

Decreasing Blood Culture Contamination Rates When Using an Initial Peripheral IV: Implementing the 5 P's and Using a Closed System Device

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ABSTRACT

Blood culture remains the gold standard for the diagnosis and treatment of bacteraemia and is the first-line tool for detecting bloodstream infections [1]. Research shows that the emergency department (ED) is an essential component of the health care system and subject to workflow challenges, which may hinder ED personnel adherence to guideline-based infection prevention practices [2]. This impact has wide-reaching effects. Moreover, a fast-paced ED presents a host of challenges with competing priorities. In addition, EDs are perceived as 24/7 portals where rapid and efficient diagnosis, urgent attention, primary care, and inpatient admission is provided for stabilizing seriously ill and wounded patients [3]. Blood culture contaminants are common, and they have a significant impact on patients and staff, contributing to unnecessary or inappropriate antibiotic treatment, increased length of stay, and costly economic burden [4]. The aim of this study was to evaluate the use of an automated blood culture collection system when drawing blood cultures from a peripheral IV and to evaluate the effectiveness of implementing evidence-based policies, procedures, practice, products, and patient care to reduce blood culture contamination rates.

Keywords

Blood Cultures, Peripheral IV, Automated Device, Contamination Rates, Quality Improvement.

Introduction

The emergency department (ED) is a very dynamic environment that encompasses different scopes of practice by nurses, phlebotomists, nurse techs, and emergency medical technicians.

Each of the respective clinicians are tasked to perform blood culture collections within their scope of practice. The blood culture represents a critical diagnostic tool for the health care professional as a means of detecting the dangerous presence of living organisms in the bloodstream [5]. False-positive blood cultures can hinder the effectiveness of this tool. False-positive occurs when organisms that are not present in the blood sample are grown in the culture [4]; they may contribute to misdiagnosis and treatment errors or delays, excessive laboratory testing, increased length of stay, and increased hospital costs [6]. The call for accountability and cost-

effectiveness applies to blood culture methods as to everything else in today's healthcare practice [7].

False-positive blood cultures are common, particularly in the ED, and results from a range of influences. The Clinical Nurse Specialist (CNS) for the five EDs recognized that four out of five EDs had a higher BC contamination rate compared to the national 3% standard.

The 3% average was adopted as a performance benchmark in 2007 when the Clinical and Laboratory Standards Institute (CLSI) included the "3% maximum blood culture contamination rate" in their guidelines [7]. Blood culture samples are frequently drawn within our fast-paced ED settings to initiate prompt, appropriate antimicrobial therapy for patients at risk for sepsis. Research shows that skin contaminants are the most common blood culture contamination source. Collecting a contaminant-free blood sample is critical to providing a blood culture result that has clinical value, as written in bioMérieux's public health educational booklet,

Blood Culture: A Key investigation for diagnosis of bloodstream infections. Proper sample collection is a vital step in the blood culture collection process. It is imperative that strict aseptic technique be done to cleanse the site before drawing blood cultures to prevent potential contamination. Our EDs, as a whole, see approximately 350,000 patients a year and collect nearly 2,000 blood cultures per month. Upon rounding, several improvement opportunities were discovered to standardize the process for drawing blood cultures and to investigate available products to help the EDs decrease the blood culture contamination rates.

Setting

The hospital system is an integrated, not-for-profit network with four hospitals with five 24-hour emergency departments located in the southeastern region of the United States.

- A community 238-bed community facility with 58 ED beds.
- A rural community-based facility and has 110 acute care beds with 23 ED beds
- A freestanding 75,000-square-foot facility featuring a 24-hour freestanding emergency department with 15 beds. This facility was omitted from the study due to already meeting the national standard for blood culture contamination.
- The flagship – 510-bed teaching hospital and referral center with a level II trauma Adult ED with 60 beds and the Pediatric ED with 11 beds.
- A community acute-care facility and offers 175 private beds with 55 ED beds

Methods

A multi-disciplinary approach was utilized to conduct a systematized process for blood culture collection and accountability unique to this institution's four emergency departments.

The process included developing the 5 P's of blood culture collection:

1. Policies – Review blood culture collection services to be provided.
2. Procedures – Create a road map showing how the service is to be delivered.
3. Practice – Identify gaps in adhering to best practices and variations in practice.
4. Products – Evaluate and gauge products used and employed a better tool for cultures.
5. Patients – Assess patients served in the emergency department and their individual needs 71.

In March 2018, the CNS requested a meeting of key stakeholders to get approval to trial a new blood culture collection device. With approval and collaboration with the Laboratory, Microbiology, Infection Control, and Emergency Department, the ED Clinical Nurse Specialist at the flagship hospital-level II trauma center started gathering data through literature review, discussions with frontline clinical staff, asking intentional questions of current practices with the understanding ED staff face particularly numerous workflow challenges, and examination

of current industry research. In June 2018, we obtained approval from our Value Analysis Team (VAT) at the Strategic Sourcing office, along with our Infection Prevention director, Emergency Department director, and Laboratory leadership. After thoughtful consideration of various blood culture diversion products on the market, we selected an initial specimen device that sidelines the initial flash of blood and skin contaminants during routine blood culture draws.

The education rollout was refined to encompass a dedicated team of company educators, a committed staff ED nurse, and the ED Clinical Nurse Specialist (CNS) to ensure staff was trained via face-to-face instruction. The initial five-week trial was completed within the flagship level II ED. With the success of the five-week pilot study, all ED directors decided to continue the process and extend the initiative to three additional EDs within the health system.

Training and feedback managed in this study included: 1:1 education and direct feedback with staff; huddle learning and demonstrations provided by vendor representatives; skills fair; staff meetings; poster presentation; email communication; education posters and animated video viewing; communication between laboratory management and emergency department management. The staff that had a blood culture contaminant was also consulted to learn more about the particular event. ED shared the overall rate with staff weekly for the pilot, then monthly when expanded into other emergency departments. During the routine data-sharing phase, we found it more impactful to share how many patients were actually involved versus simply sharing the specific rates since it resonated more with staff. For example, the ED may be under the 3% benchmark, let us say 2.5%, but that could still mean 8-10 patients may still be impacted in this particular scenario. This process raises the point that it is more beneficial to include the actual number of patients impacted and not just sharing the blood culture contamination rates with staff. Every contaminant tells a story.

During the 5 P's process, the CNS and stakeholders examined common blood culture contamination sources broken down into 4 phases:

- **Preparation** - area for sterile field breach.
- **Collection Set Assembly** – areas for a sterile field breach.
- **Venepuncture/ Peripheral IV Stick** - areas when skin contaminants may be drawn into the specimen.
- **Sample Handling** – areas when skin contaminants may be drawn into the specimen.

Results

Our pilot, along with expanding the use of the automated blood diversion kit for blood culture collection, showed improvement in our contamination rates at all four emergency departments (Figure 1-4). The key outcome is that withdrawing off a fresh peripheral IV stick using the device did not increase our contamination rates but helped decrease IV contamination rates by sidelining the first.

0.15ml of blood prior to collecting the blood culture sample. Using the kit helped decrease the skin contaminants being the source of the blood culture contaminant, causing a false-positive result.

During the period from March 2019–November 2019, ARMC experienced typical situations seen in a fast-paced ED including a fluctuating patient census, limited staff resources, increased workflow scenarios needing an all-hands-on deck approach, partial management resources to round since they were also caring for patients, and limited follow-up with blood culture contamination. ED staffs were mostly falling back into their previous practice habits.

November 2019, re-education and observation were conducted by sharing the “why” it is vital to collect better pre-analytic blood cultures and to increase the usage of the new blood culture discard device as much as possible, taking into account the needs of individual patients. One of the motivations selecting this particular automated blood culture discard device was chosen over the others was to enable caregivers to continue using familiar, proven venipuncture techniques and to be able to draw off a peripheral IV initially once stuck. This particular blood culture collection tool mirrors current clinical practice and requires minimal education. When used, the results are excellent, as we have experienced in the flagship hospital during the pilot.

COVID-19 added an extra layer of patient care issues within the ED with donning PPE trying to minimize exposure while in the room caring for the patient. Difficulty seeing, touching and communicating.

Discussion

Implementing a data-driven quality strategy for improving the blood culture collection process in a fast-paced emergency department is key to successful outcomes. We believe it is important to have something tangible to measure back to, particularly when consulting with the team members for both accolades and corrective education. We accomplished this by employing the DMAIC methodology (Define, Measure, Analyze, Improve, and Control). To support this methodology, we developed the 5 P’s of Blood Culture Collection: Policy, Procedures, Practice, Products and Patient.

The most common obstacles and barriers impeding our success was resistance and criticism from staff, lack of buy-in that this initiative will make a tremendous difference, the staff’s variation in practice drawing blood cultures, and the tracking of data. As with most any new device or tool introduced inpatient care, successful implementation requires a commitment by staff and support from leaders and educators. We found it ideal for identify one lead person from both the laboratory and the emergency department to assist in communication and to coordinate efforts. We also have found

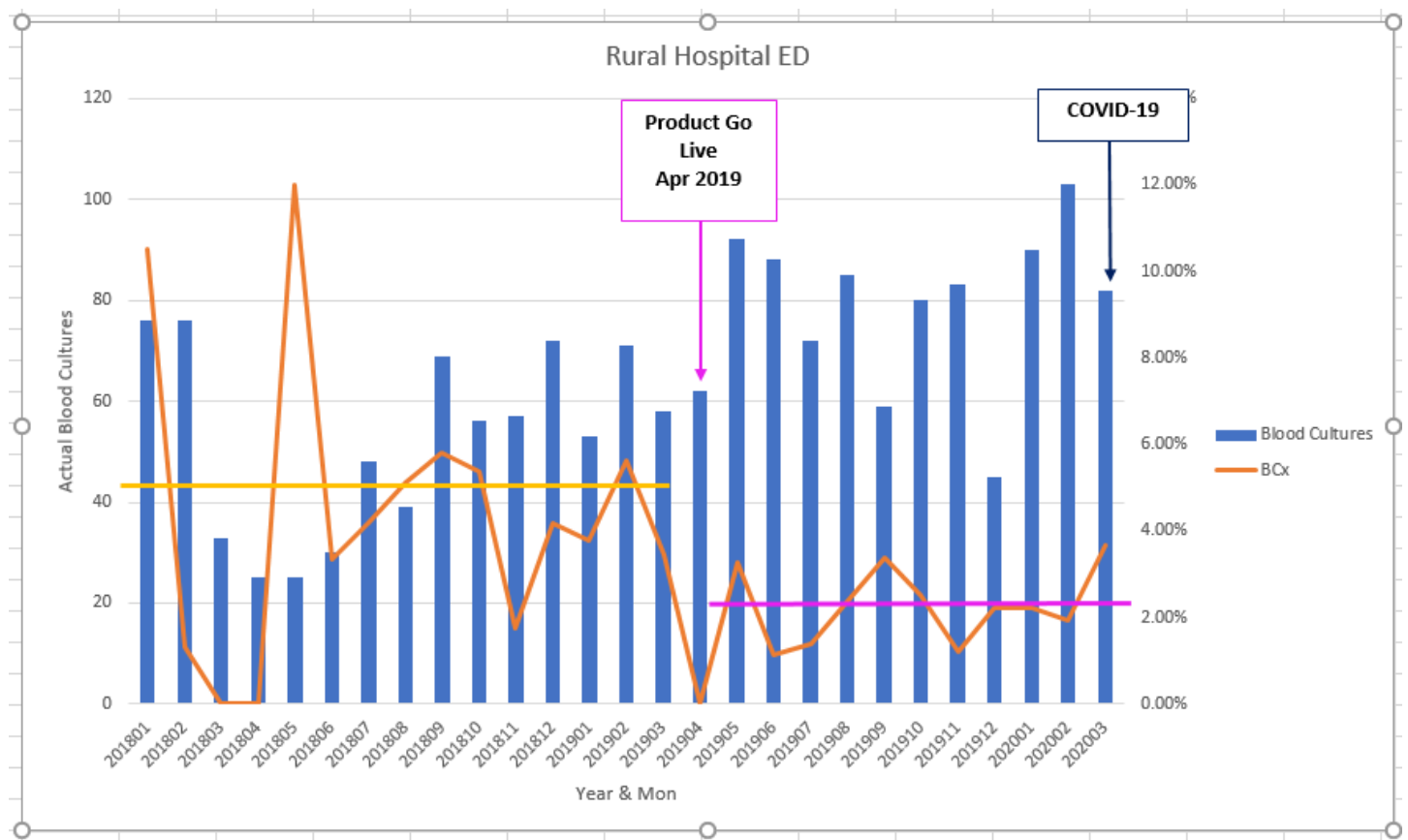


Figure 1: Timeline for rates of contamination for ED blood cultures and interventions.

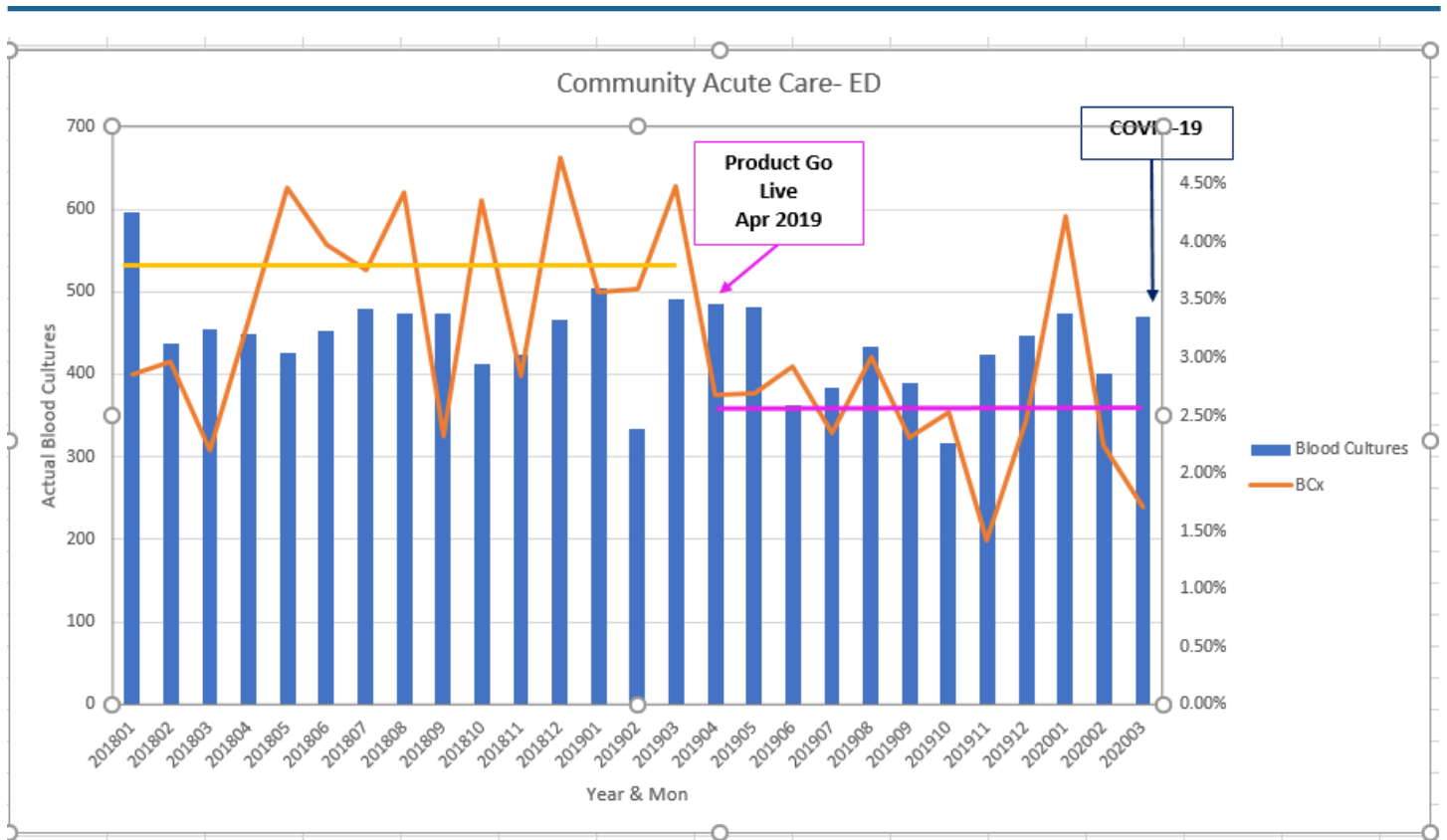


Figure 2: Timeline for rates of contamination for ED blood cultures and interventions.

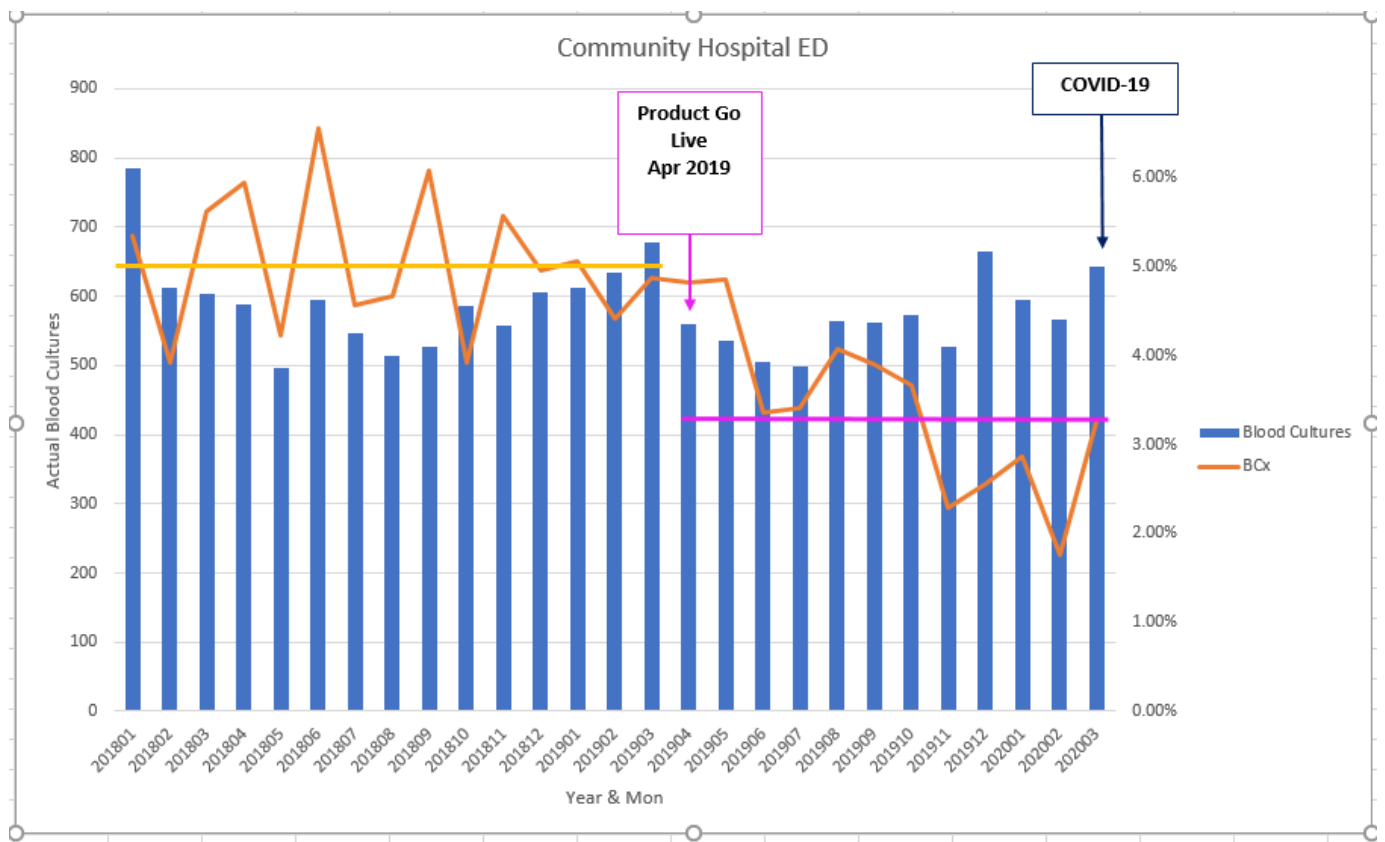


Figure 3: Timeline for rates of contamination for ED blood cultures and interventions.

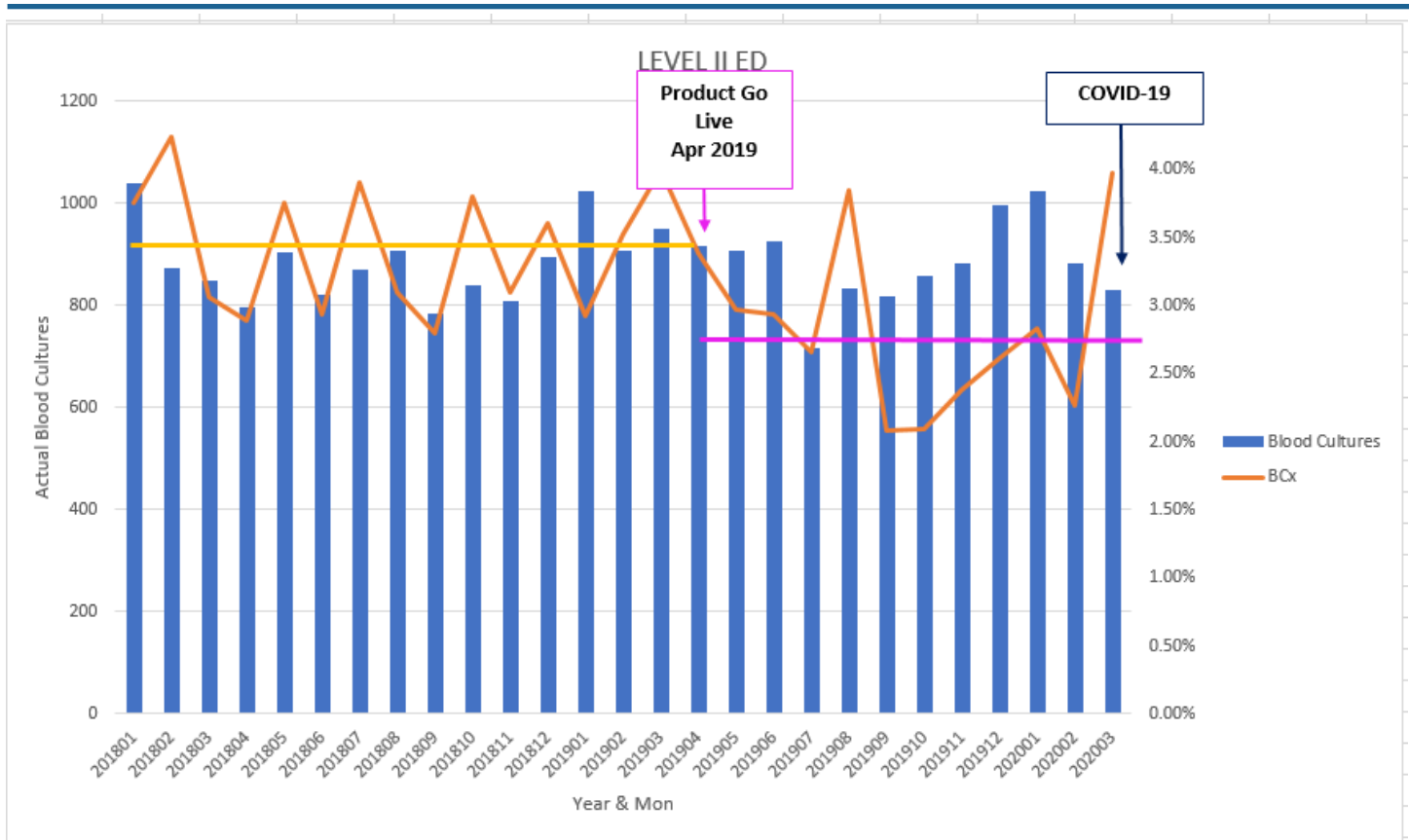


Figure 4: Timeline for rates of contamination for ED blood cultures and interventions 151.

that collaborative work between departments will take time, and all parties must be actively involved. Consistent communication and collaboration are crucial to success and sustainable outcomes, particularly between emergency department & laboratory (microbiology) leaders, educators, and respective stakeholders.

It is optimal to track and measure results bi-weekly (monthly reporting is reasonable timeframe) and share results among the teams, including drilling down data and sharing individually that had a blood culture contaminate. Tracking should allow identification of root causes of contamination. Typically, the blood culture specimens require a 5-day incubation period before it can be reported by the lab and then data can be disseminated to staff. If too much time lapses, it is challenging to take a deep dive into discovering why the contaminate may have occurred: was the clinician pulling off a syringe versus a direct to bottle draw or was a culture drawn from an existing line? This is why it is better to report data twice a month versus monthly. It makes it more manageable.

Lastly, the top three things that we incorporated into this project that became important factors to our success were:

Visibility to data – We ensured all staff and leaders had visibility of data and performance metrics via the lead person on the project.

Visibility to resources – We provided high visibility to resources such as workshops, skills fairs and education material from the vendor, including an animated video. The lead person on this

project helped track resources and managed a “wallboard” in the breakroom with important reminders.

Clear objectives and expectations – We ensured all staff had clear objectives and expectations after we have addressed their feedback and criticism. Leadership plays a significant role in this issue.

Repair Gaps in Communication – Do not hold the information hostage. We made an extra effort to collaborate and share data among staff and leaders by pushing information out and asking for replies in specific situations.

Conclusion

Using an automated discard device that offers alternatives for collecting blood cultures with no change in caregiver practice was huge factor in this study. The automated blood culture collection system offers an option to either connect directly to a freshly placed peripheral IV stick catheter, which incorporates a preassembled extension set; as well as a butterfly venipuncture discard collection set. Each automated blood culture collection set features a lock that uses an initial specimen discard technique to sideline skin contaminants during routine blood culture draws automatically. The lock serves as a flash chamber to provide visual confirmation of proper needle placement in the vein. Approximately 0.15mL of the initial blood flow is sidelined in the u-shaped Lock. This is ideal for blood conservation requiring only ≈0.15 ml of precious blood to accomplish a ≈35x washout of a 21-gauge needle. When the blood culture collection bottle is attached,

The specimen flows from the vein into the blood culture bottle through a separate channel. The device has shown to decrease our contamination rates from 3.1% to 1.3% to 0% when using the diversion product during our five-week controlled trial. Ultimately, the overall ED system wide contamination rate fell to less than 2.1%, which factors a real-world blended rate.

Partnering with our Lab directors and having them send out results of the contamination rate for each ED monthly showed to be very beneficial in keeping positive relationships between the departments. Other opportunities to help improve compliance by staff to use the product initially was pre-made bags with everything needed to draw a blood culture, frequent rounding by CNS and company representative to prevent drift in practice and to help filter out potential root causes for continuing contaminations. In addition, assigning a dedicated ED staff nurse, consistent rounding, and providing face-to-face follow-ups truly helped in decreasing our BC rates. The implications of decreasing false-positive blood cultures can be astounding; for example, contaminated blood cultures can negatively impact the length of stay, additional sticks for the patient, take time and attention away from patients that may have a true infection, and get inadvertent antibiotic therapy. Literature supports that one false-positive blood culture could have a financial impact ranging from \$4500–\$10,000 on a patient's stay within the hospital setting [8].

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