Reducing Colorectal Surgical Site Infections

October 24, 2013

A partnership of the Healthcare Association of New York State and the Greater New York Hospital Association
# Agenda

<table>
<thead>
<tr>
<th><strong>TOPIC</strong></th>
<th><strong>SPEAKERS</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>I. Welcome and Introductions</td>
<td>Wing Lee, Project Manager, NYSPFP</td>
</tr>
<tr>
<td>II. Reducing Colorectal Surgical Site Infections</td>
<td>E. Patchen Dellinger, M.D., Professor and Vice Chairman, Department of Surgery Chief, Division of General Surgery University of Washington</td>
</tr>
<tr>
<td>III. Discussion, Questions and Answers</td>
<td>Facilitated by: Maria Stala Sacco, Project Manager, NYSPFP</td>
</tr>
</tbody>
</table>
Overall SSI Rate

SSI Standardized Infection Ratio

by Year and Month

- SSI Standardized Infection Ratio
- Baseline
- Comparison

7% increase
Colon Surgery SSI Rate

COLO SSI Standardized Infection Ratio

by Year and Month

- COLO SSI Standardized Infection Ratio
- Baseline
- Comparison

35.76% increase
CABG SSI Rate

CBGC SSI Standardized Infection Ratio
by Year and Month

34.29% decrease
Hip Replacement SSI Rate

HPRO SSI Standardized Infection Ratio

*by Year and Month*

- HPRO SSI Standardized Infection Ratio
- Baseline
- Comparison

21.45% decrease
Hysterectomy SSI Rate

HYST SSI Standardized Infection Ratio
by Year and Month

HYST SSI Standardized Infection Ratio
- HYST SSI Standardized Infection Ratio
- Baseline
- Comparison

17.16% decrease
NYSPFP SSI Reduction
&
O.R. Safety

Reducing Colorectal Surgical Site Infections

E. Patchen Dellinger, MD
University of Washington
Topics for Today – Colorectal SSI’s

• Glucose control (including **NON** diabetics)
• Wound oxygenation
  - Pre- and intra-operative warming
  - FiO₂
• Antibiotic selection for colectomy
• Oral antibiotics for colectomy
• Preoperative Checklists
• Changing “stuff” after anastomosis
• The Power of the team
Glucose and SSI
Diabetes, Glucose Control, and SSIs After Median Sternotomy

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

Deep Sternal SSI and Glucose

Glucose Control and Deep Sternal Wound Infections

DSSI

Year

Early (48h) Postoperative Glucose Levels and SSI after Vascular Surgery

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

Relative Risk

# Rabbit 2 Study – Surgery
## Basal/Bolus vs Sliding Scale Insulin

<table>
<thead>
<tr>
<th></th>
<th>Basal Bolus</th>
<th>Sliding Scale</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patients</td>
<td>104</td>
<td>107</td>
<td></td>
</tr>
<tr>
<td>Mean Fasting</td>
<td>155</td>
<td>167</td>
<td>0.04</td>
</tr>
<tr>
<td>Mean Daily</td>
<td>157</td>
<td>176</td>
<td>.001</td>
</tr>
<tr>
<td>Readings &lt; 140</td>
<td>53%</td>
<td>31%</td>
<td>.001</td>
</tr>
<tr>
<td>Wound infections</td>
<td>3</td>
<td>11</td>
<td>.05</td>
</tr>
<tr>
<td>Any complication</td>
<td>9</td>
<td>26</td>
<td>.003</td>
</tr>
</tbody>
</table>

Umpierrez. Diabetes Care 2011; 34: 256-61
Risk Adjusted Odds Ratios for Infection and Operative Intervention Colectomy and Bariatric Operations

Composite Infection in Hyperglycemic Patients With and Without Use of Insulin

Odds Ratios

Glucose in **Non**Diabetics having Colectomy at Cleveland Clinic

<table>
<thead>
<tr>
<th>Highest Gluc</th>
<th>N (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 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>

Glucose in NonDiabetics having Colectomy at Cleveland Clinic

<table>
<thead>
<tr>
<th>Highest Gluc</th>
<th>SSI*</th>
<th>Sepsis¤</th>
<th>Reop¤</th>
<th>Mort+</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤ 125 mg%</td>
<td>2.9%</td>
<td>0.6%</td>
<td>3.1%</td>
<td>0.1%</td>
</tr>
<tr>
<td>126-200 mg%</td>
<td>4.8%</td>
<td>2.2%</td>
<td>5%</td>
<td>0.3%</td>
</tr>
<tr>
<td>200 mg%</td>
<td>6.1%</td>
<td>3.5%</td>
<td>7.3%</td>
<td>1.2%</td>
</tr>
<tr>
<td>All patients</td>
<td>4.4%</td>
<td>1.8%</td>
<td>4.7%</td>
<td>0.4%</td>
</tr>
</tbody>
</table>

*p<0.03, ¤ p<0.01, + p<0.05

Glucose in NonDiabetics having Colectomy at Cleveland Clinic

Glucose Control

Proven important for SSI risk:

Cardiac surgery
General surgery
Colorectal surgery
Vascular surgery
Breast surgery
Hepato-pancreatico-biliary surgery
Orthopedic surgery
Trauma surgery
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.
Oxygen and SSI
Influence of Oxygen on the Development of Wound Infection

Diameter Infectious Necrosis (mm)

Hours After Innoculation

Wound Oxygen Tension & SSI

Near InfraRed O2 Saturation in the Surgical Incision at 12 hrs

Abdominal Operations

Tissue oxygen saturation (%)

No SSI

SSI

p < 0.04

Oxygen and SSI

• Oxygen tension in the wound is important.

• How to translate that into clinical practice that lowers SSI is less obvious.
Temperature and SSI

(Oxygen)
Temperature and Tissue $O_2$ tension

- Subcut temp increase 4°C
- Subcut $O_2$ tension increase 40 torr
- Linear correlation between temperature and $O_2$ tension
- Threefold increase in local perfusion

Rabkin. Arch Surg 1987;122:221
Temperature and SSI Following Colectomy

<table>
<thead>
<tr>
<th></th>
<th>Normo (104)</th>
<th>Hypo (96)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>SSI</td>
<td>6</td>
<td>18</td>
<td>.009</td>
</tr>
</tbody>
</table>

Kurz. NEJM 1996;334:1209
Local Warming and SSI after Clean Operations

<table>
<thead>
<tr>
<th></th>
<th>Local</th>
<th>Systemic</th>
<th>Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>SSI*</td>
<td>5 (4%)</td>
<td>8 (6%)</td>
<td>19 (14%)</td>
</tr>
<tr>
<td>Post-op antibiotics*</td>
<td>9 (7%)</td>
<td>9 (7%)</td>
<td>22 (16%)</td>
</tr>
</tbody>
</table>

* p < 0.01

Melling. Lancet 2001;358:876
Perioperative Warming, Intraoperative Temperature and Complications
---
Open Abdominal Bowel Resections

<table>
<thead>
<tr>
<th></th>
<th>Periop N=47</th>
<th>Standard N=56</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blood loss</td>
<td>200 ml</td>
<td>400 ml</td>
<td>0.011</td>
</tr>
<tr>
<td>Any complication</td>
<td>32%</td>
<td>54%</td>
<td>0.027</td>
</tr>
<tr>
<td>SSI</td>
<td>13%</td>
<td>33%</td>
<td>0.09</td>
</tr>
</tbody>
</table>

Redistribution Hypothermia

Vasoconstricted → Anesthesia → Vasodilated
Hypothermia During Anesthesia

² Core Temp (°C)

Elapsed Time (h)
Keeping Your Patient Warm in the O.R.

- Prewarming and active warming in the O.R. is much more important than the O.R. room temperature.

- If you raise O.R. room temperature from $20^\circ$ to $27^\circ$, you still have an $10^\circ$ gradient between the patient’s temperature and the room temperature and everyone in the room is miserable.
Prewarming at UWMC &
First Postoperative Temperature
Post Anesthesia Care Unit (PACU) 2006

$> 36^\circ$ 7836/8132 (96.4%)

$> 36^\circ$ & $< 36.5^\circ$ 1047/2647 (40%)

$> 36.5^\circ$ 1491/2647 (56%)
Oxygen (FiO₂) and SSI
Spinal Surgery, FiO₂, & SSI

Figure 2. Effect of perioperative supplemental oxygen therapy on surgical site infection risk reduction. Risk ratios (RRs) with 95% confidence intervals (CIs) are shown for individual, combined, and sensitivity analysis (SA) values.
Effect of High Perioperative Oxygen Fraction on Surgical Site Infection and Pulmonary Complications After Abdominal Surgery
The PROXI Randomized Clinical Trial

Context Use of 80% oxygen during surgery has been suggested to reduce the risk of surgical wound infections, but this effect has not been consistently identified. The effect of 80% oxygen on pulmonary complications has not been well defined.

Objective To assess whether use of 80% oxygen reduces the frequency of surgical site infection without increasing the frequency of pulmonary complications in patients undergoing abdominal surgery.

Design, Setting, and Patients The PROXI trial, a patient- and observer-blinded randomized clinical trial conducted in 14 Danish hospitals between October 2006 and October 2008 among 1400 patients undergoing acute or elective laparotomy.

Interventions Patients were randomly assigned to receive either 80% or 30% oxygen during and for 2 hours after surgery.

Main Outcome Measures Surgical site infection within 14 days, defined according to the Centers for Disease Control and Prevention. Secondary outcomes included atelectasis, pneumonia, respiratory failure, and mortality.

Results Surgical site infection occurred in 131 of 685 patients (19.1%) assigned to receive 80% oxygen vs 141 of 701 (20.1%) assigned to receive 30% oxygen (odds ratio [OR], 0.94; 95% confidence interval [CI], 0.72-1.22; P=.64). Atelectasis occurred in 54 of 685 patients (7.9%) assigned to receive 80% oxygen vs 50 of 701 (7.1%) assigned to receive 30% oxygen (OR, 1.11; 95% CI, 0.75-1.66; P=.60), pneumonia in 41 (6.0%) vs 44 (6.3%) (OR, 0.95; 95% CI, 0.61-1.48; P=.82), respiratory failure in 38 (5.5%) vs 31 (4.4%) (OR, 1.27; 95% CI, 0.78-2.07; P=.34), and mortality within 30 days in 30 (4.4%) vs 20 (2.9%) (OR, 1.56; 95% CI, 0.88-2.77; P=.13).

Conclusion Administration of 80% oxygen compared with 30% oxygen did not result in a difference in risk of surgical site infection after abdominal surgery.

Trial Registration clinicaltrials.gov Identifier: NCT00364741
## FiO₂, SSI, Atelectasis, & Respiratory Failure

**PROXI Trial**

<table>
<thead>
<tr>
<th>Outcome</th>
<th>80% FiO₂ N=685</th>
<th>30% FiO₂ N=701</th>
<th>Adjusted Odds Ratio</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>SSI</td>
<td>131 (19.1%)</td>
<td>141 (20.1%)</td>
<td>0.91 0.69 – 1.20</td>
<td>0.51</td>
</tr>
<tr>
<td>Atelectasis</td>
<td>54 (7.9%)</td>
<td>50 (7.1%)</td>
<td>1.13 0.75 – 1.72</td>
<td>0.56</td>
</tr>
<tr>
<td>Resp Failure</td>
<td>38 (5.5%)</td>
<td>31 (4.4%)</td>
<td>1.22 0.74 – 2.03</td>
<td>0.44</td>
</tr>
</tbody>
</table>

Meyhoff. JAMA 2009; 302:1543-50
## 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>Brst &amp; hernia ops</td>
<td>3.5</td>
<td>5.2</td>
<td>58</td>
</tr>
</tbody>
</table>
Parenteral Prophylactic Antibiotics For Colectomy

Are some parenteral antibiotics better than others?
Anaerobic Coverage for Colectomy

SSI

I.V. Cefotaxime, 2 g (n=280) 44 (16%)

I.V. Cefotaxime + Metronidazole, 1.5 g (n=130) 19 (7%)

p < 0.001

Aerobic Coverage for Colectomy

<table>
<thead>
<tr>
<th>Treatment</th>
<th>SSI</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>I.V. Ticarcillin (n=131)</td>
<td>10  (8%)</td>
<td>&lt; 0.007</td>
</tr>
<tr>
<td>3 g preop and 2 h later</td>
<td></td>
<td></td>
</tr>
<tr>
<td>P.O. Tinidazole (n=130)</td>
<td>26  (20%)</td>
<td></td>
</tr>
<tr>
<td>2 g 10 hr preop</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Aerobic Coverage for Colectomy

<table>
<thead>
<tr>
<th>Treatment</th>
<th>SSI</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oral neomycin/erythromycin + I.V. cefazolin</td>
<td>4</td>
<td>&lt; 0.007</td>
</tr>
<tr>
<td>(n=55)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I.V. metronidazole alone (n=47)</td>
<td>14</td>
<td></td>
</tr>
</tbody>
</table>

Antibiotic Prophylaxis for Colectomy – Importance of Dose

SSI

Gentamicin, 80 mg + Clindamycin, 600 mg (n=72) 12 (17%)

Aztreonam, 1 g + Clindamycin, 600 mg (n=66) 8 (12%)

p > 0.6

Antibiotic Prophylaxis for Colectomy

SSI

Gentamicin, 80 mg + Clindamycin, 600 mg (n=72) 12 (17%)

Aztreonam, 1 g + Clindamycin, 600 mg (n=66) 8 (12%)

p > 0.6

Gentamicin dose too low!

Antibiotic Prophylaxis for Colectomy

Ampicillin/sulbactam, 1.5 g (n=63) 6 (10%)  
Gentamicin, 1.5 mg/kg + Metronid 500 mg (n=65) 7 (11%)  

Higher gentamicin dose.

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).

New ASHP / IDSA / SHEA / SIS Antibiotic Prophylaxis Guidelines

<table>
<thead>
<tr>
<th>Antibiotic</th>
<th>Weight (kg)</th>
<th>Dose (mg/kg or g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cefazolin</td>
<td>&gt;= 80</td>
<td>2 g</td>
</tr>
<tr>
<td></td>
<td>&gt;= 120</td>
<td>3 g</td>
</tr>
<tr>
<td>Vancomycin</td>
<td></td>
<td>15 mg/kg</td>
</tr>
<tr>
<td>Gentamicin</td>
<td></td>
<td>5 mg/kg</td>
</tr>
<tr>
<td>Dosing weight</td>
<td></td>
<td>wgt = ideal wgt + 40% of excess wgt</td>
</tr>
</tbody>
</table>

Bratzler. Am J Health Syst Pharm 2013;70:195-283
Antibiotic Prophylaxis for Colectomy

SSI

<table>
<thead>
<tr>
<th>Drug</th>
<th>SSI Count</th>
<th>Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ertapenem (n=451)</td>
<td>62</td>
<td>17.1%</td>
</tr>
<tr>
<td>Cefotetan (n=450)</td>
<td>118</td>
<td>26.2%</td>
</tr>
</tbody>
</table>

p < 0.0001

Cefotetan has poor anaerobic coverage

Itani. NEJM 2006; 355: 2640-51
# Antibiotic Choice & SSI After Colectomy - Multivariate Analysis

**Premier Data Base, n = 4634**

<table>
<thead>
<tr>
<th>Agent</th>
<th>O.R.</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cefoxitin</td>
<td>1.0</td>
<td></td>
</tr>
<tr>
<td>Ertapenem</td>
<td>0.53</td>
<td>0.34 - 0.82</td>
</tr>
<tr>
<td>Cefazolin/Metron</td>
<td>0.58</td>
<td>0.33 - 1.04</td>
</tr>
<tr>
<td>Levo/Metron</td>
<td>0.59</td>
<td>0.30 - 1.14</td>
</tr>
<tr>
<td>Amp/sulbactam</td>
<td>0.62</td>
<td>0.33 - 1.15</td>
</tr>
<tr>
<td>Cefotetan</td>
<td>0.86</td>
<td>0.45 - 1.67</td>
</tr>
</tbody>
</table>

Antibiotic Choice & SSI After Colectomy - Multivariate Analysis
MSQC, n = 4331

<table>
<thead>
<tr>
<th>Factor</th>
<th>O.R.</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ab SCIP compliant</td>
<td>0.67</td>
<td>0.04</td>
</tr>
<tr>
<td>Post-Op temp ≥36</td>
<td>0.40</td>
<td>0.01</td>
</tr>
<tr>
<td>POD #1 glucose &gt;140</td>
<td>1.52</td>
<td>0.00</td>
</tr>
<tr>
<td>Oral antibiotics</td>
<td>0.54</td>
<td>0.00</td>
</tr>
<tr>
<td>Laparoscopic</td>
<td>0.59</td>
<td>0.00</td>
</tr>
<tr>
<td>Open time &gt;100 min</td>
<td>1.65</td>
<td>0.00</td>
</tr>
<tr>
<td>BMI &gt;30</td>
<td>1.36</td>
<td>0.03</td>
</tr>
</tbody>
</table>

Antibiotic Choice & SSI After Colectomy

Reference: Non-SCIP Compliant Choices

Adjuste Odds Ratios

Cipro/Metronid
Cefaz/Metronid
Ertapenem
Amp/Sulbact
Cefazolin
Cefoxitin
Clinda/Gent
Cefotetan

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.
Antibiotic Prophylaxis for ColoRectal Operations
Do you need to cover Staph?

<table>
<thead>
<tr>
<th>Antibiotics</th>
<th>N</th>
<th>Infected (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aztreonam/metronidazole</td>
<td>71</td>
<td>23 (32%)*</td>
</tr>
<tr>
<td>Gram pos</td>
<td></td>
<td>15 (21%)**</td>
</tr>
<tr>
<td>Cefotaxime/metronidazole</td>
<td>70</td>
<td>9 (13%)*</td>
</tr>
<tr>
<td>Gram pos</td>
<td></td>
<td>4 (6%)**</td>
</tr>
</tbody>
</table>

*p < 0.01, **p < 0.02

Many of the infections involved S. aureus

Is MRSA Important for GI Operations?

<table>
<thead>
<tr>
<th>Nares Culture</th>
<th>% of Patients</th>
<th>Any SSI</th>
<th>MRSA SSI</th>
</tr>
</thead>
<tbody>
<tr>
<td>MRSA + (73)</td>
<td>6%</td>
<td>10 (14%)</td>
<td>7 (70%)</td>
</tr>
<tr>
<td>MSSA + (167)</td>
<td>15%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No Staph (897)</td>
<td>79%</td>
<td>91 (9%)</td>
<td>7 (8%)</td>
</tr>
</tbody>
</table>

* p=0.14            # p=0.000002

Ramirez. J Gastrointest Surg 2012; 17:144-52
# Duration of Prophylaxis Colorectal

<table>
<thead>
<tr>
<th>Author</th>
<th>Drug</th>
<th>Duration</th>
<th>Infection</th>
</tr>
</thead>
<tbody>
<tr>
<td>Törnqvist 1981</td>
<td>doxycycline</td>
<td>1 dose</td>
<td>10%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3 days</td>
<td>19%</td>
</tr>
<tr>
<td>Juul 1987</td>
<td>amp/metronid</td>
<td>1 dose</td>
<td>6%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3 days</td>
<td>6%</td>
</tr>
</tbody>
</table>
What About Oral Antibiotics?
When I started my residency in 1970 all patients having colectomy got a bowel prep as inpatients before their operation, and we had just seen the first widely believed paper that demonstrated a beneficial effect of parenteral prophylactic antibiotics for patients having GI operations. Oral antibiotics were not used.
## Effect of Mechanical Bowel Prep on Colon Flora (log $_{10}$)

<table>
<thead>
<tr>
<th></th>
<th>Coliforms</th>
<th>Bacteroides</th>
<th>Clostridia</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Prep</td>
<td>4.5 – 7.5</td>
<td>7.9 – 9.5</td>
<td>1.8 – 3.6</td>
</tr>
<tr>
<td>Prep</td>
<td>3.0 – 4.3</td>
<td>7.8 – 9.0</td>
<td>0.7 – 2.5</td>
</tr>
</tbody>
</table>

Nichols. Dis Col & Rect 1971; 14: 123-7
## Antibiotic and Mechanical Bowel Prep for Colectomy (48 hrs)

<table>
<thead>
<tr>
<th>Group</th>
<th>Any SSI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Placebo (63)</td>
<td>27 (43%)</td>
</tr>
<tr>
<td>Neomycin (68)</td>
<td>28 (41%)</td>
</tr>
<tr>
<td>Neo + Tetracycline (65)</td>
<td>3 (5%)</td>
</tr>
</tbody>
</table>

*p<0.01*

Antibiotic and Mechanical Bowel Prep for Colectomy (18 hrs)

<table>
<thead>
<tr>
<th>Group</th>
<th>Any SSI</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Placebo (56)</td>
<td>26 (43%)</td>
<td>0.0001</td>
</tr>
<tr>
<td>Neo + Erythro (56)</td>
<td>5 (9%)</td>
<td></td>
</tr>
</tbody>
</table>

Antibiotic and Mechanical Bowel Prep for Colectomy (48 hrs)

<table>
<thead>
<tr>
<th>Group</th>
<th>Any SSI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Placebo (59)</td>
<td>25 (42%)</td>
</tr>
<tr>
<td>Neo + Metronidazole (51)</td>
<td>9 (18%)</td>
</tr>
</tbody>
</table>

p<0.01

## Antibiotic and Mechanical Bowel Prep for Colectomy (48 hrs)

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Any SSI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Placebo (39)</td>
<td>16 (41%)</td>
</tr>
<tr>
<td>Kanamycin + Erythrococcal (38)</td>
<td>3 (8%)</td>
</tr>
</tbody>
</table>

*Wapnick. Surgery 1979; 85:317-21*
Antibiotic and Mechanical Bowel Prep for Colectomy (18 - 48 hrs)

<table>
<thead>
<tr>
<th>Year</th>
<th>Bowel Prep +</th>
<th>Placebo</th>
<th>Oral Ab</th>
</tr>
</thead>
<tbody>
<tr>
<td>1974</td>
<td></td>
<td>43%</td>
<td>5%</td>
</tr>
<tr>
<td>1977</td>
<td></td>
<td>43%</td>
<td>9%</td>
</tr>
<tr>
<td>1978</td>
<td></td>
<td>42%</td>
<td>18%</td>
</tr>
<tr>
<td>1979</td>
<td></td>
<td>41%</td>
<td>8%</td>
</tr>
</tbody>
</table>
Sometime in the 1980’s most American and Canadian surgeons adopted oral antibiotic regimens while most European surgeons abandoned oral antibiotics.
Parenteral Alone vs Parenteral and Oral Antibiotics – All with Bowel Prep for Colectomy


- Parenteral only
- Parenteral + Oral

p < 0.002
Parenteral Alone vs Parenteral and Oral Antibiotics – All with Bowel Prep for Colectomy – Meta-Analysis

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

Percent of patients

C. difficile colitis
Prolonged ileus

* P < 0.05


All patients get I.V. antibiotics
**“Evidence Based” Bundle to Prevent SSI in Colorectal Surgery**

<table>
<thead>
<tr>
<th>Process Measure</th>
<th>Study</th>
<th>Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mechanical Bowel Prep Oral Antibiotics</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>PreOp Warming</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>IntraOp Warming FiO2</td>
<td>Yes 80%</td>
<td>Yes 30%</td>
</tr>
<tr>
<td>Wound Protector</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>SCIP Parenteral Antibiotics</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Any SSI*</td>
<td>45%</td>
<td>24%</td>
</tr>
</tbody>
</table>

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!
How to Prepare for Your Surgery
Using MoviPrep to clean your bowel

Your surgery is scheduled for:
Day: ___________ Date: ___________ Time: _____ a.m./p.m.

5 Days Before Your Surgery
On: ______________________

- MoviPrep, 2 liters

Fill your prescription for MoviPrep No. 1 in Motrin-idol.
How to Prepare for Your Surgery

Using Moviprep to clean your bowel

Your surgery is scheduled for:

Day: __________ Date: __________ Time: _____ a.m./p.m.

5 Days Before Your Surgery

On: ______________________

- Fill your prescription for Moviprep, Neomycin, Metronidazole.
- If allergic, you will be given an alternate medication.
- Read this handout carefully.
You will receive three prescriptions for this bowel prep:

- MoviPrep, 2 liters
- Neomycin, three 1-gram doses
- Metronidazole, three 1-gram doses

You will need to have these prescriptions filled at a pharmacy before your surgery.
1 Day Before Your Surgery

On:______________________________________

- Do not eat any solid food.
- Drink only clear fluids such as juice (apple, grape, or cranberry), broth, black coffee, tea, lemonade, sports drinks, soda pop, or Jell-O. Do not drink unfiltered juices, such as apple cider.
- The Moviprep carton contains 4 pouches and a container for mixing. The container is divided by 4 marks, each mark is 8 ounces.
- In the morning, prepare the MoviPrep solution:
  - Empty 1 “Pouch A” and 1 “Pouch B” into container.
  - Add lukewarm water to the top line of the container.
  - Mix to dissolve.
  - Refrigerate to improve taste.
- Starting at 8 a.m, drink 1 glass (8 ounces) of the Moviprep solution every 15 minutes down to the next mark over 1 hour until full liter is complete. When you have finished the Moviprep solution, drink at least 4 glasses (8 ounces each, for a total of 32 ounces) of clear fluids of your choice. The laxative should cause diarrhea within one hour.
• Drink second dose starting at 10 a.m. Drink 1 glass (8 ounces) every 15 minutes over 1 hour down to the next mark until full liter is complete. After you have **finished** the MoviPrep solution, drink at least 4 glasses (8-ounces each, for a total of 32 ounces) of clear fluids of your choice before you go to bed. **The laxative should cause more diarrhea.**

• Remember to drink plenty of fluids to prevent dehydration from frequent bowel movements.

• **Take your antibiotics by mouth at these times after you complete the bowel prep:**
  
  - **At 1pm take Neomycin (1 gram) and Metronidazole (1 gram)**
  - **At 3 pm take Neomycin (1 gram) and Metronidazole (1 gram)**
  - **At 11 pm take Neomycin (1 gram) and Metronidazole (1 gram)**

• Do not eat or drink anything after 12 midnight.
The Day of Your Surgery

On: __________________________________________

- The morning of your surgery, take all medicines approved by the pre-surgery clinic as directed with a sip of water.

Special Instructions:

- If you have diabetes, your diabetes medicines may need to be adjusted. Please talk with the surgery clinic nurse.

- Please notify your physician if you experience dizziness, severe nausea or vomiting, severe belly pain, or if you are unable to finish the bowel prep.

- Signs of life-threatening reaction include wheezing, chest tightness, fever, or swelling of face, lips, tongue, or throat. Please seek emergency care if you experience any of the above.
Evidence Back into Practice

STRONG FOR SURGERY

100% Checklist

CERTAIN™
Focus on Decision Making

PATIENT

DOCTOR’S OFFICE

OPERATING ROOM
Focus on Decision Making in Hospital

PATIENT

DOCTOR’S OFFICE

OPERATING ROOM
Focus on Decision Making in Clinic
What is Strong for Surgery?

- State-wide public health campaign
  - Evidence-based practices to optimize the health of patients prior to surgery
    - 5 Pilot sites:
      - Virginia Mason
      - Swedish
      - Skagit Valley Medical Center
      - Harborview
      - UW Medical Center
Optimizing Nutrition
Smoking Cessation
Medications
Blood Sugar Control
Why Nutrition?

- Malnutrition is prevalent in surgical patients.
- Best determinant of surgical outcome.
- Modifiable with appropriate intervention.
- Immunonutrition may improve recovery.
Why Smoking?

• Smoking is prevalent
• 1/3 of all patients
  • Smokers have ↑ risk of complications
     Pulmonary
     Circulatory
     Infectious
     Impaired wound healing
Why Medications?

- Some medications and Herbal remedies ↑ risk of bleeding
- Aspirin can be safely continued
- Beta-blocker continuation associated with fewer cardiac events and mortality

Chest 2012; 141:e326S-e350S
JAMA 2008; 300(24):2867-2878
Arch Surg 2012; 147(5):467-473
Nutrition Screening Checklist

Screening for Malnutrition

Is BMI less than 19?
☐ Yes  ☐ No

Has the patient had unintentional weight loss of over 8 pounds in the last 3 months?
☐ Yes  ☐ No

Has the patient had a poor appetite – eating less than half of meals or fewer than two meals per day?
☐ Yes  ☐ No

Is the patient unable to take food orally (ex. dysphagia, vomiting)?
☐ Yes  ☐ No

If YES to any of the questions:
☐ Referral to Registered Dietitian for evaluation unless currently receiving nutrition therapy

Lab Tests for Risk Stratification

Is the patient having inpatient surgery?
☐ Yes  ☐ No

If YES then:
☐ Check albumin level to assess complication risk after surgery

Supplementation

Is the patient having complex surgery (example: GI anastomosis)?
☐ Yes  ☐ No

If YES then:
☐ Give evidence-based immune modulating supplementation
**Blood Sugar Control**

**All Patients**

Does the patient have a prior diagnosis of diabetes?
- Yes  □  No  □

Patient’s age > 45?
- Yes  □  No  □

Patient’s BMI ≥ 30?
- Yes  □  No  □

If **YES** to any of the questions:
- Check fasting blood sugar level on the morning of surgery prior to OR case
- If fasting blood glucose level > 200, then recommend use of insulin drip during OR case

**Diabetic Patients**

**Degree of Blood Sugar Control:**

Hemoglobin A1c level > 7.0%?
- Yes  □  No  □

OR

Has any fingerstick reading in the past 2 weeks been >200?
- Yes  □  No  □

If **YES** or **UNKNOWN** then:
- Referral for diabetes management

**Diabetic Patients**

**Perioperative Management:**

Will the patient be NPO after midnight?
- Yes  □  No  □

Is the patient having bowel prep?
- Yes  □  No  □

If **YES**, while NPO and during prep:
- Stop all diabetic medications except for pioglitazone (Actos)
- Reduce Lantus by 50%
- Check blood sugars frequently and use sliding scale as needed
Smoking Cessation Checklist

Risk Stratification

Has the patient ever smoked?
☐ Yes  ☐ No

If YES then:
☐ Record patient’s smoking status
   (smoker OR ex-Smoker)

☐ Record the number of pack-years
   (packs per day x years smoking)

Does the patient currently smoke?
☐ Yes  ☐ No

If YES then:
- Establish and document a plan to stop
- Help patient choose a quit date and smoking cessation method
- Encourage support from family and friends
- Highlight stress reduction activities

Smoking cessation programs
☐ 1-800-quit-now
☐ www.smokefreewashington.com
☐ Local Resources:
Medication Checklist

**Bleeding Risks**

Is the patient on a prescribed anticoagulant (ex. Coumadin, Plavix, other)?

- Yes  - No

- If YES then:
  - Discuss with prescribing MD the safety of stopping medication 1 week prior to surgery

Is the patient taking over the counter medications that increase bleeding risk (ex. NSAIDS)?

- Yes  - No

- If YES then:
  - Consider stopping all over the counter medications that can increase risk of bleeding 2 weeks prior to surgery

Is the patient taking herbal supplements containing ingredients that may increase bleeding risk (ex. Garlic, Ginger, Ginkgo Biloba, St. John’s Wort)?

- Yes  - No

- If YES then:
  - Consider stopping all herbal supplements that can increase risk of bleeding 2 weeks prior to surgery

**Beta-Blockers**

Is the patient taking a beta-blocker?

- Yes  - No

- If YES then:
  - Patient should take throughout perioperative period

**Aspirin**

Is the patient taking aspirin for cardiac protection?

- Yes  - No

- If YES then:
  - Patient should take throughout perioperative period
Public Health Campaign

- Statewide awareness
- Media events
- Website
- Mobilizing the community
- Strategic partnerships

- Surveillance and Feedback
- Change in behavior
Partner with CERTAIN & Strong for Surgery

- Take Part in Research Prioritization and Share with Colleagues (becertain.ideascale.com)
- Tell your Patients About the Patient Advisory Network
- Follow CERTAIN & Strong for Surgery Online
  - Websites (becertain.org, strongforsurgery.org)
  - Newsletter (sign up becertain.org/about/contact)
  - Facebook (facebook.com/certainWA, /strongforsurgery)
  - Twitter (@certainWA, @strong4surgery)
  - LinkedIn (search group "CERTAIN Learning Healthcare System")
- For more information: Sarah Lawrence, sarah@becertain.org
Other Potentially Important SSI Risk Reduction Process Measures

- Change gowns, gloves, drapes, instruments
- Surgical Technique
- Skin prep
- Wound protectors
- Antimicrobial sutures
- Postoperative wound management
- Door openings
- Noise
The Value of Standardization

• If all surgeons/teams do something essentially the same way,
• You can look at your results and decide if they are acceptable or not.
• If your results are not acceptable, you can decide to change something and observe the change.
• If everyone is doing something different you can’t know or learn what is contributing to your overall results.
Slide Set and References available by request

patch@uw.edu
Teamwork & Communication in the O.R.
Systems Approach to Understanding Errors

Environmental factors
• Equipment design
• Environmental distractions

Social factors
• Teamwork
• Communication

Supervisory issues
• Training
• Staffing
• Scheduling

Organizational Factors
• Procedures
• Policies
• Resources

Understanding Errors

Observation of 31 cardiac surgical cases

Technical “errors,” n=155, 3.7/hr
Surgical flow disruptions, n=341, 8.1/hr

Understanding Errors

Error:
An occasion in which a planned sequence of activities failed to achieve its intended outcome initially.

Surgical flow disruption:
Deviation from the natural progression of an operation

- Teamwork 52%
- Extraneous interruption 17%
- Equipment and technology 11%
- Resource-based issue 8%
- Supervisory/training-related issue 12%

Understanding Errors

Detecting Errors

Error detected by:

- Person who committed error
- Person who did not commit error

Timing of Error Detection:
- Immediate
- Delayed

Percent (%)

Understanding Errors

Poor teamwork may predispose to surgical errors; however, the results also demonstrate that good teamwork, in turn, may facilitate the detection and remediation of errors when they do occur.

Evaluation of a Preoperative Checklist and Team Briefing Among Surgeons, Nurses, and Anesthesiologists to Reduce Failures in Communication

Lorelei Lingard, PhD; Glenn Regehr, PhD; Beverley Orser, MD, PhD; Richard Reznick, MD, MEd; G. Ross Baker, PhD; Diane Doran, RN, PhD; Sherry Espin, RN, PhD; John Bohnen, MD; Sarah Whyte, MA

Objective: To assess whether structured team briefings improve operating room communication.

Design, Setting, and Participants: This 13-month prospective study used a preintervention/postintervention design. All staff and trainees in the division of general surgery at a Canadian academic tertiary care hospital were invited to participate. Participants included 11 general surgeons, 24 surgical trainees, 41 operating room nurses, 28 anesthesiologists, and 24 anesthesia trainees.

Intervention: Surgeons, nurses, and anesthesiologists gathered before 302 patient procedures for a short team briefing structured by a checklist.

Results: One hundred seventy-two procedures were observed (86 preintervention, 86 postintervention). The mean (SD) number of communication failures per procedure declined from 3.95 (3.20) before the intervention to 1.31 (1.53) after the intervention (P < .001). Thirty-four percent of briefings demonstrated utility, including identification of problems, resolution of critical knowledge gaps, decision-making, and follow-up actions.
Other Centers Experience with Briefings and Checklists

Communication Failures Before and After Team Briefing

<table>
<thead>
<tr>
<th></th>
<th>Cases without Failure</th>
<th>Failures per Procedure</th>
<th>Fail with Consequence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Briefing (86)</td>
<td>6%</td>
<td>4.0*</td>
<td>2.4</td>
</tr>
<tr>
<td>After</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Briefing (86)</td>
<td>38%</td>
<td>1.3*</td>
<td>0.9</td>
</tr>
</tbody>
</table>

*p < 0.001

Lingard. Arch Surg 2008;143:12-17
Other Centers Experience with Briefings
Non-Routine Events Before and After Team Briefing

Einav. Chest 2010; 137: 443-9
Risk-Adjusted Morbidity in Teaching Hospitals Correlates with Reported Levels of Communication and Collaboration on Surgical Teams but Not with Scale Measures of Teamwork Climate, Safety Climate, or Working Conditions

Daniel L Davenport, PhD, William G Henderson, PhD, Cecilia L Mosca, MPH, Shukri F Khuri, MD, FACS, Robert M Mentzer Jr, MD, FACS, and the Participants in the Working Conditions of Surgery Residents and Quality of Care Study

BACKGROUND: Since the Institute of Medicine patient safety reports, a number of survey-based measures of organizational climate safety factors (OCSFs) have been developed. The goal of this study was to measure the impact of OCSFs on risk-adjusted surgical morbidity and mortality.

STUDY DESIGN: Surveys were administered to staff on general/vascular surgery services during a year. Surveys included multiitem scales measuring OCSFs. Additionally, perceived levels of communication and collaboration with coworkers were assessed. The National Surgical Quality Improvement Program was used to assess risk-adjusted morbidity and mortality. Correlations between outcomes and OCSFs were calculated and between outcomes and communication/collaboration with attending and resident doctors, nurses, and other providers.

RESULTS: Fifty-two sites participated in the survey: 44 Veterans Affairs and 8 academic medical centers. A total of 6,083 surveys were returned, for a response rate of 52%. The OCSF measures of teamwork climate, safety climate, working conditions, recognition of stress effects, job satisfaction, and burnout demonstrated internal validity but did not correlate with risk-adjusted outcomes. Reported levels of communication/collaboration with attending and resident doctors correlated with risk-adjusted morbidity.

CONCLUSIONS: Survey-based teamwork, safety climate, and working conditions scales are not confirmed to measure organizational factors that influence risk-adjusted surgical outcomes. Reported communication/collaboration with attending and resident doctors on surgical services influenced patient morbidity. This suggests the importance of doctors’ coordination and decision-making roles on surgical teams in providing high-quality and safe care. We propose risk-adjusted morbidity as an effective measure of surgical patient safety. (J Am Coll Surg 2007;205:778–784. © 2007 by the American College of Surgeons)
Communication Quality and Surgical Morbidity

Davenport. JACS 2007;205: 778-784
Impact of Preoperative Briefings on Operating Room Delays

A Preliminary Report

Shantanu Nundy, MD; Arnab Mukherjee, MD; J. Bryan Sexton, PhD; Peter J. Pronovost, MD, PhD; Andrew Knight, MBA; Lisa C. Rowen, RN, DNSc; Mark Duncan, MD; Dora Syin, MD; Martin A. Makary, MD, MPH

**Hypothesis:** Preoperative briefings have the potential to reduce operating room (OR) delays through improved teamwork and communication.

**Design:** Pre-post study.

**Setting:** Tertiary academic center.

**Participants:** Surgeons, anesthesiologists, nurses, and other OR personnel.

**Intervention:** An OR briefings program was implemented after training all OR staff in how to conduct preoperative briefings through in-service training sessions. During the preoperative briefings, the attending sur-

about unexpected delays during each procedure and the relationship between communication breakdowns and delays. Responses were compared before and after the initiation of the preoperative briefings program.

**Results:** The use of preoperative briefings was associated with a 31% reduction in unexpected delays; 36% of OR personnel reported delays in the preintervention period, and 25% reported delays in the postintervention period (P<.04). Among surgeons alone, an 82% reduction in unexpected delays was observed (P<.001). A 19% reduction in communication breakdowns leading to delays was also associated with the use of briefings (P<.006).
Impact of Briefings on Delays

- **All reported delays** – 31% reduction
- **Surgeon-reported delays** – 82% reduction
- **Communication breakdowns** – 19% reduction

Nundy. Arch Surg 2008; 143:1068-72
# Impact of Briefings on Delays

Interval from **Scheduled** to **Actual** Start Time in Minutes

<table>
<thead>
<tr>
<th></th>
<th>Minimum</th>
<th>Max</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before Briefs (27)</td>
<td>2</td>
<td>77</td>
<td>31</td>
</tr>
<tr>
<td>After Briefs (34)</td>
<td>0</td>
<td>56</td>
<td>24</td>
</tr>
</tbody>
</table>

### Results of Starting Briefing for Cardiac Surgical Procedures

<table>
<thead>
<tr>
<th>Variable</th>
<th>% Decrease</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total disruptions/case</td>
<td>47</td>
<td>0.00002</td>
</tr>
<tr>
<td>Knowledge disrupt/case</td>
<td>46</td>
<td>0.007</td>
</tr>
<tr>
<td>Miscommunications/case</td>
<td>53</td>
<td>0.03</td>
</tr>
<tr>
<td>Circulator to core</td>
<td>53</td>
<td>0.008</td>
</tr>
<tr>
<td>Time circulator gone</td>
<td>56</td>
<td>0.01</td>
</tr>
</tbody>
</table>

Teamwork in the O.R.

% Reporting Good Collaboration

- Anesthesiologists w/ each other: 96%
- Surgeons w/ each other: 85%
- CRNAs w/ each other: 93%
- OR Nurses w/ each other: 81%

<table>
<thead>
<tr>
<th>Caregiver Position Performing Rating</th>
<th>Surgeon</th>
<th>Anesthesiologist</th>
<th>Nurse</th>
<th>CRNA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surgeon</td>
<td>85</td>
<td>84</td>
<td>88</td>
<td>87</td>
</tr>
<tr>
<td>Anesthesiologist</td>
<td>70</td>
<td>96</td>
<td>89</td>
<td>92</td>
</tr>
<tr>
<td>Nurse</td>
<td>48</td>
<td>63</td>
<td>81</td>
<td>68</td>
</tr>
<tr>
<td>CRNA</td>
<td>58</td>
<td>75</td>
<td>76</td>
<td>93</td>
</tr>
</tbody>
</table>
Different Perceptions of Collaboration and Communication

Definitions of collaboration:

Nurses – having their input respected
Surgeons - having nurses anticipate their needs and follow instructions

Carney. AORN J 2010; 91: 722
Different Perceptions of Collaboration and Communication

Different ratings by nurses and surgeons:

- Nurse input is well received
- Difficult to speak up if I perceive a problem with patient care
- Disagreements are resolved by what is best for the patient, not who is “right”
- It is easy to ask questions if I do not understand
- Surgeons and nurses work as a well-coordinated team

Carney. AORN J 2010; 91: 722
Different Perceptions of Collaboration and Communication in the Operating Room

Significantly different ratings by nurses and surgeons:

- I am comfortable intervening in a procedure if I have concerns about what is occurring.
- During surgical and diagnostic procedures, everyone on the team is aware of what is happening.
- Morale on our team is high.
- Everyone on our team is comfortable giving feedback to other team members.

Pre- & Post-Briefing Assessment of Personal and Other’s Teamwork in the O.R.

<table>
<thead>
<tr>
<th>Assessment (1-6) of Self</th>
<th>Before briefings</th>
<th>After briefings</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>5.63</td>
<td>5.77</td>
</tr>
</tbody>
</table>

Pre- & Post-Briefing Assessment of Personal and Other’s Teamwork in the O.R.

<table>
<thead>
<tr>
<th>Assessment (1-6)</th>
<th>of Self</th>
<th>of Peer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before briefings</td>
<td>5.63</td>
<td>5.29*</td>
</tr>
<tr>
<td>After briefings</td>
<td>5.77</td>
<td>5.74*</td>
</tr>
</tbody>
</table>

*p < 0.0001

Wrong Site Surgery
Actual Occurrences vs Near Misses

Member of Team Raised
Specific Concern

Near Miss 82%

Wrong Site Surgery
Actual Occurrences vs Near Misses

Member of Team Raised
Specific Concern

Near Miss 82%
Actual Occurrence 40%

Clinical Surgery-American

Surgical team behaviors and patient outcomes

Karen Mazzocco, R.N., J.D.\textsuperscript{a,*}, Diana B. Petitti, M.D., M.P.H.\textsuperscript{b}, Kenneth T. Fong, M.S.\textsuperscript{c}, Doug Bonacum, M.B.A.\textsuperscript{c}, John Brookey, M.D.\textsuperscript{d}, Suzanne Graham, R.N., Ph.D.\textsuperscript{e}, Robert E. Lasky, Ph.D.\textsuperscript{f}, J. Bryan Sexton, Ph.D.\textsuperscript{g}, Eric J. Thomas, M.D., M.P.H.\textsuperscript{f}

\textsuperscript{a}Sharp Metropolitan Medical Campus, Sharp Healthcare, Patient Relations and Concierge Services, San Diego, CA USA; \textsuperscript{b}Arizona State University, Tempe, AZ, USA; \textsuperscript{c}Kaiser Permanente Program Offices, Oakland, CA, USA; \textsuperscript{d}Kaiser Permanente Southern California, Pasadena, CA, USA; \textsuperscript{e}Kaiser Permanente Northern California, Oakland, CA, USA; \textsuperscript{f}University of Texas Medical School, Houston, TX, USA; \textsuperscript{g}Johns Hopkins School of Medicine, Baltimore, MD, USA
Behavioral Marker Risk Index (BMRI)

Induction, Intraoperative, & Handoff (293 cases)
- Briefing
- Information sharing
- Inquiry
- Vigilance and awareness

<table>
<thead>
<tr>
<th>Risk Factor</th>
<th>Adjusted Odds Ratio Complication or Death</th>
</tr>
</thead>
<tbody>
<tr>
<td>BMRI</td>
<td>4.82</td>
</tr>
<tr>
<td>ASA</td>
<td>1.51</td>
</tr>
</tbody>
</table>

Successful Teamwork

“To ensure that team members are empowered to seek support at any time, the team must foster an environment of continuous learning in which seeking advice or help is considered a strength and rewarded.”

Strong Team Leadership

- Set expectations
- Clarify roles
- Encourage feedback
- Debrief
- Give updates
Surgeon’s Message to the Team

I am Dr. Dellinger, and I am a good surgeon but I am vulnerable to error. So, you are here as a team to help me avoid error and to take good care of this patient.
## Checklist and Complications

London, Toronto, Seattle, Auckland, New Delhi, Amman, Manila, Ifakara

<table>
<thead>
<tr>
<th></th>
<th>Before</th>
<th>After</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n=3773</td>
<td>n=3955</td>
</tr>
<tr>
<td>SSI (down 46%)</td>
<td>6.2%</td>
<td>3.4%</td>
</tr>
<tr>
<td>Unplan Return-O.R.</td>
<td>2.4%</td>
<td>1.8%</td>
</tr>
<tr>
<td>Any Complic</td>
<td>11.0%</td>
<td>7.0%</td>
</tr>
<tr>
<td>Death</td>
<td>1.5%</td>
<td>0.8%</td>
</tr>
</tbody>
</table>

Haynes. NEJM 2009; 360: 491-9
Change in Safety Attitudes and Change in Complication Rates

Haynes. BMJ Qual Saf 2011;20:102e107
Checklist and Complications
The Netherlands

<table>
<thead>
<tr>
<th></th>
<th>Before</th>
<th>After</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n=3760</td>
<td>n=3820</td>
</tr>
<tr>
<td><strong>SSI</strong> (down 29%)</td>
<td>3.8%</td>
<td>2.7%</td>
</tr>
<tr>
<td><strong>Complic/100 pts</strong></td>
<td>27.3</td>
<td>16.7</td>
</tr>
<tr>
<td><strong>Pts with Complic</strong></td>
<td>15.4%</td>
<td>10.6%</td>
</tr>
<tr>
<td><strong>Death</strong></td>
<td>1.5%</td>
<td>0.8%</td>
</tr>
</tbody>
</table>

de Vries. NEJM 2010; 363: 1928-37
Checklist Completion and Complications

Checklist Completion  Complic
Above median  7.1%
Below median  11.7%

de Vries. NEJM 2010; 363: 1928-37
Checklist Completion and Mortality
The Netherlands

22 item checklist modeled on WHO
25,513 patients followed

Record of checklist completion:
• Not done
• Partial - at least 1 of 22 done
• Completed - all done

Checklist Completion and Mortality

Adjusted Odds Ratio

Mortality

All patients  0.85 (0.73-0.98)

## Checklist Completion and Mortality

<table>
<thead>
<tr>
<th>Completion Status</th>
<th>Adjusted Odds Ratio Mortality</th>
</tr>
</thead>
<tbody>
<tr>
<td>All patients</td>
<td>0.85 (0.73-0.98)</td>
</tr>
<tr>
<td>Completed</td>
<td>0.44 (0.28-0.70)</td>
</tr>
<tr>
<td>Partial</td>
<td>1.09 (0.78-1.52)</td>
</tr>
<tr>
<td>Not done</td>
<td>1.16 (0.86-1.56)</td>
</tr>
</tbody>
</table>

# Reduction in Complications with Use of Checklists

<table>
<thead>
<tr>
<th>Event</th>
<th>RR</th>
<th>(range)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mortality</td>
<td>0.57</td>
<td>(0.42-0.76)</td>
</tr>
<tr>
<td>Any Complication</td>
<td>0.63</td>
<td>(0.58-0.67)</td>
</tr>
<tr>
<td>SSI</td>
<td>0.62</td>
<td>(0.53-0.72)</td>
</tr>
<tr>
<td>Unplanned Return to O.R.</td>
<td>0.76</td>
<td>(0.56-1.02)</td>
</tr>
</tbody>
</table>

Intraoperative Events During 73 General Surgery Cases

- Inadequate Communication: 50.68%
- Decision Making: 17.81%
- Lack of Equipment Availability: 13.84%
- Equipment Malfunction: 36.99%
- Disruptive Behavior: 17.81%
- Interrupted Process or Flow: 36.99%
- Deviation from Aseptic Technique: 67.12%

Bliss. JACS 2012; 215: 766-76
Adherence to Checklist Process

Levy, Implementing a Surgical Checklist. Surgery 2012; 152: 331-6
Elements for Successful Introduction of Checklists

- **Explanation** - why do a checklist?
- **Introduction and support** of the checklist
- **Long-term support**
- **Specific education** about the checklist
- **Real time coaching and feedback**
- **Reading** the checklist rather than memory
- **Addressing staff concerns**
- **Multidisciplinary leadership**

Conley. JACS 2011; 212: 873-9
Before induction: Briefing

All Team Members - (Attending Surgeon or designee leads):
- Confirm patient (at least 2 identifiers), procedure, site, Left/Right
- Describe procedure, expected duration, & anticipated difficulties
- Expected blood loss & blood availability
- Need for special instruments / supplies / IV access beyond usual
- Heparin given/not needed and/or SCDs in place and turned on

Nursing/Tech reviews:
- Equipment issues (instruments ready, staff in-serviced, implants available)

Anesthesia reviews:
- Airway or other concerns
- Allergies
- Special meds, other

All Team Members
- Questions/issues/concerns from any team member & duty to speak up at any time in the procedure
Before induction: Briefing

All Team Members - (Attending Surgeon or designee leads):
- Confirm patient (at least 2 identifiers), procedure, site, Left/Right
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- Special meds, other

All Team Members:
- Questions/issues/concerns from any team member & duty to speak up at any time in the procedure
2 Before incision: Process control

- Attending Surgeon reviews: (as applicable)
  - Attending Surgeon not present for SCOAP 1? Repeat SCOAP 1.
  - Each person introduces self by name & role
  - Personnel exchanges: timing, plan for announcing changes
  - Essential imaging displayed; right & left confirmed
  - Has patient positioning changed since SCOAP 1? Is marking still visible?
  - Antibiotic prophylaxis - drug, dose, time, redosing plan
  - Active warming – needed? In place, turned on?
  - Risk of hyperglycemia? Plan for insulin protocol if needed
  - Sharps management plan
  - Specialty-specific checklist
Before incision: Process control

Attending Surgeon reviews: (as applicable)
- Attending Surgeon not present for SCOAP 1? Repeat SCOAP 1.
- Each person introduces self by name & role
- Personnel exchanges: timing, plan for announcing changes
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- Active warming – needed? In place, turned on?
- Risk of hyperglycemia? Plan for insulin protocol if needed
- Sharps management plan
- Specialty-specific checklist
3 Just before closure of operative field or removal of trocars: No retained objects

<table>
<thead>
<tr>
<th>Attending Surgeon:</th>
<th>Nursing/Tech:</th>
</tr>
</thead>
<tbody>
<tr>
<td>□ Perform methodical visual &amp; physical sweep of wound &amp; report</td>
<td>□ All music, conversation, &amp; distractions halted</td>
</tr>
<tr>
<td></td>
<td>□ Perform preliminary count of needles/sponges/instruments &amp; report</td>
</tr>
</tbody>
</table>
After skin closure complete: No retained objects, debrifing, care transition

<table>
<thead>
<tr>
<th>All Team Members (Attending Surgeon or designee leads):</th>
<th>Surgeon and Anesthesia:</th>
</tr>
</thead>
<tbody>
<tr>
<td>□ Confirm final needles/ sponges/ instruments count correct</td>
<td>□ Does patient need special monitoring?</td>
</tr>
<tr>
<td>□ Surgeon views all sponges &amp; laps in holders</td>
<td>□ Insulin drip needed?</td>
</tr>
<tr>
<td>□ Confirm name of procedure</td>
<td>□ Post-op beta blockers needed?</td>
</tr>
<tr>
<td>□ Any specimens? Confirm label &amp; instructions</td>
<td>□ Post-op anticoagulation needed?</td>
</tr>
<tr>
<td>□ Equipment issues to be addressed? If yes, response plan</td>
<td>□ Pain management by Surgery or Acute Pain Service?</td>
</tr>
<tr>
<td>□ Other issues? If yes, response plan</td>
<td>□ Other special concerns for patient recovery?</td>
</tr>
</tbody>
</table>
## After skin closure complete:
No retained objects, debriefing, care transition

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<th>All Team Members (Attending Surgeon or designee leads):</th>
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<tbody>
<tr>
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</tr>
<tr>
<td>□ Other issues? If yes, response plan</td>
<td>□ Other special concerns for patient recovery?</td>
</tr>
</tbody>
</table>
Association Between Implementation of a Medical Team Training Program and Surgical Mortality

Julia Neily, RN, MS, MPH  
Peter D. Mills, PhD, MS  
Yinong Young-Xu, ScD, MA, MS  
Brian T. Carney, MD  
Priscilla West, MPH  
David H. Berger, MD, MHCM  
Lisa M. Mazzia, MD  
Douglas E. Paull, MD  
James P. Bagian, MD, PE

Adverse events related to surgery continue to occur despite the best efforts of clinicians. Teamwork and effective communication are known determinants of surgical safety. Previous efforts at demonstrating the efficacy of patient safety initiatives have been limited because of the inability to study a control group. For example, the

Context  There is insufficient information about the effectiveness of medical team training on surgical outcomes. The Veterans Health Administration (VHA) implemented a formalized medical team training program for operating room personnel on a national level.

Objective  To determine whether an association existed between the VHA Medical Team Training program and surgical outcomes.

Design, Setting, and Participants  A retrospective health services study with a contemporaneous control group was conducted. Outcome data were obtained from the VHA Surgical Quality Improvement Program (VASQIP) and from structured interviews in fiscal years 2006 to 2008. The analysis included 182,409 sampled procedures from 108 VHA facilities that provided care to veterans. The VHA's nationwide training program required briefings and debriefings in the operating room and included checklists as an integral part of this process. The training included 2 months of preparation, a 1-day conference, and 1 year of quarterly coaching interviews.

Main Outcome Measure  The rate of change in the mortality rate 1 year after facilities enrolled in the training program compared with the year before and with non-training sites.

Results  The 74 facilities in the training program experienced an 18% reduction in annual mortality (rate ratio [RR], 0.82; 95% confidence interval [CI], 0.76-0.91; P = .01) compared with a 7% decrease among the 34 facilities that had not yet undergone training (RR, 0.93; 95% CI, 0.80-1.06; P = .59). The risk-adjusted mortality rates at baseline were 17 per 1000 procedures per year for the trained facilities and 15 per
Team Training in the O.R.

Day-long onsite learning session involving

- Surgeons
- Anesthesiologists
- Nurse anesthetists
- Nurses
- Technicians

Neily. JAMA 2010; 304:1693-1700
Team Training in the O.R.

Content

• Work as a team
• **Challenge each other** about safety risks
• Conduct **checklist guided briefings** and postoperative **debriefings**
• **Communication strategies**
  • recognize red flags
  • rules of conduct for communication
  • stepping back to reassess a situation
  • effective communication during care transitions

Neily. JAMA 2010; 304:1693-1700
Team Training and Mortality

Deaths per 1000 Procedures

Quarters of Training Program

Baseline

No. of Facilities
74 16 20 24 14

Average risk-adjusted mortality rate

Neily. JAMA 2010;304:1693-1700
Team Training and Morbidity

- 42 VA hospitals underwent team training and 32 did not during 2007.
- Both groups demonstrated reduction in overall morbidity and postoperative infections from 2006 to 2008.
- Hospitals with team training had 20% greater reduction in morbidity ($p<0.001$) and 17% greater reduction in infections ($p<0.005$).

# Improvements Reported by Medical Team Training Facilities From Structured Interviews

**Table 3.** Improvements Reported by Medical Team Training Facilities From Structured Interviews

<table>
<thead>
<tr>
<th>Reported Improvements</th>
<th>No. (%) of Facilities (n = 74)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Communication among operating room staff</td>
<td>35 (47.2)</td>
</tr>
<tr>
<td>Staff awareness</td>
<td>34 (46.0)</td>
</tr>
<tr>
<td>Overall efficiency</td>
<td>49 (66.2)</td>
</tr>
<tr>
<td>Equipment use during surgery</td>
<td>44 (59.9)</td>
</tr>
<tr>
<td>Reduced length of procedures</td>
<td>15 (20.3)</td>
</tr>
<tr>
<td>Improved first-case start times</td>
<td>30 (40.5)</td>
</tr>
<tr>
<td>Other types of efficiency improvements&lt;sup&gt;a&lt;/sup&gt;</td>
<td>6 (8.1)</td>
</tr>
</tbody>
</table>

<sup>a</sup>For example, reduced delays for surgical consent, decreased turnover time between cases, reduction in staff overtime hours.

Neily. *JAMA* 2010;304:1693-1700
Incorrect Surgical Procedures 2000 to 2010

* Team Training Program

Causes of Incorrect Surgical Procedures (n=596)

- Communication Problems
- Time-out Problems
- Nonstandardization, Other
- Human Factor Problems
- Or Schedule Problems
- Training and Education
- Other Root Causes
- Problems With Policy
- Documentation
- Staffing Problems
- Time Pressure

Neily. Arch Surg 2009; 144: 1028
<table>
<thead>
<tr>
<th>Agree or strongly agree</th>
<th>After</th>
</tr>
</thead>
<tbody>
<tr>
<td>Checklist easy to use</td>
<td>56%</td>
</tr>
<tr>
<td>Checklist improved O.R. safety</td>
<td>60%</td>
</tr>
<tr>
<td>Took a long time to complete</td>
<td>23%</td>
</tr>
<tr>
<td>I would want checklist for me</td>
<td>88%</td>
</tr>
<tr>
<td>Communication was improved</td>
<td>81%</td>
</tr>
<tr>
<td>Checklist helped to prevent errors</td>
<td>67%</td>
</tr>
</tbody>
</table>
Teamwork and Error in the Operating Room

Leadership and Management (L&M)

- Involves, Reflects on Suggestions, Visible, Accessible
- Subscribes to and Monitors standards, Intervenes for deviations, Deviates with team approval
- Team participates in planning, Plan is shared, Understanding confirmed
- Distributes & Monitors tasks, Responds to stress
- Values team input, Takes control, Persistent

Surgical trainees echoed – in fact, exaggerated – their staff surgeon’s dissonant constructions of the ‘other’. Such echoing demonstrates the shared cognition that marks professional membership and defines professional boundaries.

Lingard. Medical Education 2002; 36: 728-34
Communication in the Operating Room

- 35 observed cases contained 1–4 higher-tension events. These occurred most often between surgical and nursing staff.
- Although not combative, tension recurred.
- Communication is more subtle than the combative style of O.R. myth as on TV.
- Patterns reflect strategies for achieving goals while minimizing tension and maintaining social cohesion.

Challenges Ahead

- Institutionalizing the checklist – Every O.R., Every Case
- Supporting the culture change that the checklist suggests
- The checklist is more than a list of items to be checked. It needs to promote and support teamwork.
- Getting the “buy-in” of all Surgeons
- Streamlining the checklist to meet the needs of individual hospitals and specialties while preserving the essentials
- Remembering the Debriefing!
Quality of O.R. Briefings is Correlated with Leadership Involvement and Support

Culture of Delivering Safe, High-Acuity Perioperative Care

- Clear central goals, widely shared across organization
- Hierarchical structure honors collegial decision-making independent of rank
- Vigilance is prized & safety rewarded
- Databases support safety goals
- Reporting and simulation enhance learning

### Cause of Process Failures

50 Patients & 659 Days of Care

<table>
<thead>
<tr>
<th>Process Failure</th>
<th>Communication Failure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medication (44%)</td>
<td>40%</td>
</tr>
<tr>
<td>Care Mgmt/Delivery (39%)</td>
<td>35%</td>
</tr>
<tr>
<td>Assessment (9%)</td>
<td>36%</td>
</tr>
<tr>
<td>Investigations (8%)</td>
<td>81%</td>
</tr>
<tr>
<td>Total</td>
<td>41%</td>
</tr>
</tbody>
</table>

Hospital Performance: Process before and after checklist implementation

![Graph showing hospital performance metrics before and after checklist implementation.](image-url)
More Information

www.who.int/patientsafety/safesurgery/en.index.html

www.safesurg.org

www.scoap.org

www.nbc.com/ER/video/episodes/#vid=1059351
American College of Endocrinology Consensus Development Conference on Inpatient Diabetes and Metabolic Control

The use of standardized protocols that are developed by multidisciplinary teams is associated with improved glycemic control and lower rates of hypoglycemia. In addition to specifying insulin dose, protocols should also include specific guidelines for identifying patients at risk for hypoglycemia and actions to be taken to prevent and treat hypoglycemia.

Amer Assoc Clinical Endocrinologists-Position Statement, 16 Dec 2003
GLUCOSE CONTROL ALGORITHMS

The Rabbit 2 basal bolus protocol is online at http://care.diabetesjournals.org/lookup/suppl/doi:10.2337/dc10-1407/-/DC1

# Rabbit 2 Protocols

## 1. Basal Bolus Regimen with Insulin Glargine and Glulisine

### 1.A. Insulin Orders

- Discontinue oral antidiabetic drugs (*sulfonylureas, repaglinide, nateglinide, metformin, pioglitazone, rosiglitazone, sitagliptin*) and non-insulin injected antidiabetic medication (*pramlintide, exenatide*) on admission.

- Starting insulin total daily dose (TDD): 0.5 units per kg of body weight.
  - Reduce insulin TDD to 0.3 units per kg of body weight in patients \( \geq 70 \) years of age and/or with a serum creatinine \( \geq 2.0 \text{ mg/dL} \).

- Give half of total daily dose as insulin glargine and half as insulin glulisine.

- Give insulin glargine once daily, at the same time of the day.

- Give insulin glulisine in three equally divided doses before each meal. Hold insulin glulisine if patient not able to eat.
## 1.B. Supplemental insulin

- Give supplemental insulin glulisine following the “sliding scale” protocol (1E) for blood glucose > 140 mg/dl.

- If a patient is able and expected to eat all, give supplemental glulisine insulin before each meal and at bedtime following the “usual” column.

- If a patient is not able to eat, give supplemental glulisine insulin every 6 hours (6-12-6-12) following the “sensitive” column.
### Rabbit 2 Protocols

#### 1.C. Insulin adjustment

- If the fasting and predinner BG is between 100 - 140 mg/dl in the absence of hypoglycemia the previous day: no change
- If the fasting and predinner BG is between 140 - 180 mg/dl in the absence of hypoglycemia the previous day: increase insulin TDD by 10% every day
- If the fasting and predinner BG is >180 mg/dl in the absence of hypoglycemia the previous day: increase insulin TDD dose by 20% every day
- If the fasting and predinner BG is between 70 - 99 mg/dl in the absence of hypoglycemia: decrease insulin TDD dose by 10% every day
- If a patient develops hypoglycemia (BG <70 mg/dL), the insulin TDD should be decreased by 20%.

#### 1.D. Blood glucose monitoring.

Blood glucose will be measured before each meal and at bedtime (or every 6 hours if a patient is not eating) using a glucose meter.
## Rabbit 2 Protocols

### 1.E. Supplemental Insulin Scale

<table>
<thead>
<tr>
<th>Blood Glucose (mg/dL)</th>
<th>Insulin Sensitive</th>
<th>Usual</th>
<th>Insulin Resistant</th>
</tr>
</thead>
<tbody>
<tr>
<td>141-180</td>
<td>2</td>
<td>4</td>
<td>6</td>
</tr>
<tr>
<td>181-220</td>
<td>4</td>
<td>6</td>
<td>8</td>
</tr>
<tr>
<td>221-260</td>
<td>6</td>
<td>8</td>
<td>10</td>
</tr>
<tr>
<td>261-300</td>
<td>8</td>
<td>10</td>
<td>12</td>
</tr>
<tr>
<td>301-350</td>
<td>10</td>
<td>12</td>
<td>14</td>
</tr>
<tr>
<td>351-400</td>
<td>12</td>
<td>14</td>
<td>16</td>
</tr>
<tr>
<td>&gt; 400</td>
<td>14</td>
<td>16</td>
<td>18</td>
</tr>
</tbody>
</table>

**Check appropriate column below and cross out other columns.

The numbers in each column indicate the number of units of glulisine or regular insulin per dose. Supplemental” dose is to be added to the scheduled dose of glulisine or regular insulin.
CONSULT ENDOCRINE SERVICE FOR:

- Acute Care patients on insulin infusion receiving oral nutrition or intermittent tube feeding

GOAL Blood Glucose (BG) RANGE:

ACUTE CARE OR ICU: 100-180 mg/dL initiate when ordered
ICU ONLY: 100-140 mg/dL initiate when BG>140 x 2

Discontinue all previous insulin orders.

Insulin Infusion: 100 units insulin/ 100 mL NS given IV infusion, at:
- Algorithm 1: Start here for most patients.
- Algorithm 2: Start here if S/P CABG surgery, solid organ transplant, receiving glucocorticoids, or patient receiving >80 units/day of insulin as an outpatient.

NO PATIENT STARTS AT ALGORITHM 3 OR 4.

See back of form for the Algorithms and decision tree

When transitioning to SubQ: Use www.uwmedres.org/resources for dosing assistance: Give specified basal SubQ insulin dose, and then stop insulin infusion in 2 hours.

Fluid/Nutrition Orders:

Recommendations for patients that are not eating:

DM Type 1 (10 grams glucose/hour) DM Type 2 (5 grams glucose/hr)
- D51/2 normal saline with _____ mEq/L Potassium chloride IV at _______________ mL/hr
- D5LR with _____ mEq/L Potassium chloride IV at _______________ mL/hr
- TPN or Enteral Feeds (see separate orders)
- Other ________________________________________ at _____________ mL/hr
UW I.V. Insulin Infusion Protocol

Patient Monitoring:
- Check BG every 1 hour until it is within goal range for 4 hours. Then decrease BG checks to every 2 hours. ALWAYS resume hourly checks if BG exits goal range.
- Hourly monitoring may be indicated for critically ill patients or patients having medical or surgical procedures even if they have stable BG.

Notify the Provider:
- For any BG increase >100 mg/dL from a stable baseline
- For 2 consecutive BG decreases of >100 mg/dL
- For any hypoglycemia which results in loss of consciousness OR does not resolve within 20 min of implementing the hypoglycemia protocol below

Treatment of Hypoglycemia (BG <70 mg/dL) or symptoms of hypoglycemia
- Turn off insulin infusion for any BG below goal AND
- Give 25 mL (1/2 amp) of 50% dextrose IV if BG 50-69 mg/dL OR
- Give 50 mL (1 amp) of 50% dextrose IV if BG < 50 mg/dL.
- Recheck BG every 20 minutes until BG ≥100 mg/dL
  → IF BG is <70 mg/dL repeat 25 mL (1/2 amp) 50% dextrose
  → WHEN BG is ≥100 mg/dL, restart the insulin infusion at a lower dose by using one algorithm LEFT from previous algorithm (see “Evaluating Trends & Using Algorithms” section).
BG monitoring: Check BG every 1 hour until it is within goal range for 4 hours. Then decrease BG checks to every 2 hours. ALWAYS resume hourly checks if BG exits goal range and when there is a change in algorithm. Check BG in 20-30 minutes as noted below. Hourly monitoring may be indicated for critically ill patients or patients having medical or surgical procedures even if they have stable BG.
**UW I.V. Insulin Infusion Protocol**

### Insulin Infusion Algorithm Decision Tree

**Blood Glucose in Goal Range?**

- **Yes**
  - Was decrease more than 30 mg/dL OR previous BG below goal range?
    - **Yes**
      - Move LEFT one algorithm and adjust rate to match BG range
    - **No**
      - Adjust rate hourly to match BG range in current algorithm until BG is in goal range X 4 hrs
      - Once within goal range for 4 hrs, check BG q2hr. Do NOT adjust rate unless BG <110 or >180

- **No**
  - **Below Goal Range and Hypoglycemia**
    - TURN OFF insulin infusion
      - For BG 70-99 No dextrose
      - For BG 50-69 Give 25mL (½ amp) 50% dextrose
      - For BG < 50 Give 50mL (1 amp) 50% dextrose
      - Recheck BG in 20-30 min.
      - When BG has increased to goal range, move LEFT one algorithm. Adjust rate to match BG range

**Above Goal Range**

- **BG decreased > 75**
  - Move LEFT one algorithm and adjust rate to match BG range
  - Recheck BG in 20-30 minutes if BG decreased >100 mg/dL

- **BG decreased 50-75**
  - Adjust rate to match BG range in current algorithm

- **BG increased by any amt. or decreased <50**
  - Move RIGHT one algorithm and adjust rate to match BG range

*If TPN/Enteral nutrition is stopped or significantly reduced, decrease insulin infusion rate by moving LEFT one algorithm. Then, use algorithm table & instructions to determine subsequent rate changes AND check BG every 1 hour x 4 hours.*
<table>
<thead>
<tr>
<th>Algorithm 1</th>
<th>Algorithm 2</th>
<th>Algorithm 3</th>
<th>Algorithm 4</th>
</tr>
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<tbody>
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<td>BG</td>
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<td>BG</td>
<td>Units/hr</td>
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<tr>
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<70 = Hypoglycemia See front of form for treatment

70-99: Off x 20-30 minutes & recheck BG

If NOT achieving glycemic control with Algo 4 X >3 consecutive hours
Consider High Dose Insulin Protocol
UWMC **HIGH DOSE** Insulin Infusion Protocol

Initiate HIGH DOSE Insulin Infusion Orders **only** after documented failure to achieve glycemic control with Algorithm 4 Standard Insulin Infusion Orders X ≥3 consecutive hrs

**GOAL Blood Glucose (BG) RANGE** – check one box:

- **ACUTE CARE OR ICU:** □ 100-180 mg/dL
- **ICU ONLY:** □ 100-140 mg/dL
## UW I.V. Insulin Infusion Protocol

<table>
<thead>
<tr>
<th>Algorithm 5</th>
<th>Algorithm 6</th>
<th>Algorithm 7</th>
<th>Algorithm 8</th>
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<tr>
<td>BG</td>
<td>Unit/hr</td>
<td>BG</td>
<td>Units/hr</td>
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</tbody>
</table>

<70 = Hypoglycemia See front of form for treatment

70-99: Off x 20-30 minutes & recheck BG

100-110: Recheck BG in 20-30 min, consider moving left one Algorithm

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<tr>
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Hospital Discussion and Questions

Questions
Next Steps

- Upcoming Webinars:
  - Thursday, December 5, 7:00 – 8:00 a.m.

- Milestones for November:
  - Implemented SSI reduction interventions pre, intra and post-operatively