Colorectal Surgery SSI Reduction Initiative: Interventions Across the Episode of Care
A NSQIP based Quality Improvement Project

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Disclosures

• None
Hospital Acquired Infections (HAI)

- 2 million American hospital patients develop HAI per year
- 90,000 deaths per year directly related to HAI
- Estimated direct costs of $5.7 billion dollars
- Top 4
  - Urinary catheter associated infections (CA-UTI)
  - **Surgical site infections (SSI)**
  - Catheter associated bloodstream infection (CA-BSI)
  - Ventilator associated pneumonia (VAP)
Surgical Site Infections (SSI)

- According to the CDC
  - 2.6% of 30 million operations per year are complicated by SSI
  - SSI are the second most common healthcare associated infection accounting for 17% of all hospital acquired infections
- In surgical patients, SSI are the most common healthcare associated infection (38%)
Colon and Rectal Surgery SSI

- Colon and rectal surgery (CRS) is associated with the highest rate of SSI in the literature
  - Range 3-30%

- Multiple studies have identified
  - Patient specific risk factors
    - Malnutrition, DM, Obesity, Immuno-suppressed, Elderly
  - Disease specific risk factors
    - Inflammatory diseases, Cancer, Concurrent infections
  - Procedure specific risk factors
    - Emergent, Open v. minimally invasive, Duration, Surgeon

- Variable success of reduction efforts
  - No “Magic Bullet”
Surgical Site Infections (SSI)

- Implications of SSI
  - Increased length of hospital stay (2-4 days on average)
  - Increased costs
    - Mayo Clinic CRS data
      - Superficial SSI increased cost by $2,000 (median)
      - Deep wound SSI increased cost by $11,000 (median)
      - Organ space SSI increased cost by $14,000 (median)
  - Increased readmission rates
  - Increased patient morbidity, pain, and discomfort
  - Pose risk to other patients
Mayo Colorectal Surgery Practice

• Full spectrum of CRS
  • Benign anorectal to recurrent rectal cancers
  • >50% of all colectomies performed using a minimally invasive approach

• Eight board certified colorectal surgeons
  • General surgery residents
  • 4 colorectal surgery fellows

• Dedicated CRS operating rooms and allied health staff

• Two dedicated CRS post-operative nursing floors
“As Expected” in NSQIP CRS SSI
Quality Improvement is a Process

The DMAIC Method

- Define
- Measure
- Analyze
- Improve
- Control

Project selected by sponsor

Improvement cycle

Project either closed or transitioned to operational owner
Define Phase

- **Goal:** Reduce colorectal surgical site infections by 50% and improve OE ratio from 4th decile to 2nd decile by December 2011. 2009 overall SSI rate was 10.5%.

- **Unit of Improvement:** Colorectal Surgical Procedures
  - All patients undergoing colorectal surgery (emergency and elective) at Rochester Methodist Hospital. NSQIP CPT codes for colorectal surgery.
  - All types of Surgical Site Infections (Superficial Incisional, Deep Incisional, and Organ/Space).
  - Excludes: Trauma and Primary Transplant patients. Patients under 18 years of age
  - **Defect:** Any Surgical Site Infections  **Data source:** NSQIP Data Set
Measure Phase
Already done thanks to NSQIP
Analyze Phase

![Graph showing the percentage of Superficial, Organ, Deep, Sup & Org/Space, and Deep & Org/Space SSI types. The graph indicates that Superficial SSI occurs most frequently, followed by Organ.]
Analyze Phase
Important MCR Variables

130+ NSQIP Variables

40 NSQIP Variables
Age
Gender
BMI
Wound Class
Diabetes
Transfusion
Various Labs
CPT4 Codes
Disease

Significant Variables
Age (p = .0002)
BMI (p = .0495)
Wound Class (p = .0004)
Diabetes (p = .046)
Laparscopic (p = .0005)
Open (p = .0005)
Intra-op Blood (p = .0024)
Duration (p = .0005)
Sepsis (p = .026)
Steroid use (p = .001)
CPT-4 code (p = .024)
Analyze Phase
Major Variables for Mayo CRS SSI

• Diagnosis
  • Crohn's Disease
  • Diverticular disease
  • Ulcerative Colitis
    ▪ Represented over half of all identified NSQIP Mayo Clinic SSIs

• BMI

• Operative time

Diagnoses Influence Surgical Site Infections (SSI) in Colorectal Surgery: A Must Consideration for SSI Reporting Programs?
Improve Phase
Principles of Our Reduction Effort

- Interventions across the episode of care
- Multi-disciplinary
- Engage staff, patient, and families
- Standardize as many processes as possible
- Ensure high compliance with elements
  - Quick audits
- Build the elements into the system
- Frequent feedback and communication
The Team

- Project Leader: Robert Cima, MD
- Black Belt: Gene Dankbar, Systems and Procedures
- Kimberly Aronhalt, RN, Infection Control and Prevention
- Diane Foss, RN, Kim Gaines, RN, Nursing, Pamela Grubbs, RN,
- Pamela Maxson, RN, PhD, Jennifer Wolforth, RN, Nursing
- Sharon Nehring, RN, Roxanne Hyke, RN, Diane Tyndale, RN, NSQIP
- Jenna Lovely, PharmD, Pharmacy Services
- Sarah Pool, RN, Surgical Services, Lynn Quast, RN, Surgical Services
- Jim Rogers, Systems and Procedures
- Rajesh Pendlimari, MBBS, Research Fellow, CRS
- Karen Piotrowicz, RN, Mid-level Provider, CRS
Critical to Quality Tree: Surgical Site Infections for Colorectal Surgery

Improve Phase

Pre-operative Processes

- Patient Skin Cleansing
  - 2% Chlorhexidine Cloths @ AM admission
  - Hibiclens® shower night before and day of surgery
  - Ensure patient understanding by reading pamphlet "Preventing SSI"

- Antibiotic Administration
  - Ensure SCIP® compliance
    1. Right antibiotics
    2. Administer 90 min prior to incision
    3. Discontinued within 24 hours
  - Ensure re-dose of cefazolin within 3-4 hours after incision
  - Chloraprep® applied – use appropriate amount to ensure complete coverage of incisional area

Intra-operative Processes

- Closing Protocol at Time of Fascia Closure
  - Use closing tray for closure of fascia and skin
  - Glove change by staff before closure of fascia

- Hand hygiene education – Patient, Visitor, and Staff
- Patient shower with Hibiclens® following dressing removal

Post-operative Process

- Patient, Visitor, and Staff Hand Hygiene
  - Hand cleansing agent readily available – Patient and Staff
  - Phase room sign for Moments of Hand Hygiene
  - Purell® hand wipes made available to patients
  - Ensure dressing removal within 48 hours
  - Dismiss patient with 4 oz. bottle of Hibiclens®

Post-hospitalization Process

- Patient education on wound care and recognizing infection symptoms
- Follow-up phone call from nurses

SCIP – Surgical Care Improvement Project

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Improve Phase
Preoperative Elements

• Pre-operative Chlorhexidine packets
  o Provided to all patients preoperatively with instructions
  o Use monitored morning of admission
  o If not reported as not being used, SAGE wipes used on the entire body

• Patients with BMI > 30
  o SAGE wipes applied even if preoperative bath performed
  o Procedure listing software automatically identifies patients with BMI > 30
Improve Phase
BMI Trigger for Admissions Unit

Additional Instructions
Height recorded upon admission
Weight recorded upon admission
UCI in OR
Sequential Compression Devices bilateral lower extremity placed in OR

BMI is > 30, Cleanse total body w/chlorhexidine 2% cloths upon admission

Skin Preparations
Clip nipples to pubis
Improve Phase
Pre-operative Elements

- Pre-op antibiotic ordering
  - Procedure scheduling software automatically provides SCIP appropriate choices
- Weight-based dosing
- Software automatically orders intra-operative re-dosing dose if historical data for the specific procedure and surgeon demonstrated an average case duration >3 hours
Surgical Hospital Assignment System

**Surgery Information**

<table>
<thead>
<tr>
<th>Clinic Nbr:</th>
<th>Surgery Date: Jan 17 2011</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patient Name:</td>
<td>Time to Report: 07:15 AM</td>
</tr>
<tr>
<td>Sex/Age/DOS:</td>
<td>First Case: YES - 00:15</td>
</tr>
<tr>
<td>Type of Admission: Routine <em>GOV</em></td>
<td>Location: Gonda 15 - OR 04</td>
</tr>
<tr>
<td>Patient Admission: Outpatient, Same Day (OP-RMH)</td>
<td>Listing Status: Finalized by SGL</td>
</tr>
<tr>
<td>Planned Post Op Level of Care: No Information</td>
<td>Listing Completed by: Schilling, Aaron C. on Jan 14 2011 7:41AM</td>
</tr>
</tbody>
</table>

**Surgeon Information (CEA Supervisor) * indicates the primary physician**

Surgeon: *KAKAR, SANJEEV - ORTS/46101*

**Surgery Description**

Diagnosis: left carpal tunnel.
Indication: pain relief.
Procedure: Left wrist carpal tunnel open; left open carpal tunnel release.
(Estimated OR Time: 0:43 + 0:20 = 1:03)

**Anesthesia**

Anesthesia Approval: No PAME - Anesthesia Review
Anesthesia Type: Monitored Anes. Care (Attd. Local)

**Transfusion Medicine**

Transfusion: No Transfusion

**Preoperative Surgical Orders**

Preop Orders: Completed by Schilling, Aaron (Pager: ) on Jan 14 2011 7:41AM
Preop NPO After: 12:00 AM
Enema: Enema Not Required

**Medication(s)**

Cefazolin (Ancef) IV IN OR within 60 minutes prior to incision, repeat in 3 hours; 40 - 79 kg 1 gram with 1 gram repeat; 80 - 119 kg 2 gram with 2 gram repeat; 120 kg and above 3 gram with 2 gram repeat.

Lidocaine 1%/Bupivacaine 0.25% INJECTION IN OR used as local anesthetic (Dispense Unit 30 mL vial)

**Medical Condition**

Diabetes
Pacemaker: Manufacturer-Guidant; Model#: 1290
Call Heart Rhythm Services to determine if HRS Nurse is required.

**Drug Allergies**: See MICS Allergies Module for allergy information.
Improve Phase
Intra-operative Elements

• Hair removal by electric clipper
  • Outside of the operating room

• Standardized to Chlorhexidine-Alcohol (Chloraprep™) skin preparation for all abdominal cases
  • Surgical assistant applies skin preparation
    • All in-serviced on appropriate application
  • Must dry for 3 minutes before drapes applied
Improve Phase
Intraoperative Elements

• Pre-procedural pause includes confirming appropriate timing of antibiotics administered and documented

• Re-dosing of cefazolin for cases longer than 3 hours.
  • Circulating nurse has the preop order and pulls medication at the beginning of the case
  • Reminder window on anesthesia provider’s computer screen
    • Triggered off time of first dose administration
  • Appropriate weight-based dosing
Improve Phase
Anesthesia Antibiotic Reminder Screen

For example:
- The initial Cefazolin dose was documented at 11:00, current time is 14:00
- The reminder window appears, prompting re-dosing of “Cefazolin”
- The reminder can be delayed up to 30 minutes
- The reminder resets to 3 hours once the dose is charted
Improve Phase
Intraoperative Elements

• “Closing” Process
  • At the time of fascia closure
    • All staff change gloves
      • Gowns if soiled
    • Field re-blocked with fresh sterile towels
  • Instruments used during case removed and “closing tray” brought onto the field
Improve Phase
Postoperative Elements

- All order-sets discontinue SCIP compliant antibiotics after two postop doses or single dose when appropriate
  - Pharmacist part of team and queries service

- Hand hygiene essential on floor
  - Physician/Nursing initiative
  - Patient and Family initiative

- Sterile dressing on until morning of POD 2
  - Document removal in nursing flow sheet; electronic audits

- Chlorhexidine shower/wipes daily after dressing removal

- Standard postop order-sets orders urinary catheter removal at 8am the morning after surgery

- Dismiss with chlorhexidine soap bottle for use at home
Improve Phase

Process audits

• Audits of elements to determine compliance
  • Use different data sources
    • SCIP UHC data
    • Institutional hand hygiene compliance
    • OR process data

• Assess counterbalance effects
  • Does closing process increase operative times?
Improve Phase
Process audits

- Cefazolin re-dose after 3-4 hours if Op time > 3 hours
- Antibiotic “watcher” effective after 1/1/11
- Re-dosing after 4 hour improved from 8/12 (66%) in 2/2010 to 17/17 (100%) in 2/2011
Improve Phase
Process audits

- All CPT-4 Codes in project
- No differences in operative times
## Improve Phase
Comparison 2009/2010 to 2011 Demographics

<table>
<thead>
<tr>
<th></th>
<th>2009-2010 (Baseline)</th>
<th>2011</th>
<th>Total / Overall</th>
<th>p-values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sampled Cases</td>
<td>532</td>
<td>199</td>
<td>731</td>
<td></td>
</tr>
<tr>
<td>Number of Infections</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Superficial</td>
<td>28 (5.3%)</td>
<td>3 (1.5%)</td>
<td>33</td>
<td></td>
</tr>
<tr>
<td>Organ Space</td>
<td>28 (5.3%)</td>
<td>5 (2.5%)</td>
<td>36</td>
<td></td>
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<tr>
<td>Deep</td>
<td>1 (0.2%)</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Age (years ± SD)</td>
<td>57.3 ± 17.1</td>
<td>56.8 ± 18.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age &gt; 60</td>
<td>255 (47.9%)</td>
<td>97 (48.7%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Women</td>
<td>260 (48.9%)</td>
<td>91 (45.7%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Body Mass Index</td>
<td>27.1 ± 6.1</td>
<td>26.9 ± 5.9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BMI ≥ 30</td>
<td>145 (27.4%)</td>
<td>50 (25.1%)</td>
<td>195 (26.7%)</td>
<td>0.544</td>
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<tr>
<td>BMI ≥ 40</td>
<td>20 (3.8%)</td>
<td>7 (3.5%)</td>
<td>27 (3.7%)</td>
<td>0.877</td>
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</table>
## Improve Phase
### Comparison 2009/2010 to 2011 Demographics

<table>
<thead>
<tr>
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<th>2009-2010 (Baseline)</th>
<th>2011</th>
<th>Total / Overall</th>
<th>p-values</th>
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<tbody>
<tr>
<td><strong>BMI</strong></td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td>&lt;18.5</td>
<td>20 (3.8%)</td>
<td>6 (3%)</td>
<td>26 (3.6%)</td>
<td>0.677</td>
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<tr>
<td>18.5 – 24.9</td>
<td>185 (34.9%)</td>
<td>79 (39.7%)</td>
<td>264 (36.1%)</td>
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<tr>
<td>24.9 – 29.9</td>
<td>179 (33.8%)</td>
<td>63 (31.7%)</td>
<td>242 (33.1%)</td>
<td></td>
</tr>
<tr>
<td>&gt;30</td>
<td>146 (27.6%)</td>
<td>51 (25.6%)</td>
<td>197 (27%)</td>
<td></td>
</tr>
<tr>
<td><strong>Wound Class:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clean Contaminated</td>
<td>465 (87.4%)</td>
<td>155 (77.9%)</td>
<td>620 (84.8%)</td>
<td>0.001</td>
</tr>
<tr>
<td>Contaminated</td>
<td>16 (3%)</td>
<td>18 (9%)</td>
<td>34 (4.6%)</td>
<td></td>
</tr>
<tr>
<td>Dirty / Infected</td>
<td>51 (9.6%)</td>
<td>26 (13.1%)</td>
<td>77 (10.5%)</td>
<td></td>
</tr>
<tr>
<td><strong>ASA Class</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ASA 1 - No Disturb</td>
<td>23 (4.3%)</td>
<td>10 (5%)</td>
<td>33 (4.5%)</td>
<td>0.013</td>
</tr>
<tr>
<td>ASA 2 - Mild Disturb</td>
<td>333 (62.2%)</td>
<td>127 (63.8%)</td>
<td>458 (62.6%)</td>
<td></td>
</tr>
<tr>
<td>ASA 3 - Severe Disturb</td>
<td>177 (33.3%)</td>
<td>57 (28.6%)</td>
<td>234 (32%)</td>
<td></td>
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<tr>
<td>ASA 4 - Life Threat</td>
<td>1 (0.2%)</td>
<td>5 (2.5%)</td>
<td>6 (.8%)</td>
<td></td>
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<tr>
<td><strong>Diabetes</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Insulin</td>
<td>20 (3.8%)</td>
<td>6 (3%)</td>
<td>26 (3.6%)</td>
<td>0.24</td>
</tr>
<tr>
<td>No</td>
<td>484 (91%)</td>
<td>176 (88.4%)</td>
<td>660 (90.3%)</td>
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</tr>
<tr>
<td>Non-Insulin</td>
<td>28 (5.3%)</td>
<td>17 (8.5%)</td>
<td>45 (6.2%)</td>
<td></td>
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<tr>
<td><strong>Operative Duration (minutes)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average</td>
<td>203.1 +/- 93.1</td>
<td>191.5 +/- 88.5</td>
<td></td>
<td>0.12</td>
</tr>
</tbody>
</table>
Control Phase

Results

P Chart of Total Observed SSI by Phase

Tests performed with unequal sample sizes

\( \bar{p} = 0.0388 \)

\( UCL = 0.1837 \)

\( LCL = 0 \)
Control Phase
Results

P Chart of Superficial SSI by Phase

Tests performed with unequal sample sizes
Control Phase

Results

P Chart of Organ-Space SSI by Phase

Tests performed with unequal sample sizes
Control Phase

Results

- **Goal:** Reduce colorectal surgical site infections by 50% and improve OE ratio from 4th decile to 2nd decile by December 2011. 2009 overall SSI rate was 10.5%.

- **Result:** ACS NSQIP Semiannual Report: January 1, 2011- December 31, 2011
Lessons We Learned

- Multidisciplinary approach is essential
  - Physicians, nursing (pre, intraop, floor), pharmacy, CST, SA, administration, supply chain, quality, S&P, IT, Patient Education, Infection Control, WOCN, NSQIP team

- Reliable, timely, actionable data

- Data in depth; need details to be readily available

- Look at the entire episode
  - Pre, intra, and postoperative elements may influence SSI rates
  - Interventions designed for each phase

- Introduce elements of change and audit compliance

- Build improvements into the system to increase compliance

- No evidence for which of element(s) makes a difference in the “bundle”: the outcome is all that matters
The Needs of the Patient Come First - W.J. Mayo

Questions & Discussion
Questions

• The factors that contribute to surgical site infections are:
  • A) common across all institutions
  • B) are easily addressed by well known evidenced based interventions
  • C) most likely a complex interaction between patient, disease, and institution specific factors
  • D) not modifiable and not able to be reduced
Questions

• Surgical site infections are major contributors to post operative morbidity
  • A) that are not amenable to interventions aimed at reducing the rate
  • B) are difficult to effectively track
  • C) can be monitored and reduced by multiple interventions performed at a high compliance rate
  • D) that rarely have any identifiable risk factors