

Implementation of a Wisconsin Division of Public Health Surgical Site Infection Prevention Champion Initiative

Gwen Borlaug, MPH, CIC, FAPIC; Charles E. Edmiston, Jr, PhD, CIC, FIDSA, FSHEA, FAPIC

ABSTRACT

Approximately 900 surgical site infections (SSIs) were reported to the Wisconsin Division of Public Health annually from 2013 to 2015, representing the most prevalent reported health care–associated infection in the state. Personnel at the Wisconsin Division of Public Health launched an SSI prevention initiative in May 2015 using a surgical care champion to provide surgical team peer-to-peer guidance through voluntary, nonregulatory, fee-exempt onsite visits that included presentations regarding the evidence-based surgical care bundle, tours of the OR and central processing areas, and one-on-one discussions with surgeons. The surgical care champion visited 10 facilities from August to December 2015, and at those facilities, SSIs decreased from 83 in 2015 to 47 in 2016 and the overall SSI standardized infection ratio decreased by 45% from 1.61 to 0.88 ($P = .002$), suggesting a statewide SSI prevention champion model can help lead to improved patient outcomes.

Key words: *surgical champion, surgical care bundle, SSI prevention, peer collaboration, evidence-based practice.*

Surgical site infections (SSIs) are the most frequently reported health care–associated infection (HAI) in Wisconsin (ie, approximately 900 SSIs were reported annually to the Wisconsin Division of Public Health [WDPH] from 2013 to 2015). Approximately 1.5% of surgical procedures performed in Wisconsin are complicated by SSIs,¹ and the Centers for Disease Control and Prevention (CDC) reports that mortality associated with SSIs has been reported to be as high as 3% nationally.² Specific case scenarios (ie, organ or body space infections after laparoscopic colorectal surgeries in which anastomotic leaks occurred) have been associated with a 30-day mortality rate of 4.5%.³ Furthermore, the fiscal burden of these adverse events approaches \$10 billion annually in the United States.⁴⁻⁸ The cost of treating serious periprosthetic joint infection can exceed \$350,000, with an associated mortality rate between 2% and 7%.⁹ Thus, in addition to causing patient morbidity and mortality, treating expensive surgical complications is a major financial

challenge for hospitals striving to deliver high-quality care at a lower cost. Reducing the risk of SSIs and other costly surgical complications will reduce health care expenditures in addition to optimizing patient outcomes.¹⁰ This article describes a WDPH initiative to reduce SSIs after colorectal procedures, abdominal hysterectomies, and hip and knee arthroplasty procedures using a surgical care champion model that fosters peer-to-peer discussions of evidence-based practices.

FINDING A SOLUTION TO SSIs

As a result of the 2014 outbreak of Ebola virus disease in West Africa, the CDC granted supplemental funding to state health departments to help health care facilities in the United States address vulnerabilities in infection prevention programs that surfaced during the response to the Ebola crisis.¹¹ During 2015, a multidisciplinary team comprised of staff members from the WDPH and

the Wisconsin State Laboratory of Hygiene conducted onsite hospital visits to evaluate Ebola and general infectious disease readiness, infection prevention program infrastructure, and outbreak response capacity. Subsequently, members of the WDPH HAI Prevention Program evaluated selected hospital HAI prevention strategies based on statewide HAI surveillance data. Because SSIs were the most frequently reported HAI, the WDPH targeted HAI prevention strategies for reducing SSIs and developed a strategy in which a subject matter expert would serve as a statewide surgical care champion to present the most recent evidence-based SSI prevention practices surgical care bundle (Table 1) for use by surgeons and surgical care teams at their facilities. Through this surgical care champion initiative, the WDPH provided the opportunity for peer-to-peer learning and interdisciplinary collaboration among surgeons, perioperative nurses, anesthesia professionals, sterile processing staff members, infection preventionists, quality resources staff members, and pharmacists in implementing the bundle.

TAKING INVENTORY OF RESOURCES

One of the first steps in launching a public health surgical care champion initiative is to determine the resources needed at the state level to facilitate peer-to-peer learning and help facility personnel incorporate SSI prevention evidence into practice. Necessary resources include a funding source, access to facility-level SSI data, communication contacts at the facility level, appropriate state health department staffing levels, and recruitment of a qualified individual to serve as the state surgical care champion and subject matter expert.

The WDPH used funding provided through a grant from the CDC to cover the cost of the surgical care champion's fees; facility administrators were asked to provide only lodging and mileage for this individual to help mitigate cost barriers to conducting the visits. Additional assets needed to implement this program included access to facility-level SSI data from all hospitals performing surgical procedures. The WDPH HAI Prevention Program historically has obtained HAI data on a voluntary basis from all 113 hospitals performing surgical procedures in Wisconsin using the National Healthcare Safety Network (NHSN),¹² a national HAI database maintained by the CDC. These outcome data are important for monitoring

and tracking statewide and facility-specific progress toward SSI reduction and for assessing the effects of the SSI prevention initiative.

One of the first steps in launching a public health surgical care champion initiative is to determine the resources needed at the state level to facilitate peer-to-peer learning and help facility personnel incorporate SSI prevention evidence into practice.

Historically, the WDPH has had strong partnerships with facility infection preventionists, who have served as the chief points of contact and communication when promoting, planning, and scheduling the onsite visits, and who have served as liaisons between the WDPH and the surgical teams in preparing for the facility visits. The WDPH resources supporting the SSI prevention initiative included the HAI prevention program manager, who had previous clinical experience as a hospital infection preventionist; the HAI surveillance coordinator, who provided NHSN outcomes data for presentations at the onsite visits; and an SSI prevention researcher to act as a subject matter expert and surgical care champion.

One of the challenges of launching this initiative was obtaining funding to support the onsite visits by the surgical care champion; however, the Ebola crisis spurred an interest among federal partners to provide support to health care infection prevention programs through state health department evaluations. This funding provided the WDPH the opportunity to focus on SSI prevention using a state surgical care champion. A second challenge was conveying the benefits of the visits to facility personnel, particularly at the beginning of the initiative when data to show its efficacy were not yet available. The WDPH carefully crafted its communications to facilities to emphasize the nonregulatory and confidential nature of the onsite visits.

MARKETING AN SSI RISK REDUCTION PROGRAM

After the development of key resources and assets, promotion of the surgical care champion initiative began in

Table 1. Wisconsin Division of Public Health SSI Prevention Program Surgical Care Bundle

Component	Description
Weight-based dosing of preoperative antimicrobial agent	<ul style="list-style-type: none"> Follow the 2013 American Society of Health-System Pharmacists <i>Guidelines for Antimicrobial Prophylaxis in Surgery</i>.^{1,2} Administer prophylactic antibiotic agents based on the patient's BMI or the patient's weight in kilograms. For example, patients with a BMI <30 (or <120 kg) should receive 2 g of a beta-lactam agent; patients with a BMI ≥30 (or ≥120 kg) should receive 3 g.
Redosing of preoperative antimicrobial agent	<ul style="list-style-type: none"> Base redosing of antibiotic agents on the drug half-life and duration of surgery.
Preadmission shower or cleansing with CHG	<ul style="list-style-type: none"> Standardize the preadmission shower or cleansing process using a 4% aqueous CHG shower protocol: <ul style="list-style-type: none"> Remind patients to perform the CHG shower regimen with a text message, e-mail, or voicemail. Provide patients with both oral and written instructions regarding the standardized CHG shower regimen. Instruct patients to take two showers—one the evening before surgery and one the morning of surgery. Instruct patients to pause for 1 min after applying the CHG and before rinsing. Ensure patients use a total volume of 4 oz of CHG for each shower or a 2% CHG polyester cloth cleansing. Provide patients with both oral and written instructions regarding the standardized CHG cloth cleansing, emphasizing gentle application of the cloths to the skin. Instruct patients to use a total of 12 cloths—6 cloths the night before surgery and another 6 cloths the morning of surgery. Confirm that patients understand they should use both sides of the cloth to maximize release of the CHG onto the skin.
Glycemic control	<ul style="list-style-type: none"> Maintain a mean perioperative blood glucose level <200 mg/dL in diabetic and nondiabetic surgical patients.
Mechanical bowel preparation with oral antibiotics	<ul style="list-style-type: none"> For patients undergoing colorectal surgery, include preoperative oral antibiotics in combination with mechanical bowel preparations to reduce SSI risk.
Staphylococcal surveillance and decolonization	<ul style="list-style-type: none"> For patients undergoing orthopedic and cardiothoracic procedures, screen for both methicillin-resistant <i>Staphylococcus aureus</i> and methicillin-sensitive <i>Staphylococcus aureus</i>, and decolonize using a recommended regimen. Although the optimal decolonization regimen is unclear, the following is recommended: <ul style="list-style-type: none"> a standardized regimen of topical nasal mupirocin (ie, twice a day for 5-7 d) or an alternative approach involving the use of a nasal swab containing 5% or 10% povidone iodine applied in the nares 1 to 2 hr before surgery, along with a 2% or 4% CHG body cleansing or shower (once a day for 2 d) before surgical admission.
Normothermia	<ul style="list-style-type: none"> Maintain patient's core body temperature between 36° C (96.8° F) and 38° C (100.4° F) in the preoperative, intraoperative, and postoperative environment.
Supplemental oxygenation	<ul style="list-style-type: none"> Consider use of high oxygen supplementation as an SSI risk-reduction strategy during colorectal procedures.
Preoperative skin antisepsis	<ul style="list-style-type: none"> Use 2% CHG with 70% alcohol as the preferred intraoperative skin preparation agent. CHG is also a safe and effective antiseptic agent for obstetrical and gynecologic procedures.
SSI = surgical site infection; BMI = body mass index; CHG = chlorhexidine gluconate.	
References	
1. <i>Clinical Practice Guidelines for Antimicrobial Prophylaxis in Surgery</i> . ASHP. https://www.ashp.org/-/media/assets/policy-guidelines/docs/therapeutic-guidelines/therapeutic-guidelines-antimicrobial-prophylaxis-surgery.ashx?la=en&hash=F795135338C66BE3ABEE4CF-DA6412C5D1D4159B4 . Accessed March 15, 2018.	
2. Pradarelli JC, Nathan H. <i>Treating perioperative complications: should everyone be this expensive?</i> JAMA Surg. 2017;152(10):959. https://doi.org/10.1001/jamasurg.2017.1719 .	

May 2015 when the WDPH mailed letters to hospital administrators and infection preventionists announcing a partnership with the state surgical care champion to intensify SSI prevention efforts across the state. These efforts would include low-cost onsite visits by the

surgical care champion to meet with surgeons and surgical teams, facility administrators, quality resources staff members, and infection preventionists. The purposes of the onsite visits were to assess facility-specific needs and to present the most recent evidence-based SSI reduction

strategies to frontline team members. Additionally, the surgical care champion would provide ongoing consultation via phone and e-mail, maintain a journal library on the WDPH web site,¹³ develop a Wisconsin SSI prevention guidance document, and host annual SSI prevention summits.

In the announcement letter, the WDPH emphasized that the onsite visits were voluntary, nonregulatory, and non-punitive in nature and would be conducted only at the request of the facility. The WDPH would keep confidential all findings, discussions, and process and outcome data associated with the consultation services. The WDPH pledged not to share the information with any internal or external WDPH partners, including state and federal regulatory or accreditation agencies. The WDPH also offered a flexible agenda based on the needs of the facility, with the only requirement that surgeons and perioperative nursing staff members be available to participate in the visit.

To communicate the program further to partners across the state, the WDPH sent announcements regarding the project to partners such as the Wisconsin Hospital Association; MetaStar, Inc, the Wisconsin quality improvement organization; local public health departments; and members of the HAI Advisory Committee. The WDPH asked these organizations to distribute the announcements to their respective members and constituents.

ESTABLISHING AN AGENDA AND GOALS

The WDPH instructed facilities to contact the WDPH HAI Prevention Program manager to request a visit. Typically, the facility infection preventionist made the request. After the request, the WDPH and the surgical care champion held teleconference planning meetings with facility representatives, including surgical team members, quality resources personnel, infection prevention personnel, and other key stakeholders. The purposes of these conference calls were to identify the surgical procedures targeted for improvement and to draft an agenda designed to address the concerns of the surgical teams.

The WDPH obtained baseline outcome and process data before the visit for review by the surgical care champion. The baseline data regarding selective surgical outcomes were crucial for the success of the onsite visit because the data allowed the surgical care champion to understand the

extent of the problem, characterize the demographics of the patient population at risk, and identify interventions currently implemented by the facility.

The WDPH asked personnel at hospitals that agreed to participate to complete a line list of operative details and selected patient risk factors (Table 2) for all procedures resulting in an SSI during the previous three years and to indicate the components of the surgical care bundle currently in use for the procedures targeted for improvement. Additionally, the WDPH asked facility personnel to indicate whether patients had a period of smoking cessation and whether the surgical teams used separate wound closure trays, changed gloves before fascia and subcuticular closing, and used surgical wound edge protectors.

Through the NHSN, the WDPH accessed the number and type of SSIs reported by the facility, the total number of procedures performed, and the standardized infection

Table 2. Patient Operative Details and Selected SSI Risk Factors Before Wisconsin Division of Public Health Onsite Visits

Patient Details	SSI Risk Factors
<ul style="list-style-type: none"> • National Healthcare Safety Network event number¹ • Date of birth • Gender • Date of <ul style="list-style-type: none"> o admission o discharge o procedure • Surgical procedure • Surgical approach (open versus laparoscopic) • Duration of surgery • Surgical team members • Insertion of biomedical device (eg, abdominal mesh, prosthetic joint) • Date of SSI onset • Location of SSI (ie, superficial, deep incisional, organ or body cavity space) • Primary pathogen 	<ul style="list-style-type: none"> • Wound class • American Society of Anesthesiologists' score² • Body mass index • Diagnosis of diabetes • History of smoking • Corticosteroid therapy during past 2 y • Blood loss (in mL) • Presence of inflammatory bowel disease in patients undergoing colorectal and abdominal hysterectomy procedures • Previous abdominal surgeries • Other infections at time of surgery • Miscellaneous risk factors

SSI = surgical site infection.

References

1. National Healthcare Safety Network. Centers for Disease Control and Prevention. <https://www.cdc.gov/nhsn/index.html>. Accessed January 5, 2018.
2. ASA Physical Status Classification System. ASAHQ.com. <https://www.asahq.org/resources/clinical-information/asa-physical-status-classification-system>. Accessed January 5, 2018.

ratio for the specified time period before submitting the line list to facilities to complete. The surgical care champion reviewed these data before the visits and they served as the background for discussions with the facility stakeholders during the onsite visits.

A typical onsite visit comprised several sessions throughout the day, during which the surgical champion discussed the surgical care bundle and SSI prevention interventions tailored to the needs of the facility based on its current SSI data. The surgical care champion held an introductory meeting with representatives from administration, infection prevention, quality resources, central processing, and surgical services areas to outline the goals of the visit and to review the agenda for the day. The WDPH HAI Prevention Program manager also was present at the onsite visits to represent WDPH and to present facility-specific, Wisconsin, and national SSI summary data during the introductory meeting.

A typical onsite visit comprised several sessions throughout the day, during which the surgical champion discussed the surgical care bundle and SSI prevention interventions tailored to the needs of the facility based on its current SSI data.

Next, the surgical care champion held individual meetings with infection prevention staff members and selected surgical leadership representatives, including OR nursing staff members and managers, to allow key stakeholders to express their concerns and thoughts in a private and confidential manner. During these meetings, the surgical care champion provided an assessment of the problem based on a review of the template completed by the facility. For example, the body mass index of most of the patients in which SSIs occurred was greater than 30. However, the antimicrobial prophylaxis data indicated that the patients received doses of antibiotics that would have resulted in a subtherapeutic tissue concentration during the perioperative period. The surgical care champion then discussed how to improve practices for these patients.

After the individual meetings, the surgical care champion provided a grand rounds presentation typically scheduled

during the lunch hour. This presentation described the contemporary evidence-based practices documented in current guidelines, including those from the CDC, American College of Surgeons, and WDPH.¹⁴⁻¹⁷ This presentation focused on specific facility issues. Importantly, all stakeholders were invited to attend this portion of the visit, because multiple disciplines are involved in implementing the components of the surgical care bundle described during this presentation.

The surgical care champion then toured the OR and central processing areas. These tours are not viewed as intensive inspections, such as those conducted by The Joint Commission or the Centers for Medicare & Medicaid Services, but rather as opportunities to observe the physical environment of the OR and central processing areas and to allow staff members in these areas to consult with the surgical care champion regarding current practices.

Finally, the surgical care champion's onsite visits involved one-on-one discussions with surgeons, during which they discussed the relative merits of selected evidence-based practices. During this phase of the visit, the surgical care champion identified a member of the surgical team to act as the facility's surgical care champion. Ideally, this individual is widely respected by other surgical staff members, approachable and open to change, and willing to work with colleagues and facility leaders to implement changes leading to improved patient outcomes.

The peer-to-peer discussions with the surgeons identified areas of improvement, the evidence-based practices needed to achieve the improvements, and specific elements in an evidence-based surgical care bundle appropriate for the facility.¹⁸ The surgical care champion also emphasized the importance of developing validated methods for measuring compliance with individual components of the surgical care bundle because low compliance diminishes the benefits of evidence-based practices.¹⁹

The onsite visits concluded with a wrap-up session during which the surgical care champion summarized observations, findings, and recommendations for change, and also offered ongoing consultation and assistance via phone conversations or e-mail. In some instances, personnel at a facility requested a written report summarizing the findings and recommendations. If requested, the surgical care champion provided the report within 48 to 72 hours after the visit. When feasible, while the surgical care champion

Table 3. Wisconsin Division of Public Health Survey of Selected SSI Prevention Practices

SSI Prevention Practice	Number (%) of Hospitals Performing the Prevention Practice		
	2015, n = 82 ^a	2017, n = 105 ^a	P Value
Weight-based dosing of preoperative prophylactic antibiotics	70 (85)	100 (95)	.61
Redosing of preoperative prophylactic antibiotics	62 (76)	92 (88)	.50
CHG preoperative shower or cloth treatment before orthopedic procedures	26 (32)	99 (94)	<.01
CHG preoperative shower or cloth treatment before surgical procedures	26 (32)	63 (60)	.02

SSI = surgical site infection; CHG = chlorhexidine gluconate.
^aNumber of hospitals responding to the survey among 113 Wisconsin hospitals performing surgical procedures.

met with the surgical teams, the WDPH HAI Prevention Program manager conducted SSI data validation studies with the facility infection preventionists to determine adherence to SSI surveillance protocols and to identify and correct any systems errors that may have affected data accuracy.

ESTABLISHING A STATEWIDE FORUM

As part of this surgical care champion initiative, the WDPH HAI Prevention Program and the Medical College of Wisconsin host a yearly SSI Prevention Summit, which brings together key stakeholders such as infection preventionists, OR personnel, quality resources staff members, hospital administrators, and surgical practitioners. Approximately 200 individuals from across the state attend these symposiums, which feature nationally and internationally known speakers who share their knowledge on such topics as establishing collaborative pathways to SSI prevention, defining the surgical care bundle, identifying a facility surgical care champion, and exploring options in postoperative wound care. The WDPH also presents statewide SSI outcomes and process improvement data to report statewide progress toward SSI reduction.

A recurring theme of the SSI summits is an emphasis on intra- and interfacility collaboration to reduce SSI risk and improve surgical patient outcomes. The summits provide an important forum for Wisconsin-based clinical practitioners to share their own successes, failures, and barriers they encounter as they move forward in their collective efforts to embrace evidence-based practices to reduce surgical patient morbidity and mortality.

Statewide Survey of Surgical Care Practices

During 2015 and 2017, the WDPH conducted surveys of hospitals providing surgical services to monitor progress toward implementation of three key elements of the surgical care bundle:

- weight-based dosing of preoperative antibiotic prophylaxis,
- appropriate redosing of prophylactic antibiotics, and
- preoperative showering or cleansing with chlorhexidine gluconate.

The proportion of hospitals implementing these three practices increased during the two-year period (Table 3), and the improvement was significant regarding the use of preoperative skin showering or cleansing with chlorhexidine gluconate. The results are encouraging indications of improved surgical care practices among Wisconsin hospital surgical care centers.

PROGRAM SUCCESS

The WDPH conducted an analysis of hospital SSI data during June 2017 to determine SSI occurrence after the first onsite visits conducted from August to December 2015. Among the 10 hospitals visited during that time, reported SSIs decreased from 83 during 2015 to 47 during 2016, and the overall SSI standardized infection ratio (SIR) decreased by 45% from 1.61 to 0.88 ($P = .002$). The SIR is a summary measure used to track HAIs at a national, state, or local level over time. The SIR compares the actual number of HAIs reported with the baseline US experience (ie, NHSN aggregate data are used as the standard population), adjusting for several risk factors that have been found to be significantly

Key Takeaways

- ◆ Surgical site infections (SSIs) are the most frequently reported health care–associated infection in Wisconsin; approximately 900 SSIs were reported annually to the Wisconsin Division of Public Health (WDPH) from 2013 to 2015.
- ◆ The WDPH developed a strategy in which a subject matter expert would serve as a statewide surgical care champion to present the most recent evidence-based SSI prevention practices surgical care bundle for use by surgeons and surgical care teams at their facilities.
- ◆ Among the 10 Wisconsin hospitals visited from August to December 2015, reported SSIs decreased from 83 during 2015 to 47 during 2016, and the overall SSI standardized infection ratio decreased by 45% from 1.61 to 0.88 ($P = .002$).
- ◆ The WDPH's onsite peer-to-peer engagement with a surgical care champion and subject matter expert is considered a novel, innovative method of widely disseminating current best practices and clarifying a contemporary surgical care bundle.

associated with differences in infection incidence.²⁰ An SIR greater than 1.0 indicates that more HAIs were observed than predicted, accounting for differences in the types of patients followed; conversely, an SIR less than 1.0 indicates that fewer HAIs were observed than predicted.

Although the number of procedures these facilities performed decreased from 3,125 during 2015 to 2,834 during 2016, the predicted number of infections was very similar (ie, 42 during 2015, 41 during 2016), indicating the reduction in SSI occurrence was not a function of reduced caseload but rather represents a true reduction in the probability of acquiring an SSI after surgical procedures in these facilities. By contrast, among approximately 100 hospitals not receiving a WDPH visit during 2015, the overall SSI SIR was 0.96 during 2015 and 1.02 during 2016 ($P = .19$). The WDPH will conduct a similar analysis among the 10 hospitals visited during 2016, when SSI surveillance data are complete during mid-2018.

The WDPH estimates the reduction in SSIs represents a savings of \$300,000 to \$750,000 in health care costs using data from a 2009 HAI cost report.²¹ With a cost of approximately \$3,500 per onsite visit, these visits demonstrate a cost-effective, sound investment of public health dollars to prevent SSIs.

A MODEL FOR THE FUTURE

From the start, the overall goal of the surgical care champion initiative was to reduce patient morbidity among

Wisconsin surgical patients undergoing colorectal, orthopedic, and abdominal hysterectomy surgical procedures. Statewide data indicated little progress in SSI reduction from 2012 to 2015 and underscored the need for more effective means to improving surgical care in Wisconsin. The WDPH's onsite peer-to-peer engagement with a surgical care champion and subject matter expert is considered a novel, innovative method of widely disseminating current best practices and clarifying a contemporary surgical care bundle.

The WDPH's preliminary findings would suggest that this model of engagement has several benefits. This initiative provides all surgical centers equal access to a surgical care champion and subject matter expert with operational and functional knowledge of current evidence-based interventional practices via onsite visits that are tailored to the needs of the individual facility. The WDPH provides confidential, nonpunitive onsite visits and ongoing consultation free of charge to the facilities. Finally, this initiative expanded opportunities for collaboration among Wisconsin health care systems, opening new avenues of dialogue among providers to improve surgical patient outcomes.

CONCLUSION

The WDPH's experiences with the surgical care champion initiative suggest that a similar approach to SSI prevention could be applied to other states across the country. Although current surgical care improvement efforts in

most states focus on three selected procedures (ie, colorectal, orthopedic, abdominal hysterectomy), all surgical disciplines could benefit from embracing evidence-based practices to reduce SSI occurrences and improve surgical outcomes.

Acknowledgment: This project was funded by a grant from the Centers for Disease Control and Prevention, Atlanta, GA.

REFERENCES

1. Healthcare-Associated Infections Prevention Program—2016 Report. Wisconsin Department of Health Services, Division of Public Health. <https://www.dhs.wisconsin.gov/publications/p0/p00340.pdf>. Accessed January 8, 2018.
2. Healthcare Associated Infections: HAI Data and Statistics. The Centers for Disease Control and Prevention. <https://www.cdc.gov/hai/surveillance/index.html>. Accessed January 8, 2018.
3. Boyce SA, Harris C, Stevenson A, Lumley J, Clark D. Management of low colorectal anastomotic leakage in the laparoscopic era: more than a decade of experience. *Dis Colon Rectum*. 2017;60(8):807-814.
4. Herwaldt LA, Cullen JJ, Scholz D, et al. A prospective study of outcome, healthcare resource utilization, and costs associated with postoperative nosocomial infections. *Infect Control Hosp Epidemiol*. 2006;27(12):1291-1298.
5. Reed D, Kemmerly SA. Infection control and prevention: a review of hospital acquired infections and the economic implications. *Ochsner J*. 2009;9(1):27-31.
6. Shepard J, Ward W, Milstone A, et al. Financial impact of surgical site infections on hospitals: the hospital management perspective. *JAMA Surg*. 2013;148(10):907-914.
7. de Lissovoy G, Fraeman K, Hutchins V, Murphy D, Song D, Vaughn BB. Surgical site infection: incidence and impact on hospital utilization and treatment costs. *Am J Infect Control*. 2009;37(5):387-397.
8. Anderson DJ, Podgorny K, Berríos-Torres SI, et al. Strategies to prevent surgical site infections in acute care hospitals. 2014 update. *Infect Control Hosp Epidemiol*. 2014;35(suppl 2):S66-S88.
9. Parvizi J, Barnes S, Shohat N, Edmiston CE Jr. The environment of care: is it time to reassess microbial contamination of the operating room as a risk factor for surgical site infection in total joint arthroplasty? *Am J Infect Control*. 2017;11:1267-1272.
10. Pardarelli JC, Nathan H. Treating perioperative complications: should everyone be this expensive? *JAMA Surg*. 2017;152(10):959. <https://doi.org/10.1001/jamasurg.2017.1719>.
11. Hageman JC, Carmen Hazim C, Wilson K. Infection prevention and control for Ebola in health care settings—West Africa and United States. *MMWR Suppl*. 2016;65(3):50-56.
12. National Healthcare Safety Network: NHSN Reports. Centers for Disease Control and Prevention. <https://www.cdc.gov/nhsn/datastat/index.html>. Accessed January 8, 2018.
13. HAI Prevention—Surgical Site Infections. Wisconsin Department of Health Services. <https://www.dhs.wisconsin.gov/hai/ssi-prevention.htm>. Accessed January 8, 2018.
14. 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.
15. *Global Guidelines for the Prevention of Surgical Site Infection*. Geneva, Switzerland: World Health Organization; 2016. <http://apps.who.int/iris/bitstream/10665/250680/1/9789241549882-eng.pdf?ua=1>. Accessed January 8, 2018.
16. Ban KA, 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.
17. Edmiston CE Jr, Borlaug G, Davis JP, Gould JC, Roskos M, Seabrook GR. *Wisconsin Division of Public Health Supplemental Guidance for the Prevention of Surgical Site Infections: An Evidence-Based Perspective*. <https://www.dhs.wisconsin.gov/publications/p01715.pdf>. Published January 2017. Accessed January 8, 2018.
18. Tanner J, Assadian O, Kiernan M, Edmiston CE, Leaper D. Do surgical care bundles reduce the risk of surgical site infections in patients undergoing colorectal surgery? A systematic review and cohort meta-analysis of 8,515 patients. *Surgery*. 2015;158(1):66-77.

19. Leaper D, Tanner J, Kiernan M, Assadian O, Edmiston CE. Surgical site infection: poor compliance with guidelines and care bundles. *Int Wound J*. 2015;12(3):357-362.
20. The NHSN standardized infection ratio (SIR) a guide to the SIR: Updated July 2017. Centers for Disease Control and Prevention, National Center for Emerging and Zoonotic Infectious Diseases, Division of Healthcare Quality Promotion. <https://www.cdc.gov/nhsn/pdfs/ps-analysis-resources/nhsn-sir-guide.pdf>. Updated July 2017. Accessed January 8, 2018.
21. Scott RD II. The direct medical costs of healthcare-associated infections in U.S. hospitals and the benefits of prevention. CDC Stacks Public Health Publications <https://stacks.cdc.gov/view/cdc/11550/>. Published March 2009. Accessed January 8, 2018.

Gwen Borlaug, MPH, CIC, FAPIC, is an infection preventionist at Borlaug Infection Prevention Services, Bode, IA. Ms Borlaug has no declared affiliation that could be perceived as posing a potential conflict of interest in the publication of this article.

Charles E. Edmiston, Jr, PhD, CIC, FIDSA, FSHEA, FAPIC, is an emeritus professor of surgery in the Department of Surgery at the Medical College of Wisconsin, Milwaukee. As a recipient of a consulting fee from Ethicon and Sage Products, and as a consultant for the US Food and Drug Administration, the US Department of Defense, and Sage Products, Dr Edmiston has declared affiliations that could be perceived as posing potential conflicts of interest in the publication of this article.

WRITE FOR THE AORN JOURNAL

www.aornjournal.org

The award-winning, peer-reviewed *AORN Journal* is always looking for new authors to contribute their perioperative knowledge and expertise. Authorship provides a means to improve patient care, educate your colleagues, and continue your professional and personal growth.

Transform what you do every day into a published *AORN Journal* article. Consider submitting an article today!

The *AORN Journal* publishes the following article types:

- Clinical
- Management
- Research
- Quality Improvement
- Education
- Literature Review
- Concept Analysis

For more information on author guidelines, visit www.aornjournal.org/content/authorinfo. For editorial assistance, please contact us at aornjournal@aorn.org.

