

# Preoperative *Staphylococcus Aureus* Screening and Targeted Decolonization in Cardiac Surgery

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**Background.** We assessed the impact of preoperative *Staphylococcus aureus* screening and targeted decolonization on the incidence of postoperative methicillin-resistant *S aureus* (MRSA) colonization, intensive care unit MRSA transmission, and surgical site infections in cardiac surgery patients.

**Methods.** We reviewed medical records for all adult patients during two periods: preintervention (January 2007 to April 2010) and intervention (January 2011 to December 2014). In the intervention period, we performed nasal screening for methicillin-sensitive *S aureus* and MRSA using polymerase chain reaction within 30 days of the operation. Colonized patients received intranasal mupirocin twice daily and chlorhexidine baths daily for 5 days; patients colonized with MRSA also received prophylactic vancomycin plus cefazolin with contact isolation precautions. Nasal surveillance for MRSA was performed on intensive care unit admission and weekly thereafter. Multivariable logistic regression models were constructed to determine risk factors for postoperative MRSA colonization, and surgical site infections and the impact of our screening program was

assessed in these models. Poisson regression was used to assess MRSA transmission.

**Results.** Comparing 2,826 preintervention and 4,038 intervention patients, cases differed in age, diabetes mellitus, preoperative infection, preoperative length of stay, and bypass time (all  $p \leq 0.03$ ). Intervention patients had risk-adjusted reductions in MRSA colonization (odds ratio 0.53, 95% confidence interval [CI]: 0.37 to 0.76,  $p < 0.001$ ), transmission (incidence rate ratio 0.29, 95% CI: 0.13 to 0.65,  $p = 0.002$ ), and surgical site infections (odds ratio 0.58, 95% CI: 0.40 to 0.86,  $p = 0.007$ ). Increased duration of preoperative decolonization therapy was associated with decreased postoperative MRSA colonization (odds ratio 0.73, 95% CI: 0.53 to 1.00,  $p = 0.05$ ).

**Conclusions.** Preoperative *S aureus* screening with targeted decolonization was associated with reduced MRSA colonization, transmission, and surgical site infections. Duration of preoperative therapy correlated with decreased frequency of postoperative MRSA colonization.

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Methicillin-resistant *Staphylococcus aureus* (MRSA) remains a major contributor to health care-associated infections (HAI) [1]. The prevalence of MRSA in the intensive care unit (ICU) across the United States ranges between 7% and 11%, and continues to increase [2]. MRSA is associated with increased rates of in-hospital mortality [3], surgical site infections (SSI) [4], post-discharge mortality [5], and high costs [6]. These issues are magnified in the cardiac surgery ICU, where patients are particularly vulnerable. Colonization with MRSA at ICU admission is predictive of any type of active MRSA infection developing approximately 25% of the time [2], and decolonization has been described as an

effective strategy to mitigate HAI risks associated with MRSA [7–9].

Although MRSA screening and decolonization programs have been successfully implemented in medical-surgical ICUs [10] and the perioperative care of other surgical disciplines [11, 12], few studies have specifically described the implementation and effect of preoperative methicillin-sensitive *S aureus* (MSSA)/MRSA screening with targeted decolonization on cardiac surgery HAIs in the United States [13]; no studies have examined the effect of such an intervention on postoperative transmission of MRSA in the cardiac surgery ICU. The purpose of this

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**Abbreviations and Acronyms**

|      |                                                      |
|------|------------------------------------------------------|
| CABG | = coronary artery bypass graft surgery               |
| CI   | = confidence interval                                |
| HAI  | = health care–associated infection                   |
| ICU  | = intensive care unit                                |
| MRSA | = methicillin-resistant <i>Staphylococcus aureus</i> |
| MSSA | = methicillin-sensitive <i>Staphylococcus aureus</i> |
| OR   | = odds ratio                                         |
| PCR  | = polymerase chain reaction                          |
| SSI  | = surgical site infection                            |
| STS  | = The Society of Thoracic Surgeons                   |

study was to determine the effectiveness of a preoperative MSSA/MRSA screening with targeted decolonization program in reducing postoperative MRSA colonization, incidence of coronary artery bypass graft surgery (CABG) SSIs and postoperative ICU MRSA transmission in cardiac surgery patients.

## Patients and Methods

### Patient Population

Using electronic medical records, hospital epidemiology and infection control records, and The Society of Thoracic Surgeons (STS) institutional database, we reviewed all adult patients undergoing cardiac surgery at our institution between January 1, 2007, and December 31, 2014. That included all adult cardiac operations, heart transplants, and ventricular assist device insertions. Lung transplantations were excluded. We divided patients into preintervention and intervention periods based on implementation of a polymerase chain reaction (PCR) screening program on May 1, 2010. For the purpose of assessing MRSA colonization and transmission, all patients were included. For the determination of SSI, only CABG patients, including both isolated CABG and CABG performed in conjunction with other cardiac operations, were evaluated, as this population is carefully followed by our Hospital Epidemiology and Infection Control Department. Patients operated on during a run-in period from May 1, 2010, to December 31, 2010, when the screening program was first implemented were excluded to reduce the potential for a Hawthorne effect, which could confound the results of the decolonization program. Therefore, our preintervention era consisted of patients undergoing cardiac operations from January 1, 2007, to April 30, 2010. The intervention era consisted of patients operated on from January 1, 2011, to December 31, 2014. The Institutional Review Board approved this study.

### Intervention

A multidisciplinary quality improvement initiative was implemented in 2010 and consisted of preoperative PCR screening for MSSA/MRSA followed by skin and nasal decolonization for patients with positive screening

results. The program involved physician assistants, nurses, infection prevention epidemiologists, anesthesiologists, and surgeons in a coordinated effort to reduce perioperative MRSA transmission and infections.

This initiative was implemented in phases, first in the outpatient population before elective operations and then expanding to both inpatients and outpatients undergoing open heart surgery. In just 5 months, all adult cardiac surgery patients were receiving preoperative screening for MSSA/MRSA. Screening consisted of bilateral sampling of the nares using red cap dual-swabs (Copan Diagnostics, Murietta, CA) within 30 days of surgery.

The results of PCR testing are available within 2 hours of arrival of the swab to the microbiology laboratory. Patients testing positive for MSSA/MRSA by real-time PCR were prescribed twice-daily intranasal 2% mupirocin ointment (Bactroban; GlaxoSmithKline, Brentford, United Kingdom) and once-daily chlorhexidine baths (Hibiclens; Mölnlycke Health Care, Norcross, GA) for 5 consecutive days. In the outpatient setting, an advanced practitioner (physician assistant or nurse practitioner) called patients with positive PCR results to provide instructions on the purchase and use of chlorhexidine and additionally prescribed mupirocin. In the inpatient setting, chlorhexidine and mupirocin were ordered by the inpatient cardiac surgery team.

Standard perioperative antimicrobial prophylaxis for all patients included one preoperative dose of cefazolin in the operating room and two doses postoperatively. For operations that lasted longer than 4 hours, a second dose of cefazolin was administered. Patients with penicillin allergies were alternatively administered vancomycin. All patients who screened positive for MRSA colonization received a single dose of vancomycin before surgery along with standard cefazolin prophylaxis. On postoperative ICU admission, all patients received nasal surveillance cultures to assess MRSA colonization status. In the ICU, patients received daily chlorhexidine baths during both the preintervention and intervention phases of the study. All patients with MRSA colonization or infection were treated using contact isolation precautions throughout their hospital stay. Patients whose 5-day course of mupirocin was not completed preoperatively finished their remaining decolonization treatment in the ICU.

### Definitions

A patient was considered to have undergone preoperative MSSA/MRSA PCR screening if performed within 30 days before ICU admission. The CABG SSI data were obtained from the Hospital Epidemiology and Infection Control Department using National Healthcare Safety Network definitions. In the event of more than one SSI incurred by a patient during the hospital stay, only the first SSI was counted.

MRSA transmissions included definite and probable cases. Definite cases were patients who had cultures growing MRSA collected more than 48 hours after postoperative ICU admission, after a negative surveillance culture that was collected during the first 48 hours of postoperative ICU admission. Probable cases were those

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