hamad et al., 2016; Bowen et al., 2016b).

Finally, bias may have been introduced before the intervention was conducted. The project was discussed on the unit during the pre-intervention period spanning from January until the end of May when the microsystem assessment was taking place and planning was being conducted. This could have impacted the results as it is unknown how much discussion around contaminated blood cultures could have influenced behavior before re-education.

Efforts to Minimize Limitations
Efforts were made to minimize the impact of these types of limitations on the success of the quality improvement initiative. The informational graphics and poster are inexpensive and easily replicable. They can be adjusted to include facility-specific protocols and adapted for the majority of settings. Additionally, the interventions chosen were picked to reach as many employees as possible to enhance exposure to education despite an isolated implementation. A previous quality improvement project conducted in 2022 in the same emergency department displayed similar information on facility protocols and best practices in the staff lounge (McGuire, 2022). It is difficult to ascertain which employees frequent the staff lounge and, if they do, whether they read the informational graphic displayed there. Using the PDSA model, the current quality improvement initiative attempted to expand on the original configuration and place educational information graphics on every cart with intravenous supplies and other places such as the staff bathrooms and lounge. This ensured high exposure to staff members collecting samples, regardless of shift worked or job discipline.

**Conclusion**

Following evidence-based practices, adhering to facility protocols, and standardization are key factors in enacting quality change. This initiative adopted these tenants utilizing real-time staff re-education material and feedback in the microsystem. The resulting decreased blood culture contamination rate was below the goal threshold of 2%. Maintaining low BCC rates is crucial to ensuring proper and timely patient care.

The sustainability of this change has yet to be determined. When the original quality improvement initiative was enacted in 2022, it decreased BCC rate. Following the conclusion of that project, rates began to increase. It will take time to assess the sustainability of this current initiative. Further assessment would be needed to examine future PDSA cycle results, and if
indicated, additional adjustments to the intervention to promote further success. Both quality improvement projects resulted in a positive change and have created a strong educational foundation to build upon. Recent studies point to the need for continuous uninterrupted reeducation for sustained quality improvement, which should be considered for any future PDSA cycles (Al-Hamad et al., 2016; He et al., 2020; Ramirez et al., 2015).

This type of work directly impacts Clinical Nurse Leadership and future practice. Blood culture contamination is a quality and patient care indicator. Recent studies and improvement projects have found that continued staff re-education reduces contamination rates, even in busy critical care environments (Bool et al., 2020; He et al., 2020; Park et al., 2015). It is important to maintain an environment focused on reeducation and improvement to decrease costs, maintain an environment of safe practice, and upgrade the quality of care provided.

Additional PDSA cycles would be beneficial to assess for additional opportunities to improve. Following the assessment of the sustainability of this intervention, adjustments should be made to ensure more successful and consistent outcomes. It would also be valuable to evaluate data for other factors contributing to this microsystem’s varying BCC rates including draw site frequency, organisms detected, and which job discipline is more likely to draw a contaminated specimen. This analysis would allow for more targeted education that could potentially ensure the continuation of lower BCC rates.

**Funding**

This QI initiative did not receive funding from any public or private organization or the microsystem in which it was conducted. The project was self-funded but was limited to costs for materials used for the infographic and poster. Microsoft Excel and SPSS software were used to analyze data but incurred no cost.
References


Appendix A

PRISMA 2009 Flow Diagram

Records identified through database searching (n = 99)
Data bases used: CINHAL, PubMed, and MEDLINE

Additional records identified through other sources (n = 0)

Records after duplicates removed (n = 64)

Records excluded (n = 36)
- Irrelevant studies

Records screened (n = 64)

Full-text articles assessed for eligibility (n = 28)
- 8 Did not evaluate specific interventions, only best practice
- 7 Editorial, not research
- 2 Only a proposal, research not conducted yet
- 2 articles with insufficient evidence
- 2 Full articles not in the English Language

Studies included (n = 7)

Appendix B

Emergency Department Blood Culture Collection Policies

Title: Blood Culture Collection

Effective Date: April, 2009

Last Date Reviewed/Revised: 12/21

Purpose:

The purpose of this policy is to provide instruction on how to accurately and effectively collect a blood culture specimen.

Policy:

The detection of microorganisms in a patient’s blood has diagnostic and prognostic importance. Blood cultures are essential in the diagnosis and treatment of the etiologic agents of sepsis. Skin preparation of the venipuncture site is an important factor in reducing the rate of blood culture contamination. False positive results may be caused by contamination of the culture with the patient’s skin flora introduced into the blood specimen during collection.

The clinical uncertainty surrounding blood culture contamination can lead to unnecessary antibiotic therapy, additional laboratory testing, more frequent consultations and higher costs. Therefore, it is very important to follow the procedure outlined below when collecting blood samples for culture.

Procedure:

1. SUPPLIES:

   Venipuncture collection, Intravenous (IV) start collection and IV line collection:
   
   A. Povidone Iodine Prep for patients less than 2 months old
   B. 70% isopropyl alcohol (alcohol pads)
   C. Chloraprep sponges or Swabstic for all patients over 2 months old
   D. One blood culture set = 1 Aerobic and 1 Anaerobic bottle or 1 Single BACTEC™ Pediatric bottle.
   E. If Blood Cultures are for AFB or Fungal, draw in yellow topped SPS tubes or Bactec Myco/F Lytic bottles and Blood Culture bottles
   F. Gauze
   G. Tape

   Venipuncture collection: Safety winged blood collection set/ “butterfly”
   
   A. Syringe or Needle hub
   B. Transfer device for syringe

   IV start collection and IV line collection:
   
   A. Luer lok access device
   B. Extension device
   C. IV

2. COLLECTION

   A. SITE SELECTION

   Ideally, a minimum of 2 sets of blood cultures should be obtained from two separate venipuncture sites (e.g.
right and left antecubital veins). Blood cultures may be obtained at the time of an IV start. DO NOT routinely
collect blood cultures through an indwelling vascular catheter unless specified by the clinician. If a request is
made by a clinician to obtain a blood culture specimen from an indwelling catheter or central line then a
SPECIFIC order must be obtained for both the catheter pull back and a peripheral site. Refer to the Central
Line/PICC: Insertion (Assistant) & Care guideline when accessing a CVC.

B. DISINFECTING BLOOD CULTURE BOTTLES

1) Remove the flip-off caps from BACTEC™ culture bottles.
2) Wipe top of each vial with a 70% isopropyl alcohol pad and allow to dry. Use a separate pad for each
   vial. If drawing SPS tubes for AFB or Fungal, clean tops of tubes with a 70% isopropyl alcohol pad and
   allow to dry.

C. SITE PREPARATION

(Ages 2 months and older)
1) Clean venipuncture site using alcohol prep pad.
2) Allow site to dry.
3) Clean venipuncture site using repeated back and forth strokes of the Chloraprep applicator for
   approximately 30 seconds.
4) Allow the site to air dry for approximately 30 seconds. DO NOT blot or wipe away. DO NOT touch or
   palpate the area after cleansing. If the venipuncture proves difficult and the vein must be touched
   again to draw blood, the site should be cleansed a second time or consider wearing sterile gloves.

(Age under 2 months)
1) Clean venipuncture site using alcohol prep pad.
2) Allow site to dry.
3) Clean venipuncture site using 10% Povidone antiseptic starting at the center and moving out in
   concentric circles. The antiseptic should remain in contact with the skin for at least 30 seconds.
4) Allow the site to dry. DO NOT touch or palpate the area after cleansing. If the venipuncture proves
   difficult and the vein must be touched again to draw blood, the site should be cleansed a second time
   or consider wearing sterile gloves.
5) NOTE: After venipuncture re-cleanse the area with a new 70% isopropyl alcohol pad.

D. VENIPUNCTURE

1) Collect specimens using powerchart specimen collection. Open PCSC by clicking on the icon.
2) Scan their arm band to display pending orders.
3) Verbally confirm patient ID on computer matches arm band.
4) Patient must have arm band on to be drawn.
5) If unable to scan arm band see notes below.
6) Click on the printer icon on the right side of the newly opened pane.
7) Make sure all specimens that are being collected have the selected box checked, deselect anything
   that you are NOT collecting.
8) Choose printer.
9) Press print to print pending bar code orders.
10) Collect specimens: NOTE: Draw/fill the aerobic or pediatric bottle, draw/fill the anaerobic bottle, and
    then draw/fill the SPS tubes or Bactec Myco/F Lytic bottles if they are needed. When using the safety
    winged collection set ("butterfly") you MUST carefully monitor the volume collected by using the 5mL
    graduation marks on the vial label, not to exceed 10 mL. "Over fill" may adversely affect results. If using
    a safety winged collection set with a syringe, draw 16 to 20 mL of blood for one blood culture set.
    Aseptically transfer 8 to 10 mL of specimen into each bottle using a blood transfer device. For
    pediatric patients, a 3 mL syringe is frequently used. Draw 1 to 3 mL of blood and transfer the entire
    amount into a single BACTEC™ pediatric bottle. Pediatric patients less than 2 months old: After all
    specimens have been collected from the infant, use a sterile alcohol pad to remove the povidone-
    iodine solution from the venipuncture site. This is necessary due to the iodine's effect on the thyroid
and liver and the potential for an allergic reaction.
11) Continue to care for the venipuncture site following protocol for all venipunctures.
12) The inoculated BACTEC™ bottles should be transported as quickly as possible to the laboratory.
13) Label all tubes with printed bar codes.
14) Scan labeled tubes codes with portable scanner.
15) Click sign on the bottom of screen to accept orders have been drawn.

Notes:
If unable to scan arm band due to damage, replace the arm band before drawing.
Patients in isolation precaution rooms will have PPID overridden to reduce risk of spread of infection.
The use of "Unable to scan collections" will be audited on a regular basis to ensure compliance. This choice
should rarely be used.

E. VOLUME

The volume of blood cultured is critical because the number of organisms per mL of blood in most cases of
bacteremia is low, especially if the patient is on antimicrobial therapy. In infants and children, the number of
organisms per mL of blood during bacteremia is higher than adults, so less blood is required for culture.
Refer to Laboratory Pediatric Phlebotomy Quantity guidelines for total volume that can safely be drawn from
infants and children per day if multiple tests are ordered.

1) Children: 1 to 3 mL of blood per venipuncture. Transfer the entire amount to a BACTEC™ pediatric
bottle.
2) Adult: 16 to 20 mL of blood per venipuncture. If it is impossible to draw the required amount, aliquot
as follows:

<table>
<thead>
<tr>
<th>Amount per</th>
<th>Amount in BACTEC™</th>
<th>Amount in BACTEC™</th>
</tr>
</thead>
<tbody>
<tr>
<td>Venipuncture</td>
<td>Aerobic bottle</td>
<td>Anaerobic bottle</td>
</tr>
<tr>
<td>10 – 20 mL</td>
<td>Split equally</td>
<td>8 mL</td>
</tr>
<tr>
<td>13 – 16 mL</td>
<td>between aerobic</td>
<td>5 – 8 mL</td>
</tr>
<tr>
<td>10 – 12 mL</td>
<td>and anaerobic</td>
<td>5 mL</td>
</tr>
<tr>
<td>5 – 9 mL</td>
<td>vials</td>
<td>0</td>
</tr>
</tbody>
</table>

NOTE: The optimal volume of blood per aerobic and anaerobic BACTEC™ bottle is 8-10 mLs.

F. SPECIMEN LABELING

Specimens shall be collected and labeled through powerchart specimen collection. If the system is not
available, each vial should be labeled with the appropriate patient information and specimens must be labeled
at the patient’s bed side:

1) Patient’s full name.
2) Hospital medical record number and/or date of birth.
3) Date and time collected.
4) Employee Identification Number or first and last initials of individual who collected the specimen.
5) Site of venipuncture (e.g. “RAC” “LAC” “Central Line Port”).
6) Improperly labeled specimens are rejected (i.e. not run). (See Laboratory Specimen Collection
Chapter for reasons of rejection).

G. NUMBER AND TIMING

Most cases of bacteremia are detected using two to three sets of separately collected blood cultures. More
than three sets of blood cultures yield little additional information. Conversely, a single blood culture may miss
intermittently occurring bacteremia and make it difficult to interpret the clinical significance of certain isolated
organisms. Draw specimens from two different sites one after another or 15-30 minutes apart (can be from same site or different site). If special timing and number required based on recommended guidelines it should be specified on the order by the provider.

References:
3. Chloraprep One-Step Frepp Applicator Package Insert.

Dates Reviewed: 2/13, 4/14, 5/19, 5/20, 2/21, 12/21
Dates Revised: 3/11, 2/16, 2/17, 4/18, 6/19, 8/19
(Reviewed by JK)
Appendix C

Informational Graphic Displayed in Microsystem

### PREVENT BLOOD CULTURE CONTAMINATION!

**SKIN and CATHETER PREPARATION**

1. Clean skin with an ALCOHOL pad or CHLORAPREP applicator for 30 seconds using back-and-forth motions
2. Allow skin to FULLY dry—at least 30 seconds!
3. **DO NOT PALPATE THE SKIN ONCE CLEANED**: if the area is touched, repeat steps 1 and 2
4. If drawing blood cultures from an existing catheter, clean for 30 seconds with CHLORAPREP swab in blood culture kit

**BLOOD CULTURE COLLECTION**

1. Remove flip-off caps from BACTEC culture bottles
2. Use a separate 70% isopropyl alcohol pad for each bottle-clean the tops and allow to FULLY dry
3. Fill the BLUE (aerobic) and then the PURPLE (anaerobic) blood culture bottle
4. Collect two sets of blood cultures 15-30 minutes apart from the same or different site
5. Collect two sets of blood cultures BEFORE antibiotic administration
Appendix D

*Feedback Poster Displayed in Microsystem*

**Prevent Blood Culture Contamination!**

A blood culture is considered contaminated when a microorganism is identified after collection that is not pathogenic for the patient (Booz et al., 2020). These microorganisms typically are common skin flora introduced into the specimen during collection (Ramirez et al., 2015).

*Concord Hospital Laconia BCC Rates 2022-2023*

![Graph showing BCC rates from May 2022 to May 2023.]

- **Contamination Rate**
- **Median (2.19%)**
- **Threshold GOAL (2%)**

(Concord Blood Culture Contamination, 2022; Laconia Blood Culture Contamination, 2022)

**The Clinical Laboratory Standards Institute has set the recommended BCC level to be less than 3% but recent research points to 2% as being achievable and favorable for patients and hospitals (Booz et al., 2020).**

**Blood culture contamination is costly to patients, staff, and the hospital.**

1. **Increased Hospital Stays by up to 22 days**
2. **Increased Pharmacy Costs Ranging $210 - $12,661**
3. **Increased Laboratory Charges Ranging $2,397 - $11,152**
4. **Increased Hospital Costs Ranging $2,932 - $5,812**
5. **Increased Laboratory Costs Ranging $305 - $1,389**
6. **All results in greater strain on hospital staff and resources**

**Think B-L-O-O-D**

- **B** Be sure to clean the skin with an alcohol pad or Chloraprep applicator; DO NOT palpate the skin once it’s clean!
- **L** Let the area dry completely; at least 30 seconds
- **O** Open both collection bottles and clean them with a 70% isopropyl alcohol pad
- **O** ORDER MATTERS! Fill the BLUE (aerobic) and then the Purple (anaerobic) bottle
- **D** Do collect TWO sets of cultures BEFORE antibiotic administration!