Quality and Safety in the OR: A 7 Step Bundle To Prevent SSIs

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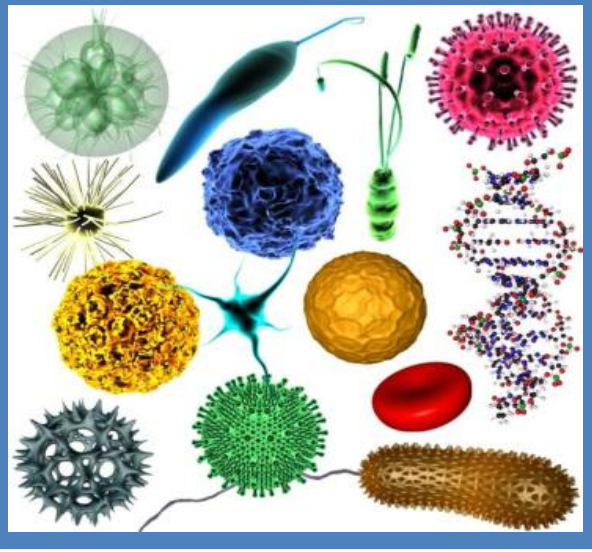
Epidemiology of HAI



Standardized Infection Ratio (SIR)

- Observed Cases = Number of infections
- Predicted Cases =

  (NHSN Pooled Mean x Unit-specific # Device days)/1000

  - Yields a risk adjusted comparison number based on unit specific device use
- SIR formula = Observed/Predicted

SIR

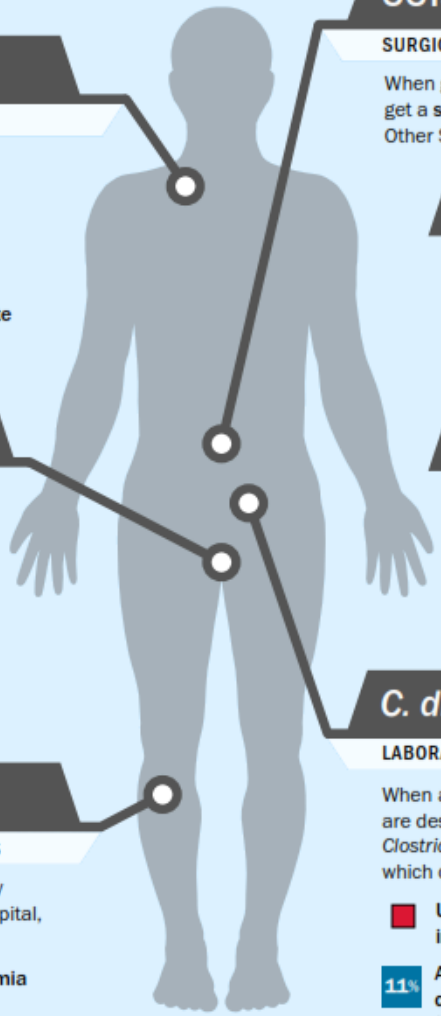
- The SIR value will be from ZERO to 1 and above
  - A value LESS than 1 indicates that observed cases were LOWER than expected (Desirable)
    - SIR = 0.75 = Performing at 25% lower than comparable groups
  - A value of 1 indicates that observed cases were EQUAL to expected
  - A value MORE than 1 indicates that observed cases were HIGHER than expected (Undesirable)
    - SIR = 1.30 = Performing at 30% higher than comparable groups
    - SIR = 2.50 = Performing at 150% higher than comparable groups

HEALTHCARE ASSOCIATED INFECTIONS PROGRESS

NATIONAL

ACUTE CARE HOSPITALS

Healthcare-associated infections (HAIs) are infections patients can get while receiving medical treatment in a healthcare facility. Working toward the elimination of HAIs is a CDC priority. The standardized infection ratio (SIR) is a summary statistic that can be used to track HAI prevention progress over time; lower SIRs are better. The infection data are reported to CDC's National Healthcare Safety Network (NHSN). HAI data for nearly all U.S. hospitals are published on the Hospital Compare website.
This report is based on 2014 data, published in 2016.



CLABSIs

↓50% LOWER COMPARED TO NAT'L BASELINE*

CENTRAL LINE-ASSOCIATED BLOODSTREAM INFECTIONS

When a tube is placed in a large vein and not put in correctly or kept clean, it can become a way for germs to enter the body and cause deadly infections in the blood.

- **U.S. hospitals reported a significant decrease in CLABSIs between 2013 and 2014.**
- 10% **Among the 2,442 hospitals in U.S. with enough data to calculate an SIR, 10% had an SIR significantly higher (worse) than 0.50, the value of the national SIR.**

CAUTIs

0% NO CHANGE COMPARED TO NAT'L BASELINE

CATHETER-ASSOCIATED URINARY TRACT INFECTIONS

When a urinary catheter is not put in correctly, not kept clean, or left in a patient for too long, germs can travel through the catheter and infect the bladder and kidneys.

- **U.S. hospitals reported a significant decrease in CAUTIs between 2013 and 2014.**
- 12% **Among the 2,880 U.S. hospitals with enough data to calculate an SIR, 12% had an SIR significantly higher (worse) than 1.00, the value of the national SIR.**

MRSA Bacteremia

↓13% LOWER COMPARED TO NAT'L BASELINE*

LABORATORY IDENTIFIED HOSPITAL-ONSET BLOODSTREAM INFECTIONS

Methicillin-resistant *Staphylococcus aureus* (MRSA) is bacteria usually spread by contaminated hands. In a healthcare setting, such as a hospital, MRSA can cause serious bloodstream infections.

- **U.S. hospitals reported a significant decrease in MRSA bacteremia between 2013 and 2014.**
- 8% **Among the 2,042 U.S. hospitals with enough data to calculate an SIR, 8% had an SIR significantly higher (worse) than 0.87, the value of the national SIR.**

SSIs

SURGICAL SITE INFECTIONS

See pages 3-5 for additional procedures

When germs get into an area where surgery is or was performed, patients can get a **surgical site infection**. Sometimes these infections involve only the skin. Other SSIs can involve tissues under the skin, organs, or implanted material.

SSI: Abdominal Hysterectomy

↓17% LOWER COMPARED TO NAT'L BASELINE*

- **U.S. hospitals reported no significant change in SSIs related to abdominal hysterectomy surgery between 2013 and 2014.**
- 6% **Among the 794 U.S. hospitals with enough data to calculate an SIR, 6% had an SIR significantly higher (worse) than 0.83, the value of the national SIR.**

SSI: Colon Surgery

↓2% LOWER COMPARED TO NAT'L BASELINE*

- **U.S. hospitals reported a significant increase in SSIs related to colon surgery between 2013 and 2014.**
- 8% **Among the 2,051 U.S. hospitals with enough data to calculate an SIR, 8% had an SIR significantly higher (worse) than 0.98, the value of the national SIR.**

C. difficile Infections

↓8% LOWER COMPARED TO NAT'L BASELINE*

LABORATORY IDENTIFIED HOSPITAL-ONSET *C. DIFFICILE* INFECTIONS

When a person takes antibiotics, good bacteria that protect against infection are destroyed for several months. During this time, patients can get sick from *Clostridium difficile* (*C. difficile*), bacteria that cause potentially deadly diarrhea, which can be spread in healthcare settings.

- **U.S. hospitals reported a significant increase in *C. difficile* infections between 2013 and 2014.**
- 11% **Among the 3,554 U.S. hospitals with enough data to calculate an SIR, 11% had an SIR significantly higher (worse) than 0.92, the value of the national SIR.**

*Statistically significant

CDC

HEALTHCARE ASSOCIATED INFECTIONS PROGRESS

NATIONAL

ACUTE CARE HOSPITALS

Learn how your hospital is performing: **www.medicare.gov/hospitalcompare**
For additional information:

- 2014 HAI Progress Report: **www.cdc.gov/hai/progress-report/**
- NHSN: **www.cdc.gov/nhsn**
- Preventing HAIs: **www.cdc.gov/hai**

Healthcare-associated infection (HAI) data give healthcare facilities and public health agencies knowledge to design, implement, and evaluate HAI prevention efforts.

LEGEND

↓ 2014 Nat'l SIR is significantly lower (better) than comparison group in column header

↑ or ↓ Change in 2014 Nat'l SIR compared to group in column header is not statistically significant

↑ 2014 Nat'l SIR is significantly higher (worse) than comparison group in column header

HAI TYPE	# OF U.S. HOSPITALS THAT REPORTED DATA TO CDC'S NHSN, 2014[+]	2014 NAT'L SIR vs. 2013 Nat'l SIR	2014 NAT'L SIR vs. Nat'l Baseline[‡]	2014 NAT'L SIR
CLABSI Nat'l Baseline: 2008	3,655	↓ 8%	↓ 50%	0.50
CAUTI Nat'l Baseline: 2009	3,791	↓ 5%	0%	1.00
SSI, Abdominal Hysterectomy Nat'l Baseline: 2008	3,225	↑ 5%	↓ 17%	0.83
SSI, Colon Surgery Nat'l Baseline: 2008	3,377	↑ 5%	↓ 2%	0.98
MRSA Bacteremia Nat'l Baseline: 2011	3,949	↓ 4%	↓ 13%	0.87
***C. difficile* Infections** Nat'l Baseline: 2011	3,994	↑ 4%	↓ 8%	0.92

[+]The number of hospitals that reported to NHSN and are included in the SIR calculation. This number may vary across HAI types; for example, some hospitals do not use central lines or urinary catheters, or do not perform colon or abdominal hysterectomy surgeries.

[‡]Nat'l baseline time period varies by HAI type. See first column of this table for specifics.

For additional data points, refer to the technical data tables.

Pathogens Involved with SSIs	No (%) of SSI Pathogens	Rank
Staph aureus (includes MRSA)	**6415 (30.4)**	**1**
Coagulase neg staph	**2477 (11.7)**	**2**
E.Coli	1981 (9.4)	3
Enterococcus faecalis	1240 (5.9)	4
Pseudomonas aerug	1156 (5.5)	5
Enterobacter spp	849 (4.0)	6
Klebsiella spp	844 (4.0)	7
Enterococcus spp	685 (3.2)	8
Proteus spp	667 (3.2)	9
Enterococcus faecium	517 (2.5)	10
Serratia spp	385 (1.8)	11
Candida albicans	367 (1.3)	12
Acinetobacter baum	119 (0.6)	13
Other Candida spp	96 (0.5)	14
Other organisms	3399 (16.1)	
Total	21,100 (100)	

Sievert DM at al Antimicrobial resistant pathogens associated with healthcare associated infections. Summary of data reported to the Centers for Disease Control and Prevention 2009-2010 . *Infection control and hospital epidemiology*. 2013;34(1):1-14.

Mortality risk is high among patients with SSIs

- A patient with an SSI is:
  - **5x** more likely to be readmitted after discharge[1]
  - **2x** more likely to spend time in intensive care[1]
  - **2x** more likely to die after surgery[1]

- The mortality risk is higher when SSI is due to MRSA
  - A patient with MRSA is **12x** more likely to die after surgery[2]

1. *WHO Guidelines for Safe Surgery 2009*.
2. Engemann JJ et al. *Clin Infect Dis*. 2003;36:592-598.

Cost of Healthcare associated infections

Original Investigation

Health Care–Associated Infections
A Meta-analysis of Costs and Financial Impact on the US Health Care System

Eyal Zimlichman, MD, MSc; Daniel Henderson, MD, MPH; Orly Tamir, PhD, MSc, MHA; Calvin Franz, PhD; Peter Song, BSE; Cyrus K. Yamin, MD; Carol Keohane, BSN, RN; Charles R. Denham, MD; David W. Bates, MD, MSc

OBJECTIVE To estimate costs associated with the most significant and targetable HAIs.

DATA SOURCES For estimation of attributable costs, we conducted a systematic review of the literature using PubMed for the years 1986 through April 2013. For HAI incidence estimates, we used the National Healthcare Safety Network of the Centers for Disease Control and Prevention (CDC).

STUDY SELECTION Studies performed outside the United States were excluded. Inclusion criteria included a robust method of comparison using a matched control group or an appropriate regression strategy, generalizable populations typical of inpatient wards and critical care units, methodologic consistency with CDC definitions, and soundness of handling economic outcomes.

JAMA Intern Med. doi:10.1001/jamainternmed.2013.9763
Published online September 2, 2013.

HAI	Est Annual %	Est Direct Cost	Avg Length of Stay	Attributable Mortality
Surgical Site Infection (SSI)	33.7%	$20 785	~11 days	~4%
➢ MRSA SSI		$42 300	~23 days	
Central Line Associated Bloodstream Infection (CLABSI)	18.9%	$45 814	~10 days	~26%
➢ MRSA CLABSI			~16 days	
Ventilator Associated Pneumonia (VAP)	31.6%	$40 144	~13 days	~24%
Catheter Associated Urinary Tract Infection (CAUTI)	<1%	$896	< 1 day	<1%
Clostridium difficile Infection (CDI)	15.4%	$11 285	~ 3 days	~4%

Zimlichman. Et al: "Health Care–Associated Infections A Meta-analysis of Costs and Financial Impact on the US Health Care System" *JAMA Intern Med. September 2013*

A 7 S Bundle Approach to Preventing Surgical Site Infections

7 “S” bundle to prevent SSI
www.7sbundle.com

SAFETY – Safe OPERATING ROOM

SCREEN – Screening for presence of MRSA & MSSA

SHOWERS – Showers pre-op night before and morning of surgery with CHLORHEXIDINE (CHG)

SKIN PREP – Skin with alcohol based antiseptics such as CHG or Iodophor

SOLUTION – Surgical irrigation with 0.05% CHG

SUTURES – Sutures with antibacterial protection

SKIN CLOSURE – Sealing the incision with topical incisional adhesive

#1 – Safety - Is Your OR Safe?

- ✓ Traffic control, number of surgeons, staff, reps, visitors in the OR
- ✓ Improper surgical attire resulting in skin cells/organisms into environment from uncovered arms, hair, back of neck
- ✓ Improperly maintained air handling systems, filtration
- ✓ Hair clipping in the operating room
- ✓ Inadequate surgical prophylaxis (selection, dosing, timing)
- ✓ Inadequate room turnover and terminal cleaning procedures
- ✓ Inadequate surgical technique and handling of tissues
- ✓ Improper instrument cleaning/sterilization process, lack of use of enzymatic solution
- ✓ Improper use of biological indicators
- ✓ Contamination from storage of supplies, supply bins, carts, tables, stationary equipment

Follow AORN Evidence Based Practices

www.aorn.org

- ✓ Preoperative Patient Skin Antisepsis
- ✓ Environmental Cleaning in the Perioperative Setting
- ✓ Surgical Tissue Banking
- ✓ Surgical Hand Antisepsis
- ✓ Cleaning and Care of Instruments and Powered Equipment
- ✓ Cleaning and Care of Surgical Instruments
- ✓ Cleaning and Processing of Flexible Endoscopes
- ✓ High Level Disinfection
- ✓ Cleaning and Processing Anesthesia Equipment
- ✓ Sterilization in the Perioperative Setting
- ✓ Hand Hygiene in the Perioperative Setting
- ✓ Prevention of Transmissible Infections in Perioperative Settings
- ✓ Surgical attire
- ✓ Sharps Safety

Joint Commission Surgical Care Improvement Program (SCIP)

*Surgical prophylaxis: selection, time, discontinuation of abx (24hrs or 48hrs cardiac)
*Hair clippers (no razors) – done outside the OR room
*Warming patient (pre-postop)
*Increased oxygen
*Remove Foley catheter within 48 hours post-op

Antimicrobial prophylaxis

- Performance measures include the antibiotic being
  - given within 60 minute before incision
  - consistent with current published recommendations (2 grams cefazolin and re-dose)
  - re-dosed if the time since administration exceeds two half-lives of the medication
  - dose per BMI
  - discontinued within 24 hours of conclusion of procedure

ASHP 2013 Surgical Prophylaxis Guidelines 2013

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

Surgical attire

- Normal individuals shed more than 10 million particles from their skin every day.
- Approximately 10% of skin squames carry viable microorganisms and it's estimated that individuals shed approximately **1 million microorganisms** from their bodies each day.
- Head cover or hood should be designed to minimize microbial dispersal
- Skullcaps may fail to contain the side hair above and in front of the ears and hair at the nape of the neck

Boyce, Evidence in Support of Covering the Hair of OR Personnel AORN Journal ● Jan 2014

Laminar Flow and Exhaust Suits

- **No data to support reduction in SSIs (may be used for surgeon protection)**
  - Lipsett PA. Do we really need laminar flow ventilation in the operating room to prevent surgical site infections? Ann Surg 008;248:701
  - Der Tavitian J, Ong SM, Taub NA, et al. Body-exhaust suit versus occlusive clothing. A randomised, prospective trial using air and wound bacterial counts. J Bone Joint Surg Br 2003;85:490.
  - Pasquarella C, Pitzurra O, Herren T, et al. Lack of influence of body exhaust gowns on aerobic bacterial surface counts in a mixed-ventilation operating theatre. A study of 62 hip arthroplasties. J Hosp Infect 2003;54:2.
  - Brown AR, Taylor GJ, Gregg PJ. Air contamination during skin preparation and draping in joint replacement surgery. J Bone Joint Surg Br 1996;78:92.

Scrubs and Jackets in OR

AORN – Surgical Attire 2014

- Facility approved, clean, and freshly laundered surgical attire
- If scrubs are worn into the institution from outside, they should be changed before entering semi-restricted or restricted areas to minimize the potential for contamination (eg, animal hair, dust, cross contamination from other uncontrolled environments)
- Home laundering of surgical attire is not recommended
- Non scrubbed personnel should wear long sleeved jackets that are buttoned or snapped closed during use
- Complete closure of the jacket avoids accidental contamination of the sterile field
- Long-sleeved attire is advocated to prevent bacterial shedding from bare arms and is included in the Occupational Safety and Health Administration (OSHA) regulation for the use of personal protective equipment (PPE)”

Hair removal

- Shaving increases risk for SSI
- Hair removal should be performed
  - using a clipper
  - on the day of surgery
  - in a location **outside** of the procedure room
  - Assure clipper is cleaned between use
- Only interfering hair should be removed

Hair left on clipper from previous patient

New Vacuum-assisted Technology to Eliminate the Need for Surgical Clipping Cleanup and Use of Tape

Infection control concern: previous patient hair in clippers and contaminated tape

Cleaning / sterilization of instruments www.aami.org

- Expect both TJC and CMS to spend a lot of time in Central Sterile Processing during Surveys
- Assure IFUs from manufactures are located in CSS (not the managers office) – online software best option (www.onsource.com)
- Challenges with instruments
  - Lumens, grooves, sorting, hand cleaning, disassembly required – massive kits
  - Many instruments cannot be disassembled
  - Correct use of Biologic Indicators
  - Double Packaging
- Pre-soaking and rinsing of tissue and blood from the instruments in the operating room before sent to decontamination with enzymatic

Environmental cleaning

- Evaluate between room cleaning procedures
- Terminal cleaning procedures on evening/night shift
- Correct process – top to bottom, clean to dirty
- Is there sufficient staff to terminally clean all OR rooms each day?

AORN RP: Environmental Cleaning in the Perioperative Setting 2014

Pathogens survive on surfaces

Organism	Survival period
Clostridium difficile	35- >200 days.[2,7,8]
Methicillin resistant *Staphylococcus aureus* (MRSA)	14- >300 days.[1,5,10]
Vancomycin-resistant enterococcus (VRE)	58- >200 days.[2,3,4]
Escherichia coli	>150- 480 days.[7,9]
Acinetobacter	150- >300 days.[7,11]
Klebsiella	>10- 900 days.[6,7]
Salmonella typhimurium	10 days- 4.2 years.[7]
Mycobacterium tuberculosis	120 days.[7]
Candida albicans	120 days.[7]
Most viruses from the respiratory tract (eg: corona, coxsackie, influenza, SARS, rhino virus)	Few days.[7]
Viruses from the gastrointestinal tract (eg: astrovirus, HAV, polio- or rota virus)	60- 90 days.[7]
Blood-borne viruses (eg: HBV or HIV)	>7 days.[5]

1. Beard-Pegler et al. 1988.. *J Med Microbiol*. **26**:251-5.
2. BIOQUELL trials, unpublished data.
3. Bonilla et al. 1996. *Infect Cont Hosp Epidemiol*. **17**:770-2
4. Boyce. 2007. *J Hosp Infect*. **65**:50-4.
5. Duckworth and Jordens. 1990. *J Med Microbiol*. **32**:195-200.
6. French et al. 2004. *ICAAC*.
7. Kramer et al. 2006. *BMC Infect Dis*. **6**:130.
8. Otter and French. 2009. *J Clin Microbiol*. **47**:205-7.
9. Smith et al. 1996. *J Med*. **27**: 293-302.
10. Wagenvoort et al. 2000. *J Hosp Infect*. **45**:231-4.
11. Wagenvoort and Joosten. 2002. *J Hosp Infect*. **52**:226-7.

Prior room occupancy increases risk

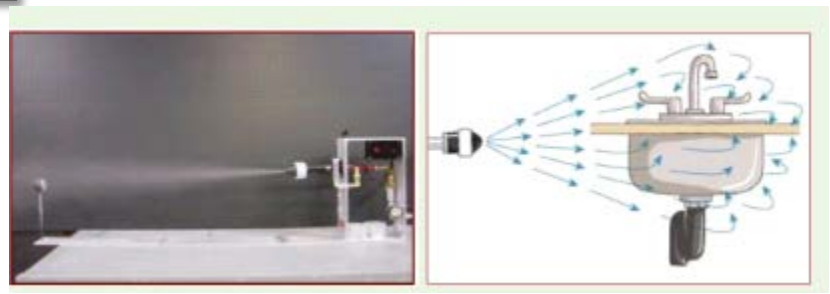
Study	Healthcare associated pathogen	Likelihood of patient acquiring HAI based on prior room occupancy (comparing a previously 'positive' room with a previously 'negative' room)
Martinez 2003[1]	VRE – cultured within room	2.6x
Huang 2006[2]	VRE – prior room occupant	1.6x
	MRSA – prior room occupant	1.3x
Drees 2008[3]	VRE – cultured within room	1.9x
	VRE – prior room occupant	2.2x
	VRE – prior room occupant in previous two weeks	2.0x
Shaughnessy 2008[4]	*C. difficile* – prior room occupant	2.4x
Nseir 2010[5]	*A. baumannii* – prior room occupant	3.8x
	P. aeruginosa – prior room occupant	2.1x

1. Martinez *et al. Arch Intern Med* 2003; 163: 1905-12.
2. Huang *et al. Arch Intern Med* 2006; 166: 1945-51.
3. Drees *et al. Clin Infect Dis* 2008; 46: 678-85.
4. Shaughnessy. ICAAC/IDSA 2008. Abstract K-4194.
5. Nseir et al. Clin Microbiol Infect 2010 (in press).

New Technology for Operating Room Terminal Cleaning Being Used in Some Operating Rooms

Ultraviolet C lights
www.TruD.com
www.rapiddisinfector.com
www.xenex.com

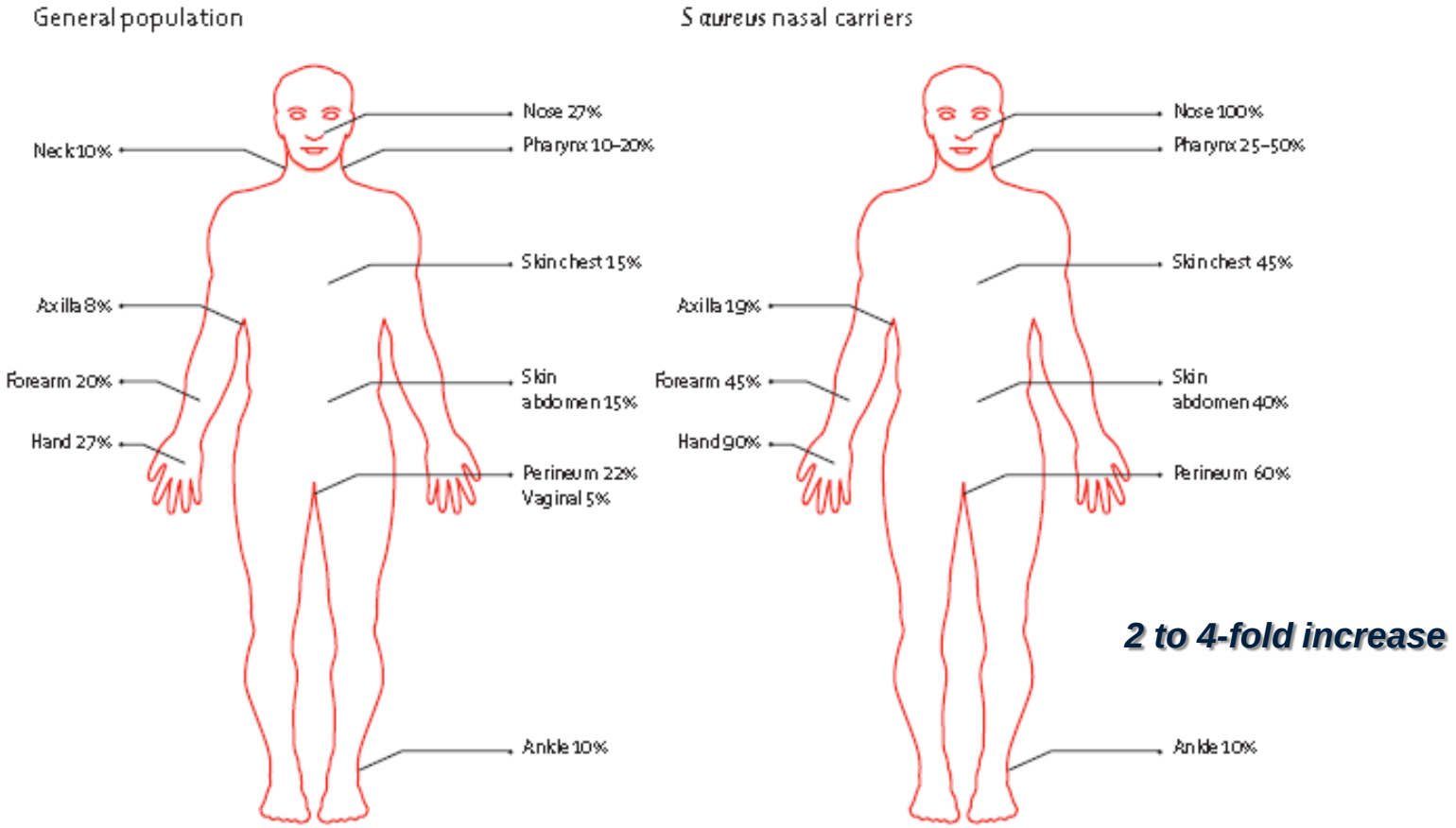
Disinfecting White/Indigo Lights
www.indigoclean.com
www.vidashield.com



Disinfectant surface sprays
http://www.byosafemt.com/

#2 SCREEN for MRSA and MSSA Colonization

S. aureus Colonization: Impact of Nasal Carriage



2 to 4-fold increase

Hill RLR et al. J Antimicrob Chemother 1988;22:377
Sanford MD et al. Clin Infect Dis 1994;19:1123

Lancet Infect Dis 2005;5:751

SURGICAL INFECTIONS
Volume 17, Number 2, 2016

DOI: 10.1089/sur.2015.257

Is Staphylococcal Screening and Suppression an Effective Interventional Strategy for Reduction of Surgical Site Infection?

Charles E. Edmiston, Jr,[1] Nathan A. Ledeboer,[2] Blake W. Buchan,[2] Maureen Spencer,[3] Gary R. Seabrook,[1] and David Leaper[3,4]

Results: Culture methods used to identify MRSA colonization involve selective, differential, or chromogenic media. These methods are the least expensive, but turnaround time is 24–48 h. Although real-time polymerase chain reaction (RT-PCR) technology provides rapid turnaround (1–2 h) with exceptional testing accuracy, the costs can range from three to 10 times more than conventional culture methodology. Topical mupirocin, with or without pre-operative chlorhexidine showers or skin wipes, is the current ''gold-standard'' for nasal decolonization, but inappropriate use of mupirocin is associated with increasing staphylococcal resistance.
Conclusions: Selection of an effective active universal or targeted surveillance strategy should be based upon the relative risk of MSSA or MRSA surgical site infection in patients undergoing orthopedic or cardiothoracic device related surgical procedures.

Surgical Infections Vol 17 No 3 2016

Risk Factors for Orthopedic Surgical Infections

Table 4. Infection risk factor

Risk factor	Odds ratio (confidence interval)	p value
Current tobacco use	3.00 (1.78 5.06)	< 0.001
Current or history of bone cancer	12.85 (4.64 35.59)	< 0.001
Diabetes mellitus	2.44 (1.55 3.82)	< 0.001
Hepatitis B	7.34 (0.96 56.1)	0.027
Hepatitis C	5.59 (2.21 14.19)	< 0.001
MRSA colonization or prior infection	7.34 (2.85 18.91)	< 0.001
MSSA colonization or prior infection	8.64 (3.75 19.89)	< 0.001
Staphylococcal colonization or prior infection	6.52 (3.41 12.51)	< 0.001
Underweight (BMI < 18.5 kg/m^2)	1.90 (0.26 13.7)	0.56
Overweight (BMI 25.0 29.9 kg/m^2)	0.60 (0.24 1.50)	0.24
Obese (BMI 30.0 39.9 kg/m^2)	0.84 (0.51 1.41)	0.52
Morbid obesity (BMI 40.0 49.9 kg/m^2)	1.28 (0.61 2.65)	0.51
Super obesity (BMI 50 + kg/m^2)	15.69 (5.97 41.21)	< 0.001
Obesity hypoventilation syndrome	10.2 (1.17 88.5)	0.01

MRSA = methicillin resistant *Staphylococcus aureus*; MSSA = methicillin susceptible *S aureus*; BMI = body mass index.

Everheart JS et al. Medical comorbidities are independent preoperative risk factors for surgical infections after total joint arthroplasty. Clin orthoped relat res. March22, 2013

THE JOURNAL OF BONE & JOINT SURGERY

JB&JS

This is an enhanced PDF from The Journal of Bone and Joint Surgery

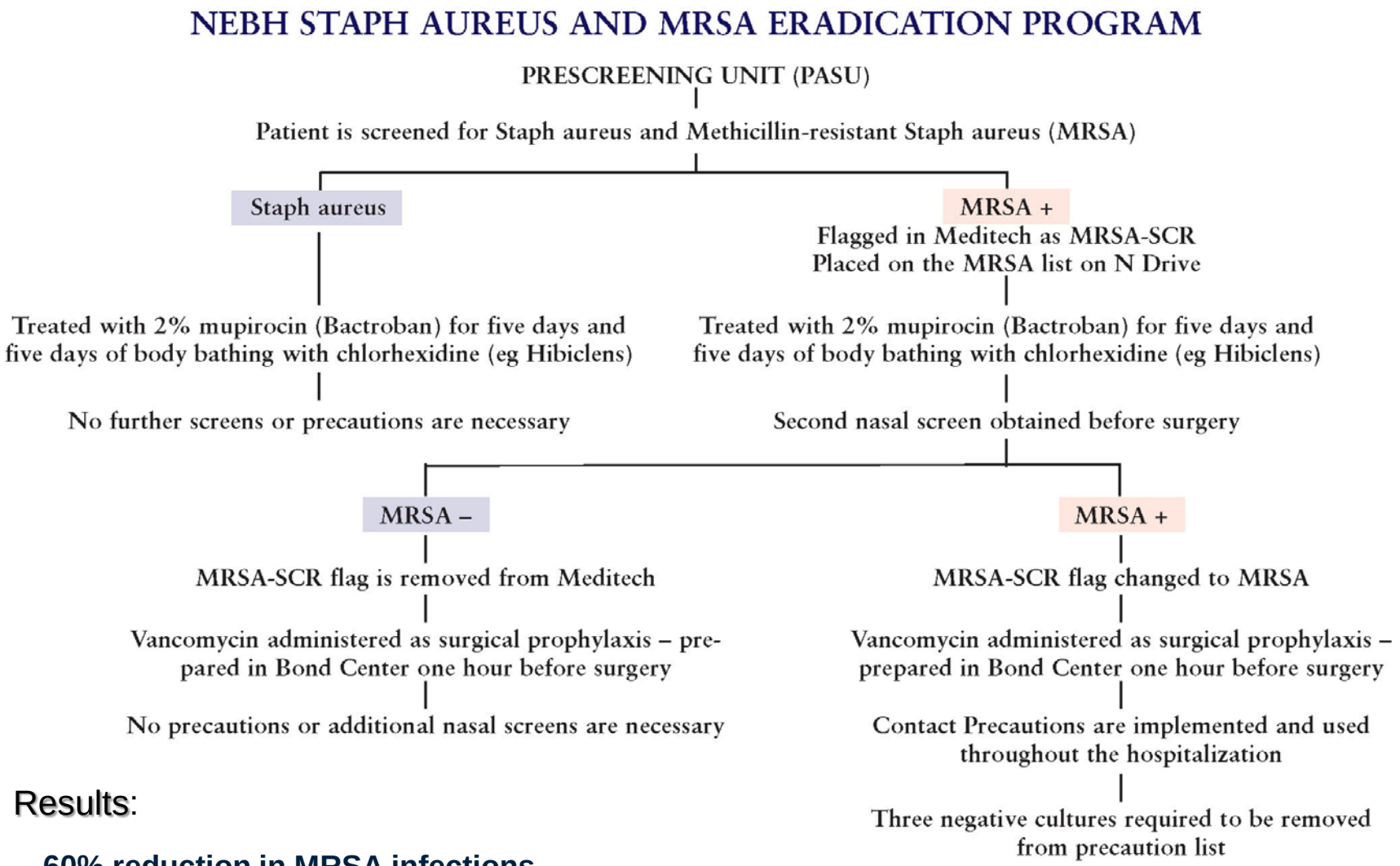
The PDF of the article you requested follows this cover page.

Institutional Prescreening for Detection and Eradication of Methicillin-Resistant Staphylococcus aureus in Patients Undergoing Elective Orthopaedic Surgery

David H. Kim, Maureen Spencer, Susan M. Davidson, Ling Li, Jeremy D. Shaw, Diane Gulczynski, David J. Hunter, Juli F. Martha, Gerald B. Miley, Stephen J. Parazin, Pamela Dejoie and John C. Richmond

J Bone Joint Surg Am. 2010;92:1820-1826. published Jul 7, 2010; doi:10.2106/JBJS.I.01050

Institutional Prescreening for Detection and Eradication of Methicillin Resistant Staphylococcus aureus in Patients Undergoing Elective Orthopaedic Surgery



Results:

60% reduction in MRSA infections
40% reduction in MSSA infection ***p<0.001***

Kim DH, Spencer M, Davidson SM, et al. J Bone Joint Surg Am 2010;92:1820-1826

#3 – Showers with CHG


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.

Edmiston et al. JAMA Surg 2015;150:1027-33

ORIGINAL ARTICLE

Preadmission Application of 2% Chlorhexidine Gluconate (CHG): Enhancing Patient Compliance While Maximizing Skin Surface Concentrations

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OBJECTIVE. Surgical site infections (SSIs) are responsible for significant morbidity and mortality. Preadmission skin antisepsis, while controversial, has gained acceptance as a strategy for reducing the risk of SSI. In this study, we analyze the benefit of an electronic alert system for enhancing compliance to preadmission application of 2% chlorhexidine gluconate (CHG).

DESIGN, SETTING, AND PARTICIPANTS. Following informed consent, 100 healthy volunteers in an academic, tertiary care medical center were randomized to 5 chlorhexidine gluconate (CHG) skin application groups: 1, 2, 3, 4, or 5 consecutive applications. Participants were further randomized into 2 subgroups: with or without electronic alert. Skin surface concentrations of CHG (μg/mL) were analyzed using a colorimetric assay at 5 separate anatomic sites.

INTERVENTION. Preadmission application of chlorhexidine gluconate, 2%

RESULTS. Mean composite skin surface CHG concentrations in volunteer participants receiving EA following 1, 2, 3, 4, and 5 applications were 1,040.5, 1,334.4, 1,278.2, 1,643.9, and 1,803.1 μg/mL, respectively, while composite skin surface concentrations in the no-EA group were 913.8, 1,240.0, 1,249.8, 1,194.4, and 1,364.2 μg/mL, respectively (ANOVA, $P < .001$). Composite ratios (CHG concentration/minimum inhibitory concentration required to inhibit the growth of 90% of organisms [MIC^{90}]) for 1, 2, 3, 4, or 5 applications using the 2% CHG cloth were 208.1, 266.8, 255.6, 328.8, and 360.6, respectively, representing CHG skin concentrations effective against staphylococcal surgical pathogens. The use of an electronic alert system resulted in significant increase in skin concentrations of CHG in the 4- and 5-application groups ($P < .04$ and $P < .007$, respectively).

CONCLUSION. The findings of this study suggest an evidence-based standardized process that includes use of an Internet-based electronic alert system to improve patient compliance while maximizing skin surface concentrations effective against MRSA and other staphylococcal surgical pathogens.

Edmiston et al. Infect Control Hosp Epidemiol 2016; 2016;37:254-259

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

The 4% Story

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

The 2% Cloth Story

- An SMS, text or voicemail reminder
- Oral and written patient instructions – Cleanse gently
- TOTAL OF SIX CLOTHS SHOULD BE USED – 3 NIGHT BEFORE AND 3 THE MORNING OF SURGERY
- Use both sides of the cloth – maximize release of CHG
- CLEANSE GENTLY

OPINION

To Bathe or Not to Bathe With Chlorhexidine Gluconate: Is It Time to Take a Stand for Preadmission Bathing and Cleansing?

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RUSSELL N. OLMSTED, *MPH, BS, CIC;* **SUE BARNES,** *BSN, RN, CIC;*
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AORNJ 2015;101:529-538

Clin Orthop Relat Res
DOI 10.1007/s11999-016-4767-6

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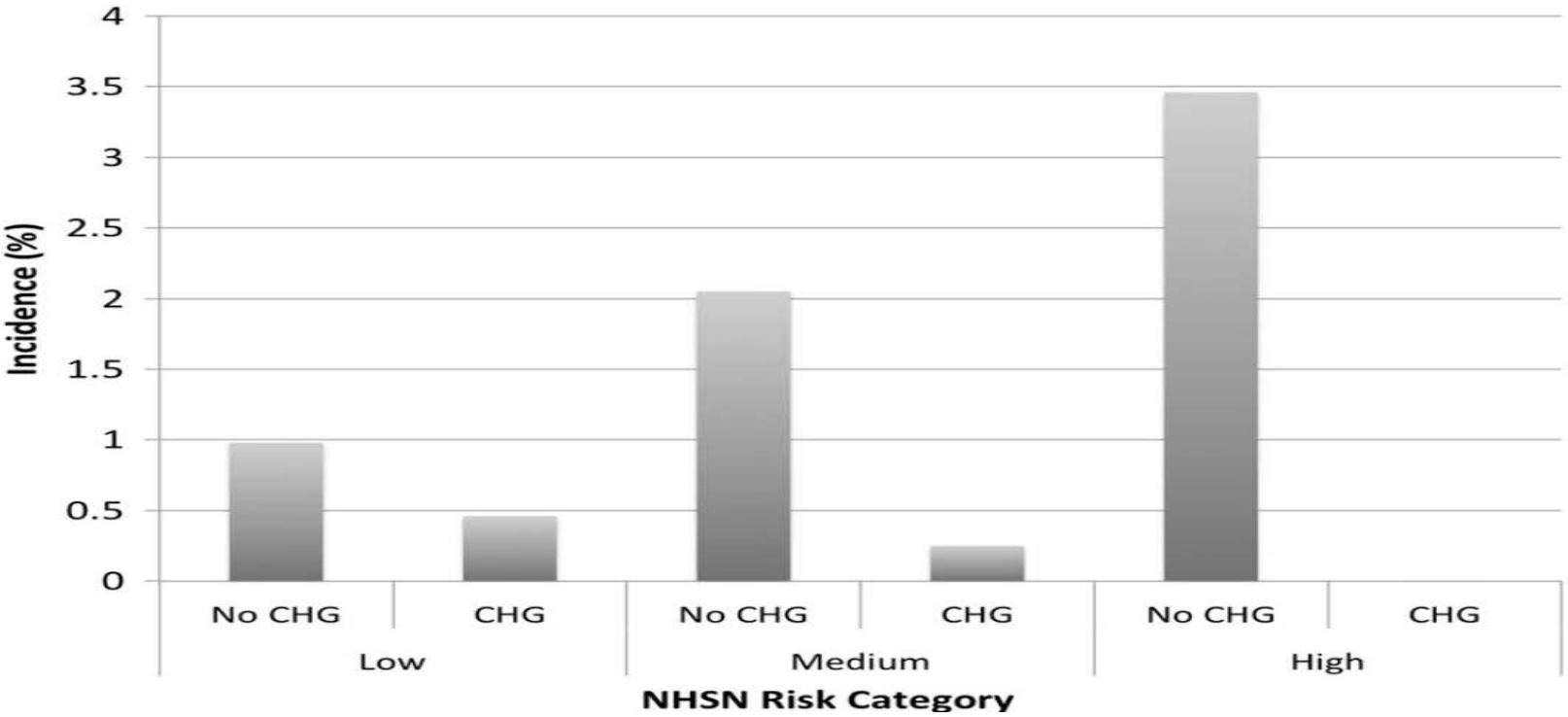
SYMPOSIUM: PROCEEDINGS OF THE 2015 MUSCULOSKELETAL INFECTION SOCIETY

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

Bhaveen H. Kapadia MD, Peter L. Zhou BA, Julio J. Jauregui MD,
Michael A. Mont MD



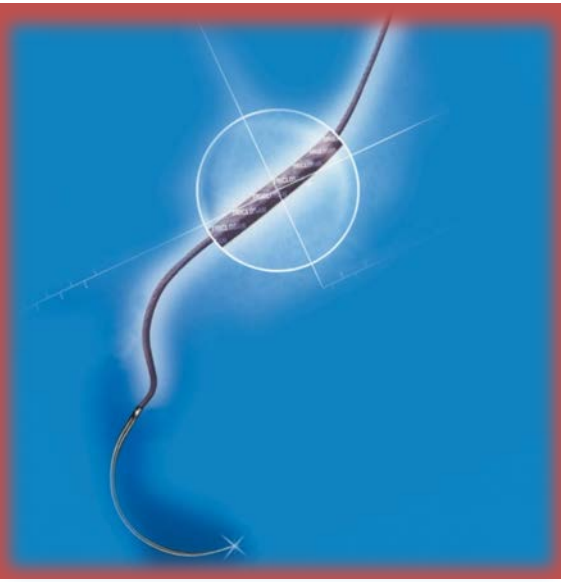
#4 Skin Prep – Alcohol based surgical skin prep

Use an alcohol-containing antiseptic agent for preoperative skin preparation

- Two types of preoperative skin preparations that combine alcohol (which has an immediate and dramatic killing effect on skin bacteria)
- Long-acting antimicrobial agents appear to be more effective at preventing SSI than povidone-iodine (an iodophor) alone:
  - Chlorhexidine plus alcohol
  - Iodophor plus alcohol

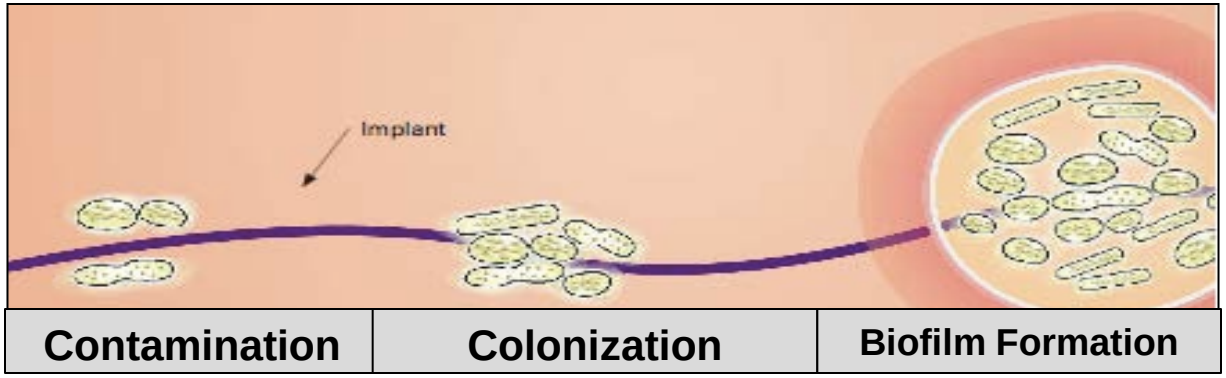
Institute for Healthcare Improvement (IHI): Prevention of SSI: Use Alcohol based antiseptics 2012

5 Sutures – Vicryl Plus Antimicrobial



Bacterial colonization of suture

- Like all foreign bodies, sutures can be colonized by bacteria:
  - Implants provide nidus for attachment of bacteria[1]
  - Bacterial colonization can lead to biofilm formation[1]
  - Biofilm formation increases the difficulty of treating an infection[2]

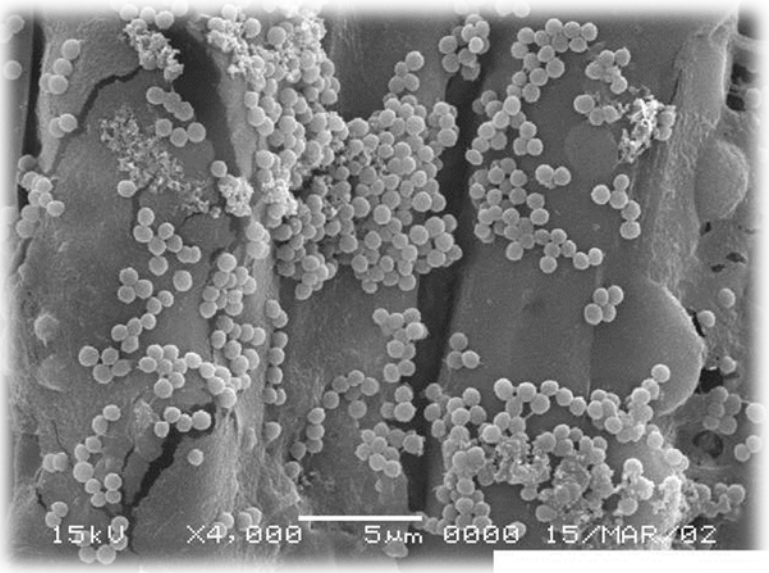


On an implant, such as a suture, it takes only 100 staphylococci per gram of tissue for an SSI to develop[3]

1. *Ward KH et al. J Med Microbiol. 1992;36: 406-413.*
2. *Kathju S et al Surg infect. 2009;10:457-461*
3. *Mangram AJ et al. Infect Control Hosp Epidemiol.1999;27:97-134..*

Potential for Contamination of Sutures at End of Case

Suture with Staphylococcus colonies

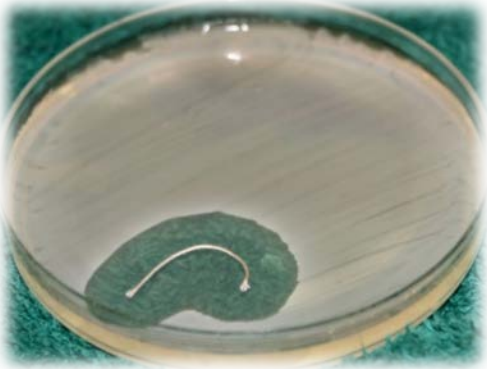


Air settling plates in the operating room at the last hour of a total joint case from the anesthesia

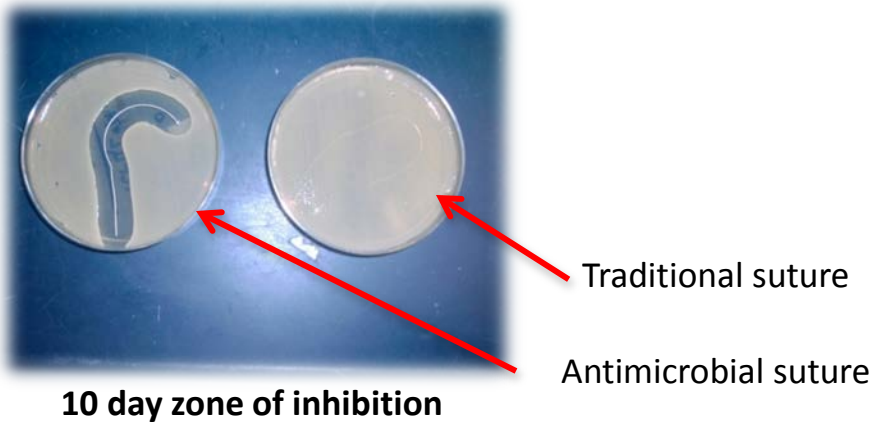
Spencer et al: Reducing the Risk of Orthopedic Infections: The Role of Innovative Suture Technology NAON 2010 Annual Congress - May 15-19, 2010

Antibacterial Suture Challenge

- Studied the "zone of inhibition" around the suture
  - A pure culture—0.5 MacFarland Broth—of *S. aureus* was prepared on a culture plate
  - An antibacterial suture was aseptically cut, planted on the culture plate, and incubated for 24 hrs – held at 5 and 10 days



5 day zone of inhibition



10 day zone of inhibition

Spencer et al: Reducing the Risk of Orthopedic Infections: The Role of Innovative Suture Technology NAON 2010 Annual Congress - May 15-19, 2010

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]

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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.

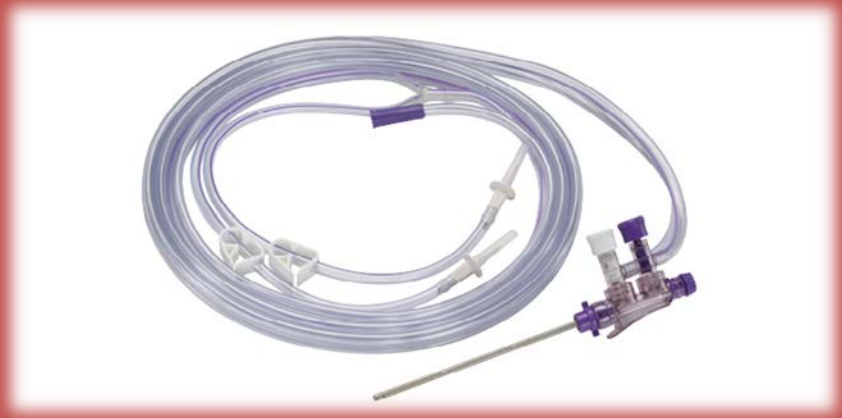
Conclusion: TCS demonstrated a significant beneficial effect in the prevention of SSI after surgery.

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

How Does One Evaluate An Antimicrobial Risk-Reduction Technology?

1. Safety
   - No MAUDE (FDA) reports (in 13 years) documenting direct evidence linking triclosan to adverse impact in surgical wounds
2. Microbicidal Activity (Spectrum)
   - Documented Gram-positive and Gram-negative antimicrobial activity and no published studies have demonstrated that use of triclosan coated sutures are associated with the emergence of resistant surgical pathogens
3. Evidence-based Clinical Effectiveness (Meta-Analysis)
   - Currently 6 meta-analysis in the peer-literature document clinical efficacy of triclosan (antimicrobial) suture technology
4. Cost-Effectiveness
   - Singh et al. (*Infect Control Hosp Epidemiol 2014;35:1013*) documents that use of triclosan-coated sutures provides significant fiscal benefit to hospital, third party-payer and patient

#6 Solution – to Pollution is Dilution



Pulsatile Lavage Irrigation

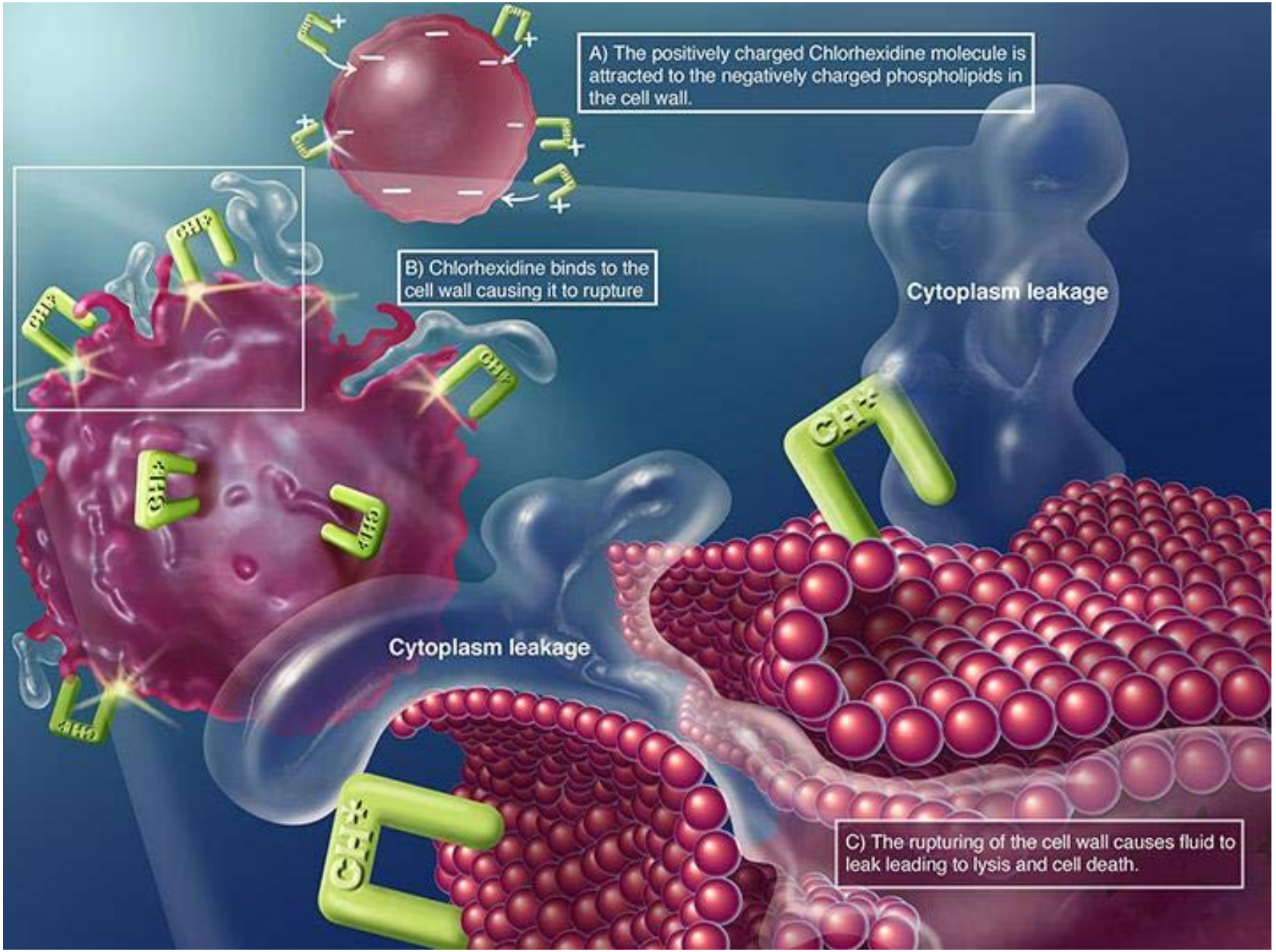
- Higher irrigant pressures result in greater osseous damage and perhaps impairment of osseous healing[1]
- Kalteis et al. revealed that compared with brush and bulb-syringe lavage high and low-pressure pulsatile lavage resulted in significantly ($p < 0.001$) higher rates of deep bacterial seeding in bone[2]
- No evidence that Bacitracin/Polymixin irrigations reduce rate of SSI[2] (and risk of anaphylaxis with Bacitracin)

- *1. Kalteis T, Lehn N, Schroder HJ, Schubert T, Zysk S, Handel M, Grifka J. Contaminant seeding in bone by different irrigation methods: an experimental study. J Orthop Trauma. 2005;19:591-6.*

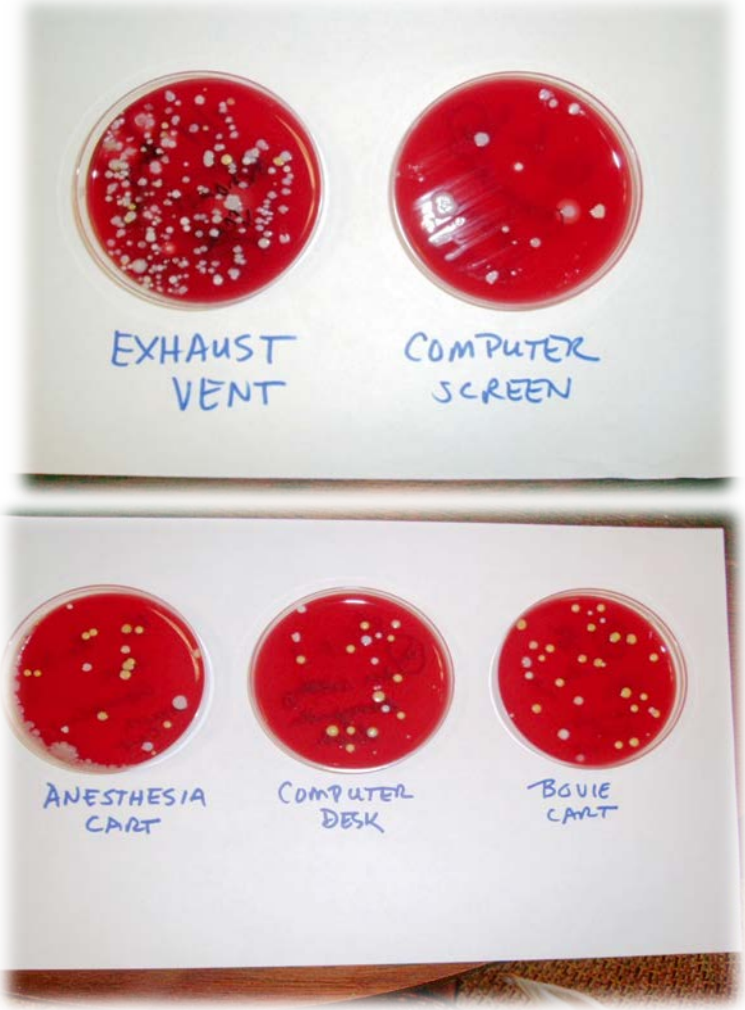
2. Fletcher N, et al: Prevention of perioperative infections. J Bone Joint Surg Am. 2007;89:1605-1618

Chlorhexidine 0.05% Irrigation Solution

- Chlorhexidine Gluconate 0.05% is an excellent biocide that binds to tissues
- It has demonstrated antimicrobial efficacy and persistence in laboratory testing
- The mechanical action effectively loosens and removes wound debris
- Safe for mucous membranes – approved by FDA
- **www.irrisept.com**


A) The positively charged Chlorhexidine molecule is attracted to the negatively charged phospholipids in the cell wall.
B) Chlorhexidine binds to the cell wall causing it to rupture
Cytoplasm leakage
Cytoplasm leakage
C) The rupturing of the cell wall causes fluid to leak leading to lysis and cell death.

Why CHG Irrigation? Air current contaminants can be flushed out before closure



CHG Irrigant leaves a 2 week antimicrobial action in the tissue

American Journal of Infection Control 42 (2014) 525-9

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journal homepage: www.ajicjournal.org

Practice forum

Surgical wound irrigation: A call for evidence-based standardization of practice

Sue Barnes RN, BSN, CIC[a], Maureen Spencer RN, MEd, CIC[b], Denise Graham[c], Helen Boehm Johnson MD[d,*]

- Surgeons, perioperative nurses, and infection preventionists must partner to deliver exceptional infection prevention results.
- Infection preventionists need to know more about what happens "behind the red line" and how they can support practice changes that deliver real results.
- There is currently an absence of evidence-based science addressing surgical irrigation. As a result, there is a lack of guidance and standardization in perioperative practice. Standardization must address irrigation solution type(s), volume(s), and method(s) of delivery.
- Existing published evidence is sufficient to support:
  - Elimination of antibiotic solution for surgical irrigation;
  - avoidance of surfactants for surgical irrigation
- Current existing published evidence is not sufficient to guide delivery method and volume. Expert opinion could instead be used to guide best practice.

#7 Skin Adhesive – Care of the Incision

Challenges in the post-op patient

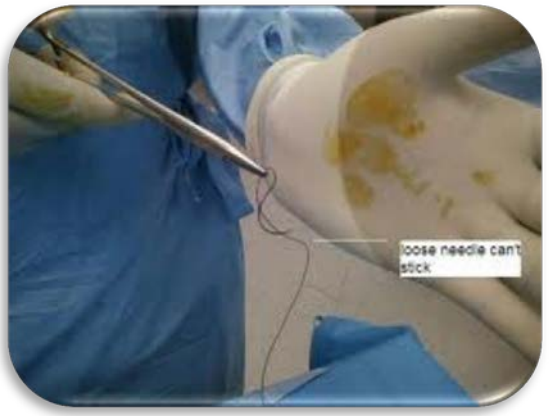
- Incision collects fluid – serum, blood - growth medium for organisms – small dehiscence between staples and steri-strips
- Spine fusions -incisions close to the buttocks or neck
- Body fluid contamination from bedpans/commodes
- Heavy perspiration common with obese patients
- Friction and sliding - tears and blisters
- Itchy skin - due to pain medications –
skin breakdown



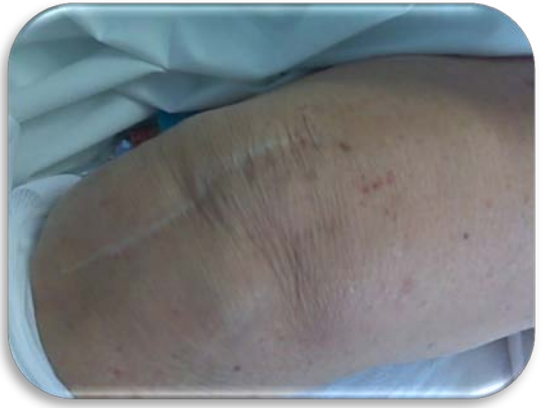


Topical Skin Adhesive: Benefits Beyond Risk Reduction

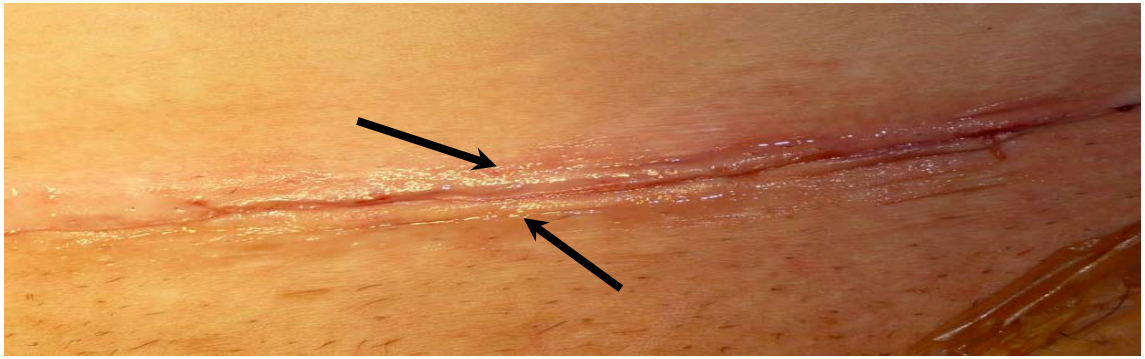
- For Hospital Staff
  - No time spent removing staples or sutures
  - Reduces hospitalization costs
  - Reduces number of suture set ups
  - Simplifies post-op wound checks
  - Reduces number of wound dressings
  - Can reduce staff suture exposures

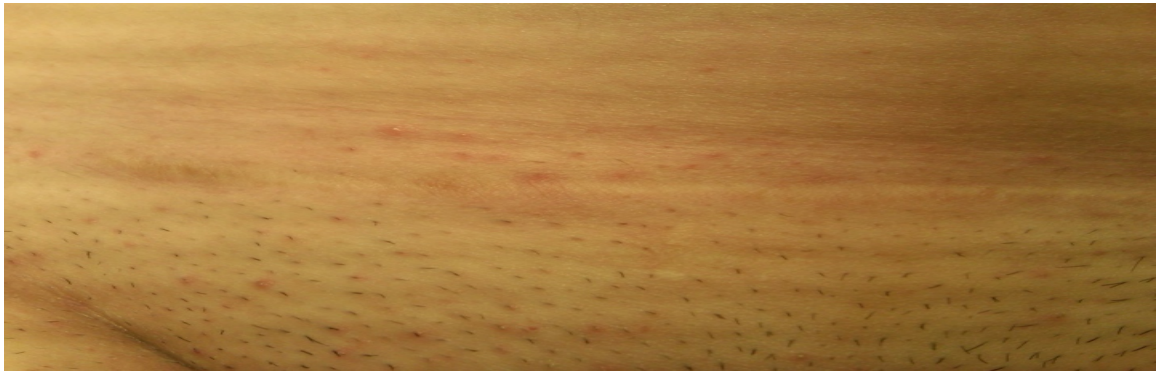


- For Patients
  - **7 days of wound healing strength in less than one minute** of application
  - Shower immediately
  - Outstanding cosmesis
  - Reduced follow-up
  - Less pain and anxiety

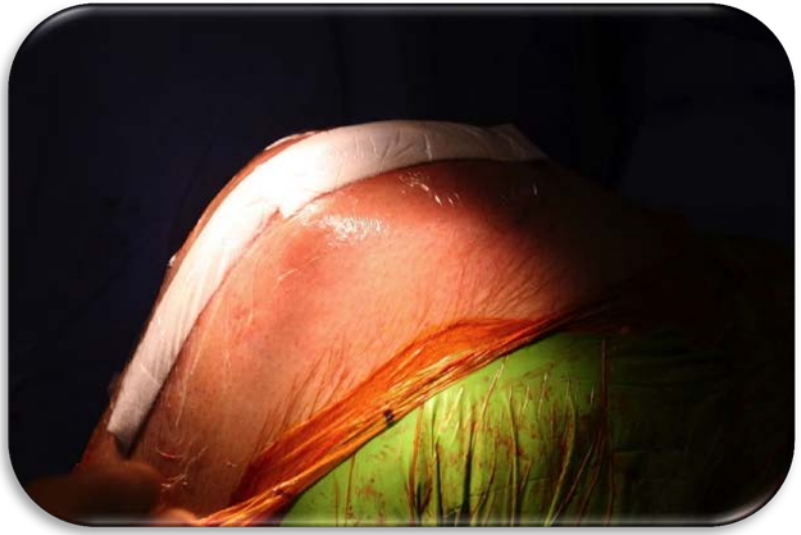


Adhesive Border and Healing
6 Weeks Post-op and Beyond



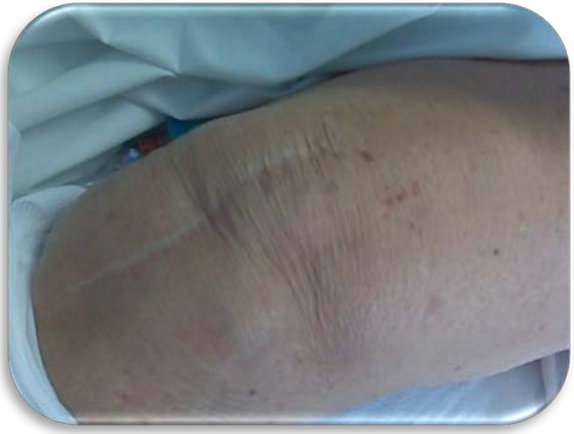


Incisional Adhesive on Total Knee



Clinical Use of Incisional Adhesive in Orthopedic Total Joints

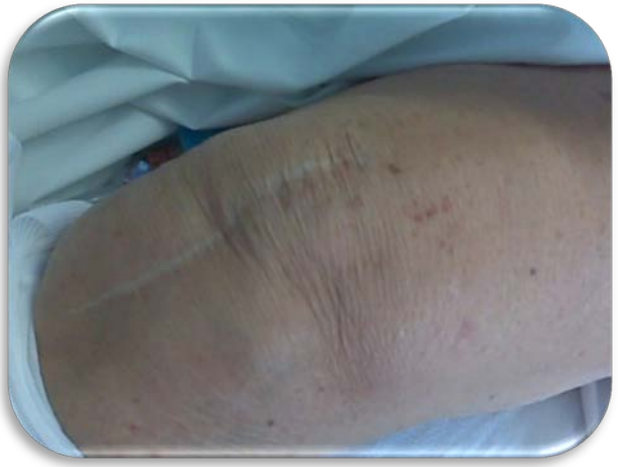
Hip: Sealed with adhesive covered with gauze and transparent dressing for incision protection



Healed incision

Knee: Sealed with incisional adhesive, covered with Telfa and a transparent dressing for incision protection

Which Would You Prefer???



Topical Incisional Adhesive (TSA)
Octyl Cyanoacrylate

OTHER OPTIONS when adhesives are contraindicated

Antimicrobial Dressings (PHMB, Silver)

Spencer et al: The Use of Antimicrobial Gauze Dressing (AMD) After Orthopedic Surgery To Reduce Surgical Site Infections NAON 2010 Annual Congress - May 15-19, 2010

Other Bundled Approaches to Colorectal SSI Prevention

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

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

Judith Tanner, PhD,[a] **Wendy Padley, MSc,**[b] **Ojan Assadian, MD,**[c] **David Leaper, MD,**[c] **Martin Kiernan, MPH,**[d] *and* **Charles Edmiston, PhD,**[e] *Nottingham, Leicester, Huddersfield, and London, UK, and Milwaukee, WI*

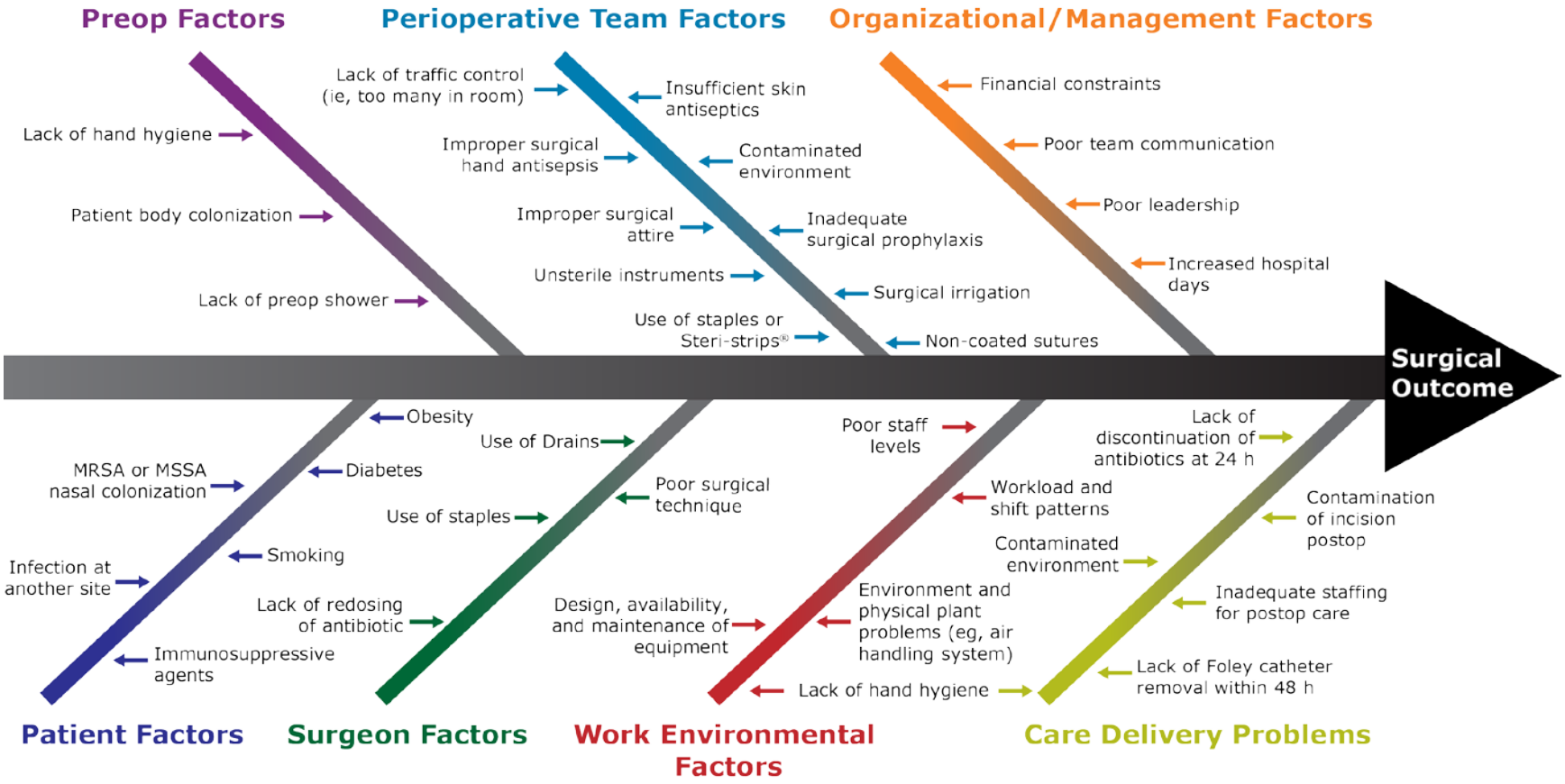
Background. *Care bundles are a strategy that can be used to reduce the risk of surgical site infection (SSI), but individual studies of care bundles report conflicting outcomes. This study assesses the effectiveness of care bundles to reduce SSI among patients undergoing colorectal surgery.*
Methods.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

From the School of Health Sciences,[a] *University of Nottingham, Nottingham; Faculty of Health and Life Sciences,*[b] *De Montfort University, Leicester; Institute of Skin Integrity and Infection Prevention,*[c] *University of Huddersfield, Huddersfield; Richard Wells Research Centre,*[d] *University of West London, London, UK; and Department of Surgery,*[e] *Medical College of Wisconsin, Milwaukee, WI*

Surgery 2015;158:66-77

In Conclusion…..


Many Risk Factors Influence SSI



One thing could lead to the failure

Surgical infection prevention team

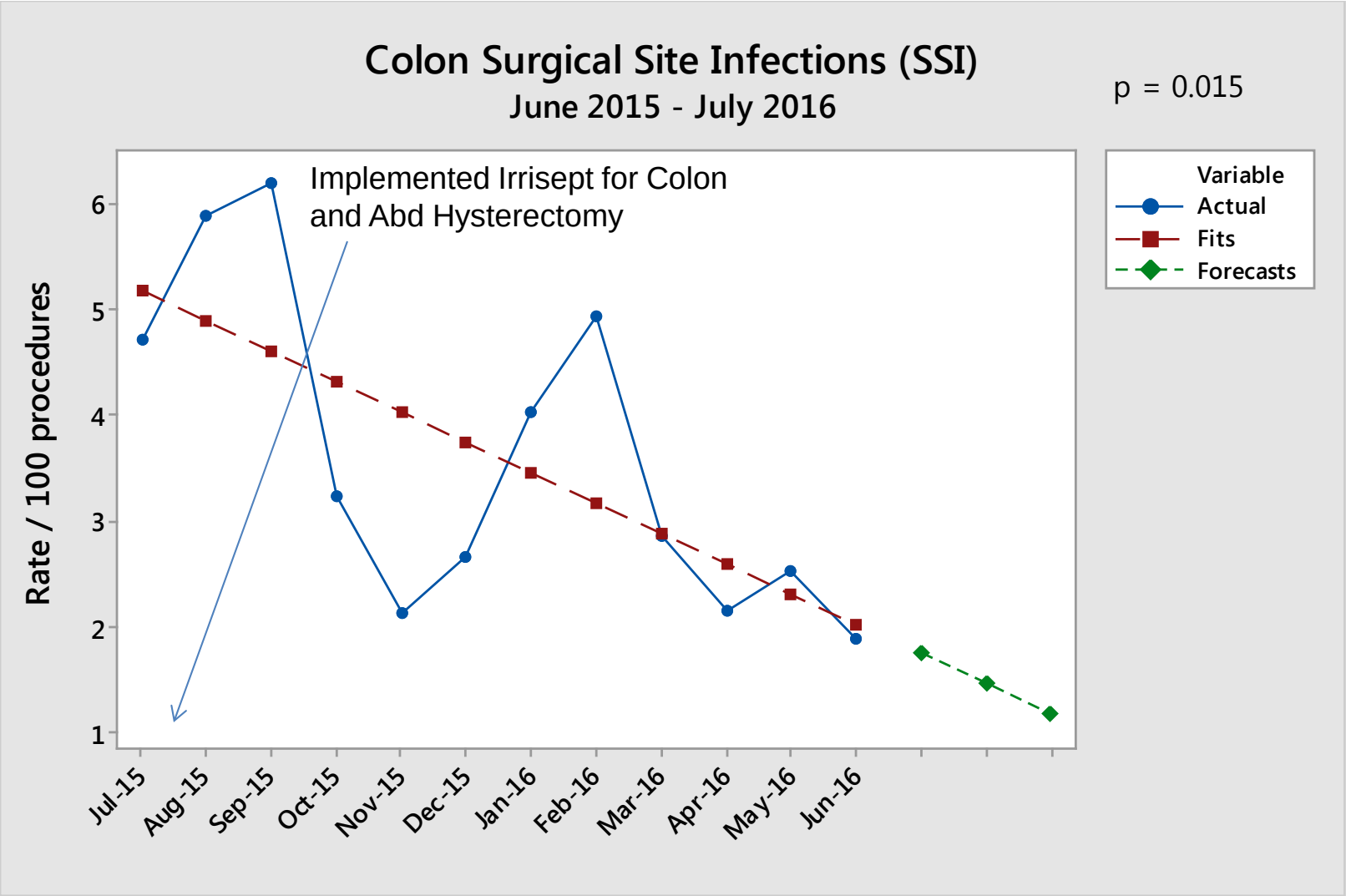
- Senior leadership and surgeons – Must be involved and lead the effort
- Clear goals
  - Structured program with clearly defined goal of zero tolerance for HAIs
- Communication – effective and consistent
- Ongoing and creative education
- Financial support to Infection Prevention program
- Use process improvement tools

UHS Surgical Site Infections 2015-2016

SSI 2015	Count	Expected	Rate	UHS SIR	National NHSN SIR
Abd Hysterectomy	13	20	1.24	0.67	**0.83**
Colon	41	63	3.91	0.65	**0.98**
CABG	6	16	1.59	0.39	**0.55**
SSI Jan-Jun 2016	**Infection Count**	**Number Expected**	**Rate**	**UHS SIR**	**National SIR**
SSI - Abdominal Hysterectomy	6	11	0.51	0.57	**0.83**
SSI - Colon Surgery	24	35	3.03	0.68	**0.98**
SSI - CABG	3	8	0.38	0.37	**0.55**

Patient Safety Work Product

PSWP Colon SSIs

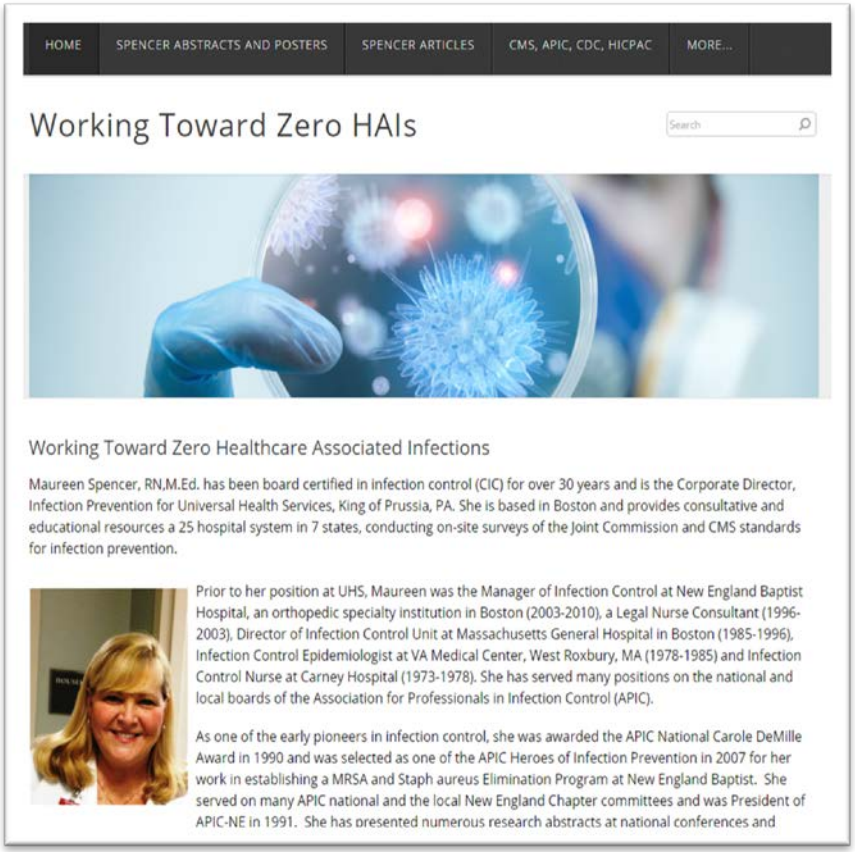


Patient Safety Work Product

Additional resources

www.7sbundle.com

www.workingtowardzero.com



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