The Health Care Improvement Foundation
2018 Delaware Valley Patient Safety and Quality Award
Entry Form

1. Hospital Name

   Einstein Medical Center Montgomery

2. Title Of Initiative

   Integrating Positive Blood Culture PCR Testing and Antimicrobial Stewardship Decreases Unnecessary Antibiotic Treatment and Hospital Costs

3. Abstract (Please limit this description to 250 words.)

   Bloodstream infections and sepsis are an all too common causes of patient morbidity and mortality. Prompt antibiotic therapy is a cornerstone of treatment and is directly linked to survival. Broad-spectrum antibiotics are used empirically to treat bloodstream infections due to the rise of antibiotic-resistant organisms. Our hospital wished to reduce the amount of broad spectrum antibiotics utilized while still appropriately treating bloodstream infections with empiric therapy.

   Our microbiology lab in collaboration with the hospital's antimicrobial stewardship team implemented a rapid blood culture identification (BCID) polymerase chain reaction (PCR) test. The microbiology lab would automatically run the BCID PCR test in tandem with the Gram-stain. The results of both tests would then be reported to the nurse and a pharmacist 24/7. The pharmacist would make an immediate recommendation to the provider on how to manage the current antibiotic regimen based on the BCID result. The lab would continue to perform manual identification and sensitivities on the culture; however, antibiotics would already have begun to be tailored.

   Our team looked at 4 months before and after the implementation of the BCID. The addition of rapid organism identification and antimicrobial resistance marker detection shortened the average time to effective therapy by 24 hours. Patients who were not on antibiotics were also immediately started on appropriate antibiotics rather than broad empiric therapy through utilization of the BCID PCR. An average 1.76 length of stay reduction for bacteremic patients was also observed resulting in $1.1 million cost avoidance.

4. What were the goals of your initiative?

   The goal of our program was to improve antibiotic prescribing by optimizing the use of empiric broad spectrum antibiotics for patients with bacteremia. We sought to use a polymerase chain reaction (PCR) test on positive blood cultures to identify the pathogen quicker. The panel tested for 24 Gram-positive, Gram-negative, and yeast pathogens and 3 antibiotic resistance genes. By using this technology, we expected a decrease in time to antibiotic adjustment; therefore, decreasing the total amount of broad spectrum antibiotics. Our goal was to decrease the time to adjustment of antibiotic therapy by

15%. Adjusted therapy includes appropriate de-escalation or escalation of antibiotics, dosing modifications, and/or discontinuation of unnecessary coverage.

5. What were the baseline data and the results of your initiative?

Implementation of our PCR test occurred on 05/01/2017. Data was collected from our electronic health record from 01/01/2017 to 08/31/2017 on any patient that had a positive blood culture at our institution. Data was analyzed 4 months pre- and post-implementation. Patients were excluded if they grew an organism not found on the PCR test, were discharged from the emergency department, were discharged prior to having the Gram-stain reported, or if samples were from an outpatient lab.

A total of 99 patients before and 104 patients after implementation were assessed. The average time to antibiotic adjustment was 2.30 days after before PCR testing and 1.26 days after, a reduction of 45% ($p < .0001$). We observed the length of stay for patients with bacteremia decrease from 8.59 to 7.14, a total reduction of 1.45 days. We observed 32/99 (32%) patients before and 40/104 (38%) after implementation were in the ICU with an ICU length of stay 6.06 days and 4.86 days, respectively.

When a pharmacist would call the provider with the results of the Gram-stain and PCR, recommendations regarding the antibiotics would also be provided. These recommendations were accepted 82% of the time. Of the 85 patients for which recommendations were accepted we avoided starting vancomycin in 14 cases that were determined to be contaminates, escalated antibiotics 5 times, started narrow-spectrum antibiotics on 18 patients who were previously on no antibiotics, and adjusted antibiotics on 48 patients. We avoided 70 broad-spectrum antibiotic days during the period observed.

Based on the length of stay reduction of 1.45 days, we observed a cost avoidance of $322,508 over the 4 months which is annualized to a total cost avoidance per year of $967,524. Cost data was derived from the average cost per patient day at our institution.

6. Describe the interventions that were instrumental in achieving the results for your initiative.

Our microbiology lab in collaboration with the hospital's antimicrobial stewardship team implemented a rapid blood culture identification (BCID) polymerase chain reaction (PCR) test. The microbiology lab would automatically run the BCID PCR test in tandem with the Gram-stain whenever a blood culture is positive. The results of both tests are then reported to the nurse and a pharmacist 24/7. The pharmacist would make an immediate recommendation to the provider on how to manage the current antibiotic regimen based on the BCID result. The recommendations were created in collaboration with our infectious disease physicians and antibiotic stewardship pharmacist. The lab would continue to perform manual identification and sensitivities on the culture; however, antibiotics would already have begun to be tailored.

7. Describe the key steps required to successfully replicate this initiative throughout the region. (Please limit this description to 100 words.)

   Initial resources were needed to implement the PCR technology; however, our team worked to justify the implementation by demonstrating a cost benefit. The support and buy-in of microbiology, pharmacy, senior leadership, hospitalists, and the infectious disease providers was essential to our success. Without everyone adhering to a unified process we would not have been able to make the results provided by the PCR clinically meaningful. The protocol treated the PCR results as a critical value, creating a sense of urgency in reporting the results. Our team also audited compliance to ensure the procedure was followed.

8. Explain how the initiative demonstrates innovation (Please limit this description to 100 words.)

   While the technology employed in our project is not new, our team worked together to create a novel approach to reporting the results at a small to medium size community hospital. Our testing occurs 24/7 with results being interpreted and acted on all times of the day allowing us to tailor antibiotics in a more expedited fashion. This is possible because we created an algorithm in collaboration with our antimicrobial stewardship team and infectious diseases providers to allow our entire pharmacist staff to report back and recommend therapy.

9. How does this initiative demonstrate collaboration with other providers within the continuum of care? (Please limit this description to 100 words.)

   Members of our antimicrobial stewardship team initially reached out to leaders in microbiology, pharmacy, and senior leadership to discuss the potential benefit of the PCR technology. After agreeing that it would be beneficial for our patients, our antimicrobial stewardship pharmacist coordinated a workflow that was agreeable with the physicians, infectious diseases providers, pharmacists, and microbiologists. Our pharmacist audited the workflow to continually improve the process upon implementation. We identified and fixed gaps in reporting with the microbiologists and pharmacist. Gaps were also identified in blood draw techniques with phlebotomists and nurses and we successfully worked to reduce our contamination rate.

10. Explain ways in which senior leadership exhibited commitment to the initiative (Please limit this description to 100 words.)

    Senior leadership demonstrated commitment to the initiative by providing resources and initial capital for its operation. Our senior leadership involved in the project was engaged with its implementation and worked with our antimicrobial stewardship team to engage and bring together all the departments involved.

11. Appendices (i.e., tables and graphs)

Blood Culture Review

Methods

Data was collected from PowerInsight from 01/01/2017 to 08/31/2017 on any patient that had a positive blood culture. Patients were excluded if they grew an organism not found on the PCR panel, were discharged from the emergency department, were discharged prior to having the Gram stain reported, or if samples were from an outpatient lab. Cost data was derived from the Consolidated Statement of Revenues and Expenses report cost per adjusted patient day averaged from January to June 2017 ($2227.61/day).

Outcomes

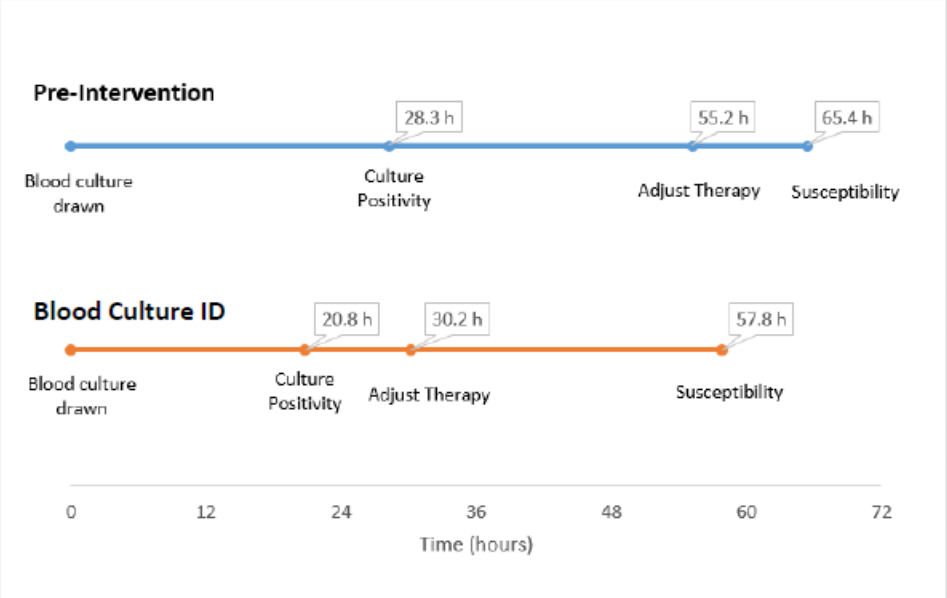

Figure 1: Timeline comparison of pre-intervention and BCID study periods showing the differences in the average time to therapy adjustment. Adjusted therapy includes appropriate de-escalation or escalation of antibiotics, dosing modifications, and/or discontinuation of unnecessary coverage. Pre-intervention data was collected from 01/01/2017 to 04/30/2017. BCID data was collected from 05/01/2017 to 08/31/2017. The decrease in time to culture positivity and susceptibility may be due to the increase in Gram-negative organisms and decrease in contaminants.

Table 1. Cost Outcomes

Length of Stay Reduction	1.45 days
Cost per adjusted patient day	$2227.61
Cost avoidance per patient	$3230.03
Cost avoidance per year (104 patients/4 months)	$1,007,771
Cost of BCID per test	($129)
Total cost avoidance per year	**$967,524**

The final length of stay cost avoidance is $967,524. This does not take into account the decrease in drug cost or cost associated with unnecessary patient isolation. During the initiative, nurses and phlebotomists were also retrained on proper blood draw technique to decrease the amount of contaminants.

Table 2. Patient demographics, outcomes, and recommendation acceptance rate

	Pre-BCID 01/01/2017 - 04/30/2017	Post-BCID 05/01/2017 - 08/21/2017
Number of Patients	99	104
Age, mean (years)	65	67
Male gender (%)	46 (46%)	49 (52%)
Mean LOS	8.59	7.14
Patients in ICU (%)	32 (32%)	40 (38%)
Mean ICU LOS	6.06	4.86
Time between Culture Draw and Gram stain (days)	1.18	0.89
Time to First Antibiotic De-escalation (days)	2.30	1.26
Time to Sensitivities (days)	2.71	2.41
% of Patients with ID Consult	76.77%	80.00%
Patients Not on Empiric Antibiotics (%)	10	18
% of Pharmacist BCID Recommendations Accepted		82%

Table 3. Organisms identified from positive blood cultures. Totals may not add up to the number of patients due to multiple organisms isolated from a sample.

Pathogen Identified	Pre-BCID	Post-BCID
Enterococcus - not VRE	5	2
Enterococcus – VRE	1	0
Listeria monocytogenees	0	0
Staphylococcus species	**37**	**27**
Staphylococcus aureus - no mecA (MSSA)	**5**	**11**
Staphylococcus aureus - mecA (MRSA)	8	12
Streptococcus species	8	8
Streptococcus agalactiae	**1**	**7**
Streptococcus pyogenes	**2**	**0**
Streptococcus pneumoniae	2	3
Acinetobacter baumannii	0	0
Haemophilus influenzae	0	0
Neisseria meningitidis	0	0
Pseudomonas aeruginosa	2	2
Enterobacteriaceae	1	2
Enterobacter cloacae complex	1	4
Escherichia coli	18	22
Klebsiella oxytoca	0	0
Klebsiella pneumoniae	4	8
Proteus	2	0
Serratia marcescens	0	1
Candida albicans	2	0
Candida glabrata	0	0
Candida krusei	0	0
Candida parapsilosis	0	0
Candida tropicalis	0	0