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Contents lists available at ScienceDirect

## American Journal of Infection Control

journal homepage: [www.ajicjournal.org](http://www.ajicjournal.org)

## Brief report

## Increasing the efficiency of a targeted methicillin-resistant *Staphylococcus aureus* screening program



Jennifer C. Goldsack MChem, MA, MS<sup>a,\*</sup>, Christine DeRitter BSN, RN-BC<sup>b</sup>,  
Michelle Power BSMT(ASCP), CIC<sup>c</sup>, Amy Spencer MSN, RN-BC<sup>b</sup>,  
Cynthia L. Taylor RN, MS, CRN<sup>c</sup>, Christine J. Manta<sup>a</sup>, Ryan Kirk<sup>a</sup>, Marci L. Drees MD<sup>d</sup>

<sup>a</sup> Value Institute, Christiana Care Health System, Newark, DE<sup>b</sup> Department of Nursing, Christiana Care Health System, Newark, DE<sup>c</sup> Infection Prevention Department, Christiana Care Health System, Newark, DE<sup>d</sup> Department of Medicine, Christiana Care Health System, Newark, DE

**Key Words:**  
MRSA  
Cost  
Psychosocial  
Surveillance

An interdisciplinary team implemented a screening program targeting patients with a history of methicillin-resistant *Staphylococcus aureus* (MRSA), to reduce unnecessary contact isolation. After converting from a 2-step culture-based protocol to single polymerase chain reaction (PCR) testing, we increased the efficiency of the screening program from 77% to 100%. Despite the higher cost of PCR-based testing, this program remained cost-saving.

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Methicillin-resistant *Staphylococcus aureus* (MRSA) is a primary cause of hospital-acquired infections.<sup>1</sup> Patients with a history of MRSA are often presumed colonized when readmitted,<sup>2,3</sup> leading many hospitals to place historically MRSA-positive patients in contact isolation on readmission. The duration of contact precautions needed for MRSA is poorly defined given the high variability in colonization duration,<sup>4</sup> resulting in unnecessary isolation of patients who are no longer colonized.

Previous work demonstrated that active surveillance targeting historically MRSA-positive patients can reduce unnecessary isolation, thereby improving outcomes and patient experience while reducing cost.<sup>1,5</sup> Our interdisciplinary program flagged MRSA-positive patients in the electronic medical record (EMR), successfully reducing unnecessary isolations. Using 2-swab culture-based testing, we found that 80% of flagged patients completing testing were no longer colonized<sup>1</sup>; however, nearly one-quarter of eligible patients failed to complete screening because of discharge before the second test or initiation of antibiotic therapy.<sup>1</sup> In March 2014, the institution adopted rapid polymerase chain reaction (PCR) technology for MRSA screening, allowing faster turnaround using a single test. In the

present study, we reassessed the efficiency and cost-effectiveness of screening using PCR.

### METHODS

#### *Study overview and setting*

This process improvement project was implemented on 7 medical/surgical units at Christiana Hospital, a 907-bed hospital in Delaware. Screening began in February 2013 with the 2-culture process and then transitioned to PCR in March 2014. This report describes patients screened with PCR between March 2014 and January 2015. Details of the implementation and evaluation of this project have been published previously.<sup>1</sup> The culture-based screening results have been updated, and aspects specific to the PCR-based phase of this program are described below. The Christiana Care Institutional Review Board approved the study.

#### *Intervention design and implementation*

#### *Study population*

All inpatients admitted to study units with MRSA-positive flagged in the EMR were included. In accordance with institutional policy, patients with any positive MRSA cultures within the previous 12 months or who received specific antibiotics<sup>1</sup> in the previous 72 hours were excluded.

\* Address correspondence to Jennifer C. Goldsack, MChem, MA, MS, Research Associate, Christiana Care Health System, Value Institute, John H. Ammon Medical Education Center, 4755 Ogleton-Stanton Rd, Suite 2E55, Newark, DE 19718.

E-mail address: [jgoldsack@christianacare.org](mailto:jgoldsack@christianacare.org) (J.C. Goldsack).

Conflicts of interest: None to report.

**Table 1**  
Demographic and clinical characteristics of the study subjects (n = 112)

Characteristic	Value
Age, y, mean ± SD	59.6 ± 15.6
Sex, n (%)	
Male	55 (49)
Female	57 (51)
Length of stay, d, mean ± SD	7.6 ± 9.0
Hospital visits in 12 mo before screening, mean ± SD	0.98 ± 1.7
Hospitalizations since initial diagnosis, mean ± SD	4.8 ± 6.0
Location before admission, n (%)	
Home	98 (88)
Nursing/group home	8 (7)
Hospital	2 (2)
Other	3 (3)
Significant history of drug use, n (%)	24 (21)
Chronic steroid use, n (%)	6 (5)
Top 10 comorbidities, n (%)	
Diabetes mellitus	50 (45)
Chronic kidney disease/end-stage renal disease	31 (28)
Coronary artery disease/myocardial infarction	25 (31)
Cerebrovascular accident	22 (20)
Chronic obstructive pulmonary disease/bronchitis	21 (19)
Obstructive sleep apnea	20 (18)
Congestive heart failure	19 (17)
Morbid obesity	15 (13)
Miscellaneous autoimmune disease	15 (13)
Peripheral vascular disease/peripheral arterial disease	13 (12)

**Program implementation**

Infection prevention and nursing staff collaborated to identify and test eligible patients. Patients with negative PCR tests had the MRSA-positive EMR flag removed and isolation discontinued.

**Screening process**

Nursing staff collected 1 anterior nares specimen from each eligible patients. Laboratory staff used a GeneOhm real-time PCR machine (BD Diagnostics Systems, Sparks, MD) to identify MRSA, operating according to the manufacturer's instructions.

**Clinical and cost evaluation of the MRSA clearance program**

The primary study outcome was the percentage of tested patients no longer colonized. We compared this outcome with the results of our previous study using the  $\chi^2$  test. The annual cost impact of screening was calculated based on the cost of screening and the estimated cost of unnecessary isolation.

**RESULTS**

During the culture-based phase of the project (February 2013 to March 2014), 269 patients were eligible for MRSA screening, of whom 64 (24%) were unable to complete screening owing to discharge or antibiotic use.<sup>6</sup> In contrast, during the subsequent 9-month PCR-based period, the 7 units admitted a total of 112 eligible patients (Table 1), all of whom completed the single-swab PCR screening. Thus, using a single PCR test rather than 2 cultures reduced the number of eligible but incomplete patients from 24% (64 of 269) to 0% (0 of 112) ( $P < .0001$ ).

PCR identified fewer patients remaining colonized as well; of the 112 patients tested by PCR, 108 (96%) were no longer colonized, compared with 80% (163 of 205) of patients using the 2-culture protocol ( $P < .0001$ ). Of the 108 patients identified by PCR as no longer colonized, as of April 2015, 4 patients (3.7%) were recolonized at the time of subsequent hospital admission, based on clinical cultures.

In our setting, each PCR test (including materials and labor) cost \$50.47, compared with \$18.15 for 2 cultures (using CHROMAgar).

**Table 2**  
Cost impact of PCR screening program

Variable	Value
Cost of screening for 9 mo	
Materials	
Cost per MRSA cartridge and swab, \$	38.14
Number of tests	112
Total, \$	4271.68
Microbiological analysis	
Cost per MRSA analysis (labor only), \$	12.33
Number of MRSA tests analyzed	112
Total cost, \$	1380.96
Total cost of screening for 9 mo, \$	5652.64
Cost of screening for 1 y, \$	(7536.85)
Cost of providing care in unnecessary isolation	
Cost of disposable equipment, \$	
Cost of disposable stethoscope, \$	4.39
Cost of disposable blood pressure cuff, \$	36.14
Cost of disposable thermometer, \$	3.74
Number of patients in unnecessary isolation over 9 mo	108
Total cost, \$	4781.16
Cost of protective clothing	
Cost of 1 pair of gloves, \$	0.08
Cost of 1 gown, \$	0.40
Estimated patient contacts per day	52
Patients in unnecessary isolation over 9 mo	108
LOS of MRSA flagged patients, d, mean	7.7
Total cost, \$	20,756.74
Cost of nursing time to gown and glove	
Cost of 60 s of nursing time to gown and glove	0.47
Estimated visits per day	24
Patients in unnecessary isolation over 9 mo	108
LOS of MRSA flagged patients, d, mean	7.7
Total cost, \$	9380.45
Total cost for 9 mo, \$	34,918.35
Total annual cost, \$	46,557.80
Cost of unnecessary room cleaning	
Cost of housekeeping	
Cost of housekeeping staff for 20 min to change curtain, \$	7.50
Unnecessarily isolated patient rooms in 9 mo	108
Total cost, \$	810
Cost of laundering a single curtain, \$	8.00
Number of unnecessarily laundered curtains	108
Total cost, \$	864
Total cost for 9 mo, \$	1674
Total annual cost, \$	2232
Cost of unnecessary isolation for 1 y, \$	48,789.80
Total cost impact of screening program for 1 y on 7 med/surg units, \$	41,252.95

For the 7 participating medical/surgical study units, the projected annual screening costs were \$7540, and the costs of unnecessary isolation were \$48,790 (Table 2). This indicates a potential annual cost savings of \$41,250.

**DISCUSSION**

Our findings suggest that replacing culture-based testing with PCR to screen known MRSA-positive patients and discontinue contact isolation increases the number of noncolonized patients identified while still reducing costs.

The higher sensitivity of PCR testing compared with culture<sup>7,8</sup> enables collection of a single nares swab, thereby maximizing feasibility. A single nares culture for MRSA has limited sensitivity<sup>7</sup>; thus, most institutions require 2 or more swabs to declare a patient MRSA-free.<sup>1,5</sup> Maximizing the number of patients who complete testing increases the program's ability to avoid unnecessary isolation and its potential negative impact on patient outcomes, safety, satisfaction, and hospital flow.<sup>1,9</sup>

The increased expense of PCR compared to culture does reduce the direct cost savings of this surveillance program. However, we

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