Driving Improvements in Surgical Site Infections: Colon Surgeries

HIIN Leadership, Improvement Advisors, and Hospitals Pacing Event

March 21, 2019
Welcome!

Who’s in the Room?

Kendall K. Hall, MD, MS
Managing Director
IMPAQ International, LLC
NCD Project Director
Overview

• Preventing SSIs Related to Colon Surgeries
  • E. Patchen Dellinger, MD (University of Washington / WSHA HIIN)

• Surgical Infection Prevention at the Hospital Level
  • Katale Salele, MPH, RN (University of Washington Medical Center / WSHA HIIN)

• Questions and Answers

• CMS Comments
Questions to Run On

• What are the commonly missed opportunities for preventing colon surgery SSIs, and how can your HIIN or hospital monitor and address these?

• How can your HIIN or hospital use information and data from SSI cases to drive its ongoing improvement efforts?

• How can your HIIN or hospital leverage what you hear about the UWMC Surgical Infection Prevention Committee’s goals and work in your SSI reduction efforts?
Preventing SSI

- A Surgeon’s Perspective -
  Colectomies with a Comment on Penetrating Abd Trauma

E. Patchen Dellinger, MD
University of Washington
Prophylactic Antibiotics
Questions

- Which cases benefit?
- Which drug should you use?
- When should you start?
- How much should you give?
- How long should antibiotics be continued?
# Relative Benefit from Antibiotic Surgical Prophylaxis

<table>
<thead>
<tr>
<th>Operation</th>
<th>Prophylaxis (%)</th>
<th>Placebo (%)</th>
<th>NNT*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Colon</td>
<td>4-12</td>
<td>24-48</td>
<td>3-5</td>
</tr>
<tr>
<td>Other (mixed) GI</td>
<td>4-6</td>
<td>15-29</td>
<td>4-9</td>
</tr>
<tr>
<td>Vascular</td>
<td>1-4</td>
<td>7-17</td>
<td>10-17</td>
</tr>
<tr>
<td>Cardiac</td>
<td>3-9</td>
<td>44-49</td>
<td>2-3</td>
</tr>
<tr>
<td>Hysterectomy</td>
<td>1-16</td>
<td>18-38</td>
<td>3-6</td>
</tr>
<tr>
<td>Craniotomy</td>
<td>0.5-3</td>
<td>4-12</td>
<td>9-29</td>
</tr>
<tr>
<td>Spinal operation</td>
<td>2.2</td>
<td>5.9</td>
<td>27</td>
</tr>
<tr>
<td>Total joint repl</td>
<td>0.5-1</td>
<td>2-9</td>
<td>12-100</td>
</tr>
<tr>
<td>Breast &amp; hernia ops</td>
<td>3.5</td>
<td>5.2</td>
<td>58</td>
</tr>
</tbody>
</table>
Surgical Antibiotic Prophylaxis

My Choices

Bacteroides expected
- Cefazolin 2 g + Metronidazole 1g, IV in OR
- Repeat cefazolin q 3 h during procedure

Bacteroides not expected
- Cefazolin 2 g, IV in OR
- Repeat q 3 h during procedure
Antibiotic Choice & SSI
After Colectomy

Antibiotic Choice & SSI After Colectomy

Cefazolin and metronidazole are compatible in the same I.V. bag, and the UWMC pharmacy has this combination pre-mixed and available in the O.R. pharmacy.
Prophylactic Antibiotics

Questions

Which cases benefit?
Which drug should you use?
When should you start?
How much should you give?
How long should antibiotics be continued?
Timing of Prophylactic Antibiotic Administration – Cardiac, Arthroplasty, Hysterectomy

Steinberg. TRAPE. Ann Surg 2009; 250:10
Timing of Prophylactic Antibiotic Administration and Risk of SSI

4,453 patients

Koch. JACS 2013; 217: 628-35
Repeat Antibiotic Prophylaxis Doses in Gastrointestinal Procedures

Surgical Site Infections

Percent

Cefaz x 1  Cefaz x 2  Cefotetan

Timing, Dose, Redose, Weight

All the evidence suggests that having effective drug levels in tissue and blood (more is better) during the entire operation reduces SSI risk.

Dosing close to incision, redosing, and using weight based dosing are logical ways to accomplish this.
Prophylactic Antibiotics Questions

• Which cases benefit?
• Which drug should you use?
• When should you start?
• How much should you give?
• How long should antibiotics be continued?
Gentamicin Levels and SSI Risk for Colectomy

<table>
<thead>
<tr>
<th>Closing Gent level (mg/L)</th>
<th>D.M. (%)</th>
<th>Stoma (%)</th>
<th>Age</th>
</tr>
</thead>
<tbody>
<tr>
<td>SSI</td>
<td>1.3±1.0</td>
<td>29</td>
<td>50</td>
</tr>
<tr>
<td>No SSI</td>
<td>2.1±0.9</td>
<td>2</td>
<td>24</td>
</tr>
<tr>
<td>p</td>
<td>0.02</td>
<td>0.02</td>
<td>0.04</td>
</tr>
</tbody>
</table>

Gent level < 0.5 at close had 80% SSI rate (p=0.003).

Dose of Antibiotic for Prophylaxis

- Always give at least a full therapeutic dose of antibiotic.
- Consider the upper range of doses for large patients and/or long operations.
- Repeat doses for long operations.
New ASHP / IDSA / SHEA / SIS Antibiotic Prophylaxis Guidelines

- **Cefazolin**
  - > 80 kg: 2 g
  - ≥ 120 kg: 3 g

- **Vancomycin**: 15 mg/kg

- **Gentamicin**: 5 mg/kg
dosing wgt = ideal wgt + 40% of excess wgt

Bratzler. Surgical Infections 2013;14:73-156
Prophylactic Antibiotics
Questions

• Which cases benefit?
• Which drug should you use?
• When should you start?
• How much should you give?
• How long should antibiotics be continued?
Antibiotic Prophylaxis
Duration

Most studies have confirmed efficacy of \( \leq 12 \text{ hrs.} \).

Many studies have shown efficacy of a single dose.

Whenever compared, the shorter course has been as effective as the longer course.
Most Recent SSI Prevention Guidelines


“Surgical antibiotic prophylaxis administration should not be prolonged after completion of the operation.”
## Antibiotic and Mechanical Bowel Prep for Colectomy (18 hrs)

<table>
<thead>
<tr>
<th>Group</th>
<th>Any SSI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Placebo (56)</td>
<td>26 (43%)</td>
</tr>
<tr>
<td>Neo + Erythro (56)</td>
<td>5 (9%)</td>
</tr>
</tbody>
</table>

*p=0.0001*

MBP – yes / no?
Antibiotics – oral / I.V. / both?

Bowel Preparation Prior to Elective Colectomy in Michigan (n=1648)

Overall SSI Rate in Michigan is 8.0%

- No Prep: 11.3%
- Mechanical Prep and PO antibiotics: 36.4%
- Mechanical Prep Only: 49.3%

Surgical Site Infection Rates following Elective Colectomy

The Michigan Surgical Quality Collaborative

- **No Prep**
  - n=195
  - 10.6%

- **Mechanical Prep and PO Antibiotics**
  - 4.8%

- **Mechanical Prep Only**
  - 11.2%

All patients get I.V. antibiotics.

Propensity Matched Analysis (n=740)

Oral Antibiotics with a Bowel Preparation

A Propensity Matched Analysis (n=740)

- No Oral Antibiotics
- Oral Antibiotics

* P < 0.05

## Most Recent Cochrane Review

<table>
<thead>
<tr>
<th>Comparison</th>
<th>Odds Ratio</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ab Proph vs none</td>
<td>0.34</td>
<td>0.28 – 0.41</td>
</tr>
<tr>
<td>Oral + I.V. vs I.V.</td>
<td>0.56</td>
<td>0.43 – 0.74</td>
</tr>
<tr>
<td>Oral + I.V. vs Oral</td>
<td>0.56</td>
<td>0.40 – 0.76</td>
</tr>
</tbody>
</table>

Greater than 2300 pts in each comparison

GRADE evidence quality **HIGH**

Nelson RL, Cochrane Rev 2014; #5: CD001181
Oral Antibiotics (OA) and Mechanical Bowel Prep (MBP) NSQIP Data, 2012-2015

<table>
<thead>
<tr>
<th>Prep</th>
<th>Pts</th>
<th>Odds SSI</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>5471 (23%)</td>
<td>1.0 (ref)</td>
</tr>
<tr>
<td>MBP only</td>
<td>7617 (33%)</td>
<td>0.87 (0.75-1.0)</td>
</tr>
<tr>
<td>OA only</td>
<td>1374 (6%)</td>
<td>0.63 (0.47-0.83)</td>
</tr>
<tr>
<td>MBP+OA</td>
<td>8855 (38%)</td>
<td>0.39 (0.33-0.46)</td>
</tr>
<tr>
<td>Total</td>
<td>27804</td>
<td>1398 (5%)</td>
</tr>
</tbody>
</table>

Oral Antibiotics (OA) and Mechanical Bowel Prep (MBP)
NSQIP Data, 2012-2015

MBP + OA also better for:

<table>
<thead>
<tr>
<th>Condition</th>
<th>O.R.</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Organ Space Inf</td>
<td>0.56 (0.47-0.68)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Anast Leak</td>
<td>0.53 (0.43-0.65)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Wound Dehisc</td>
<td>0.43 (0.27-0.69)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>C. Difficile</td>
<td>0.53 (0.29-0.95)</td>
<td>0.035</td>
</tr>
</tbody>
</table>

# Latest Meta-Analysis

14 RCTs & 8 Observational with 57,207 pts

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Odds Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Any SSI</td>
<td>0.45 (0.34-0.59)</td>
</tr>
<tr>
<td>Organ Space SST</td>
<td>0.58 (0.52-0.66)</td>
</tr>
<tr>
<td>Anast Leak</td>
<td>0.59 (0.53-0.67)</td>
</tr>
<tr>
<td>Unplanned ReOp</td>
<td>0.72 (0.65-0.80)</td>
</tr>
<tr>
<td>Ileus</td>
<td>0.78 (0.72-0.83)</td>
</tr>
<tr>
<td>Unplanned ReAdmit</td>
<td>0.87 (0.81-0.93)</td>
</tr>
<tr>
<td>Mortality</td>
<td>0.65 (0.50-0.83)</td>
</tr>
<tr>
<td>Length Stay</td>
<td>-0.6 (-1.0-10.3) days</td>
</tr>
</tbody>
</table>

McSorley. BJS Open 2018; 2: 185-94
Conclusions - ?

• If you are not going to give any oral antibiotics then the MBP is not necessary and there is a suggestion of harm along with more GI symptoms.

• However, if you are going to take my colon out I will suffer through the bowel prep and take oral antibiotics in advance of the operation for the lowest SSI rate!

What About Penetrating Abdominal Trauma?

If the bowel is injured the case is contaminated and should be reported that way.

If there are gross feces in the abdominal cavity the case is dirty.
Penetrating Abdominal Trauma?

You can’t give prophylactic antibiotics before the injury, but there should be an E.D. protocol to give prophylactic intravenous antibiotics appropriate for colonic surgery ASAP when the patient arrives.
Penetrating Abdominal Trauma?

Regardless of bowel injury, “prophylactic” antibiotics should not be continued beyond 12 hours.

Glucose and SSI
Diabetes, Glucose Control, and SSIs After Median Sternotomy

![Bar chart showing the percentage of infections based on glucose levels: <200, 200-249, 250-299, >300.]

Latham. ICHE 2001; 22: 607-12
Hyperglycemia and Risk of SSI after Cardiac Operations

• Hyperglycemia - doubled risk of SSI
• Hyperglycemic:
  48% of diabetics
  12% of nondiabetics
  30% of all patients
• 47% of hyperglycemic episodes were in nondiabetics

Postop Glucose (within 48h) and SSI – General Surgery

Relative Risk

Glucose

Glucose in NonDiabetics having Colectomy at Cleveland Clinic

<table>
<thead>
<tr>
<th>Highest Gluc</th>
<th>N (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤ 125 mg%</td>
<td>816 (33%)</td>
</tr>
<tr>
<td>126-200 mg%</td>
<td>1289 (53%)</td>
</tr>
<tr>
<td>200 mg%</td>
<td>342 (14%)</td>
</tr>
<tr>
<td>All patients</td>
<td>2447 (100%)</td>
</tr>
</tbody>
</table>

Kiran, Ann Surg 2013; 258: 599-605
Glucose in NonDiabetics having Colectomy at Cleveland Clinic

* p<0.03, ▼ p<0.01, + p<0.05

Kiran, Ann Surg 2013; 258: 599-605
Meta-analysis of Strict vs. Conventional Glucose Control – Randomized Studies

O.R. 0.27 (0.09-0.78)

Upper limit target

110-150  180-220

Glucose Control

Proven important for SSI risk:
Cardiac surgery
General surgery
**Colorectal surgery**
Vascular surgery
Breast surgery
Gynecologic Oncology surgery
Hepato-pancreatico-biliary surgery
Orthopedic surgery
**Trauma surgery**
Regardless of the Diagnosis of Diabetes (or not) Hyperglycemia Increases

- Morbidity
- Mortality
- Length of Stay
Glucose Levels & SSI

• The exact “best” level of glucose control in the perioperative period is not known.

• High glucose levels unequivocally increase the risk of SSI and other perioperative infections.

• Tight glucose control in the perioperative period is tricky.

• Hypoglycemia increases the risk of morbidity and mortality.
Potentially Preventable SSI

An SSI is potentially *preventable* if a known preventive measure (prophylactic antibiotics, sterile instruments, normothermia, hyperoxia, euglycemia, uninfected patient/surgeon) was available but not employed in that patient’s care.
Apparently Unavoidable SSI

An SSI that occurs despite the appropriate application of all known preventive measures is apparently unavoidable.
A Non-Achievable Goal

No Surgical Site Infections
An Achievable Goal

No potentially preventable Surgical Site Infections
Preventing SSI

- Good teamwork & communication at all times
- **Prewarm the patient & warm in O.R.**
- Enough of the right antibiotic, close to incision time, repeat if necessary, and stop when operation done
- Don’t shave
- Thorough skin prep including alcohol
- Warm the patient in the O.R.
- High FiO₂
- Control glucose
- Good teamwork & debrief
Slide Set with References available by request

Send request to patch@uw.edu
Surgical Infection Prevention at University of Washington Medical Center

Katale Salele, MPH, RN
UWMC
University of Washington Medical Center
Seattle, WA
Surgical Infection Prevention Committee

- Started in 2001
- Committee currently meets quarterly
- Goals
  - Attain zero potentially preventable surgical site infections (SSIs).
  - Focus on evidence based SSI preventable measures incrementally - such that when a consistent improvement has been achieved, the focus shifts to another measure.
Surgical Infection Prevention Committee

Members

- Surgeon (Co-chair)
- Medical Director of Infection Prevention (Co-chair)
- Infection Preventionist
- Antimicrobial Stewardship
- Pharmacy
- Central Sterile Processing
- Surgical Services
- Anesthesiology
- General Surgery
- Orthopedic Surgery
- Head & Neck Surgery

- Plastic Surgery
- OB/GYN Surgery
- Cardiothoracic Surgery
- Transplant Surgery
- Neurosurgery
- Vascular Surgery
- Oral and Maxillofacial Surgery
- Ophthalmologic Surgery
- Interventional Radiology
- Employee Health
Surgical Infection Prevention

Priorities and Focus Areas

1. Antimicrobial Prophylaxis
2. Hand hygiene
3. SSI Surveillance
4. Hair removal
5. Normothermia
6. Glycemic control
7. Oxygenation
8. Aseptic technique
9. Antiseptic prophylaxis
10. Implants: biological, chemical
11. Surgical Attire
12. Pre-op education
13. Surgical drains
14. Environment: personnel, devices, construction
Surgical Infection Prevention

**Preoperative**
- Treat remote infections.
- Avoid hair removal; use clippers.
- Antiseptic showering/bathing.
- Hand/forearm antiseptic scrub.
- Nails short; no artificial nails.
- Restrict infected personnel.
- Antimicrobial prophylaxis.
- Antiseptic skin preparation.

**Intraoperative**
- Ventilation: pos. pressure, 15 air exchanges/hr; filter air; door closed.
- Sterile instruments/equipment.
- Sterile allografts.
- Avoid flash sterilization.
- Surgical attire and drapes.
- Asepsis/sterile surgical technique.
- Normothermia.
- Glucose control.

**Postoperative**
- Wound management.
- Surveillance for SSIs.
- Measures to prevent other post-op infections, e.g., VAE, catheter-related.
Surgical Infection Prevention

Data collected on Confirmed SSIs

- Patient name & U number
- Diagnosis
- Procedure performed
- Date of procedure
- NHSN procedure category
- Date of event
- Notes/review of SSI determination
- Service
- Surgeon
- Operating room
- Class of wound
- SSI Site (Superficial, Deep, Organ/Space)

- NHSN / WSHA reportable
- Organisms found
- Risk factors (ASA class, Age, obesity, & others)
- Length of surgery (start, Stop)
- Preventive measures
  - Prophylactic antibiotics (appropriate timing)
  - Normothermia maintained
  - Glycemic control (hyperglycemia; If yes, Treated?)

- Sensitivity of Microorganisms
Outcomes Measures

- Surgical Site Infection (SSI) rates by Clean-Wound Classification
- Potentially Preventable SSIs Based on:
  - Appropriateness of antibiotic prophylaxis
  - Normothermia (> 36°C)
  - Glucose Control
  - Oxygen (FIO2) Utilization

Process Measures

- Temperature audit on PACU admission and discharge
- Instrument Sterilization Audit
- Procedure observations
Preventive Measures (during procedure)

- In all the cases; Normothermia was maintained
- In all cases, either:
  - Patient did not require glycemic control (BS WNL) or
  - Glycemic control initiated (Insulin given)
- In almost all cases, prophylactic antibiotics were given within appropriate time before incision
- FiO2 adjusted to maintain SaO₂ above 95%
Surgical Infection Prevention

- **Achievements**
  - An exceptionally low rate of SSIs among NHSN targeted inpatient clean surgeries for well over a decade

- **Attributions to the Success**
  - The extraordinary dedication of the entire HCW workforce to provide the safest possible care to the patients
  - The Surgical Infection Prevention Committee which involves a close collaboration between the Surgical Service and the Infection Prevention Service
  - A comprehensive approach to surveillance for surgical site infections
  - The realistic approach described by Dr. Dellinger of working on well established evidence based infection prevention measures
Thank you!
Questions to Run On

• What are the commonly missed opportunities for preventing colon surgery SSIs, and how can your HIIN or hospital monitor and address these?

• How can your HIIN or hospital use information and data from SSI cases to drive its ongoing improvement efforts?

• How can your HIIN or hospital leverage what you heard about the UWMC Surgical Infection Prevention Committee’s goals and work in your SSI reduction efforts?
Please share your questions for our presenters!

To share a question, you may enter it into the chat box or press 7# on your telephone keypad to have your line unmuted.
Key Takeaways

• Preventing colon surgery SSIs requires the implementation of a comprehensive approach that employs multiple evidence-based interventions. A few key strategies to monitor and address include proper antibiotic prophylaxis; combining oral antibiotics and bowel preparation; and managing glucose.

• Use available evidence and guidelines to implement and monitor prevention strategies. Please see the references included throughout Dr. Dellinger’s presentation, as well as reference the guidelines from:
  – The World Health Organization (WHO)
  – The Centers for Disease Control and Prevention (CDC)
    • [https://jamanetwork.com/journals/jamasurgery/fullarticle/2623725](https://jamanetwork.com/journals/jamasurgery/fullarticle/2623725)

• Successful standardization and implementation of SSI prevention best practices requires the support and collaboration of a multi-disciplinary team.

• Use data and information from confirmed SSI cases to provide feedback to teams, recognize successes, identify gaps, and address opportunities for improvement.
Participant Polling

Please share your feedback!
CMS Comments

Latrail Gatlin

Shelly Coyle
Upcoming Events

NCD Weekly Pacing Event
Thursday, March 28, 1:00 – 2:00 PM ET
Topic: Health Equity (Data Deep Dives and Disparities Impact Statement Efforts)

NCD Weekly Pacing Event
Thursday, April 4, 1:00 – 2:00 PM ET
Topic: Antibiotic Stewardship