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Brief report

Influence of a total joint infection control bundle on surgical site infection rates

Lori Fornwalt RN, CIC [a], David Ennis MD [a], Mark Stibich PhD [b,*]

[a] Trinity Medical Center, Birmingham, AL
[b] Xenex Disinfection Services, San Antonio, TX

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Quality improvement initiatives combined with pulsed xenon ultraviolet room disinfection were implemented to reduce surgical site infections (SSIs) in patients undergoing total joint procedures. After 12 months, knee SSIs were reduced from 4 to 0 ($P = .03$) and hip SSIs were reduced from 3 to 0 ($P = .15$) for a combined prevention of 7 SSIs ($P = .01$) and a savings of $290,990.

Orthopedic surgical site infections (SSIs) from total knee or hip procedures are associated with a 3% rate of mortality[1] and an additional cost of care of $20,785.[2] Although Trinity Medical Center (www.trinitymedicalonline.com) SSI rates were already below the national average in 2012, facility leadership introduced the multiple interventions described below to reduce SSIs still further in 2013.

Trinity Medical Center is a 534-bed community health care provider that employs 200 professionals to serve Birmingham, Alabama, with inpatient, outpatient, diagnostic, surgical, and emergency services.

Best practices for perioperative care are well documented.[1] Surface contamination in operating rooms can contaminate hands, instruments, and wounds, often through organisms becoming airborne during surgery.[3-5] Studies show that pulsed xenon ultraviolet (PX-UV) light reduces microbial burden,[6,7] so enhanced surface disinfection incorporating PX-UV was additionally deployed. Use of PX-UV is reported to have reduced hospital-acquired infection rates of *Clostridrium difficile*, methicillin-resistant *Staphylococcus aureus* (MRSA), and multiple drug-resistant organisms within acute-care settings by 57%, 53%, and 20%, respectively.[8-10] We report our experience of a change in SSI rates after combining PX-UV with quality improvement interventions.

METHODS

Two approaches were combined to reduce total joint SSIs: quality improvement and no-touch environment disinfection.

Quality improvement

The orthopedic wing was renovated and dedicated to total joint procedures only. Quality interventions were unified under a theme of promoting team spirit among both staff and patients. Stages of patient care were described as moving a ball into the end zone in football. Stages were preoperative classes, preoperative screening, and decolonization for MRSA/methicillin-sensitive *S aureus*, 2 preoperative showers with chlorhexidine gluconate, skin cleansing with chlorhexidine gluconate immediately before surgery, standardized perioperative order sets, and early ambulation on the day of surgery when possible (Table 1). Stages were monitored and quantified when possible.

No-touch environment disinfection

Operating rooms were disinfected nightly using PX-UV. The PX-UV device (Xenex Healthcare Services, LLC, San Antonio, Tex) consists of a single bulb that produces a full spectrum (200-280 nm) ultraviolet C pulse from 505 J electrical energy.[6] The device was operated for between 5 and 10 minutes in each of multiple positions selected to cover each operating room. Internal research demonstrated a 65.3% reduction in bacterial load after PX-UV disinfection compared with previous standard terminal cleaning. Upon discharge, patient rooms were also terminally cleaned and

* Address correspondence to Mark Andrew Stibich, PhD, Xenex Disinfection Services, 121 Interpark, Suite 104, San Antonio, TX 78216.
E-mail address: stibich@gmail.com (M. Stibich).

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Table 1
Quality improvement changes

2012	2013
• Catheters discontinued on unit within 24 h	• Catheters discontinued in postanesthesia care unit
• Zero nurses were certified in orthopedics	• More than 50% of orthopedics nurses passed orthopedics certification
• No safety huddles	• Safety huddles twice daily (1/shift) to discuss patients
• Patients were dangled off the side of bed the day of surgery	• Patients begin assisted ambulation the day of surgery. On postoperative day 2, they get up and stay up all day. They are not allowed to get back into bed unless medically necessary
• 35% of total-hip patients and 46% of total-knee patients attend preoperative education sessions	• After initiation of the formal total-joint program, highly organized preoperative education classes with recording were started and 63% of total-hip patients and 66% total-knee patients completed preoperative education
• No coach	• Each patient is assigned a coach who is a family member/significant other. The coach stays with the patient during the hospital stay and wears a coach T-shirt. The patient is given a football squeezy to help with stress and pain
• No incentive to ambulate early	• The coach mirrors the number of steps the patient takes. For each step, the patient gets to move his or her football-helmet icon on a bulletin board that resembles a football field. The patient has to walk to the board to move the helmet
• No anterior approach hip procedures	• Started performing anterior approach total hip procedures
• Patients ate meals in their room and were not part of a group	• Patients do not eat in their room. In the new structural design for the total-joint program, all patients eat in the dining room with their coaches and with other patients in their group
• Procedures scheduled each day of the week	• Procedures scheduled 2 or 3 times/wk. Patients grouped by surgery day
• Length of stay: 3 d	• Length of stay 2.8 d*
• Silver-impregnated dressing	• Continue silver-impregnated dressing
• No preoperative methicillin-resistant *Staphylococcus aureus* decolonization	• Preoperative methicillin-resistant *S aureus*/methicillin-sensitive *S aureus* testing with decolonization if methicillin-resistant *S aureus* positive

*Approximate (this is being verified).

Table 2
Comparison of pre- and postintervention surgical site infection rates for total-hip and total-knee procedures

Type	Year	Incidence	No. of cases	Rate	*P* value
Total hip (pre)	2012	4	200	0.0200	.033
Total hip (post)	2013	0	191	0	
Total knee (pre)	2012	3	344	0.0087	.149
Total knee (post)	2013	0	394	0	
Combined (pre)	2012	7	544	0.0129	.015
Combined (post)	2013	0	585	0	

additionally disinfected using the PX-UV device. Compliance with the PX-UV disinfection regimen was evaluated using the onboard data log.

RESULTS

Both components of the intervention were implemented fully by January 1, 2013. Patients before (2012) and after (2013) implementation did not differ in terms of age and MRSA score and surgeons and seniority of nursing staff remained constant over the 2 years. Except for the interventions introduced, antibiotic treatment and wound dressings also remained constant. The average American Society of Anesthesiologists risk score for patients undergoing total-knee and total-hip procedure in 2012 and 2013 were 2.56 and 2.60, respectively.

Before full implementation, 4 SSIs were reported from 200 total-hip procedures (rate = 0.02) and 3 SSIs were reported from 191 total-knee procedures (rate = 0.0087) (Table 2); in sum, 7 infections from 544 procedures (rate = 0.0129). After full implementation, no SSIs were reported from either 191 total-hip procedures or 394 total-knee procedures (585 procedures). Using a rank sum test, *P* values on these changes were .033 (hips), .149 (knees), and .015 (combined).

DISCUSSION

SSIs from total-hip and total-knee procedures were effectively eliminated following adoption of the combined interventions. Hence, a combination of renovation, consolidation of procedures, quality improvement, and no-touch disinfection seems to have made a substantial improvement in patient safety.

Using reported SSI costs[2] and mortality[1] data, this intervention may have prevented 7 infections, averted 1 death, and saved $290,990 over the 12 months studied. The practices introduced in 2013 have been continued to date with 1 infection occurring in 493 procedures in from January to June 2015 (rate = 0.002).

Although this was not a controlled clinical trial, retrospective investigation of hospital records for risk factors for SSIs other than those addressed by the interventions did not yield an obvious confounder.

This study is unable to assess the influence on SSI rates of the individual components of the program. This was neither the design nor possible from the low number of events. Regardless, the overall cost of implementing the combined interventions was less than the estimated cost of the 7 SSIs that were prevented. Therefore, implementation of a similar combination of interventions and further investigations to maximize patient safety in total-joint procedures seems a logical recommendation.

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