Mayo Clinic: Colorectal Surgical Site Infections (SSI) Reduction Project

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On behalf of the Mayo Clinic CRS SSI Reduction Team
Minnesota IPAC Meeting
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Disclosures
• None

Hospital Acquired Infections
• 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
Division of MCR Colon and Rectal Surgery

- One of the oldest dedicated CRS units in the U.S.
- Eight board certified colon and rectal surgeons
- National and International referral practice
  - ~2,500 colorectal procedures annually
- Highest SSI rate in the MCR surgical practice
  - 5%-10.5%*

CRS SSI Reduction Effort 2010

- Drivers
  - MCR IPAC
  - Mayo Clinic Enterprise Leadership
  - MCR Department of Surgery
  - MCR Division of Colon and Rectal Surgery
  - Our Patients

Quality Construct

The best care for every patient every day...

Culture
- Safety survey response
- Preventable harm metrics
- Habits, fair & just culture
- Focused clinical areas
  - Infection prevention
  - Medication safety

Engineering
- Numerator/Interactor/Intervenator
- 30 day readmissions, Wound Dehiscence
- IV line, Foley catheter, Ventilation
- Surgery, spine center, Intubated patients

Execution
- Diffusion implementation
- Reorganize for Value
- Value Metrics
- PQRS
- Service
- Simulation

Infrastructure
- Refine Value Creation System
- Expand Quality Academy
- Spread Specialty Councils
- Leverage Enterprise Information Management
- Utilize Ask Mayo Expert
- Coordinate Improvement Assets
Transformation as a Process
The DMAIC Method

Where were we starting?
- We knew we needed SSI rates but which data was the one to base the reduction effort?
  - Institutional IPAC data
    - Quarterly evaluation
    - Culture based
    - Follow-up requires notification
    - Weighted towards deep infections
  - National Surgical Quality Improvement Program (NSQIP)
    - Chart abstraction by trained abstractors
    - Mandated 30 day follow-up with active outreach to patient

SSI Surveillance Systems
- IPAC triggers
  - Positive culture
  - Readmission to hospital with diagnosis implying a wound or organ space infection
  - Return to the OR with preop diagnosis of wound or organ space infection
  - Call from provider indicating a SSI
  - NHSN definition and risk adjustment
- NSQIP abstraction guidelines
  - Only sample of patients
  - 30 day post-op follow up
  - Standard definitions
    - Wound cellulitis
    - Superficial SSI
    - Deep incisional SSI
    - Organ / Space SSI
NSQIP Sites Locations

NSQIP Quality Improvement Process

- Hospitals abstract data by trained abstractors
  - Strict abstraction criteria
- Data is analyzed by ACS NSQIP
- Data is reported back to institution
  - Raw rates
  - Observed/Expected ratio performance compared to other institutions
- Hospitals act on their data
- Hospitals monitor interventions with data

ACS NSQIP Case Selection

- **Systematic Sampling Process**
  - 8-day cycle assures cases have equal chance of being selected
  - The first 40 cases meeting inclusion/exclusion criteria are selected
- **Inclusion/Exclusion Criteria**
  - Inclusion based on CPT codes
  - Exclusion criteria
    - Under age 16
    - >3 inguinal herniorrhaphies, >3 lumpectomies, or >3 laparoscopic cholecystectomies per cycle
    - Trauma and Transplant
    - ASA class 5
Data Collection

- **Preoperative data**
  - Demographics - 9 variables
  - 40 clinical variables and 13 laboratory variables

- **Intraoperative data**
  - Surgical Profile - 9 variables
  - 18 clinical variables and 3 complications

- **Postoperative data**
  - 30-day outcomes (inpatient and outpatient)
  - 20 complications, 12 laboratory variables, and 9 discharge variables

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**RMH Colorectal Surgery 30-Day Mortality**

- Observed rate: 0.93%
- Expected Rate: 1.08%
- O/E Ratio: 0.85
- Status: As Expected

Semiannual Report, June 2009
Dates of Surgery: January 1, 2007 to December 31, 2007 Mayo Clinic Rochester Methodist Hospital

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**Comparison of CRS SSI Recorded Events**

<table>
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<th>IPAC</th>
<th>NSQIP</th>
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To verify the representation of the sample in both the groups
Time Frame: Jan 2009 to April 2010
IPAC data identified 79 SSI
NSQIP data identified 40 SSI
Define Phase

- **Goal:** Reduce colorectal surgical site infections by 50% and improve OE ratio from 4th decile to 2nd decile by Oct 31, 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

Measurement Phase

**Metric 1 – Observed Colorectal SSIs**

- Baseline: 10% (2009) → Target: 5%

**SSIs by Type - Superficial**
**Data Analysis & Collection Plan**

**130+ NSQIP Variables**

- Significant Variables
  - Age (p = .0002)
  - BMI (p = .0495)
  - Wound Class (p = .0004)
  - Diabetes (p = .046)
  - Transfusion (p = .0005)
  - Various Labs (p = .0005)
  - CPT4 Codes (p = .024)

- Key Factors (examples)
  - Patient preparation (Pre/Intra & Post-op)
  - Appropriate Abx re-dosing
  - Continued SCIP Elements
  - Closing tray
  - Gown change
  - Dressing change @ 48h
  - Stoma care
  - Intra-op cleansing and coverage
  - Add'l cleansing for pts BMI>30

**Factors that influenced CRS SSI**

- **Diagnosis**
  - Crohn’s Disease
  - Diverticular disease
  - Ulcerative Colitis
  - Represented over half of all identified NSQIP Mayo Clinic SSIs

- **BMI**

- **Operative time**
What About the Surgeon's Practices

- Distributed a detailed survey of relevant practice/procedure questions related to elements thought to contribute to colorectal SSIs
- All surgeons in the practice included
- All responded
- Shared findings with surgeons at practice meeting

What About the Surgeon?

Survey of surgeon practices for "relevant" items

1. Do you routinely order a bowel preparation?
2. If you use a bowel preparation, do you order oral antibiotics with the bowel preparation?
3. If you do not use a bowel preparation, do you still order oral antibiotics?
4. Do your patients routinely receive an enema prior to arriving in the operating room?
5. Do you routinely provide your patients with a medicated soap (antibacterial) to shower with prior to surgery?
6. For left-sided colectomies/rectal surgery, do you irrigate the rectum?
7. What skin preparation do you routinely use?
8. Do you routinely use an Ioban type drape over the prepared abdomen during your procedures?
9. Do you routinely use wound protectors during the operation? (e.g. sponges under fixed retractors or a wound protector product)
10. Do you routinely use saline or antibiotic irrigation of the abdomen?
11. Do you routinely air test all colorectal anastomoses?
12. For small bowel or colon anastomoses, what type anastomosis do you routinely perform?
13. Do you routinely have antibiotics re-dosed at four hours for your longer cases?
14. Your routine fascial closure is what style?
15. Do you use fresh clean instruments that had not been on the table during the case to close the abdomen?
16. Do you have the team members change gloves and/or gowns just prior to abdominal closure?
17. Do you routinely irrigate the subcutaneous space prior to skin closure with saline and/or antibiotic irrigation?
18. Do you routinely use a subcutaneous drain at the site of the primary incision closure?
19. Do you routinely use a subcutaneous drain at the site of an ostomy?
20. When do you remove the dressing applied in the operating room if it is not soaked?
21. Do you have your patients shower/bathe with medicated (antibacterial) soap while in the hospital?
Surgeon Survey Results

- Demonstrated
  - Wide variability amongst the surgeons on most elements
    - We all trained at the Mayo Clinic but all do something different
  - Started a conversation on the “best” practice
  - Gained consensus to move towards more standardization on specific surveyed items

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 Archalt, 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 Hylke, 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
Reduce SSI by 50% (10/5%)

Pre-operative Processes

- Patient Cleansing
  - Antibiotic administration
  - Closing protocol @ time of fascia closure

- Patient and Hand hygiene
  - Chlorhexidine cloths @ AM admission
  - Hibiclens® shower night before and day of surgery

- Ensure understanding by reading pamphlet “Preventing SSI”
- Ensure SCIP compliance
  1. Right antibiotics
  2. Administer 60 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
- Use Closing tray for closure of fascia and skin
- Glove change by staff before closure of fascia
- Practice good hand hygiene
- Patient shower with Hibiclens® following dressing removal
- Hand Cleansing agent readily available
- Signage encouraging hand hygiene
- Purell® hand wipes made available to patients
- Ensure dressing removal within 48 hours
- Dismiss patient with 4 oz. bottle of Hibiclens®
- Patient education on wound care and recognizing infection symptoms
- Follow-up phone call from nurses

Critical to Quality Tree: SSI for Colorectal Surgery

Pre-operative Elements

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

- Patients with BMI > 30
  - SAGE wipes applied even if pre-op bath performed
  - Procedure listing software automatically identifies patients with BMI > 30

BMI Trigger for Pre-op Unit

Additional Instructions:
- Weights recorded upon admission
- UC 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
- Gild supplies to public
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
Pre-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

Intra-operative Elements

- Pre-procedural pause includes confirming appropriate antibiotics administered and documented
- Re-dosing of cefazolin for cases longer than 3 hrs.
  - Circulating nurse has the pre-op 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
Anesthesia Antibiotic Reminder Screen

A reminder will display 15 minutes after Clindamycin has been started in the OR. The reminder delay can set to immediate if 15 minutes. Once an antibiotic has been documented, the window will pop up for the recommended dosing interval of 30 minutes.

Intra-operative Elements

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

- All order-sets discontinue SCIP compliant antibiotics after two post-op doses or single dose when appropriate
- Hand hygiene essential on floor
  - Physician/Nursing initiative
  - Patient and Family initiative
- Sterile dressing on until morning of POD 2
  - Document removal
- Chlorhexidine shower/wipes daily after dressing removal
- Standard post-op order-sets orders urinary catheter removal at 8 am the morning after surgery
- Dismiss with chlorhexidine soap bottle for use at home

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?
- Cost implications
  - Impact of standardizing skin preparation

Antibiotic Re-dosing

- Cefazolin re-dose after 3-4hr if Op time > 3hr
- Antibiotic “watcher” effective after 1/1/11
- Re-dosing after 4 hr improved from 8/12 (66%) in 2/2010 to 17/17 (100%) in 2/2011
Operative Time – has it increased due to our changes?

- Analysis of Op. time over last 4 months
- Right Hemicolectomy with no concurrent procedures were selected
- No difference in operative times were noted (p=0.26)

NSQIP Reported Cases: 2011

<table>
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<tr>
<th>Month</th>
<th>Total Cases</th>
<th>Super SSI</th>
<th>Deep SSI</th>
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Mayo Clinic CRS SSI Reduction Effort

- Lessons Learned
  - Multi-disciplinary approach is essential
  - Physicians, nursing (pre, intra-op, floor), pharmacy, CST, SA, administration, supply chain, quality, SAP, IT, Patient Education, Infection Control, WOCN, NSQIP team
  - Understand your own data
  - Address the entire surgical episode of care
  - Pre-, Intra-, Post-operative elements may influence SSI rates
  - Interventions designed for each phase
  - Introduce elements of change and audit compliance
  - No evidence for which of element(s) makes a difference in the “bundle”
  - Get over it: the outcome is all that matters
  - Too early to tell if we have made a long-term difference but the early results looks promising