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

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Universal Health Services
www.uhsinc.com

www.7sbundle.com
www.workingtowardzero.com
Epidemiology of HAI
Standardized Infection Ratio (SIR)

- Observed Cases = Number of infections
- Predicted Cases =
  \( \frac{(\text{NHSN Pooled Mean} \times \text{Unit-specific \# Device days})}{1000} \)
  - Yields a risk adjusted comparison number based on unit specific device use
- SIR formula = Observed/Predicted
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)
  - $SIR = 0.75 = \text{Performing at 25\% lower than comparable groups}$

- 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)
  - $SIR = 1.30 = \text{Performing at 30\% higher than comparable groups}$
  - $SIR = 2.50 = \text{Performing at 150\% higher than comparable groups}$
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**

**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.
- 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**

**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.
- 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**

**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.
- 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**

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**

- U.S. hospitals reported no significant change in SSIs related to abdominal hysterectomy surgery between 2013 and 2014.
- 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**

- U.S. hospitals reported a significant increase in SSIs related to colon surgery between 2013 and 2014.
- 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**

**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.
- 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*
### Healthcare-Associated Infections (HAI) Data

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

#### Table: National Data

<table>
<thead>
<tr>
<th>HAI Type</th>
<th># of U.S. Hospitals That Reported Data to CDC's NHSN, 2014*</th>
<th>2014 Nat'l SIR vs. 2013 Nat'l SIR</th>
<th>2014 Nat'l SIR vs. Nat'l Baseline†</th>
<th>2014 Nat'l SIR</th>
</tr>
</thead>
<tbody>
<tr>
<td>CLABSI</td>
<td>3,655</td>
<td>8%</td>
<td>50%</td>
<td>0.50</td>
</tr>
<tr>
<td>Nat'l Baseline: 2008</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CAUTI</td>
<td>3,791</td>
<td>5%</td>
<td>0%</td>
<td>1.00</td>
</tr>
<tr>
<td>Nat'l Baseline: 2009</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SSI, Abdominal Hysterectomy</td>
<td>3,225</td>
<td>5%</td>
<td>17%</td>
<td>0.83</td>
</tr>
<tr>
<td>Nat'l Baseline: 2008</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SSI, Colon Surgery</td>
<td>3,377</td>
<td>5%</td>
<td>2%</td>
<td>0.98</td>
</tr>
<tr>
<td>Nat'l Baseline: 2008</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MRSA Bacteremia</td>
<td>3,949</td>
<td>4%</td>
<td>13%</td>
<td>0.87</td>
</tr>
<tr>
<td>Nat'l Baseline: 2011</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C. difficile Infections</td>
<td>3,994</td>
<td>4%</td>
<td>8%</td>
<td>0.92</td>
</tr>
<tr>
<td>Nat'l Baseline: 2011</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*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.
<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><strong>Total</strong></td>
<td><strong>21,100 (100)</strong></td>
<td></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\(^2\)

Cost of Healthcare associated infections
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.
<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>

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 minutes 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
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. SAYWER, 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
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 2008;248:701
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 (e.g., 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

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

2. BIOQUELL trials, unpublished data.
## Prior room occupancy increases risk

<table>
<thead>
<tr>
<th>Study</th>
<th>Healthcare associated pathogen</th>
<th>Likelihood of patient acquiring HAI based on prior room occupancy (comparing a previously ‘positive’ room with a previously ‘negative’ room)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Martinez 2003¹</td>
<td>VRE – cultured within room</td>
<td>2.6x</td>
</tr>
<tr>
<td>Huang 2006²</td>
<td>VRE – prior room occupant</td>
<td>1.6x</td>
</tr>
<tr>
<td></td>
<td>MRSA – prior room occupant</td>
<td>1.3x</td>
</tr>
<tr>
<td>Drees 2008³</td>
<td>VRE – cultured within room</td>
<td>1.9x</td>
</tr>
<tr>
<td></td>
<td>VRE – prior room occupant</td>
<td>2.2x</td>
</tr>
<tr>
<td></td>
<td>VRE – prior room occupant in previous two weeks</td>
<td>2.0x</td>
</tr>
<tr>
<td>Shaughnessy 2008⁴</td>
<td>C. difficile – prior room occupant</td>
<td>2.4x</td>
</tr>
<tr>
<td>Nseir 2010⁵</td>
<td>A. baumannii – prior room occupant</td>
<td>3.8x</td>
</tr>
<tr>
<td></td>
<td>P. aeruginosa – prior room occupant</td>
<td>2.1x</td>
</tr>
</tbody>
</table>

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

Lancet Infect Dis 2005;5:751
Is Staphylococcal Screening and Suppression an Effective Interventional Strategy for Reduction of Surgical Site Infection?

Charles E. Edmiston, Jr, Nathan A. Ledeboer, Blake W. Buchan, Maureen Spencer, Gary R. Seabrook, and David Leaper

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.
# Risk Factors for Orthopedic Surgical Infections

<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 (BMI 40.0 – 49.9 kg/m²)</td>
<td>1.28 (0.61 2.65)</td>
<td>0.51</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.
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

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


60% reduction in MRSA infections
40% reduction in MSSA infection  \( p<0.001 \)

#3 – Showers with CHG
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 P. Spencer, MEd; David Leaper, MD; Kellie R. Brown, MD; Brian D. Lewis, MD; Michael J. Malinowski, MD; Peter J. Rossi, MD; Cary G. Seabrook, MD

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

CHARLES E. EDMISTON JR, PhD, MS, BS, CIC, FIDSA, FSHEA; OJAN ASSADIAN, MD, DTM&H; MAUREEN SPENCER, MEd, BSN, CIC; RUSSELL N. OLMSTED, MPH, BS, CIC; SUE BARNES, BSN, RN, CIC; DAVID LEAPER, MD, ChM, FRCS, FACS, FLS
Does Preadmission Cutaneous Chlorhexidine Preparation Reduce Surgical Site Infections After Total Knee Arthroplasty?

Bhaveen H. Kapadia MD, Peter L. Zhou BA, Julio J. Janregui MD, Michael A. Mont MD
#4  Skin Prep – Alcohol based surgical skin prep
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
# 5 Sutures – Vicryl Plus Antimicrobial
Like all foreign bodies, sutures can be colonized by bacteria:

- Implants provide nidus for attachment of bacteria
- Bacterial colonization can lead to biofilm formation
- Biofilm formation increases the difficulty of treating an infection

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

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

![5 day zone of inhibition](image1)

![10 day zone of inhibition](image2)

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,1 Frederic C. Daoud, MD,1 and David Leaper, MD, FACS,2 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 = 0.73; 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.)

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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: dingyin@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% 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% 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.
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
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)


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.

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

Sue Barnes RN, BSN, CIC, Maureen Spencer RN, MEd, CIC, Denise Graham, Helen Boehm Johnson MD

- 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

**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 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
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 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, ab 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, Wendy Padley, MSc, Ojan Assadian, MD, David Leaper, MD, Martin Kiernan, MPH, and Charles Edmiston, PhD, 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 1^2 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, University of Nottingham, Nottingham; Faculty of Health and Life Sciences, De Montfort University, Leicester; Institute of Skin Integrity and Infection Prevention, University of Huddersfield, Huddersfield; Richard Wells Research Centre, University of West London, London, UK; and Department of Surgery, Medical College of Wisconsin, Milwaukee, WI
In Conclusion.....
Many Risk Factors Influence SSI

- **Preop Factors**
  - Lack of hand hygiene
  - Patient body colonization
  - Lack of preop shower

- **Perioperative Team Factors**
  - Insufficient skin antiseptics
  - Improper surgical hand antisepsis
  - Improper surgical attire
  - Use of staples or Steri-strips

- **Organizational/Management Factors**
  - Financial constraints
  - Poor team communication
  - Poor leadership
  - Increased hospital days

- **Patient Factors**
  - MRSA or MSSA nasal colonization
  - Infection at another site
  - Immunosuppressive agents

- **Surgeon Factors**
  - Diabetes
  - Use of drains
  - Smoking

- **Work Environmental Factors**
  - Use of staples
  - Design, availability, and maintenance of equipment
  - Lack of hand hygiene

- **Care Delivery Problems**
  - Workload and shift patterns
  - Environment and physical plant problems (e.g., air handling system)
  - Inadequate staffing for postop care

One thing could lead to the failure
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
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<th>Expected</th>
<th>Rate</th>
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Colon Surgical Site Infections (SSI)
June 2015 - July 2016

Implemented Irrisept for Colon and Abd Hysterectomy

Rate / 100 procedures

p = 0.015

Variable
- Actual
- Fits
- Forecasts

Patient Safety Work Product
Additional resources

www.7sbundle.com

www.workingtowardzero.com
Additional References

The End