# Reducing Blood Culture Contamination in the Emergency Room

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April 17, 2023

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## Abstract

**Purpose/Objectives:**

When blood culture contamination in emergency departments is above 3%, it is associated with adverse patient outcomes, inappropriate antibiotic use, and increased hospital costs. In a large, Midwestern, level I trauma hospital, there is a blood culture contamination (BCC) rate of 8.32%.

**Description of the Project:** The project entailed creating an education process, including principles of aseptic technique, skin and bottle preparation, sample transfer, and ensuring all supplies are readily available. Data collected included the overall number of blood cultures completed by nursing staff, the number of contaminated specimens, the type of contamination, and the contamination rate.

**Outcomes:** The goal of reducing blood culture contamination by one percent was exceeded. The contamination rate was reduced from 8.3% to 4.4%.

**Conclusion:** A reduction in nurse drawn blood culture contamination was observed. However, they were unable to achieve the recommended standard of less than three percent contamination. Potential barriers to achieving this reduction could be attributed to resistance from staff to perform the procedure correctly, the fast-paced environment, a high rate of staff turnover, and an increase in patients being boarded in the emergency department.

**Discussion:** This project has potential to improve patient outcomes by decreasing false-positive blood cultures, improving patient satisfaction, reducing the length of stay, decreasing need for unnecessary antibiotics, and decreasing hospital-acquired conditions. This organization has multiple hospitals in its healthcare system. The quality improvement project, education, and intervention will be introduced at all the remaining EDs in the system which could decrease overall hospital costs by $27,000 to $117,000 dollars per month.

## Reducing Blood Culture Contamination in the Emergency Room

Blood culture contamination (BCC) continues to be a significant problem in the emergency department (ED). Accurate blood cultures are essential for providing safe, timely, and effective care for patients with severe infections (Snyder et al., 2012). False-positive blood cultures are attributed to increased length of stay, unnecessary or inappropriate antibiotic use, and an increased financial burden (Posillico et al., 2018). The emergency department environment is often crowded and fast-paced due to patient census fluctuations, increasing the probability of BCC (Shaheen et al., 2020). Adding to the difficulty, acutely ill patients do not only arrive by ambulance, but also through emergency department triage, contributing to slower treatment times (Prekker & Puskarich, 2018). High staff turnover rates may also contribute to a lack of knowledge. This paper explores blood culture contamination and evidence-based interventions to improve blood culture collection in emergency departments.

## Background

Bloodstream infections in 2013 cost the U.S. healthcare system over $24 billion per year (Paoi et el., 2018). One of the most common causes of bloodstream infections is community-acquired sepsis or septic shock (Thompson et al., 2019). The Centers for Medicare and Medicaid Services (CMS) defines septic shock as severe sepsis plus lactate ≥4 mmol/L and/or systolic blood pressure < 90 mmHg or mean arterial pressure < 65 mmHg after 20 mL/ kg of crystalloid fluid (Loza-Gomez et al., 2021). The Society of Critical Care Medicine's Surviving Sepsis Campaign recommends that in the first hour of arrival, providers measure a lactate level, obtain two blood cultures before administering antibiotics, rapidly administer crystalloids of 30mL/Kg for hypotension or lactate greater than 4mmol/L, and initiate vasopressors if unresponsive to fluid resuscitation (Society of Critical Care Medicine, 2019). Blood cultures diagnose acute

illnesses such as sepsis or septic shock and direct providers to select appropriate antibiotics (Bool et al., 2019). Blood cultures are an essential diagnostic tool, and the potential for BCC increases when improper technique is used. According to the organization's policy, a blood culture may be collected from a new peripheral intravenous cannula (PIV), a central line, or a venipuncture meant only for obtaining a blood culture. The skin must be prepared adequately by cleaning with an approved substance for 30 seconds and allowed to dry completely. The culture collection bottles must also be adequately prepared by cleaning the top of the bottles with isopropyl alcohol. Each vial should contain 5-10 milliliters (ml) of blood. The cultures should be obtained from two different sites to ensure the accuracy of the specimen obtained.

The Clinical and Laboratory Standards Institute (CLSI) defines BBC as a microorganism isolated from a blood culture during collection or processing that was not infectious to the patient (CLSI, 2007). The most common skin contaminants reported are *coagulase-negative staphylococci*, *Corynebacterium* species, *Bacillus* species other than *Bacillus anthracis, Propionibacterium acnes*, *Micrococcus* species, *Viridans* group streptococci, enterococci, *Lactobacillus* species, and *Clostridium perfringes* (McLeod, 2019; Hall & Lyman 2006). Contamination of the specimen most commonly occurs during improper skin preparation where the bacterium may pass through the needle (Zimmerman, 2020). However, improper collection techniques, the order in which samples were obtained, and obtaining a sample through an established PIV are additional sources of contamination (McLeod, 2019). There is an increased prevalence of BCC in emergency departments, ranging from 6-10%, compared to intensive care units (ICUs) or medical/surgical units (MSUs) which have BCC rates of 2-3% on average (Skoglund et al., 2019; Bool et al., 2020).

## Significance of Problem

According to the CLSI, blood culture contamination rates should not exceed 3% (Skoglund et al., 2019). A large majority of BCC is preventable, and the organization's goal is to reach under 3% for all practice areas. However, BCC rates in hospitals vary widely, ranging from 0.6% to 12.5%, with the highest rates associated with emergency department settings (Snyder et al., 2012). Factors contributing to higher contamination rates in emergency departments include a "fast-paced environment, frequent changes in staffing, increasing pressure for rapid culture collection before antimicrobial administration, lack of adequate training, and lack of accountability for adherence to the correct procedure to draw cultures" (Dempsey et al., 2018, p. 963). Additionally, the aseptic technique is less of a priority to staff during patient resuscitation (Bool et al., 2019). These patients are often critically ill and may need immediate medication intervention.

BCC leads to false positives that have significant costs associated with antibiotic therapy, length of stay, and the unnecessary administration of antibiotics (Skoglund et al., 2019). Laboratory costs increase with BCC. Multiple blood culture samples were drawn, and antibiotic levels such as Vancomycin monitoring increased laboratory charges (Dempsey et al., 2018). Potential additional costs come from various areas such as procedures, consultation, and microbiology. Several studies have shown significant differences in the charges between false-positive and negative blood cultures (Dempsey, 2018; Posillico et al., 2018). To put this information in perspective, Skoglund et al. (2021) estimated a contamination rate of 6%, the total expected cost was $9,165, and the overall hospital cost for patients with contaminated blood cultures was $12,824 per patient. Applying Skoglund's estimation to this Midwestern hospital with 183 contaminated specimens, total costs are estimated at $2,346,792.

At the project site, the monthly blood culture contamination rate in July and August 2021 was 4.77% and 8.78%, respectively. It is essential to recognize additional factors contributing to the increased contamination rates during this time period, such as inadequate staff, high acuity levels, and increased capacity due to coronavirus disease 2019 (Covid-19; Bool et al., 2019). A Strengths, Weaknesses, Opportunities, and Threats (SWOT) analysis and gap analysis were conducted to determine which factors may be directly contributing to their contamination rate and which evidence-based intervention may assist in reducing their contamination rates (see Appendix A and Appendix B).

The analysis identified there is gap in education for nursing staff. In its current state, there is no formal education process to teach nursing staff how to obtain a blood culture. Additionally, when a contamination does occur, there is no accountability or feedback for the specimen collector. The care environment may also contribute to contamination with crowding, multiple high-acuity patients, and high staff turnover. The final area identified in the gap analysis is improper preparation of either the patient's skin or culture bottles.

In future state, the organization would like to see a formal education process for both nursing and laboratory staff. This may include a computer learning module with a video demonstrating proper sterile technique. An in-person demonstration with return demonstration will also be required before the staff members will be allowed to draw blood cultures. Lastly, a new quality system will be implemented when nursing staff have a contaminated specimen: they will be notified by secure email and recognition of receipt will be required. If the staff member has more than two contaminations in a three-month period, they will be required to repeat the education before they will be allowed to collect blood culture samples again.

## Problem Statement

Blood culture contamination in emergency departments has been above the 3% contamination rate, associated with adverse patient outcomes, inappropriate antibiotic use, and increased hospital costs (McLeod, 2019; Posillico et al., 2018). This Midwestern hospital has a BCC of 8.32% in the emergency room. This paper aims to explore evidence-based interventions in blood culture collection to reduce the overall BCC rates in the emergency room.

## Theoretical Framework

The John Hopkins Evidence-Based Practice model (JHEBM) will be used to evaluate the necessity of improving blood culture contamination. The JHEBM was chosen because the model aligns with the organization's culture, mission, vision, and values. The organization's focus on clinical quality and best practices aligns with JHEBM as well. The JHEBM promotes evidence-based healthcare and continuous inquiry and allows for the translation of evidence into practice (Dang et al., 2022). There are three interrelated components of the JHEBM: inquiry, practice, and learning (Dang et al., 2022). The article evidence was assessed and evaluated using Question Development (see Appendix C).

### Inquiry

The inquiry process of the JHEBM is what led to the blood culture contamination problem and which factors contribute to it. A fishbone diagram was completed to identify possible causes of contamination (see Appendix B). The areas identified were environment, improper skin preparation, patient acuity, staff turnover, improper bottle preparation, and a lack of knowledge.

The organization currently has blood culture supplies in smart carts in all treatment rooms. Items included in the carts are gloves, non-sterile gauze, culture bottles, isopropyl

alcohol, chlorhexidine gluconate alcohol skin prep (CHG), transfer devices, tourniquet, peripheral IV supplies, or winged peripheral draw needles. The necessary syringes are in the drawer below. All necessary supplies to adequately perform a blood culture appear readily available, which poses the question: why is the contamination rate so high?

The organization's policy states the person performing the blood culture should perform hand hygiene and gather all necessary supplies before beginning. Blood cultures require both aerobic and anaerobic bottles. The optimal amount of blood in each container should be 10 or 20 milliliters total. They then disinfect the blood culture bottles using a CHG swab, using one swab per bottle and allowing it to air dry entirely, which is roughly 15 to 30 seconds. After selecting a suitable vein, the venipuncture site is prepared. The patient's arm is scrubbed vigorously by scrubbing back and forth for 30 seconds and allowing the solution to air dry completely. After preparation, area that has been cleaned should not be touched. If the site needs to be palpated again, sterile gloves must be worn.

An area of confusion in the policy is the order of draw. If using a male device (winged infusion), then the draw order is aerobic (green) followed by anaerobic (orange). If using a female device (syringe), the order is reversed. This can be confusing for staff to know in which order the cultures should be drawn.

An additional barrier is that patients in the emergency room are often acutely ill and present with life-threatening symptoms such as severe hypotension. Staff often prioritize correcting the life-threatening symptoms and do not emphasize maintaining proper practice when obtaining blood cultures from peripheral IV starts. Also, when nursing staff starts new peripheral lines, other nursing staff or laboratory staff may transfer the blood into the culture specimens, which may increase the potential for contamination.

## Practice Improvements

The practice improvement process allows an organization to implement evidence-based interventions to improve quality and safety (Leming-Lee and Watters, 2018). Interventions that do not prove valuable can either be modified or discontinued, and another intervention may replace them. Currently, the practice is for all nursing staff to perform bedside blood culture collections and may defer to phlebotomy when available. The hospital policy was last updated on 02/21/2022. Upon careful review, there will need to be updates made to the policy to link to the organizations policies on central venous catheters (CVC) and implanted venous catheters. Due to the pandemic, a check-off procedure has not been re-implemented. A literature search will be conducted to identify evidence-based strategies that will decrease the blood culture contamination rate within six months in the emergency department.

## Search Strategy

The search strategy began by using databases Cumulative Index to Nursing and Allied Health Literature (CINAHL) and PubMed with the search terms “blood culture” and emerg* or “emergency dep*” or “emergency room” and contam*. Twenty-four articles resulted in CINAHL, and 393 articles resulted from PubMed. Inclusion criteria: articles dated 2015 through 2022, adult patients, and English. Exclusion criteria: pediatrics and non-English. Excluding duplicate articles leaving three articles by title, this number was further reduced to 22 by reading abstracts and articles for appropriateness to practice questions. Please see Appendix D for the PRISMA diagram.

## Literature Synthesis

Using the John’s Hopkins Evidence Based Practice model, the articles found ranged from level I, quality A to level 3, quality C. The articles ran with the most substantial evidence in

randomized control trials to the weakest evidence in an integrative review. See Appendix E for the Level of Evidence table. After reviewing the articles, three significant themes resulted from the literature search: cost, specimen diversion, and a bundled approach.

**Cost**

When blood cultures are contaminated, there are significant costs associated. Of the articles reviewed, costs were mentioned in 13 of them. Contamination costs are estimated from a low of $3,000 (Syed et al., 2018) to a high of $13,000 (Buzzard et al., 2018) per contaminated specimen. Other associated costs are laboratory, microbiology, staffing, hospital, and medication costs (Skoglund et al., 2019; Bool et al., 2020; Rupp, 2017). Therefore, a reduction in contamination rate can significantly decrease healthcare costs for both the hospital and the patient (Bool et al., 2020; Shaheen, 2020).

**Specimen Diversion**

Specimen diversion is where a small amount of blood and potential contaminants are diverted away from the rest of the sample. The reduction in the amount of contamination gives these products an advantage overs. Currently, there are two brands of specimen diversion devices: the Steri-Path® made by Magnolia Medical and the Kurin Lock® by Kurin. These devices described a significant reduction in BCC when the device was correctly used. A sustained decrease in contamination of 80-87% was observed by several studies (Brownfield, 2021; Skoglund et al., 2019; Bell et al., 2018; Nielson et al., 2022). Rupp et al. (2017) reported a reduction in contamination from 2.6% to 0.22%. Both devices divert the initial blood sample away from the specimen collection container. The most significant difference is that Steri-Path® uses 1.5-2 ml of blood while the Kurin Lock® uses 0.15 ml of blood. These devices come as prepackaged sterilized kits to decrease the possibility of contaminating the blood culture. These

devices may also be used alone or as part of a bundled approach to further reduce the likelihood of contamination. A potential barrier noted was staff resistance to using the device for every blood culture drawn.

Another diversion technique is to use either a syringe or a different blood tube to divert the potentially contaminated sample. When diverting a blood culture sample, the steps do not necessarily need to be high-tech (Zimmerman et al., 2019). However, they do have the potential to introduce contaminants when they are not used, stored, or prepared correctly.

## Bundled Approach

There are different options on what to include in a bundled approach. Bool et al. (2019) utilized education, a self-assessment and review, monitoring and feedback, appropriate technique compliance, and an aseptic no-touch technique. Kai et al. (2020) used a "Stop the Contamination" bundle, which includes the use of chlorhexidine for disinfection, use of isopropyl alcohol at the venipuncture site before disinfection, hand hygiene before venipuncture, use of sterile gloves during venipuncture, use of sterile probe covers for ultrasound-guided IV's, and the use of upper extremities rather than groin or lower extremities. When this bundle was used effectively, it had an 80% decrease in BCC. All the interventions in the bundle are relatively easy to implement, making this bundled approach cost-effective. Burnie and Vining (2021) implemented a blood culture collection kit. Staff members were educated on the collection process, site, bottles, and sterilization techniques. A bundled approach also decreased blood culture contamination in each study and proved to be more effective than each intervention implemented individually (Kai et al., 2020). Having a bundle of evidence-based interventions may have the ability to improve blood culture contamination.

### *Skin Preparation*

Proper skin preparation is an essential step in preventing BCC. According to the literature, the use of chlorhexidine swabs for skin sterilization is the leading intervention. The previous study has shown the efficacy of chlorhexidine over iodine or alcohol (Kai et al., 2020). This step coincides with using the aseptic technique mentioned in other studies, including scrubbing the skin for 30 seconds with a vigorous back and forth motion, allowing the skin to dry completely, and not touching the area upon peripheral IV insertion or venipuncture (Rupp et al., 2017; Zimmerman et al., 2020; Kai et al., 2020).

***Specimen Draw Order***

Specimens draw order, specimen collection volume, and the use of peripheral IV or venipuncture were minor themes in the following articles. When drawing blood, cultures should be drawn first, and the aerobic bottle should be the first bottle filled (Posillico, 2018). Blood cultures should be drawn first to decrease the possibility of contamination from other blood tubes. Zimmerman et al. recommended using sterile blood sample tubes before aspiration for cultures as an alternative to using a specimen diversion device (2019).

Blood cultures bottles require a volume of five to ten milliliters of blood per vial. To correctly determine if there is a pathogen in the blood, there must be enough blood in the vial to determine the pathogen (Syed et al., 2018). However, it may present a challenge as it may be difficult to obtain blood samples in acutely ill patients.

Lastly, two articles question whether performing venipuncture is better than collecting blood cultures from new peripheral IV starts (Bool et al., 2019; Posillico et al., 2018). Often when a septic patient arrives in the emergency room, staff are distracted with the resuscitation process rather than ensuring the aseptic technique is utilized when placing peripheral IV lines.

Obtaining a separate venipuncture blood culture from the peripheral IV may reduce the number of BCC in severely ill patients.

### *Staff Education*

The literature emphasizes the need for frequent continuing education to staff to maintain skills and keep BCC low (Bram et al., 2021; Bool, 2021; Burnie et al., 2019; Moeller, 2017; McLeod, 2019; Mullan et al., 2018; Paur et al., 2019; Shaheen et al., 2020; Skoglund et al., 2019.) Appropriate training for staff performing blood cultures may come from phlebotomists, nursing staff, or providers. Bram et al. (2021) discuss the need for individualized staff education and create a step-by-step video. Moeller (2017) and Mullan et al. (2018) recommend using itemized checklists to improve overall compliance and decrease contamination. They also emphasize the need for frequent continuing education to maintain skills and keep BCC low. Understanding how adults learn and using a combination of methods may help staff retain concepts they have learned. Various techniques such as lectures or hands-on approaches help many learners retain information better (Braungart et al., 2019).

### *Dedicated Teams*

Four articles mentioned having a dedicated draw or phlebotomy team as an intervention to prevent BCC. However, due to limited staffing, increased patient census, increased acuity, and decreased capacity of phlebotomy drawing every culture and is increasingly drawn by nursing staff (Nielson et al., 2022; Bell et al., 2018; Burnie et al., 2021; Skoglund et al., 2019). Like many other health professions, having enough phlebotomists on staff to cover all hospital areas has been in short supply. This leaves all patient blood draws, including blood cultures, to the nursing staff.

### *Monitoring*

Interventions aimed at quality include monthly monitoring, a weekly email with current contamination rates, and providing individual feedback to those who may be struggling with BCC. Displaying information in the department about current contamination rates helps keep the BCC at the forefront for staff members. A weekly email with contamination information will again be at the forefront of staff members' thoughts. Providing feedback to individuals who may be struggling or need re-education was proven to reduce the number of individuals who had a BCC (McLeod, 2019). A contributing factor to the need for frequent re-education and training is the frequency of staff turnover in the emergency room (Dempsey et al., 2018; McLeod, 2020; Bool et al., 2020). A robust training and education program for blood culture collection will be essential to maintaining a low BCC rate.

## Summary

The literature review revealed there are evidence-based interventions available to reduce BCC in the emergency department. The most successful interventions were implemented in a bundle or in combination with each other. A synthesis of the literature revealed the importance of educating staff in collecting a sterile blood sample, performing correct skin and bottle preparation, and using a specimen diversion device emerged as priorities to reduce contamination.

## Methods

The creation of formal education process will include an online learning management system to educate staff on how to collect a blood culture sample correctly. The education will include sterile technique, skin preparation, bottle preparation, sample transfer, and ensuring all supplies are readily available. The learning module will be based on the organization’s policy on

BCC and provide visual examples on collection, as well as a test at the end of the module. Successful completion of the education will signify that the staff member has learned how to correctly obtain a blood culture. Rounding will be completed throughout the education process to ensure nursing staff has understood the education and the collection process is being followed properly. The organization already collects data on contaminated blood cultures. The additional data collected will be the overall number of blood cultures completed by nursing staff, the number of contaminated specimens by nursing staff, the type of contamination, and rate of contamination. The data will be compared to the three months prior to the start of the project and three months after. The goal of the project is to see a reduction of 1% in the number of contaminated blood culture specimens.

## Project Site and Population

The project site is a large, Midwestern, level I trauma hospital with approximately 1,000 hospital beds of which 234 are designated for critical care (Statesman Journal, 2022). This emergency department has 92 beds, 15 hallway beds, and a trauma bay which can house three patients at once. The emergency department sees more than 110,000 visitors annually. The population served by this hospital is 65.5% white, 18.1% Black, 16.3% Hispanic, 2.6% Asian, and 0.3% other, with an estimated population of approximately 198,500 (Census.gov, 2020).

## Ethical Considerations/Protection of Human Subjects

Approval from the hospital partner will be obtained in an agreement letter prior to submitting the Internal Review Board (IRB). Michigan State University IRB approval, and approval of the organization IRB has been granted. Data will be provided by the data management department and will be anonymous, de-identified and aggregated.

## Setting Facilitators and Barriers

The large emergency room is broken down into sections called mods. There are six mods in this ED. The mods are staffed by ten nurses at 0700 and the number of staff continues to increase throughout the day with a total of 22 nurses at 1500. As patients arrive by private vehicle there are three triage bays in which a registered nurse (RN) will register the patient and triage them upon arrival. They have a bed traffic control (BTC) RN who assigns the patients to a mod based on what bed is available and on the patient's acuity. There is also an ambulance bay which can hold seven ambulances at one time. Ambulance traffic is also directed by the BTC RN. The purpose of the BTC RN is to keep the department flow running smoothly.

Facilitators to this process include all necessary blood culture collection supplies are already provided by the organization, and the collection supplies are kept at the bedside in each room. Additional resources needed will be obtained through the nurse education team. In collaboration with the nurse education team, an education learning module will be created for nursing staff. ED leadership, the unit Clinical Nurse Specialist (CNS), education champion, and charge staff will round during this process, assist with project implementation, and address staff questions and concerns. The learning module will be interactive and geared towards adult learning.

Potential barriers will be resistance of staff to adapt to change, high acuity environment, and a high staff turnover. To address these barriers, leadership will meet with staff to see if any necessary modifications are needed to address challenges brought forward by the staff. An example of an intervention for addressing high-acuity patients is to refrain from collecting blood cultures during active resuscitation. These patients will need to have blood cultures drawn after resuscitation is completed. Lastly, the issue of staff turnover can be combatted by including blood culture education for all new hires and travel staff.

## The Intervention

The Plan, Do, Study, Act (PDSA) will be used to guide to begin the implementation of the project. The PDSA cycle will allow for project evaluation and adaptation that may be necessary throughout its implementation.

### Plan

The project will begin by creating a bundled approach to reducing blood culture contamination in the emergency department. The implementation of a complex intervention program including staff education, the creation of standardized work for blood culture collection, and feedback regarding blood culture contamination rates has shown to reduce BCC rates (McLeod, 2019). To begin, an education module will be developed that all ED nursing staff will be required to complete. This education will include the initial preparation, the collection process including aseptic technique, and proper labeling of specimens. Collection of a blood culture is a complex process and specimen contamination may occur easily.

Since specimen diversion has been proven effective at reducing contamination by as much as 83% (Brownfield and Peterson, 2021,), this project will utilize a pre-packaged three milliliter (ml) syringe for diversion. The process of collection will include diverting the first one to two mls of blood into a three ml syringe. This blood may be used for additional laboratory testing if it is ordered, to decrease waste and patient discomfort. This process of collection is used by the organizations laboratory staff with current contamination rates of less than 1% over a one-year period.

The policy on blood culture collection will be modified pending results of this quality improvement project. Clarification on the waste process for all blood culture collections including from central lines and additional evidence-based improvements will be made to the

policy. Additional changes will be made to reflect all clinical staff who may obtain blood cultures. Currently, the policy language is emphasized for phlebotomy staff, and it also includes all clinical staff.

Educational sessions demonstrating proper blood culture collection will be held as well as discussion at shift changes. Rounding on the unit will be completed by the CNS, charge nurses, and ED leadership to ensure staff are collecting blood cultures properly. Secure emails will be sent by the nursing supervisor to the nursing staff who have a contaminated specimen. Any staff who has more than two contaminations in a one-month period will need to demonstrate they are competent in completing a blood culture correctly.

**Do**

The education period ran over four weeks. During this time, educational sessions were held at each shift huddle to ensure the maximum number of staff received the training. To aid staff in remembering the correct steps of blood culture collection, a five-step education tool was emailed to the staff. In addition to the education, a job aid was emailed to the nursing staff breaking the procedure down step by step. Nursing staff was notified by the CNS through secure email when a specimen contamination occurred to obtain information regarding the specific details of the situation and determine if re-education or changes were necessary.

**Study**

Blood culture contamination rates will be compared three months prior to and after bundle implementation. This will help determine if the implementation of the bundle reduces the blood culture contamination rates in the emergency room by 1%.

**Act**

Changes to the policy and procedure will depend on the successful decrease in contamination rates after three months. If there is not a reduction in contamination rates, the hospital leaders would be interested in piloting a trial for a specimen diversion device in the emergency room.

## Timeline

This quality improvement plan will begin the education phase in October 2022. The intervention will take place from November 2022 through February 2023. Data analysis will be completed by March 2023.

## Sustainability Plan

The ED leadership has determined that the clinical nurse specialist will continue to monitor the blood culture contamination and will take over notifying staff of contamination. Nursing educators will be responsible for completing the quality improvement project. The education will be completed yearly as part of annual nursing competencies. The unit CNS will be responsible for any necessary changes to policy or educational content.

## Results

Using a bundled approach, the project met its goal with a reduction in blood culture contamination from 8.3% to 4.4% over three months. The organization decided against the original education plan and needed a new approach. Mini-education sessions were held for four weeks at every team huddle by the charge nurse, nursing supervisor, or the DNP CNS student. The mini-education sessions covered a five-step blood culture contamination process to help staff with retention (see Appendix F). The steps included preparing all necessary supplies before starting, correct preparation of the patient's skin and bottles, using aseptic technique when

collecting specimens, specimen diversion using a three ml syringe, and using the appropriate device when transferring specimens into the culture bottles.

## Discussion/Implications for Nursing

This project has potential to improve patient outcomes by decreasing false-positive blood cultures. This will be accomplished by improving patient satisfaction, reducing the length of stay, decrease the need for unnecessary antibiotics, and decrease the potential incidence of hospital acquired conditions for patients. Additionally, a successful implementation may lead to decreased costs to the organization. This organization has 12 hospitals in their healthcare system, with the success of the quality improvement project, the education and intervention will be introduced at all the remaining EDs in the system, which could lead to a substantial savings for the organization.

## Cost-Benefit Analysis

Blood culture contamination remains a large problem for the organization in the emergency room. The current blood culture contamination rate is greater than five percent. As discussed previously, contamination costs range $3,000 to $13,000 per contaminated specimen (Syed et al., 2018; Buzzard et al., 2018). Additional associated costs are laboratory, microbiology, staffing, hospital, and medication costs (Skoglund et al., 2019; Bool et al., 2020; Rupp, 2017). If the organization can reduce their contamination rate by one percent, or approximately nine less contaminations per month, it would represent a savings of $27,000 to $117,000 per month. The organization experienced 376 contaminated specimens in 2022, with an estimated cost to the organization of $1,6692,000. See Appendix L for 2022 contamination information.

## Conclusion

Blood culture contamination remains a significant problem in the emergency room. A contaminated blood culture has a negative impact on patients' health. They may have an increased length of stay, are given antibiotics they do not need, and may contract a hospital acquired illness such as clostridiodes difficile, which requires additional antibiotics to treat. For this quality improvement project, we will implement a bundled approach to decrease blood culture contamination in the emergency department. A new education module will inform and demonstrate the correct procedure to nursing staff on blood culture collection. In combination with the education module, a new blood waste intervention will be implemented following evidence-based practice on specimen diversion and the reduction of contamination of blood cultures.

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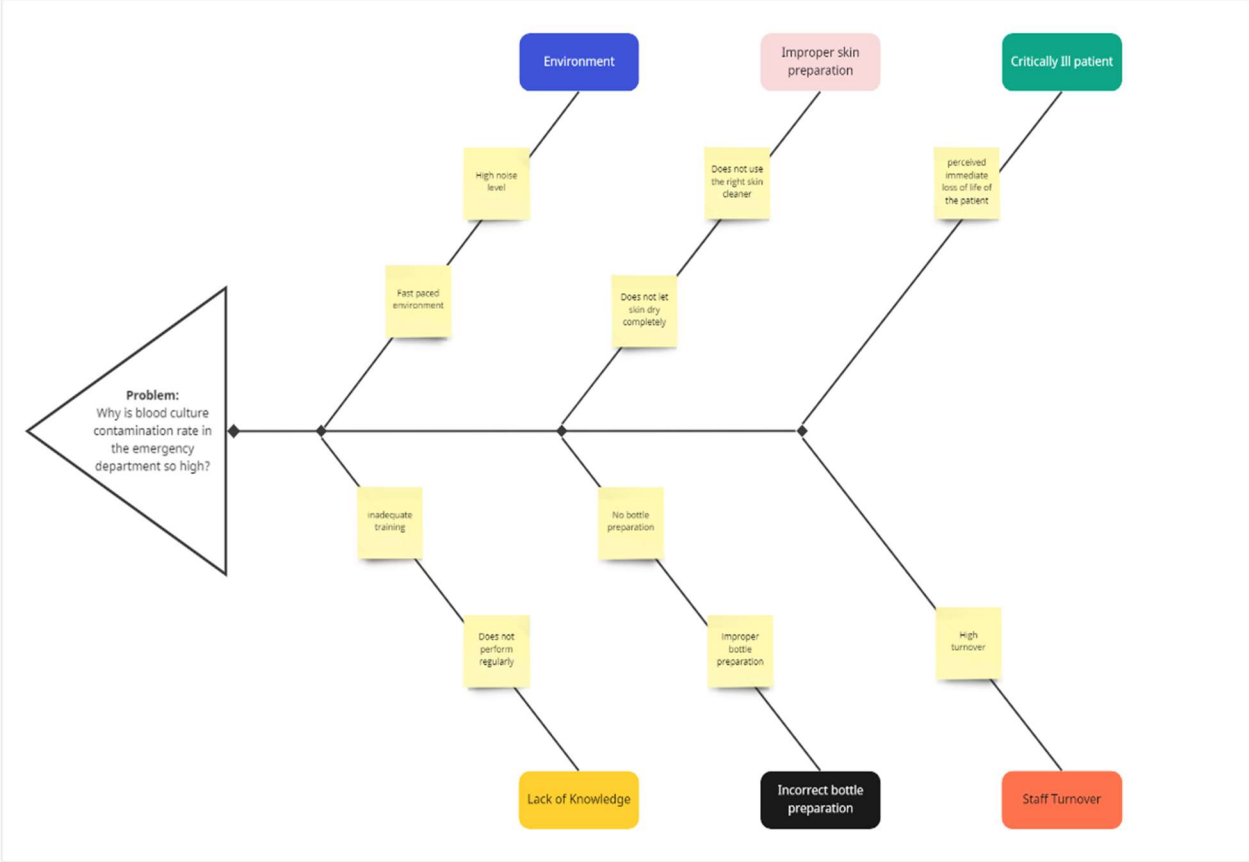
# Appendix A

SWOT Analysis

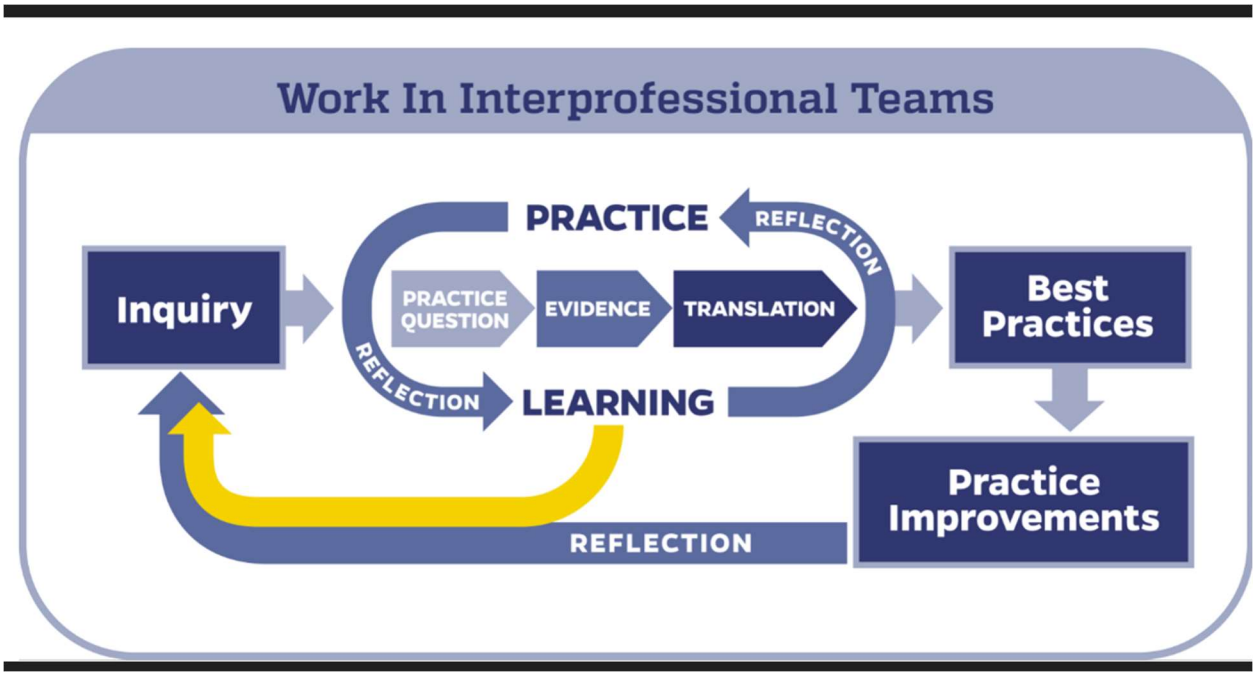
# Appendix B

Fishbone Diagram



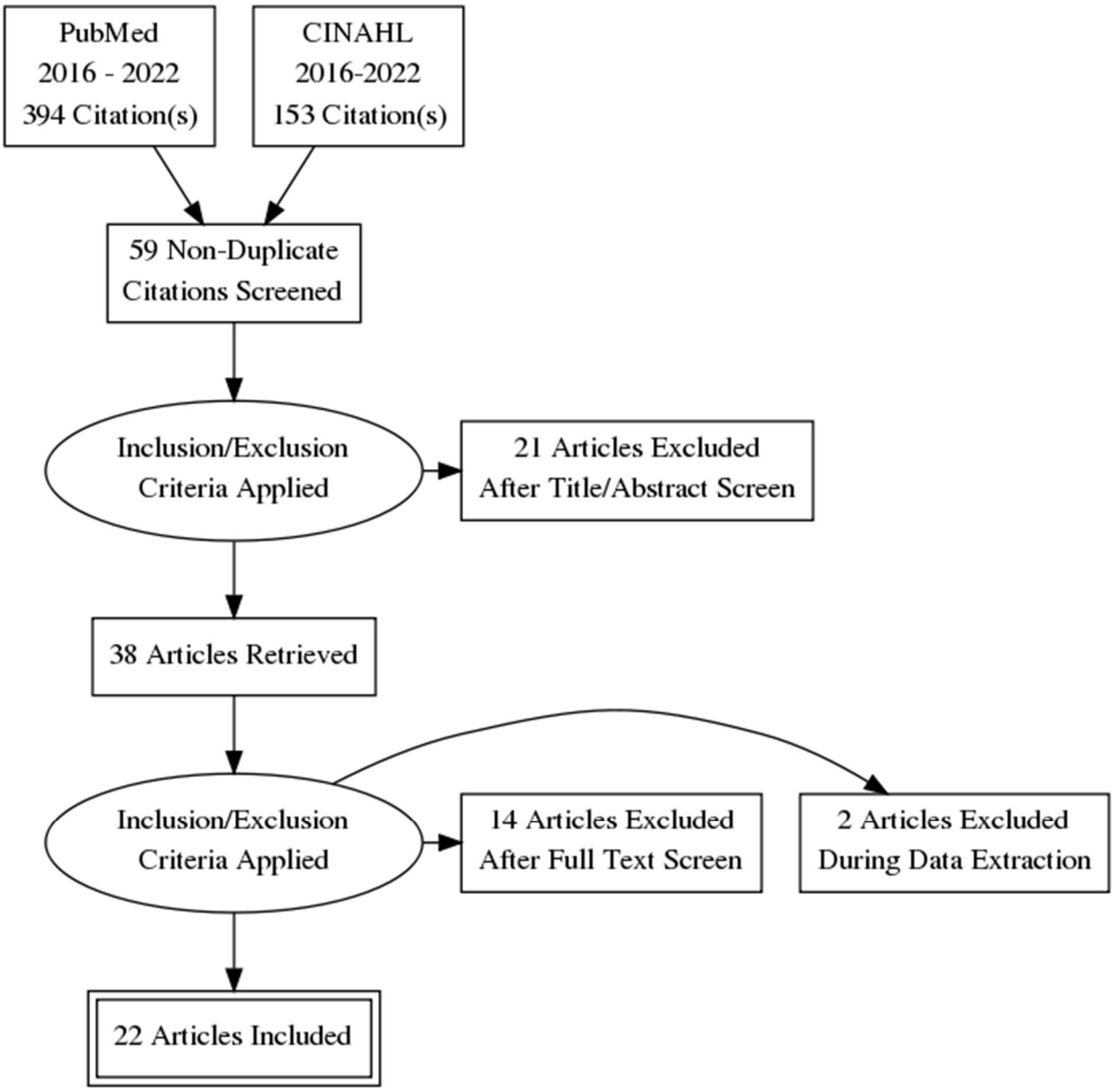
## Appendix C

John Hopkin's Evidence-Based Model



## Appendix D

PRISMA Diagram



# Appendix E

## Level of Evidence Table

| Author Citation | Design/Purpose | Sample Size | Setting | Evidence Level |
|---|---|---|---|---|
| Brownfield, K., & Peterson, M. (2021). | Controlled Cohort Study | 500 | ED | Level III, quality A |
| Lalezari A, et al., 2020 | Randomized Control Trial | 756 | Hospital-wide but mainly E.D. | Level I, Quality A |
| McLeod CG., 2020 . | Quantitative pre and post-intervention | 1137 | ED | Level III, Quality A |
| Shaheen N et al., 2020 | Interventional Study | 8868 | ED | Level III, Quality A |
| Bell M. et al., 2018 | Observationa l | 6293 | ED | Level III, Quality A |
| Nielsen LE. et al., 2022 | Interventional Study | 1816 | ED | Level III, Quality A |
| Hughes, J. A., 2018 | Systematic Review | Unreported | Acute Care | Level II, Quality B |
| Buzard, B. A., Evans, P., & Schroeder, T. (2021). | Retrospective study | 3331 | ED | Level III, Quality A |
| Zimmerman FS. et al., 2020 | Randomized Control Trial | 970 | ED | Level I, Quality A |
| Syed S. et al., 2018 | Quantitative Pre and Post Intervention | 13,350 | ED | Level III, Quality A |
| Sundermann, A. et al., 2017 | Retrospective Study | 3022 | ED | Level III, Quality A |
| Dempsey C, et al., 2018 | Systematic review | Unreported | E.D. | Level II, Quality B |
| Choi, E. C. et al., 2019 | Retrospective cohort study | 400 | ED | Level III, Quality B |
| Burnie J, and Vining S. 2021 | Quality Improvement | 250 | ED | Level V, Quality A |
| Skoglund E. et al., 2019 | Cost-Benefit Analysis | 48 | E.D. | Level III, Quality C |
| Kai M, et al., 2020 | Quantitative pre and post-intervention | 910 | ED | Level III, Quality A |
| Rupp, M. E., et al., 2017 | Controlled Trial | 904 | ED | Level III, Quality A |
| Bool M, et al., 2020 | Integrative Review | Unreported | E.D. | Level III, Quality C |
| Brownfield, K., & Peterson, M. (2021). | Controlled Cohort Study | 3170 | ED | Level III, Quality A |
| Posillico SE. et al., 2018 . | Retrospective Study | 20,978 | Hospital-wide | Level III, Quality A |
| Martinez et al., 2017 | RCT | 563 | Hospital-wide | Level I, Quality A |
| Ota et al., 2021 | Observational Study | 249 | ED | Level III, Quality A |
| Paoli et al., 2018 | Retrospective Observational Study | 2,566,689 | Hospital-wide | Level III, Quality A |

# Appendix F

Five Step Blood Culture Process

## Appendix G

Cost Analysis

| Staff | Salary | Time | Cost | Total |
|---|---|---|---|---|
| Educator | 25/hr | 3hrs | $75 | $75 |
| 140 Nurses | 30/hr | 10 min | .50 | $70 |
| | | | | $145 |

Savings Projected

| Goal Reduction | Rate | Contaminated specimens June 2022 | Total Specimens Collected | Cost per contamination Low $3,000 | Cost per contamination high $13,000 | Savings projected monthly |
|---|---|---|---|---|---|---|
| Current | 5.4% | 30 | 550 | $90,000 | $390,000 | |
| Target 1% | 4.4% | 24 | 550 | $72,000 | $312,000 | $18,000 - $78,000 |
| 2% | 3.4% | 19 | 550 | $57,000 | $247,000 | $33,000 - $143,000 |
| CLSI Standard | 2.9% | 16 | 550 | $48,000 | $208,000 | $42,000 - $182,000 |

# Appendix H

## Intervention Table

| Author Citation | Cost | Specimen Diversion | Bundled Approach | 1 vs. 2 sets of cultures | interventions | PIV vs. venipuncture | Correct order | Volume |
|---|---|---|---|---|---|---|---|---|
| Brownfield, K., & Peterson, M. (2021). | | X Kurin | | | | | | |
| Lalezari A, et al., 2020 | | X | | | | | | |
| McLeod CG., 2020 . | X | | X | X | Education, weekly feedback, standardized practice, checklist | X | | |
| Shaheen N et al., 2020 | | | | | Interactive sessions, collection kit, flyer for use | | | |
| Bell M. et al., 2018 | | X Steri-path | | | Education, aseptic technique, monitoring, retraining, dedicated phleb. team | | | |
| Nielsen LE. et al., 2022 | X 4500-9000 | X Steri-path | | | Aseptic Dedicated phleb. team | | | X |
| Hughes, J. A., 2018 | X 7500 | | X | | Email contamination rated, chlorhexidine, collection packs, individual feedback | | X | X |
| Buzard, B. A., Evans, P., & Schroeder, T. (2021). | X 8750 | X Steri-path | | | Independent venipuncture, chlorhexidine, phlebotomy | | | |
| Zimmerman FS. et al., 2020 | X 4385-8720 | X | | | Hand hygiene, skin prep, venipuncture | | X | |
| Syed S. et al., 2018 | X 3400-4000 | X | X | | Frequent in-service, educational campaigns, phlebotomy | | X | X |
| Sundermann, A. et al., 2017 | | | | | | X | | |
| Dempsey C, et al., 2018 | X 12,000 | | | | | | | |
| Choi, E. C. et al., 2019 | X | | | | | | | |
| Burnie J, and Vining S. 2021 | | X | X | | Collection kit, dedicated draw team, new blood culture draw device | | | |
| Skoglund E. et al., 2019 | X | X Ster-path | | | Sterile collection kit, trained phlebotomy team | | | |
| Kai M, et al., 2020 | | | X | | Chlorhexidine, sterile gloves, use of upper extremity, sterile probe cover | | | |
| Rupp, M. E., et al., 2017 | X | X Steri-path | | | Skin prep, culture kit, training, monitoring | | | |
| Bool M, et al., 2020 | X | | X | X | Education, self-assessment monitor and eval, feedback, appropriate technique | X | X | X |
| Brownfield, K., & Peterson, M. (2021). | | X Kurning | | | | | | |
| Posillico SE. et al., 2018 . | | | | | | | X | X |
| Martinez et al., 2017 | X | | | | Antiseptic technique, sterile gloves, Chlorhexidine | | | X |
| Ota et al., 2021 | | | | | | X | | |
| Paoli et al., 2018 | X 16,000 | | | | | | | |

## Appendix I

Quality Improvement/EBP Project Approval Form

Date: _2/5/22 _

Student Name: Susan Pell

PID: A60108228

Phone: 616-318-0544

Quality Improvement/EBP Project Title:

Changing the culture on nurse drawn blood cultures in the E.D.

Brief description:

In Butterworth's emergency department, a large majority of blood cultures are nurse drawn. There has been a negative trend in blood culture contamination by nursing staff in the emergency room. This Q.I. will attempt to uncover what factors are involved in contamination and what evidence-based interventions can be used to improve the current nurse-drawn blood culture contamination rate of 8% to the desired state of less than 3%.

Agency: Spectrum Health Butterworth

Preceptor/Mentor: Tracy Hosford

**Approval Signatures:**

Course Faculty: Jackeline Iseler, DNP, RN, ACNS-BC, CNE

CNS Program Director: Jackeline Iseler, DNP, RN, ACNS-BC, CNE

# Appendix J

Faculty/ Student Feedback

| Student/Faculty | Suggestion | Correction |
|---|---|---|
| Iseler | No running head needed | Removed |
| Alexis | Add additional information on opening paragraph. | Additional information added |
| Alexis | Add additional sentences to background to lead into the idea of contamination | Paragraph adjusted |
| Alexis | Direct quote from CLSI pg # | Changed from direct quote to paraphrase and still cited. |
| Alexis | Medical/Surgical (M.S.) to medical/surgical Unit | Change made |
| Alexis | Add summary to background to not end paragraph with a citation | Paragraph changed |
| Iseler | Combine sentences on background paragraph | Additional information added on sample collection process |
| Iseler | Second paragraph, 3-5 common sources of contamination | added the common sources of contamination |
| Iseler | Citation needed for improper skin prep. | Citation made |
| Iseler | Split paragraph into 2 why mistakes happen and how much does it cost. Pg 3 | Change made |
| Alexis | Add additional sentence to sum up your thoughts, try not to end with a quote | Adjusted |
| Iseler, Alexis | Citation pg # for direct quote from Dempsey | Citation added is pg 963 |
| Iseler | Removed and rephrase paragraph on bottom of pg 3 | Changes made |
| Iseler | Spell out Covid 19 | Change made |
| Alexis | How much money is associated with false positives | Costs are added |
| Iseler | Problem statement is it E.D. or hospital wide | Paragraph now reflects it is E.D. specific |
| Iseler | Ed contamination rate of 2020 | Request has been made, hope to have this information for next semester. Notation has been made. |
| Iseler | Explain Hopkin's model for use | Framework update |
| Iseler | Do not start sentence with a number | Corrected |
| Iseler | Keep information to BCC | Adjusted |
| Nido | Grammar change to PICOT | Adjusted |
| Iseler | Refine PICOT question | Adjusted |
| Nido | Rephrase sentence with article search | Changed |
| Iseler | Spell out CINAHL | Changed |
| Iseler | Appendix after reference | Corrected |
| Iseler | Level of Evidence Table | Corrected to bold |
| Iseler | Journals spelled out | Corrected |
| Edit's beginning for 935 | | |
| Iseler | Remove Running head text | Corrected |

| | | |
|---|---|---|
| Iseler | Add to intro | Additional info added |
| Iseler | Info on standard practice | Standard septic shock info added |
| Iseler | Blood draw terminology | Changed to blood culture |
| Iseler | Spell out ml | Corrected |
| Iseler | Add more to paragraph on contamination rates | Paragraph edited and info added |
| Iseler | Change emergency room to dept. | Changed throughout |
| Iseler | Add info on why JHEBM was chosen | Additional information expanded on and edited |
| Iseler | In inquiry add what is going on in dept | Additional paragraph added to describe what occurs |
| Iseler | Removal of practice question, evidence, translation, best practice | Corrected |
| Iseler | Edited PICOT | No change needed |
| Iseler | PRISM | We talked about this, a PRIMSA is in the appendix, but now it is referenced |
| Iseler | Summarize level of evidence | Corrected |
| Iseler | Expand on costs, and reference additional articles | Corrected |
| Iseler | Add picture of devices | Added as figures |
| Iseler | Cost reduction of devices, cite articles | Added |
| Iseler | Why is there staff resistance | Added |
| Iseler | Add citation for diversion technique | Added |
| Iseler | Bundled approach expand not summary | Still working on this |
| Iseler | Change order of interventions as noted | Corrected |
| Iseler | Articles for skin prep? | Added to |
| Iseler | Staff education | Added to and still revising |
| Iseler | Monitoring or dashboard | Added to and still revising |
| Iseler | Citations for dedicated teams | Corrected |
| Iseler | Double space references | fixed |
| Iseler | Lit and intervention table separate | Corrected |
| Jones | Link between E.D. crowding and fast paced and blood cultures? | Looking for additional articles to support this |
| Jones | Ambulance arrival? Incomplete thought | Information added |
| Jones | Remove “an” | Corrected |
| Jones | Change this to the | Corrected |
| Jones | Rephrase sentence | Corrected |
| Jones | Rephrase to “are preventable” | Corrected |

# Appendix K

Specimen Diversion

Magnolia's Steripath product (Magnolia Photo)

**Appendix L**

2022 Contamination Rates