Can surgical site infections be reduced with the adoption of a bundle of simultaneous initiatives? The use of NSQIP incidence data to follow multiple quality improvement interventions

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SUMMARY

Surgical site infections (SSI) are a common complication after surgical procedures. To reduce the incidence of SSIs, Oakville Trafalgar Memorial Hospital decided to institute a bundle of initiatives to change multiple factors simultaneously based on best available evidence and the understanding of infection pathophysiology. We used National Surgical Quality Improvement Program data on the incidence of SSIs in our targeted and essentials, general surgery and orthopedic surgery cases before and after the implementation of an SSI reduction bundle. This article discusses whether the use of intervention bundles may assist in the reduction of a variety of postoperative surgical complications.

Surgical site infections (SSIs) are a common complication after surgical procedures and have substantial associated health care costs.[1] The SSI bundle — simultaneous implementation of a variety of quality improvements — has proven successful at reducing the rate of postoperative SSIs in a number of institutions.[2,3] Oakville Trafalgar Memorial Hospital, a 469-bed facility in Oakville, Ont., instituted an SSI bundle in October 2015 based on best available evidence and the understanding of infection pathophysiology.

The National Surgical Quality Improvement Program (NSQIP) was introduced by the American College of Surgeons in 2001 and was the first nationally validated, risk-adjusted outcomes–based program designed to measure and improve the quality of surgical care in the United States.[4] Dr. Timothy Jackson, surgical lead at Health Quality Ontario and a general surgeon at the University Health Network introduced this program in Toronto in 2010. We used the NSQIP procedure-targeted option and essentials option, collecting 1680 cases per year from our departments of general surgery (colectomy, ventral hernia, appendectomy) and orthopedic surgery (total knee and total hip arthroplasties, hip fractures) to assess data to help focus quality-improvement efforts. We collected data for the 6 months before implementation of the SSI bundle (April to September 2015), during which the bundle was developed. After implementing the bundle we continued our data collection for 6 months (October 2015 to March 2016).

OUR BUNDLE

The following quality-improvement measures were implemented simultaneously in order to reduce the rate of SSIs at our institution.

- Preoperative shower (chlorhexidine gluconate 4%)
- Preoperative mechanical bowel preparation (sodium picosulfate, magnesium oxide, and citric acid) and oral antibiotics (2 g of neomycin and 2 g of metronidazole) taken at 7 pm and 9 pm, respectively, the evening before colon resection

- Hair clipping, if needed, to be done outside the operating room (OR)
- No routine performance of open appendectomy (laparoscopic appendectomy preferred)
- Preoperative antibiotics (e.g., 2 g of cefazolin, 3 g if the patient weighs more than 120 kg, and redose if the surgery is longer than 4 h)
- Proper preoperative skin preparation and technique
- Double gloving and changing outer gloves every 60 minutes
- Use of fascial wound protector
- Closing bundle and glove change, with extensive pressurized wound irrigation for laparotomies
- Education on minimizing OR traffic
- Skin dressing changes as needed, and daily after 48 h

The interventions

Preoperative showering with soap or specialized antiseptic solutions, such as chlorhexidine gluconate, has been shown to reduce the risk of SSIs. We developed a preoperative instruction sheet (Appendix 1, available at canjsurg.ca/006417-a1).

Mechanical bowel preparations combined with oral antibiotics have been shown to reduce SSIs in patients who undergo colonic resection.[5] We instituted preoperative bowel preparation with sodium picosulfate, magnesium oxide, and citric acid combined with 2 g of neomycin and 2 g of metronidazole administered at 7 pm and 9 pm, respectively, the evening before the procedure.

To reduce particulate dispersion in the OR, we moved hair clipping, in cases where it is required, from the OR to a dedicated clipping zone.

Laparoscopic appendectomy is associated with a significantly decreased risk of SSI compared with open appendectomy. At our institution only 1 surgeon out of 7 routinely performed open appendectomies before institution of the SSI bundle, and when presented with this information, he switched to the laparoscopic approach.

The latest recommendations for preoperative prophylactic antibiotics for SSI reduction suggest the routine use of 2 g of cefazolin, (3 g in patients who weigh more than 120 kg), with redosing for surgical procedures lasting longer than 4 h.

Skin preparation protocols varied at our institution, and we switched to single-use sponges presoaked with a measured quantity of 2% chlorhexidine gluconate and 70% isopropyl alcohol with a standardized method (Appendix 1).

Surgical glove perforation exposes patients to the skin flora of operating personnel and exposes operating personnel to the patient's bloodborne pathogens. Double gloving has been instituted as routine policy at our institution.

The fascial wound protector has been postulated as a mechanism to reduce subcutaneous fatty tissue and fascial exposure to skin flora and intraluminal gastrointestinal flora (Fig. 1). For laparotomies we have recommended the routine use of an inexpensive bowel bag (e.g., Vi-Drape Isolation Bag, Cardinal Health), which can be easily turned into a fascial wound protector by cutting off the bottom. We have recently started using the Alexis O retractor (Applied Medical).

The gloves and the instruments used in a case can be exposed to skin flora or gastrointestinal organisms. At the end of a laparotomy we have instituted the use of closing trays (Fig. 2), and for laparotomies we use the Pulseavac Plus (Zimmer Biomet) battery-powered, pressurized irrigation system to irrigate the subcutaneous fatty tissue.

Modern OR laminar airflow systems are designed to reduce particulate density at the level of the OR table. We have instituted an educational campaign and appropriate signage (Fig. 3) so that personnel enter ORs through the central sterile core when cases are underway.

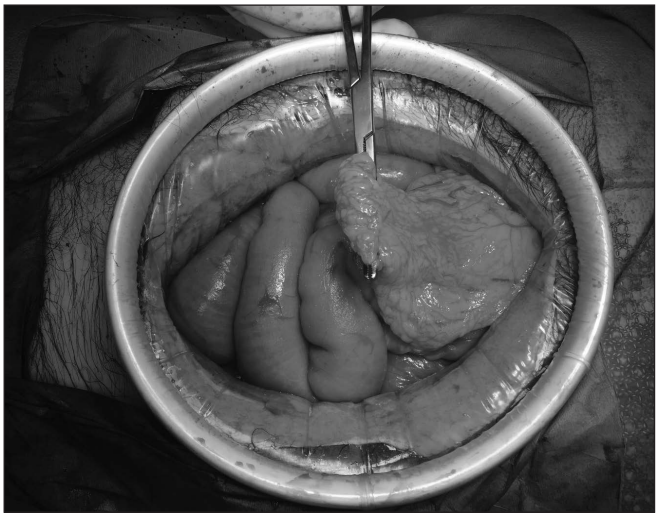

Fig. 1: Fascial wound protector.

Fig. 2: Closing tray.

Fig. 3: Signage minimizing operating room traffic.

Table 1. All case SSI rates at Oakville-Trafalgar Memorial Hospital

SSI rate, no. (%)	Prebundle* n = 828	Postbundle† n = 844	p value
Overall	28 (3.4)	9 (1.0)	0.001
Superficial	17 (2.1)	6 (0.7)	0.021
Deep incisional	5 (0.6)	2 (0.2)	0.29
Organ/space	6 (0.7)	1 (0.1)	0.07

SSI = surgical site infection.
*April to September 2015.
†October 2015 to March 2016.

Results

In the 6-month preintervention period of April to September 2015, our overall SSI rate was 3.4% (28 of 828 cases). With the introduction of our SSI bundle, the overall SSI rate dropped to 1.0% (9 of 844 cases, p = 0.001; Table 1)

Traditional methods of patient care can be very difficult to change. We adapted the Johns Hopkins Comprehensive Unit-Based Safety Program model to create our surgical quality initiative team (SQUINT), with a core group that meets every 2 weeks and a larger group that includes representatives from the emergency department, surgical wards, OR, anesthesiology, general surgery, orthopedic surgery, urology and surgical administration that meets monthly. Regular communication and an openness to bidirectional learning have allowed the rapid implementation of multiple changes.

Conclusion

It can be difficult to have a study adequately powered to show improvements in outcomes for some interventions. Consequently, the bundle approach with the simultaneous implementation of multiple measures based on best practices, available studies and the understanding of disease pathophysiology has been recommended to improve complication rates, despite the lack of overwhelming and convincing evidence of individual efficacy. It is quite possible that a synergistic effect occurs when these multiple low-impact interventions are combined.

The NSQIP-ON collaborative allows the sharing of information and quality-improvement measures to allow all participants access to each other's insights, regardless of success.

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Competing interests: None declared.

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