Prevention of Surgical Site Infections: Beyond Core Measures

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Disclosures

Speaker’s Bureau:
- Cubicin
- Merck
- Sage
Burden estimates to support prioritization of public health problems


**Estimating Health Care-Associated Infections and Deaths in U.S. Hospitals, 2002**

**SYNOPSIS**

**Objective.** The purpose of this study was to provide a national estimate of the number of healthcare-associated infections (HAI) and deaths in United States hospitals.

**Methods.** No single source of nationally representative data on HAIs is currently available. The authors used a multi-step approach and three data sources...

- 1.7 million infections in hospitals
  - Most (1.3 million) were outside of ICUs
  - 9.3 infections per 1,000 patient-days
  - 4.5 per 100 admissions
- 99,000 deaths associated with infections
  - 36,000 – pneumonia
  - 31,000 – bloodstream infections

### Table 1. Distribution of top ranking pathogens associated with NHSN reportable HAIs; January 2006 - October 2007

<table>
<thead>
<tr>
<th>Pathogen (n=33,848) (25,502 infections)</th>
<th>CLABSI</th>
<th>CAUTI</th>
<th>VAP</th>
<th><strong>SSI</strong></th>
<th>Total *</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>%</td>
<td>N</td>
<td>%</td>
<td>N</td>
</tr>
<tr>
<td>A. baumannii</td>
<td>252</td>
<td>2.21</td>
<td>109</td>
<td>1.16</td>
<td>498</td>
</tr>
<tr>
<td>CoNS</td>
<td>3900</td>
<td>34.13</td>
<td>234</td>
<td>2.50</td>
<td>79</td>
</tr>
<tr>
<td>Candida spp.</td>
<td>1342</td>
<td>11.74</td>
<td>1974</td>
<td>21.05</td>
<td>160</td>
</tr>
<tr>
<td>Enterococcus spp.</td>
<td>1834</td>
<td>16.05</td>
<td>1393</td>
<td>14.85</td>
<td>77</td>
</tr>
<tr>
<td>Enterobacter spp.</td>
<td>443</td>
<td>3.88</td>
<td>384</td>
<td>4.10</td>
<td>498</td>
</tr>
<tr>
<td>P. aeruginosa</td>
<td>357</td>
<td>3.12</td>
<td>938</td>
<td>10.00</td>
<td>972</td>
</tr>
<tr>
<td>S. aureus</td>
<td>1127</td>
<td>9.86</td>
<td>208</td>
<td>2.22</td>
<td>1456</td>
</tr>
</tbody>
</table>

*Total reflects post procedure pneumonia event as well (not included in this table)

Source: Hidron et al., ICHE 2008
Preventing SSIs
Case

MJ is a 66 year-old WF admitted for an elective CAB. Patient is obese with IDDM and hypertension. She is a non-smoker. History of “boils” in past.

- Day 1-CAB with LIMA and sephenous vein (4.5 hr)-1 gram cefazolin prophylaxis given within 40 min of incision; discontinued at 36 hours post closure
- Day 2-3-weaned from ventilator POD 2-6 AM BS 190 and 197
- Day 5-fever to 103° and increasing sternal pain-blood cultures drawn-started on vancomycin and cefepime
- Day 6-new cloudy drainage from sternal incision-cultured
- Day 7-CT chest fluid under sternum-blood cultures and sternal drainage growing gram-positive cocci
- Day 8-blood and sternum growing___________________
• Day 9 - patient taken back to OR for sternal debridement and drainage of mediastinal abscess - cefepime was discontinued
• Day 9-15 vent dependent
• Day 13 - respikes fever to 102° - new infiltrate on CXR - TA and blood cultures obtained
• Day 14 - TA and blood growing a gram-negative rod - cefepime restarted
• Day 15 - extubated - blood and TA grew _______
• Day 18 - transferred to floor
• Day 22 transferred to LTAC
“Next, an example of the very same procedure when done correctly.”
Patient characteristics
Preoperative issues
Intra-operative issues
Postoperative issues

SSI: Modifiable Risks

Glucose control
Preoperative CHG shower
Appropriate hair removal
Hand hygiene
Skin antisepsis
Antimicrobial prophylaxis
Normothermia

5 Million lives. Institute for Healthcare Improvement. Available at:
Category IA Recommendations (8 total)

- Remote infections
- Hair removal (2)
- Antimicrobial prophylaxis (4)
- Aseptic procedures/skin preparation
CDC Guideline for Prevention of Surgical Site Infections, 1999

Category IB Recommendations (42)
Include: serum glucose control, skin prep, surgical hand scrub, restricting vancomycin for AP, OR ventilation, sterilization, surveillance

Category II Recommendations (11)
Include: ultraclean air for orthopedic procedures, sterile dressing changes, post-discharge SSI surveillance
<table>
<thead>
<tr>
<th>Category/Grade</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strength of Recommendation</td>
<td></td>
</tr>
<tr>
<td>A</td>
<td>Good evidence to support a recommendation for use.</td>
</tr>
<tr>
<td>B</td>
<td>Moderate evidence to support a recommendation for use.</td>
</tr>
<tr>
<td>C</td>
<td>Poor evidence to support a recommendation.</td>
</tr>
<tr>
<td>Quality of Evidence</td>
<td></td>
</tr>
<tr>
<td>I</td>
<td>Evidence from $\geq 1$ properly randomized, controlled trial.</td>
</tr>
<tr>
<td>II</td>
<td>Evidence from $\geq 1$ well-designed clinical trial, without randomization; from cohort or case-controlled analytic studies (preferably from $\geq 1$ center); from multiple time-series; or from dramatic results from uncontrolled experiments.</td>
</tr>
<tr>
<td>III</td>
<td>Evidence from opinions of respected authorities, based on clinical experience, descriptive studies, or reports of expert committees.</td>
</tr>
</tbody>
</table>
I. Basic Practice for Prevention

A. Recommendations

1. Perform surveillance for SSI (A-II)
   - identify high-risk, high-volume procedures to be targeted
   - identify, collect, store, and analyze data
   - use CDC definitions for SSI
   - perform post-op surveillance for 30 days; extend to 12 months if prosthetic material implanted

2. Provide feedback to surgical and operating staff and leadership (A-II)
Surgical Wound Infection
NNIS(NHSN) Patient Risk Index

- American Society of Anesthesiologists (ASA) assessment 3, 4 or 5
- Contaminated or dirty operation
- Time > 75th percentile

Culver. Amer J Med. 1991;91(suppl 3B):152S.
Surgical Wound Infections

Patient Risk Index

Culver. Amer J Med. 1991;91(suppl 3B):152S.
In a study of nearly 300,000 operations performed at 173 hospitals from 2005 to 2007, the authors found that the 30-day rate of infectious complications rose by almost 2.5% for every 30 minutes between incision and closing.

After adjusting for patient variables, type and complexity of surgery, wound class, and need for transfusion, operative time remained a significant predictor of postoperative infection. Compared to patients whose operations took no more than an hour, those whose surgery lasted 2.1 to 2.5 hours had nearly double the risk of infectious complications.

Across all procedures, hospital stays increased geometrically along with operative times, at a rate of about 6% for every 30 minutes.
General Surgical Operative Duration is Associated with Increased Risk-Adjusted Infectious Complication Rates and Length of Stay

*J Am Coll Surg* 2010;210:60-65
3. Increase the efficiency of surveillance through utilization of automated data (A-II)
   - electronic transfer of OR data
   - automated data on readmissions, micro results, and antimicrobial dispensing

4. Administer antimicrobial prophylaxis according to standards for best practices (A-I)
   - administer within one hour before incision (two hours for vancomycin or FQ)
   - select drug based on the surgical procedure
   - discontinue drug within 24 hours after surgery except cardiovascular (48 hours)
Perioperative Prophylactic Antibiotics
Timing of Administration

Timing of Antimicrobial Prophylaxis and the Risk of SSIs

*Ann Surg* 2009; 250:10
Antibiotic Prophylaxis
Duration

• Most studies have confirmed efficacy of \( \leq 12 \) hrs.
• Many studies have shown efficacy of a single dose.
• Whenever compared, the shorter course has been as effective as the longer course.
Prophylactic Antibiotics
Size of Patient and Size of Dose

Surg 1989; 106:750

• Morbidly obese patients having bariatric operation
• Cefazolin levels lower than in non-obese patients at same dose
• Cefazolin dose changed from 1 g to 2 g
  – Infection rate at 1 g: 16.5%
  – Infection rate at 2 g: 5.6%
Repeat Antibiotic Prophylaxis Doses in Gastrointestinal Procedures

*Am Surg* 1997; 63:59

**Surgical Site Infections**

<table>
<thead>
<tr>
<th>Drug</th>
<th>&lt; 3 hr</th>
<th>&gt; 3 hr</th>
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</thead>
<tbody>
<tr>
<td>Cefaz x 1</td>
<td>1</td>
<td>6</td>
</tr>
<tr>
<td>Cefaz x 2</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Cefotetan</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>
Repeat Prophylaxis During Long Cardiac Operations and Risk of Infection

*Emerg Infect Dis* 2001; 7:828

- 1548 operations longer than 240 min
- 459 (30%) received repeat doses
- 276 (18%) redosed within 240 min
- 6 additional postoperative doses given
Repeat Prophylaxis During Long Cardiac Operations and Risk of Infection

- 38% increase SSI rate per extra hour duration of operation
- For procedures > 400 min redosing resulted in 56% reduction in SSI
- Redosing before 240 min was more effective than redosing after 240 min
- Redosing every case >240 minutes would have reduced total SSI rate by 16%
Timing of Antimicrobial Prophylaxis and the Risk of SSIs

*Ann Surg* 2009; 250:10

**Intraop Redosing in Surgeries > 4 h**

<table>
<thead>
<tr>
<th></th>
<th>Infection/#</th>
<th>Infection Risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>redosing</td>
<td>2/112</td>
<td>1.8%</td>
</tr>
<tr>
<td>no redosing</td>
<td>22/400</td>
<td>5.5%*</td>
</tr>
</tbody>
</table>

*P* = 0.06
5. Do not remove hair unless the presence of hair will interfere with the operation. Do not use razors (A-II)

6. Control blood glucose during immediate post-op period for cardiac patients (A-I)
   - maintain <200 mg/dL
   - measure at 6 AM on postoperative day one and two

7. Measure and feedback to providers on the rates of compliance with process measures, including antimicrobial prophylaxis, proper hair removal, and glucose control (cardiac surgery) (A-III)

8. Implement policies and practices aimed at reducing risk of SSI that meet regulatory and accreditation requirements and that are aligned with CDC/HICPAC (A-II)
Sternal Wound Infection Rates

3-Day Average Post-op Blood Glucose mg/dl

Furnary Endocr Pract 2004;10(Suppl 2):21-33
Antimicrobial Skin Preparations

- Alcohol
- Tincture of iodine
- Povidone-iodine (PVP-I) (Iodophor)
- Chlorhexidine Gluconate (CHG)
- Miscellaneous agents:
  - Triclosan
  - PCMX
  - Sodium hypochlorite
- Combination products
  - 2+ active agents
2% CHG/70% IPA for Foot & Ankle Surgery

Comparison of Surgical Wound Infection after Preoperative Skin Preparation with 4% Chlohexidine and Povidone Iodine: A Prospective Randomized Trial

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* Department of Surgery, Faculty of Medicine, Thammasat University, Bangkok, Thailand
** Infectious Unit, Department of Medicine, Faculty of Medicine, Thammasat University, Bangkok, Thailand

Background: Antiseptic scrub and paint can reduce bacterial colonization and postoperative wound infection. Two forms of antiseptics, povidone iodine and chlorhexidine, are commonly used in the operating theater.

Objective: To study the efficacy of the reduction of bacterial colonization and surgical wound infection among these antiseptic.

Material and Method: Five hundred surgical patients were randomly divided into two groups. Povidone Iodine and Chlorhexidine were used for skin preparation in group 1 and 2 respectively. Bacterial colonization and postoperative wound infection were examined after skin preparation. Demographic data was analyzed by student’s t test; the culture result and surgical wound infection were analyzed by Mantel-Haenszel method for relative risk and 95% CI.

Results: There was a significant reduction of bacterial colonization and wound infection after skin preparation in group 2 compared with group 1.

Conclusion: Colonization of bacterial and postoperative surgical wound infection were significantly reduced in the chlorhexidine group. Chlorhexidine antiseptic should be the first consideration for preoperative skin preparation.

Keywords: Chlorhexidine, Povidone-iodine, Skin, Surgical wound infection

<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>Overall</td>
<td>31%</td>
<td>19%</td>
<td>7%</td>
<td>0.05</td>
<td>&lt;0.0001</td>
<td>0.01</td>
</tr>
<tr>
<td>Coagulase-negative Staphylococcus</td>
<td>19%</td>
<td>4%</td>
<td>2%</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
<td>0.41</td>
</tr>
<tr>
<td><em>Propionibacterium acnes</em></td>
<td>15%</td>
<td>12%</td>
<td>7%</td>
<td>0.53</td>
<td>0.07</td>
<td>0.23</td>
</tr>
<tr>
<td>Corynebacterium</td>
<td>2%</td>
<td>1%</td>
<td>0%</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td><em>Staphylococcus aureus</em></td>
<td>2%</td>
<td>0%</td>
<td>1%</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Enterobacter aerogenes</td>
<td>0%</td>
<td>1%</td>
<td>0%</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Lactobacillus</td>
<td>0%</td>
<td>1%</td>
<td>0%</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Eubacterium</td>
<td>0%</td>
<td>1%</td>
<td>0%</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Bacillus</td>
<td>0%</td>
<td>1%</td>
<td>0%</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Peptostreptococcus</td>
<td>0%</td>
<td>1%</td>
<td>0%</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>
Observational studies

- Observational studies suggested the superiority of chlorhexidine over povidone-iodine for vaginal hysterectomy and foot and ankle surgery
  - Culligan *Am J Ob Gyn* 2005
  - Ostrander *J Bone Joint Surg Am* 2005
  - Bibbo *Clin Orthop Relat Res* 2005
Cochrane Systematic Review 2009: Does pre-operative skin antisepsis prevent SSI?

• 7 studies included
• All with limitations
  – small size
  – short follow-up
  – variety of SSI definitions
Cochrane Systematic Review 2009: Does preoperative skin antisepsis prevent SSI?

- CHG vs. pov-iodine (Berry 1982): Higher SSI rate with pov-iodine
- Pov-iodine vs. iodophor-alcohol (2 studies): No significant difference
- Single vs. multiple-step application (4 studies): No sig difference
- Iodophor-impregnated drapes vs. regular drapes (4 studies): No sig difference
- Conclusion: Insufficient evidence to support recommending the use of one antiseptic agent over another
Comparison of 3 skin antisepsis products

- Single institution sequential implementation study design (Swenson *ICHE* 2009; 30:964) comparing:
  1) povidone-iodine scrub (PVP-I) and paint→alcohol paint (70% isopropyl alcohol)→PVP-I paint (period 1)
  2) 2% chlorhexidine plus 70% isopropyl alcohol (period 2)
  3) iodine povacrylex in isopropyl alcohol (period 3)
• **Conclusion**: Lower SSI rates for iodine-containing regimens
• 6.4% for povidone-iodine
• 3.9% for iodine povacrylex-alcohol
• 7.1% for CHG-alcohol
• Caveat: sequential implementation design, only adult general surgery (clean and clean contaminated), single institution
Povidone-iodine versus CHG-alcohol

- Randomized, multicenter study of patients undergoing clean-contaminated surgery (Darouiche NEJM 2010; 362:18).
  - Povidone-iodine scrub and paint vs. CHG-alcohol scrub.

- Conclusion: SSI rates for CHG-alcohol were significantly lower than pov-iodine for superficial (4.2% vs. 8.6%, P=0.008) and deep (1% vs. 3%, P=0.05) SSI, but not organ/space SSI
Conclusions

• Limited data on this topic
• Based on the recent multicenter RCT study (Darouiche), CHG-alcohol scrub is better than traditional povidone-iodine

• Caveat:
  – Only clean-contaminated procedures were included in this study
  – No comparsion with CHG without alcohol or iodine povacrylex-alcohol
• Special approaches (lack of control despite basic practices)

1. perform expanded surveillance for SSI to determine source and extent of problem (B-II)
   -expand surveillance to include additional procedures
   -use direct surveillance (daily observation of the surgical site by the physician, physician extender, or ICP)

2. Use pre-op intranasal and pharyngeal CHG for patients undergoing CV procedures (B-I)*

* removed final version since CHG cream is not FDA approved or available in US
Compendium SSI #6
Unresolved Issues *ICHE* 2008; 29:S51-S61

- Pre-operative bathing with CHG
- Routine screening for MRSA or routine attempts to decolonize surgical patients with an anti-staph agent (mupiricin) in the pre-operative setting
- Maintain oxygenation with supplemental oxygen during and following colorectal procedures
- Maintain normothermia (>36°C) immediately following colorectal surgery
– No standardized pre-op body cleansing protocol in literature

Study:
– 2% CHG Cloths used house wide
– Patients instructed in pre-op holding
– Application, neck down
Reducing Surgical Site Infection
2% CHG Cloth Reduces SSI Rates by >70% Difference Resulting in a $154,869 Cost Avoidance
Henry Rhee, M.D. and Bonnie Harris, CIC

BACKGROUND
Postoperative surgical site infection (SSI), considered the most common healthcare-associated infection in surgical patients, is a significant contributor to patient injury, morbidity, and healthcare costs. It is estimated that between 2,000,000 and 750,000 SSIs occur annually in the United States, and cost from $1.6 to $3.3 Billion in excess hospital charges. Patients who develop SSIs are 60% more likely to spend time in an ICU, five times more likely to be rehospitalized to the hospital, and have twice the mortality.

Overall, up to 5% of patients undergoing surgery develop SSIs, which increase the length of hospital stay by an average of 7-10 days. Rates of SSIs following orthopedic surgery can be as high as 20%. Wunderbald at al estimated that up to 356,000 patients each year have SSIs following orthopedic surgery. Orthopedic SSIs prolong total hospital stays by a median of 2 weeks per patient, approximately double readmission rates, and increase healthcare costs by more than 50%.

One of the primary goals of the Surgical Care Improvement Project (SCIP) partnership, part of the national 5 Million Lives Campaign, initiated by the Institute for Healthcare Improvement (IHI), is to reduce the incidence of postoperative complications by preventing SSIs and thereby reduce patient morbidity, cost, and length of stay. Since SSIs following "clean surgery" are mostly caused by endogenous skin organisms introduced into the surgical wound during operation, effective and permanent skin antiseptics is crucial in reducing the risk of SSI.

METHODS
PWH is an 17-bed acute-care facility located in Manassas, Virginia. The patient population for this study was all patients having a procedure or same day surgery.

Prior to the SCIP intervention, PWH did not have a standardized pre-op body cleansing protocol. A standardized protocol was initiated, using a pre-packaged 2% CHG-impregnated no-rinse cloth (Sage 2% CHG Cloth, Sage Products Inc., Cary, IL, equivalent to 500 mg chlorhexidine gluconate per cloth) for skin antiseptics in pre-op. To maintain normothermia, the 2% CHG cloths were pre-heated in warmers. In the holding area prior to surgery, patients were instructed to perform a body cleansing/ "prepping" from the neck down.

After applying the 2% CHG cloth, the patient signed his/her instruction sheet indicating that he/she understood and completed with the information provided and the correct use of the product. This form then validated the number of cases with the CHG cloths.

RESULTS
PWH realized a >70% percent difference in the SSI rate after one month following implementation of the new 2% CHG cloth, which remained sustainable.

SSI mean rate went from 2.2% prior to use of CHG to 0.6% after SCIP implementation.

Return-on-Investment cost realized was $154,869 in a six-month period.

SSI rate decline continued with higher skin antiseptics product cost, the decreased number of SSIs resulted in significant cost savings.

Number of patients readmitted for SSI decreased by 70%.

Compliance in pre-op skin antiseptics remains good.

Preparation time for surgery was not significantly increased.

Clear instruction, prewarming, and involvement of the patient contributed to ease of use and satisfaction of the 2% CHG cloth.

LESSONS LEARNED
- SSIs are preventable and negatively impact the patient in terms of health and well-being.
- The SCIP program offers evidence-based criteria to eliminate SSI. The favorable outcomes for the 2% CHG cloth product offer an additional component to the safety issues.
- The impact on reducing the patient is a more clinically efficient and cost-effective recovery with lower risk of post-operative infection.
- The impact for the facility is the cost savings in treating an infection, decreased readmission rate, improved postoperative outcomes, and stakeholder satisfaction.
- The use of the 2% CHG product may be considered a limitation but is offset by significant potential cost savings.
- This project is applicable across most surgery and invasive procedure settings.
- Since January 2007, PWH has been using the 2% CHG cloth for pre-operative skin antiseptic hospital wide.
- Normothermia was easily maintained and most likely contributed to the effectiveness of our new protocol.
- Because surgical wound infection may be prevented by multidrug prophylaxis, hypotheses due to decreased antibiotic resistance, maintaining prophylactic antimicrobial can help reduce the risk of SSI.
- The ability to easily pre-warm the 2% CHG cloth contributes to patient comfort and satisfaction, increasing the likelihood of compliance.

REFERENCES
Preoperative Shower Revisited: Can High Topical Antiseptic Levels Be Achieved on the Skin Surface Before Surgical Admission?

Pre-operative screening and decolonization for S. aureus
No recommendation to preoperatively apply mupirocin to nares to prevent SSI-unresolved issue
Routine mupirocin administration is recommended for all patients undergoing cardiac surgical procedures in the absence of a documented negative testing for Staphylococcal colonization (Level A)
Recent Literature

• Perioperative intranasal mupiricin decreased SSIs in nongeneral surgery (cardiothoracic and orthopedic) but not in general surgery

  *Infect Control Hosp Epidemiol* 2005; 26:916

• Intranasal mupiricin significantly reduced S. aureus SSI rates in cardiac surgery

  *Am J Infect Control* 2006; 34:44
Randomized Trial of Prophylactic Mupiricin + CHG Shower


• Nasal carriage of *S. aureus* eliminated in 83.4% v. 27.4% in placebo (*p*<0.001)

• SSI 7.9% v. 8.5% (ns)

• *S. aureus* SSI 2.3% v. 2.4% (ns)

• In carriers:
  - any HA staph infection (most SSI) 4% v. 7.7% (OR 7.7% 95% CI 0.25-0.92)
  - 84.6% PFGE match between nares and SSI

• All surgical procedures combined-overall infection rate low
Relative Risk of Hospital-Acquired *Staphylococcus aureus* Infection and Characteristics of Infections (Intention-to-Treat Analysis)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mupirocin–Chlorhexidine (N = 504)</th>
<th>Placebo (N = 413)</th>
<th>Relative Risk (95% CI)*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>no. (%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>S. aureus</em> infection</td>
<td>17 (3.4)</td>
<td>32 (7.7)</td>
<td>0.42 (0.23–0.75)</td>
</tr>
<tr>
<td>Source of infection†</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Endogenous</td>
<td>12 (2.4)</td>
<td>25 (6.1)</td>
<td>0.39 (0.20–0.77)</td>
</tr>
<tr>
<td>Exogenous</td>
<td>4 (0.8)</td>
<td>6 (1.5)</td>
<td>0.55 (0.16–1.92)</td>
</tr>
<tr>
<td>Unknown</td>
<td>1 (0.2)</td>
<td>1 (0.2)</td>
<td></td>
</tr>
<tr>
<td>Localization of infection‡</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Deep surgical site‡</td>
<td>4 (0.9)</td>
<td>16 (4.4)</td>
<td>0.21 (0.07–0.62)</td>
</tr>
<tr>
<td>Superficial surgical site‡</td>
<td>7 (1.6)</td>
<td>13 (3.5)</td>
<td>0.45 (0.18–1.11)</td>
</tr>
<tr>
<td>Lower respiratory tract</td>
<td>2 (0.4)</td>
<td>2 (0.5)</td>
<td>0.82 (0.12–5.78)</td>
</tr>
<tr>
<td>Urinary tract</td>
<td>1 (0.2)</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Bacteremia</td>
<td>1 (0.2)</td>
<td>1 (0.2)</td>
<td></td>
</tr>
<tr>
<td>Soft tissue</td>
<td>2 (0.4)</td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>

* Relative risks are for *S. aureus* infection in the mupirocin–chlorhexidine group.† The source of the *S. aureus* infections was determined by comparing nasal strains with strains isolated from the infection site by pulsed-field gel electrophoresis.‡ Data are for surgical patients only: 441 in the mupirocin–chlorhexidine group and 367 in the placebo group.
HCA’s MRSA Solution: The A,B,Cs...

• **A**ctive Surveillance of high risk patients
• **B**arrier Precautions
• **C**ompulsive Hand Hygiene
• **D**isinfection / Environmental Cleaning
• **E**xecutive Championship
Differences in MRSA Colonization by Age and Surgical Procedure
(Average = 4.5%)
Decolonization and surgical prophylaxis of MRSA+ patients were at discretion of surgeon.
Definition of Teamwork

A joint action by a group of people, in which each person subordinates his or her individual interests and opinions to the unity and efficiency of the group

Webster’s New World Dictionary
Traditional Model
Teamwork Disconnect

• RN: Good teamwork means I am asked for my input
• MD: Good teamwork means the nurse does what I say
Physicians and RN Collaboration

% of respondents reporting above adequate teamwork

- L&D RN/MD: 48%
- ICU RN/MD: 48%
- OR RN/Surg: 54%
- CRNA/Anesthetist: 59%

Physician rates RN
- RN rates Physician

- 83%
- 88%
- 90%
- 93%
What we were never taught in medical school

What we learned:

.........“I am the Captain of the Ship”

........................................“Autonomy”

.......“if you want it done right…”

.......“results matter most”

...“implied & assumed”

......I “give” you my patients so its your job to make everything else work
Figure 1. General and vascular surgery surgical site infection (SSI) observed-to-expected ratios (O/E), January 1, 2006 to December 31, 2006. The O/E SSI ratios for 117 private sector hospitals in North America, participating in the American College of Surgeons-National Surgical Quality Improvement Project (ACS-NSQIP) in 2006. From this analysis, two groups of hospitals were identified: low outliers (n = 20) had significantly fewer surgical site infections than would have been expected, and high outliers (n = 13) had significantly more surgical site infections than would have been expected. # denotes hospitals that had an O/E SSI ratio that was statistically significant (95% CI > 1 for high outliers and < 1 for low outliers.)
SSI Prevention: The Importance of Operative Duration and Blood Transfusions
J Am Coll Surg 2008; 207:810

• Hospitals that were high outliers for SSIs:
  – Higher trainee-to-bed ratios (0.61 vs. 0.25 p<0.0001)
  – Operation took longer (128.3 vs. 102.7 min p<0.001)

• Patients operated on at low outlier hospital:
  – Less likely to be anemic (4.9% vs. 9.7% p<0.007)
  – Less likely to receive transfusion (5.1% vs 8% p<0.03)
**Table 8. Summary Results of Site Visits at the Low Outlier Hospitals (Low Infection Rates)**

<table>
<thead>
<tr>
<th>Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>No trainees</td>
</tr>
<tr>
<td>Little turnover of surgeons</td>
</tr>
<tr>
<td>Little turnover of nurses</td>
</tr>
<tr>
<td>No traveling nurses in the operating room</td>
</tr>
<tr>
<td>Perioperative efficiency</td>
</tr>
<tr>
<td>Positive safety culture</td>
</tr>
<tr>
<td>Strong leadership support for quality</td>
</tr>
<tr>
<td>improvement initiatives</td>
</tr>
<tr>
<td>Environment that fostered ease of</td>
</tr>
<tr>
<td>communication</td>
</tr>
<tr>
<td>Few breaks during surgery</td>
</tr>
</tbody>
</table>
Tactics systems use to promote a culture of quality and safety

<table>
<thead>
<tr>
<th></th>
<th>High-Performing Systems (n=26)</th>
<th>Low-Performing Systems (n=19)</th>
</tr>
</thead>
<tbody>
<tr>
<td>measures safety culture</td>
<td>81</td>
<td>63</td>
</tr>
<tr>
<td>shares safety culture</td>
<td>84</td>
<td>68</td>
</tr>
<tr>
<td>provides teamwork training</td>
<td>81</td>
<td>74</td>
</tr>
</tbody>
</table>

Note: High performing systems rank in the top quintile of performance; low performing systems rank in the bottom quintile
We can't change the human condition, but we can change the conditions under which humans work

James Reasons
The New Model
Results The rate of death was 1.5% before the checklist was introduced and declined to 0.8% afterward ($P=0.003$). Inpatient complications occurred in 11.0% of patients at baseline and in 7.0% after introduction of the checklist ($P<0.001$). (NEJM 2009)
Surgical Care Improvement Project (SCIP) Infection-Prevention Process Measures

*JAMA* 2010;303:2479-2485

### Individual SCIP measures

<table>
<thead>
<tr>
<th>Measure Description</th>
<th>Nonadherent Discharges</th>
<th>Adherent Discharges</th>
<th>Adjusted Odds Ratio (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>INF-1: prophylactic antibiotic received within 1 h prior to surgical incision</td>
<td>251 18,147</td>
<td>1394 190,025</td>
<td>0.89 (0.75-1.06)</td>
</tr>
<tr>
<td>INF-2: prophylactic antibiotic selection for surgical patients</td>
<td>266 12,670</td>
<td>1486 198,002</td>
<td>0.83 (0.69-1.00)</td>
</tr>
<tr>
<td>INF-3: prophylactic antibiotics discontinued within 24 h after surgery end time</td>
<td>310 26,499</td>
<td>1024 173,228</td>
<td>0.94 (0.73-1.13)</td>
</tr>
<tr>
<td>INF-4: cardiac surgery patients with controlled 6 AM postoperative blood glucose</td>
<td>65 4168</td>
<td>362 31,512</td>
<td>0.93 (0.68-1.27)</td>
</tr>
<tr>
<td>INF-6: surgery patients with appropriate hair removal</td>
<td>104 21,308</td>
<td>3539 360,111</td>
<td>1.00 (0.85-1.10)</td>
</tr>
<tr>
<td>INF-7: colorectal surgery patients with immediate postoperative normothermia</td>
<td>181 4564</td>
<td>676 18,101</td>
<td>1.00 (0.81-1.23)</td>
</tr>
</tbody>
</table>

### Composite measures

<table>
<thead>
<tr>
<th>Measure Description</th>
<th>Nonadherent Discharges</th>
<th>Adherent Discharges</th>
<th>Adjusted Odds Ratio (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>S-INF-Core: all 3 original Surgical Infection Prevention (SIP) project periproductive infection-prevention measures</td>
<td>511 44,417</td>
<td>816 154,963</td>
<td>0.86 (0.74-1.01)</td>
</tr>
<tr>
<td>S-INF: all patients with at least 2 recorded SCIP infection-prevention measures</td>
<td>843 50,358</td>
<td>1070 158,304</td>
<td>0.85 (0.75-0.95)</td>
</tr>
</tbody>
</table>
Adherence Rates and Postoperative Infection Rates of Surgical Care Improvement Project (SCIP) Infection-Prevention Measures

JAMA 2010;303:2479-2485
case

MJ is a 66 year-old WF admitted for an elective CAB. Patient is obese with IDDM and hypertension. She is a non-smoker. History of “boils” in past.

- Day 1-CAB with LIMA and sephenous vein(4.5 hr)-1 gram cefazolin prophylaxis given within 40 min of incision discontinued at 36 hours

- Day 2-3-weaned from ventilator POD 2-6 AM BS 190 and 197

- Day 5-fever to 103° and increasing sternal pain-blood cultures drawn-started on vancomycin and cefepime

- Day 6-new cloudy drainage from sternal incision-cultured

- Day 7-CT chest fluid under sternum-blood cultures and sternal drainage growing gram-positive cocci

- Day 8-blood and sternum growing______________________________

Did this patient meet core measures?
Organizations that Seek to Meet Standards Will Never Achieve Excellence

Ed Septimus, M.D.
• People change because of love for something—a deep emotional involvement
• The best incentive for our employees is being the best
• The burning platform is always inside people
• Motivation to improve comes from knowledge and inspiration, not orders

Goran Henriks
chief learning and innovation
Jonkoping, Sweden
How will the world be different tomorrow as a result of what we do today?

Kathie Dannemiller
Questions