Establishing A Culture of Safety: The 7 S Bundle To Prevent Surgical Site Infections

Maureen Spencer, RN, M.Ed., CIC
Corporate Infection Preventionist Consultant
Universal Health Services

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

Overview of HAC reduction program

Starting in FY2015, CMS will penalize institutions in top 25% for HAC rates by reducing overall Medicare payments by 1%

Penalty is in addition to withheld Medicare reimbursement related to these conditions

Several major infections will be tracked, including central line-associated bloodstream infections (CLABSI) and surgical site infections (SSI)

<table>
<thead>
<tr>
<th>Metric</th>
<th>FY 2015</th>
<th>FY 2016</th>
<th>FY 2017</th>
</tr>
</thead>
<tbody>
<tr>
<td>CLABSI</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Catheter-associated urinary tract infection (CAUTI)</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>SSI – Colon</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>SSI – Abdominal Hysterectomy</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>MRSA</td>
<td></td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>C. Difficile</td>
<td></td>
<td></td>
<td>✓</td>
</tr>
</tbody>
</table>
Increasing Financial Penalty for HAIs


VBP = Value-Based Purchasing Program; RRP = Readmission Reduction Program.
The Hospital Readmissions Reduction Program (RRP) will penalize institutions with high readmission rates

Overview of RRP

Starting in FY2013, hospitals with above-average readmission rates for specific conditions will see a reduction in overall Medicare payments

Conditions evaluated under RRP:
- Acute myocardial infarction (AMI)
- Heart failure
- Pneumonia
- COPD*
- Total Hip Arthroplasty
- Total Knee Arthroplasty
- CABG*
- PCI**

Medicare payment reduction:

<table>
<thead>
<tr>
<th>Year</th>
<th>2013</th>
<th>2014</th>
<th>2015</th>
</tr>
</thead>
<tbody>
<tr>
<td>1%</td>
<td>2%</td>
<td>3%</td>
<td></td>
</tr>
</tbody>
</table>

*COPD = chronic obstructive pulmonary disease
*CABG = coronary artery bypass graft
**PCI = percutaneous coronary intervention
## FINANCIAL IMPACT OF HAIs

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

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\(^2\)

A 7 S BUNDLE APPROACH TO PREVENTING SURGICAL SITE INFECTIONS

DEVELOPED IN 2012
7 “S” Bundle to Prevent SSI

www.7sbundle.com

**SAFETY** – is your OPERATING ROOM safe?

**SCREEN** – are you screening for risk factors and presence of MRSA & MSSA

**SHOWERS** – do you have your patients cleanse their body the night before and morning of surgery with CHLORHEXIDINE (CHG)?

**SKIN PREP** – are you prepping the skin with alcohol based antiseptics such as CHG or Iodophor?

**SOLUTION** - are you irrigating the tissues prior to closure to remove exogenous contaminants? Are you using CHG?

**SUTURES** – are you closing tissues with antimicrobial sutures?

**SKIN CLOSURE** – are you sealing the incision or covering it with an antimicrobial dressing to prevent exogenous contamination?
AORN Recommended Practices and Evidence Based Guidelines

- 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
#1 – Safe Operating Room

- Traffic control, number staff in room

- Air handling systems, filtration, grills
  - Relative Humidity in the OR – Joint Communication to Healthcare Organizations, January 2015 (AORN, AAMI, TJC, ASHE, AHA, and others)

- SCIP: hair clipping, warmers, oxygenation, surgical prophylaxis – weight based dosing, Foley catheter removal 48 hrs

- Room turnover and terminal cleaning
  - AORN EVS Cleaning and Disinfection 2014

- Surgical technique and handling of tissues
  - AORN Recommended Practices for Sterile Technique 2012

- Instrument cleaning/sterilization process, biological indicators
  - AORN Recommended Practices for Cleaning and Care of Surgical Instruments 2014

- Storage of supplies, clean supply bins, carts, tables, stationary equipment
  - AORN EVS Cleaning and Disinfection 2014
Surgical Care Improvement Program (SCIP)

Surgical prophylaxis: selection, time, discontinuation of abx (24hrs or 48hrs cardiac)
Hair clippers (no razors)
Warming patient (pre-postop)
Increased oxygen
Remove Foley catheter within 48 hours

Several studies questioning the value of the SCIP initiative:

Hair Clipping in Surgery

- Clipping should always be done outside of the OR.
- Removal of stray hairs from clipping should be done using tape and/or suction, while clipping on top of a disposable underpad.
- In cases of excessive amounts of hair and sensitivity/privacy for the patient, the ClipVac suction device and associated single-use disposable can be used in the OR after the patient is anesthesitized.
- Always remove and dispose of single-use clipper head immediately after use and clean the clipper unit according to manufacturer instructions before storing.
Prevent Colon and Abd Hysterecomy SSIs—Wound Protector/Retractor

- Wound protector/retractor provides 360 of circumferential, atraumatic retraction, while significantly reducing surgical site infection and maintaining moisture at the incision.

- The self-retaining design of the wound protector/retractor effectively holds the incision site open, allowing the surgeon to easily access the operative field and maximize surgical assistance.


Hair Coverage in OR

• 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.
• AORN “Recommended practices for surgical attire” section IV.a. states:
  • “a clean, low-lint surgical head cover or hood that confines all hair and covers scalp skin should be worn. The 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.”

Check out this simulation of Indoor Microbiome Animation https://vimeo.com/90059732

1. AORN RP – Surgical Attire 2014
2. Boyce, Evidence in Support of Covering the Hair of OR Personnel AORN Journal • Jan 2014
Scrubs and Jackets in OR

- Facility approved, clean, and freshly laundered surgical attire should be donned in a designated dressing area of the facility upon entry or reentry to the facility.
- 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 (e.g., animal hair, dust and dirt, 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 (circulator, anesthesia, reps).
- 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).
Environmental cleaning and disinfection

- Evaluate and observe between room cleaning procedures – are they done correctly (clean to dirty)
- Evaluate and observe terminal cleaning procedures on evening/night shift – use of checklist
- Are there sufficient staff to terminally clean all OR rooms **each day** (plus PACU, offices, hallways, Pre-op, etc)
- New operating rooms are much larger and will need increased staff

- AORN RP: Environmental Cleaning in the Perioperative Setting Updated 2014
- Spencer M, Edmiston C. The Role of the OR Environment in Preventing Surgical Site Infections. AORN Journal December 2014
Hot Topic due to recent outbreaks: Cleaning/Sterilization of Instruments

- Inspection of Instruments
  - Lumens, grooves, sorting, hand cleaning, disassembly required – massive kits for ortho cases
  - Many instruments cannot be disassembled
  - Daily use of Biologic Indicators, accurate logs
- Pre-soaking and rinsing of tissue and blood in the operating room before sent to decontamination
- Ultrasonic machine cleaning
- Brushes, enzymatic solution
- Sterilizer maintenance and cleaning
- Air pressure: negative in decontamination and positive in sterile processing

Key Outbreak:
#2 SCREEN for MRSA and MSSA Colonization
## Risk Factors for Orthopedic Surgical Infections

**Table 4. Infection risk factor**

<table>
<thead>
<tr>
<th>Risk factor</th>
<th>Odds ratio (confidence interval)</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current tobacco use</td>
<td>3.00 (1.78 5.06)</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Current or history of bone cancer</td>
<td>12.85 (4.64 35.59)</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Diabetes mellitus</td>
<td>2.44 (1.55 3.82)</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Hepatitis B</td>
<td>7.34 (0.96 56.1)</td>
<td>0.027</td>
</tr>
<tr>
<td>Hepatitis C</td>
<td>5.59 (2.21 14.19)</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>MRSA colonization or prior infection</td>
<td>7.34 (2.85 18.91)</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>MSSA colonization or prior infection</td>
<td>8.64 (3.75 19.89)</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Staphylococcal colonization or prior infection</td>
<td>6.52 (3.41 12.51)</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Underweight (BMI &lt; 18.5 kg/m²)</td>
<td>1.90 (0.26 13.7)</td>
<td>0.56</td>
</tr>
<tr>
<td>Overweight (BMI 25.0 – 29.9 kg/m²)</td>
<td>0.60 (0.24 1.50)</td>
<td>0.24</td>
</tr>
<tr>
<td>Obese (BMI 30.0 – 39.9 kg/m²)</td>
<td>0.84 (0.51 1.41)</td>
<td>0.52</td>
</tr>
<tr>
<td>Morbid obesity</td>
<td>1.28 (0.61 2.65)</td>
<td>0.51</td>
</tr>
<tr>
<td>(BMI 40.0 – 49.9 kg/m²)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Super obesity (BMI 50 + kg/m²)</td>
<td>15.69 (5.97 41.21)</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Obesity hypoventilation syndrome</td>
<td>10.2 (1.17 88.5)</td>
<td>0.01</td>
</tr>
</tbody>
</table>

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*
Screening and Decolonization Protocol
Evidence Based


Does using mupirocin eradicate *Staph aureus* nasal carriage? – Evidence Based

- Short-term nasal mupirocin (4-7 days) is an effective method for *Staph aureus/MRSA* eradication
- >80% success at one week
- Low level mupirocin resistance when used at home

Systematic review (Ammerlaan HS, et al. CID 2009): 8 studies comparing mupirocin to placebo
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

Polymerase Chain Reaction (PCR) for Nasal Screens – Lab Challenges

- **Challenges:**
  - Instructing staff on how to obtain a nares specimen with proper swabs
  - Lab differentiation of the colonized screens from routine cultures.
  - Molecular lab up and running in a short time frame with cross-training of staff of Cepheid’s GeneXpert System
  - Reporting system for positive results
Institutional Prescreening for Detection and Elimination of Methicillin Resistant Staphylococcus aureus in Patients Undergoing Elective Orthopaedic Surgery

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>5293</td>
<td>7019</td>
<td></td>
</tr>
<tr>
<td>MRSA Infection</td>
<td>10 (0.18%)</td>
<td>4 (0.06%)</td>
<td>0.0315</td>
</tr>
<tr>
<td>MSSA Infection</td>
<td>14 (0.26%)</td>
<td>9 (0.13%)</td>
<td>0.0937</td>
</tr>
<tr>
<td>Total SSIs</td>
<td>24 (0.46%)</td>
<td>13 (0.18%)</td>
<td>0.0093</td>
</tr>
</tbody>
</table>

#3 – Showers with CHG
OR Risk Factors: Bacteria on Patient’s Skin

• Pre-op Showers:
  – Liquid chlorhexidine shower
  – CHG impregnated washcloths
Empowering the Surgical Patient: A Randomized, Prospective Analysis of an Innovative Strategy for Improving Patient Compliance with Preadmission Showering Protocol

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


Figure 2. Mean skin-surface concentration (µg/mL) of 4% chlorhexidine gluconate after 3 preadmission showers. Group B1 subjects were alerted by short message service text, email, or voicemail. Group B2 subjects were not alerted before showering. The 90% minimum inhibitory concentration = 5 µg/mL for skin staphylococcal flora (including MRSA). LF, left; RT, right.
#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) with long-acting antimicrobial agents appear to be more effective at preventing SSI than povidone-iodine (an iodophor) alone:

- Chlorhexidine plus alcohol
- Iodophor plus alcohol
### Skin antiseptic agents

<table>
<thead>
<tr>
<th>Antiseptic agent</th>
<th>Rapidity of action</th>
<th>Persistent activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alcohol</td>
<td>Excellent</td>
<td>None</td>
</tr>
<tr>
<td>CHG</td>
<td>Moderate</td>
<td>Excellent</td>
</tr>
<tr>
<td>PI</td>
<td>Moderate</td>
<td>Minimal</td>
</tr>
<tr>
<td>CHG w/alcohol</td>
<td>Excellent</td>
<td>Excellent</td>
</tr>
<tr>
<td>PI w/alcohol</td>
<td>Excellent</td>
<td>Moderate</td>
</tr>
<tr>
<td>PCMX</td>
<td>Moderate</td>
<td>Moderate</td>
</tr>
</tbody>
</table>
# 5 Sutures – Antimicrobial Plus Sutures
Bacterial colonization of sutures

• 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\(^3\)

---

Why Antimicrobial Sutures?
OR Air Current Contamination

In teaching hospitals:
- Surgeon leaves room
- Resident, Physician Assistant or Nurse Practitioner work on incision
- Circulating Nurse counts sponges and starts room breakdown
- Scrub Technician starts breaking down tables and preparing instruments for Central Processing
- Anesthesia move in and out of room
- Instrument representative might leave room and visitors may leave room
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

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

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, Frederic C. Daoud, MD, and David Leaper, MD, FACS, 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 were 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.)

---

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

Z. X. Wang1,2, C. P. Jiang1,2, Y. Cao1,2 and Y. T. Ding1,2

1Department of Hepatobiliary Surgery, Affiliated Drum Tower Hospital, School of Medicine, Nanjing University, and 2Jiangsu 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: dingyizao@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.
Meta-Analysis of Prevention of Surgical Site Infections following Incision Closure with Triclosan-Coated Sutures: Robustness to New Evidence

Frederic C. Daoud, Charles E. Edmiston, Jr, and David Leaper

Abstract

Background: A systematic literature review (SLR) and meta-analysis of surgical site infections (SSIs) after surgical incision closure with triclosan-coated sutures (TS) compared with non-antibacterial coated sutures (NTS) previously published by the authors suggested that fewer SSIs occurred in the TS study arm. However, the results were vulnerable to the removal of one key randomized control trial (RCT) because of insufficient data. Furthermore, recently published RCTs highlighted the need for an update of the SLR to challenge the robustness of results.

Methods: The protocol for the new SLR included more stringent tests of robustness than initially used and the meta-analysis was updated with the results of two new RCTs as well as the count of patients and SSIs by U.S. Centers for Disease Control and Prevention (CDC) incision class.

Results: The updated SLR included 15 RCTs with 4,800 patients. No publication bias was suggested in the analysis. The predominant effect estimated a relative risk of 0.67 (95% CI: [0.54, 0.84], p = 0.0065) with an overall lower frequency of SSI in the TS arm than in the NTS arm. Results were robust to sensitivity analysis.

Conclusions: The two additional peer-reviewed double-blind RCTs of this update confirmed the predominant effect found in the authors’ previous meta-analysis and established the robustness of conclusions that were previously lacking. This SLR and meta-analysis showed that the use of triclosan antimicrobial sutures reduced the incidence of SSI after clean, clean-contaminated, and contaminated surgery. The Centre for Evidence-based Medicine (CEBM) evidence concentration level of this SLR was reinforced.

Triclosan-Coated Sutures Reduce the Risk of Surgical Site Infections: A Systematic Review and Meta-analysis

Anucha Apisarnthanarak, MD; Nalini Singh, MD, MPH; Aila Nica Bandong, MS; Gilbert Madriga, PTRP

OBJECTIVE. To analyze available evidence on the effectiveness of triclosan-coated sutures (TCS) in reducing the risk of surgical site infection (SSI).

DESIGN. Systematic review and meta-analysis.

METHODS. A systematic search of both randomized (RCTs) and nonrandomized (non-RCT) studies was performed on PubMed, Medline, OVID, EMBASE, and SCOPUS, without restrictions in language and publication type. Random-effects models were utilized and pooled estimates were reported as the relative risk (RR) ratio with 95% confidence interval (CI). Tests for heterogeneity as well as meta-regression, subgroup, and sensitivity analyses were performed.

RESULTS. A total of 29 studies (22 RCTs, 7 non-RCTs) were included in the meta-analysis. The overall RR of acquiring an SSI was 0.65 (95% CI: 0.53–0.77; I² = 42.4%, P = .001) in favor of TCS use. The pooled RR was particularly lower for the abdominal surgery group (RR: 0.56; 95% CI: 0.41–0.77) and was robust to sensitivity analysis. Meta-regression analysis revealed that study design, in part, may explain heterogeneity (P = .03). The pooled RR subgroup analyses for randomized controlled trials (RCTs) and non-RCTs were 0.74 (95% CI: 0.61–0.89) and 0.53 (95% CI: 0.42–0.66), respectively, both of which favored the use of TCS.

CONCLUSION. The random-effects meta-analysis based on RCTs suggests that TCS reduced the risk of SSI by 26% among patients undergoing surgery. This effect was particularly evident among those who underwent abdominal surgery.

Infec Control Hosp Epidemiol 2015;36(2):1–11
#6 Solution – to Pollution is Dilution

CDC Draft SSI Guideline 2014
2A.1. No recommendation can be made regarding the safety and effectiveness of intraoperative antimicrobial irrigation (e.g., intra-abdominal, deep or subcutaneous tissues) for the prevention of surgical site infection. (No recommendation/unresolved issue)
Surgical wound irrigation: A call for evidence-based standardization of practice

Sue Barnes RN, BSN, CIC\textsuperscript{a}, Maureen Spencer RN, MEd, CIC\textsuperscript{b}, Denise Graham\textsuperscript{c}, Helen Boehm Johnson MD\textsuperscript{d,}\ast

- 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.
Chlorhexidine 0.05% Irrigation

- Meets American College of Emergency Physicians (ACEP) guidelines for wound irrigation volume and pressure
- Proprietary SplatterGuard protects healthcare workers, patients and the environment from biohazard contamination
- 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
Why CHG Irrigation: OR airborne contaminants can be flushed out before closure

CHG Irrigant leaves an antimicrobial effect for 2 weeks in the tissue
Chlorhexidine Gluconate (CHG)

- CHG is a broad-spectrum biocide effective against Gram-positive bacteria, Gram-negative bacteria and fungi.¹, ⁶, ⁷
- CHG inactivates microorganisms with a broader spectrum than other antimicrobials (e.g. antibiotics) - has a quicker kill rate than other antimicrobials (e.g. povidone-iodine, PI).², ⁶, ⁷
- It has both bacteriostatic and bactericidal mechanisms of action - kills by destabilizing the cell membrane within 20-30 second of application.³, ⁴, ⁷
- Unlike PI, CHG is not affected by the presence of body fluids such as blood.⁵

5. Lim et al. Anaesthesia Intensive Care 2008;36:4
Impact of Intraoperative Saline and 0.05% CHG Irrigation on Resolution of MRSA Contaminated Polypropylene Mesh – Sprague-Dawley Animal Model

7 days Post Challenge – 3.0 $\log_{10}$ CFU/mL

(p<0.001)

ACS 2013

* Irrisept
#7 Skin Adhesive – Care of the Incision

## Wound Healing Phases

### Inflammatory
1. Immediate to 2-5 days
2. Bleeding stops (haemostasis)
   - i. Constriction of the blood supply
   - ii. Platelets start to clot
   - iii. Formation of a scab
3. Inflammation
   - i. Opening of the blood supply
   - ii. Cleansing of the wound

### Proliferative
1. 5 days to 3 weeks
2. Granulation
   - i. New collagen tissue is laid down
   - ii. New capillaries fills in defect
3. Contraction
   - i. Wound edges pull together
4. Epithelialization
   - i. Cells cross over the moist surface
   - ii. Cell travel about 3 cm from point of origin

### Maturation
1. Collagen forms which increases tensile strength to wounds
2. Scar tissue is only 80 percent as strong as original tissue
3. 3 weeks to 2 years
Challenges in the Post-op Patient

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

- Wounds are most vulnerable to infection in the **first 48-72 hours**\(^1\)
  - Until the epithelial barrier is complete (usually within 48 hours) wounds are solely dependent on the wound closure device to maintain integrity\(^1\)

- The extent of microbial protection depends on barrier integrity\(^1\)
  - Effective barriers must maintain their integrity for the first 48 hours

- Incisional adhesive provides a **strong microbial barrier** that prevents bacteria from entering the incision site\(^2\)

Topical Skin Adhesive: Benefits

- **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

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

Healed incision
Which Would You Prefer???

Topical Incisional Adhesive (TSA)
Octyl Cyanoacrylate
OTHER OPTIONS
WHEN ADHESIVES ARE NOT USED
Antimicrobial (PHMB) Dressings with Hypoallergenic Fabric Tape

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
Antimicrobial Silver Dressings

Silver dressing and transparent dressing left on until discharge – seals the incision from exogenous contaminants

NAON – May 2006
Spencer et al: The Use of A Silver Gauze Dressing in Spine Surgery to Reduce the Incidence of MRSA Surgical Site Infections
Many Risk Factors Influence SSI

One thing could lead to the failure
Working Toward Zero Teams

- Intent is paramount – no infection is acceptable
- Senior leadership and surgeons – must be involved and lead the effort
- 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 (fishbone, pareto, mind-mapping)


Conclusion

• Reducing variability in healthcare system improves quality of care
• Standardization of skin related preparation may aid quality initiatives in surgical care
• “Evaluate, engage, educate and execute” (4 E’s) is the key process for quality culture change
• Leverage resources available for 4 E’s in standardizing skin related preparation
Additional References


The End