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# An Incision Closure Bundle for Colorectal Surgery

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## PURPOSE/GOAL

To provide the learner with knowledge of best practices related to incision closure bundles for colorectal surgery.

## OBJECTIVES

1. Discuss the purpose of an incision closure bundle for colorectal surgery.
2. Describe the endogenous and exogenous factors that can lead to incisional contamination.
3. Identify evidence-based components of an incision closure bundle.

## ACCREDITATION

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Charles E. Edmiston, Jr, PhD; David J. Leaper, MD, ChM, FRCS, FACS, FLS; Sue Barnes, BSN, RN, CIC, FAPIC; William Jarvis, MD; Maureen Spencer, Med, BSN, RN; Denise Graham; and Helen Boehm Johnson, MD, have declared affiliations that could be perceived as posing potential conflicts of interest in the publication of this article. Marsha Barnden, MSN, RNC, CIC, has no declared affiliation that could be perceived as posing a potential conflict of interest in the publication of this article.

The behavioral objectives for this program were created by Kristi Van Anderson, BSN, RN, CNOR, clinical editor, with consultation from Susan Bakewell, MS, RN-BC, director, Perioperative Education. Ms Van Anderson and Ms Bakewell have no declared affiliations that could be perceived as posing potential conflicts of interest in the publication of this article.

## SPONSORSHIP OR COMMERCIAL SUPPORT

No sponsorship or commercial support was received for this article.

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<http://doi.org/10.1002/aorn.12120>

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## ABSTRACT

Surgical site infections (SSIs) are among the most common and expensive of all health care–associated infections, and as many as 50% are considered preventable. Surgical care bundles, which involve a small set of reliably performed evidence-based practices, may effectively reduce SSI rates. However, closure of the surgical incision is one aspect of surgical care that is not well described in current SSI prevention bundles; this presents an opportunity for perioperative professionals to improve care by identifying and implementing evidence-based incision closure practices for high-risk procedures (eg, colorectal surgery). We propose and review the evidence supporting a colorectal incision closure bundle composed of a glove and sterile instrument set change, irrigation with 0.05% chlorhexidine solution, use of triclosan-coated sutures, removal of surgical drapes after applying postoperative dressings, use of topical skin adhesive or an antiseptic dressing, and distribution of comprehensive postoperative patient instructions.

**Key words:** *colorectal surgical bundle, incision closure bundle, surgical site infection, SSI prevention bundle, colorectal surgery.*

**S**urgical site infections (SSIs) represent a substantial burden to health care in the United States, accounting for greater than 20% of health care–associated infections (HAIs) and ranking as the most expensive of all HAIs.<sup>1,2</sup> Patients with HAIs experience higher mortality rates than those who do not experience HAIs. A 2012 review of HAIs in Pennsylvania indicated a mortality rate of 9.1% for patients with an HAI, compared with a mortality rate of 1.7% for patients who did not experience an HAI.<sup>3</sup> The annual cost for all SSIs in the United States is estimated to be between \$3.5 and \$10 billion.<sup>1</sup> The true costs, however, are likely to be far greater, because these numbers do not account for intangibles such as the postoperative quality of life (ie, patient suffering, lost productivity, pressure on home caregivers, medicolegal costs) that often accompany procedures that are complicated by infection.<sup>4</sup>

As many as half of all SSIs could be prevented.<sup>5</sup> This statistic, in addition to pressure from consumer action groups (eg, the Consumer's Union), has led to mandated changes in performance-based reimbursement by the Centers for Medicare & Medicaid Services, which holds health care facilities accountable for their SSI rates and efforts directed at SSI prevention.<sup>6</sup> Accordingly, the stakes for health care facilities and their patients and caregivers are high, and this has resulted in vigorous efforts to identify and apply strategies that effectively reduce SSIs.

In this article, the term *antiseptic* refers to a nonantibiotic antimicrobial substance designed to reduce the risk of infection (eg, chlorhexidine gluconate [CHG], povidone iodine). Antiseptics include bactericides, which are substances with proven ability to act specifically against

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<http://doi.org/10.1002/aorn.12120>

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bacteria (eg, triclosan). *Antibiotics* are medications that inhibit the growth of or destroy bacteria (eg, penicillin) and exclude bactericides (eg, triclosan).

## SSI PREVENTION BUNDLES

A popular strategy to reduce the risk of SSI has been the bundle approach, in which a small number of evidence-based practices are used together as part of a larger SSI prevention plan. One example is the “7 S Bundle,” which is composed of the following seven elements:

- safe OR (eg, traffic control, proper surgical attire),
- screen for methicillin-resistant *Staphylococcus aureus* (MRSA) and methicillin-sensitive *Staphylococcus aureus*,
- showers with CHG,
- skin prep with alcohol-based antiseptics,
- sutures with an antiseptic,
- solution to irrigate with CHG, and
- skin adhesive or antiseptic dressing to protect the incision.<sup>7</sup>

Many SSI prevention bundles have reduced infection rates across a wide spectrum of surgical specialties.<sup>4,8-12</sup> Although several incision closure bundles have been studied, many have failed to include multiple evidence-based interventions with a well-documented risk-reduction potential, such as 0.05% CHG surgical irrigation before incision closure and the use of triclosan-coated sutures. The method used to close the surgical incision has a significant effect on patient morbidity, especially in individuals with multiple comorbidities.<sup>1,13-17</sup> For most surgical procedure types, there remains no standardized approach to incision closure. This wide variability in practice and its potential to affect SSI risk and morbidity offer an opportunity to reduce SSI risk using a reliable application of a bundle of evidence-based incision closure practices, initially targeting one or more high-risk surgical procedures.

Nonlaparoscopic colorectal surgery is a high-risk procedure because of its high SSI rate, reported to be between 15% and 30%.<sup>10</sup> Because of the high-risk nature of this procedure, it is among those tracked in the Centers for Medicare & Medicaid Services’ Hospital-Acquired Reduction Program, confirming that a focus on risk reduction for this procedure is a national priority.<sup>10,18,19</sup>

To ensure any successful practice change in the OR, a facility or organization must work to ensure support for the change at the executive level and with affected staff members. This should include robust multidisciplinary engagement involving surgeons and perioperative nurse executives, directed by an oversight group such as an OR committee. Without executive-level support, surgeon preferences may prevail and continue to guide practice.

## THE EPIDEMIOLOGY OF INTRAOPERATIVE INCISIONAL CONTAMINATION

In 1920, Sir Berkeley Moynihan, MD, surgeon to the crown, reported that “every operation is an experiment in bacteriology.”<sup>20(p27)</sup> Dr Moynihan recognized that multiple factors, both endogenous (eg, bacteria on the patient’s skin) and exogenous (eg, personnel, environment, materials used for surgery) can contribute to the intraoperative contamination of a surgical incision, which remains true today. The risk of contamination is heightened in colorectal procedures, in which a significant multispecies bacterial load is encountered. In one study, researchers reported that 48% of incisions made during 100 elective open colon procedures were contaminated during surgery (from endogenous and exogenous sources), and 21% of these contaminated incisions developed a clinically relevant infection.<sup>21</sup>

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## Incisional Contamination Resulting From Human Factors

In surgeries with a clean wound classification, a potential source of incisional contamination is the skin flora of patients and surgical staff members.<sup>22,23</sup> Preoperative skin and nasal preparation protocols, both those that the patient performs at home and that surgical staff members perform before incision, are designed to reduce transient and resident microorganisms on a patient’s skin and in his or her nasal passages.<sup>24,25</sup> However, patient compliance with preoperative bathing and nasal decolonization protocols is not always guaranteed, nor is proper skin preparation technique by surgical personnel in the OR. Even with full compliance and proper technique, residual bacteria can

persist on the patient's skin, depending on the body site, in numbers sufficient to cause an SSI. For example, one study of 50 patients demonstrated that *Propionibacterium acnes*, a common cause of SSI after shoulder surgery, remained present on the shoulder skin in 29% of patients after routine surgical skin preparation in the OR.<sup>26</sup> In the same study, when the application of 5% benzoyl peroxide preceded routine surgical skin preparation, the researchers reported *P acnes* to be present on the shoulder skin of only 6% of patients. Perioperative personnel should understand this type of procedure-specific SSI risk.<sup>26</sup>

Bacteria are routinely introduced into the surgical site when an incision is made through the skin because the transection of sebaceous glands results in a release of bacteria in the margins of the incision.<sup>27</sup> Errors in surgical technique also can lead to incision contamination. This is particularly true in abdominal surgery during which inadvertent enterotomy can spill bacteria-rich feces into the surgical site.<sup>28</sup> The omission of mechanical bowel preparation or oral antibiotics also can increase SSI risk in colorectal surgery.<sup>29</sup> Incomplete cleaning and sterilization of surgical instruments, particularly complex instruments (eg, robotic instruments), also can lead to intraoperative incisional contamination. A recent study concluded that complete removal of residual protein from robotic surgical instruments is "virtually impossible."<sup>30(p146)</sup>

### Incisional Contamination by Failure of Personal Protective Equipment

Surgical glove perforation is perhaps one of the most common failures of surgical personal protective equipment. Gloves serve as a barrier to the transmission of bacteria and viruses between the patient and health care providers; however, multiple studies have demonstrated that this barrier is often compromised during surgery because of glove perforation.<sup>31-35</sup> Glove failure can result from perforation by surgical instruments or sharp, bony fragments, or from a primary defect in the glove itself. Even micro-perforations of surgical gloves allow the transfer of skin flora from surgical personnel to the surgical incision.<sup>36</sup> In a study of 67 total hip and knee arthroplasties in which personnel did not perform double gloving, researchers documented that at least one of the two surgeons' gloves was damaged in 38.9% of procedures.<sup>34</sup>

Other personal protective equipment, including head covers, scrubs, and surgical masks, may not fully prevent

bacteria-laden aerosols, squamous skin cells, and hair from reaching the surgical site.<sup>23,37,38</sup> A study of surgical face masks found that although the masks provided an effective barrier for bacterial dispersal from the surgical personnel at the beginning of an operation, they were "almost ineffective" after two hours of wear.<sup>37</sup> Using pulsed-field gel electrophoresis, researchers recovered strains of coagulase-negative staphylococci and *S aureus* in air samples from the OR and linked these microorganisms to the operating team despite all staff members wearing surgical face masks.<sup>39</sup> Similarly, evidence has shown that bacterial shedding can occur through surgical scrub attire.<sup>38</sup>

### Incisional Contamination From OR Air

In the OR, circulating particles laden with microorganisms are also a source of surgical site contamination if those particles settle onto the incision. Perioperative personnel use engineering controls, including positive pressure, high-efficiency particulate air filtration, and air exchanges (eg, 20 air exchanges per hour), in addition to long sleeves for surgical team members and strategies to control door openings to minimize microorganisms in the air. However, personnel may not routinely test air quality in ORs. Door openings and foot traffic in ORs cause disruption of air currents and can lead to bacteria from personnel and the environment settling onto the surgical incision.<sup>40-44</sup> Seminal research has demonstrated that approximately 300 million squamous skin cells are released into the air each day per person, 30% of which can carry bacteria.<sup>45,46</sup> Investigators studying intraoperative microbial contamination during 70 vascular surgery procedures found that 35% to 50% of the time they could detect *S aureus* or *S epidermidis* in the OR room air less than one meter from the surgical incision.<sup>39</sup>

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### A BUNDLE TO STANDARDIZE THE INCISION CLOSURE PROCESS

A compelling body of evidence demonstrates the effectiveness of surgical care bundles in reducing the risk of SSI

after colorectal surgery.<sup>10,11,18,47-50</sup> A 2017 meta-analysis reviewed 23 studies (17,557 patients) that reported outcomes from the use of surgical care bundles.<sup>51</sup> The researchers noted an SSI risk reduction of 40% ( $P < .001$ ), with a 44% reduction of superficial SSIs ( $P < .001$ ) and a 34% reduction of organ and space SSIs ( $P = .048$ ). Bundles that included sterile closure trays, mechanical bowel preparation with oral antibiotics, and pre-closure glove changes had significantly greater SSI risk reduction.<sup>51</sup> This study and others have incorporated limited aspects of incision closure elements, predominantly glove and gown change before closure and a dedicated incision closure tray. To our knowledge, no studies have addressed standardizing the entire process of incision closure, beginning with the use of irrigation. The few reports of specific incision closure bundles have included a variety of elements. One study reported an incision closure bundle composed of changing gown and gloves, redraping, using wound lavage, and using a new set of instruments for closure.<sup>15</sup> These bundles consistently omitted two evidence-based interventions that have a well-documented risk-reduction potential: use of antiseptic-coated suture and 0.05% CHG surgical irrigation.

Multiple organizations have published peer-reviewed, evidence-based SSI prevention guidelines in the last two years, including guidelines from the Centers for Disease Control and Prevention (CDC) Healthcare Infection Control Practices Advisory Committee,<sup>5</sup> the American College of Surgeons (ACS) and Surgical Infection Society (SIS),<sup>1</sup> Health Research & Educational Trust,<sup>52</sup> and the World Health Organization.<sup>53</sup> Each of these guidelines, with the exception of the CDC guideline, offer some direction regarding incision closure.

The current variability in incision closure practice and the potential to affect surgical infection risk and morbidity suggests an opportunity to standardize evidence-based incision closure practices, beginning with colorectal surgical procedures. To support SSI prevention for colorectal surgery procedures, we propose an incision closure bundle with seven elements. Each element is supported either by Level 1 evidence of efficacy, an evidence-based guideline, one or more clinical studies, or expert opinion (Table 1).

### **Glove Change and Dedicated Closure Instrument Tray**

The practices of changing gloves and using a dedicated sterile instrument tray to close a surgical incision are

included in multiple surgical care bundles that have been shown to reduce SSI rates.<sup>1,10,11,49,50</sup> Although no research directly supports these individual practices outside of surgical bundles, the 2016 ACS and SIS SSI guideline concludes that

*although the literature lacks evidence to support the practice of changing gloves before closure and the use of new instruments, these practices are recommended for colorectal cases based on expert consensus and evidence supporting bundles that incorporate these practices.*<sup>1(p67-68)</sup>

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## **The current variability in incision closure practice and the potential to affect surgical infection risk and morbidity suggests an opportunity to standardize evidence-based incision closure practices, beginning with colorectal surgical procedures.**

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### **Irrigation With Aqueous 0.05% CHG Solution**

Surgeons often irrigate the surgical site throughout a procedure with sterile saline to improve visibility, keep tissues moist, and remove contaminants, although this is not universally practiced. Despite the potential benefit of surgical irrigation, there is virtually no standardization of the practice across all surgical specialties, and no official guideline from any major professional or accrediting organization.<sup>54</sup> The type of irrigation fluid, additives (eg, antiseptics, antibiotics), volume, and delivery method vary widely and are rarely reflected in departmental protocols or SSI prevention bundles.<sup>55,56</sup>

Despite the lack of standardization, there is sufficient evidence to support multiple principles of surgical irrigation practice.<sup>55,57</sup> Published reports favor low-pressure irrigation (eg, provided by bulb syringe), typically between 5 to 15 psi, to remove bacteria from the surgical site without causing soft tissue or bone injury that is reported with higher pressures (eg, using pulsatile jet lavage).<sup>55,57</sup> Historically, the use of antibiotic or antiseptic additives in irrigation fluids has been common in certain procedures (eg, joint arthroplasties).

**Table 1. Recommended Incision Closure Bundle Elements**

Bundle Element	Evidence
Outer surgical glove change before incision closure	<ul style="list-style-type: none"> <li>• Expert opinion</li> <li>• ACS SSI prevention guideline<sup>1</sup></li> <li>• Peer-reviewed papers<sup>2-5</sup></li> </ul>
Use of a dedicated sterile incision closure instrument tray	<ul style="list-style-type: none"> <li>• Expert opinion</li> <li>• ACS SSI prevention guideline<sup>1</sup></li> <li>• Peer-reviewed papers<sup>2-5</sup></li> </ul>
Irrigation with 0.05% CHG following the manufacturer’s IFU before closure	<ul style="list-style-type: none"> <li>• Peer-reviewed papers<sup>6-16</sup></li> </ul>
Use of antibacterial triclosan-coated sutures	<ul style="list-style-type: none"> <li>• Peer-reviewed papers<sup>17-28</sup></li> </ul>
Removal of the surgical drape after applying the dressing	<ul style="list-style-type: none"> <li>• Expert opinion</li> <li>• AST guideline<sup>29</sup></li> </ul>
Application of topical skin adhesive (with or without mesh) over subcuticular or absorbable skin suture or antimicrobial dressing	<ul style="list-style-type: none"> <li>• Expert opinion</li> <li>• Peer-reviewed papers<sup>30,31</sup></li> </ul>
Comprehensive postoperative instructions for the patient	<ul style="list-style-type: none"> <li>• Expert opinion</li> <li>• Peer-reviewed papers<sup>2,32-37</sup></li> </ul>

ACS = American College of Surgeons; SSI = surgical site infection; CHG = chlorhexidine gluconate; IFU = instructions for use.

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Table 1. (continued)

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However, mounting evidence has demonstrated a lack of efficacy of antibiotic irrigation in reducing SSI rates, and the potential for contributing to bacterial resistance has led to calls to eliminate its use.<sup>55,56</sup> These calls have grown louder given the clinical imperative of antibiotic stewardship programs that aim to reduce the development of bacterial resistance and to ensure the appropriate use of antibiotics. Experts have suggested that antiseptic irrigation is an effective alternative to antibiotic irrigation.<sup>56-59</sup>

The two antiseptics most commonly used in surgical irrigation are povidone-iodine (PVI) and CHG.<sup>55</sup> However, PVI does not have approval from the US Food and Drug Administration (FDA) for use in open surgical wounds and has been shown to be toxic to host cells and to have an inhibitory effect on wound healing.<sup>55,60,61</sup> Furthermore, the evidence for the efficacy of PVI as an irrigant additive is inconclusive. A recently published study of more than 3,000 women undergoing cesarean delivery compared the use of no irrigation with

PVI irrigation and found that PVI had no effect on the SSI rate.<sup>62</sup>

A growing body of evidence supports the use of sterile aqueous 0.05% CHG solution for surgical irrigation.<sup>61-65</sup> This solution is used just before closure of the incision to eliminate any contaminants that were introduced during the surgical procedure, and after waiting one minute for antimicrobial effect, is then rinsed out with sterile saline. Although higher concentrations of CHG are not approved for use on mucous membranes, the 0.05% concentration has been studied and determined to be safe and effective on mucous membranes.<sup>61</sup> The efficacy, rapid onset of action, persistent effect (up to 48 hours after initial application), and safety profile of CHG at 0.05% concentration renders it an appropriate addition for surgical site irrigation before closure.<sup>59,63-65</sup> The Wisconsin Division of Public Health recently released SSI prevention guidelines that include a recommendation for the use of aqueous 0.05% CHG solution for intraoperative irrigation.<sup>66</sup>

## Triclosan-Coated Sutures

In all types of surgical procedures, the method of surgical incision closure varies, and surgeon preference for the closure method is often the determining factor. The options for incision closure include suture (triclosan-coated and noncoated versions of absorbable, nonabsorbable, monofilament, braided, and knotless or barbed suture), skin staples, and topical skin adhesive with and without self-adhesive polyester mesh tape. Researchers have studied some closure methods extensively. Some of the most robust evidence guiding incision closure has resulted from studies of cesarean delivery procedures. These studies consistently report that the use of sutures is associated with a lower SSI risk than the use of staples.<sup>13,14,16,67</sup> In one meta-analysis, researchers reported a two-fold increase in SSIs after cesarean deliveries when surgeons used staples rather than sutures.<sup>14</sup> In a large meta-analysis, researchers found that the risk of SSI after hip surgery was four times greater when the surgeon used staples compared with sutures. The author concluded that “the use of staples for closing hip or knee surgery wounds ... cannot be recommended.”<sup>68(p1)</sup>

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Coating sutures with triclosan, a nontoxic antibacterial, is a strategy designed to reduce bacterial attachment to the suture and the formation of a biofilm.<sup>69</sup> In vitro testing of triclosan-coated sutures has demonstrated an inhibitory effect (that was sustained for seven days) on the growth of many common SSI pathogens, including MRSA and gram-negative extended spectrum beta lactamase bacteria.<sup>70,71</sup> Several independent meta-analyses of randomized controlled trials report a lower SSI risk when comparing triclosan-coated sutures with conventional (ie, noncoated) sutures.<sup>17,72-77</sup> Two recent studies<sup>78,79</sup> have suggested that the use of triclosan-coated sutures, in the words of Leaper et al, “may result in significant savings across various surgical wound types.”<sup>79(pe134)</sup> According to the Centre for Evidence-Based Medicine’s criteria, the large number of well-designed randomized control trials, systematic reviews, and meta-analyses reporting a reduction in SSIs after the use of triclosan-coated sutures represents

Level 1A clinical evidence.<sup>72</sup> Surgical site infection prevention guidelines from the World Health Organization, CDC, ACS and SIS, and the Wisconsin Supplemental SSI Prevention Guidelines all recommend the use of triclosan-coated sutures as an effective strategy for the prevention of SSIs.<sup>1,5,53,66</sup>

The risk of SSI is not the only factor to consider when choosing a method for incision closure. Surgeons must factor in other complications, such as incision dehiscence or unacceptable scarring (eg, hypertrophic, keloid, spreading scars).

## Removal of the Surgical Drape After Postoperative Dressing Application

To prevent contaminating the surgical incision during drape removal, the surgical team should remove the surgical drape only after the surgeon applies the postoperative dressing. After applying the postoperative dressing, the surgical technologist or surgeon may gently hold the dressing in place with one hand while removing the drape.<sup>80</sup> As the drape is being removed, it should be rolled up so that the exterior is contained within itself to prevent contamination.<sup>81</sup>

## Topical Skin Adhesive or Antiseptic Dressing

During the past several decades, surgeons have used topical skin adhesives in combination with subcuticular sutures to create an aseptic incision closure until skin edges begin to heal.<sup>82</sup> Skin adhesives have been demonstrated to maintain incision edge approximation effectively, but their effect on the reduction of SSIs is less clear.<sup>83</sup> An in vitro study found that topical skin adhesives promote a strong antiseptic barrier, preventing penetration by both gram-positive and gram-negative motile and nonmotile bacterial species.<sup>84</sup> A study of patients undergoing spinal surgery showed that the use of topical skin adhesives in combination with subcuticular sutures effectively maintained incision edge approximation and also reduced SSI rates when compared with conventional suture closure.<sup>85</sup> Topical skin adhesives can enhance practice efficiency by reducing the number of suture set-ups and dressings, reducing exposure to sharps, and simplifying postoperative incision management by eliminating the need for future staple or suture removal.

The use of antiseptic dressings on surgical incisions is another strategy for reducing postoperative SSI risk.

## Key Takeaways

- ◆ Surgical site infections (SSIs) are expensive and represent a substantial burden to health care in the United States. However, as many as 50% of all SSIs are considered preventable. Surgical site infection bundles—collections of a small number of evidence-based practices used together as part of a larger SSI prevention plan—can be used to reduce SSI risk.
- ◆ Multiple factors can contribute to the contamination of a surgical incision, including human factors, failure of personal protective equipment, and organisms in the OR air.
- ◆ For most surgical procedure types, there remains no standardized approach to incision closure. This wide variability in practice and its potential to affect SSI risk and morbidity offer an opportunity to reduce SSI risk using an incision closure bundle, initially targeting one or more high-risk surgical procedures.
- ◆ An incision closure bundle for colorectal surgery, which carries a high risk of SSI, could include the following evidence-based elements: outer surgical glove change before incision closure, use of a dedicated sterile incision closure instrument tray, irrigation with 0.05% chlorhexidine gluconate, use of antibacterial triclosan-coated sutures, removal of the surgical drape after applying the dressing, application of topical skin adhesive over subcuticular or absorbable skin suture or antimicrobial dressing, and comprehensive postoperative instructions for the patient.

A wide variety of commercially available dressings are impregnated with antiseptics, the most popular of which contain silver or polyhexamethylene biguanide.<sup>86</sup> Both of these antiseptics have been shown to have a broad spectrum of activity, including against MRSA.<sup>86</sup> Multiple studies have demonstrated a reduction in SSIs after the use of antiseptic dressings compared with basic wound contact dressings; however, large-scale reviews have found a high degree of bias in most of these studies.<sup>86,87</sup> Additional high-quality research is needed to establish best practice and until such research is available, logic supports the use of nontoxic antiseptic dressings to protect the vulnerable healing incision from bacterial contamination if the surgeon does not use topical skin adhesives.

### Postoperative Patient Instructions

Although most SSI prevention measures focus on the preoperative and intraoperative phases, the postoperative phase is also critical. Until the exudative and proliferative phases of wound healing are complete, the incisional edges are not fully sealed and the surgical incision remains vulnerable to exogenous bacterial contamination from the environment and substandard wound care.<sup>39,54,88</sup> For example, lumbar spinal fusion surgery incisions may be close to the buttocks and perineum, and contamination from bedpans and commodes can pose an infection risk. Body fluids, including blood and serum, that collect in the

incision can provide a rich growth medium for any contaminating organisms. The heavy perspiration that may collect in the skin folds in obese patients also can facilitate bacterial replication in a surgical incision.<sup>83</sup>

Because guidelines contain few recommendations regarding postoperative instructions for patients or caregivers regarding incision care after discharge, practitioners must use logic to create comprehensive postoperative patient instructions. General patient hygiene is important and the most recent ACS and SIS SSI guidelines state that early showering (defined as 12 hours after surgery) does not increase SSI risk.<sup>1</sup> Showering with CHG preparations has been included in preoperative surgical care bundles that have demonstrated significant reductions in SSIs, and although current evidence does not support routine postoperative showering with CHG, the practice is worthy of consideration.<sup>10,24,25</sup> Based on these published conclusions, at a minimum, we suggest that postoperative patient and caregiver instructions include guidance for hand hygiene, dressing care, routine personal hygiene and bathing, and environmental hygiene.

### CONCLUSION

Given the substantial morbidity, mortality, and costs associated with SSIs, there is ample opportunity to improve care. One aspect of surgical care that is variable and based primarily on surgeon preference instead of evidence is

the closure of the surgical incision. Establishing standardized best practices for incision closure has the potential to improve patient outcomes and reduce health care costs. We suggest that, although incision closure could be improved for all types of surgical procedures, colorectal procedures are an appropriate initial target for improving SSI rates. Between 300,000 and 600,000 open colorectal procedures are performed in the United States every year and they are associated with some of the highest SSI rates of any surgical procedure.<sup>12</sup> A comprehensive surgical incision closure bundle could provide an opportunity to improve outcomes after colorectal surgery and, if successful, could be applied to other specialties.

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## Continuing Education

## An Incision Closure Bundle for Colorectal Surgery

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## PURPOSE/GOAL

To provide the learner with knowledge of best practices related to incision closure bundles for colorectal surgery.

## OBJECTIVES

1. Discuss the purpose of an incision closure bundle for colorectal surgery.
2. Describe the endogenous and exogenous factors that can lead to incisional contamination.
3. Identify evidence-based components of an incision closure bundle.

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## QUESTIONS

1. A \_\_\_\_ infection is the most expensive of all health care-associated infections.
  - a. catheter-associated urinary tract
  - b. surgical site
  - c. central line-associated bloodstream
  - d. ventilator-associated pneumonia
2. A surgical site infection (SSI) bundle is defined as a small number of evidence-based practices that are used together as part of a larger SSI prevention plan.
  - a. true
  - b. false
3. The SSI rate for colorectal surgery is reported to be between \_\_\_\_ and \_\_\_\_\_.
  - a. 5%; 10%
  - b. 15%; 20%
  - c. 15%; 30%
  - d. 30%; 45%
4. Exogenous factors that can contribute to intraoperative contamination of a surgical incision include
  1. materials used for surgery.
  2. personnel.
  3. bacteria on the patient's skin.
  4. the environment.
    - a. 1 and 3
    - b. 1, 2, and 4
    - c. 1, 3, and 4
    - d. 1, 2, 3, and 4
5. Human factors that can contribute to intraoperative contamination of a surgical incision include
  1. patient compliance with preoperative bathing.
  2. skin flora of patients.
  3. omission of oral antibiotics.
  4. patient compliance with nasal decolonization protocols.
  5. skin flora of surgical staff members.
    - a. 4 and 5
    - b. 1, 2, and 3
    - c. 1, 2, 3, and 4
    - d. 1, 2, 3, 4, and 5
6. Door openings and foot traffic in ORs may contribute to contamination of a surgical incision because these factors cause disruption of air currents and can lead to bacteria from personnel and the environment settling onto the surgical incision.
  - a. true
  - b. false
7. The authors propose seven elements of an incision closure bundle for colorectal surgery, including

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<http://doi.org/10.1002/aorn.12120>

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1. use of antibacterial triclosan-coated sutures.
  2. comprehensive postoperative instructions for the patient.
  3. use of a dedicated sterile incision closure instrument tray.
  4. removal of the surgical drape after applying the dressing.
  5. irrigation with 0.05% chlorhexidine gluconate before closure.
  6. outer surgical glove change before incision closure.
    - a. 1, 3, and 5
    - b. 2, 4, and 6
    - c. 2, 3, 5, and 6
    - d. 1, 2, 3, 4, 5, and 6
8. The antiseptics most commonly used in surgical irrigation are
1. bacitracin.
  2. povidone-iodine.
  3. chlorhexidine gluconate.
- a. 1 and 2
  - b. 1 and 3
  - c. 2 and 3
  - d. 1, 2, and 3
9. Multiple studies have found incision closure using \_\_\_\_\_ to be associated with higher SSI rates when compared with using suture.
- a. topical skin adhesive
  - b. self-adhesive polyester mesh tape
  - c. staples
10. Benefits of using a topical skin adhesive include
1. simplifying postoperative incision management.
  2. reducing exposure to sharps.
  3. eliminating the need for a sterile incision closure instrument tray.
  4. reducing the number of dressings needed.
    - a. 1 and 3
    - b. 2 and 4
    - c. 1, 2, and 4
    - d. 1, 2, 3, and 4

## Continuing Education

## An Incision Closure Bundle for Colorectal Surgery

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## OBJECTIVES

To what extent were the following objectives of this continuing education program achieved?

- Discuss the purpose of an incision closure bundle for colorectal surgery.  
Low 1. 2. 3. 4. 5. High
- Describe the endogenous and exogenous factors that can lead to incisional contamination.  
Low 1. 2. 3. 4. 5. High
- Identify evidence-based components of an incision closure bundle.  
Low 1. 2. 3. 4. 5. High

## CONTENT

- To what extent did this article increase your knowledge of the subject matter?  
Low 1. 2. 3. 4. 5. High
- To what extent were your individual objectives met?  
Low 1. 2. 3. 4. 5. High

- Will you be able to use the information from this article in your work setting?  
1. Yes 2. No
- Will you change your practice as a result of reading this article? (If yes, answer question #7A. If no, answer question #7B.)
  - How will you change your practice? (*Select all that apply*)
    - I will provide education to my team regarding why change is needed.
    - I will work with management to change/implement a policy and procedure.
    - I will plan an informational meeting with physicians to seek their input and acceptance of the need for change.
    - I will implement change and evaluate the effect of the change at regular intervals until the change is incorporated as best practice.
    - Other: \_\_\_\_\_
  - If you will not change your practice as a result of reading this article, why? (*Select all that apply*)
    - The content of the article is not relevant to my practice.
    - I do not have enough time to teach others about the purpose of the needed change.
    - I do not have management support to make a change.
    - Other: \_\_\_\_\_

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<http://doi.org/10.1002/aorn.12120>

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