Surgical Care Safety

The Ultimate Update

Surgical Site Infection Prevention

Claude Laflamme MD, FRCPC, MHSc
Medical Director, Cardiac Anesthesia
CPSI Faculty
Objectives

- Introduction to the National Integrated Patient Safety Strategy and Surgical Care Safety
- Review SSI GSK 2014 updates
- Highlight significant similarities and discrepancies between SSI GSK and the CDC draft and SHEA
Four goals
1. Provide leadership on the establishment of a National Integrated Patient Safety Strategy
2. Inspire and sustain patient safety knowledge within the system, and through innovation, enable transformational change
3. Build and influence patient safety capability at organizational and system levels
4. Engage all audiences across the health system in the national patient safety agenda

Four Clinical Priority Areas
1. Medication safety
2. Surgical care safety
3. Infection Prevention & Control
4. Home care safety
Surgical Care Safety
MAKING CARE SAFER
FROM HOSPITAL TO HOME CARE

A collaborative report from
Accreditation Canada and the Canadian Patient Safety Institute

ACCREDITATION CANADA
AGRÉMÉNT CANADA

Canadian Patient Safety Institute

cpsi - icsp
SSI GSK Update Timeline 2013/14

- **Sept-Oct (2013)**
  - Literature Search Strategy (2005-2013)
  - Data Collection

- **Nov-Dec (2013)**
  - Data Analysis
  - New topics

- **Jan-April (2014)**
  - Updating the previous topics based on new evidence
  - Writing up additional topics
  - SSI faculty review
  - English draft completed

- **May-July (2014)**
  - CPSI Edits
  - Translation
  - Formatting

SHEA/IDSA practice recommendation
Infection control and hospital epidemiology June 2014, vol. 35, no. 6

Draft CDC guideline, 2014
The updated SSI GSK will be ready for dissemination in English and French.

- Webex launch
- SSI GSK online
Draft Guideline for the Prevention of Surgical Site Infection

Sandra I. Berrios-Torres, MD¹, Craig A. Umscheid, MD, MSCE², Dale W. Bratzler, DO, MPH³, Brian Leas, MA, MS², Erin C. Stone, MS¹, Rachel R. Kelz, MD, MSCE, FACS², Caroline Reinke, MD, MPH², Sherry Morgan, RN, MLS, PhD², Joseph S. Solomkin, MD⁴, John E. Mazuski, MD, PhD⁵, E. Patchen Dellinger, MD⁶, Kamal Itani, MD⁷, Elie F. Berbari, MD⁸, John Segreti, MD⁹, Javad Parvizi, MD¹⁰, Joan Blanchard, MSS, BSN, RN, CNOR, CIC¹¹, George Allen, PhD, CIC, CNOR¹², J. A. J. W. Kluymans, MD¹³, Rodney Donlan, PhD¹, William P. Schecter, MD⁴ and the Healthcare Infection Control Practices Advisory Committee¹⁵

¹Division of Healthcare Quality Promotion, Centers for Disease Control and Prevention, Atlanta, GA; ²Center for Evidence-based Practice, University of Pennsylvania Health System, Philadelphia, PA; ³University of Oklahoma Health Sciences Center, College of Public Health, Oklahoma City, OK; ⁴University of Cincinnati, University of Cincinnati College of Medicine, Cincinnati, OH; ⁵Washington University, Washington University School of Medicine, Saint Louis, MO; ⁶University of Washington Medical Center, Seattle, WA; ⁷Veterans Affairs Boston Healthcare System, Boston, MA; ⁸Mayo Clinic College of Medicine, Rochester, MN; ⁹Rush University Medical Center, Chicago, IL; ¹⁰Rothman Institute, Philadelphia, PA; ¹¹Littleton Adventist Hospital, Quality Department, Denver, CO; ¹²Downstate Medical Center, Brooklyn, NY; ¹³Laboratory for Microbiology and Infection Control, Amphia Hospital, Breda, the Netherlands; ¹⁴University of California, San Francisco, San Francisco General Hospital, San Francisco, CA
Strategies to Prevent Surgical Site Infections in Acute Care Hospitals: 2014 Update

Deverick J. Anderson, MD, MPH;1 Kelly Podgorny, DNP, MS, RN;2 Sandra I. Berrios-Torres, MD;3 Dale W. Bratzler, DO, MPH;4 E. Patchen Dellinger, MD;5 Linda Greene, RN, MPS, CIC;6 Ann-Christine Nyquist, MD, MSPH;7 Lisa Saiman, MD, MPH;8 Deborah S. Yokoe, MD, MPH;9 Lisa L. Maragakis, MD, MPH;10 Keith S. Kaye, MD, MPH11
This kit provides updated information on four major prevention strategies to reduce surgical site infections in adults:

1) Prophylactic Antimicrobial coverage
   a. Appropriate use of prophylactic antibiotics
   b. Antiseptic use

2) Appropriate hair removal

3) Maintenance of perioperative glucose control

4) Perioperative normothermia
Additional Evidence-Based Recommendations

1) Coated Surgical Sutures
2) SSI Decolonization
3) Canadian Pediatric SSI Journey – B.C. Children’s Hospital
4) SSI Health Economics
5) SSI Individual Factors
6) OR Environment and SSI
7) SSI Impact on Patient’s Perspective and Quality of Life
Not included

- Supplemental Oxygen
  - SHEA: Decrease SSI by 25%, Most effective in colorectal Sx, Combine with glucose control, normothermia and normovolemia
  - CDC draft: Higher FiO2 intra and post-op for patients under GA, ETT, normal lung function
- Gentamicin-Collagen Sponges (SHEA)
  - No benefit in Colorectal surgery
  - Beneficial in Cardiothoracic surgery (heterogeneous data)
- Incisive drapes +/- Iodophor coated
  - No Benefit (CDC, SHEA)
Figure 1: Incidence of Surgical Site Infections in patients undergoing clean surgery in Canada from 2006 to 2014
## Antibiotic Prophylaxis

<table>
<thead>
<tr>
<th>Abx Administration</th>
<th>Suggested Discontinuation Time</th>
<th>Suggested Re-dose time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Within <strong>60 min</strong> before skin incision or tourniquet inflation / <strong>120 min</strong> for Vancomycin &amp; Fluoroquinolone SHEA and CDC (Also applies to tourniquet application, cesarean section, percutaneous cardio-vascular procedure and trauma patients)</td>
<td>Antibiotics administered for cardiac, thoracic, orthopaedic and vascular patients should be discontinued within 24 hours of the end of surgery, whereas other surgeries require no further administration following surgery</td>
<td>Repeat for surgeries lasting <strong>longer than two half-lives</strong> of the antibiotic or with significant blood loss SHEA same CDC no recommendations</td>
</tr>
</tbody>
</table>
Antibiotic Prophylaxis – Dosing

• WEIGHT ADJUSTED
  • CDC draft: no recommendations
  • SHEA: recommend weight based

• REDOSING
  • CDC draft: no recommendations
  • SHEA: as SSI GSK
Antibiotic Prophylaxis – Cont’d

### Recommended Doses, Administration, and Redosing Intervals for Commonly Used Antimicrobials for Surgical Prophylaxis

<table>
<thead>
<tr>
<th>Prophylactic Antibiotic</th>
<th>Recommended Adult Dose</th>
<th>Recommended Pediatric Dose†</th>
<th>Recommended Administration</th>
<th>Recommended intraoperative redosing interval (from time of administration of pre-op dose)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cefazolin</td>
<td>2 g*</td>
<td>30 mg/kg</td>
<td>IV push</td>
<td>q4h†</td>
</tr>
<tr>
<td>Cefuroxime</td>
<td>1.5 g</td>
<td>50 mg/kg</td>
<td>IV push</td>
<td>q4h†</td>
</tr>
<tr>
<td>Ceftriaxone</td>
<td>1-2 g</td>
<td>50-75 mg/kg</td>
<td>IV push</td>
<td>NA</td>
</tr>
<tr>
<td>Ciprofloxacin PO</td>
<td>500 mg</td>
<td>NA</td>
<td>Administer 1-2 hours pre-op</td>
<td>NA</td>
</tr>
<tr>
<td>Ciprofloxacin IV</td>
<td>400 mg</td>
<td>10 mg/kg</td>
<td>Administer over 60 minutes just prior to procedure</td>
<td>NA</td>
</tr>
<tr>
<td>Clindamycin</td>
<td>600-900 mg</td>
<td>10 mg/kg</td>
<td>Administer over 30 minutes just prior to procedure</td>
<td>q4-6h</td>
</tr>
<tr>
<td>Co-trimoxazole PO</td>
<td>1 DS tablet</td>
<td>NA</td>
<td>Administer 1-2 hours pre-op</td>
<td>NA</td>
</tr>
<tr>
<td>Gentamicin</td>
<td>1.5 mg/kg**</td>
<td>2.5 mg/kg</td>
<td>Administer over 30 minutes just prior to procedure</td>
<td>NA</td>
</tr>
<tr>
<td></td>
<td>or</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>5 mg/ kg**</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>SHEA</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Metronidazole</td>
<td>500mg</td>
<td>15 mg/kg</td>
<td>Administer over 20 minutes just prior to procedure</td>
<td>q8h</td>
</tr>
<tr>
<td>Vancomycin</td>
<td>15 mg/kg***</td>
<td>15 mg/kg</td>
<td>Administer ≤1g over at least 60 minutes, &gt;1g-1.5g over at least 90 minutes, and &gt;1.5g over 120 minutes just prior to procedure</td>
<td>q8h</td>
</tr>
</tbody>
</table>
### Antiseptic Use

<table>
<thead>
<tr>
<th>Antiseptic Agents</th>
<th>Length of Cleanse</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) 2% chlorhexidine gluconate + 70% isopropyl alcohol</td>
<td><strong>Optimal pre-op timing?</strong></td>
</tr>
<tr>
<td>2) Chlorhexidine Gluconate Prep</td>
<td><strong>At least one shower</strong> (pre-op)</td>
</tr>
<tr>
<td>should not be washed away at least 6 h after surgery</td>
<td>CDC: soap or antiseptic agent</td>
</tr>
</tbody>
</table>
Antiseptic Use (Cont’d)

NEUROSURGERY

- Caution should be exercised to avoid CGH contact with the eyes, the inside of the ears, the meninges, or other mucous membranes for all patients, especially neuro patients (AORN 2010)

TRAUMA

- If there is not enough time for chlorhexidine/alcohol to dry before the operation, then it should not be used
Decolonization

- *Staphylococcus aureus* is the most common cause of SSI and it colonizes in the anterior nares

- Mupirocin nasal ointment along with chlorhexidine soap has the ability to nearly eradicate *Staphylococcus aureus* from the nasal sites

- There was a 56% reduction in the rate of infection in the mupirocin-chlorhexidine group compared to the placebo group (Bode et al, 2010)

- Rao et al. also demonstrates that 26% of the patients that tested positive for *Staphylococcus aureus* completed the decolonization protocol and had no post-op infections at 1-year follow up (2008)

- SHEA: For orthopedic and cardiac surgery
Photodynamic Therapy

- Photodynamic Therapy has been known to be an effective decolonization method.
- In preliminary human testing, PDT eradicated MRSA completely from the nose with total treatment times <10 minutes (Street et al, 2009).
- An advantage of photodynamic therapy stems from its mechanism involving singlet oxygen generation that makes it impossible to induce effective resistance mechanisms (Wilson, 2004).
- The issue in PDT for SSIs is how to eliminate the pathogens without damaging the host tissue and without compromising the local protective mechanism initiated by the very existence of the pathogens (Moghissi, 2010).
- One way to ensure that the Photosensitizer (PS) binds as much as possible to microbial cells and as little as possible to host cells is to deliver the PS directly into the infected area by topical application to skin or mucous membranes, instillation into a hollow organ, or by local injection into an abscess (Hamling and Dai, 2010).
Patients who received decolonization therapy were less likely to have a SSI (51/3398) compared to those who were not decolonized (n=24/443). (p<0.0001; OR = 3.759) (Bryce et al, 2013)

The risk of a *Staphylococcus aureus* infection was much higher if patients were not decolonized; 67% (16 S.aureus/24 cases) compared to 31% (16 S.aureus/51 cases) in the decolonized group. (p=0.0052; OR =4.375) (Bryce et al 2013)

The combination of PDT and CHG wipes immediately pre-operatively reduces SSIs and specifically decreases the risk of a *Staphylococcus aureus* infection.

No recommendations possible at this point.
Surgical Sutures

- Sutures coated with antimicrobial agents (Triclosan most commonly used) have been recommended to reduce the rate of SSIs
- A recent systematic review and meta-analysis of 17 Randomized Controlled Trials assessed 3720 patients undergoing a variety of surgeries (breast, cardiac and other contaminated/dirty operations)
- In the overall results, it was shown that Triclosan-Coated Sutures (TCS) reduced the rate of SSIs by 30% (Wang et al, 2013)
- Future plans regarding antimicrobial sutures include investigating the potential development of bacterial resistance and cost-effectiveness of the TCS
Surgical Sutures

- CDC draft
  - Use of antimicrobial coated sutures is not necessary (2011-4 RCTs)

- SHEA
  - Do not routinely use coated sutures

- Edmiston
  - Surgery. 2013 Jul;154(1):89-100 13 RCTs
  - Care bundle approach, Clinical Effectiveness of Triclosan Level 1 evidence

- Wang
  - “consistent results in favor of TCS in adult patients, abdominal procedures, and clean or clean-contaminated surgical wounds”
# Hair Removal

<table>
<thead>
<tr>
<th>Method of Hair Removal</th>
<th>Time between Hair Removal and Surgery</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Remove hair ONLY if it will interfere with the operation (specially C-Section);</td>
<td><strong>Morning of surgery</strong> (as close to surgery time as possible)</td>
</tr>
<tr>
<td>hair removal by <strong>clipping</strong> or with <strong>depilatories</strong></td>
<td></td>
</tr>
<tr>
<td>- Depilatory creams have some disadvantages</td>
<td></td>
</tr>
<tr>
<td>o May require an allergy and irritant patch test 24 hours before the full application</td>
<td></td>
</tr>
<tr>
<td>o Would have to be carried out in the patient’s own home due to reduced preadmission time</td>
<td></td>
</tr>
</tbody>
</table>
## Glucose Control

<table>
<thead>
<tr>
<th>Normal Range Blood Glucose Level</th>
<th>Type of Therapy</th>
<th>Timing of Glucose Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 10-11.1 mmol/L</td>
<td>- Frequent Glucose Monitoring</td>
<td>- Start to maintain <strong>24-48 h before surgery</strong></td>
</tr>
<tr>
<td>SHEA: 10 mmol/li CDC 11.1 mmol/li</td>
<td></td>
<td>o Develop protocols to suggest patients and family to control their pre-op glucose levels at home</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>48-72 h post surgery</strong></td>
</tr>
</tbody>
</table>
Normothermia (core temperature $36^0\text{C} – 38^0\text{C}$) should be maintained preoperatively, intraoperatively, and in PACU by implementing any combination of the following:

- Pre-printed order sets
- Warmed forced-air blankets when surgery is expected to last $>30$ minutes
- Warmed Intravenous fluids for abdominal surgeries of $>1$ hour duration
- Warmed lavage liquids for colorectal surgery
- Increase the ambient temperature in the operating room to 20-23$^0\text{C}$
- Hats and booties on patients during surgery
- Pre-warming should be initiated between 30 minutes to 2 hours prior to major surgery
Normothermia

CDC draft
“Maintain perioperative normothermia” (Category 1A)

SHEA
Maintain normothermia: Core temperature ≥ 35.5° Celsius
Normothermia in Cardiac Surgery

- It is common practice in Canada to rewarm patients to 37° Celsius before weaning from Cardio-Pulmonary Bypass (CPB)
- It is recommended to use the skin-warming surface technology (Forced-Air warming system being the most commonly used and studied) for all cardiac surgery cases with or without the assistance of CPB
- Normothermia reduces blood loss by 40-60%, myocardial damage, extubation time and improves Cardiac Index
Recommendations to Control SSI in the OR:

- Reduce the number of times the door opens
- The number of OR staff should be limited
- The doors should close properly
- Practice of appropriate hand hygiene
- Appropriate sterilization of the equipment
- Use of laminar flow ventilation*
- Relative OR environment humidity of 30%-60%

* Also evidence not showing benefits
## SSI and Additional Hospital LOS

<table>
<thead>
<tr>
<th>Authors (Year)</th>
<th>Types of Surgery</th>
<th>Additional Hospital Length of Stay</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kasatpibal et al' (2005)</td>
<td>Various</td>
<td>14 days (median)</td>
</tr>
<tr>
<td>Weber et al'' (2008)</td>
<td>Various</td>
<td>16.8 days (mean)</td>
</tr>
<tr>
<td>Alfonso et al³ (2007)</td>
<td>Various</td>
<td>13.8 days (mean)</td>
</tr>
<tr>
<td>Coello et al⁴ (2005)</td>
<td>Various</td>
<td>11.6 days (mean)</td>
</tr>
<tr>
<td>Coskun et al⁵ (2005)</td>
<td>Cardiothoracic</td>
<td>28 days (mean)</td>
</tr>
<tr>
<td>Penel et al⁶ (2008)</td>
<td>Head and Neck Cancer</td>
<td>16 days (mean)</td>
</tr>
<tr>
<td>McGarry et al’ (2004)</td>
<td>S. aureus infections</td>
<td>11 days (median)</td>
</tr>
</tbody>
</table>
29 Canadian Hospitals enrolled in NSQIP

NSQIP provides validated and risk adjusted surgical outcomes data, including SSI

none of the sites enrolled in NSQIP have ‘exemplary’ performance across all specialties when compared to other 375 other surgical sites across North America

SSI remains one of the key areas needing improvement across surgical programs in Canadian Hospitals

very few Canadian sites performing as exemplary and many in the bottom 30% of the 375 comparison hospitals
Enhanced Recovery After Surgery

- Multimodal perioperative care pathway designed to achieve early recovery for patients undergoing major surgery
- Overlaps with the recommendations in this kit which highlight prophylactic timing and normothermia
- The ERAS pathway can expect a decrease of 2.44 days from their primary hospital stay (cost effective)
- To decrease surgical site infections from 11.5% to 4.9%, deep wound infections from 6.6% to 1.6%
- The biggest challenge with implementing ERAS is the change management elements post-surgery for: ambulation, early feeding and prophylactic nausea/vomiting and pain control
- Majority of research started on colorectal but, outside of Canada they are applying pathways in other surgical areas i.e., neurology, urology and orthopaedics
- [http://www.erassociety.org](http://www.erassociety.org)
Canadian Pediatric SSI Journey – B.C. Children’s Hospital

- BC Children’s Hospital began participating in the National Surgical Quality Improvement Program-Pediatrics (NSQIP-P) in May 2011
- A clinical pathway for Appendectomies based upon best evidence available for pediatrics, and consensus at their site: initial fluid management, pre-operative antibiotics, surgical antibiotic prophylaxis, standardized skin prep as well as standardized post-operative care
- Re-dosing for surgical prophylaxis is provided if more than 2 (antibiotic-specific) half-lives have elapsed since the previous dose
- Pre-warming for non-cardiac cases slated to last more than 2hrs, in children over 10kg, with a temp check q30 min
- also working on validating a pre-operative nutrition assessment tool to identify those patients at high risk
- BCCH is in the early stages of introducing a chlorhexidine washcloth for pre-operative bathing practices in high risk surgical patients
Individual Patient Factors

The major individual risk factors include:

- Obesity
- Diabetes
- Malnutrition
- Smoking
- Pre-existing body site infection
Process and Outcome Measures

• Antibiotic on time prior to skin incision for C/S
• Normothermia rates
• Organizational perceived gap
• Suits the organization
• Should evolve according to the Action Plan
SSI Surveillance

- National Healthcare Safety Network (NHSN) (2014) recommends that an SSI surveillance period should be at least **30 days** for all superficial incisional SSIs and many of the deep incisional and organ/space SSIs.
- The National Surgical Quality Improvement Project (NSQIP) also employs a 30 days surveillance period to generate SSI outcomes.
- There are some surgeries like cardiac and hip/knee prosthesis that require a **90 days post-op surveillance period**. This list of surgical procedures can be found at: [http://www.cdc.gov/nhsn/pdfs/pscmanual/9pscssicurrent.pdf](http://www.cdc.gov/nhsn/pdfs/pscmanual/9pscssicurrent.pdf).
- In agreement with SHEA and CDC.
Conclusion

• Prophylactic Antibiotics
  • Timing 60 min prior to skin incision including C/S and Tourniquet
  • Weight Adjusted
  • Re-dosing
  • Discontinuation after skin closure?

• Antiseptic Use
  • At least one shower/Bath the might before
  • Alcohol based skin prep
  • Leave the prep solution under the dressing
Conclusion

- Decolonization
  - Nasal Mupirocin ointment
  - Photodynamic therapy
- Antibiotic-coated sutures
  - Decrease SSI by 30%
  - Selective use
- Hair removal: No change, No Clipper
Conclusion

• Glucose Control
  • Pre-op ≤ 10-11,1 mmol/li
  • Intra-op ≤ 10-11,1 mmol/li
  • Post-op for 48-72 hours

• Normothermia at the end of Cardiac Surgery
  • Reduces Blood Loss by 40-60%
  • Facilitate earlier extubation
  • Minimize myocardial damage leading to better CI
Conclusion

• OR environment: Back to Basics
• SSI Cost
• NSQIP
• ERAS
• B.C. Children’s Hospital
• Trauma
Questions?