Positive Impact of Rapid Blood Culture Identification and Antibiotic Stewardship for Patients with *S. aureus* bacteremia at a Community Hospital

Marijo Roiko[1], Susan Kuntz[1], Kevin Kern[2]
Department of Pathology and Laboratory Services[1]; Department of Pharmacy[2]; Altru Health System, Grand Forks, ND

Abstract

S. aureus bacteremia is a potentially fatal infection and the positive impacts of rapid pathogen identification from positive blood cultures and antibiotic stewardship have been previously documented. However, many of these studies have been conducted at large, urban health care facilities, and the translation of outcomes to another health care setting may fail for unforeseen reasons. Here we demonstrate the translation of these positive outcomes to a medium-sized hospital serving a rural population. We performed a retrospective comparison study of outcomes for patients with *S. aureus* bacteremia prior to (n = 33) and after (n = 33) implementing a rapid blood culture identification panel (FilmArray BCID) simultaneously with antibiotic stewardship. We observed a three-day reduction in the average length of hospital stay, a 50% reduction in the 30 day readmission rate, and a 15% reduction in 30 day all-cause mortality. The reduced length of hospital stay resulted in an estimated savings of $4,290 per patient (ICU and other ancillary costs not determined) and a positive return on investment. These outcomes are in line with those previously reported in the literature, and support the utility of rapid blood culture identification technology and antibiotic stewardship measures at medium-sized hospitals.

Introduction

Staphylococcus aureus causes a wide range of infections including localized skin and soft tissue infections, abscesses, joint infections, and blood stream infections (bacteremia). Bacteremia is detected by a positive blood culture, with Gram staining and subculture to solid media for culture-based identification of the isolated micro-organism. While the Gram stain is rapid and the microscopic morphology provides a general categorization of the pathogen, it is not sufficient to distinguish between closely related organisms with the same morphology, such as *S. aureus* and coagulase-negative staphylococci (CoNS) (Figure 1). The ability to rapidly differentiate *S. aureus* from CoNS is clinically important as *S. aureus* is considered a pathogen and CoNS are common contaminants.

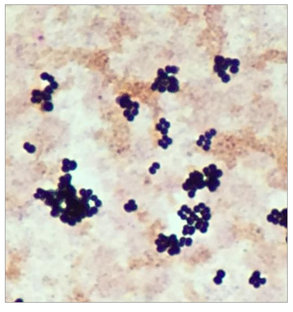

Figure 1: Gram stain from positive blood culture with Gram-positive cocci in clusters, suggestive of *Staphylococcus*.

Rapid methods to test for *S. aureus* from a positive blood culture have been previously described[1]. These methods have the greatest impact on patient outcome when combined with antibiotic stewardship efforts[2]. However, the majority of these studies have been conducted at academic medical centers[2,3,5,6,7]. Here, we examine the impact of a rapid blood culture identification test with antibiotic stewardship on outcomes for patients with *S. aureus* bacteremia at a community hospital.

Methods

Blood cultures were performed according to standard practice. Blood cultures were incubated in a continuously monitoring system (BD Bactec Fx) and culture-based identification and susceptibility testing was performed on the Vitek2 system (bioMerieux, Inc.). Prior to BCID+AS, antibiotic stewardship was performed with daily review of positive of blood cultures (M-F) by a pharmacist and infectious diseases physician, as availability permitted. Rapid blood culture identification was performed according to manufacturer's instructions (FilmArray BCID, BioFire) for all newly positive blood cultures and repeat positives after 72 hours. Simultaneously with BCID implementation, positive blood culture results were reported not only to the ordering provider, but also to the antibiotic stewardship pharmacist or on-call hospital pharmacist (Figure 2).

Methods, continued

Chart review was conducted to determine length of stay, 30-day readmission, and 30-day mortality. Length of stay was determined by calendar day of admission and discharge or death. Mortality was excluded for patients that died within the first 48 hours of admission or were lost to follow-up. Readmission was examined for patients within 30 days of hospital discharge and excluded patients that expired or were lost to follow-up. A similar number of *S. aureus* bacteremia cases were examined before and after implementation of the BCID with antibiotic stewardship.

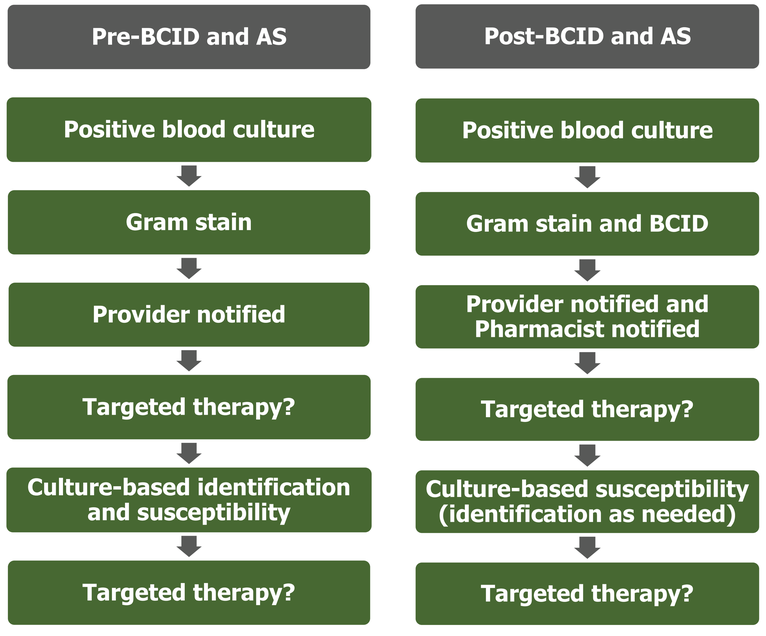

Figure 2: A schematic of positive blood culture process before and after implementation of rapid blood culture identification (BCID) with antibiotic stewardship (AS).

Results

Parameter	Pre-BCID + AS	Post-BCID + AS
Number of patients	33 (21M, 12F)	33 (24M, 9F)
Average age in years (range)	64 (7-104)	60 (7-93)
MRSA bacteremia	13/33 (39.4%)	13/33 (39.4%)
30-day readmission	7/28 (25%)	3/27 (11.1%)
30-day mortality	5/32 (15.6%)	4/30 (13.3%)

Table 1: An equivalent number of *S. aureus* bacteremia cases were examined in each group. The patient age, gender, and MRSA rate were similar in both groups; 30-day readmission and 30-day all-cause mortality were lower in the post-BCID+AS group.

Results, continued

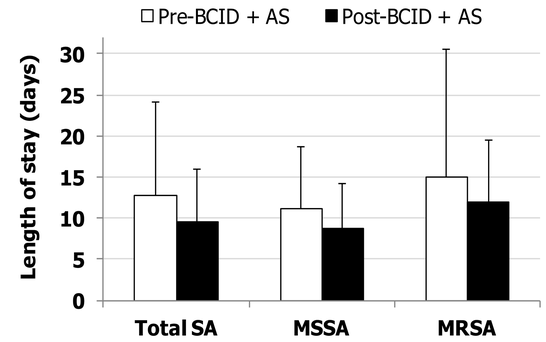

Figure 3: The average length of stay (LOS) for patients with *S. aureus* bacteremia before and after implementation of BCID with antibiotic stewardship. Total SA (n=33/group) = all cases of *S. aureus* bacteremia LOS = 12.7 pre- vs. 9.6 post; MSSA = methicilllin susceptibile *S. aureus* (n=20/group) LOS = 11.1 pre vs. 8.7 post; MRSA = methicillin resistant *S. aureus* (n=13/group) LOS = 15 pre vs. 11.9 post. Error bars indicate standard deviation.

Parameter	Pre-BCID + AS	Post-BCID + AS
Time to de-escalation (days)	3 ± 0.83	1 ± 0.22
Appropriate de-escalation	19/33 (58%)	18/33 (55%)
No de-escalation	8/33 (24%)	6/33 (18%)
De-escalation not indicated	6/33 (18%)	9/33 (27%)

Table 2: The average time to antibiotic de-escalation was reduced from 3 days to 1 day. Both groups had similar numbers of patients who had antibiotics de-escalated, for whom de-escalation was not indicated, and who received no de-escalation. The percentage of patients eligible for de-escalation without de-escalation decreased: 8/27 (30%) to 6/24 (25%). Patients for whom de-escalation was not indicated had co-morbid conditions, expired, or transferred to another facility.

Summary

We found a positive impact on patient outcomes after implementing a rapid blood culture identification test along with antibiotic stewardship for patients with *S. aureus* bacteremia. Overall length of stay, time to antibiotic de-escalation, 30-day readmission rate, and 30-day all-cause mortality were reduced in the post-BCID+AS group. The estimated cost savings from the reduced length of stay (4290 USD/patient x 33 patients = 141,570 USD) are sufficient to cover capital expenditure and reagent costs (78,960 USD).

These results replicate findings previously published at other medical centers[2-7]. Results from studies at academic medical centers may not necessarily transfer to the community hospital setting due to differences such as patient demographics, smaller test volumes, staff availability and training. However, our results demonstrate the importance of rapid identification and antibiotic stewardship for patients with *S. aureus* bacteremia and provide support for the adoption of these practices in the community hospital setting.

References:
1. Opota, O, et. Al. CMI 2015 Apr;21(4):313-22
2. Banerjee, R, et. al. CID 2015 Oct 1;61(7):1071-80
3. MacVane, S, et. al. JCM 2016 Oct;54(10):2455-63
4. Box, M, et. al. Pharmacotherapy 2015 Mar;35(3):269-76
5. Pardo, J, et. al. DMID 2016 Feb;84(2): 159-64
6. Southern, T, et. al. DMID 2015 Feb;81(2):96-101
7. Bauer, K. et. al. CID 2010 Nov 1;51(9):1074-80

Altru® HEALTH SYSTEM