Staphylococcus aureus Screening and Decolonization for Pediatric Patients Undergoing Cardiovascular Surgery at Texas Children's Hospital: A Trainee Quality Improvement Initiative

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ABSTRACT

Background: Colonization with *Staphylococcus aureus* increases the risk of developing healthcare-associated infections (HAIs) in adults, but its role in pediatrics remains unclear. We hypothesized that use of a *S. aureus* screening and decolonization protocol for pediatric patients undergoing cardiovascular (CV) surgery would result in a reduction of invasive *S. aureus* infections.

Methods: A *S. aureus* screening and decolonization protocol (Table 1) was implemented for patients undergoing CV surgery at TCH on 1/1/2018. We retrospectively identified and reviewed charts of pediatric patients with *S. aureus* infections following CV surgery pre-protocol (2017) and post-protocol (January 1, 2018 - March 31, 2018). We defined invasive *S. aureus* infections as: bacteremia, mediastinitis, superficial and deep surgical site infections (SSIs) and ventilator-associated pneumonias (VAPs). A subset of charts were reviewed pre- and post-protocol for methicillin-resistant *S. aureus* (MRSA) polymerase chain reaction (PCR) result, use of mupirocin and chlorhexidine gluconate (CHG), and choice of intraoperative antibiotic. Data was analyzed with Fisher's exact.

Results: Of 694 pediatric CV surgery patients in 2017, we identified 13 patients with 15 invasive *S. aureus* infections: bacteremia (5), VAP (4), and SSI (6). Twelve of these infections were caused by methicillin-susceptible *S. aureus* (MSSA) and 3 were MRSA. The median time to infection was 19 days. In the first 3 month post-protocol period, there were 175 pediatric CV surgery patients with 0 invasive *S. aureus* infections. Seventy-five charts each were reviewed pre- and post-protocol to assess protocol adherence (Figure 3). Post-protocol MRSA screening peaked at 64%, which increased further to 70% when excluding infants <30 days. Of 40 patients screened with a MRSA PCR, only 1 (2.5%) was positive. Cefazolin use remained high pre- and post-protocol (72/75 vs 73/75 respectively).

Conclusion: Most pediatric invasive *S. aureus* infections are caused by MSSA. Following protocol implementation, we observed a decrease in invasive *S. aureus* infections in CV surgery patients at TCH (p=0.05), though continued monitoring for protocol compliance and development of *S. aureus* and other bacterial infections are needed.

OBJECTIVES

- ❑ **To implement a *Staphylococcus aureus* screening and decolonization protocol for children undergoing cardiovascular surgery at Texas Children's Hospital (TCH).**
- ❑ **To assess protocol compliance and monitor incidence of invasive *S. aureus* infections pre and post-protocol.**

INTRODUCTION

- Colonization with *Staphylococcus aureus* increases the risk of developing healthcare-associated infections (HAIs) in adults, but its role in pediatrics remains unclear.
- Screening for *S. aureus* and decolonizing surgical patients with an anti-staphylococcal agent in the preoperative setting may be beneficial for certain high-risk procedures such as orthopedic or cardiothoracic procedures. (Anderson *et al. Infect Control Hosp Epidemiol*. 2014 Jun; 35(6): 605–627)
- Bode and colleagues demonstrated a 2 fold reduction in the risk of *S. aureus* postoperative infection in patients screened for *S. aureus* by rapid polymerase chain reaction (PCR) and decolonized with combination mupirocin and chlorhexidine gluconate (CHG) compared to placebo. (Bode et al. *N Engl J Med*. 2010;362(1):9–17)
- We hypothesized that use of a *S. aureus* screening and decolonization protocol for pediatric patients undergoing cardiovascular (CV) surgery would result in a reduction of invasive *S. aureus* infections.

METHODS

Study design and Population

- A *S. aureus* screening and decolonization protocol (Table 1) was implemented for patients undergoing CV surgery at TCH on 1/1/2018.
- We retrospectively identified and reviewed charts of pediatric patients with *S. aureus* infections following CV surgery pre-protocol (2017) and post-protocol (January 1, 2018 - March 31, 2018).
- We defined invasive *S. aureus* infections as: bacteremia, mediastinitis, superficial and deep SSIs and ventilator-associated pneumonias (VAPs) occurring within 1 year of the patient's surgery.
- A subset of charts were reviewed pre- and post-protocol for methicillin-resistant *S. aureus* (MRSA) polymerase chain reaction (PCR) result, use of mupirocin and CHG, and choice of intraoperative antibiotic.

Statistical Analysis

- Statistical analysis was performed with Fisher's exact test using STATA11 software (College Station, TX).
- Two-tailed P-values <0.05 were considered statistically significant.

Table 1. *Staphylococcus aureus* Infection Prevention Protocol for Pediatric Patients Undergoing Cardiovascular Surgery at TCH

Recommendation	Description
Universal Decolonization	▪ Population: All patients undergoing CV surgery ▪ Action: Apply topical mupirocin to anterior nares BID for 5 days AND use 2% chlorhexidine gluconate antiseptic wipes as directed according to patient weight daily for 5 days ▪ Timing: Start 5 days prior to surgical procedure date
Universal MRSA Screening	▪ Population: All patients undergoing CV surgery ▪ Action: Using a single swab, swab the nares, axilla, and groin of the patient for MRSA PCR testing ▪ Timing: Perform at least 3-4 hours prior to surgery
Screening-Directed Preoperative Antibiotic	• Population: All patients undergoing CV Surgery • Action: Administer cefazolin[a] • Timing: 0-60 minutes prior to incision; re-dose every 4 hours • Population: MRSA-positive patients undergoing CV surgery should receive cefazolin in addition to the following: • Action: Administer vancomycin • Timing: 0-120 minutes prior to incision; no re-dosing

[a]Cefazolin was the first-line agent for intraoperative prophylaxis at our institution pre protocol. In patients with a β-lactam allergy, may refer to A&I for penicillin allergy testing. If β-lactam allergy confirmed, administer clindamycin and re-dose every 6 hours or a one-time dose of vancomycin for gram-positive coverage.

RESULTS

- Our SMART Aim was: "to decrease the prevalence of invasive *S. aureus* infections by 20% in pediatric patients undergoing cardiac surgery at TCH by May, 2018".
- A fishbone diagram and Plan, Do, Study, Act (PDSA) cycles are shown (Figure 1&2).
- Our outcome measure was the number of invasive *S. aureus* infections and our process measures included: the number of patients who were screened for MRSA, decolonized with mupirocin, and received appropriate intraoperative antibiotic.

S. aureus Infections

- Of 694 pediatric CV surgery patients in 2017, we identified 13 patients with 15 invasive *S. aureus* infections: bacteremia (5), VAP (4), and SSI (6).
- Twelve of these infections were caused by methicillin-susceptible *S. aureus* (MSSA) and 3 were MRSA.
- The median time to infection was 19 days (range 9, 197).
- The most common underlying cardiac conditions were Shone's complex (3) and transposition of the great arteries (3).
- In the first 3 month post-protocol period, there were 175 pediatric CV surgery patients with 0 invasive *S. aureus* infections. (Fisher's exact, p=0.05)

Protocol Compliance

- Seventy-five charts each were reviewed pre- and post-protocol to assess protocol adherence (Figure 3).
- Post-protocol MRSA screening peaked at 64%, which increased further to 70% when excluding infants <30 days.
- Of 40 patients screened with a MRSA PCR, only 1 (2.5%) was positive.

Figure 1. Cause and Effect Diagram for Invasive *S. aureus* Infections

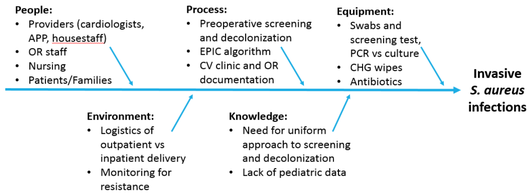
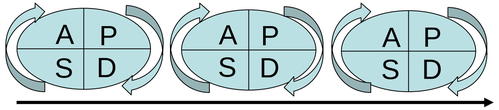


Figure 2. Plan, Do, Study, Act Cycles

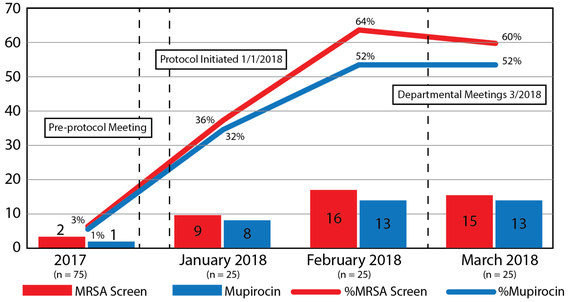


Cycle 1
-Project conceptualization
-Review of literature for *S. aureus* infection prevention strategies
-Collection of pre-protocol data

Cycle 2
-Meeting with key stakeholders
-*S. aureus* screening and decolonization protocol created, revised, and implemented

Cycle 3
-Collection of post-protocol data
-Multidepartment feedback sessions
-Ongoing monitoring of protocol compliance

Figure 3. *S. aureus* Infection Prevention Protocol Use



Fisher exact comparing pre vs post MRSA screen and mupirocin, p <0.0001 for both

- Cefazolin use remained high pre- and post-protocol (96% vs 97%, respectively).

Future Directions

- For our next PDSA cycle, we plan to interview patients and families regarding their understanding and satisfaction with the *S. aureus* decolonization protocol. In doing so, we hope to identify any barriers to completion of decolonization with mupirocin and CHG wipes.
- We plan to review charts of all CV surgery patients at TCH for invasive *S. aureus* infections for a 1 year period following protocol implementation (through 12/1/18).
- We are also working with the TCH Microbiology Laboratory regarding availability of a *S. aureus* (i.e. both MSSA and MRSA) PCR. If this PCR is used, then we may adapt our protocol to targeted decolonization for patients who screen positive for *S. aureus*.

CONCLUSIONS

- Most pediatric invasive *S. aureus* infections are caused by MSSA.
- Following implementation of a *S. aureus* infection prevention protocol, we observed a decrease in invasive *S. aureus* infections in CV surgery patients at TCH (p=0.05).
- Continued monitoring for protocol compliance and development of *S. aureus* and other bacterial infections are needed.

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