Surgical Site Infection Prevention in 2018 and Beyond

Sue Barnes, BSN, RN, CIC, FAPIC

There has never been greater focus on infection prevention than in today's health care system as a result of pay-for-performance programs, nonreimbursement policies, and mandatory reporting of health care–associated infections (HAIs). In part, this heightened attention has been generated by a demand from patient advocacy and consumer organizations for improved patient safety.[1]

The majority of states in this country now have laws or regulations requiring public reporting of HAIs.[2] For almost a decade, the care necessitated to treat many of these infections has not been reimbursed by the Centers for Medicare & Medicaid Services. A different approach has been adopted by private insurers with pay-for-performance or value-based purchasing programs. Both types of programs are designed to incentivize safer care, either with financial rewards for meeting certain performance measures or with penalties for poor outcomes, such as HAIs.[3] At the same time, a variety of national collaborative infection prevention (IP) initiatives have been undertaken. Unfortunately, many of the proposed practice improvements in the IP initiatives are often ineffective in producing improved outcomes because they are not executed well or sustainable (eg, staff member hand hygiene compliance).[4] In addition, the pay-for-performance and value-based purchasing programs are not consistently effective. Authors from the Harvard and Stanford University Business Schools have reported that the penalties have had a negative effect by increasing the incidence of hospital up-coding, possibly unintentionally (ie, a provider bills a health insurance payer using a Current Procedural Terminology [CPT] code for a more expensive service than was performed) to collect greater reimbursement.[5]

The Centers for Disease Control and Prevention's (CDC's) 2013 National HAI Progress Report does reflect significant reductions at the national level for nearly all types of HAIs. However, the report concludes with

> *Despite progress, more action is needed at every level of public health and health care to eliminate infections that commonly threaten hospital patients.*[6]

There remains significant opportunity for innovative, evidence-based, sustainable strategies to reduce the risk and rate of HAIs.

EFFECT OF SURGICAL SITE INFECTIONS

Of all the HAIs in the United States, surgical site infections (SSIs) are the most common and costly, accounting for 20% of all HAIs, with an estimated annual national cost of $3 to $5 billion.[7] That estimate accounts for only those patients who survive. It is important to note that SSIs are associated with a two- to elevenfold increased risk of mortality.[8]

As the number and complexity of procedures in both inpatient and outpatient facilities continue to increase, the infection risk increases in parallel. From 1992 to 2012, the total number of inpatient surgeries in the United States increased by 17% to approximately 26.8 million and outpatient surgeries increased by 10% to approximately 17.3 million.[9] As an example of increasing procedural

http://doi.org/10.1002/aorn.12144

complexity, a number of surgical procedure types have integrated the use of robotic-assisted systems. Although this innovation has been introduced to improve outcomes, the procedures involve extremely complex, difficult-to-clean instrumentation, which increases the risk of retained bioburden on instruments and associated surgical wound contamination risk. In some cases, robotic procedures have been reported to increase costs and complications, including infection.[10]

SSI PREVENTION EFFORTS

The CDC estimates that 50% of all SSIs are preventable.[11] Surgical site infection prevention is the responsibility of both the patient and the health care providers. For the patient, smoking cessation, blood glucose control, and weight loss are important SSI prevention measures. For health care providers, there are myriad products and practices designed to help prevent SSIs. As procedures become more complex and numerous and are performed in a variety of settings, the approach to reducing SSI risk must continue to expand and evolve. Practice must keep pace with rapidly evolving products and practices designed to reduce SSI risk, and must be guided by the quality of supporting evidence.

Numerous national IP initiatives are dedicated to reducing SSI risk, including The Joint Commission Surgical Care Improvement Project (SCIP) and National Patient Safety Goals. The introduction of SCIP IP measures initially resulted in reduced surgical infection rates, but that effect has since leveled off. Furthermore, one element of SCIP is venous thromboembolism prophylaxis, which has been reported to increase the risk of postoperative infection.[12] Experts have recommended that the focus should now be placed on additional evidence-based strategies that go beyond SCIP recommendations to prevent SSIs, such as optimizing antimicrobial prophylaxis dosing, preparing the colon with mechanical bowel preparation and oral antibiotics, optimizing tissue oxygenation, and using a surgical safety checklist.[13,14]

More comprehensive bundled approaches to SSI prevention are succeeding in decreasing SSI rates in many surgical procedure categories.[15,16] Successful projects have been reported in which innovation and surgeon champions were key factors. One such project, the Comprehensive Unit-based Safety Program (CUSP) for Safe Surgery coordinated by the Agency for Healthcare Research and Quality, was a four-year national project to reduce SSIs and other complications in which more than 250 hospitals participated across the United States. Each enrolled hospital adopted CUSP, an approach created at Johns Hopkins Hospital, Baltimore, Maryland, for improving safety culture and engaging frontline clinicians in identifying and resolving defects in care delivery. Using this approach, the Johns Hopkins Hospital team reduced SSIs in colorectal procedures by 33%.[17] The following interventions were applied during the project: standardization of antiseptic skin preparation, administration of preoperative chlorhexidine showers, warming of patients in the preanesthesia area, adoption of enhanced sterile techniques for skin and fascial closure, and addressing previously unrecognized lapses in antibiotic prophylaxis.

COMPARISON OF SSI PREVENTION GUIDELINES

Certainly, in many ORs, there is ample opportunity to move closer to standardized, evidence-based practice to support reliable design of SSI prevention programs. Reliable design allows the consistent application of evidence-based medicine to improve outcomes. However, working against reliable design in SSI prevention is permissive clinical autonomy, which creates and allows wide performance margins. The variability among the four SSI prevention guidelines published in the past year reflects this variation in practice and interpretation of published evidence. The four recently published surgical infection prevention guidelines are from the CDC Healthcare Infection Control Practices Advisory Committee, the World Health Organization, the Wisconsin Public Health Department, and the American College of Surgeons and Surgical Infection Society.[11,18-20]

There is concurrence among these four evidence-based guidelines, including the following measures and conclusions.[11,18-20]

- Preoperative prevention measures and conclusions:
  - Using a dual agent (ie, alcohol plus iodine or chlorhexidine) skin prep
  - There is no SSI reduction benefit from sealant
  - There is no SSI reduction benefit from adhesive incise drapes

- Intraoperative prevention measures:
  - Using wound edge protectors for abdominal procedures
  - Using triclosan-coated antibacterial sutures

- Postoperative prevention measures:
  - Using negative pressure wound therapy for high-risk procedures including open abdominal and vascular (eg, groin) cases

There is variation among the guidelines, including the following areas of practice.[11,18-20]

- Preoperative prevention measures:
  - Performing nasal screening for *Staphylococcus aureus* and methicillin-resistant *S aureus* before high-risk surgical procedures
  - Performing universal (all patients) or targeted (for patients positive for *S aureus* and methicillin-resistant *S aureus*) nasal and skin decolonization (decolonization products and protocols vary as well)
  - Requiring standardization of the preoperative bath and shower protocol (detailed guidelines for frequency and timing of chlorhexidine gluconate [CHG] shower and CHG bathing cloths)
  - Ensuring weight-based dosing of prophylactic antibiotics (eg, body mass index > 30 = 3 g versus 2 g cefazolin)
  - Using preoperative oral antibiotics in combination with mechanical bowel prep for colorectal procedures
  - Following a standard glycemic control protocol
  - Using a text reminder or phone call to remind patients about preoperative baths and showers
  - Standard recommendation for perineal skin or mucous membrane prep (iodine versus CHG or other)
  - Using a standard type of warming device or process to support normothermia

- Intraoperative prevention measures:
  - Using a standard type of warming device or process to support normothermia
  - Using oxygen supplementation
  - Using a standard type of head cover (skull cap versus bouffant)
  - Performing sterile glove change before fascia and skin closure
  - Using a dedicated wound closure tray for fascia and skin
  - Re-dosing prophylactic antibiotics for prolonged surgical procedures
  - Using intraoperative topical antibiotics (eg, cement, paste, powder)
  - Using a standard type, volume, and delivery method for intraoperative surgical irrigation
  - Using subcuticular sutures and talc application for obstetric and gynecology procedures

- Postoperative prevention measures:
  - Using a standard type of warming device or process to support normothermia
  - A recommended time period for postoperative dressing removal
  - A recommended time period for postoperative showering
  - Daily wound probing in contaminated wounds
  - Using antimicrobial postoperative dressings

CONCLUSION

The recently published SSI prevention guidelines have successfully established concurrence on a small number of recommendations.[11,18-20] There remains significant opportunity to continue moving toward consensus among professional organizations to increase standardization and reliable design of SSI prevention programs. In addition, advancing the practice of SSI prevention will necessitate looking beyond the basics, adopting innovative practices, and ensuring a collaborative team approach inclusive of a surgeon champion and the patient. The authors in this special infection prevention issue of the *AORN Journal* provide their expert insights and strategies in support of improving SSI prevention programs.

Editor's note: *Current Procedural Terminology is a registered trademark of the American Medical Association, Chicago, IL.*

REFERENCES

1. Arias KM. Mandatory reporting and pay for performance: health care infections in the limelight. *AORN J*. 2008;87(4):750-758.
2. Marsteller JA, Hsu YJ, Weeks K. Evaluating the impact of mandatory public reporting on participation and performance in a program to reduce central line-associated bloodstream infections: evidence from a national patient safety collaborative. *Am J Infect Control*. 2014;42(10 suppl):S209-S215.
3. Ibrahim AM, Nathan H, Thumma JR, Dimick JB. Impact of the hospital readmission reduction program on surgical readmissions among medicare beneficiaries. *Ann Surg*. 2017;266(4):617-624.

4. DiDiodato G. Has improved hand hygiene compliance reduced the risk of hospital-acquired infections among hospitalized patients in Ontario? Analysis of publicly reported patient safety data from 2008 to 2011. *Infect Control Hosp Epidemiol*. 2013;34(6):605-610.
5. Bastani H, Goh J, Bayati M. Evidence of upcoding in pay-for-performance programs. http://web.stanford.edu/~bayati/papers/upcoding.pdf. Accessed February 20, 2018.
6. Healthcare-associated Infections (HAI) Progress Report. Centers for Disease Control and Prevention. https://www.cdc.gov/hai/surveillance/progress-report/index.html. Accessed March 2, 2018.
7. Merkow RP, Ju MH, Chung JW, et al. Underlying reasons associated with hospital readmission following surgery in the United States. *JAMA*. 2015;313(5):483-495.
8. Anderson DJ, Kaye KS, Chen LF, et al. Clinical and financial outcomes due to methicillin resistant *Staphylococcus aureus* surgical site infection: a multi-center matched outcomes study. *PLoS One*. 2009;4(12):e8305. https://doi.org/10.1371/journal.pone.0008305.
9. TrendWatch Chartbook - Chapter 3: Utilization and Volume. American Hospital Association. https://www.aha.org/2017-12-11-trendwatch-chartbook-chapter-3-utilization-and-volume. Accessed February 20, 2018.
10. Alemzadeh H, Raman J, Leveson N, Kalbarczyk Z, Iyer RK. Adverse events in robotic surgery: a retrospective study of 14 years of FDA data. *PLoS One*. 2016;11(4):e0151470. https://doi.org/10.1371/journal.pone.0151470.
11. Berríos-Torres SI, Umscheid CA, Bratzler DW, et al. Centers for Disease Control and Prevention Guideline for the Prevention of Surgical Site Infection, 2017. *JAMA Surg*. 2017;152(8):784-791.
12. Wang Z, Chen F, Ward M, Bhattacharyya T. Compliance with surgical care improvement project measures and hospital-associated infections following hip arthroplasty. *J Bone Joint Surg Am*. 2012;94(15):1359-1366.
13. Anderson DJ. Prevention of surgical site infection: beyond SCIP. *AORN J*. 2014;99(2):315-319.
14. Hawn MT, Vick CC, Richman J, et al. Surgical site infection prevention: time to move beyond the surgical care improvement program. *Ann Surg*. 2011;254(3):494-499.
15. Dua A, Desai SS, Seabrook GR, et al. The effect of Surgical Care Improvement Project measures on national trends on surgical site infections in open vascular procedures. *J Vasc Surg*. 2014;60(6):1635-1639.
16. van der Slegt J, van der Laan L, Veen EJ, Hendriks Y, Romme J, Kluytmans J. Implementation of a bundle of care to reduce surgical site infections in patients undergoing vascular surgery. *PLoS One*. 2013;8(8):e71566. https://doi.org/10.1371/journal.pone.0071566.
17. Johns Hopkins patient safety pilot program slashes colorectal surgical site infections (SSIs) by 33 percent: researchers estimate similar interventions nationwide could save more than $100 million annually. Johns Hopkins Medicine. https://www.hopkinsmedicine.org/news/media/releases/johns_hopkins_patient_safety_pilot_program_slashes_colorectal_surgical_site_infections_ssis_by_33_percent. Published July 30, 2012. Accessed February 20, 2018.
18. *Global Guidelines for the Prevention of Surgical Site Infection*. Geneva, Switzerland: World Health Organization; 2016. https://www.ncbi.nlm.nih.gov/books/NBK401132/. Accessed March 2, 2018.
19. Wisconsin Division of Public Health Supplemental Guidance for the Prevention of Surgical Site Infections: An Evidence-Based Perspective. Wisconsin Division of Public Health. https://www.dhs.wisconsin.gov/publications/p01715.pdf. Published January 2017. Accessed February 20, 2018.
20. Ban K, Minei JP, Laronga C, et al. American College of Surgeons and Surgical Infection Society: Surgical Site Infection Guidelines, 2016 Update. *J Am Coll Surg*. 2017;224(1):59-74.

Sue Barnes, BSN, RN, CIC, FAPIC, is an independent infection prevention consultant in San Mateo, CA. *As a recipient of consulting fees from Nozin, Aerobiotix, and Ethicon, Inc (a subsidiary of Johnson & Johnson), Ms Barnes has declared affiliations that could be perceived as posing potential conflicts of interest in the publication of this article.*