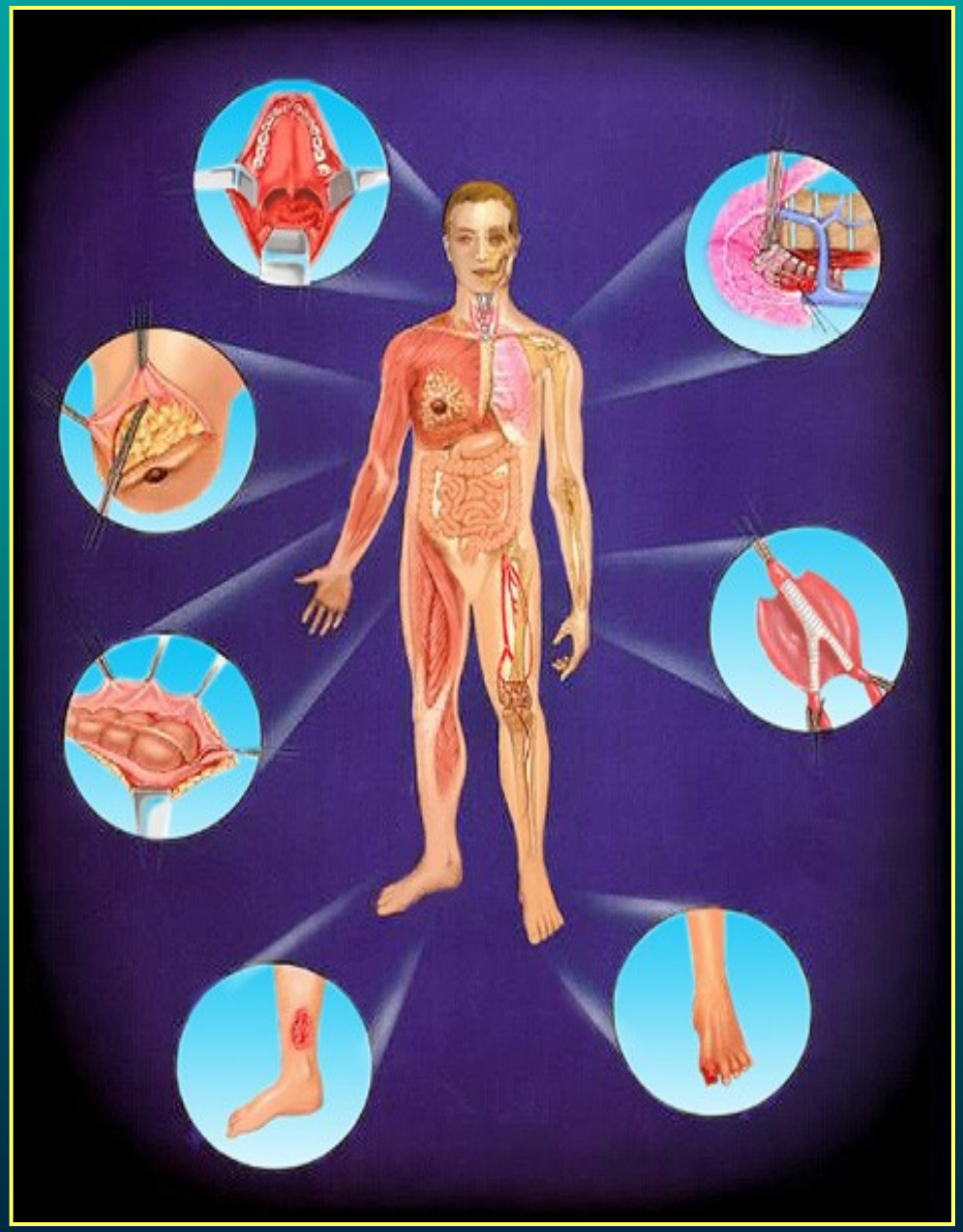

Reducing the Risk of Surgical Site Infections Through Evidence-Based Pathways: Moving Beyond SCIP

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MEDICAL COLLEGE OF WISCONSIN

Disclaimer – Caveat

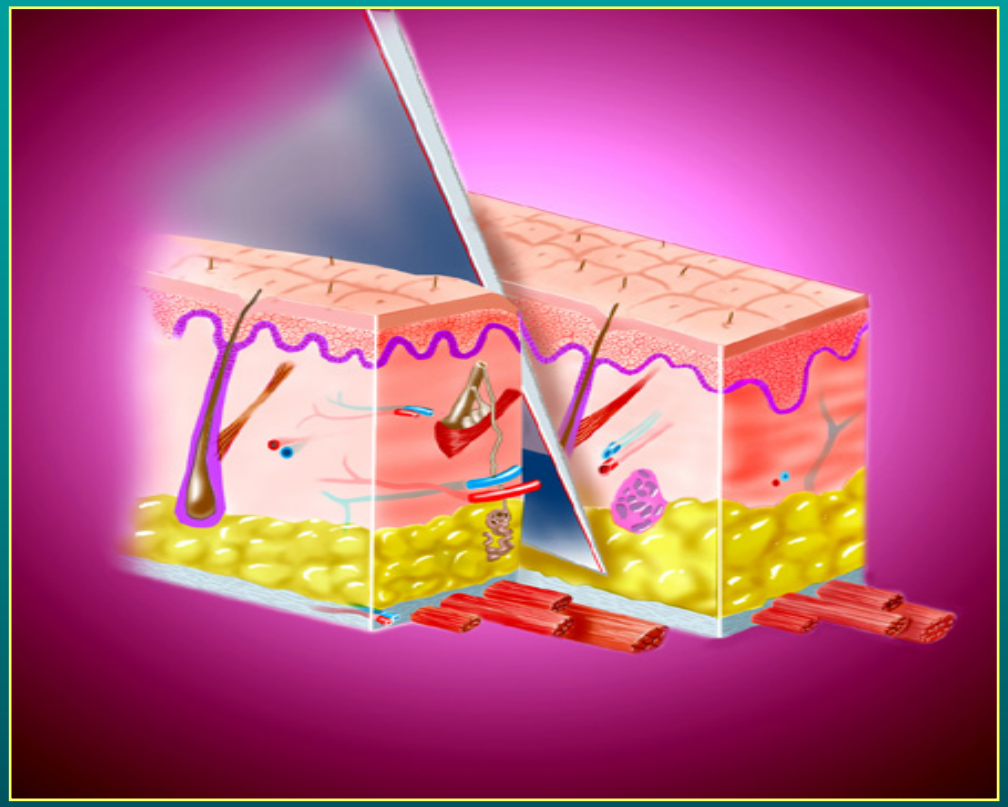
“I DON’T HAVE ALL OF THE ANSWERS”

Surgical Site Infections Often Represent a Complex and Multifactorial Process - the Mechanistic Etiology or the Search for Resolution May be Quite Elusive – Therefore, Risk Reduction is an Evolutionary Process

Items For Discussion Today

- Fiscal and Morbid Risk of Surgical Site Infections
- Complexity of Surgical Site Infections
- SSI Prevention Guidelines – Mechanistic Considerations
- Demystifying the Surgical Care Bundle in the Prevention of Surgical Site Bundle

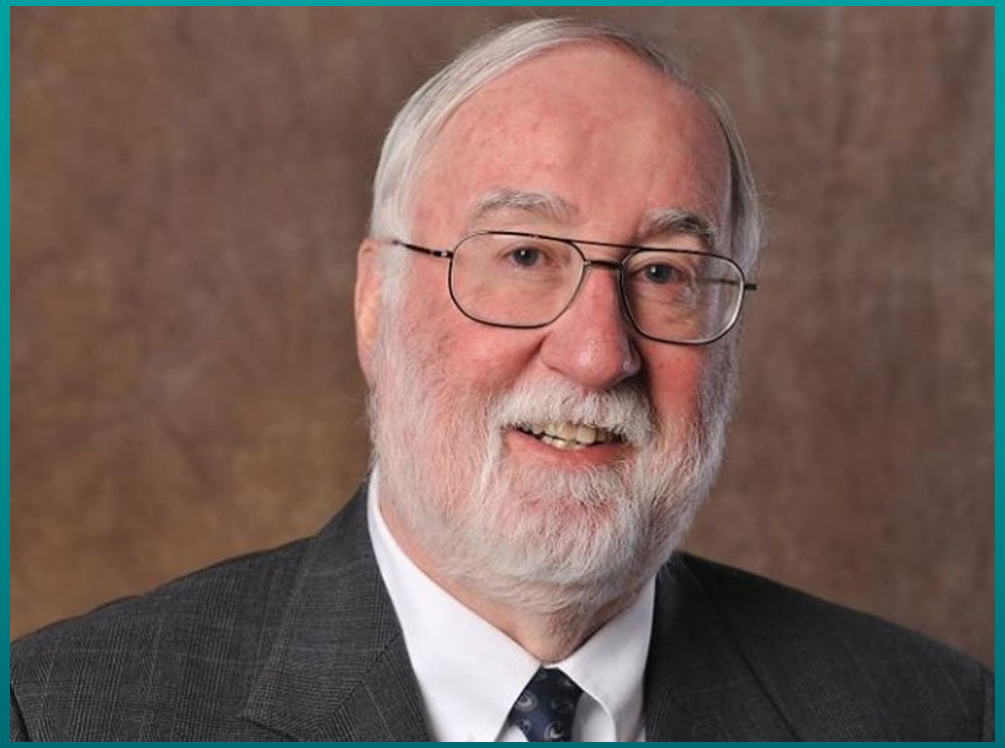
The Fundamental Problem

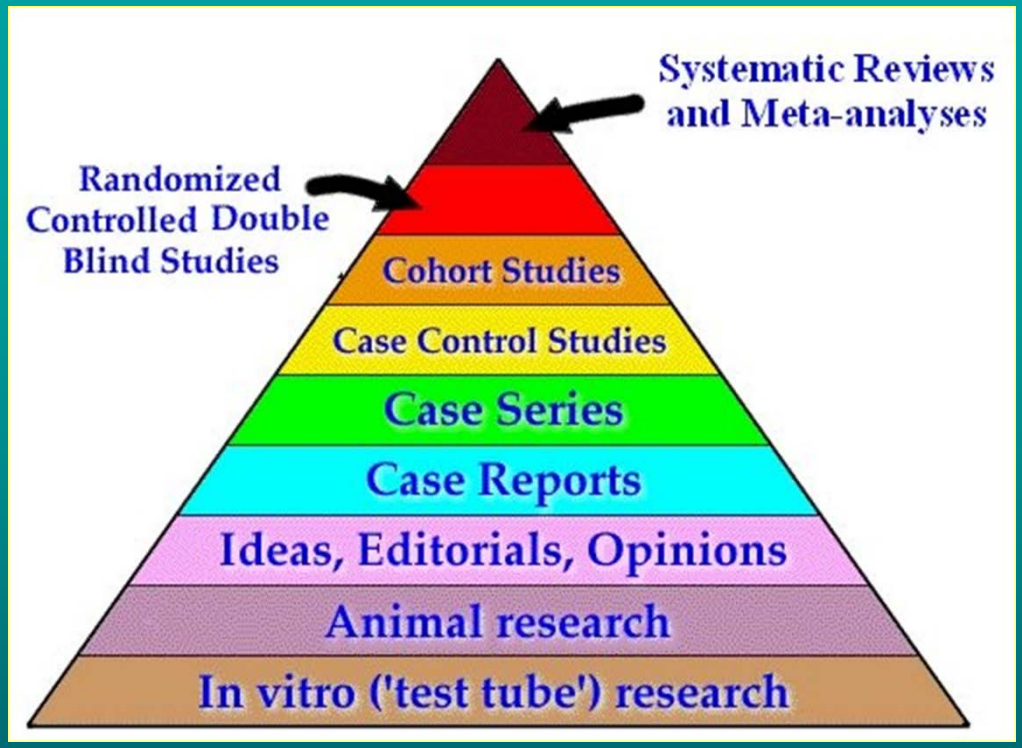


“It’s all about the surgical wound”

“….all surgical wounds are contaminated to some degree at closure – the primary determinant of whether the contamination is established as a clinical infection is related to host (wound) defense”

Belda et al., JAMA 2005;294:2035-2042





"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

GUIDELINE FOR PREVENTION OF SURGICAL SITE INFECTION, 1999

Alicia J. Mangram, MD; Teresa C. Horan, MPH, CIC; Michele L. Pearson, MD; Leah Christine Silver, BS; William R. Jarvis, MD;
The Hospital Infection Control Practices Advisory Committee

Hospital Infections Program
National Center for Infectious Diseases
Centers for Disease Control and Prevention
Public Health Service
US Department of Health and Human Services

Hospital Infection Control Practices Advisory Committee Membership List, January 1999

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Concord, California

Robert A. Weinstein, MD
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Chicago, Illinois

Mitigating Risk - Surgical Care Improvement Project (SCIP) – An Evidence-Based "Bundle" Approach in 2006

- Timely and appropriate antimicrobial prophylaxis
- Glycemic control in cardiac and vascular surgery
- Appropriate hair removal
- Normothermia in general surgical patients

Goal: Reduce preventable surgical morbidity and mortality by 25% by the year 2010

Was this the Holy Grail?

Why Do We Really Need a Surgical Care Bundle to Reduce the Risk of Infection: A Few Examples

JAMA Surgery | Original Investigation

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.

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

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 Operation 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%

JAMA Surg 2017;152:686-690

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

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.

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.

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).

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.

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Dis Colon Rectum 2020 00 00–00
DOI: 10.1097/DCR.0000000000001799

Longitudinal Study

- Infection Rate (107,665 Colorectal Patients): 23.9%
- 50% of infections diagnosed at 3-25 days while 75% of infections diagnosed by 2 months
- At 12-months "real-world" costs ranged from:
  - $36,429 - $144,809 – Commercial Payers
  - $17,551 - $102,280 – Medicare

Diseases of Colon and Rectum 2020;63:1628-1638

American Journal of Infection Control 47 (2019) 1225–1232

Contents lists available at ScienceDirect

American Journal of Infection Control

journal homepage: www.ajicjournal.org

Major Article

Impact of patient comorbidities on surgical site infection within 90 days of primary and revision joint (hip and knee) replacement

Charles E. Edmiston Jr., PhD [a], Abhishek S. Chitnis MPharm, PhD [b,*], Jason Lerner PT, MBA, MSc [c], Ekoué Folly MPH [b], Chantal E. Holy PhD [b], David Leaper DSc, MD, ChM, FRCS, FACS, FLS [d]

[a] Department of Surgery, Medical College of Wisconsin, Milwaukee
[b] Real World Data Sciences, Medical Devices Epidemiology, Johnson and Johnson, New Brunswick, NJ
[c] Health Economics and Market Access Analytics, DePuy Synthes, Raynham, MA
[d] Newcastle University, Newcastle upon Thyme, and University of Huddersfield, United Kingdom

IBM MarketScan Analysis of 498,681 Orthopedic Patients

2009 – 2015 Observational Cohort

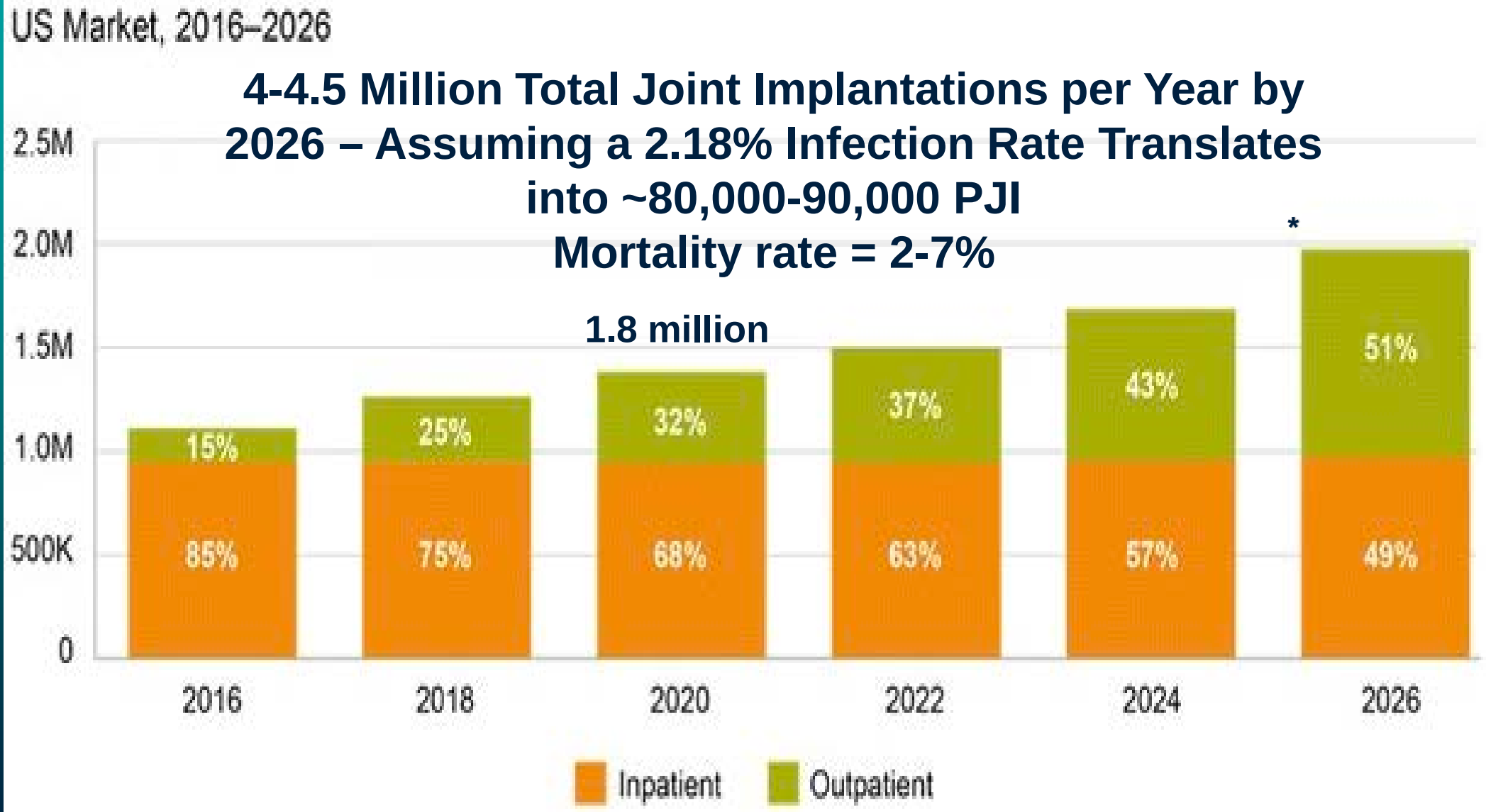
- 335,134 – TKR
- 14,488 – rTKR (revision)
- 163,547 – THR
- 11,791 – rTHR (revision)

- TKR – 2.2% Infection rate
- rTKR – 15.6% “ “
- THR – 2.1% “ “
- rTHR – 8.6% “ “

- 34 comorbid risk factors
- Typical 65 y.o. patient will have 7-9 comorbid risk factors

American Journal of Infection Control 47 (2019) 1225–1232

Projected Trends and it is not Pretty



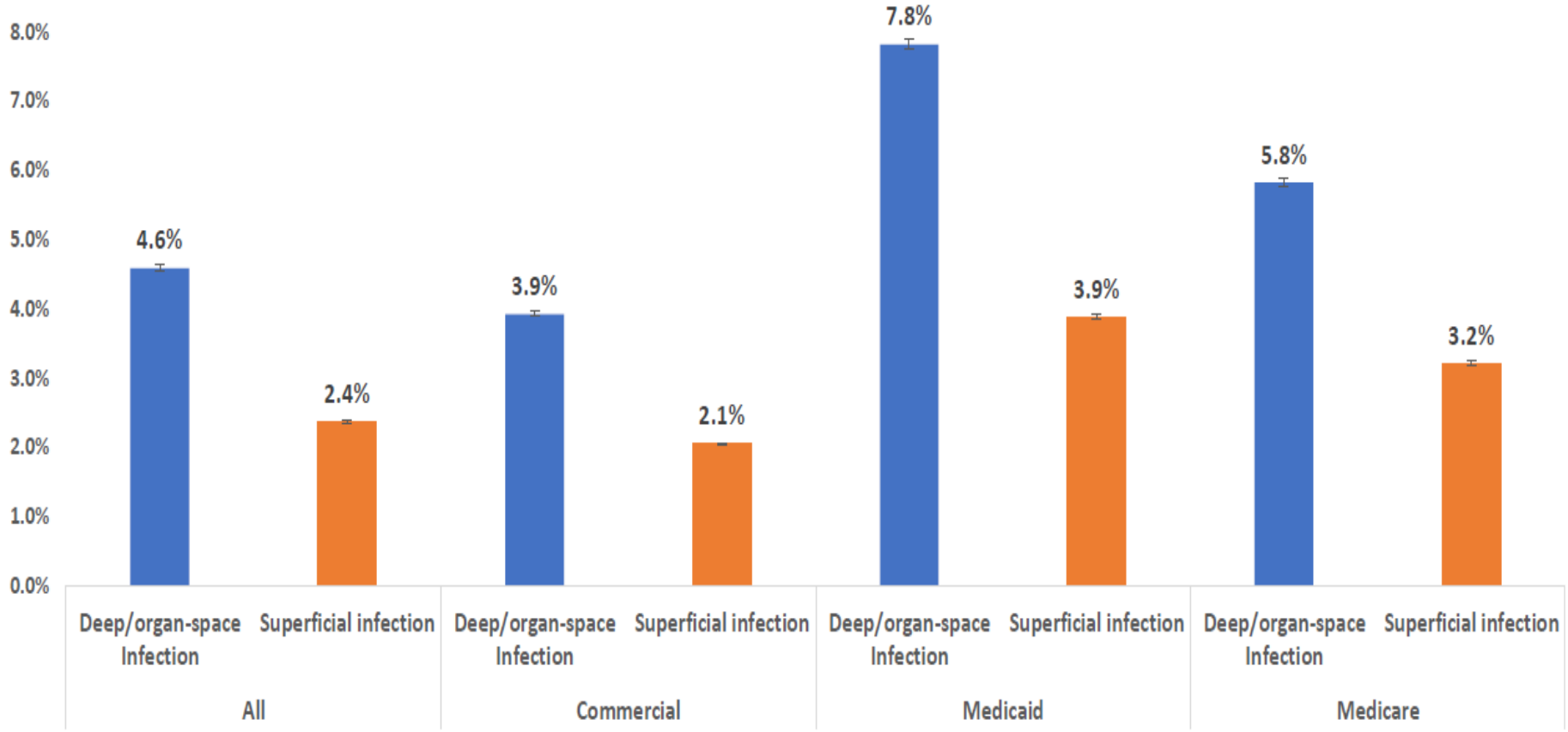
Tisosky et al. J Am Acad Orthop Surgeons 2017;1:e34

Assessment of Risk and Economic Burden of Surgical Site Infection (SSI) Post Hysterectomy Using a US Longitudinal Database

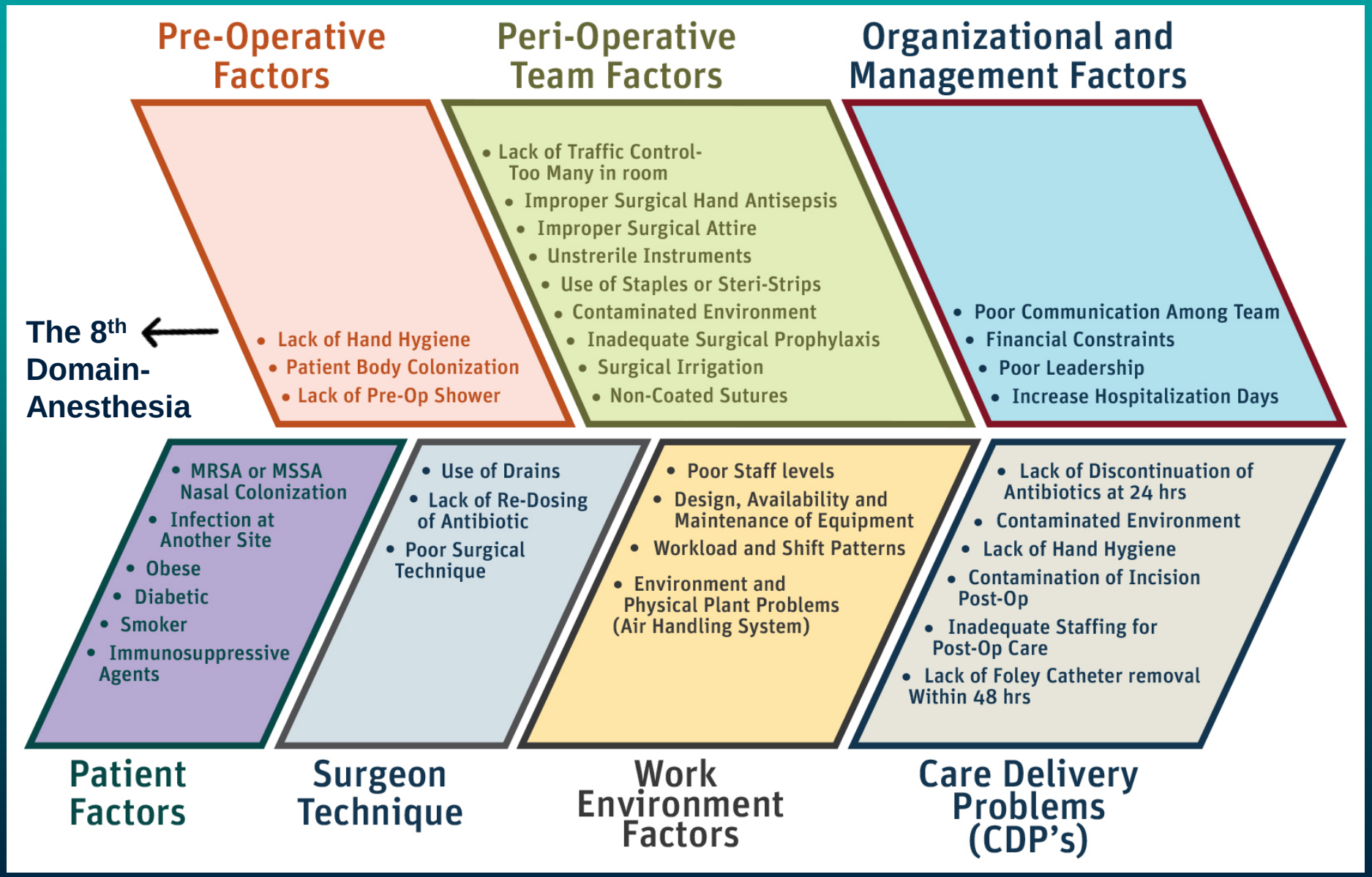
- The analysis identified 141,869 women who underwent hysterectomy between 2014-2018.
- Within 6 months of the index procedure, 7.0% of patients were diagnosed with an SSI.
- Deep incisional/organ-space infections accounted for 4.6% of infections and superficial incisional infections for the remaining 2.4%.
- Incremental postoperative costs continued to increase over the 24-month study period for all payer types Commercial, Medicare and Medicaid.
- The rate of deep incisional/organ space SSI following hysterectomy was found to be higher than previously reported when surrogate data was used - Most vulnerable component of the population – Medicare and Medicaid patients

Edmiston et al., In Press: Surgery

Figure 2. Incidence of deep incisional/organ-space and superficial SSI after hysterectomy



Risk is a Myriad of Events - SSI Fishbone Diagram



Courtesy of Maureen Spencer

Are SSI Prevention Guidelines Helpful – A Mechanistic Basis?

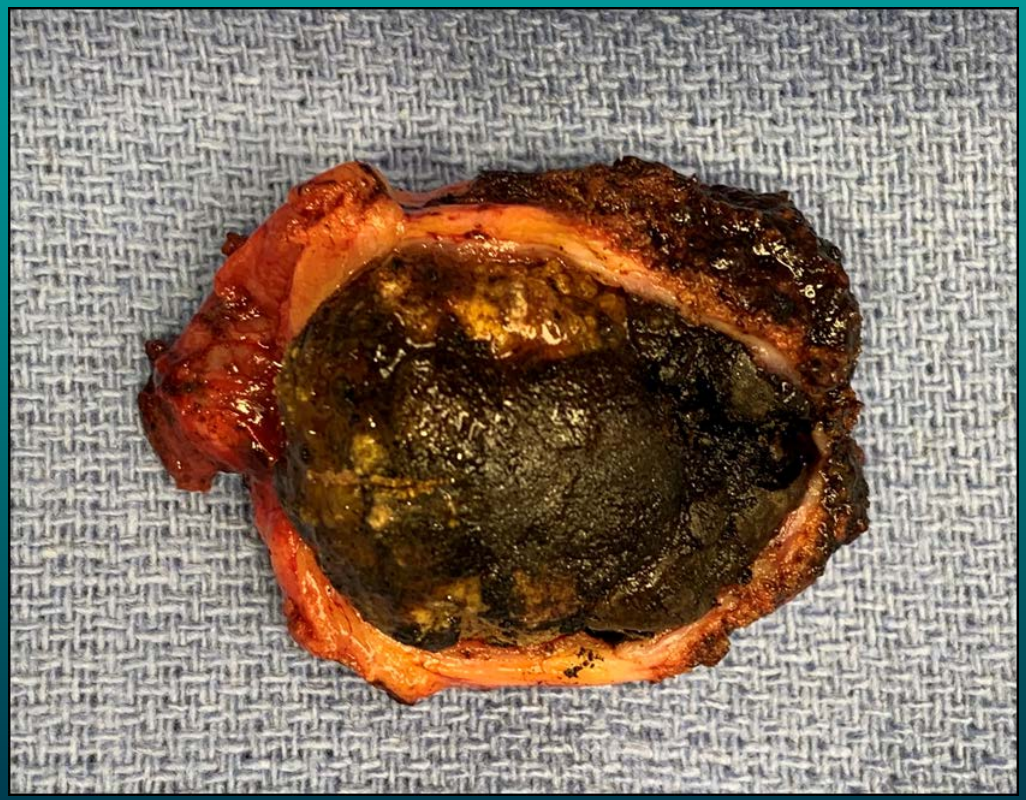
Comparative Analysis of WHO, Proposed CDC, ACS and Wisconsin SSI Prevention Guidelines

INTERVENTION	WHO Guidelines	CDC Guidelines	ACS Guidelines	WISCONSIN SSI Prevention
Normothermia	Maintain normothermia	Maintain normothermia	Maintain normothermia	Maintain normothermia - FAW reduces incidence of SSI = 1A
Wound Irrigation	No recommendation	Intraoperative irrigation recommended - povidone iodine	No recommendation	Recommend – 0.05% CHG (Professional Expertise)
Antimicrobial Prophylaxis	Short durational	Short durational	Short durational	Short durational – Follow ASHP weight-based dosing = 1A
Glycemic Control	Recommended	Recommended – No recommendation for HA1c	Highly beneficial	Highly beneficial HbA1c $\leq$7 ($\leq$154) $\leq$8 (<183) = 1A
Perioperative Oxygenation	Recommended	Administer increased FIO_2 during surgery after extubation, immediate postop period	Recommended	Recommended – Strongest (High – 1A) for colorectal surgery
Preadmission Showers	Advised patients to bathe or shower with soap	Advise patients to bathe or shower with soap or antiseptic agent –at least night before surgery	Advise patients to shower with CHG	Two standardized shower/cleansing with 4% or 2% CHG night before/morning (High)
Antimicrobial Sutures	Use antimicrobial sutures independent of type of surgery	Consider use of triclosan-coated sutures for prevention of SSI	Recommended for clean and clean-contaminated abdominal procedures	The use of triclosan sutures represents = 1A clinical evidence

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 antisepsis / intraoperative conc > MIC^{90} 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 antisepsis / minimize the risk of biofilm formation
Preadmission CHG shower / cleansing	High-1A	Skin antisepsis / reduce skin bioburden
Perioperative skin-prep – 2% CHG / 70% alcohol	1A	Skin antisepsis / reduce skin bioburden
Separate wound closure tray	Moderate	Mitigate instrument contamination
Glove change prior to fascia / subcuticular closure	Moderate	Disrupt cross-contamination across tissue planes

Supplemental Interventions Evidence-Based	Class	Major Mechanistic Benefits
Supplemental oxygen – Colorectal	Moderate to High	Enhanced oxygenation and immune fuction / host-metabolic benefits
Oral antibiotics / Mechanical bowel prep – Colorectal	1A	Reduce bioburden (protease-producing bacteria) within the bowel lumen and on brush border surfaces
Wound edge protector – Colorectal, Vascular, OB/GYN	Moderate	Intraoperative wound antisepsis / minimizing wound contamination
Staphylococcal decolonization – Orthopedic and CT	1A	Mitigate *S. aureus* 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

Normothermia – Always!!!



Journal of Clinical Anesthesia (2016) 34, 282–289

ELSEVIER

Journal of Clinical Anesthesia

Original Contribution

Unexpectedly high incidence of hypothermia before induction of anesthesia in elective surgical patients☆,☆☆,★

Anna J. Wetz (Dr med)[a,*], Thorsten Perl (PD Dr med)[a], Ivo F. Brandes (PD Dr med)[a], Markus Harden[b], Martin Bauer (Prof Dr Dr med, MPH)[a], Anselm Bräuer (Prof Dr med, DEAA)[a]

[a]*Department of Anesthesiology, University of Goettingen, Robert-Koch-Str 40, 37075 Goettingen, Germany*
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Received 12 October 2014; revised 27 April 2015; accepted 16 March 2016

Keywords:
Core temperature;
Hypothermia;
Hypothermia before induction of anesthesia;
Incidence of hypothermia;
Predictor of hypothermia

Abstract

Study objective: Perioperative hypothermia is a frequently observed phenomenon of general anesthesia and is associated with adverse patient outcome. Recently, a significant influence of core temperature before induction of anesthesia has been reported. However, there are still little existing data on core temperature before induction of anesthesia and no data regarding potential risk factors for developing preoperative hypothermia. The purpose of this investigation was to estimate the incidence of hypothermia before anesthesia and to determine if certain factors predict its incidence.

Design/setting/patients: Data from 7 prospective studies investigating core temperature previously initiated at our department were analyzed. Patients undergoing a variety of elective surgical procedures were included.

Interventions/measurements: Core temperature was measured before induction of anesthesia with an oral (314 patients), infrared tympanic (143 patients), or tympanic contact thermometer (36 patients). Available potential predictors included American Society of Anesthesiologists status, sex, age, weight, height, body mass index, adipose ratio, and lean body weight. Association with preoperative hypothermia was assessed separately for each predictor using logistic regression. Independent predictors were identified using multivariable logistic regression.

Main results: A total of 493 patients were included in the study. Hypothermia was found in 105 patients (21.3%; 95% confidence interval, 17.8%-25.2%). The median core temperature was 36.3°C (25th-75th percentiles, 36.0°C-36.7°C). Two independent factors for preoperative hypothermia were identified: male sex and age (>52 years).

The Optimal Time and Method for Surgical Prewarming: A Comprehensive Review of the Literature

Lauren Connelly, BSN, RN, Emily Cramer, BSN, RN, Quinn DeMott, BSN, RN, Jennifer Piperno, BSN, RN, Bethany Coyne, PhD, APRN, PNP-BC, Clara Winfield, BSN, CAPA, RN, Michael Swanberg, BSN, MA, PhD(c), RN

Purpose: *Inadvertent hypothermia is a common problem in the operating room. This can contribute to many unfavorable outcomes –rising costs, increased complications, and higher morbidity rates.*
Design: *This review determined the optimal method and time to prewarm a surgical patient to prevent perioperative hypothermia.*
Methods: *CINAHL and PubMed were searched. Fourteen articles were ultimately included in this review.*
Findings: *Based on the literature reviewed, it was suggested that forced-air warming was most effective in preventing perioperative hypothermia. Eighty-one percent of the experimental studies reviewed found that there was a significantly higher temperature throughout surgery and in the postanesthesia care unit for patients who received forced-air prewarming.*
Conclusions: *Thirty minutes was found to be the average suggested amount of time for prewarming among the literature; however, a minimum of 10 minutes of prewarming was suggested to significantly reduce rates of hypothermia in perioperative patients and decrease the adverse effects of hypothermia.*

Keywords: *prewarming, perioperative hypothermia, forced air warming.*

Lauren Connelly, BSN, RN, University of Virgina School of Nursing, Charlottesville, VA; Emily Cramer, BSN, RN, University of Virginia School of Nursing, Charlottesville, VA; Quinn DeMott, BSN, RN, University of Virginia School of Nursing, Charlottesville, VA; Jennifer Piperno, BSN, RN, University of Virginia School of Nursing, Charlottesville, VA; Bethany Coyne, PhD, APRN, PNP-BC, is an Assistant Professor of Nursing with the Family, Community, and Mental Health Systems, University of Virginia School of Nursing, Charlottesville, VA; Clara Winfield, BSN, CAPA, RN, University of Virginia School of Nursing, Charlottesville, VA; and Michael Swanberg, BSN, MA, PhD(c), RN, is an Instructor of Nursing with the Family, Community, and Mental Health Systems, University of Virginia School of Nursing, Charlottesville, VA.

Conflict of interest: None to report.

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1089-9472/$36.00
http://dx.doi.org/10.1016/j.jopan.2015.11.010

INADVERTENT PERIOPERATIVE HYPOTHERMIA is a risk during all surgical procedures and is associated with surgical complications such as increased blood loss, impaired wound healing, and even cardiac arrest. Up to 70% of surgical patients develop perioperative hypothermia.[1] Perioperative hypothermia is defined by the American Society of PeriAnesthesia Nurses as a core temperature below 36°C.[2] Maintaining perioperative normothermia, defined as a core temperature of 36 to 38°C, is a high priority for the multidisciplinary surgical team because of the adverse effects of hypothermia. If intraoperative normothermia can be maintained, studies have found that this may reduce the length of a patient's hospital stay by 40%[3] and may also reduce the rate of perioperative infections by up to 64%.[2,3] These reductions in length of stay and postoperative

Antimicrobial Prophylaxis - Does BMI Increase Risk?

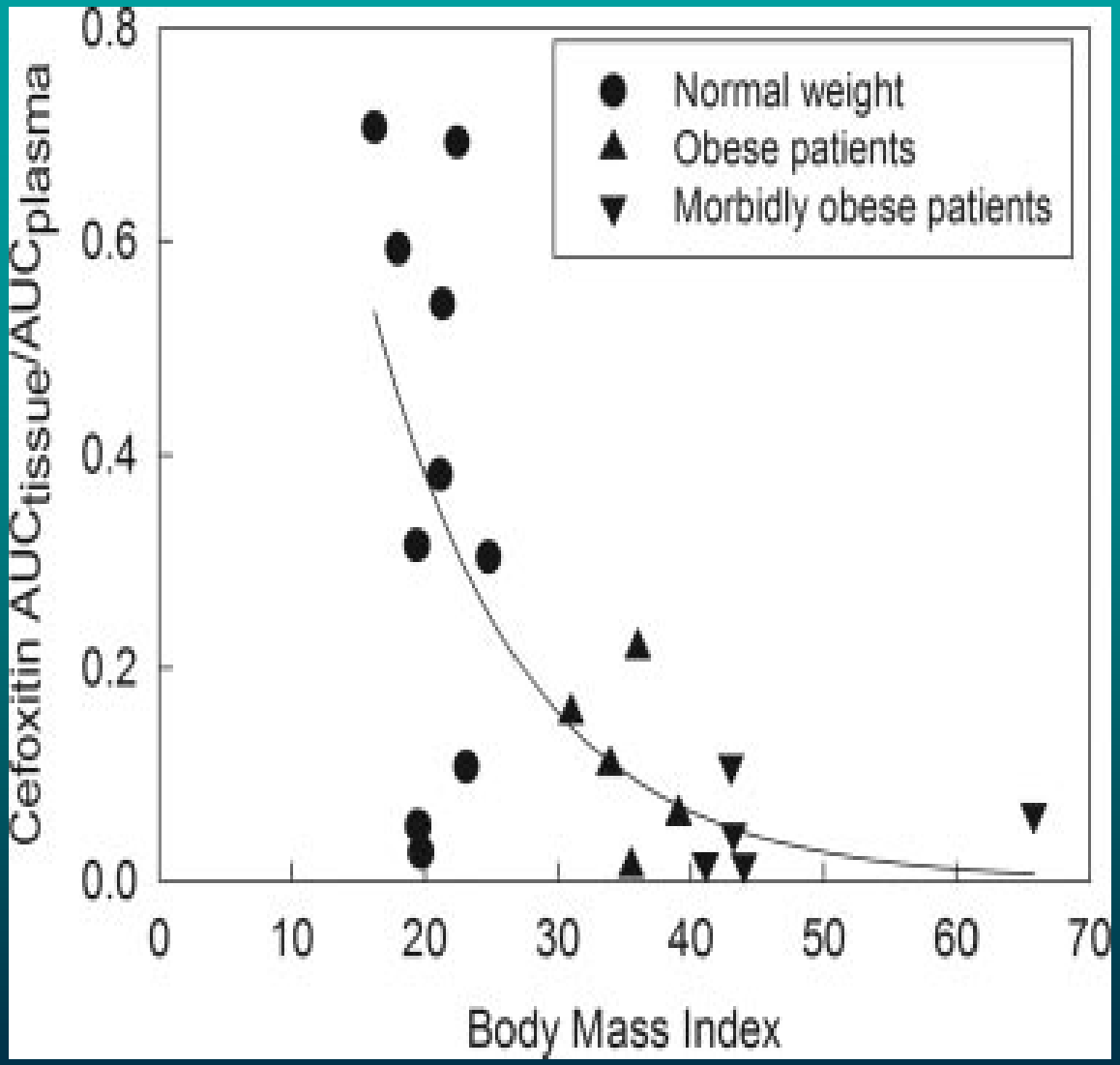
Perioperative Antimicrobial Prophylaxis in Higher BMI (>40) Patients: Do We Achieve Therapeutic Levels?

Percent Therapeutic Activity of Serum / Tissue Concentrations Compared to Surgical Isolate (2002-2004) Susceptibility to Cefazolin Following 2-gm Perioperative Dose

Organisms	n	Serum	Tissues
Staphylococcus aureus	70	68.6%	27.1%
Staphylococcus epidermidis	110	34.5%	10.9%
E. coli	85	75.3%	56.4%
Klebsiella pneumoniae	55	80%	65.4%

Edmiston et al, Surgery 2004;136:738-747

Weight-Based Dosing



Toma et al., Anesthesia Analgesia 2011;113:730-737

- **"Measured and dose-normalized subcutaneous cefoxitin concentrations and AUCs in the obese patients were significantly lower than in the normal-weight subjects.**
- **There was an inverse relationship between cefoxitin tissue penetration (AUC tissue/ AUC plasma ratio) and body mass index.**
- ❖ **Tissue penetration was substantially lower in the obese patients compared to normal weight controls (*p = 0.05*)."**
- **"This occurred despite 2-fold-higher cefoxitin dosage (1 to 2 gms).**
- ❖ **Diminished tissue antibiotic concentrations in morbid obesity may influence the incidence of SSIs."**

ASHP REPORT

Clinical practice guidelines for antimicrobial prophylaxis in surgery

DALE W. BRATZLER, E. PATCHEN DELLINGER, KEITH M. OLSEN, TRISH M. PERL, PAUL G. AUWAERTER, MAUREEN K. BOLON, DOUGLAS N. FISH, LENA M. NAPOLITANO, ROBERT G. SAWYER, DOUGLAS SLAIN, JAMES P. STEINBERG, AND ROBERT A. WEINSTEIN

Am J Health-Syst Pharm. 2013; 70:195–283

These guidelines were developed jointly by the American Society of Health-System Pharmacists (ASHP), the Infectious Diseases Society of America (IDSA), the Surgical Infection Society (SIS), and the Society for Healthcare Epidemiology of America (SHEA). This work represents an update to the previously published ASHP Therapeutic Guidelines on Antimicrobial Prophylaxis in Surgery,[1] as well as guidelines from IDSA and SIS.[2,3] The guidelines are intended to provide practitioners with a standardized approach to the rational, safe, and effective use of antimicrobial agents for the prevention of surgical-site infections (SSIs) based on currently available clinical evidence and emerging issues.

Prophylaxis refers to the prevention of an infection and can be characterized as primary prophylaxis, secondary prophylaxis, or eradication. Primary prophylaxis refers to the prevention of an initial infection. Secondary prophylaxis refers to the prevention of recurrence or reactivation of a preexisting infection. Eradication refers to the elimination of a colonized organism to prevent the development of an infection. These guidelines focus on primary perioperative prophylaxis.

Guidelines development and use

Members of ASHP, IDSA, SIS, and SHEA were appointed to serve on an expert panel established to ensure the validity, reliability, and utility of the revised guidelines. The work of the panel was facilitated by faculty of the University of Pittsburgh School of Pharmacy and University of Pittsburgh Medical Center Drug Use and Disease State Management Program who served as contract researchers and writers for the project. Panel members and contractors were required to disclose any possible conflicts of interest before their appointment and throughout the guideline development process. Drafted documents for each surgical procedural section were reviewed by the expert panel and, once revised, were available for public comment on the ASHP website. After additional revisions were made to address reviewer comments, the final document was

Microbial Ecology of Skin Surface

- Scalp 6.0 Log_{10} cfu/cm^2
- Axilla 5.5 Log_{10} cfu/cm^2
- Abdomen 4.3 Log_{10} cfu/cm^2
- Forearm 4.0 Log_{10} cfu/cm^2
- Hands 4.0-6.6 Log_{10} cfu/cm^2
- Perineum 7.0-11.0 Log_{10} cfu/cm^2

To Maximize Skin Surface Concentrations of CHG – A Standardize Process Should Include

Research

Original Investigation

Evidence for a Standardized Preadmission Showering Regimen to Achieve Maximal Antiseptic Skin Surface Concentrations of Chlorhexidine Gluconate, 4%, in Surgical Patients

Charles E. Edmiston Jr, PhD; Cheong J. Lee, MD; Candace J. Krepel, MS; Maureen Spencer, MEd; David Leaper, MD; Kellie R. Brown, MD; Brian D. Lewis, MD; Peter J. Rossi, MD; Michael J. Malinowski, MD; Gary R. Seabrook, MD

Invited Commentary

IMPORTANCE To reduce the amount of skin surface bacteria for patients undergoing elective surgery, selective health care facilities have instituted a preadmission antiseptic skin cleansing protocol using chlorhexidine gluconate. A Cochrane Collaborative review suggests that existing data do not justify preoperative skin cleansing as a strategy to reduce surgical site infection.

4% Aqueous CHG

- Dose - 4-ozs. for each shower
- Timing - 1-minute pause before rinsing (4% CHG)
- Duration - TWO SHOWERS (CLEANSINGS) – NIGHT BEFORE/MORNING OF SURGERY
- An SMS, text or voicemail reminder to shower
- A standardized regimen – instructions – Oral and written

CHG conc ≥1000 µg/ml

Remember the devil is always in the details

Edmiston et al. JAMA Surg 2015;150:1027-1033

Evidence-Based Bundled Quality Improvement Intervention for Reducing Surgical Site Infection in Lower Extremity Vascular Bypass Procedures

Katherine E Hekman, MD, PhD, Eriberto Michel, MD, Eddie Blay Jr, MD, Irene B Helenowski, PhD, Andrew W Hoel, MD, FACS

BACKGROUND: Surgical site infection (SSI) poses a significant burden to patients and healthcare resources. Vascular Quality Initiative (VQI) data identify a higher rate of SSIs for lower extremity bypass than other vascular procedures. Bundled interventions have successfully reduced SSIs in other surgical procedures.

STUDY DESIGN: We evaluated our institution-specific VQI data for modifiable risk factors associated with index hospitalization SSI from January 2012 through October 2015. We implemented an evidence-based lower extremity bypass operation SSI reduction bundle (ie perioperative chlorhexidine showers and transverse groin incisions) and prospectively enrolled all patients who had lower extremity bypass procedures, with a target adherence rate of 50% per bundle component. Bundle adherence and SSI events were measured from March 2016 through August 2017. We carried out a pre-post evaluation of bundle effectiveness in reducing index hospitalization SSI.

RESULTS: In the pre-intervention period, 43 of 234 (18%) patients had SSI events. The only risk factors associated with SSI (ie female sex, diabetes, overweight BMI) were not readily modifiable. In an 18-month period after introduction of our intervention, adherence rates to preoperative chlorhexidine showers, a transverse incision, and a postoperative chlorhexidine shower were 71% (52 of 73), 48% (24 of 50), and 88% (64 of 73), respectively. Compliance with all applicable bundle components was 36% (26 of 73). The SSI rate post-intervention decreased from 18% to 4% (3 of 73). Intention-to-treat multivariable analysis showed a 97% SSI risk reduction with the bundle ($p = 0.002$). As-treated analysis identified 85% ($p = 0.02$) and 62% ($p = 0.047$) SSI risk reductions from the preoperative and postoperative chlorhexidine showers, respectively.

CONCLUSIONS: In this evaluation study of the effectiveness of a quality improvement intervention, SSIs were markedly decreased after implementation of our evidence-based bundle for lower extremity vascular bypass procedures. (J Am Coll Surg 2019;228:44–53. © 2018 by the American College of Surgeons. Published by Elsevier Inc. All rights reserved.)

Surgical site infection (SSI) poses a significant burden to both patients and healthcare resources. Among vascular surgery procedures, the lower extremity bypass has the highest rate of SSI, at approximately 10%.[1] These SSI events lead to prolonged hospital stays and greater resource use.[2] More importantly, in the setting of

Disclosure Information: Nothing to disclose.

Support: Dr Hekman is supported by NIH grant 1F32HL137292 and Dr Blay is supported by NIH grant 5T32HL094293.

Presented at the American College of Surgeons 104th Annual Clinical Congress, Scientific Forum, Boston, MA, October 2018.

Received July 1, 2018; Revised October 1, 2018; Accepted October 2, 2018.

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J Am Coll Surg. 2019 Jan;228(1):44-53

Clin Orthop Relat Res (2016) 474:1583–1588
DOI 10.1007/s11999-016-4748-9

Clinical Orthopaedics and Related Research®
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SYMPOSIUM: PROCEEDINGS OF THE 2015 MUSCULOSKELETAL INFECTION SOCIETY

Does Preadmission Cutaneous Chlorhexidine Preparation Reduce Surgical Site Infections After Total Hip Arthroplasty?

Bhaveen H. Kapadia MD, Julio J. Jauregui MD, Daniel P. Murray BA, Michael A. Mont MD

Published online: 18 February 2016

Abstract

Background Periprosthetic hip infections are among the most catastrophic complications after total hip arthroplasty (THA). We had previously proven that the use of chlorhexidine cloths before surgery may help decrease these infections; hence, we increased the size of the previously reported cohort.

Questions/purposes (1) Does a preadmission chlorhexidine cloth skin preparation protocol decrease the risk of surgical site infection in patients undergoing THA? (2) When stratified using the National Healthcare Safety Network (NHSN) risk categories, which categories are associated with risk reduction from the preadmission chlorhexidine preparation protocol?

Methods Between 2007 and 2013, a group of 998 patients used chlorhexidine cloths before surgery, whereas a group of 2846 patients did not use them and underwent standard perioperative disinfection only. Patient records were reviewed to determine the development of periprosthetic infection in both groups of patients.

Results Patients without the preoperative chlorhexidine gluconate disinfection protocol had a higher risk of infections (infections with protocol: six of 995 [0.6%]; infections in control: 46 of 2846 [1.62%]; relative risk: 2.68 [95% confidence interval {CI}, 1.15–0.26]; p = 0.0226). When stratified based on risk category, no differences were detected; preadmission chlorhexidine preparation was not associated with reduced infection risk for low, medium, and high NHSN risk categories (p = 0.386, 0.153, and 0.196, respectively).

Conclusions The results of our study suggest that this cloth application appears to reduce the risk of infection in patients undergoing THA. When stratified by risk categories, we found no difference in the infection rate, but these findings were underpowered. Although future multicenter randomized trials will need to confirm these preliminary findings, the intervention is inexpensive and is unlikely to be risky and so might be considered on the basis of this retrospective, comparative study.

Level of Evidence Level III, therapeutic study.

One of the authors (MAM) received an educational grant from Sage Products LLC (Cary, IL, USA).
All ICMJE Conflict of Interest Forms for authors and *Clinical Orthopaedics and Related Research®* editors and board members are on file with the publication and can be viewed on request.
Clinical Orthopaedics and Related Research® neither advocates nor endorses the use of any treatment, drug, or device. Readers are encouraged to always seek additional information, including FDA-approval status, of any drug or device prior to clinical use.
Each author certifies that his or her institution approved the human protocol for this investigation, that all investigations were conducted in conformity with ethical principles of research, and that informed consent for participation in the study was obtained.
This work was performed at the Rubin Institute for Advanced Orthopedics, Center for Joint Preservation and Replacement, Sinai Hospital of Baltimore, Baltimore, MD, USA.

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M. A. Mont (✉)

Introduction

CHG = chlorhexidine.

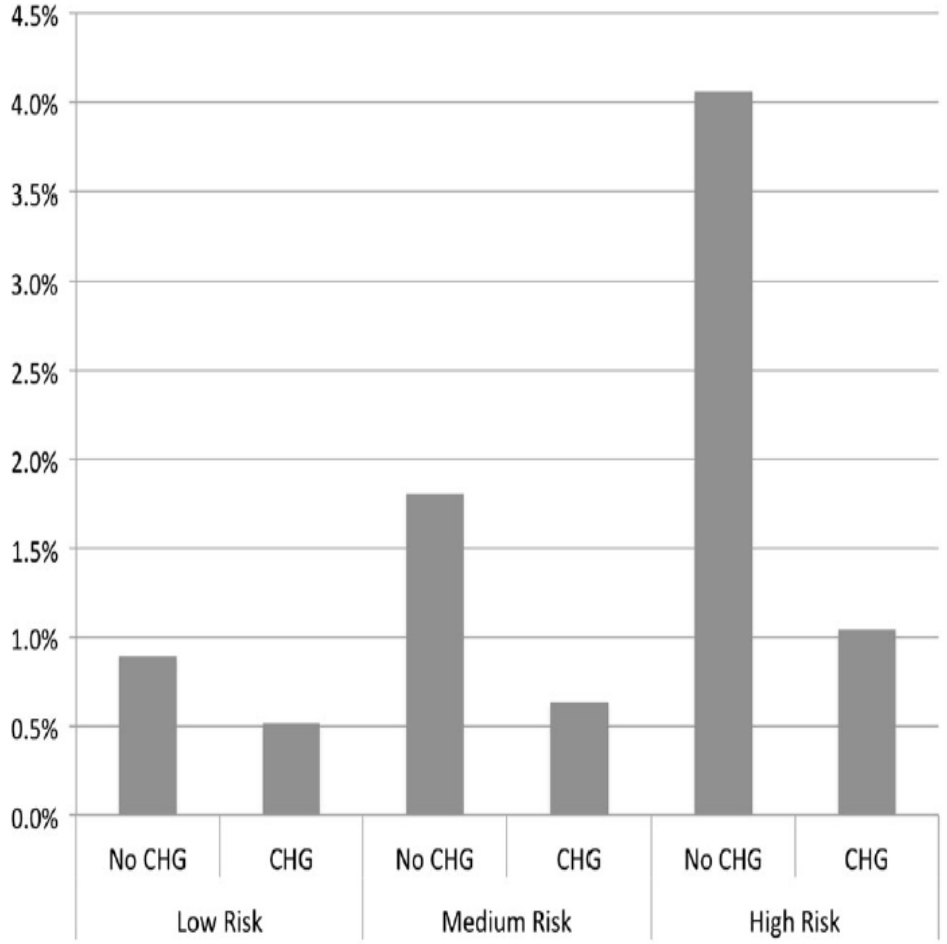
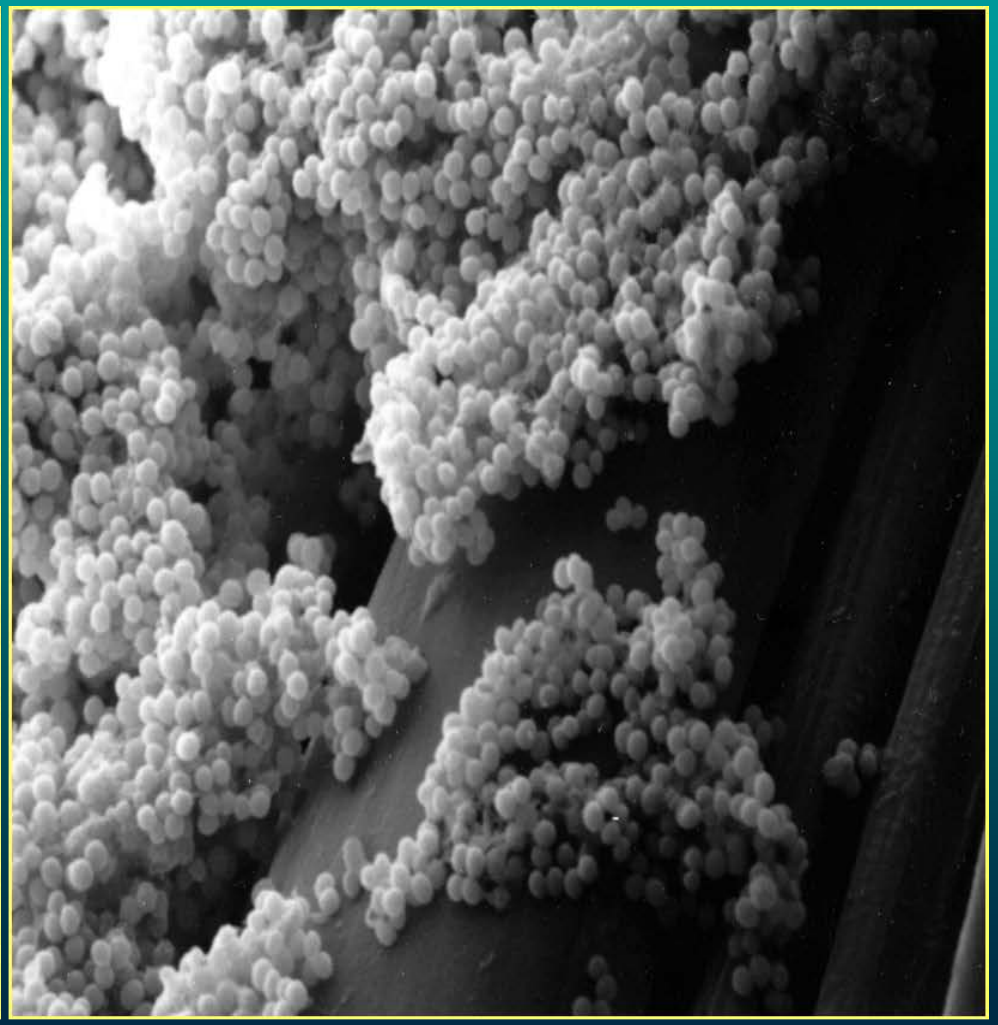


Fig. 1 Bar graph representing the incidence of infection stratified by risk classification. CHG = chlorhexidine gluconate.

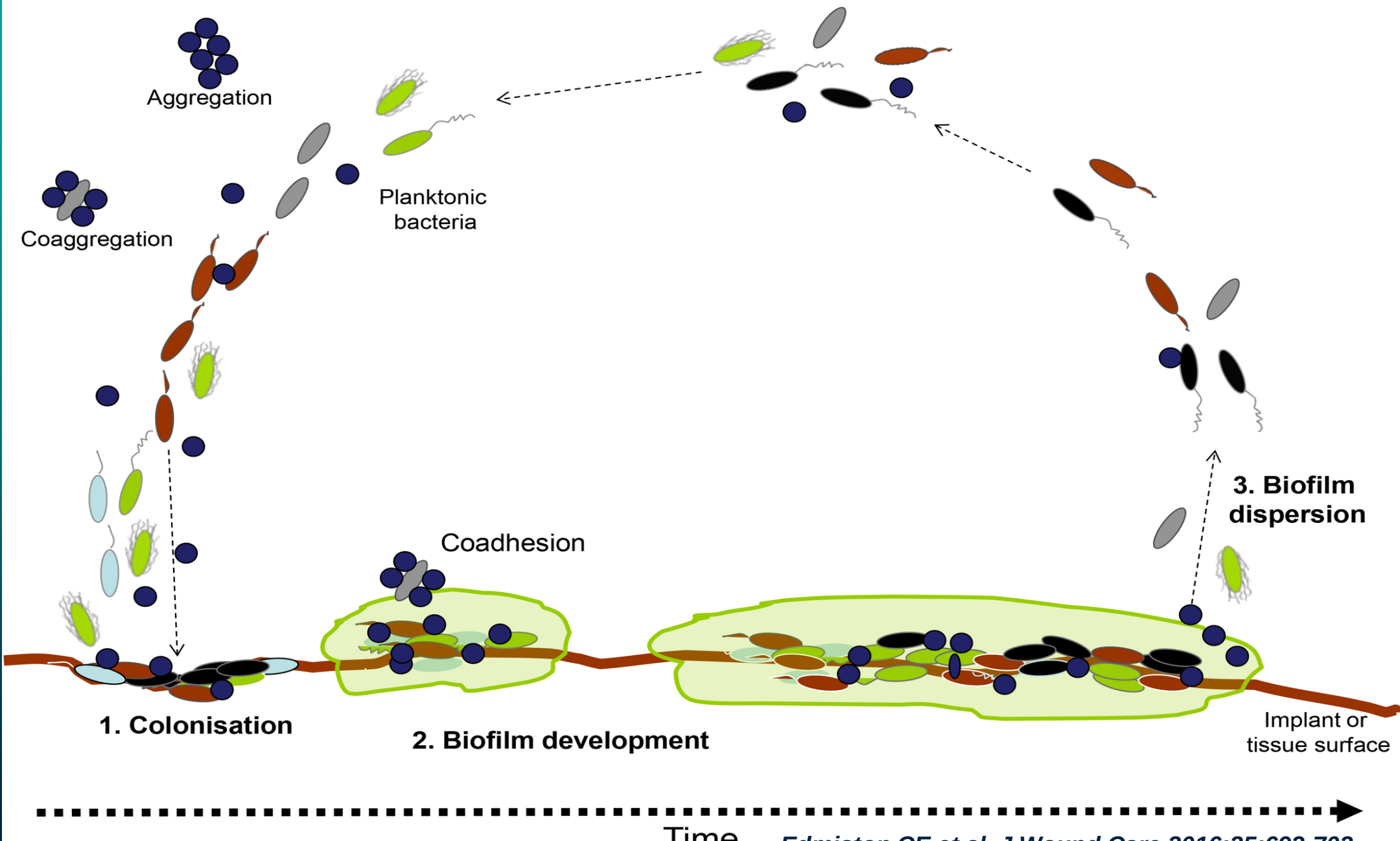
Can a Suture Really be a Nidus for Infection?

What Does an SSI Look Like from a Microscopic Perspective?



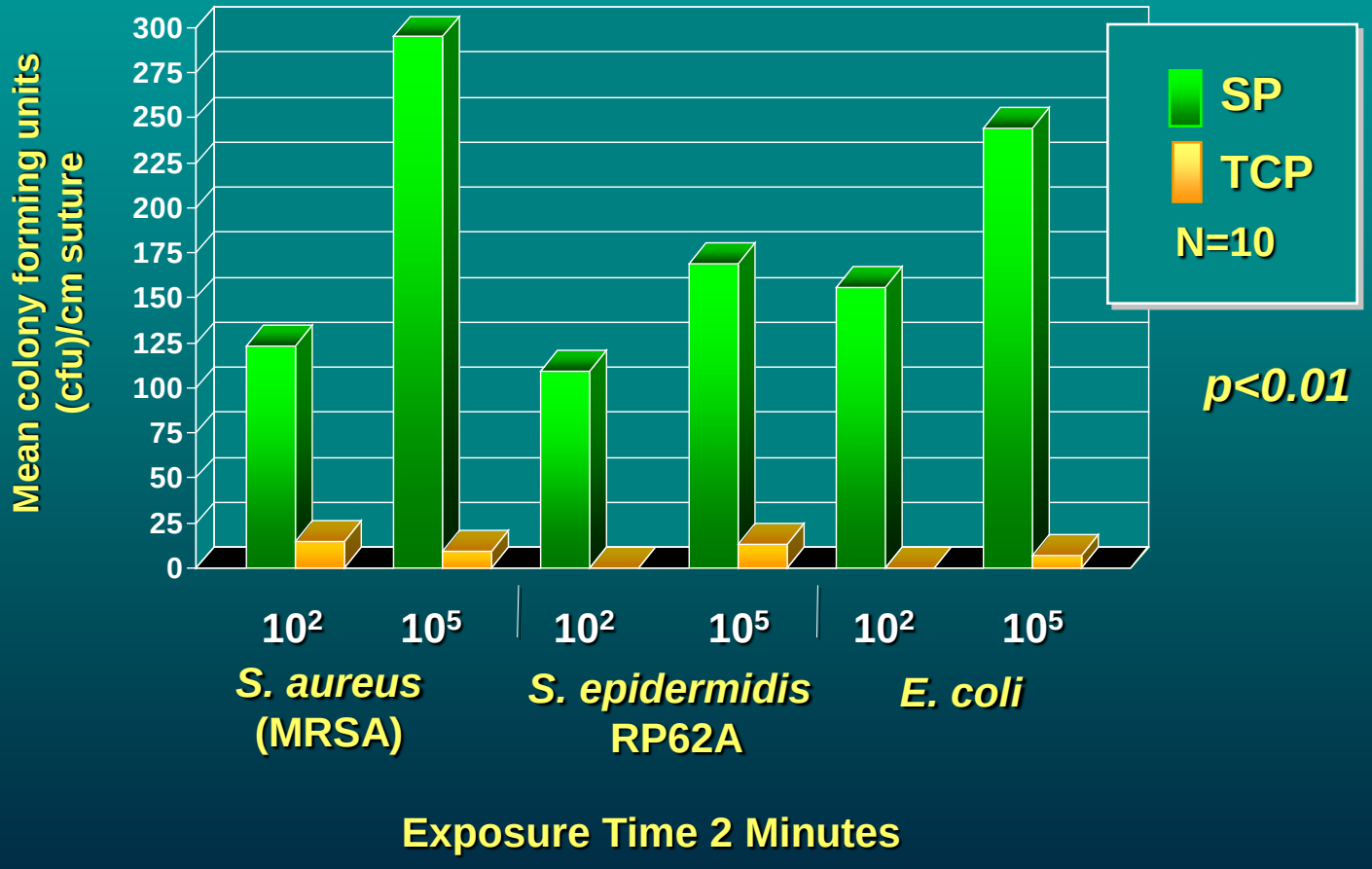
Surgical Microbiology Research Laboratory, Milwaukee - 2005

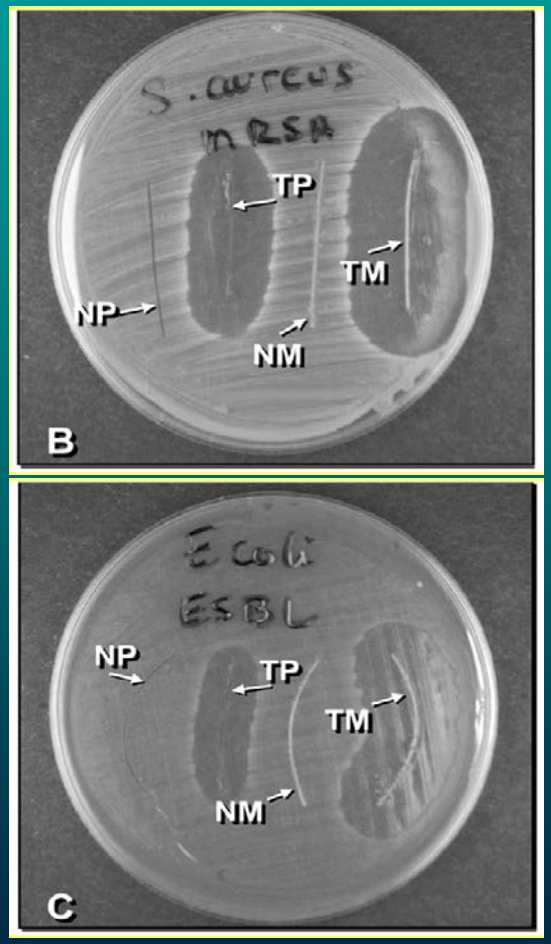
Fig. 1. Edmiston *et al.*



Edmiston CE et al. J Wound Care 2016;25:693-702

Mean Microbial Recovery from Standard Polyglactin Sutures Compared to Triclosan (Antimicrobial)-Coated Polyglactin Closure Devices





Edmiston et al, J Am Coll Surg 2006;203:481-489

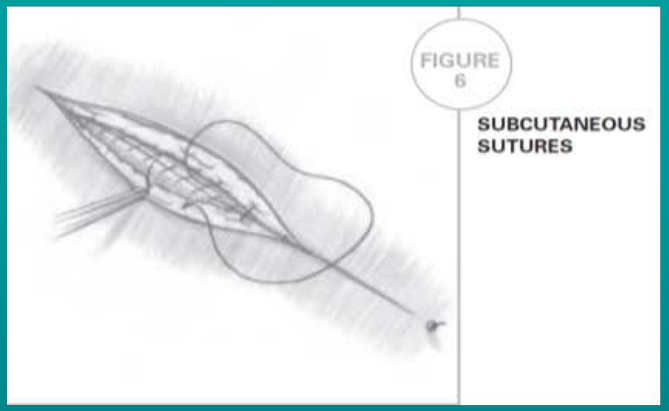


FIGURE
6
SUBCUTANEOUS
SUTURES

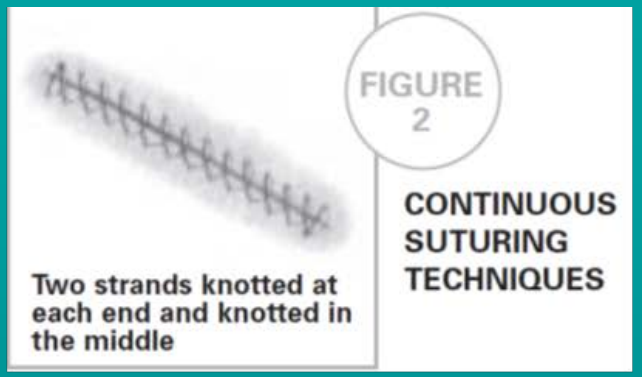
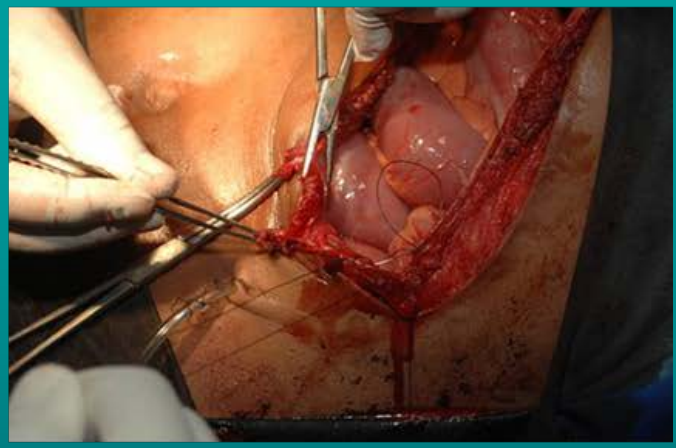


FIGURE
2
CONTINUOUS
SUTURING
TECHNIQUES
Two strands knotted at
each end and knotted in
the middle




S. aureus
MRSA
TP
TM
NP
NM
B
E coli
ESBL
NP
TP
TM
NM
C

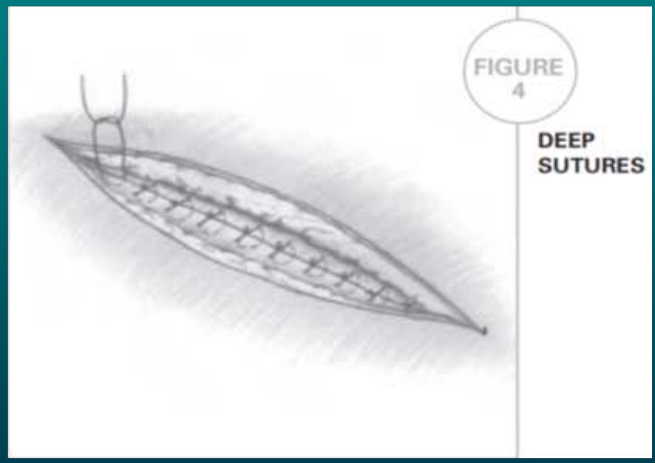
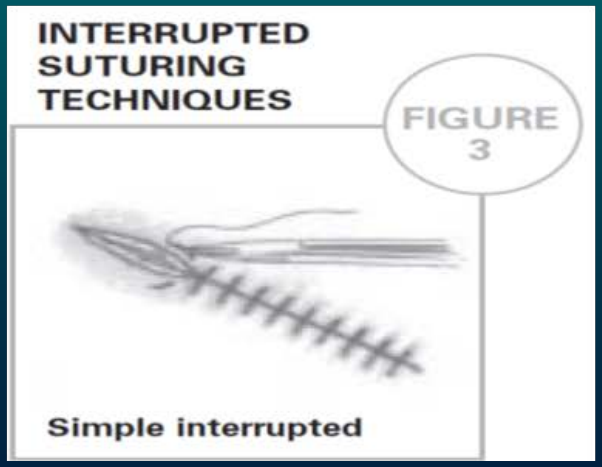


FIGURE
4
DEEP
SUTURES


INTERRUPTED
SUTURING
TECHNIQUES
FIGURE
3
Simple interrupted

Is there an evidence-based argument for embracing an antimicrobial (triclosan)-coated suture technology to reduce the risk for surgical-site infections?: A meta-analysis

Charles E. Edmiston, Jr, PhD,[a] **Frederic C. Daoud, MD,**[b] *and* **David Leaper, MD, FACS,**[c] *Milwaukee, WI, Paris, France, and London, UK*

Background. *It has been estimated that 750,000 to 1 million surgical-site infections (SSIs) occur in the United States each year, causing substantial morbidity and mortality. Triclosan-coated sutures were developed as an adjunctive strategy for SSI risk reduction, but a recently published systematic literature review and meta-analysis suggested that no clinical benefit is associated with this technology. However, that study was hampered by poor selection of available randomized controlled trials (RCTs) and low patient numbers. The current systematic review involves 13 randomized, international RCTs, totaling 3,568 surgical patients.*

Methods. *A systematic literature search was performed on PubMed, Embase/Medline, Cochrane database group (Central Register of Controlled Trials, Cochrane Database of Systematic Reviews, Health Economic Evaluations Database/Database of Health Technology Assessments), and www.clinicaltrials.gov to identify RCTs of triclosan-coated sutures compared with conventional sutures and assessing the clinical effectiveness of antimicrobial sutures to decrease the risk for SSIs. A fixed- and random-effects model was developed, and pooled estimates reported as risk ratio (RR) with a corresponding 95% confidence interval (CI). Publication bias was assessed by analyzing a funnel plot of individual studies and testing the Egger regression intercept.*

Results. *The meta-analysis (13 RCTs, 3,568 patients) found that use of triclosan antimicrobial-coated sutures was associated with a decrease in SSIs in selected patient populations (fixed effect: RR = 0.734; 95% CI: 0.590–0.913; P = .005; random-effect: RR = 0.693; 95% CI: 0.533–0.920; P = .011). No publication bias was detected (Egger intercept test: P = .145).*

Conclusion. *Decreasing the risk for SSIs requires a multifaceted "care bundle" approach, and this meta-analysis of current, pooled, peer-reviewed, randomized controlled trials suggests a clinical effectiveness of antimicrobial-coated sutures (triclosan) in the prevention of SSIs, representing Center for Evidence-Based Medicine level 1a evidence. (Surgery 2013;154:89-100.)*

Edmiston et al., Surgery 2013;154;89-100

Meta-analysis

Systematic review and meta-analysis of triclosan-coated sutures for the prevention of surgical-site infection

Z. X. Wang[1,2], C. P. Jiang[1,2], Y. Cao[1,2] and Y. T. Ding[1,2]

[1]Department of Hepatobiliary Surgery, Affiliated Drum Tower Hospital, School of Medicine, Nanjing University, and [2]Jiangsu Province's Key Medical Centre for Liver Surgery, Nanjing, Jiangsu Province, China

Correspondence to: Professor Y. T. Ding, 321 Zhong Shan Road, Nanjing, Jiangsu Province, China 210008 (e-mail: dingyitao@yahoo.com.cn)

Background: Surgical-site infections (SSIs) increase morbidity and mortality in surgical patients and represent an economic burden to healthcare systems. Experiments have shown that triclosan-coated sutures (TCS) are beneficial in the prevention of SSI, although the results from individual randomized controlled trials (RCTs) are inconclusive. A meta-analysis of available RCTs was performed to evaluate the efficacy of TCS in the prevention of SSI.

Methods: A systematic search of PubMed, Embase, MEDLINE, Web of Science®, the Cochrane Central Register of Controlled Trials and internet-based trial registries for RCTs comparing the effect of TCS and conventional uncoated sutures on SSIs was conducted until June 2012. The primary outcome investigated was the incidence of SSI. Pooled relative risks with 95 per cent confidence interval (c.i.) were estimated with RevMan 5.1.6.

Results: Seventeen RCTs involving 3720 participants were included. No heterogeneity of statistical significance across studies was observed. TCS showed a significant advantage in reducing the rate of SSI by 30 per cent (relative risk 0·70, 95 per cent c.i. 0·57 to 0·85; $P < 0·001$). Subgroup analyses revealed consistent results in favour of TCS in adult patients, abdominal procedures, and clean or clean-contaminated surgical wounds.

Conclusion: TCS demonstrated a significant beneficial effect in the prevention of SSI after surgery.

Wang et al., British J Surg 2013;100;465-473

What Do the Various Meta-Analyses Tell Us About Triclosan Suture as a Risk Reduction Strategy?

- 2013 - Sajid et al, Gastroenterol Report 2013:42-50: 7 RCT (1631 patients) – Odds of SSI 56% less in triclosan suture group compared to controls ($p<0.04$)
- 2013 - Wang et al, BJS 2013;100-465: 17 RCT (3720 patients) – 30% decrease in risk of SSI ($p<0.001$)
- 2013 - Edmiston et al, Surgery 2013;154:89-100: 13 RCT (3568 patients) – 27% to 33% decrease in risk of SSI ($p<0.005$)
- 2014 - Daoud et al, Surg Infect 2014;15:165-181: 15 RCT (4800 patients) – 20% to 50% decreased risk of SSI ($p<0.001$)
- 2015 - Apisarnthanarak et al. Infect Cont Hosp Epidemiol 2015;36:1-11: 29 studies (6,930 patients) – 26% reduction in SSI ($p<0.01$)
- 2016 - Guo et al, Surg Research 2016; doi:10.1016/j.jss.2015.10.015 – 13 RCT (5256 patients) (risk ratio [RR] 0.76, 95% confidence interval [CI] 0.65e0.88, $p < 0.001$)
- 2017 – Wu et al, Eur J Clin Microbiol Infect Dis 2017;36:19-32: 13 RCT (5,346 patients) (risk ratio [RR] 0.72,95% confidence interval [CI] 0.59-0.88, $p<0.001$)
- 2017 – De Jonge et al, BJS 2017;104:e118-e133: 21 RCT (6,462 patients) (risk ratio [RR] 28% reduction, 95% confidence ratio [CI] 0.60-0.88, $p<0.001$)
- 2019 – Ahmed I et al, BMJ 2019;9:029727; doi.10.1136/bml-open-2019-029727: 25 RCT
- (11,957 patients) – Test of overall effect: $Z = 5.2$ ($p<0.0001$)

How Does One Evaluate An Antimicrobial Risk - Reduction Technology – The Triclosan Suture Story?

Safety (>1 Billion strands)

- No MAUDE (FDA) reports (19 years) documenting significant evidence linking triclosan to adverse impact in surgical wounds; No evidence of pediatric toxicity, *Renko et al. Lancet Infectious Disease 2016;17:50–57;* No evidence of human toxicity following oral or dermal exposure, *Roidricks et al. Crit. Rev. Toxicol. 2010;40:422. doi: 10.3109/10408441003667514*.

Microbicidal Activity (Spectrum)

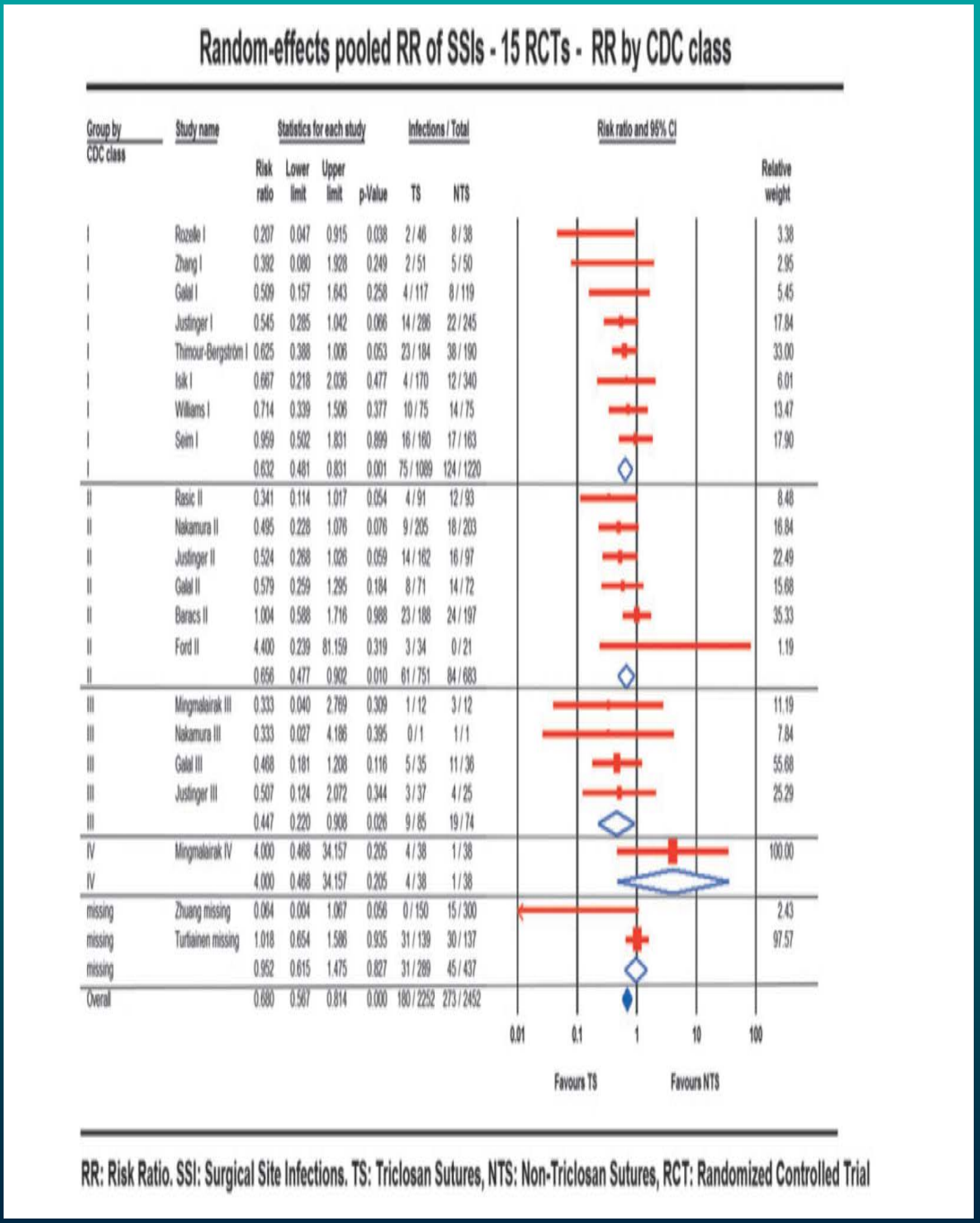
- Gram-positive and Gram-negative antimicrobial activity - No published studies have demonstrated that use of triclosan coated sutures are associated with the emergence of resistant surgical pathogens.

Evidence-based Clinical Effectiveness (Meta-Analysis)

- >20 meta-analysis in the peer-literature document clinical efficacy of triclosan (antimicrobial) suture technology.

Cost-Effectiveness

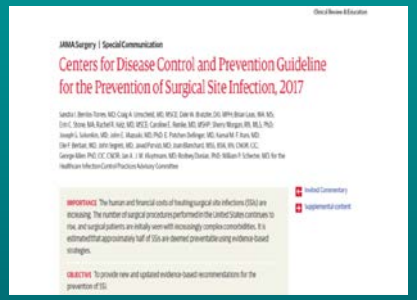
- Two recent studies, [*Singh et al. Infect Control Hosp Epidemiol 2014;35:1013; Leaper and Edmiston. British Journal Surgery 2017;104:e134-e144]* document that use of triclosan-coated sutures provides significant fiscal benefit to hospital, third party-payer and patient.

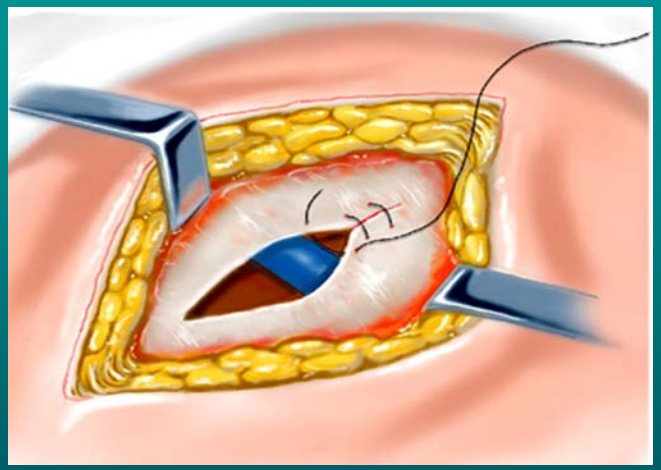


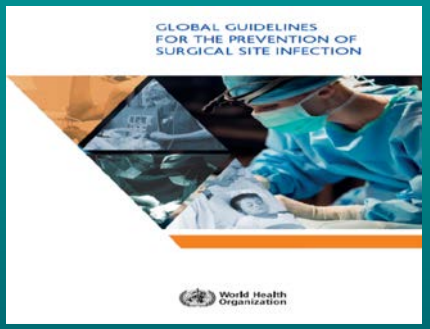
Daoud, Edmiston, Leaper - Surgical Infections 2014;15:165-181

Multiple Clinical Studies Have Documented That Triclosan-Coated Sutures Provide A Significant SSI Risk Reduction For:

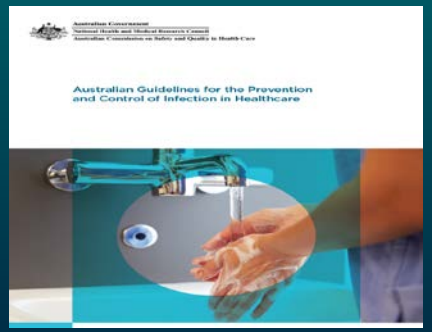
- **Clean – Class I**
- **Clean-Contaminated – Class II**
- **And Contaminated Surgical Procedures – Class III**







19 Year Evidence-Based Journey



What Evidence Exist to Document the Benefits of a Surgical Care Bundle?

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

Seth A. Waits, MD,[a] Danielle Fritze, MD,[a] Mousumi Banerjee, PhD,[a,b] Wenying Zhang, MA,[a] James Kubus, MS,[a] Michael J. Englesbe, MD,[a] Darrell A. Campbell, Jr, MD,[a] *and* Samantha Hendren, MD, MPH,[a] *Ann Arbor, MI*

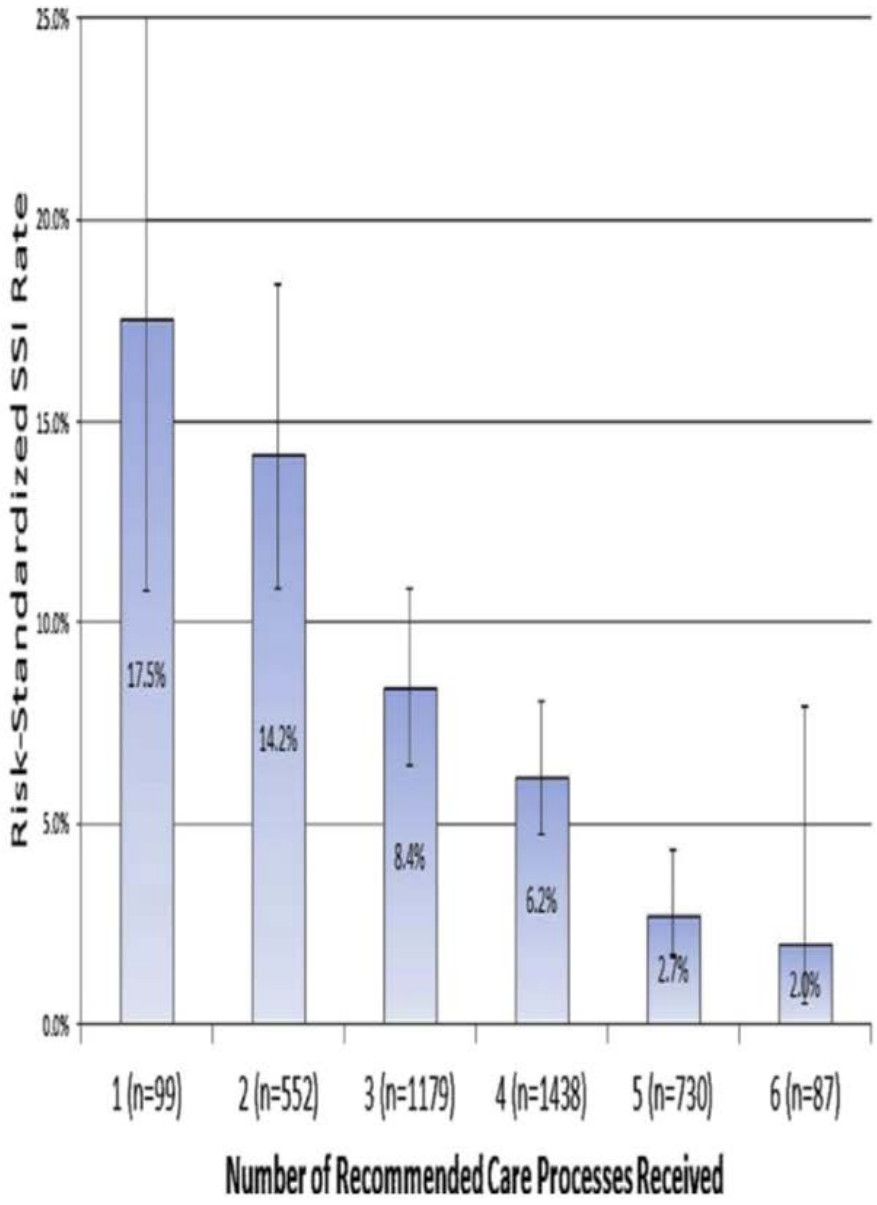
Background. *Surgical site infection (SSI) remains a costly and morbid complication after colectomy. The primary objective of this study was to investigate whether a group of perioperative care measures previously shown to be associated with reduced SSI would have an additive effect in SSI reduction. If so, this would support the use of an "SSI prevention bundle" as a quality improvement intervention.*

Methods. *Data from 24 hospitals participating in the Michigan Surgical Quality Collaborative were included in the study. The main outcome measure was SSI. Hierarchical logistic regression was used to account for clustering of patients within hospitals.*

Results. *In total, 4,085 operations fulfilled inclusion criteria for the study (Current Procedural Terminology codes 44140, 44160, 44204, and 44205). A "bundle score" was assigned to each operation, based on the number of perioperative care measures followed (appropriate Surgical Care Improvement Project-2 antibiotics, postoperative normothermia, oral antibiotics with bowel preparation, perioperative glycemic control, minimally invasive surgery, and short operative duration). There was a strong stepwise inverse association between bundle score and incidence of SSI. Patients who received all 6 bundle elements had risk-adjusted SSI rates of 2.0% (95% confidence interval [CI], 7.9–0.5%), whereas patients who received only 1 bundle measure had SSI rates of 17.5% (95% CI, 27.1–10.8%).*

Conclusion. *This multi-institutional study shows that patients who received all 6 perioperative care measures attained a very low, risk-adjusted SSI rate of 2.0%. These results suggest the promise of an SSI reduction intervention for quality improvement; however, prospective research are required to confirm this finding. (Surgery 2014;155:602-6.)*

From the Departments of Surgery[a] and Biostatistics,[b] University of Michigan, Ann Arbor, MI



Waits 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.[1] • Ahmet Rencuzogullari, M.D., F.T.B.S.[1]
Volkan Ozben, M.D., F.T.B.S.[1] • Luca Stocchi, M.D.[1] • Thomas Fraser, M.D.[2,3]
Cigdem Benlice, M.D.[1] • Tracy Hull, M.D.[1]

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

BACKGROUND: Surgical site infections are the most common hospital-acquired infection after colorectal surgery, increasing morbidity, mortality, and hospital costs.

OBJECTIVE: The purpose of this study was to investigate the impact of preventive measures on colorectal surgical site infection rates in a high-volume institution that performs inherent high-risk procedures.

DESIGN: This was a prospective cohort study.

SETTINGS: The study was conducted at a high-volume, specialized colorectal surgery department.

PATIENTS: The Prospective Surgical Site Infection Prevention Bundle Project included 14 preoperative, intraoperative, and postoperative measures to reduce surgical site infection occurrence after colorectal surgery. Surgical site infections within 30 days of the index operation were examined for patients during the 1-year period after the surgical site infection prevention bundle was implemented. The data collection and outcomes for this period were compared with the year immediately before the implementation of bundle elements. All of the patients who underwent elective colorectal surgery by a total of 17 surgeons were included. The following procedures were excluded from the analysis to obtain a homogeneous patient population: ileostomy closure and anorectal and enterocutaneous fistula repair.

MAIN OUTCOME MEASURES: Surgical site infection occurring within 30 days of the index operation was measured. Surgical site infection–related outcomes after implementation of the bundle (bundle February 2014 to February 2015) were compared with same period a year before the implementation of bundle elements (prebundle February 2013 to February 2014).

RESULTS: Between 2013 and 2015, 2250 abdominal colorectal surgical procedures were performed, including 986 (43.8%) during the prebundle period and 1264 (56.2%) after the bundle project. Patient characteristics and comorbidities were similar in both periods. Compliance with preventive measures ranged between 75% and 99% during the bundle period. The overall surgical site infection rate decreased from 11.8% prebundle to 6.6% at the bundle period ($P < 0.001$). Although a decrease for all types of surgical site infections was observed after the bundle implementation, a significant reduction was achieved in the organ-space subgroup (5.5%–1.7%; $P < 0.001$).

LIMITATION: We were unable to predict the specific contributions the constituent bundle interventions made to the surgical site infection reduction.

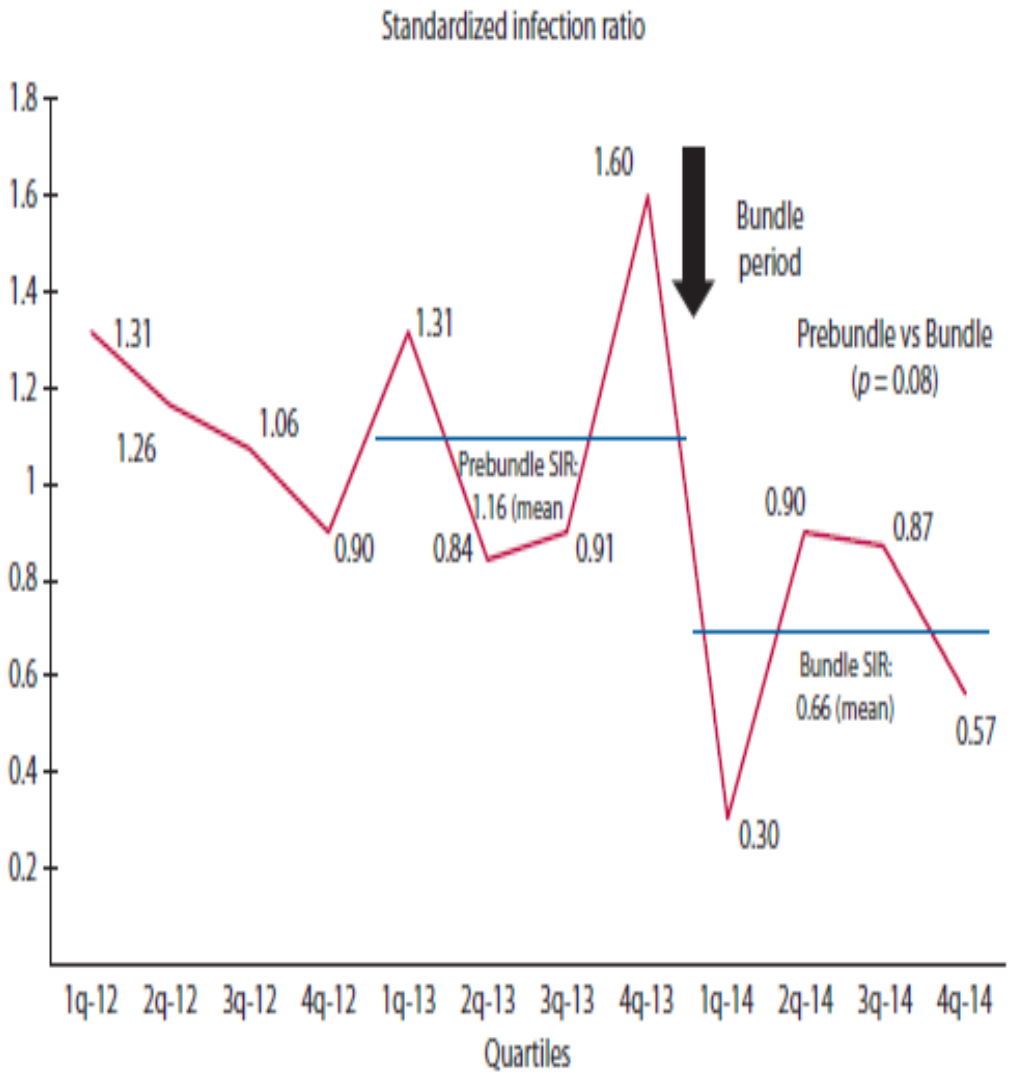
CONCLUSIONS: The prospective Surgical Site Infection Prevention Bundle Project resulted in a substantial decline in surgical site infection rates in our department. Collaborative and enduring efforts among multiple providers are critical to achieve a sustained reduction See **Video Abstract** at http://links.lww.com/

Funding/Support: None reported.

Financial Disclosure: None reported.

Presented at the meeting of the Surgical Infection Society, Palm Beach, FL, May 18 to 21, 2016.

Correspondence: Emre Gorgun, M.D., Department of Colorectal Surgery, Cleveland Clinic, 9500 Euclid Ave, A-30, Cleveland, OH 44195



Dis Colon Rectum 2018; 61: 89–98

Do surgical care bundles reduce the risk of surgical site infections in patients undergoing colorectal surgery? A systematic review and cohort meta-analysis of 8,515 patients

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Background. *Care bundles are a strategy that can be used to reduce the risk of surgical site infection (SSI), but individual studies of care bundles report conflicting outcomes. This study assesses the effectiveness of care bundles to reduce SSI among patients undergoing colorectal surgery.*

Methods. *We performed a systematic review and meta-analysis of randomized controlled trials, quasi-experimental studies, and cohort studies of care bundles to reduce SSI. The search strategy included database and clinical trials register searches from 2012 until June 2014, searching reference lists of retrieved studies and contacting study authors to obtain missing data. The Downs and Black checklist was used to assess the quality of all studies. Raw data were used to calculate pooled relative risk (RR) estimates using Cochrane Review Manager. The I^2 statistic and funnel plots were performed to identify publication bias. Sensitivity analysis was carried out to examine the influence of individual data sets on pooled RRs.*

Results. *Sixteen studies were included in the analysis, with 13 providing sufficient data for a meta-analysis. Most study bundles included core interventions such as antibiotic administration, appropriate hair removal, glycemic control, and normothermia. The SSI rate in the bundle group was 7.0% (328/4,649) compared with 15.1% (585/3,866) in a standard care group. The pooled effect of 13 studies with a total sample of 8,515 patients shows that surgical care bundles have a clinically important impact on reducing the risk of SSI compared to standard care with a CI of 0.55 (0.39–0.77; P = .0005).*

Conclusion. *The systematic review and meta-analysis documents that use of an evidence-based, surgical care bundle in patients undergoing colorectal surgery significantly reduced the risk of SSI. (Surgery 2015;158:66-77.)*

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J Gastrointest Surg (2017) 21:1915–1930
DOI 10.1007/s11605-017-3465-3

REVIEW ARTICLE

Bundles Prevent Surgical Site Infections After Colorectal Surgery: Meta-analysis and Systematic Review

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Received: 29 December 2016 / Accepted: 23 May 2017 / Published online: 15 June 2017

Abstract

Introduction Colorectal surgeries (CRS) have one of the highest rates of surgical site infections (SSIs) with rates 15 to >30%. Prevention "bundles" or sets of evidence-based interventions are structured ways to improve patient outcomes. The aim sof this study is to evaluate CRS SSI prevention bundles, bundle components, and implementation and compliance strategies.

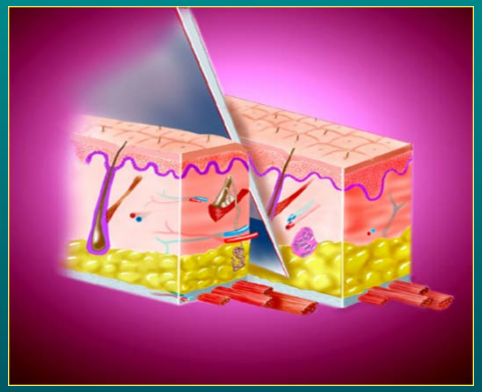
Methods A meta-analysis of studies with pre- and post-implementation data was conducted to assess the impact of bundles on SSI rates (superficial, deep, and organ/space). Subgroup analysis of bundle components identified optimal bundle designs.

Results Thirty-five studies (51,413 patients) were identified and 23 (17,557 patients) were included in the meta-analysis. A SSI risk reduction of 40% ($p < 0.001$) was noted with 44% for superficial SSI ($p < 0.001$) and 34% for organ/space ($p = 0.048$). Bundles with sterile closure trays (58.6 vs 33.1%), MBP with oral antibiotics (55.4 vs 31.8%), and pre-closure glove changes (56.9 vs 28.5%) had significantly greater SSI risk reduction.

Conclusion Bundles can effectively reduce the risk of SSIs after CRS, by fostering a cohesive environment, standardization, and reduction in operative variance. If implemented successfully and complied with, bundles can become vital to improving patients' surgical quality of care.

Keywords Surgical site infection · SSI · Bundle · Colorectal which ranges from 15.1 to over 30%.[2–7] In 2014, the Joint

Selecting an Evidence-Based (EB) Surgical Care Bundle



- Antimicrobial Prophylaxis – Weight-based ★
- Normothermia ★
- Glycemic Control ★
- Limit OR Traffic ★
- Mechanical Bowel Prep Oral Antibiotics ★
- Triclosan Sutures Fascia/ Sub-cuticular closure ★
- 0.05% CHG Irrigation of Surgical Wound ★
- Staphylococccal Decolonization ★
- 2% / 4% CHG Preadmission Shower/cleansing ★
- Wound Edge Protector ★
- Supplemental Oxygen ★
- Smoking Cessation ★
- Separate Wound Closure Tray ★
- Glove Change Prior to Fascia / Subcuticular Closure ★
- 70% alc / 2% CHG Skin Antisepsis ★

★ Moderate to High (1A) Level of Evidence-Based Documentation

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.*

Borlaug and Edmiston – AORNJ 2018;107:570-578.

Building an Effective Surgical Care Bundle*

Baseline Evidence-Based Interventions – Designated Moderate -1A**

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

Inclusive Evidence-Based Intervention for Consideration in 2019**

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

**Evidence-Based Medicine is a Moving Target*

*** Published level of evidence*

Enhanced Recovery After Surgery Protocol (ERAS)

Preoperative

- Patient Education
- Smoking Cessation
- Prehabilitation
- Care coordination
- Diabetes control
- Skin decontamination
- Immunonutrition
- Bowel preparation
- Carbohydrate loading
- NPO Status

Day of Surgery

- NPO
- Carbohydrate loading
- Hair management
- Skin decontamination
- Patient Warming
- Ileus Prevention
- Glucose management
- Pain management
- DVT
- EPIC/Grease Board

Intraoperative

- Patient Warming
- Skin preparation
- OR Traffic
- Antibiotics
- IVF Management
- Glucose management
- Supplemental Oxygen
- PONV Prevention
- Pain management
- NGT / Drains
- MIS
- Near infrared vascular imaging
- Wound Protector
- ★ Wound Closing Protocol
- Wound management
- Residual neuromuscular weakness
- Wound classification

Postoperative

- Active warming
- Glucose management
- PONV prophylaxis
- Ileus management
- DVT prophylaxis
- Pain management
- Rehabilitation
- WOCN
- Nutrition
- Immunonutrition
- IVF
- Urinary catheters
- Supplemental oxygen
- Care Coordination
- ★ Audit compliance
- Reporting

Source: Marc Singer, MD, FAC, SSI Symposium VI
September 21, 2018 – Wisconsin Dells, WI

CLINICAL

An Incision Closure Bundle for Colorectal Surgery

PODCAST

2.0 CE www.aornjournal.org/content/cme

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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.*

Surgical 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.[1,2] 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.[3] The annual cost for all SSIs in the United States is estimated to be between $3.5 and $10 billion.[1] 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.[4] As many as half of all SSIs could be prevented.[5] 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.[6] 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

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

Incisional Wound Closure Bundle

- Gown/Gloves change prior to wound closure [1,2,3]
- Dedicated wound closure tray [1,2,3]
- Irrigation with 0.05% CHG [2,3]
- Use of antimicrobial sutures for wound closure [1,2,3]
- Remove surgical drape after applying dressing [2,3]
- Application of skin adhesive following subcuticular wound closure [2,3]
- Comprehensive postoperative patient instructions [2,3]

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

Edmiston CE, AORNJ 2018;107:552-565

Do Surgical Care Bundles Provide A Fiscal Benefit?

Colorectal Scenario: Is There A Fiscal Benefit For Implementing a Surgical Care Bundle with Plus Sutures?

(Estimated Cost of Surgical Care Bundle = $50-$75 ~ $60USD)

Low Estimated Cost Benefit of Surgical Care Bundle

$36,429 / $60 USD = can fund 607 additional surgeries

607 / 200 cases per year = ~3 years

High Estimated Cost Benefit of Surgical Care Bundle

$144,809 / $60 USD = can fund 2,413 additional surgeries

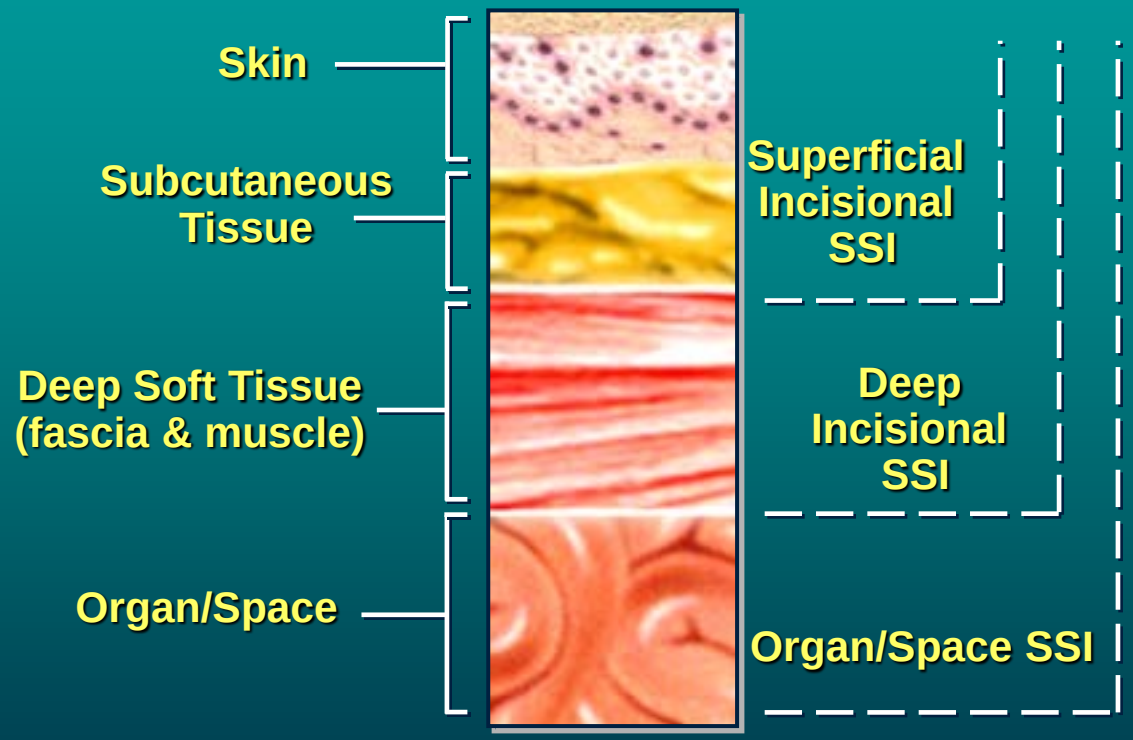
2,413 / 200 cases per year = ~12 years

Additional Cost of Using Antimicrobial Closure Technology
(3 to 4 strands) = $0.48/per strand ~ $1.44 to $1.92
(2.4% - 3.2% of total bundle cost)

Cost Data from Leaper, Spencer and Edmiston - Diseases of Colon and Rectum 2020;63:1628-1638

What Barriers Persist in the Implementation of an Effective Surgical Care Bundle?

The Complexity of Risk - Classification of Surgical Site Infections (SSI)



Major Barriers to Improvement

- Poor compliance – Complacency (laxity)
- Lack of shared goals and priorities
- Poor communication
- Less than robust institutional commitment – Remember when they say it is never about the money – It is always about the money

So, what is the weakest link?

Recognition of the surgical locus of infection influences the development of specific interventional strategies

Mangram AJ, et al. Am J Infect Control 1999;27:97-132

international wound journal

The Absolute Weakest Link

International Wound Journal ISSN 1742-4801

ORIGINAL ARTICLE

Surgical site infection: poor compliance with guidelines and care bundles

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Key words
Care bundles; Compliance; Guidelines; Surgical site infection

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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.

Leaper et al. Int Wound J. 2014 Feb 25. doi: 10.1111/iwj.12243

Moving Forward into The Future of Risk Reduction

- To reduce the risk of surgical site infections we must clearly understand the mechanistic nature of how these infections occur
- All co-morbid risk must be considered when developing an effective mitigation strategy
- Risk reduction is a moving target – As our knowledge increases – So should our evidence-based practices to mitigate that risk
- The cost of mitigation is always minuscule compared to the human and fiscal cost of a surgical site infection

SSI Prevention Is Not a Solo Recital But Rather a Symphony and We Are All Part of the Orchestra

Thank You