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Implementation of a Pediatric Orthopaedic Bundle to Reduce Surgical Site Infections

Jan Schriefer ▼ James Sanders ▼ Julie Michels ▼ Kori Wolcott ▼ Connor Ruddy ▼ Jenna Hanson

Surgical site infections (SSIs) cost an estimated $27,288 per case. An analysis of the National Surgical Quality Improvement Program data at the University of Rochester Medical Center suggested that rates of SSIs could be lowered in comparison with both peers and baseline. The aim of this study was to reduce the number of SSIs to zero through the implementation of a "bundle" or a combination of practices. Meetings were held with the multidisciplinary care team that includes surgeons and staff from pediatric pharmacy, pediatric infectious diseases, anesthesia, and nursing to create a care bundle for all pediatric orthopaedic surgery patients. Bundle elements included use of chlorhexidine gluconate wipes the night before surgery and the day of surgery, use of preoperative nutrition screens, development and use of a prophylactic antibiotic dosing chart, use of methicillin-resistant *Staphylococcus aureus* screening, maintenance of normal patient temperature, and use of nasal swabs in the operating room. The SSI rate dropped from a baseline figure of 4% in 2013 (n = 154) and 3.2% in 2014 (n = 189) to 0.0% (n = 198) in 2015 after the bundles were implemented. Both compliance with the bundle and SSI rates must be monitored monthly. Staff and providers should be offered monthly feedback on SSI rates and care bundle compliance. If an SSI does occur, a root–cause analysis is performed with the multidisciplinary care team using a standardized review form.

Although surgical site infections (SSIs) occur infrequently in the pediatric population (~1.8% for the general pediatric population [Saito et al., 2013], 2.6%–9.3% for children undergoing spinal surgery [Ballard et al., 2012], and 6% in the pediatric intensive care population [Richards, Edwards, Culver, & Gaynes, 1999]), they are potentially devastating and largely preventable (Toltzis et al., 2014). Prevention of SSIs is of great importance to the health and well-being of patients as well as the hospital: SSIs are associated with greater mortality, higher readmission rates, longer length of stay, and greater cost for patients who incur them (Institute for Healthcare Improvement, 2012). Sparling et al. (2007) examined the costs of SSIs in a matched sample of surgical pediatric patients with and without SSIs and found that for those with SSIs, there was an average increase in length of stay by 10.6 days, with increased costs of $27,288 per SSI.

Initiatives to Prevent SSIs

Prevention of SSIs was brought to the forefront with the introduction in 2003 of the Surgical Care Improvement Project (SCIP), a national quality partnership whose goal in 2006 was to improve patient safety by driving down postoperative complications by 25% by 2010. Thompson, Oldenburg, Deschamps, Rupp, and Smith (2011) reported on implementation of a SCIP-bundled intervention with a 57% decrease in the SSI rate and a cost savings of nearly $1 million during the 14-month (May 1, 2008–June 30, 2010) study period. Munday, Deveaux, Roberts, Fry, and Polk (2014) did a systematic review of studies implementing the SCIP program, and data demonstrated an 18% decrease in the odds of developing SSIs and a cumulative 4% decrease in SSIs.

The majority of quality improvement programs aimed at lowering SSIs have been focused on adults. A review of the literature suggested that few pediatric studies have been conducted. Ryckman et al. (2009) reported on a pediatric interdisciplinary improvement project aimed at

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reducing SSIs in a large children's hospital. Strategies found effective for adult patients were examined for relevance to the pediatric population and a bundle consisting of a selection of prophylactic antibiotics, preoperative skin preparation, maintenance of normothermia during surgery, enhanced perioperative oxygenation, and glycemic control in the operating room and in the 24-hour postoperative period was developed. The authors reported a 64% reduction in SSI rates and, as importantly, a continuation of low incidence in the months between the study completion (August 2007) and publication (April 2009). Toltzis, O'Riordan, Cunningham, et al. (2014) reported on a statewide collaborative of children's hospitals in Ohio that adopted an SSI-reduction bundle for cardiac, orthopaedic spinal, and neurological surgical procedures. The bundle contained three interventions: restriction of razors for skin preparation, use of chlorhexidine-alcohol for incisional site preparation, and correct timing of prophylactic antibiotic administration. Results showed a substantial reduction (58%) in the incidence of pediatric SSIs across the collaborative. Specific to orthopaedic spinal surgery, the reduction was 44%.

Ballard et al. (2012) reported on a bundle study to improve infection rates in pediatric spine surgery. Three bundles were implemented—one for the preoperative period and the other two for the intraoperative and postoperative periods. The preoperative bundle consisted of a chlorhexidine wash 24 hours before surgery, methicillin-resistant *Staphylococcus aureus* (MRSA) nasal swab for polymerase chain reaction assay, warming blankets, and a history of recent antibiotic usage. The intraoperative bundle consisted of gowning/gloving for line placement, preincision antibiotics and antibiotic redosing, limiting of personnel in the operating room, and warming blankets. The postoperative bundle consisted of discontinuation of antibiotics 24 hours postoperatively, removing of drains prior to 48 hours postoperatively, and initiation of aggressive pulmonary therapy. Results showed a decrease from 7.8% to 4.5%, an overall relative risk reduction of 43%. Bruny et al. (2013) reported on implementation of a similar pediatric spinal surgical bundle to reduce variability in SSI rates across institutions. This care bundle resulted in a decrease in pediatric spinal fusion SSI rates from 3.7 to 2.1 per 100 procedures.

The evidence suggests that bundles are effective in reducing the incidence of SSIs in children; however, implementation remains a challenge. The outcome of bundles is largely associated with compliance rates in bundle implementation. Klinger et al. (2015) reported on low rates of full compliance with prophylactic antibiotic guidelines. Ryckman et al. (2009) emphasized the need for reliability in bundle implementation. To this end, in Ryckman et al.'s (2009) study, bundled strategies were clearly delineated and process measures were tracked (i.e., the percentage of all high-risk patients who receive care in accordance with the prevention bundle).

Quality Improvement Project to Lower SSIs

Golisano Children's Hospital at the University of Rochester Medical Center is one of the largest pediatric orthopaedic surgery centers in New York State, performing approximately 200 pediatric orthopaedic inpatient surgical procedures a year. The hospital was a participant in the American College of Surgeons National Surgical Quality Improvement Program (ACS NSQIP), which is a risk-adjusted outcomes tracking system used to track surgical programs trend outcomes over time and compare their results with other hospitals. The NSQIP requires participating facilities to report data on preoperative risk factors, operating room variables, and postoperative morbidity and mortality outcomes. The data are collected by staff at each hospital; all staff members working on the NSQIP receive special training to ensure data validity and reliability. Data from each site are sent through a secure web-based program and then NSQIP sends reports back to each site.

A review of ACS National Surgical Quality Improvement Program Pediatric (NSQIP-P) data at Golisano Children's Hospital showed that our rate of pediatric orthopaedic SSIs to be 4% at baseline in 2013 (n = 154). This rate is based on risk-adjusted data, which eliminated any rationale that our SSI rate was higher as we cared for higher risk patients than our peers. The multidisciplinary care team—with representation from medicine, nursing, pharmacy, radiology, and infection prevention—made its 2014 quality initiative project the reduction of SSIs.

The aim of the project was to design and implement a prevention bundle to reduce SSIs in our pediatric orthopaedic surgical population. Our goal was zero pediatric orthopaedic SSIs in 2015.

The project took about 1 year to implement. The first step was to review relevant NSQIP-P data and perform a review of the literature to gather the needed evidence for bundle development. The multidisciplinary care team met monthly for 6 months to evaluate evidence and finalize best practices specific to skin preparation, preoperative nutrition management, antibiotic dosing, increased wound culturing, and patient temperature management preoperatively, in the operating room, and postoperatively. Guiding the discussion on reducing SSIs were the Centers for Disease Control and Prevention (CDC) guidelines (Mangram, Horan, Pearson, Silver, & Jarvis, 1999) and Ryckman et al.'s (2009) study on reducing SSIs at a pediatric academic medical center. The team set a consistent meeting schedule and met for 90 minutes each month. Minutes were taken and distributed to document progress and inform others not participating in the actual meetings. As evidence was reviewed, the need for additional expertise to discuss targeted best practices was recognized; in response, subgroup meetings were held with technical area experts. For example, several meetings were held with anesthesia attending staff and operating room staff to discuss the use of warming devices to help maintain patient temperature. Meetings with the anesthesiologists also occurred to discuss the use and appropriate timing of the povidone–iodine nasal antiseptic swabs. Subgroup meetings with pediatric pharmacy and pediatric infectious disease staff were convened to discuss guidelines for antibiotic prophylaxis dosing.

In agreeing on best practice interventions, committee members decided that bundle strategies needed to vary on the basis of risk level, as some patients are at higher risk than others because of type of surgery (e.g.,

neuromuscular or complex surgical procedures) or comorbidities (e.g., nutritional deficits). One bundle was proposed for high-risk patients—those having large amounts of instrumentation inserted (e.g., spine fusion and those with a neuromuscular diagnosis). A second bundle was proposed for the low-risk patient population. Low-risk patients included those without nutritional deficiencies who were not having implants placed during their procedures. Table 1 describes the components of the SSI bundles, with citations.

Prior to bundle implementation, the recommended antibiotic prophylaxis guidelines were vetted by the pediatric surgery subspecialties. The guidelines and bundles were then approved by the hospital clinical council. To enhance compliance with the antibiotic dosing portion of the bundle, guidelines were incorporated into the electronic medical record (EMR) system. These order sets were approved by the Antibiotic Subcommittee and the Therapeutics Committee. Figure 1 is the pediatric prophylactic antibiotic dosing guideline embedded in the EMR.

Implementation and Results

Adherence with the bundles is the key to success in reducing SSIs. To this end, processes were implemented to audit compliance with the total bundle and compliance with each component of the bundle to identify areas for further focus. In addition, the process for monitoring SSIs as recommended by Schriefer and Leonard (2012) calls for a root–cause analysis (RCA) to be conducted on any SSI case. The RCA assessment form developed for our facility is shown in Figure 2.

The bundle was implemented in the spring of 2014, and the multidisciplinary care team transitioned from bundle development to monitoring and response using a phased approach. New members added for the ongoing review included the pediatric orthopaedic operating room nurse leader and the orthopaedic quality improvement expert. The team continues to meet monthly, with a focus on examining adherence to the bundle, SSI occurrences, and the corresponding RCI. Audit tools were developed to track compliance; the high-risk bundle audit tool is shown in Figure 3. The goal in bundle compliance is to achieve a total compliance score (all elements complied with) of 95%. As can be seen in Figure 3, the total scores ranged from a low of 75% to a high of 92%. To identify areas that needed greater focus, compliance with specific bundle elements was examined and plans for enhancing adherence in these areas was discussed. The audit results were shared with staff in

Table 1. Pediatric Surgical Bundle Elements and Evidence

	High Risk	Low Risk
Antimicrobial prophylaxis Antibiotic dosing	Prescribed weight-based prophylactic antibiotics using the prophylactic antibiotic dosing table embedded within the EMR (Klinger et al., 2011)	
Nutrition evaluation and treatment	Prealbumin and vitamin D screening Referrals to pediatric gastroenterology and nutritionist prior to elective surgery, if prealbumin >16 mg/dl or vitamin D <30 ng/ml. Deficiencies treated prior to surgery	No nutrition lab values are drawn if BMI is normal using CDC BMI calculator
Antiseptic skin cleansing	2% CHG wipes the night before AND day of surgery (Edmiston, Okoli, Graham, Sinski, & Seabrook, 2010)	2% CHG wipes the day of surgery (Darouiche et al., 2010)
Staphylococcus aureus screening and/or decolonization	Preoperative povidone–iodine nasal antiseptic swabs postinduction by the anesthesiologist regardless of MRSA cultures (Bode et al., 2010)	
Warming	Prewarming the operating room to a minimum of 75°F prior to the patient's entry (Blanchard, 2009)	
	All spine surgery patients prewarmed with BAIR huggers Other high-risk patients prewarmed using warming blankets, thermal gowns, and thermal hats	Prewarm using warming blankets, thermal gowns, and thermal hats (Torossian, 2008)
Urinary catheter	Discontinue urinary catheter within 24–48 hours postoperative per hospital guideline, unless otherwise justified	
Wound dressing	Standardized intraoperative application of wound dressing	
Blood transfusion	Discussion with attending physician prior to blood transfusion intra-/postoperatively	
MRSA surveillance	Active MRSA surveillance where there is a history of MRSA, e.g., those residing in group home/institution	
Antibiotics	Bone graft antibiotics for spine surgery using doses recommended by an infectious disease consult (Mangram et al., 1999)	

Note. BMI = body mass index; CDC = Centers for Disease Control and Prevention; CHG = chlorhexidine gluconate; EMR = electronic medical record; MRSA = methicillin-resistant *Staphylococcus aureus*.

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University of Rochester Medical Center
Prophylactic Antibiotics For Neonatal/Pediatric Surgery

General Considerations

- Not all procedures require antibiotic prophylaxis. (For example, typically not required for clean procedures).
- Antibiotics must be started within 60 minutes before surgery (120 minutes for vancomycin or ciprofloxacin) and at least 50% should be infused prior to incision.
- Intraoperative redosing may be required for long cases(>2h); see table.
- Antibiotics during the operation can prevent infections. Extending antibiotics beyond 24 hours after surgery is of no benefit. Exception is heart transplant and ventricular assist device prophylaxis.
- These antibiotics represent reasonable but not exclusive choices for surgical prophylaxis. Other antibiotic choices should be predicated by current or prior antibiotic therapies.

Neonatal (< 72 hours of age) Prophylactic Antibiotic Regimens

All Major Procedures: ampicillin + gentamicin

Neonatal (> 72 hours of age) & Pediatric Prophylactic Antibiotic Regimens

(Prophylaxis targeted to colonizing/nosocomial organisms and operative site)

Surgery	Recommended Regimen	Alternative Regimen	Notes
Cardiac Surgery			
	CeFAZolin	CeFAZolin + Vancomycin (if MRSA known/likely)	If severe penicillin or known cephalosporin allergy, use Vancomycin + Gentamicin
Gastrointestinal Procedures			
Esophageal, Gastroduodenal, Hernia Repair, Biliary Tract, PEG Tube Placement, Cholecystectomy (High Risk)[1]	CeFAZolin	CeFAZolin + Vancomycin (if MRSA known/likely)	Not needed for elective cholecystectomy
Colorectal	One of the following: 1) CefOXitin +/- gentamicin[2] 2) (For High Risk Only) Gentamicin + MetroNIDAZOLE +/- Ampicillin	1) Meropenem	24 hours of coverage is enough
Hind Gut Surgery – High Risk[2]	CefOXitin + / - Gentamicin[2]		
Appendectomy (Interval) for acute appendicitis	One of the following: 1) CefOXitin 2) (For High Risk Only) Gentamicin + MetroNIDAZOLE +/- Ampicillin	1) Meropenem	If ruptured, see "Ruptured Viscus"
Ruptured Viscus	Treat as complicated intraabdominal infection		

Figure 1. University of Rochester Medical Center prophylactic antibiotics for neonatal/pediatric surgery. MRSA = methicillin-resistant *Staphylococcus aureus*; PEG = percutaneous endoscopic gastrostomy. (Courtesy of University of Rochester Medical Center, Rochester, NY.)

Surgery	Recommended Regimen	Alternative Regimen	Notes
Head & Neck Procedures			
Clean-Contaminated	CeFAZolin	CeFAZolin + Vancomycin (if MRSA known/likely)	Some prefer clindamycin + gentamicin
Neurosurgery			
Laminectomy, Craniotomy	CeFAZolin	CeFAZolin + Vancomycin (if MRSA known/likely)	Optional for laminectomy
Obstetrics & Gynecology			
Abdominal/Vaginal Hysterectomy	One of the following: 1) Cefazolin + Metronidazole 2) Cefoxitin 3) Ampicillin/Sulbactam	One of the following: 1) Clindamycin + either: Gentamicin, Ciprofloxacin, or Aztreonam 2) Metronidazole + either: Gentamicin or Ciprofloxacin	Single dose
Orthopedic			
Clean Orthopedic Surgery	CeFAZolin	CeFAZolin + Vancomycin (if MRSA known/likely)	With or Without Implants; Not needed for arthroscopy
Plastic Surgery			
Implants & complex reconstructions, mesh	CeFAZolin	CeFAZolin + Vancomycin (if MRSA known/likely)	Not required in most cases
Radical Prostatectomy	CeFAZolin	CeFAZolin + Vancomycin (if MRSA known/likely)	
Urological Procedures			
Clean, Clean-contaminated with entry into genital and urinary tract only	CeFAZolin	CeFAZolin + Vancomycin (if MRSA known/likely)	Add gentamicin for prosthetic material
Clean-contaminated – Other	One of the following: 1) CefOXitin 2) (For High Risk Only) A. Gentamicin + MetroNIDAZOLE +/- Ampicillin B. Gentamicin + Clindamycin +/- Ampicillin	One of the following: 1) CefOXitin + / - Gentamicin 2) Meropenem	Alternative - Ciprofloxacin
Vascular Surgery			
Vascular surgery, Dialysis access procedures	CeFAZolin	CeFAZolin + Vancomycin (if MRSA known/likely)	If severe penicillin or known cephalosporin allergy, use Vancomycin

[1]High risk Cholecystectomy: acute cholecystitis, obstructive jaundice, common duct stone

[2]High risk Hind Gut or Colorectal Surgery: add gentamicin for hind gut or colorectal surgery that meets one of the following criteria: > 2 weeks from prior hind gut surgery, repeat hind gut surgery that includes a complete/partial bowel obstruction, repeat hind gut surgery expected to last > 3 hours, OR have a planned insertion of mesh during hind gut surgery

FIGURE 1. Continued.

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Neonatal/Pediatric Perioperative Dosing Chart

DRUG	DOSE	REDOSE (Hours)*	
		Routine	Large Blood Loss
Ampicillin	**50 mg/kg** Max Single Dose: 2000 mg	≤ 14 days age: 4 All others ages: 2	≤ 14 days age: 3 All others ages: 2
CeFAZolin (Ancef)	**30 mg/kg** Max Single Dose: 2000 mg	All ages: 4	All ages: 2
CefOXitin (Mefoxin)	**40 mg/kg** Max Single Dose: 2000 mg	All ages: 2	All ages: 2
Ciprofloxacin	**10 mg/kg** Max Single Dose: 400 mg	No Redose	No Redose
Clindamycin	**10 mg/kg** Max Single Dose: 900 mg	All ages: 6	All ages: 4
Gentamicin	Age < 1 month: **4 mg/kg** Age > 1 month: **5 mg/kg**	No Redose	No Redose
Meropenem	**20 mg/kg** Max Single Dose: 1000 mg	≤ 3 months age: 4 All other ages: 3	≤ 3 months age: 4 All other ages: 2
Metronidazole	**15 mg/kg*** *(Neonate<1.2kg weight: 7.5mg/kg) Max Single Dose: 500 mg	No Redose	No Redose
Vancomycin	**15 mg/kg** Max Single Dose: 1500 mg	All ages: 8	All ages: 6

* Redosing recommendations are for patients with normal renal function.

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FIGURE 1. Continued.

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Approval History:
Antibiotic Subcommittee: September 2014
Therapeutics Committee: September 2014

Guidelines are intended to be flexible. They serve as reference points or recommendations, not rigid criteria. Guidelines should be followed in
most cases, but there is an understanding that, depending upon the patient, the setting, the circumstances, or other factors, guidelines can and
should be tailored to fit individual needs.

Figure 1. Continued.

the preanesthesia, pediatric orthopaedic operating room, and pediatric floor; during audit presentations, staff discussed factors contributing to the compliance score and changes that might be made to improve low scores.

In examining the audit findings, areas of overall strength (100% compliance) included preoperative antibiotic selection and timing, use of vancomycin for all patients screening positive for MRSA in the preoperative visit, the use of nasal swaps in the operative room, and the standardized wound dressing application. Anesthesia and nursing staff used the nasal swabs with patients who tested MRSA positive. The swabs are easy to use and were used after the patient was already induced with anesthesia. The preoperative MRSA screening allowed the surgeon and anesthesia attending staff to determine whether the patient needed vancomycin instead of cefazolin. Vancomycin requires a 2-hour administration time, so it does create some logistical issues that are not present with cefazolin. To facilitate this administration, a peripherally inserted central catheter-certified nurse was available the morning of surgery for those patients who were MRSA positive so that a line could be placed before going to the operating room. This line placement allowed staff to initiate the vancomycin early, thereby preventing drug reactions caused by vancomycin infusing too quickly.

The audit identified several areas for improvement. The documentation of chlorhexidine gluconate (CHG) wipes the night before surgery and the day of surgery along with the temperature of the patient in the operating room were not at 100% compliance. Use of CHG wipes the night before surgery is not something in direct control of the staff: Clinic staff provide the wipes to parents along with oral and written instructions on the importance and approach to using the wipes. Instructions are written at a seventh-grade reading level and are also available in Spanish. We also give parents a paper copy of the CDC SSI FAQ sheet that explains the ways to prevent infections (https://www.cdc.gov/HAI/pdfs/ssi/SSI_tagged.pdf). It was difficult to ensure that parents used the CHG wipes the night before surgery and monitoring, of course, involved self-report of completion. We have requested a standardized place in the EMR to document CHG wipe use.

Prevention of hypothermia in the high-risk patient remains an ongoing challenge. We are working closely with the operating room staff to get patient intraoperative temperature above 36°C by reporting compliance back to the operating room quality improvement committee. This is a complex issue because staff find the requirement of room warming to 24°C (75°F) to be personally uncomfortable. Moreover, staff must wear lead aprons to reduce radiation exposure when frequent x-ray films are required; the lead aprons tend to increase body temperature. The project has increased awareness of the importance of patient and operating room temperature control, and there have been more directed efforts to keep the operating room at the recommended 75°F (Blanchard, 2009).

Our efforts to implement and audit bundle compliance were instrumental in achieving our overall aim of no SSIs in 2015. The SSI rate since bundle implementation can be seen in Figure 4. The SSI rate dropped from a baseline of 4% in 2013 (n = 154) to 3.2% in 2014 (n = 3.2) and to 0.0% in 2015 (n = 198) after implementation of the new bundle plan. Our next steps will include celebration with the providers and staff over the reduction in SSIs, with ongoing transparent reporting of run charts distributed to staff.

Lessons Learned

Key elements to our success included the interdisciplinary approach and the routine auditing and monthly analysis of bundle compliance and SSI rates. The monthly multidisciplinary care team meetings were scheduled at a time of day that worked well for all members of the team; meetings featured presentations from four to five team members focusing on presentation of evidence or audit data. After each meeting, minutes, along with bundle compliance data, were circulated to all involved staff members. Another lesson learned was that each member of our team needed to be actively involved in the rollout to obtain buy-in from the multiple disciplines. The physician and nursing staff shared the workload of data collection, literature, and education of staff. We expect to hold the gains and keep our SSI rate as close to zero as possible by continuing to audit and report results back to staff.

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QA CASE REVIEW FORM

CONFIDENTIAL QA MATERIAL

Patient Name (Last, First):	**Hospital MR#:**
Age:	

Directions:

1. Review to be completed by peer(s), not the individual(s) involved in the care of the patient. Summarize statements, do not use direct quotes.
2. Complete each section.
3. For thorough review, please consider cues/prompts provided. Always include enough information for an outside reviewer to understand the event and the conclusions that were drawn.
4. Submit completed review, via e-mail, to designated SMH QA Office representative within 30 days of the review, or sooner upon request.
5. File copies of review in department QA file and provider's department file (e.g. physician profile).

Comprehensive review performed by: __ Individual (not the practitioner) **X** Committee (2 or more individuals)

OR Information

Surgery Date:	MRSA Screening Pre-op (y/n):
Date Infection Identified:	Pre-op Nutrition Labs (y/n):
Surgeon:	Pre-op Nutrition Labs Normal (y/.n)
Surgery Resident:	CHG Wipes at Home (y/n):
Operating Room:	CHG Bath Pre-op (y/n):
Anesthesiologist:	Hair Removal (y/n):
Anesthesia Resident:	Flash Autoclaving (y/n):
Scrub Nurse:	
Circulating Nurse:	Highest Glucose:
Total Length of Procedure:	Skin Prep Used:
Blood Loss (cc's):	ID Consult Date:
ASA Classification:	
SSI Type:	
Wound Classification:	

Temperature Monitoring	**Antibiotic Information:**
OR Temp at Start of Case:	Antibiotic Given:
Patient Temp Entering OR:	Time(s) Antibiotic Given:
Average of All Temps:	Correct Antibiotic Choice (y/n)
Temp Leaving OR:	Correct Antibiotic Timing (y/n)
	Correct Redosing of Antibiotic (y/n)

Synopsis:

Consider the following: Patient History, Presenting Symptoms, and Plan of Care. If patient underwent a procedure, what were the indications for the procedure? Details on SSI. Was this an adverse/unexpected outcome? If so, what is the usual risk for the adverse/unexpected outcome? Was the pt. at increased risk for this outcome? Were alternatives considered? What interventions were taken to mitigate potential adverse outcomes? Were there any technical difficulties? Was the pt. /family dissatisfied with the care If so, were reasonable expectations for outcome communicated? Was communication between disciplines/providers and pt. /family timely, coordinated and consistent?

FIGURE 2. University of Rochester Medical Center QA case review form. ABX = antibiotic; CHG = chlorhexidine gluconate; MRSA = methicillin-resistant *Staphylococcus aureus*; PI = povidone–iodine. (Courtesy of University of Rochester Medical Center, Rochester, NY.)

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QA CASE REVIEW FORM

CONFIDENTIAL QA MATERIAL

Patient Name (Last, First): **Hospital MR#:**
Age:

Conclusions, Analysis and Rationale:

Consider the following when analyzing this case and drawing conclusions. **Policies and procedures:** In place? Followed?
Environment/Equipment/Supplies: Physical space appropriate? Equipment/supplies available, used and functioning as expected?
Human Issues: Proper qualifications? Appropriate staffing? Human error a contributing factor? **Information/Communication Issues:** Necessary information available, accurate, complete, clear? Delays or omissions of care? Communication was without barriers? Communication among participants (care providers and/or patient/family members) effective?

Response to questions as per Patient Relations or Interdepartmental Quality Review Referral.
(you may copy/paste questions from the referral form here)

Did the quality of care and services meet generally accepted standards of clinical practice? **(required for all reviews)**

_ Yes, no action needed
_ Yes, with room for improvement
_ No, attributable to systems
_ No, attributable to an individual practitioner
_ No, attributable to team.

Were opportunities for improvement identified? **__Yes** **__No**
If yes, specify/explain:

What recommendations/actions have taken place to prevent a similar occurrence in the future?
(check all that apply; provide details below)

___ no action
___ a change in policy
___ formal education or reeducation
___ discipline taken
___ audit/data collection and analysis
___ a process improvement
___ refer to other council/committee (use referral form)
___ root cause analysis
___ Other (please explain):

Please describe actions taken:

REVIEW DATE: **PREPARED BY:**

PEER REVIEWER: **PEER REVIEWER SIGNATURE:**

FIGURE 2. Continued.

Preoperative	Mo 1	Mo 2	Mo 3	Mo 4	Mo 5	Mo 6	Mo 7
o Documentation of CHG wipes and instructions SSI prevention and understanding	67% N=9	88% N=8	100% N=7	100% N=8	100% N=2	100% N=8	93% N=14
o MRSA screening for high risk patients	100% N=9	100% N=8	100% N=7	100% N=8	100% N=2	100% N=8	100% N=14
o Nutrition screening—labs documented pre-op	100% N=2	100% N=2	100% N=1	100% N=4	100% N=1	100% N=3	100% N=7
o CHG wipes night before surgery	56% N=9	63% N=8	71% N=7	ND	ND	25% N=8 Only 2 document	7% N=14 Only 1 documented
PreAn/ Holding							
o CHG wipes day of surgery	100% N=9	100% N=8	71% N=7	75% N=8	50% N=2	88% N=8	92% N=12
o Pt normothermic pre-op	100% N=9	100% N=8	100% N=7	100% N=8	100% N=2	88% N=8	100% N=13
o Bair Hugger for spine cases	75% N=4	100% N=4	100% N=2	50% N=2	100% N=2	33% N=6	0% N=5 No documentation
Intraoperative							
o 5% PI nasal antiseptic	22% N=9	63% N=8	57% N=7	88% N=8	100% N=2	100% N=8	7% N=14 1 documented
o Appropriate prophylactic antibiotic ordered	100% N=9	100% N=8	100% N=7	100% N=8	100% N=2	100% N=8	100% N=14
o ABX given 1h prior to incision	100% N=9	100% N=8	100% N=7	100% N=8	100% N=2	100% N=8	100% N=14
o Vanco within2H	100% N=1	N/A	N/A	N/A	N/A	0% N=1 Rm delay	N/A
o Redose ABX	100% N=6	100% N=5	100% N=3	100% N=3	100% N=2	100% N=5	100% N=5
o Bone Graft ABX	100% N=2	100% N=5	100% N=2	100% N=5	100% N=2	100% N=6	100% N=2
o Standard skin prep	100% N=9	100% N=8	100% N=7	100% N=8	100% N=2	100% N=8	100% N=14
o Betadine irrigation	100% N=6	100% N=6	100% N=2	100% N=6	100% N=2	100% N=4	100% N=3
o Pt. temp ≥ 36.0	56% N=9	75% N=8	71% N=7	75% N=8	50% N=2	50% N=4	29% N=14
o Discontinue ABX within 24h	100% N=8	100% N=7	100% N=7	100% N=8	100% N=3	100% N=8	100% N=14
o Discontinue foley within 48h	100% N=6	100% N=5	67% N=3	100% N=6	100% N=3	100% N=6	92% N=12
o Communication prior to blood transfusion	100% N=3	100% N=1	100% N=1	50% N=2	100% N=2	100% N=1	0% N=1 No documentation
Average monthly compliance	88%	92%	90%	91%	91%	85%	75%

FIGURE 3. Pediatric orthopaedic high-risk audit tool.

We found that the bundle development and the rollout process took longer than we anticipated. Once we had our draft bundle developed, it took multiple meetings and approvals from numerous people. Having supportive leadership that was committed to the process and outcome helped speed up the process, but we should have built into the process more time for discussion and approvals with stakeholders. Another time-consuming component was the process of getting new products into the system and workflow, as the bundle rollout required use of new supplies (CHG wipes and nasal antiseptic swabs).

Conclusion

The implementation of a care bundle systematized evidence-based practices to reduce SSIs. The multidisciplinary care team approach of monthly reviews of clinical audit data helps ensure consistent attention to bundle implementation and rapid-cycle improvement to address gaps in implementation. The NSQIP benchmarking information provides feedback to the team that allows for comparison with baseline and with other surgical hospital and participating facilities.

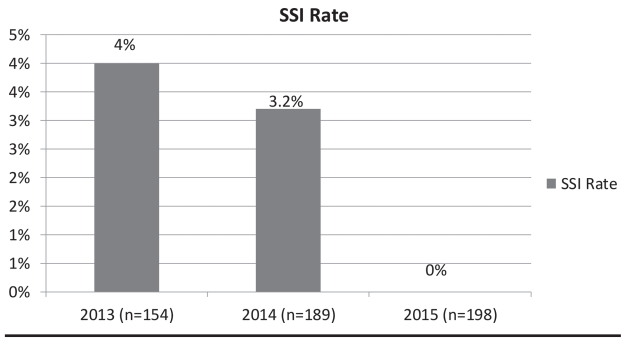

FIGURE 4. Pediatric orthopaedic SSI 2013–2015. SSI = surgical site infection.

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