

# APIC Grand Canyon Chapter 88



# Let's Talk About Surgical Site Infections (SSI) – Questions And Some Possible Answers



*Edmiston CE et al. World Journal of Surgery 1990;14:176-183*

*Charles E. Edmiston Jr., PhD., CIC, FIDSA,  
FSHEA, FSIS, FAPIC  
Emeritus Professor of Surgery  
Department of Surgery  
Medical College of Wisconsin  
Milwaukee, Wisconsin USA  
edmiston@mcw.edu*



# Disclosure

I Don't Have All Of The Answers - Surgical Site Infections Often Represent A Complex And Multifactorial Process - The Mechanistic Etiology Or The Search For Resolution May At Times Be Quite Elusive

There is No Magic Bullet

# Compliance with Guidelines: Why are rates not falling?

- Compliance appears to be an issue with the use of both checklists and bundles
- Implementation of protocols can work in reducing SSI rates with the improvement of compliance using electronic prompts
- Perioperative team is responsible for ensuring that out of date, non-evidence-based practices are recognized and that using bundles with the best available evidence are implemented
- Use of checklists in hospitals may result in 'guideline blindness', but evidence that they are being used effectively and beneficially may be shared with the operating team by highlighting the 'near-miss' events prevented by their use
- Gaining acceptance and adoption requires considerable individual, cultural and institutional change with institutional support systems and governance
- Compliance to bundled intervention is variable (20-60%) in both USA and UK
- Surgeons are often identified as being key factors in non-compliance; some being unable to change personal and professional behavior to comply with checklists

*Leaper DJ, Tanner J, Kiernan M, Assadian O, Edmiston Jr CE. Surgical site infection: poor compliance with guidelines and care bundles. International wound journal. 2015;12(3):357-62*

# Something to Think About

## ORIGINAL CONTRIBUTION

### Assessment of the Risk and Economic Burden of Surgical Site Infection Following Colorectal Surgery Using a US Longitudinal Database: Is There a Role for Innovative Antimicrobial Wound Closure Technology to Reduce the Risk of Infection?

David J. Leaper, D.Sc.<sup>1</sup> • Chantal E. Holy, Ph.D.<sup>2</sup> • Maureen Spencer, M.Ed.<sup>3</sup>  
Abhishek Chitnis, Ph.D.<sup>2</sup> • Andrew Hogan, M.Sc.<sup>4</sup> • George W.J. Wright, Ph.D.<sup>4</sup>  
Brian Po-Han Chen, Sc.M.<sup>5</sup> • Charles E. Edmiston, Jr, Ph.D.<sup>6</sup>

AQ1

**BACKGROUND:** Colorectal surgical procedures place substantial burden on health care systems because of the high complication risk, in particular, surgical site infections. Risk of postoperative colorectal surgical site infection is one of the highest of any surgical specialty.

**OBJECTIVE:** The purpose of this study was to determine the incidence, cost of infections after colorectal surgery, and potential economic benefit of using antimicrobial wound closure to improve patient outcomes.

Supplemental digital content is available for this article. Direct URL citations appear in the printed text, and links to the digital files are provided in the HTML and PDF versions of this article on the journal's Web site ([www.dcrjournal.com](http://www.dcrjournal.com)).

**Funding/Support:** Funding was provided by Ethicon, Inc.

**Financial Disclosures:** Drs Edmiston and Leaper, and M. Spencer are members of the Johnson and Johnson Speakers Bureau. M. Spencer is on the speaker's bureau for Ethicon. Drs Holy and Chitnis, and B.P.-H. Chen are employees of Johnson and Johnson, Inc. A. Hogan and Dr Wright are employees of CRG-Eversana Canada Inc, which was contracted by Ethicon, Inc, which provided funding to assist in the analysis and review of the manuscript.

**Correspondence:** Charles E. Edmiston, Jr, Ph.D., Department of Surgery, Medical College of Wisconsin, 8701 Watertown Plank Rd, Milwaukee, WI 53226. E-mail: [edmiston@mcw.edu](mailto:edmiston@mcw.edu)

Dis Colon Rectum 2020 00 00-00  
DOI: 10.1097/DCR.0000000000001799  
© The ASCRS 2020

DISEASES OF THE COLON & RECTUM VOLUME XX: X (2020)

**DESIGN:** Retrospective observational cohort analysis and probabilistic cost analysis were performed.

**SETTINGS:** The analysis utilized a database for colorectal patients in the United States between 2014 and 2018.

**PATIENTS:** A total of 107,665 patients underwent colorectal surgery.

**MAIN OUTCOME MEASURES:** Rate of infection was identified between 3 and 180 days postoperatively, infection risk factors, infection costs over 24 months postoperatively by payer type (commercial payers and Medicare), and potential costs avoided per patient by using an evidence-based innovative wound closure technology.

**RESULTS:** Surgical site infections were diagnosed postoperatively in 23.9% of patients (4.0% superficial incisional and 19.9% deep incisional/organ space). Risk factors significantly increased risk of deep incisional/organ-space infection and included selective patient comorbidities, age, payer type, and admission type. After 12 months, adjusted increased costs associated with infections ranged from \$36,429 to \$144,809 for commercial payers and \$17,551 to \$102,280 for Medicare, depending on surgical site infection type. Adjusted incremental costs continued to increase over a 24-month study period for both payers. Use of antimicrobial wound closure for colorectal surgery is projected to significantly reduce median payer costs by \$809 to \$1170 per patient compared with traditional wound closure.

1

- Infection Rate (107,665 Colorectal Patients): 23.9%
- 50% of infections diagnosed at 3-25 days while 75% of infections diagnosed by/after 2 months
- CDC-NHSN & ACS-NSQIP closes the books on colorectal surveillance at 30-days

## Colorectal

- SSIs in patients undergoing colorectal surgery between 2014 and 2018

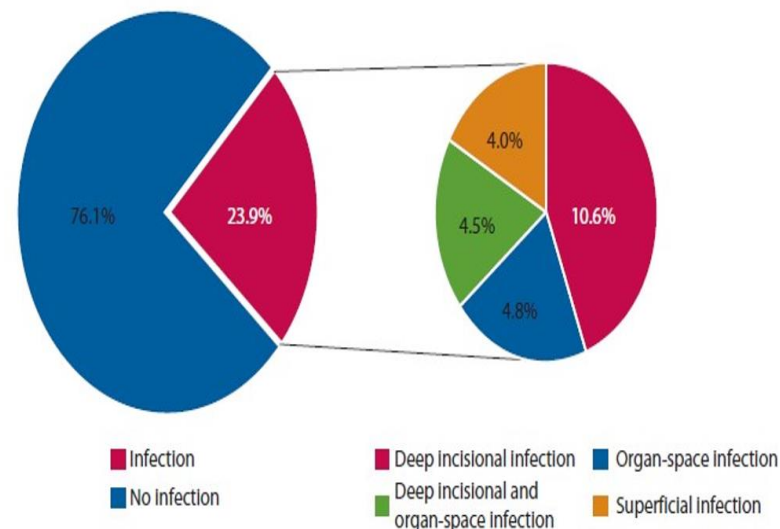


FIGURE 4. Surgical site infection rate at 6 months after the index colorectal surgery by infection type.

We Are Missing 30-35% of Colorectal Infections Due To Our Current Surveillance Strategies

## Question #1:

We are just beginning a ERAS program, focusing first on the colorectal patient population. Would you be able to discuss this with our ID physician?

Ans: Yes, I would be more than happy to discuss this issue with your ID and other essential players!

But a successful program is multidisciplinary, involving multiple players – especially a surgical champion.

First, what does it look like on paper?



# Colorectal Surgery Enhanced Recovery Protocol

## Pre-operative

- Patient education
- Smoking cessation
- Prehabilitation
- Nutrition assessment
- WOCN visit
- Diabetes Optimization
  - Universal HbA1C
- Preop Optimization Clinic
- Standardized Labs
- MRSA Screening
- Immunonutrition
  - Impact BID x 5 days
- Skin decontamination
  - CHG Shower
- Mechanical Bowel Prep
  - SUPREP split dose
- Oral Antibiotics
  - Neomycin 1g
  - Metronidazole 500mg
- Carbohydrate Loading
  - Ensure Pre-Surgery
- NPO
  - Continue clears

## Day of Surgery

- Bowel Preparation
- Clears until 3-4 hours preop
- Carbohydrate Loading
  - Ensure Pre-Surgery
- Hair Management
- Skin decontamination
  - CHG Wipes
- Glucose Management
  - Acucheck in preop
- Patient Warming
  - Bair Paws
- Ileus Prevention
  - Alvimopan 12mg
- DVT Prophylaxis
  - Heparin 5000u
- Pain Management
  - Gabapentin 600mg
  - Celecoxib 400mg
  - Acetaminophen 975mg

## Intra-operative

- Limit OR traffic
- Patient Warming
  - Bair Paws
- Skin Prep
  - Chloraprep by RN
- Antibiotics
  - Ceftriaxone 2g
  - Metronidazole 500mg
- Pain
  - TAP Liposomal bupivacaine
  - Ketorolac 30 mg
  - Ketamine 2 mcg/kg/min
- IV Fluids
  - Avoid overload
  - Avoid .9NS
- Glucose management
  - Hourly if DM
- Supplemental O<sub>2</sub> 80%
- PONV prevention
  - Dexamethasone 8mg
  - Ondansetron 4 mg
- Avoid NGT / Drains
- Minimally Invasive Surgery
- Wound protector
- Closing Protocol
  - Regown team
  - Redrape the patient
  - Closing instruments
  - Plus Antimicrobial sutures

## Post-operative

- Patient Warming
- Acucheck in PACU
- PONV
  - Ondansetron 4mg q6 x 48
- Ileus
  - Alvimopan 12 mg BID
  - Chewing Gum QID and PRN
- DVT Prophylaxis
  - Heparin 5000u q 8
- Pain
  - Acetaminophen 650mg q6
  - Ketorolac q6 x 6
  - Gabapentin 600 q12
  - Ketamine drip x 24-48h
  - Tramadol 50mg q6
  - Norco/Oxycodone PRN
- Rehabilitation
  - Up to chair POD#0
  - Ambulate QID
- WOCN
- Nutrition
  - Clears POD#0
  - Low Residue POD#1
- Heplock POD#1
- Urinary Catheter
  - POD#1 for colectomy
  - POD#2 for proctectomy
- Supplemental O<sub>2</sub> until POD#1
- Post discharge phone call
- Follow up 1 week

• Irrigation

# A New Era In Improving Patient Outcomes

Clinical Review & Education

JAMA Surgery | Review

## 'Enhanced Recovery After Surgery' A Review

Olle Ljungqvist, MD, PhD; Michael Scott, MD; Kenneth C. Fearon, MD, PhD<sup>1</sup>

**IMPORTANCE** Enhanced Recovery After Surgery (ERAS) is a paradigm shift in perioperative care, resulting in substantial improvements in clinical outcomes and cost savings.

**OBSERVATIONS** Enhanced Recovery After Surgery is a multimodal, multidisciplinary approach to the care of the surgical patient. Enhanced Recovery After Surgery process implementation involves a team consisting of surgeons, anesthesiologists, an ERAS coordinator (often a nurse or a physician assistant), and staff from units that care for the surgical patient. The care protocol is based on published evidence. The ERAS Society, an international nonprofit professional society that promotes, develops, and implements ERAS programs, publishes updated guidelines for many operations, such as evidence-based modern care changes from overnight fasting to carbohydrate drinks 2 hours before surgery, minimally invasive approaches instead of large incisions, management of fluids to seek balance rather than large volumes of intravenous fluids, avoidance of or early removal of drains and tubes, early mobilization, and serving of drinks and food the day of the operation. Enhanced Recovery After Surgery protocols have resulted in shorter length of hospital stay by 30% to 50% and similar reductions in complications, while readmissions and costs are reduced. The elements of the protocol reduce the stress of the operation to retain anabolic homeostasis. The ERAS Society conducts structured implementation programs that are currently in use in more than 20 countries. Local ERAS teams from hospitals are trained to implement ERAS processes. Audit of process compliance and patient outcomes are important features. Enhanced Recovery After Surgery started mainly with colorectal surgery but has been shown to improve outcomes in almost all major surgical specialties.

**CONCLUSIONS AND RELEVANCE** Enhanced Recovery After Surgery is an evidence-based care improvement process for surgical patients. Implementation of ERAS programs results in major improvements in clinical outcomes and cost, making ERAS an important example of value-based care applied to surgery.

JAMA Surg. 2017;152(3):292-298. doi:10.1001/jamasurg.2016.4952  
Published online January 11, 2017.

The Enhanced Recovery After Surgery (ERAS) protocol was developed by a group of academic surgeons in Europe in 2001 when they formed the ERAS Study group (Table 1). Although the term *fast-track surgery* had been described, the group wanted to emphasize that the key surgical end point is the quality, rather than speed, of recovery. The concept rested on several components: a multidisciplinary team working together around the patient; a multimodal approach to resolving issues that delay recovery and cause complications; a scientific, evidence-based approach to care protocols; and a change in management using interactive and continuous audit. This review describes the development of ERAS, how these ideas are brought into practice, and how they are now spreading to various disciplines of surgical practice, as well as some of the main outcome improvements and an implementation strategy to achieve sustained outcome improvements.

A project to improve outcomes of coronary artery bypass surgery by bundling perioperative treatments under a concept name, *Fast*

*Track*, was published in 1994.<sup>1</sup> This study showed a reduction in length of stay in the intensive care unit by about 20%. A year later, Bardram et al<sup>2</sup> reported a substantial shortening of recovery time in 8 patients undergoing sigmoid resection who were discharged 2 days after surgery. This publication was followed by a report by Kehlet and Mogensen<sup>3</sup> of a larger series confirming a rapid recovery after sigmoid resection using a multimodal approach. Kehlet, a surgeon, promoted thoracic epidural anesthesia as a way of controlling pain, improving mobility, and reducing postoperative ileus. Concurrently, other ERAS group members were addressing perioperative care from an endocrine<sup>4</sup> and metabolic viewpoint. This approach included the roles of specific amino acids in perioperative nutrition,<sup>5</sup> inflammation and protein metabolism in surgical patients with cancer,<sup>6</sup> and metabolic preparation using a preoperative carbohydrate drink to avoid effects of fasting.<sup>7</sup> The group was focused on enhancing recovery and reducing complications by modifying the metabolic response to surgical insult rather than just limiting length of stay.

CME Quiz at  
jamanetworkcme.com

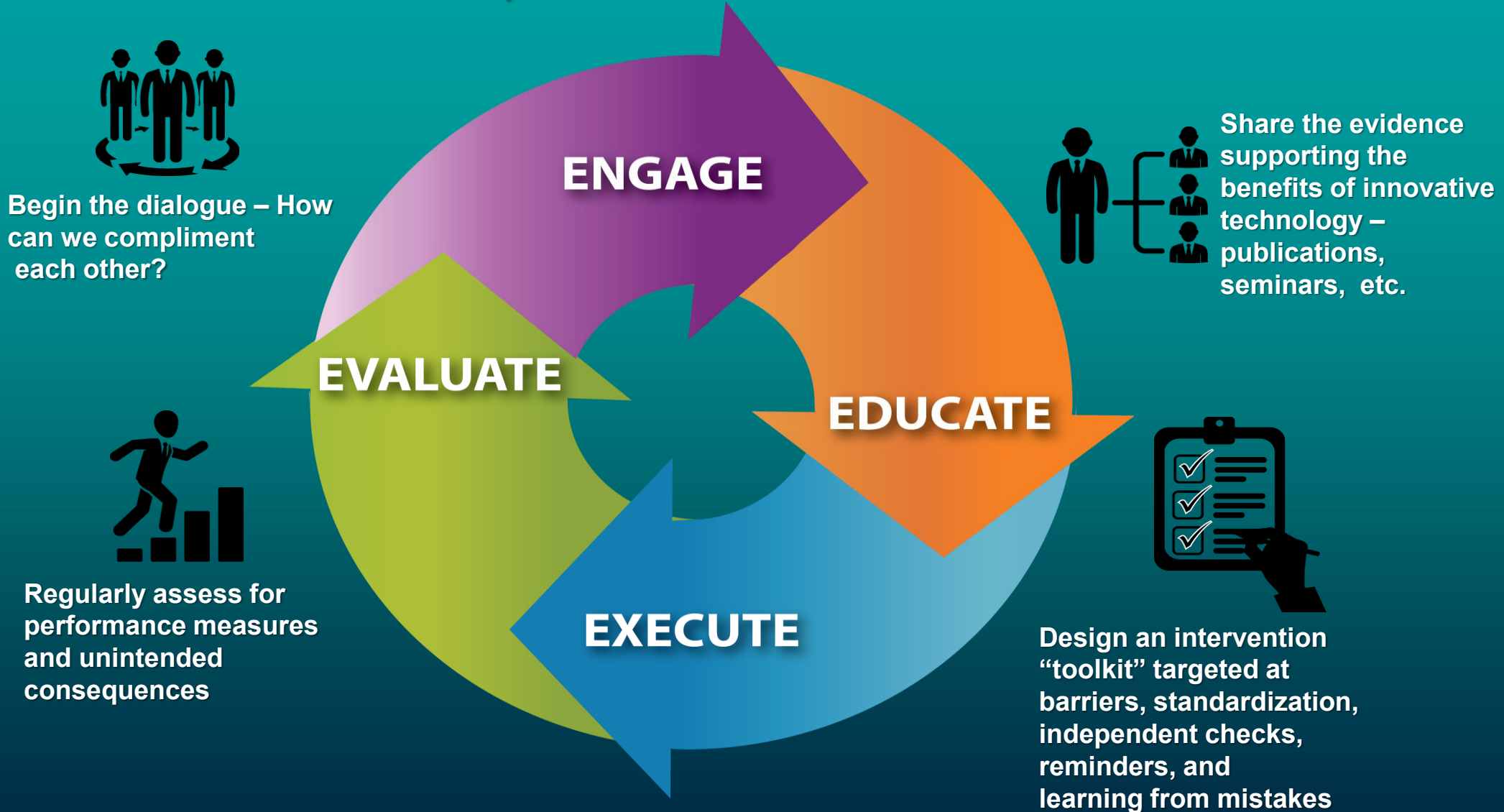
**Author Affiliations:** Faculty of Medicine and Health, School of Health and Medical Sciences, Department of Surgery, Örebro University Örebro, Sweden (Ljungqvist); Royal Surrey County National Health Service Foundation Trust, University of Surrey, Guildford, England (Scott); Department of Anesthesiology, Virginia Commonwealth University School of Medicine, Richmond (Scott); Clinical Surgery, School of Clinical and Surgical Sciences, University of Edinburgh, Royal Infirmary, Edinburgh, Scotland (Fearon).  
**Corresponding Author:** Olle Ljungqvist, MD, PhD, Faculty of Medicine and Health, School of Health and Medical Sciences, Department of Surgery, Örebro University Hospital, SE-701 85 Örebro, Sweden (olle.ljungqvist@oru.se).

- Requires multidisciplinary team working together to improve patient outcomes
- Multimodal strategies to resolve issues that delay recovery, causing complications
- A scientific, evidence-based approach to care protocols
- Studies document reduction in length of stay (IOS), decreased mortality, fewer postop complications and cost-effectiveness
- Focus on nutritional aspects of care – includes the role of specific amino acids and perioperative nutrition
- May include 24 or more core elements that have scientific documentation for improving clinical outcome
- Requires an interactive management with continuous audits – Surgical leadership (support) is crucial and must exist within a collaborative framework

## Question #2:

I think IPs often feel intimidated by the operating room environment and staff, especially surgeons. Do you have any advise to IPs regarding how to develop a collaborative SSI prevention efforts with their surgical teams?

# A Collegial Partnership in an Evidence-Based Space to Improve Patient Outcomes



*Pronovost PJ, et al. BMJ. 2008;337:963-965*

*Anderson DJ, et al, Infect Control Hosp Epidemiol. 2014;35:605-627*

## Questions #3 and #4

For facilities that may have low compliance with an SSI Prevention strategy (bundle) - What is the best way to gain buy-in from surgeons and perioperative staff?

What strategies helped you move the implementation into standard practice?

You Must **ABSOLUTELY** Read The  
Appropriate Surgical Literature – The  
Infection Control or ID Literature **WILL NOT**  
Always Provide You With The Information  
That You Will Need To Effectively Reduce  
Co-morbid Risk

**PS: If your library doesn't have the source material that you need – Contact me  
([edmiston@mcw.edu](mailto:edmiston@mcw.edu)) - I'll get the papers for you.**

## SHEA/IDSA/APIC Practice Recommendation

# Strategies to prevent surgical site infections in acute-care hospitals: 2022 Update

Michael S. Calderwood MD, MPH<sup>1,a</sup>, Deverick J. Anderson MD, MPH<sup>2,a</sup>, Dale W. Bratzler DO, MPH<sup>3</sup>, E. Patchen Dellinger MD<sup>4</sup>, Sylvia Garcia-Houchins RN, MBA, CIC<sup>5</sup>, Lisa L. Maragakis MD, MPH<sup>6</sup>, Ann-Christine Nyquist MD, MSPH<sup>7</sup>, Kiran M. Perkins MD, MPH<sup>8</sup>, Michael Anne Preas RN, MS, CIC<sup>9</sup>, Lisa Saiman MD, MPH<sup>10</sup>, Joshua K. Schaffzin MD, PhD<sup>11</sup>, Marin Schweizer PhD<sup>12</sup>, Deborah S. Yokoe MD, MPH<sup>13</sup> and Keith S. Kaye MD, MPH<sup>14,b</sup>

<sup>1</sup>Dartmouth Hitchcock Medical Center, Lebanon, New Hampshire, United States, <sup>2</sup>Duke Center for Antimicrobial Stewardship and Infection Prevention, Duke University School of Medicine, Durham, North Carolina, United States, <sup>3</sup>University of Oklahoma Health Sciences Center, Oklahoma City, Oklahoma, United States, <sup>4</sup>University of Washington Medical Center, Seattle, Washington, United States, <sup>5</sup>The Joint Commission, Oakbrook Terrace, Illinois, United States, <sup>6</sup>Johns Hopkins School of Medicine, Baltimore, Maryland, United States, <sup>7</sup>Children's Hospital Colorado, University of Colorado School of Medicine, Aurora, Colorado, United States, <sup>8</sup>Division of Healthcare Quality Promotion, Centers for Disease Control and Prevention, Atlanta, Georgia, United States, <sup>9</sup>University of Maryland Medical System, Baltimore, Maryland, United States, <sup>10</sup>Columbia University Irving Medical Center and NewYork-Presbyterian Hospital, New York, New York, United States, <sup>11</sup>Children's Hospital of Eastern Ontario, University of Ottawa, Ottawa, Ontario, Canada, <sup>12</sup>Center for Access and Delivery Research and Evaluation, Iowa City VA Health Care System, University of Iowa, Iowa City, Iowa, <sup>13</sup>University of California-San Francisco, San Francisco, California, United States and <sup>14</sup>Rutgers Robert Wood Johnson Medical School, New Brunswick, New Jersey, United States

### Abstract and purpose

The intent of this document is to highlight practical recommendations in a concise format designed to assist acute-care hospitals in implementing and prioritizing their surgical site infection (SSI) prevention efforts. This document updates the *Strategies to Prevent Surgical Site Infections in Acute Care Hospitals* published in 2014.<sup>1</sup> This expert guidance document is sponsored by the Society for Healthcare Epidemiology of America (SHEA). It is the product of a collaborative effort led by SHEA, the Infectious Diseases Society of America (IDSA), the Association for Professionals in Infection Control and Epidemiology (APIC), the American Hospital Association (AHA), and The Joint Commission, with major contributions from representatives of a number of organizations and societies with content expertise.

(Received 20 March 2023; accepted 21 March 2023)

### Summary of major changes

This section lists major changes from the *Strategies to Prevent Surgical Site Infections in Acute Care Hospitals: 2014 Update*,<sup>1</sup> including recommendations that have been added, removed, or altered. Recommendations are categorized as essential practices that should be adopted by all acute-care hospitals (in 2014 these were "basic practices," renamed to highlight their importance as a foundation for hospitals' healthcare-associated infection (HAI) prevention programs) or additional approaches that can be considered for use in locations and/or populations within hospitals when SSIs are not controlled after implementation of essential practices (in 2014 these were called "special approaches"). See Table 1 for

a complete summary of recommendations contained in this document.

### Essential practices

- Modified recommendation to administer prophylaxis according to evidence-based standards and guidelines to emphasize that antimicrobial prophylaxis should be discontinued at the time of surgical closure in the operating room.
- The use of parenteral and oral antibiotics prior to elective colorectal surgery is now considered an essential practice. This recommendation was included in the 2014 document but was a sub-bullet recommendation. This recommendation was elevated to its own recommendation for increased emphasis.
- Reclassified decolonization of surgical patients with an antistaphylococcal agent for cardiothoracic and orthopedic procedures from an Additional Approach to an Essential Practice.
- The use of vaginal preparation with an antiseptic solution prior to cesarean delivery and hysterectomy was added as an essential practice.

**Author for correspondence:** Michael S. Calderwood, MD, MPH, [michael.s.calderwood@hitchcock.org](mailto:michael.s.calderwood@hitchcock.org)

<sup>a</sup>Authors of equal contribution.

<sup>b</sup>Senior author.

**Cite this article:** Calderwood MS, Anderson DJ, Bratzler DW, et al. Strategies to prevent surgical site infections in acute-care hospitals: 2022 Update. *Infect Control Hosp Epidemiol* 2023. doi: 10.1017/ice.2023.67

# Clinical Practice Guidelines for Enhanced Recovery After Colon and Rectal Surgery From the American Society of Colon and Rectal Surgeons and the Society of American Gastrointestinal and Endoscopic Surgeons

Jennifer L. Irani, M.D.<sup>1</sup> • Traci L. Hedrick, M.D.<sup>2</sup>  
Timothy E. Miller, M.D.<sup>3</sup> • Lawrence Lee, M.D., Ph.D.<sup>4</sup>  
Emily Steinhagen, M.D.<sup>5</sup> • Benjamin D. Shogan, M.D.<sup>6</sup>  
Joel E. Goldberg, M.D.<sup>7</sup> • Daniel L. Feingold, M.D.<sup>8</sup> Amy L. Lightner, M.D.<sup>9</sup>  
Ian M. Paquette, M.D.<sup>10</sup>

- 1 Department of Surgery, Division of Colorectal Surgery, Brigham and Women's Hospital, Harvard Medical School, Boston, Massachusetts
- 2 Department of Surgery, University of Virginia Health System, Charlottesville, Virginia
- 3 Department of Anesthesiology, Duke University, Durham, North Carolina
- 4 Department of Surgery, McGill University, Montreal, Quebec, Canada
- 5 Department of Surgery, University Hospital Cleveland Medical Center, Cleveland, Ohio
- 6 Department of Surgery, University of Chicago Pritzker School of Medicine, Chicago, Illinois
- 7 Department of Surgery, Division of Colorectal Surgery, Brigham and Women's Hospital, Harvard Medical School, Boston, Massachusetts
- 8 Department of Surgery, Section of Colorectal Surgery, Rutgers University, New Brunswick, New Jersey
- 9 Department of Colorectal Surgery, Cleveland Clinic Foundation, Cleveland Clinic
- 10 Division of Colon and Rectal Surgery, University of Cincinnati College of Medicine, Cincinnati, Ohio

The American Society of Colon and Rectal Surgeons (ASCRS) and the Society of American Gastrointestinal and Endoscopic Surgeons (SAGES) are dedicated to ensuring high-quality innovative patient care for surgical patients by advancing the science, prevention, and management of disorders and diseases of the colon, rectum, and anus as well as advancing minimally invasive surgery. The ASCRS and SAGES society members involved in the creation of these guidelines were chosen because they have demonstrated expertise in the specialty of colon and rectal surgery and enhanced

recovery. This consensus document was created to lead international efforts in defining quality care for conditions related to the colon, rectum, and anus and develop clinical practice guidelines based on the best available evidence. Although not prescriptive, these guidelines provide information based on which decisions can be made and do not dictate a specific form of treatment. These guidelines are intended for use by all practitioners, health care workers, and patients who desire information on the management of the conditions addressed by the topics covered in these guidelines. These guidelines should not be deemed

**Funding/Support:** None reported.

**Financial Disclosure:** The funding bodies (ASCRS and SAGES) did not influence the content of this work, and no other specific funding was received from other entities.

This publication was approved by both the ASCRS and SAGES executive council and then peer-reviewed by the *Diseases of the Colon & Rectum and Surgical Endoscopy and Other Interventional Techniques*. The articles are identical except for minor stylistic and spelling differences in keeping with each journal's style. Either citation can be used when citing this article. In order to encourage its wide dissemination, this article is freely accessible on *Surgical Endoscopy and Other Interventional Techniques and Diseases of the Colon & Rectum* journal web sites.

Jennifer L. Irani and Traci L. Hedrick are co-first authors.

**Correspondence:** Ian M. Paquette, M.D., Division of Colon and Rectal Surgery, University of Cincinnati College of Medicine, 2123 Auburn Avenue #524, Cincinnati, OH 45219. E-mail: [ian.m.paquette@gmail.com](mailto:ian.m.paquette@gmail.com)

*Dis Colon Rectum* 2023; 66: 15–40  
DOI: 10.1097/DCR.0000000000002650

Copyright © 2022 The Author(s). Published by Wolters Kluwer Health, Inc. on behalf of the American Society of Colon and Rectal Surgeons. This is an open-access article distributed under the terms of the Creative Commons Attribution-Non Commercial-No Derivatives License 4.0 (CC BY-NC-ND), where it is permissible to download and share the work provided it is properly cited. The work cannot be changed in any way or used commercially without permission from the journal.

# Evolution of the Surgical Wound Taskforce (SWT) – 1992 Froedtert Hospital Milwaukee - MCW Affiliate

- Why a SWT? – Limited intimate knowledge of the interplay between the surgical teams, patient risk factors, OR environment, surgical technology and selective invasive procedures
- Components of the SWT:
  - Monthly Meeting
  - 4 ICPs
  - Hospital Epidemiologist
  - Invited Surgeons
  - Invited Selective OR Personnel (Managers)
  - ★ Food – Lunch
- Agenda – initiated to discuss difficult cases - expanded to encompass the OR environment and how can we help each other to improve the surgical outcome by implementing evidence-based strategies and build trust/respect between clinical practitioners and Infection Control

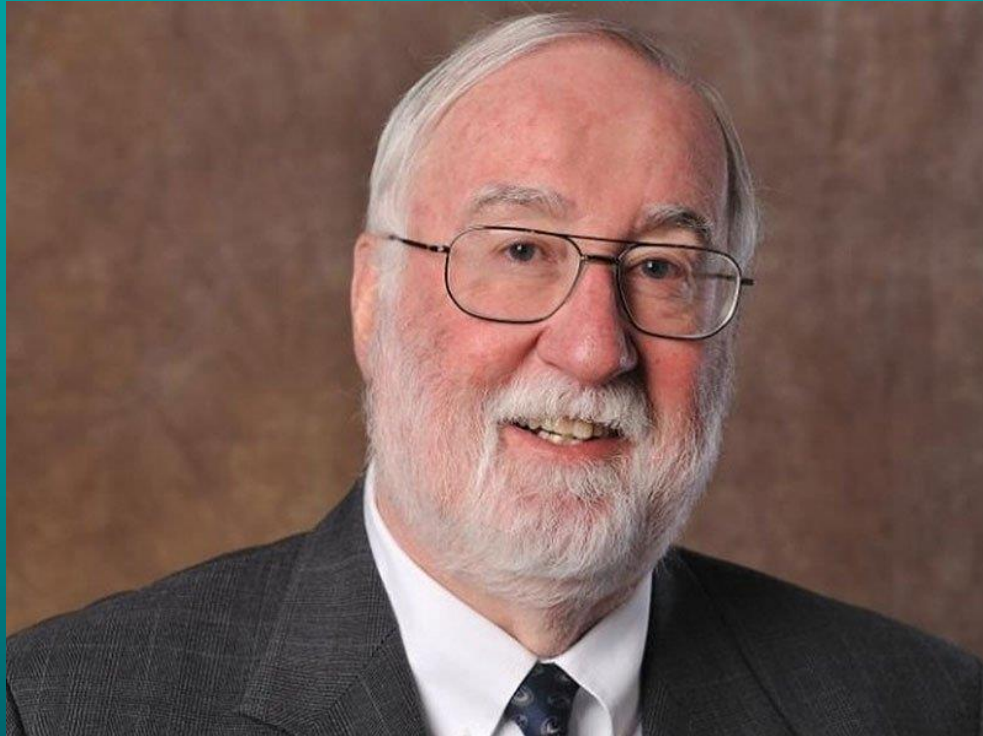
## Question #5, #6 and #7

Have you identified bundle elements that correlate most strongly with SSI reduction?

How do you build in resiliency to ensure the bundle is completed 100% of the time in this dynamic environment?

How do you handle the situation when surgeons want to individualize their patient care outside the bundle recommendations?

# Let Me Address Question Number 7 First



“The practice of evidence-based medicine means integrating individual clinical expertise with the best external evidence from systematic reviews.”

*Sackett et al. Evidence-based medicine: what it is and what it isn't. BMJ 1996;312:71-72*

# Postoperative Wound Care Begins in the Operating Room: Incisional Wound Closure Bundle

- Glove change prior to wound closure<sup>1,2,3</sup>
- Dedicated wound closure tray<sup>1,2,3</sup>
- Irrigation with 0.05% CHG<sup>2,3</sup>
- Use of antiseptic sutures for wound closure<sup>1,2,3</sup>
- Application of skin adhesive following subcuticular wound closure<sup>2,3</sup>
- Remove surgical drape after applying dressing<sup>2,3</sup>
- Comprehensive postoperative patient instructions<sup>2,3</sup>

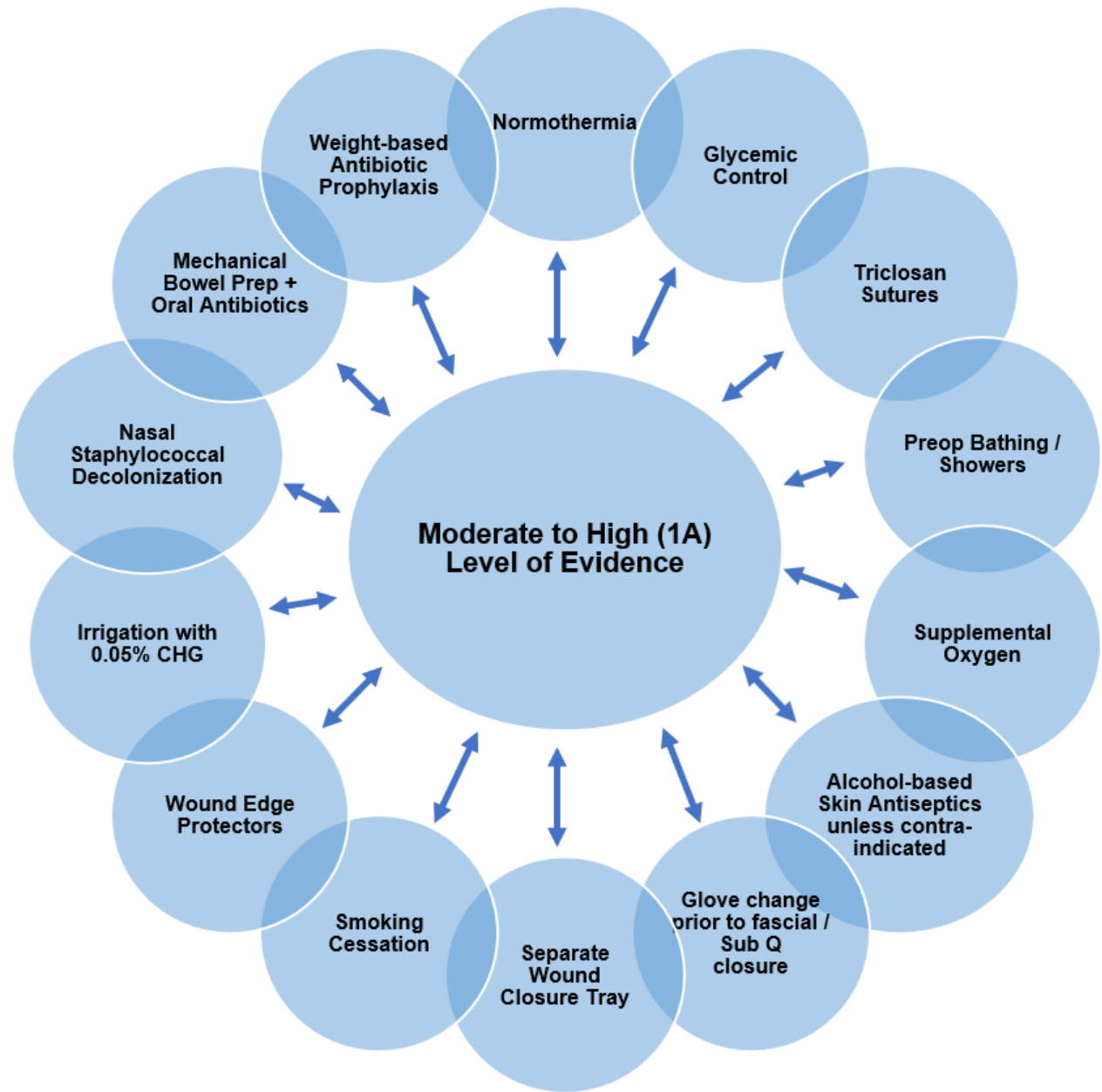
1: CDC SSI Guidelines; 2: Expert opinion; 3: Peer literature



Edmiston CE et al, AORN J 2018;107:552-565

So, Where Do We Start?

# Selecting An Evidence-Based (EB) Surgical Care Bundle



## CLINICAL

### 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.*

# Building an Effective Surgical Care Bundle

## Baseline Evidence-Based Interventions – Designated High to 1A\*

- Normothermia – 1A
- Perioperative antimicrobial prophylaxis – Weight-based – 1A
- Antimicrobial (triclosan) coated sutures (fascia / subcuticular closure) – 1A
- Preadmission CHG shower/cleansing – Standardized regimen – 1A
- Perioperative antisepsis – 2% CHG/ 70% alcohol – 1A
- Glycemic control – 1A
- Separate wound closure tray – Moderate
- Glove change prior to fascia/subcuticular closure – Moderate
- Smoking cessation – High

## Inclusive Evidence-Based Intervention for Consideration in 2019\*

- Supplemental oxygen – Colorectal – 1A
- Oral antibiotics / Mechanical bowel prep – Colorectal – 1A
- Wound edge protector – Colorectal – 1A
- Staphylococcal decolonization – Orthopedic / CT - 1A
- Irrigation with 0.05% CHG - Moderate
- OR traffic control – Device-related procedures – Low

\* Published level of evidence

OPEN  
CLINICAL PRACTICE GUIDELINES

### Clinical Practice Guidelines for Enhanced Recovery After Colon and Rectal Surgery From the American Society of Colon and Rectal Surgeons and the Society of American Gastrointestinal and Endoscopic Surgeons

Jennifer L. Irani, M.D.<sup>1</sup> • Traci L. Hedrick, M.D.<sup>2</sup>  
Timothy E. Miller, M.D.<sup>3</sup> • Lawrence Lee, M.D., Ph.D.<sup>4</sup>  
Emily Steinhagen, M.D.<sup>5</sup> • Benjamin D. Shogan, M.D.<sup>6</sup>  
Joel E. Goldberg, M.D.<sup>7</sup> • Daniel L. Feingold, M.D.<sup>8</sup> Amy L. Lightner, M.D.<sup>9</sup>  
Ian M. Paquette, M.D.<sup>10</sup>

1 Department of Surgery, Division of Colorectal Surgery, Brigham and Women's Hospital, Harvard Medical School, Boston, Massachusetts  
2 Department of Surgery, University of Virginia Health System, Charlottesville, Virginia  
3 Department of Anesthesiology, Duke University, Durham, North Carolina  
4 Department of Surgery, McGill University, Montreal, Quebec, Canada  
5 Department of Surgery, University Hospital Cleveland Medical Center, Cleveland, Ohio  
6 Department of Surgery, University of Chicago Pritzker School of Medicine, Chicago, Illinois  
7 Department of Surgery, Division of Colorectal Surgery, Brigham and Women's Hospital, Harvard Medical School, Boston, Massachusetts  
8 Department of Surgery, Section of Colorectal Surgery, Rutgers University, New Brunswick, New Jersey  
9 Department of Colorectal Surgery, Cleveland Clinic Foundation, Cleveland, Ohio  
10 Division of Colon and Rectal Surgery, University of Cincinnati College of Medicine, Cincinnati, Ohio

The American Society of Colon and Rectal Surgeons (ASCRS) and the Society of American Gastrointestinal and Endoscopic Surgeons (SAGES) are dedicated to ensuring high-quality innovative patient care for surgical patients by advancing the science, prevention, and management of disorders and diseases of the colon, rectum, and anus as well as advancing minimally invasive surgery. The ASCRS and SAGES society members involved in the creation of these guidelines were chosen because they have demonstrated expertise in the specialty of colon and rectal surgery and enhanced recovery. This consensus document was created to lead international efforts in defining quality care for conditions related to the colon, rectum, and anus and develop clinical practice guidelines based on the best available evidence. Although not prescriptive, these guidelines provide information based on which decisions can be made and do not dictate a specific form of treatment. These guidelines are intended for use by all practitioners, health care workers, and patients who desire information on the management of the conditions addressed by the topics covered in these guidelines. These guidelines should not be deemed

**Funding/Support:** None reported.

**Financial Disclosure:** The funding bodies (ASCRS and SAGES) did not influence the content of this work, and no other specific funding was received from other entities.

This publication was approved by both the ASCRS and SAGES executive council and then peer-reviewed by the *Diseases of the Colon & Rectum* and *Surgical Endoscopy And Other Interventional Techniques*. The articles are identical except for minor stylistic and spelling differences in keeping with each journal's style. Either citation can be used when citing this article. In order to encourage its wide dissemination, this article is freely accessible on *Surgical Endoscopy And Other Interventional Techniques* and *Diseases of the Colon & Rectum* journal web sites.

DISEASES OF THE COLON & RECTUM VOLUME 66: 1 (2023)

recovery. This consensus document was created to lead international efforts in defining quality care for conditions related to the colon, rectum, and anus and develop clinical practice guidelines based on the best available evidence. Although not prescriptive, these guidelines provide information based on which decisions can be made and do not dictate a specific form of treatment. These guidelines are intended for use by all practitioners, health care workers, and patients who desire information on the management of the conditions addressed by the topics covered in these guidelines. These guidelines should not be deemed

Jennifer L. Irani and Traci L. Hedrick are co-first authors.  
Correspondence: Ian M. Paquette, M.D., Division of Colon and Rectal Surgery, University of Cincinnati College of Medicine, 2123 Auburn Avenue #524, Cincinnati, OH 45219. E-mail: ian.m.paquette@gmail.com  
Dis Colon Rectum 2023; 66: 15–40  
DOI: 10.1097/DICR.0000000000002650  
Copyright © 2022 The Author(s). Published by Wolters Kluwer Health, Inc. on behalf of the American Society of Colon and Rectal Surgeons. This is an open-access article distributed under the terms of the Creative Commons Attribution-Non Commercial-No Derivatives License 4.0 (CC BY-NC-ND), where it is permissible to download and share the work provided it is properly cited. The work cannot be charged in any way or used commercially without permission from the journal.

Irani JL, et al. DCR 2023

# There Are Many Models For The Concept Of Implementation Science

- Embrace the sentinel stakeholders through collaboration (nursing, surgeons, IDs, IPs and other potential interested parties including C-Suite players)
- Through collaboration, identify the underlying causes of the current problems and/or potential barriers to adopting an effective Surgical Care Bundle (SCB)
- Validate the mechanistic benefits of embracing an evidence-based pathway (SCB)
- Continuously monitor outcomes and retool the failures
- Share the successes with the other surgical services – get all of the teams onboard and **keep them onboard**

**Remember – This works best if everyone is on-board**

## ORIGINAL ARTICLE

# Surgical site infection: poor compliance with guidelines and care bundles

David J Leaper<sup>1</sup>, Judith Tanner<sup>2</sup>, Martin Kiernan<sup>3</sup>, Ojan Assadian<sup>4</sup> & Charles E Edmiston Jr<sup>5</sup>

1 School of Applied Sciences, University of Huddersfield, Huddersfield, UK

2 Clinical Nursing Research, DeMontfort University, Leicester, UK

3 Prevention and Control of Infection, Southport and Ormskirk Hospitals NHS Trust, Southport, UK

4 Department of Hospital Hygiene, Medical University of Vienna, Vienna, Austria

5 Department of Surgery, Medical College of Wisconsin, Milwaukee, WI USA

**Key words**

Care bundles; Compliance; Guidelines;  
Surgical site infection

**Correspondence to**

DJ Leaper

Professor of Clinical Sciences

University of Huddersfield

Huddersfield

West Yorkshire

UK

E-mail: profdavidleaper@doctors.org.uk

Leaper DJ, Tanner J, Kiernan M, Assadian O, Edmiston CE Jr. Surgical site infection: poor compliance with guidelines and care bundles. *Int Wound J* 2014; doi: 10.1111/iwj.12243

**Abstract**

Surgical site infections (SSIs) are probably the most preventable of the health care-associated infections. Despite the widespread international introduction of level I evidence-based guidelines for the prevention of SSIs, such as that of the National Institute for Clinical Excellence (NICE) in the UK and the surgical care improvement project (SCIP) of the USA, SSI rates have not measurably fallen. The care bundle approach is an accepted method of packaging best, evidence-based measures into routine care for all patients and, common to many guidelines for the prevention of SSI, includes methods for preoperative removal of hair (where appropriate), rational antibiotic prophylaxis, avoidance of perioperative hypothermia, management of perioperative blood glucose and effective skin preparation. Reasons for poor compliance with care bundles are not clear and have not matched the wide uptake and perceived benefit of the WHO 'Safe Surgery Saves Lives' checklist. Recommendations include the need for further research and continuous updating of guidelines; comprehensive surveillance, using validated definitions that facilitate benchmarking of anonymised surgeon-specific SSI rates; assurance that incorporation of checklists and care bundles has taken place; the development of effective communication strategies for all health care providers and those who commission services and comprehensive information for patients.

# Is Evidence-Based Processes Hardwired into Standard of Care?

SURGICAL INFECTIONS  
Volume 24, Number X, 2023  
© Mary Ann Liebert, Inc.  
DOI: 10.1089/sur.2022.411

## Original Article

Open camera or QR reader and scan code to access this article and other resources online.



### Effectiveness versus Uptake: The Challenges of Implementing Evidence-Based Strategies to Reduce Surgical Site Infection in Patients with Colon Surgeries

Lena Camperlengo,<sup>1</sup> Maureen Spencer,<sup>2</sup> Peter Graves,<sup>3</sup> Walter Danker,<sup>4</sup> and Charles Edmiston, Jr.<sup>5</sup>

#### Abstract

**Background:** National and international recommendations for the prevention of surgical site infection (SSI) were published six years ago, but little is known about implementation in colon surgeries.

**Methods:** We conducted an observational study to evaluate the implementation of seven SSI-prevention elements in colon surgeries. Study coordinators recorded the implementation using an electronic case report. Surgeons completed a survey that identified key drivers of implementation. Three peer-to-peer calls and a study coordinator survey provided insights on the obstacles and drivers to implementation.

**Results:** The elements ranged in compliance from 100% to below 1%. Absence of documentation in the electronic medical record (EMR), conflicting local policies, and a lack of standardization of processes and products were significant obstacles in implementation.

**Discussion:** Standardizing peri-operative procedures may be accomplished by implementing guidelines. Using implementation science to reduce variability and stocking leads to product standardization with items that support evidence-based practices. Administration, material management, and surgical leadership all have a duty to the patient to reduce obstacles to implement evidence-based practices.

**Conclusions:** Our study reveals variability in the integration of published guidelines into clinical practice. Every surgical patient deserves the best possible care by using evidence-based guidelines and practices centered on reducing SSIs.

**Keywords:** colorectal; guidelines; implementation; standardization; SSI; sutures

**S**URGICAL SITE INFECTION (SSI) after colorectal surgery is a common complication associated with poor outcomes, longer length of stays, and increased re-admissions.<sup>1</sup> Reports indicate that up to 55% of infections in patients who had colorectal surgery could have been prevented.<sup>2,3</sup> In 2016, the World Health Organization (WHO)<sup>4</sup> and the American College of Surgeons (ACS)<sup>5</sup> published evidence-based guide-

lines to reduce and prevent SSIs. The following year, the U.S. Centers for Disease Control and Prevention (CDC) published their SSI-prevention guidelines.<sup>6</sup>

The use of published guidelines,<sup>5-9</sup> standardized SSI definitions, and surveillance reporting<sup>10-13</sup> demonstrate benefit in colorectal SSI reduction. However, implementing them poses challenges, as does sustaining new behaviors.<sup>14</sup> Key

## RESULTS: COMPONENTS OBSERVED

	Element Met							
	Total number of observed cases	Skin Prep n (%)	IV Antibiotics n (%)	Triclosan Sutures n (%)	Blood glucose n (%)	Body temp n (%)	Order pre-op MBP + oral ATBs n (%)	Oxygen n (%)
Site one	319	319 (100)	305 (95.6)	176 (55.2)	263 (82.4)	40 (12.5)	122 (38.2)	3 (0.9)
Site two	277	276 (99.6)	277 (100)	277 (100)	243 (87.7)	171 (61.7)	18 (6.5)	61 (22.0)
Site three	262	261 (99.6)	253 (96.6)	212 (80.9)	49 (18.7)	30 (12.9)	18 (6.9)	16 (6.1)
Aggregate Sum	858	856 (99.8)	835 (97.3)	650 (75.8)	555 (64.9)	443 (51.6)	158 (18.4)	80 (9.3)

DOMINANT THEME:  
LACK OF DOCUMENTATION

*"I interviewed the surgeon regarding that question, whether the patient was put on oxygen from three hours up until at least two hours after waking in post-up. Lots of times, the surgeons do not know the answer. So, they advised me to reach out to anesthesia and I also tried to find information in Epic. It looks like it's not well documented and that's one of the challenges that we are having right now."*

- Site 2 Study Coordinator

DOMINANT THEME:  
LACK OF DOCUMENTATION

*"Finding the mechanical bowel prep. To do that, we checked the operative note while we're looking at it for other elements. If it's not there - and it usually isn't - then we look for a medication order. And then we look in the pre-op paperwork and the nursing notes to see if it was documented there. No matter what happens, this especially feels like a point that we could bring to our quality improvement people and say that we need to be documenting this better."*

-Study Coordinator Site 2

# Implementing Evidence-Based Strategies to Reduce Surgical Site Infection in Patients with Colon Surgeries

Element	Guideline Recommendation	Implementation Strategies
<b>Normothermia</b>	<p>Policy/protocol includes documentation of:</p> <ul style="list-style-type: none"><li>• Body temperature measurement should be standardized</li><li>• Maintain perioperative normothermia at <math>&gt;36.0^{\circ}\text{C}</math> or <math>36.5^{\circ}\text{C}</math></li></ul>	<ul style="list-style-type: none"><li>• <b>Include documentation of body temperature into the Electronic Medical Record (EMR)</b></li><li>• Standardize use of temperature measurement devices</li><li>• Use facility approved warming devices preoperatively, intraoperatively, and in the post anesthesia care unit</li><li>• Use warmed fluids intra-operatively</li><li>• Apply hats and booties preoperatively</li><li>• Conduct education campaign on normothermia with preop staff, anesthesia, and PACU</li><li>• Monitor engineering controls to maintain the operating room temperature within recommended parameters</li></ul>

*Camperlengo L, Spencer M, Graves P, Danker W, Edmiston C. Effectiveness versus Uptake: The Challenges of Implementing Evidence-Based Strategies to Reduce Surgical Site Infection in Patients with Colon Surgeries. Surg Infect, 2023. 24(4): p. 382-389*

# Implementing Evidence-Based Strategies to Reduce Surgical Site Infection in Patients with Colon Surgeries

Element	Guideline Recommendation	Implementation Strategies
<p style="text-align: center;"><b>Oral Antibiotics + Mechanical Bowel Prep</b></p>	<p>Policy/protocol includes:</p> <ul style="list-style-type: none"> <li>• Preoperative oral antibiotics in combination with mechanical bowel preparations (OA-MBP) as a safe and effective adjunctive strategy for reducing the risk of infection following colorectal surgery.</li> <li>• Current peer-reviewed evidence indicates that OA-MBP should be part of a comprehensive colorectal surgical care bundle.</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Develop standardized order sets within the EMR and Document that MBP + oral ATBs was given/taken prior to surgery</b></li> <li>• Review the process for patient education to perform the bowel prep prior to surgery</li> <li>• Conduct an observational study of a cohort of surgical procedures to determine the preoperative oral antibiotics in combination with mechanical bowel preparations.</li> <li>• Conduct education campaign with surgeons, PA, NP's, and nursing</li> </ul>

Camperlengo L, Spencer M, Graves P, Danker W, Edmiston C. Effectiveness versus Uptake: The Challenges of Implementing Evidence-Based Strategies to Reduce Surgical Site Infection in Patients with Colon Surgeries. *Surg Infect*, 2023. 24(4): p. 382-389

## Question #8:

Once the Implemental strategy (bundle) is in place, how do you track progress and compliance?

# Checklist – A Mixed Blessing for Validating Implementation of Evidence- based Strategies

# Getting It Right During The Perioperative Period – Accountability For All

## COMPREHENSIVE SURGICAL CHECKLIST

Blue = World Health Organization (WHO)    Green = The Joint Commission - Universal Protocol 2016 National Patient Safety Goals    Teal = Joint Commission and WHO

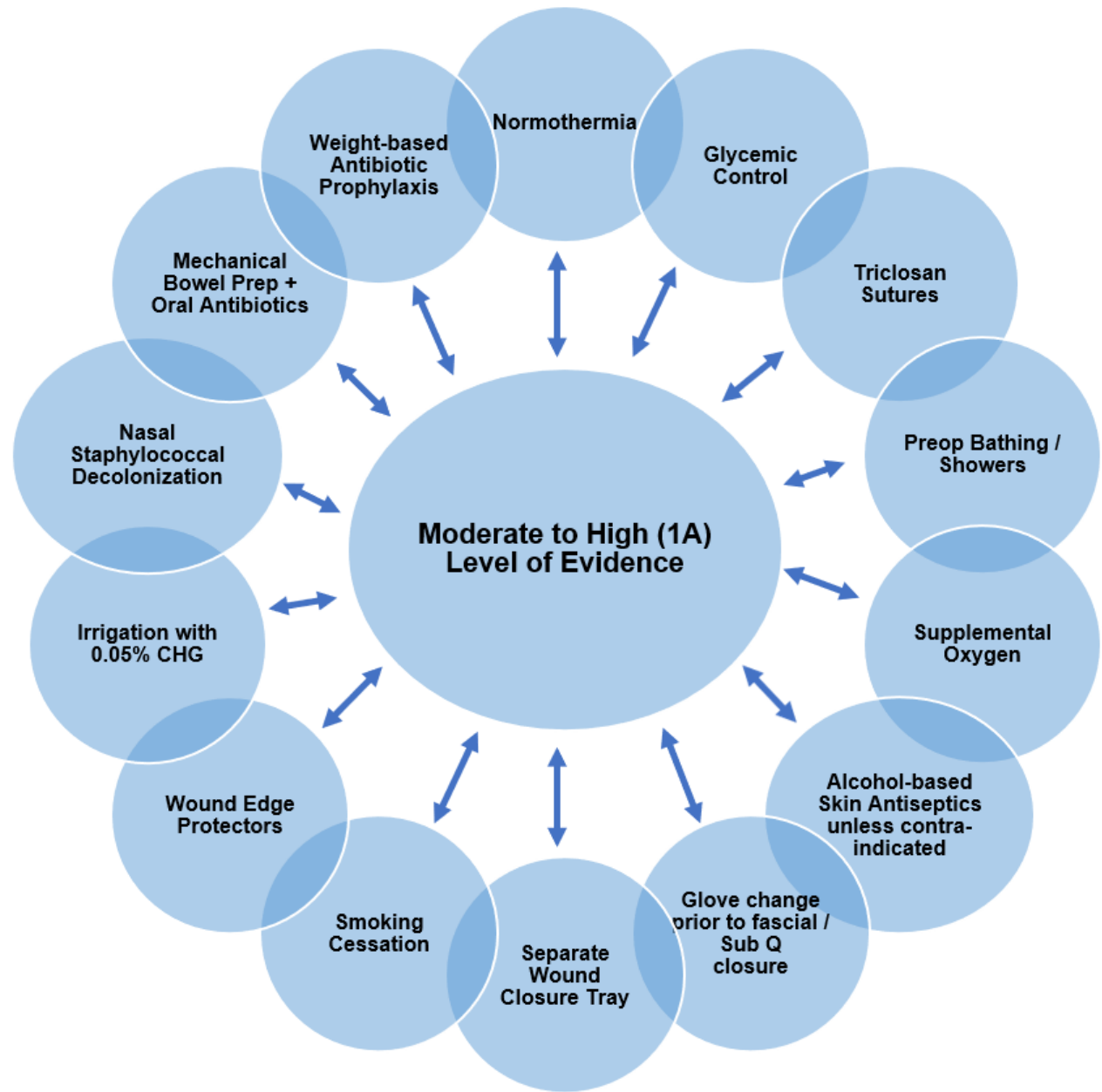
PREPROCEDURE CHECK-IN	SIGN-IN	TIME-OUT	SIGN-OUT
<b>In Preoperative Ready Area</b>	<b>Before Induction of Anesthesia</b>	<b>Before Skin Incision</b>	<b>Before the Patient Leaves the Operating Room</b>
<b>Patient or patient representative actively confirms with registered nurse (RN):</b>	<b>RN and anesthesia professional confirm:</b>	<b>Initiated by designated team member:</b> All other activities to be suspended (except in case of life-threatening emergency)	<b>RN confirms:</b>
Identity <input type="checkbox"/> Yes Procedure and procedure site <input type="checkbox"/> Yes Consent(s) <input type="checkbox"/> Yes Site marked <input type="checkbox"/> Yes <input type="checkbox"/> N/A by a licensed independent practitioner who is ultimately accountable for the procedure and will be present when the procedure is performed.  <b>RN confirms presence of:</b> History and physical <input type="checkbox"/> Yes Preanesthesia assessment <input type="checkbox"/> Yes Nursing assessment <input type="checkbox"/> Yes Diagnostic and radiologic test results <input type="checkbox"/> Yes <input type="checkbox"/> N/A Blood products <input type="checkbox"/> Yes <input type="checkbox"/> N/A Any special equipment, devices, implants <input type="checkbox"/> Yes <input type="checkbox"/> N/A Include in Preprocedure check-in as per institutional custom: Beta-blocker medication given <input type="checkbox"/> Yes <input type="checkbox"/> N/A Venous thromboembolism prophylaxis ordered <input type="checkbox"/> Yes <input type="checkbox"/> N/A Normothermia measures <input type="checkbox"/> Yes <input type="checkbox"/> N/A	Confirmation of the following: identity, procedure, procedure site, and consent(s) <input type="checkbox"/> Yes Site marked <input type="checkbox"/> Yes <input type="checkbox"/> N/A Patient allergies <input type="checkbox"/> Yes <input type="checkbox"/> N/A Pulse oximeter on patient <input type="checkbox"/> Yes Difficult airway or aspiration risk <input type="checkbox"/> No <input type="checkbox"/> Yes (preparation confirmed) Risk of blood loss (> 500 mL) <input type="checkbox"/> Yes <input type="checkbox"/> N/A # of units available _____ Anesthesia safety check completed <input type="checkbox"/> Yes  <b>Briefing:</b> All members of the team have discussed care plan and addressed concerns <input type="checkbox"/> Yes	Introduction of team members <input type="checkbox"/> Yes <b>All:</b> Confirmation of the following: identity, procedure, incision site, consent(s) <input type="checkbox"/> Yes Site is marked and visible <input type="checkbox"/> Yes <input type="checkbox"/> N/A Fire Risk Assessment and Discussion <input type="checkbox"/> Yes (prevention methods implemented) <input type="checkbox"/> N/A Relevant images properly labeled and displayed <input type="checkbox"/> Yes <input type="checkbox"/> N/A Any equipment concerns <input type="checkbox"/> Yes <input type="checkbox"/> N/A <b>Anticipated Critical Events</b> <b>Surgeon:</b> States the following: <input type="checkbox"/> Critical or nonroutine steps <input type="checkbox"/> Case duration <input type="checkbox"/> Anticipated blood loss <b>Anesthesia professional:</b> Antibiotic prophylaxis within 1 hour before incision <input type="checkbox"/> Yes <input type="checkbox"/> N/A Additional concerns <input type="checkbox"/> Yes <input type="checkbox"/> N/A <b>Scrub person and RN circulator:</b> Sterilization indicators confirmed <input type="checkbox"/> Yes Additional concerns <input type="checkbox"/> Yes <input type="checkbox"/> N/A <b>RN:</b> Documented completion of time out <input type="checkbox"/> Yes	Name of operative procedure: _____ Completion of sponge, sharp, and instrument counts <input type="checkbox"/> Yes <input type="checkbox"/> N/A Specimens identified and labeled <input type="checkbox"/> Yes <input type="checkbox"/> N/A Equipment problems to be addressed <input type="checkbox"/> Yes <input type="checkbox"/> N/A Discussion of Wound Classification <input type="checkbox"/> Yes <b>To all team members:</b> What are the key concerns for recovery and management of this patient? _____ _____ _____ <b>Debriefing with all team members:</b> Opportunity for discussion of – team performance – key events – any permanent changes in the preference card

May 2024

## Question #9:

Have you identified bundle elements that correlate most strongly with SSI reduction?

# Selecting An Evidence-Based (EB) Surgical Care Bundle

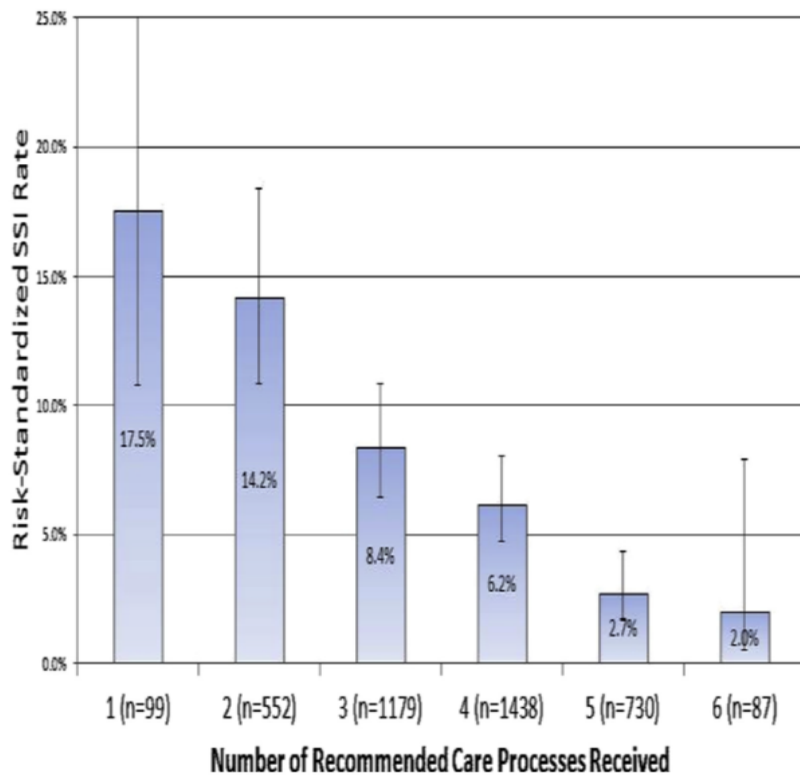


Baseline Interventions Evidence-Based	Class	Mechanistic Benefits
Normothermia	1A	Less bleeding / preserve immune function in wound bed / enhanced wound healing
Perioperative antimicrobial prophylaxis – “Weight-Based”	1A	Tissue antiseptics / intraoperative conc > MIC <sup>90</sup> wound pathogens
Glycemic control	1A	Preserve granulocytic immune function / enhance wound healing
Antimicrobial (triclosan) coated sutures (fascia / subcuticular closure)	1A	Mitigate nidus of wound contamination / local tissue antiseptics / minimize the risk of biofilm formation
Preadmission CHG shower / cleansing	High-1A	Skin antiseptics / reduce microbial skin bioburden
Perioperative skin-prep – 2% CHG / 70% alcohol	1A	Skin antiseptics / reduce microbial skin bioburden
Separate wound closure tray	Moderate	Mitigate instrument contamination
Glove change prior to fascia / subcuticular closure	Moderate	Disrupt cross-contamination across tissue planes

<b>Supplemental Interventions Evidence-Based</b>	<b>Class</b>	<b>Major Mechanistic Benefits</b>
Supplemental oxygen – Colorectal	Moderate to High	Enhanced tissue oxygenation and immune function / host-metabolic benefits
Oral antibiotics / Mechanical bowel prep – Colorectal	1A	Reduce bioburden (protease-producing bacteria) within bowel lumen and brush border surface
Wound edge protector – Colorectal, Vascular, OB/GYN	Moderate	Intraoperative wound antisepsis-minimizing wound contamination
Staphylococcal decolonization – Orthopedic and CT	1A	Mitigate <i>S. aureus</i> and MRSA pathogenicity
Smoking cessation – Orthopedic, Neuro, CT - likely all surgical procedures	High to 1A	Preserve angiogenesis /reduce risk of dehiscence / enhance wound healing
Intraoperative irrigation of the surgical wound with 0.05% chlorhexidine gluconate	Moderate	Mitigate wound contamination prior to closure
OR traffic control – minimize door openings	Low to Moderate	Reduce OR air bioburden

# Developing an argument for bundled interventions to reduce surgical site infection in colorectal surgery

Seth A. Waits, MD,<sup>a</sup> Danielle Fritze, MD,<sup>a</sup> Mousumi Banerjee, PhD,<sup>a,b</sup> Wenyng Zhang, MA,<sup>a</sup> James Kubus, MS,<sup>a</sup> Michael J. Engesbe, MD,<sup>a</sup> Darrell A. Campbell, Jr, MD,<sup>a</sup> and Samantha Hendren, MD, MPH,<sup>a</sup> *Ann Arbor, MI*



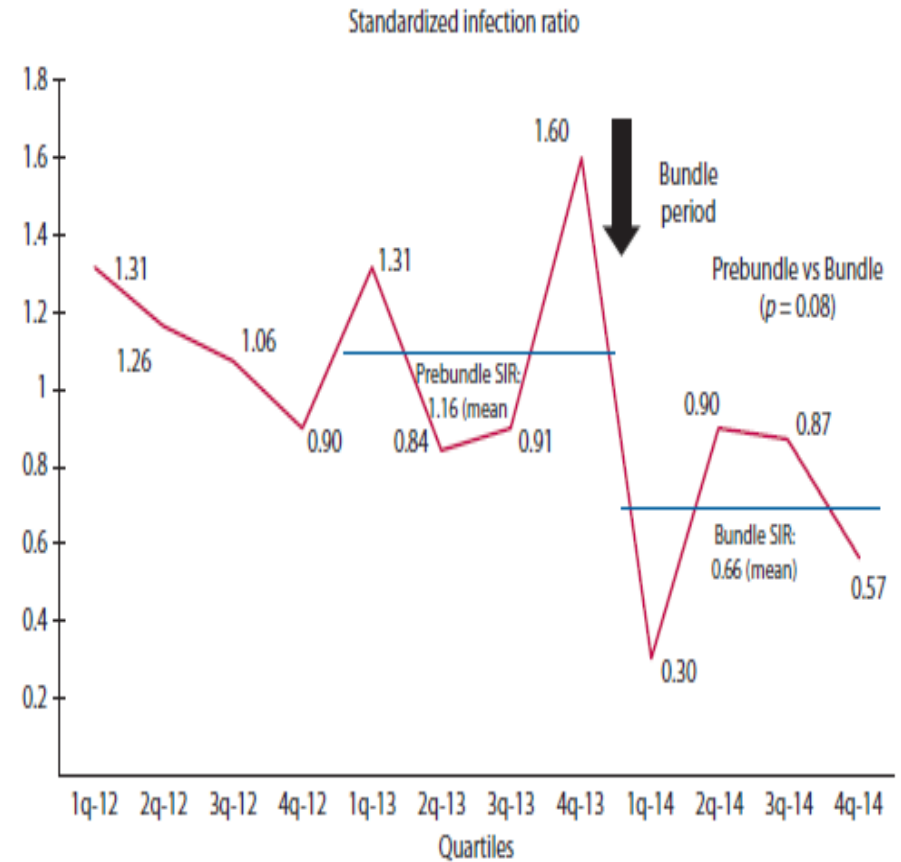
Waits SA, et al. *Surgery* 2014;155:602

## ORIGINAL CONTRIBUTION

# An Effective Bundled Approach Reduces Surgical Site Infections in a High-Outlier Colorectal Unit

Emre Gorgun, M.D.<sup>1</sup> • Ahmet Rencuzogullari, M.D., F.T.B.S.<sup>1</sup>  
 Volkan Ozben, M.D., F.T.B.S.<sup>1</sup> • Luca Stocchi, M.D.<sup>1</sup> • Thomas Fraser, M.D.<sup>2,3</sup>  
 Cigdem Benlice, M.D.<sup>1</sup> • Tracy Hull, M.D.<sup>1</sup>

<sup>1</sup> Department of Colorectal Surgery, Digestive Disease Institute, Cleveland Clinic, Cleveland, Ohio  
<sup>2</sup> Department of Infectious Disease, Cleveland Clinic, Cleveland, Ohio  
<sup>3</sup> Department of Quality, Quality & Patient Safety Institute, Cleveland Clinic, Cleveland, Ohio



Dis Colon Rectum 2018; 61: 89–98

# Using Bundled Interventions to Reduce Surgical Site Infection After Major Gynecologic Cancer Surgery

Megan P. Johnson, PA-C, Sharon J. Kim, BA, Carrie L. Langstraat, MD, Sneha Jain, MHA, CSSBB, Elizabeth B. Habermann, PhD, Jean E. Wentink, RN, MPH, Pamela L. Grubbs, MS, APRN, Sharon A. Nehring, RN, BSN, Amy L. Weaver, MS, Michaela E. McGree, BS, Robert R. Cima, MD, Sean C. Dowdy, MD, and Jamie N. Bakkum-Gamez, MD

**OBJECTIVE:** To investigate whether implementing a bundle, defined as a set of evidence-based practices performed collectively, can reduce 30-day surgical site infections.

**METHODS:** Baseline surgical site infection rates were determined retrospectively for cases of open uterine cancer, ovarian cancer without bowel resection, and ovarian cancer with bowel resection between January 1, 2010, and December 31, 2012, at an academic center. A perioperative bundle was prospectively implemented during the intervention period (August 1, 2013, to September 30, 2014). Prior established elements were: patient education, 4% chlorhexidine gluconate shower before surgery, antibiotic administration, 2% chlorhexidine gluconate and 70% isopropyl alcohol coverage of incisional area, and cefazolin redosing 3–4 hours after incision. New elements initiated were: sterile closing tray

and staff glove change for fascia and skin closure, dressing removal at 24–48 hours, dismissal with 4% chlorhexidine gluconate, and follow-up nursing phone call. Surgical site infection rates were examined using control charts, compared between periods using  $\chi^2$  or Fisher exact test, and validated against the American College of Surgeons National Surgical Quality Improvement Program decile ranking.

**RESULTS:** The overall 30-day surgical site infection rate was 38 of 635 (6.0%) among all cases in the preintervention period, with 11 superficial (1.7%), two deep (0.3%), and 25 organ or space infections (3.9%). In the intervention period, the overall rate was 2 of 190 (1.1%), with two organ or space infections (1.1%). Overall, the relative risk reduction in surgical site infection was 82.4% ( $P=.01$ ). The surgical site infection relative risk reduction was 77.6% among ovarian cancer with bowel resection, 79.3% among ovarian cancer without bowel resection, and 100% among uterine cancer. The American College of Surgeons National Surgical Quality Improvement Program decile ranking improved from the 10th decile to first decile; risk-adjusted odds ratio for surgical site infection decreased from 1.6 (95% confidence interval 1.0–2.6) to 0.6 (0.3–1.1).

**CONCLUSION:** Implementation of an evidence-based surgical site infection reduction bundle was associated with substantial reductions in surgical site infection in high-risk cancer procedures.

(*Obstet Gynecol* 2016;127:1135–44)

DOI: 10.1097/AOG.0000000000001449

From the Department of Obstetrics and Gynecology, Division of Gynecologic Surgery, the Division of Healthcare Policy and Research, Infection Prevention and Control, the Department of Nursing, the Surgery Research Office, the Division of Biomedical Statistics and Informatics, and the Department of General Surgery, Division of Colorectal Surgery, Mayo Clinic, and Mayo Medical School, Mayo Clinic, Minnesota.

Presented at the American College of Surgeons National Surgical Quality Improvement Program Annual Meeting, July 25–28, 2015, Chicago, Illinois.

The authors thank Karen Rucker and Cory Hiatt of the Mayo Clinic Revenue Cycle for their expert technical help with International Classification of Diseases, 9th Revision and Current Procedural Terminology code identification as well as Whitney Bergquist, PharmD, MBA, BCPS, for her assistance with pharmacy measure audits.

Corresponding author: Jamie N. Bakkum-Gamez, MD, Department of Obstetrics

Open camera or QR reader and scan code to access this article and other resources online.



## Prevention of Orthopedic Prosthetic Infections Using Evidence-Based Surgical Site Infection Care Bundles: A Narrative Review

Charles E. Edmiston, Jr.<sup>1</sup> and David John Leaper<sup>2</sup>

### Abstract

**Background:** The number of primary/revision total joint replacements (TJR) are expected to increase substantially with an aging population and increasing prevalence of comorbid conditions. The 30-day re-admission rate, in all orthopedic specialties, is 5.4% (range, 4.8%–6.0%). A recent publication has documented that the surgical site infection (SSI) infection rate associated with revision total knee (rTKR, 15.6%) and revision total hip (rTHR, 8.6%) arthroplasties are four to seven times the rate of the primary procedures (2.1%–2.2%). These orthopedic infections prolong hospital stays, double re-admissions, and increase healthcare costs by a factor of 300%.

**Methods:** A search of PubMed/MEDLINE, EMBASE and the Cochrane Library publications, which reported the infection risk after TKR and THR, was undertaken (January 1, 1995 to December 31, 2021). The search also included documentation of evidence-based practices that lead to improved post-operative outcomes.

**Results:** The evidence-based approach to reducing the risk of SSI was grouped into pre-operative, peri-operative, and post-operative periods. Surgical care bundles have existed within other surgical disciplines for more than 20 years, although their use is relatively new in peri-operative orthopedic surgical care. Pre-admission chlorhexidine gluconate (CHG) showers/cleansing, staphylococcal decolonization, maintenance of normothermia, wound irrigation, antimicrobial suture wound closure, and post-operative wound care has been shown to improve clinical outcome in randomized controlled studies and meta-analyses.

**Conclusions:** Evidence-based infection prevention care bundles have improved clinical outcomes in all surgical disciplines. The significant post-operative morbidity, mortality, and healthcare cost, associated with SSIs after TJR can be reduced by introduction of evidence-based pre-operative, intra-operative, and post-operative interventions.

**Keywords:** arthroplasty; comorbid risk; evidence-based interventions; evidence-based SSI prevention bundle; peri-prosthetic infection

MORE THAN 600,000 knee and nearly 300,000 hip replacement procedures are undertaken annually in the United States [1–4]. The number of primary and revision total joint replacement (TJR) are expected to increase by 2030 with an aging population and an increasing prevalence of arthritis and comorbid conditions [5,6]. The number of TJRs may

reach 572,000 primary hip replacements, 3.48 million primary knee replacements, 90,000 revision hip replacements, and 250,000 revision knee procedures [3]. The reported incidence of SSI ranges from 0.5% to 8% after both primary and revision TJR [4,6,7]. Factors shown to be associated with an increased risk include patient demographics, comorbid

# What Is The Cumulative Evidence That Surgical Care Bundles Reduce the Risk of SSIs?



## Literature Review

### The Impact of Care Bundles on the Incidence of Surgical Site Infections: A Systematic Review

Pinar Avsar, PhD, MSc, BSc, RGN; Declan Patton, PhD, MSc, PGDipEd, PGCRM, BNS(Hons), RNT, RPN; Aicha Sayeh, PhD; Karen Ousey, PhD, RGN, FHEA, CMgr MCMI; Joanna Blackburn, PhD, MSc, BSc; Tom O'Connor, EdD, MSc Ad Nursing, PG Dip Ed, BSc, Dip Nur, RNT, RGN; and Zena Moore, PhD, MSc, FFMRCSE, PG Dip, Dip First Line Management, RGN

#### ABSTRACT

**OBJECTIVE:** This systematic review assesses the effects of care bundles on the incidence of surgical site infections (SSIs).

**DATA SOURCES:** The search was conducted between February and May 2021, using PubMed, CINAHL, SCOPUS, Cochrane, and EMBASE databases.

**STUDY SELECTION:** Studies were included if they used systematic review methodology, were in English, used a quantitative design, and explored the use of care bundles for SSI prevention. A total of 35 studies met the inclusion criteria, and 26 provided data conducive to meta-analysis.

**DATA EXTRACTION:** Data were extracted using a predesigned extraction tool, and analysis was undertaken using RevMan (Cochrane, London, UK). Quality appraisal was undertaken using evidence-based librarianship.

**DATA SYNTHESIS:** The mean sample size was 7,982 (median, 840) participants. There was a statistically significant difference in SSI incidence in favor of using a care bundle (SSI incidence 4%, 703/17,549 in the care bundle group vs 7%, 1,157/17,162 in the usual care group). The odds ratio was 0.55 (95% confidence interval, 0.41–0.73;  $P < .00001$ ), suggesting that there is a 45% reduction in the odds of SSI development for the care bundle group. The mean validity score for all studies was 84% (SD, 0.04%).

**CONCLUSIONS:** The results indicate that implementing care bundles reduced SSI incidence. However, because there was clinically important variation in the composition of and compliance with care bundles, additional research with standardized care bundles is needed to confirm this finding.

**KEYWORDS:** care bundle, health, surgical site infection, systematic review, well-being

ADV SKIN WOUND CARE 2022;35:386–93.  
DOI: 10.1097/01.ASW.0000031080.51977.0b

#### INTRODUCTION

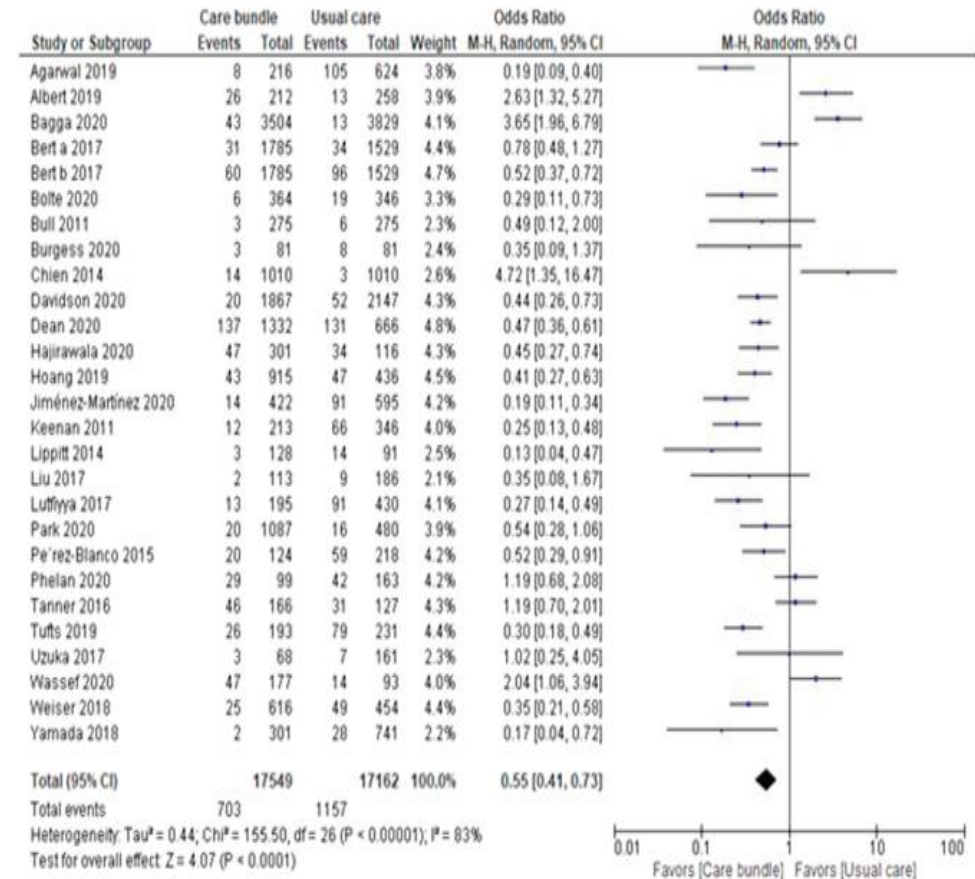
Surgical site infection (SSI) is a common healthcare-acquired infection,<sup>1</sup> and can vary in severity from superficial, involving the skin only, to more serious infection involving deeper tissue, organs, or implanted material.<sup>2</sup> Although SSI rates vary depending on the type of surgery and the degree of contamination, the World Health Organization found that, overall, 11% of patients who undergo surgery develop an SSI.<sup>3</sup> According to the annual epidemiologic report by the European Centre for Disease Prevention and Control,<sup>4</sup> SSI incidence varies from 0.5% to 10.1%, depending on the type of surgical procedure.

Surgical site infections negatively impact patients' physical and mental health, and SSI is a leading cause of patient discomfort, resulting in longer inpatient stays, higher costs to the healthcare system, and increased mortality.<sup>5–7</sup> Patients with an SSI may also experience delayed wound healing, becoming more vulnerable to secondary complications, such as bacteremia.<sup>8,9</sup> One systematic review determined that the cost per day of hospitalization rose from €350 to €1,140 with SSI development.

A considerable decrease in SSI rates can be achieved by using evidence-based measures such as care bundles, which can improve patient safety and quality of life.<sup>10</sup> A care bundle is a small, straightforward set of evidence-based practices or interventions (usually three to five). Care bundles enhance clinical outcomes through consistent use of reliable interventions that define a standard of care, enable adequate and efficient treatment, and control infections.<sup>10</sup> They improve patient outcomes when performed collectively and consistently.<sup>11</sup>

A large body of literature has used systematic review methodology to explore SSI incidence and prevention care bundles in relation to a specific type of surgery, primarily cesarean delivery or colorectal surgery.<sup>12,13</sup> No previous study has investigated the elements of SSI

Figure 2. FOREST PLOT OF CARE BUNDLE VERSUS USUAL CARE AND ODDS RATIO OF SURGICAL SITE INFECTION



Avsar P, et al. The Impact of Care Bundles on the Incidence of Surgical Site Infections: A Systematic Review. *Adv Skin Wound Care* 2022;35:386–93



Check for updates

## SKIN MICROBIOME

## Contribution of the patient microbiome to surgical site infection and antibiotic prophylaxis failure in spine surgery

Dustin R. Long<sup>1\*</sup>, Chloe Bryson-Cahn<sup>2</sup>, Adam Waalkes<sup>3</sup>, Elizabeth A. Holmes<sup>3</sup>, Kelsi Penewit<sup>3</sup>, Celeste Tavoraro<sup>4</sup>, Carlo Bellabarba<sup>4</sup>, Fanygi Zhang<sup>4,5</sup>, Jeannie D. Chan<sup>2,6</sup>, Ferric C. Fang<sup>3,7,8</sup>, John B. Lynch<sup>2</sup>, Stephen J. Salipante<sup>3</sup>

Despite modern antiseptic techniques, surgical site infection (SSI) remains a leading complication of surgery. However, the origins of SSI and the high rates of antimicrobial resistance observed in these infections are poorly understood. Using instrumented spine surgery as a model of clean (class I) skin incision, we prospectively sampled preoperative microbiomes and postoperative SSI isolates in a cohort of 204 patients. Combining multiple forms of genomic analysis, we correlated the identity, anatomic distribution, and antimicrobial resistance profiles of SSI pathogens with those of preoperative strains obtained from the patient skin microbiome. We found that 86% of SSIs, comprising a broad range of bacterial species, originated endogenously from preoperative strains, with no evidence of common source infection among a superset of 1610 patients. Most SSI isolates (59%) were resistant to the prophylactic antibiotic administered during surgery, and their resistance phenotypes correlated with the patient's preoperative resistome ( $P = 0.0002$ ). These findings indicate the need for SSI prevention strategies tailored to the preoperative microbiome and resistome present in individual patients.

Copyright © 2024, the Authors, some rights reserved; exclusive licensee American Association for the Advancement of Science. No claim to original U.S. Government Works

Downloaded from https://

Long DR, et al. *Sci Transl Med* 2024 Apr 10;16(742):eadk8222

## JAMA Surgery | Review

## Preventing Surgical Site Infections in the Era of Escalating Antibiotic Resistance and Antibiotic Stewardship

Dustin R. Long, MD; Adam Cifu, MD; Stephen J. Salipante, MD, PhD; Robert G. Sawyer, MD; Kaylie Machutta, BS; John C. Alverdy, MD

+ CME at [jamacmelookup.com](http://jamacmelookup.com)

**IMPORTANCE** According to the Centers for Disease Control and Prevention and governing bodies within the American College of Surgeons, the administration of antibiotics as prophylaxis against infection prior to a planned elective procedure is, with rare exception, routinely recommended. The goal of “getting to zero” infections remains a high priority for policymakers, practitioners, and certainly for patients.

**OBSERVATIONS** Despite the many advances in surgical technique, skin decontamination, sterile procedure, and enhanced recovery programs, surgical site infections continue to adversely affect procedures as diverse as dental implant surgery, joint arthroplasty, and major abdominal surgery. Although surgical site infection rates are at historically low levels, progress has stalled in recent reporting periods and such infections remain disabling, costly, and occasionally lethal. Stakeholders in the field, including surgeons, infectious diseases specialists, and industry, advocate for strategies emphasizing greater levels of intraoperative sterility or broader-spectrum antibiotic coverage as the most appropriate path forward.

**CONCLUSIONS AND RELEVANCE** The current emphasis on ever-increasing levels of intraoperative sterility and extended-spectrum antibiotic use are not sustainable long-term solutions. Continuing to escalate these approaches may contribute to unintended consequences including antimicrobial resistance. Principles of antimicrobial stewardship and microbiome sciences can be applied to inform a more effective and sustainable approach to infection prevention in the field of surgery.

**Author Affiliations:** Division of Critical Care Medicine, Department of Anesthesiology & Pain Medicine, University of Washington, Seattle (Long); Department of Internal Medicine, University of Chicago, Chicago, Illinois (Cifu); Department of Laboratory Medicine & Pathology, University of Washington, Seattle (Salipante); Department of Surgery, Western Michigan University Homer Stryker School of Medicine, Kalamazoo (Sawyer); University of Nevada Reno School of Medicine, Reno (Machutta); Department of Surgery, University of Chicago, Chicago, Illinois (Alverdy).

**Corresponding Author:** John C. Alverdy, MD, FSIS, Department of Surgery, University of Chicago, 5841 S Maryland, MC 6090, Chicago, IL 60637 ([jalverdy@bsd.uchicago.edu](mailto:jalverdy@bsd.uchicago.edu)).

*JAMA Surg.* doi:10.1001/jamasurg.2024.0429  
Published online June 26, 2024.

Long DR, et al. *JAMA Surg.* 2024;159:949-956

- Study results identify the patient microbiome as the primary reservoir for SSI.
- Most SSI isolates (59%) were resistant to the prophylactic antibiotic administered during surgery, and their resistance phenotypes correlated with the patient's preoperative resistome ( $p=0.0002$ ).
- The anticipated global increase in colonization of healthy individuals with antimicrobial resistant organisms will be reflected in a rapidly changing microbial landscape within our hospitals and communities.
- These findings suggest that future efforts in infection prevention should enable, (1) more individualize and (2) patient-centered interventional strategies (BM) = bundle modification

## Question #10:

What emerging technologies or practices do you think will significantly impact this space over the next 5-10 years?

## 1. AI-Driven Surgical Intelligence (Beyond Robotics)

Real-time AI surveillance of postop surgical outcomes

Computer vision tracking:

- Sterility breaks

- Instrument usage

- Procedure steps

## 2. Robotics 2.0 (Automation + Decision Support)

- Reduced tissue trauma

- More consistent outcomes

- Lower complication rates

This will directly affect: SSI rates and wound healing and surgical outcomes

## 3. Precision Infection Prevention

Rapid intraoperative diagnostics (minutes, not days)

Microbiome-based risk profiling

Smart wound sensors detecting:

- Early infection

- Biofilm formation

- Nanotechnology coatings

ABSTRACT ONLY · Volume 30, Supplement 1, S17-S18, November 2025

## Redefining Surgical Incision Outcomes: A Modified Delphi Study to Establish a Novel Universal Classification System

[Prof. Philip L. Russo<sup>1,2,3</sup>](#) · [Prof Marja Boermeester<sup>4,9</sup>](#) · [Mr Giles Bond-Smith<sup>5</sup>](#) · [Prof Antonia Chen<sup>6</sup>](#) ·

[Prof David Leaper<sup>7,8</sup>](#)

# DISH Classification System

## Clinical Intervention/Management Scale

	Dehiscence	Inflammation/Infection	Seroma	Hematoma
0	None	None	None	None
1	Patient self-monitoring	Patient self-monitoring	Patient self-monitoring	Patient self-monitoring
2	Local treatment, with or without local anesthesia	Healthcare professional monitoring; closed incision management; antibiotics optional	Healthcare professional monitoring with or without radiological imaging	Healthcare professional monitoring
3	Surgical re-intervention with general, spinal or regional anesthesia but without reconstruction	Surgical re-intervention with local anesthesia, or percutaneous drainage; antibiotics optional	Local treatment with local anesthesia, or percutaneous drainage	Local treatment with local anesthesia, or percutaneous drainage, or embolization
4	Surgical re-intervention with general, spinal or regional anesthesia and with reconstruction	Surgical re-intervention, with general, spinal or regional anesthesia	Surgical re-intervention, with general, spinal or regional anesthesia	Surgical re-intervention or radiological intervention with general, spinal or regional anesthesia

## Clinical Presentation Scale

	Dehiscence	Inflammation/Infection	Seroma	Hematoma
a	Partial separation of the incision edges with no to minimal fluid discharge	One or more of the following clinical signs of inflammation related to the incision: redness, swelling, heat, pain, or serous exudate	Presence of localized fluid collection related to the surgical incision with no to minimal discomfort or pressure in the affected area	Bruising related to the incision, with or without swelling, but not causing substantial symptoms to the patient
b	Substantial separation of the incision edges, without disrupting fascia or the deep tissue	Two or more of the following clinical signs: redness, swelling, heat, pain, non-serous exudate; plus one or more of the following: elevated C-reactive protein, increased serum white blood cell count, temperature over 38°C (100.4°F), positive wound or blood culture, gas in tissues	Large fluid collection causing moderate discomfort or pressure in the affected area	Enlarging hematoma causing swelling and pain
c	Extensive separation of the incision edges, involving deep tissue layers	Severe infection related to the incision with systemic signs of sepsis or mono-organ failure	Large, complex fluid collection causing significant symptoms	Significant hematoma causing substantial swelling, pain, and compromising nearby organs or structures
d	Most severe incision dehiscence of all surgical tissue layers with or without organ exposure	Septic shock; Sepsis related multi-organ failure	Large, complex fluid collection causing life-threatening symptoms or a chronic walled-off collection	Significant hematoma, with active bleeding

## Question #11:

What is one misconception about SSI prevention that you wish healthcare teams understood better?

“If we follow the checklist, we’ll prevent SSI.”

Reality: Checklists alone don’t prevent infections – It’s how people execute them that does. Two OR teams can follow the same protocol and get very different outcomes

SSI Prevention is Influenced by Risk & Modifiable System Factors:

- Knowledge of Risk Factors
- Procedural Techniques (Operative, Irrigation, Wound Closure, etc.)
- OR Culture
- Environmental Factors
- Workflow (Policy/Practice) Consistency
- Human Behavior

# Risk Stratification for Surgical Site Infections in Colon Cancer

Ramzi Amri, MD, PhD; Anne M. Dinaux, BSc; Hiroko Kunitake, MD; Liliana G. Bordeianou, MD; David L. Berger, MD

 Invited Commentary  
page 690

**IMPORTANCE** Surgical site infections (SSIs) feature prominently in surgical quality improvement and pay-for-performance measures. Multiple approaches are used to prevent or reduce SSIs, prompted by the heavy toll they take on patients and health care budgets. Surgery for colon cancer is not an exception.

**OBJECTIVE** To identify a risk stratification score based on baseline and operative characteristics.

**DESIGN, SETTING, AND PARTICIPANTS** This retrospective cohort study included all patients treated surgically for colon cancer at Massachusetts General Hospital from 2004 through 2014 (n = 1481).

**MAIN OUTCOMES AND MEASURES** The incidence of SSI stratified over baseline and perioperative factors was compared and compounded in a risk score.

**RESULTS** Among the 1481 participants, 90 (6.1%) had SSI. Median (IQR) age was 66.9 (55.9-78.1) years. Surgical site infection rates were significantly higher among people who smoked (7.4% vs 4.8%;  $P = .04$ ), people who abused alcohol (10.6% vs 5.7%;  $P = .04$ ), people with type 2 diabetics (8.8% vs 5.5%;  $P = .046$ ), and obese patients (11.7% vs 4.0%;  $P < .001$ ). Surgical site infection rates were also higher among patients with an operation duration longer than 140 minutes (7.5% vs 5.0%;  $P = .05$ ) and in nonlaparoscopic approaches (clinically significant only, 6.7% vs 4.1%;  $P = .07$ ). These risk factors were also associated with an increase in SSI rates as a compounded score ( $P < .001$ ). Patients with 1 or fewer risk factors (n = 427) had an SSI rate of 2.3%, equivalent to a relative risk of 0.4 (95% CI, 0.16-0.57;  $P < .001$ ); patients with 2 risk factors (n = 445) had a 5.2% SSI rate (relative risk, 0.78; 95% CI, 0.49-1.22;  $P = .27$ ); patients with 3 factors (n = 384) had a 7.8% SSI rate (relative risk, 1.38; 95% CI, 0.91-2.11;  $P = .13$ ); and patients with 4 or more risk factors (n = 198) had a 13.6% SSI rate (relative risk, 2.71; 95% CI, 1.77-4.12;  $P < .001$ ).

**CONCLUSIONS AND RELEVANCE** This SSI risk assessment factor provides a simple tool using readily available characteristics to stratify patients by SSI risk and identify patients at risk during their postoperative admission. Thereby, it can be used to potentially focus frequent monitoring and more aggressive preventive efforts on high-risk patients.

JAMA Surg. 2017;152(7):686-690. doi:10.1001/jamasurg.2017.0505  
Published online April 12, 2017.

## Risk Stratification

- Patient who smoked (7.4% vs 4.8%;  $p = 0.04$ )
- Patients who abused alcohol (10.6% vs 5.7%;  $p = 0.04$ )
- Patients with type 2 diabetics (8.8% vs 5.5%;  $p = 0.046$ )
- Obese patients (11.7% vs 4.0%;  $p < 0.001$ )
- Surgical site infection rates higher when operative duration longer than 140 minutes (7.5% vs 5.0%;  $p = 0.05$ )

**These risk factors were also associated with an increase in SSI rates as a compounded score ( $P < 0.001$ ).**

- Patients with 1 or fewer risk factors (n = 427) - SSI rate of 2.3%
- Patients with 2 risk factors (n = 445) – SSI rate 5.2%
- Patients with 3 factors (n = 384) had a 7.8% SSI rate
- Patients with 4 or more risk factors (n = 198) > 13.5%

**Author Affiliations:** Division of General and Gastrointestinal Surgery, Massachusetts General Hospital, Harvard Medical School, Boston.

**Corresponding Author:** David L. Berger, MD, Massachusetts General Hospital, Wang 460 15 Parkman St, Boston, MA 02114 (dberger@mgh)

## Question #12:

What is the actual risk, and effective interventional strategy for preventing an anastomotic leak?

# Incidence of Anastomotic Leak Following Colorectal Surgery

When faced with patients who have multiple risk factors the incidence of an anastomotic leak can vary from 3% to 12%. With some peer publications reporting leak rates that are even higher.

# Risk Factors for Anastomotic Leak - Systemic Factors

## Pre-Existing Comorbidities:

- An American Society of Anesthesiologists (ASA) score of greater or equal to 3 has been found to be associated with high rates of anastomotic leak.
- Co-morbidities such as diabetes, pulmonary diseases, and renal diseases have all been implicated in higher risk of anastomotic leak. Diabetes has been associated with poor tissue healing and increased risk of post-operative infective complications.
- Hyperglycemia leads to impairment of inflammatory mediated response and neutrophil function which leads to decreased peripheral blood flow and angiogenesis that can negatively affect the anastomosis.

# Risk Factors Continued

## Anemia and Tissue Hypoxia:

- Anemia was found to be a modifiable risk factor for anastomotic leak. An international study, defined anemia as a hemoglobin level (Hb) of less than 10.5 g/dL for males and less than 9.7 g/dL for Females.
- In a recent systematic review (47 cohort studies and two RCTs), higher intraoperative blood loss was associated with increased risk of anastomotic leak. Twenty-three out of the 49 studies reported the influence of intraoperative blood loss (200 mL to 750 mL) which decreased oxygen carrying capacity, with resultant tissue hypoxia affecting the healing of colorectal anastomoses.
- An adequate blood pressure is also important for adequate tissue perfusion. However, it is thought that vasopressors lead to vasoconstriction, deterioration of microcirculation, and potentially result in local tissue hypoxia.

# Risk Factors Continued

## Smoking and Alcohol:

Multiple regression analysis of 333 consecutive patients who underwent colorectal surgery with anastomosis for both benign and malignant disease revealed that patients who smoked or consumed excessive alcohol were at an increased risk of anastomotic leak, with a relative risk of 3.18 and 7.18, respectively. A recent study showed that previous smoking history was a risk factor for anastomotic leak, with smoking cessation for up to 10 years still associated with higher risk compared to never-smokers.

Excessive alcohol consumption may be considered a surrogate for poor nutrition, which in itself is a risk factor.

## Nutritional Status:

Patients who experienced weight loss of greater than 10% may be at increased risk of anastomotic leak because of malnutrition.

# ★ Evidence-Based Strategies to Improve (Enhance) Patient Outcomes

**Mechanical bowel preparation combined with pre operative oral antibiotics:** Has its origin in the late 60s – early 70s. Currently recommended by multiple evidence-based studies and societal guidelines (SHEA, ASCRS, SAGES)

It has been reported that anastomotic injury is associated with significant changes in tissue-associated microbiota with 200-fold and 500-fold increase in the relative abundance of *Enterococcus* and *Escherichia/Shigella*. *Enterococcus* has been shown to produce a zinc-dependent endopeptidase that has the capacity to degrade the extracellular matrix (ECM), demonstrating a collagen-lytic activity, suggesting a sentinel role in the development of an anastomotic leak following colorectal surgery.

# The Efficacy of Oral Antimicrobials in Reducing Aerobic and Anaerobic Colonic Mucosal Flora

Jonathan I. Groner, MD; Charles E. Edmiston, Jr, PhD; Candace J. Krepel;  
Gordon L. Telford, MD; Robert E. Condon, MD, MS

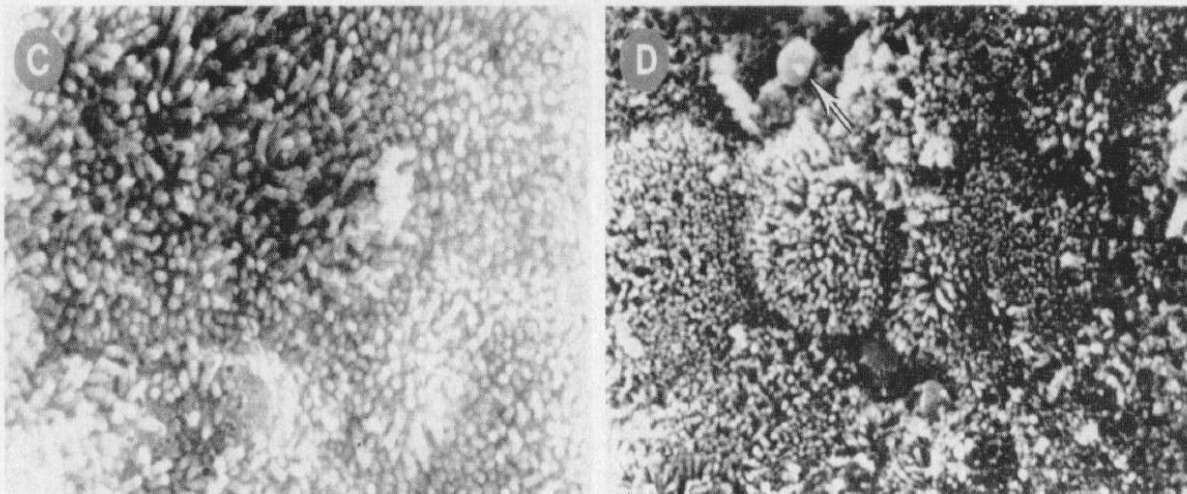
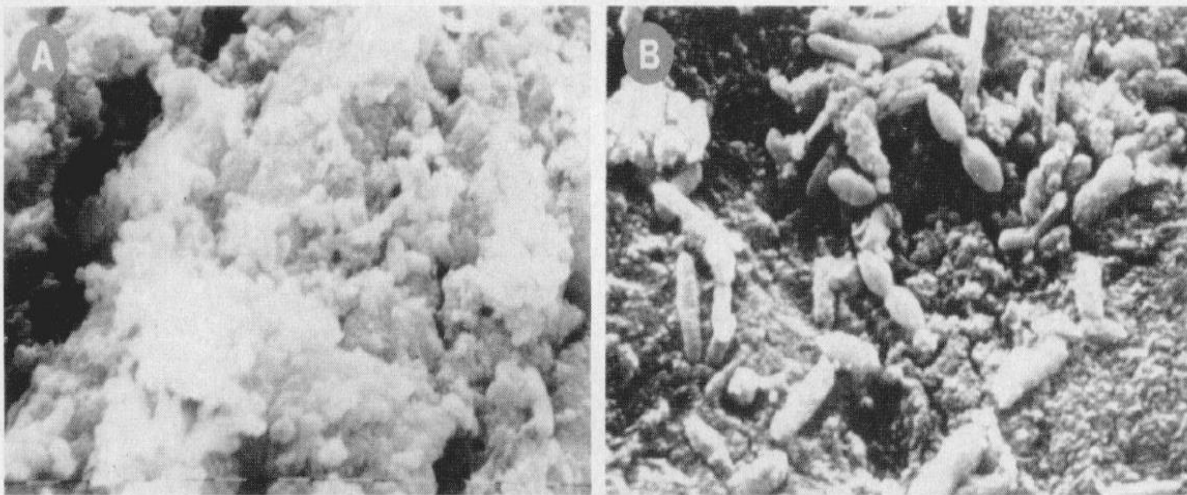


Table 1.—Quantitative Recovery of Aerobic and Anaerobic Mucosa-Associated Bacteria From Canine Colonic Segments\*

Group	Microbial Recovery		
	Proximal	Midcolon	Distal
<b>Aerobes</b>			
A	8.6 ± 0.5	8.3 ± 0.6	8.7 ± 0.5
B	7.4 ± 1.6	6.7 ± 2.0	7.2 ± 1.7
C	5.5 ± 0.6	5.4 ± 0.8	5.7 ± 1.0
D	2.4 ± 0.7	3.1 ± 0.2	2.5 ± 1.2
<b>Anaerobes</b>			
A	9.5 ± 0.4	9.7 ± 0.4	9.8 ± 0.9
B	9.0 ± 0.9	8.6 ± 2.1	8.6 ± 1.6
C	8.2 ± 0.9	7.4 ± 0.7	7.4 ± 1.0
D	2.6 ± 1.0	3.0 ± 1.4	2.6 ± 1.1

\*Expressed as log<sub>10</sub> colony-forming units per milligram (wet weight) of tissue, mean ± SD. Group A (n = 6) received no bowel preparation; group B (n = 7), clear-liquid diet; group C (n = 8), mechanical preparation; and group D (n = 7), oral antimicrobial prophylaxis.

**Groner, Edmiston, Krepel et al. Arch Surg. 1989;124:281**

# Core Components Leading to Successful Implementation of an Effective Interventional Strategy

## Promote Compassion for the Patient – Leading With Empathy

Active Listening Among All Parties

Robust Dialogue Between Players

Empowerment through Engagement

Flexibility in Planning

Uniting and Empowering Individual Leadership and

Collegiality (Not “I” but Us”)

Focus on the Sustainability of the Interventions

“Centuries of experience makes it clear that establishing the effectiveness of a clinical innovation is not sufficient to guarantee its uptake into routine use.”

*Bauer and Kirchner, Psychiatry Research  
Volume 283, January 2020, 112376*



# Relevant Literature

1. Bauer MS, Kirchner, J. Implementation science: What is it and why should I care? *Psychiatry Research* 2020;283:112376.
2. Camperlengo L, Spencer M, Graves P, Danker W, Edmiston CE Jr. Effectiveness versus Uptake: The Challenges of Implementing Evidence-Based Strategies to Reduce Surgical Site Infection in Patients with Colon Surgeries. *Surgical Infections* 2023; 24:382-389.
3. Rubin M. It Takes an Average of 17 Years for Evidence to Change Practice—the Burgeoning Field of Implementation Science Seeks to Speed Things Up. *JAMA Online*: April 5, 2023;329:1333-1336.
4. Leaper DJ, Tanner J, Kiernan M, Assadian O, Edmiston Jr CE. Surgical Site Infection: Poor Compliance with Guidelines and Care Bundles. *International Wound Journal*. 2015;12:357-62.
5. Pronovost PJ, Berenholtz SM, Needham DM. Translating Evidence into Practice: A Model for Large Scale Knowledge Translation. *British Medical Journal* 2008;337:963-965.
6. Borlaug G, Edmiston CE Jr. Implementation of Wisconsin Division of Public Health Surgical Site Infection Champion Initiative. *AORN J*. 2018;107:570-578.
7. Edmiston CE, Leaper DJ, Barnes S, Jarvis W, Barnden M, Spencer M, Graham D, Johnson HB. An Incision Closure Bundle for Colorectal Surgery. *AORN J* 2018;107:552-565.
8. De Mello NF, Nascimento S, Gomes DF, da Motta-Girardi J, Barreto JOM. Models and Frameworks for Assessing the Implementation of Clinical Practice Guidelines: A Systematic Review. *Implementation Science* 2024;19:59
9. Nasser JS, Chung KC, Implementation Science in Surgery: Translating Outcome to Action. *Plastic Reconstructive Surgery* 2023;151:237-243.
10. Shelton RC, Cooper B, Stirman S. The Sustainability of Evidence-Based Interventions and Practice in Public health and Health Care. *Annual Review Public Health* 2018;39:55-76.