Reducing the Risk of SSI Using a Collaborative, Evidence Based Process

Darrell A. Campbell, Jr  MD
Wisconsin SSI Prevention Summit  V
Sept 29, 2017
Members/affiliates as of March, 2012

For more information about MSQC, please visit our website www.msqc.org
Michigan Stadium

107,501
425,000 cases: 137 data elements/case

- Prospective
- Standardized definitions
- trained nurse reviewers
- interrater reliability
- defined endpoints
- 30 day mortality
- 30 day morbidity
- RISK ADJUSTMENT
Michigan Surgical Quality Collaborative

A Patient Safety Organization

http://www.msqc.org/
2011 Blue Works Award

Close collaboration with BCBSM/BCN
90 day episode cost vs Quality Composite

BCBSM pays less as quality improves
MSQC

Celebrating 12 Years of Collaboration

2005-2017
Celebrating 10 Years of Collaboration

MSQC

Michigan Surgical Quality Collaborative

2005
2015
Data driven, hands on

- Develop a positive culture
- Establish a Learning Health System
- Prioritize
- Standardize definitions, endpoints, collect data
- Use data to inform strategy
- Feedback data on implementation
- Determine best practices for implementation
- Evaluate results
Develop a positive culture
Why we do what we do

Autonomy
Mastery
Purpose

“The best use of money as a motivator is to pay people enough to take the issue of money off the table”
(Pay for participation)
Culture is important

FRIENDLY

• Collegial
• Non-competitive
• Evidence-based
• We will not use the data for competitive advantage (no billboards)
• Information shared at working group meetings is confidential
• There are no secrets among our group
The site visit fills an important gap

- Team building!
- Validate quantitative information- does it have “face value”
- Identify barriers to implementation
- Collect new qualitative info

- Troy-Beaumont
- Allegience
- Genesys
- Marquette
- Hurley
- Sparrow
- St Joseph-AA
- Oakwood
Establish a Learning Health System
MSQC is a Learning Health System

- Routinely and efficiently study and improve itself
- Develop data and analytics
- Feedback of knowledge
- Change behavior to improve health outcomes
Success factors for the MSQC

STRUCTURE
- Financial support
- Flexible to user needs
- Reliable data (doctors believe it)
- Quality data (robust IRR audit schedule)
- Regional rather than national organization
- 24/7 web-based, risk-adjusted reporting & data entry
- Multidisciplinary & interdisciplinary
- Academically-based
- Nurses as data reviewers
- Site visits

CULTURE
- High standards
- Non-threatening
- Non-competitive
- Engagement
- Exceptional customer service
- Commitment to discovery and innovation
Prioritize

Dangerous
Frequent
Costly
Pressure ulcers 3.9$ billion
Post op infections 3.7$ billion
Mechanical complications of devices, implants or grafts 1.1$ billion
Postlaminectomy syndrome 1.1$ billion
Hemorrhage complications .96$ billion
Claims data 24 million cases
How to prevent SSI in Michigan

A Major MSQC Initiative
Evidence base not followed

• SCIP 1 82% overall compliant (57%) for emergent
• SCIP 2 80% overall compliant (53% for emergent)
• Weight based dosing 55% compliant
• Redosing at 3 hours 7% compliant
• Oral antibiotic w bowel prep 39%
Standardize definitions and endpoints, collect data
Use data to inform strategy

420,000 cases in MSQC database
137 variables per case

What factors are independently associated with low infection rates?
• Commonly performed procedure

• Surgical technique changing rapidly

• High incidence of complications
Six “Colon bundle” elements

Derived from multivariable logistic regression analysis

- Use of appropriate parenteral antibiotics
- Oral non absorbable antibiotics also
- Maintenance of temperature during surgery
- Control of blood glucose level
- Use of laparoscopic approach to surgery
- Short duration of surgery
How many bundle elements per case?
SSI-Total Rate by Bundle Score

Adjusted SSI Rate

Bundle Compliance

0% 5% 10% 15% 20% 25%

0-1 2 3 4 5 6
Average Total Payment by Bundle Score

Adjusted Payment

Bundle Compliance

0-1  2  3  4  5  6

$0  $5,000  $10,000  $15,000  $20,000  $25,000
Feedback data on implementation
DOMAIN D: SSI COLECTOMY BUNDLE*

Adjusted and Rescaled Average with 90%, 95% and 99% CIs by Hospital and Star Rating**
Elective Colectomy***, MSQC 2012-2014 (50 hospitals, 4,042 cases)

Star Rating (95%CI)

*Calculated as the sum of point values for six components: 1) Appropriate IV prophylactic antibiotics, 2) Postoperative normothermia (temp>96.8°F), 3) Oral antibiotics with mechanical bowel prep, 3) Postoperative day 1 glucose =140mg/dl, 4) Minimally invasive surgery, 5) Short Operative Duration (<100min).

**Reliability adjusted for hospital as a Bayesian random effect. Scaling on a 0 to 1 range. Star rating is determined by non-overlap of 95% CIs with the overall average.

***CPT code in 44140, 44160, 44204 and 44205.
SSI Bundle Colectomy

Hospital Variation by Bundle Component

- Minimally Invasive Surgery
- Oral Antibiotics w. Mech. Bowel Prep
- Appr. IV Prophylactic Antibiotics
- Post-op day 1 Glucose $\leq$ 140mg/dl
- Operative Duration $<$ 100min
- Post-op Normothermia

Adjusted Rate (%)
<table>
<thead>
<tr>
<th>SSI Bundle Component</th>
<th>Portion of Explained Variation (%)</th>
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</thead>
<tbody>
<tr>
<td>Minimally Invasive Surgery</td>
<td>10.2</td>
</tr>
<tr>
<td>Appr. IV Prophylactic Antibiotics</td>
<td>5.6</td>
</tr>
<tr>
<td>Post-op day 1 Glucose&lt;=140mg/dl</td>
<td>3.5</td>
</tr>
<tr>
<td>Operative Duration &lt;100min</td>
<td>3.0</td>
</tr>
<tr>
<td>Post-op Normothermia</td>
<td>0.4</td>
</tr>
</tbody>
</table>
A Statewide Assessment of Surgical Site Infection Following Colectomy

The Role of Oral Antibiotics

Michael J. Englesbe, MD,* Linda Brooks, RN,* James Kubus, MS,* Martin Luchtefeld, MD,† James Lynch, MD,‡ Anthony Senagore, MD,† John C. Eggenberger, MD,§ Vic Velanovich, MD,¶ and Darrell A. Campbell, Jr., MD*
FIGURE 3. Surgical site infection rates among propensity matched cohorts of patients who either did or did not receive oral nonabsorbable antibiotics at the time of mechanical bowel preparation prior to elective colon surgery. Patients that received oral antibiotics were observed to have significantly lower rates of organ space infections, superficial surgical site infection, and overall surgical site infection rates.
Oral Antibiotics w. Mech. Bowel Prep by Year
Elective Colectomy\textsuperscript{*}, MSQC 2008-2015

\begin{center}
\begin{tikzpicture}
\begin{axis}[
    width=\textwidth,\
    height=0.8\textwidth,\
    xlabel=Year,\
    ylabel=adj.\%,\
    xmin=2012, xmax=2015,\
    ymin=55.0, ymax=67.5,\
    ytick={55.0,57.5,60.0,62.5,65.0,67.5},\
    yticklabels={55.0,57.5,60.0,62.5,65.0,67.5},\
    ]

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(2012,54.9)
(2013,61.2)
(2014,63.8)
(2015,67.4)
};
\end{axis}
\end{tikzpicture}
\end{center}

\textsuperscript{*}CPT codes 44140, 44160, 44204, 44205.

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<table>
<thead>
<tr>
<th>Bundle Elements</th>
<th>2012</th>
<th>2015</th>
<th>% Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Appropriate Antibiotics</td>
<td>87.4%</td>
<td>89.1%</td>
<td>+ 2</td>
</tr>
<tr>
<td>Normothermia</td>
<td>94.8%</td>
<td>96.3%</td>
<td>- 3</td>
</tr>
<tr>
<td>Oral Antibiotics</td>
<td>54.9%</td>
<td>67.4%</td>
<td>+ 23</td>
</tr>
<tr>
<td>Glucose &lt; 150</td>
<td>57.2%</td>
<td>66.1%</td>
<td>+ 16</td>
</tr>
<tr>
<td>Weight Based Dosing</td>
<td>87.1%</td>
<td>95.4%</td>
<td>+ 10</td>
</tr>
<tr>
<td>Redosing &gt; 3 Hours</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Minimally Invasive Surgery</td>
<td>44.0%</td>
<td>56.2%</td>
<td>+ 28</td>
</tr>
<tr>
<td>Operative Duration &lt; 100 min</td>
<td>33.4%</td>
<td>27.9%</td>
<td>- 16</td>
</tr>
<tr>
<td>Ave. Bundle Elements/Case</td>
<td>3.56%</td>
<td>3.95%</td>
<td>+ 11</td>
</tr>
</tbody>
</table>
Evaluate results
Hospital Quartile by Six-Item Bundle Compliance Score

- Lowest Quartile: 6.5%
- 2nd Quartile: 6.3%
- 3rd Quartile: 5.8%
- Highest Quartile: 4.5%

* p = 0.049
Elective Colectomy

SSI-Superficial by Year
Non-Emergent Colectomy, MSQC 2008-2015

*CPT codes 44140, 44204, 44207, 44208, 44141, 44143, 44144, 44146, 44206, 44145, 44147, 44160, 44205, 44150, 44151, 44210, 44155, 44156, 44157, 44158, 44211, 44212.

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Elective Colectomy

SSI-Total by Year
Non-Emergent Colectomy, MSQC 2008-2015

*CPT codes 44140, 44204, 44207, 44208, 44141, 44143, 44144, 44146, 44206, 44145, 44147, 44160, 44205, 44150, 44151, 44210, 44155, 44156, 44157, 44158, 44211, 44212.

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Elective Colectomy

LOS by Year
Non-Emergent Colectomy*, MSQC 2008-2015

* CPT codes 44140, 44204, 44207, 44208, 44141, 44143, 44144, 44146, 44206, 44145, 44147, 44160, 44205, 44150, 44151, 44210, 44155, 44156, 44157, 44158, 44211, 44212.

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Total SSI After Colectomy*
Hospitals in Michigan vs Hospitals Outside of Michigan, 2008-2014

*CPT code in 44140 44141 44143 44144 44145 44146 44147 44150 44151 44155 44156 44157 44158 44160 44204 44205 44206 44207 44208 44210 44211 44212.
What about parenteral antibiotics?
• 121 different antibiotic combinations for the same operation

• SCIP-2 compliant 2,431

• SCIP-2 non-compliant 389 (16%)
Colon surgery and SSI antibiotics: MSQC

- cefoxitin (n=602),
- cefazolin and metronidazole (n=554),
- ertapenem (n=506),
- ampicillin/sulbactam (n=215), and
- cefotetan (n=206)
- ciprofloxacin and metronidazole (n=121)
- cefazolin (n=193)
Determine best practices for implementation

Bundle Elements
Antibiotic Choice (Parenteral)
SSI Bundle Colectomy

Trends for Non-actionable Bundle Items

- **Postop Normothermia**
  - Line: Red
  - 100% in 2012, 100% in 2013, 100% in 2014, 100% in 2015, 100% in 2016

- **Minimally invasive surgery**
  - Line: Green
  - 60% in 2012, 60% in 2013, 60% in 2014, 60% in 2015, 50% in 2016

- **Short Operative Duration <100min**
  - Line: Brown
  - 30% in 2012, 30% in 2013, 30% in 2014, 30% in 2015, 20% in 2016

*Note: Elective colectomy with a principal procedure CPT of 44140, 44160, 44204, or 44205 and an operation date between 1-jul-2012 and 31-mar-2016.*
**Six Bundle Elements**

- Appropriate SCIP-2 prophylactic intravenous antibiotics
- Postoperative normothermia (temperature of >96.8°F)
- Oral antibiotics with mechanical bowel preparation ("Nichols prep")
- Minimally invasive surgery
- Postoperative day-1 glucose < 140 mg/dL
- Short operative duration

**Actionable Process Measures**

- Cefazolin-metronidazole
- Oral antibiotics with mechanical bowel preparation
- Postoperative day-1 glucose < 140 mg/dL
Trends for SSI-Total and SSI Bundle (3-items)

SSI Bundle (3-items)

SSI-Total

*Elective colectomy with a principal procedure CPT of 44140, 44160, 44204, or 44205 and an operation date between 1-jul-2012 and 31-mar-2016.
MSqcStatsTicket: t1030e3721v6_f1g1
Trends for SSI-Total and SSI Bundle (3-items)

- Oral Abx w Mech Bowel Prep
- Post-op day 1 glucose <140mg/
- cefazolin + metronidazole
- SSI-Total

*Elective colectomy with a principal procedure CPT of 44140, 44160, 44204, or 44205 and an operation date between 1-jul-2012 and 31-mar-2016.*

**MsqcStatsTicket:** tfG30e3721v6_fig2
Greater Colectomy Bundle Compliance Associated with Decreased Rates of Complications
Antibiotic Choice Trends

SSI Bundle (unadjusted %)

- cefazolin + metronidazole
- cefoxitin
- ertapenem
- cefotetan
- ampicillin + sulbactam
- ceftriaxone + metronidazole

*Elective colectomy with a principal procedure CPT of 44140, 44160, 44204, or 44205 and an operation date between 1-jul-2012 and 31-mar-2016.

MsqcStatsTicket: t1030e3721v8_fig4
Evaluate Progress

SSI Reduction Team

Plan Do
Act Study

Outcomes

SSI Reduction Team

Cycling Quality Improvement

- Presurgical Preparation & Intervention
- Intraoperative Efficiency
- Targeted Post-op Intervention

QI Initiatives

Clinical Practice Pathway

Morbidity /Mortality
SSI
LOS
Readmissions
Postop ED visits

Adapted from IHI Process Improvement Model
Are perioperative bundles associated with reduced postoperative morbidity in women undergoing benign hysterectomy? Retrospective cohort analysis of 16,286 cases in Michigan

John A. Harris, MD, MSc; Anne G. Sammarco, MD, MPH; Carolyn W. Swenson, MD; Shitanshu Uppal, MD; Neil Kamdar, MA; Darrel Campbell, MD; Sarah Evilsizer, RN; John O. DeLancey, MD; Daniel M. Morgan, MD

AJOG 2016

- Surgical approach
- Antibiotics
- Avoidance of hemostatic agents
- Operative time
Outcomes with Hysterectomy Bundle

- Surgical approach
- Antibiotics
- Avoidance of hemostatic agents
- Operative time

Harris J et al. AJOG 2016
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AJOG 2016

- Surgical approach
- Antibiotics
- Avoidance of hemostatic agents
- Operative time
Antibiotic choices

1. Cephalosporins equivalent to Gentamicin and Clindamycin?

2. Cefazolin equivalent to 2nd generation (cefoxitin)?

3. Cefazolin versus Cefazolin + Flagyl?
Prophylactic Antibiotic Choice and Risk of Surgical Site Infection After Hysterectomy

Shitanshu Uppal, MBBS, John Harris, MD, Ahmed Al-Niaimi, MD, Carolyn W. Swenson, MD, Mark D. Pearlman, MD, R. Kevin Reynolds, MD, Neil Kamdar, MS, Ali Bazzi, MS, Darrell A. Campbell, MD, and Daniel M. Morgan, MD

- Beta-lactam antibiotics (n=17,827; 79.1%)
  - Cephalosporins, 1st generation: 15,178; 85%
  - Cephalosporins, 2nd generation: 2,415; 13.5%
  - Ampicillin and sulbactam: 213; 1.2%
  - Ertapenem: 21; 0.3%

- Beta-lactam alternatives (n=2,878; 12.8%)
  - Clindamycin and gentamicin or quinolone or aztreonam: 2,404; 83.0%
  - Metronidazole and gentamicin or quinolone: 450; 15.6%
  - Others*: 24; 0.8%

- Nonstandard antibiotics (n=653; 2.8%)
  - Clindamycin alone: 438; 67.0%
  - Gentamicin alone: 53; 8.1%
  - Aztreonam alone: 36; 5.5%
  - Metronidazole alone: 30; 4.6%
  - Others*: 96; 14.7%

79% Beta Lactam
13% Beta Lactam Alternatives
QI improvement opportunity?

1. Eliminate monotherapies
2. Safely decrease the use of beta lactam alternatives in patients with unknown allergies or intolerance (nausea & vomiting)?
Reducing surgical site infections after hysterectomy: metronidazole plus cefazolin compared with cephalosporin alone

Sara R. Till, MD, MPH; Daniel M. Morgan, MD; Ali A. Bazzi, MD; Mark D. Pearlman, MD; Zaid Abdelsattar, MD, MSc; Darrell A. Campbell, MD; Shitanshu Uppal, MBBS

Risk adjusted* rates of surgical site infection

![Graph showing predicted rates of SSI for different antibiotic regimens: Cefazolin, Cefazolin + Metronidazole, and Second Generation Cephalosporin. The graph illustrates a lower predicted rate for the combination of Cefazolin and Metronidazole compared to Cefazolin alone.](image-url)
“Non traditional” approaches to reducing SSI

Linkage to anesthesia
Local anesthesia
Prehabilitation
Minimally invasive surgery
Kheterpal et al

Anesthesiology Performance Improvement and Reporting Exchange

www.aspirecqi.org
Anesthesia management profoundly influences “surgical” outcomes and resource utilization

At present non-standardized

- Use of Nerve block vs GA
- Epidural vs GA
- Transfusion threshold
- Volume of resuscitation
- BP mgt w Neosynephrine
- Mgt of Post op Nausea and Vomiting
- Mgt of Post op pain
- Intra op glycemic control
- Maintenence of Normothermia
- Discontinuation of pre op ASA
- Use of pre op Beta blockers, statins
Local Anesthesia: A Strategy for Reducing Surgical Site Infections?

Fig. 1 Surgical site infection (SSI) rates in unadjusted and propensity-matched local anesthesia and nonlocal anesthesia outpatient cases. In the unmatched analysis, patients given local anesthesia had a significantly lower incidence of SSIs than patients given nonlocal anesthesia (0.7 vs. 1.4%, P = 0.013). Similarly, after propensity matching, the incidence of SSIs for patients given local anesthesia was significantly lower than for that of patients given nonlocal anesthesia (0.8 vs. 1.4%, P = 0.043)
Michigan Surgical Home and Optimization Program

CMS Innovation Center 2014: $6.4 million to place MiSHOP in 40 MSQC Hospitals
Stop smoking-incentive spirometer
Progressive ambulation (pedometer)
HgbA1c for diabetics
Correct anemia (hct <30%)
Nasal culture for Staph
Evaluate for sleep apnea
Antibacterial soap X 3 days
Consider starting a Beta blocker
Consider starting a statin
Nutritional Counseling
Open vs lap SSI

SSI-Total by Year
Non-Emergent Colectomy, MSQC 2008-2015

Surgical Approach: Open (44140, 44160) - Laparoscopic (44204, 44205)

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Even older
Success...

...is a relative term

<table>
<thead>
<tr>
<th>Age</th>
<th>Event</th>
<th>Age</th>
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<tbody>
<tr>
<td>4</td>
<td>Not peeing in your pants</td>
<td>80</td>
</tr>
<tr>
<td>12</td>
<td>Having friends</td>
<td>75</td>
</tr>
<tr>
<td>18</td>
<td>Having a drivers license</td>
<td>70</td>
</tr>
<tr>
<td>20</td>
<td>Having Healthy sex life</td>
<td>60</td>
</tr>
<tr>
<td>35</td>
<td>Having money</td>
<td>50</td>
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