Disclosure

• Technical Specialist

3M Infection Prevention Division Laboratory
Supporting Antiseptic Drug Products
Objectives

- Discuss the importance of nasal carriage of *Staphylococcus aureus* and methicillin-resistant *Staphylococcus aureus* (MRSA) as they relate to Surgical Site Infections
- Discuss three means of reducing the bacterial load on skin and mucous membranes prior to high risk procedures.
- Describe the guidelines that support each indication.
House Keeping

- Questions
- Mute feature (*7 = unmute, *6 = mute)
- “Chat” feature
- Technical difficulties
- CE credits
- Post session follow-up
According to the CDC: Healthcare Associated Infections (HAIs) are one of the top 10 leading causes of death in the U.S.

http://www.cdc.gov/ncidod/dhqp/healthdis.html
Surgical Site Infections (SSIs) are the second leading cause of HAIs

Surgical Site Infections

- Surgical procedures are becoming increasingly more complicated
- Population of surgical patients has more underlying conditions
- These factors increase the risk for developing surgical site infection (SSI)
High Risk SSI Procedures

• Certain surgical procedures are considered high risk for SSI because when an infection develops
  • patients have high morbidity and mortality rates
  • high impact on consumption of healthcare resources and attributable cost

• High risk procedures:
  • cardiac open heart procedures,
  • orthopedic total joint procedures,
  • neurological procedures
  • transplant procedures
  • bariatric surgery
Cardiac Open Heart Procedures

• Patients often have many underlying risk factors
  • diabetes
  • obesity
  • nicotine use
  • extremes of age

• Patients are more susceptible to infections

• Have a more difficult time fighting off the infection than a young healthy person

• Attributed cost of sternal wound infections after open heart surgery is between $11,000 and $17,000


Orthopedic Total Joint Arthroplasty Procedures

- Higher risk of developing SSI
  - artificial joint implant becomes a medium for bacterial growth
  - formation of biofilms
- Quantitatively
  - surgical site is contaminated with $>10^5$ (100,000) microorganisms per gram of tissue, the risk of SSI is markedly increased
  - When foreign material (e.g., implants or sutures) is present at the site contaminating dose decreases (e.g., $10^2$ or 100 microorganisms per gram of tissue)

CDC Guideline for Prevention of Surgical Site Infection, 1999
http://www.cdc.gov/ncidod/dhqp/pdf/guidelines/SSI.pdf
Orthopedic Total Joint Arthroplasty Procedures

- According to the American Academy of Orthopedic Surgeons,
  - approximately 1 million total joint arthroplasties are performed annually in the United States
  - estimated cost of treating an infection at the site of a total hip or knee can exceed $50,000

According to the 1999 CDC Guideline for Prevention of Surgical Site Infections, for most SSIs, the source of pathogens is the endogenous flora of the patient’s skin, mucous membranes or hollow visera.
If possible, this would be the best solution!!

M. Ritter et Al.
J. of Bone and Joint Surgery, 1980
Reducing the patients' bacterial load before surgery will reduce the risk of SSI
Reducing Bacterial Load

• Common practices
  • Pre-op Showers/Wipes
    • Remove dirt, debris, oils
    • Remove transient organisms
  • Pre-op Patient Prep
    • Fast acting, persistent antimicrobial activity

• Newer practices
  • Oral care/hygiene
  • Nasal decontamination
Reducing the Bacterial Load on the Patient’s Body Preoperatively
Bacteria found on the Skin

• Found on all areas of the body

• Significantly higher numbers in moist areas
  • axilla,
  • skin folds
  • webs of the feet,
  • perineal area and peri-anal area
Decreasing Microbial Counts on the Skin

- **Preoperative showers/baths/wipes**
  - Cleanse the skin by removing dirt and debris
  - Products that include an antimicrobial agent will also decrease microbial counts
Preoperative Bathing Recommended Practice

CDC – Guideline for Prevention of Surgical Site Infections, 1999

➢ Require patients to shower or bathe with an antiseptic agent at least the night before the operative day (*Category IB*)

“Chlorhexidine gluconate-containing products require several applications to attain maximum antimicrobial benefit, so repeated antiseptic showers are usually indicated. Even though preoperative showers reduce the skin's microbial colony counts, they have not definitively been shown to reduce SSI rates.”

Centers for Disease Control and Prevention, “Guideline for Prevention of Surgical Site Infections,” Infection Control and Hospital Epidemiology, 19 Vol 20, No 4, April 1999
Unless contraindicated, patients should be instructed or assisted to perform two preoperative baths or showers with CHG before surgery to reduce the number of microorganisms on the skin and reduce the risk of subsequent contamination of the surgical wound.

“Although there is sufficient evidence of the effectiveness of two CHG showers to reduce microbial counts, there is insufficient research to definitively link this decrease in microbial count to a reduction in surgical site infection rates.”
Preoperative Bathing Recommended Practice

SHEA/IDSA* – Strategies to Prevent Surgical Site Infections, 2008(14)

➢ Preoperative bathing with chlorhexidine-containing products (Unresolved issue)

“Preoperative showering with agents such as chlorhexidine has been shown to reduce bacterial colonization of the skin. Several studies have examined the utility of preoperative showers, but none has definitively proven that they decrease SSI risk. A recent Cochrane review evaluated the evidence for preoperative bathing or showering with antiseptics for SSI prevention. Six randomized, controlled trials evaluating the use of 4% chlorhexidine gluconate were included in the analysis, with no clear evidence of benefit noted. To gain the maximum antiseptic effect of chlorhexidine, it must be allowed to dry completely and not be washed off.”

Preoperative Skin Antiseptics

• Should:
  • Significantly reduce microorganisms on intact skin
  • Contain non-irritating antimicrobial preparation
  • Be broad spectrum
  • Be fast acting
  • Have persistent activity
Surgical Site Patient Skin Preparation

Agent Selection

<table>
<thead>
<tr>
<th>SHEA/IDSA(^1)</th>
<th>Wash and clean skin around incision site; use an appropriate antiseptic agent   (\text{A-II})</th>
</tr>
</thead>
<tbody>
<tr>
<td>CDC</td>
<td>Use an appropriate antiseptic agent for skin preparation (Table 6). (\text{Category IB})</td>
</tr>
<tr>
<td>Guideline for the Prevention of Surgical Site Infection(^2)</td>
<td>Apply preoperative antiseptic skin preparation in concentric circles moving toward the periphery. The prepared area must be large enough to extend the incision or create new incisions or drain sites, if necessary. (\text{Category II})</td>
</tr>
<tr>
<td>AORN(^3)</td>
<td>Recommendation II (\text{Preoperative skin antiseptic agents that have been FDA-approved or -cleared and approved by the health care organization’s infection control personnel should be used for all preoperative skin preparation.})</td>
</tr>
</tbody>
</table>

None of these state that one antiseptic agent is preferred over another

2. Centers for Disease Control and Prevention, “Guideline for Prevention of Surgical Site Infection,” Infection Control and Hospital Epidemiology, Vol 20, No 4, April 1999  
## Antiseptic Skin Preparation

<table>
<thead>
<tr>
<th>Antiseptic</th>
<th>Meets FDA Criteria</th>
<th>Abdomen</th>
<th>Meets FDA Criteria</th>
<th>Groin</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>10 min</td>
<td>6 hour</td>
<td></td>
<td>10 min</td>
</tr>
<tr>
<td>Povidone Iodine</td>
<td>Yes</td>
<td>Yes</td>
<td></td>
<td>Yes</td>
</tr>
<tr>
<td>Scrub &amp; Paint</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aqueous CHG scrub</td>
<td>Yes</td>
<td>Yes</td>
<td></td>
<td>Yes</td>
</tr>
<tr>
<td>Iodine</td>
<td>Yes</td>
<td>Yes</td>
<td></td>
<td>Yes</td>
</tr>
<tr>
<td>Povacrylx/alcohol</td>
<td>Yes</td>
<td>Yes</td>
<td></td>
<td>Yes</td>
</tr>
<tr>
<td>CHG/alcohol</td>
<td>Yes</td>
<td>Yes</td>
<td></td>
<td>Yes</td>
</tr>
</tbody>
</table>
Evidence

There are now two recently published studies that compare commonly used agents with surgical site infection as the main outcome measurement.
## Clinical Studies Evaluating Effect of Prep on SSI Rate

<table>
<thead>
<tr>
<th></th>
<th><strong>Swenson et al.</strong></th>
<th><strong>Darouiche et al.</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Title</strong></td>
<td>“Effects of preoperative skin preparation on postoperative wound infection rates: a prospective study of 3 skin preparation protocols”</td>
<td>“Chlorhexidine-Alcohol versus Povidone-Iodine for Surgical-Site Antisepsis”</td>
</tr>
<tr>
<td><strong>Design</strong></td>
<td>Quasi-experimental, (sequential assignment of interventions) single center</td>
<td>Randomized six centers</td>
</tr>
</tbody>
</table>

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# Surgical Skin Preparations Used

<table>
<thead>
<tr>
<th>Treatments:</th>
<th>Swenson et al.</th>
<th>Darouiche et al.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Povidone Iodine (PVP-I)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PVP-I scrub (7.5% PVP-I)</td>
<td>3 consecutive applications</td>
<td>PVP-I scrub</td>
</tr>
<tr>
<td>Alcohol paint (70% isopropyl alcohol)</td>
<td>Application protocol not described</td>
<td>X</td>
</tr>
<tr>
<td>PVP-I paint (10% PVP-I)</td>
<td>3 consecutive applications</td>
<td>PVP-I paint (10% PVP-I)</td>
</tr>
<tr>
<td>Allow prep to dry</td>
<td></td>
<td>Application protocol not described</td>
</tr>
<tr>
<td><strong>CHG</strong></td>
<td>2% CHG and 70% Isopropyl Alcohol</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Chloraprep®</td>
<td></td>
</tr>
<tr>
<td></td>
<td>30 sec or 2-min application – Application protocol not described in NEJM study</td>
<td></td>
</tr>
<tr>
<td><strong>Iodine Povacrylex</strong></td>
<td>Iodine Povacrylex [0.7% available iodine] and Isopropyl Alcohol (74% w/w)</td>
<td>X</td>
</tr>
<tr>
<td></td>
<td>DuraPrep™</td>
<td></td>
</tr>
<tr>
<td>Surgery Type</td>
<td>Swenson et al.</td>
<td>Darouiche et al.</td>
</tr>
<tr>
<td>--------------</td>
<td>---------------</td>
<td>------------------</td>
</tr>
<tr>
<td>General surgery (clean, clean-contaminated, dirty)</td>
<td>Clean-contaminated (included specialty surgeries, eg, gyn, urol, gi, thoracic)</td>
<td></td>
</tr>
<tr>
<td>Primary outcome</td>
<td>Any SSI within 30 days of surgery</td>
<td></td>
</tr>
<tr>
<td>Secondary outcome</td>
<td>Any SSI within 30 days of surgery tracked by prep received</td>
<td>Individual types of SSI</td>
</tr>
<tr>
<td>Number of Subjects</td>
<td>3,209</td>
<td>849</td>
</tr>
<tr>
<td>Overall SSI Rates</td>
<td>Swenson et al.</td>
<td></td>
</tr>
<tr>
<td>-------------------</td>
<td>---------------</td>
<td></td>
</tr>
<tr>
<td><strong>By Preferred Prep (Study Period):</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Period 1 PVP-I with alcohol 6.4%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Period 2 Chlorhexidine-alcohol 7.1%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Period 3 Iodine povacrylex 3.9% (P=0.002)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>By Prep Actually Received:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PVP-I with alcohol t 4.8%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chlorhexidine-alcohol 8.2%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Iodine povacrylex 4.8% (P=0.001)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

A strong trend of higher SSI rates with the use of CHG, compared with the two iodophor-based preps, was also observed in a multivariate analysis although not significant (P=0.073)

<table>
<thead>
<tr>
<th>Conclusions</th>
<th>Swenson et al.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Skin preparation is an important factor in prevention of SSIs. <strong>Iodophor-based compounds may be superior to chlorhexidine</strong> for SSI prevention in general surgery patients</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Darouiche et al.</th>
</tr>
</thead>
<tbody>
<tr>
<td>PVP-I 16.1%</td>
</tr>
<tr>
<td>Chlorhexidine-alcohol 9.5% (P=0.004)</td>
</tr>
</tbody>
</table>

Preoperative cleansing of the patient’s skin with **chlorhexidine-alcohol** is superior to cleansing with **povidone-iodine** for preventing SSI after clean-contaminated surgery
**Limitations**

**Swenson et al.**

(Infect Control Hosp Epidemiol 2009; 30:964-971)

- **Not randomized**
  (justification: authors wanted to implement protocol as commonly seen in practice and maximize the consistency of prep application)
- **Single center**
- **Compliance** with prep used by period (~70% for CP and DP)

**Darouiche et al.**


- **DuraPrep**, one of the commonly used one-step skin preps in the USA, was **not included**
- Compared CHG/Alcohol with a **reference prep containing only PVP-I, without alcohol**, despite the well known synergistic effect of both antiseptics due to their different mechanisms of action
  
  **Compared 2 agents with 1 agent**

**Conclusions:**

- Each of these studies has its limitations
- Body of evidence incomplete for widely recommending one prep over another
Additional Considerations

Skin Preparation

• Characteristics of a surgical procedure
  • Irrigation, blood, body fluids
    • Preps should be effective after exposure to blood and saline
  • Drape adhesion
    • Certain aqueous based preps and antiseptic agents interfere with the adhesion of drapes and tapes.

• Patient Safety
  • Product warnings and contraindications. May increase personal and institutional liability if warnings and contraindications are disregarded

• Application Instructions
  • The efficacy of an antimicrobial product is based on proper application.

• Cost
  • Health economics of product choices
Oral Care
Reducing the Risk of Post-Procedure Pneumonia
Oral Care

- Mouth has its own ecosystem of bacteria
  - When an individual is healthy and has good oral hygiene is kept in check by a variety of the body’s own defense mechanisms

- Dental plaque is bacterial biofilm that builds up on the teeth. If not removed regularly, it
  - Can lead to dental cavities and gingivitis
  - Plaque then becomes a reservoir for bacteria that cause pneumonia
Oral Care

• When a person becomes ill and is intubated
  • Body’s natural defense mechanisms change
  • Increase in colonization of gram negative bacteria in the oropharynx in patients that have pulmonary disease, are in a coma, or have an endotracheal or nasogastric tube in place.
  • Changes in secretions during many disease states make bacteria are better able to adhere to tissue
Preoperative CHG Oral Rinse

• Chohexidine Gluconate 0.12% Oral Rinse Reduces the Incidence of Total Nosocomial Respiratory Infection and Nonprophylactic Systemic Antibiotic Use in Patients Undergoing Heart Surgery
  • Anthony DeRiso, et. al.
  • Published in Chest June, 1996
  • Prospective, randomized, double blind, placebo controlled clinical study
    • 353 patients - coronary artery bypass grafting, valve, or other open heart procedures
    • CHG oral rinse preoperatively and BID postoperatively until discharge from ICU

Preoperative CHG Oral Rinse

• Primary efficacy variable was the reduction in all nosocomial infection rate between active and placebo groups
  • Wound, Blood/line, Urinary, Respiratory

• CHG treated group
  • 65% (p>0.01) reduction in nosocomial infection was significantly
  • Total respiratory tract infections were 69% less common (p<0.05)
  • 59% reduction in Gram-negative bacteria as a causative organism
  • 43% (p<0.05) decrease in use of nonprophylactic IV antibiotics
  • Authors conclude: results in significant cost savings for those patients who avoid treatment with additional antibiotics, and may impact favorably on mortality
Preoperative Oral Care Guidelines

CDC - Guidelines for Preventing Health-Care-Associated Pneumonia, 2003

- Develop and implement a comprehensive oral-hygiene program (that might include the use of an antiseptic agent) for patients in acute-care settings or residents in long-term care facilities who are at high risk of developing health-care-associated pneumonia. CATEGORY II
- Use an oral chlorhexidine gluconate (0.12%) rinse during the perioperative period on adult patients who undergo cardiac surgery CATEGORY II

“Recently, the antiseptic chlorhexidine gluconate (0.12%) was used successfully as a perioperative oral rinse to decrease the overall incidence of nosocomial respiratory tract infections in patients who underwent cardiac surgery.”
# Preoperative Oral Care Guidelines

<table>
<thead>
<tr>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>➢ Modulation of oropharyngeal colonization by the use of oral chlorhexidine has prevented ICU-acquired HAP in selected patient populations such as those undergoing coronary artery bypass grafting, but its routine use is not recommended until more data becomes available</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>American Association of Critical Care Nurses - Practice Alert: Oral Care in the Critically Ill, 2007</th>
</tr>
</thead>
<tbody>
<tr>
<td>➢ Use an oral chlorhexidine gluconate (0.12%) rinse twice a day during the perioperative period for adult patients who undergo cardiac surgery. Routine use in other populations is not recommended at this time.</td>
</tr>
</tbody>
</table>

- American Association of Critical Care Nurses Practice Alert: Oral Care in the Critically Ill [http://www.aacn.org/WD/Practice/Docs/Oral_Care_in_the_Critically_III.pdf](http://www.aacn.org/WD/Practice/Docs/Oral_Care_in_the_Critically_III.pdf)
Preoperative Oral Care Guidelines

American Academy of Orthopaedic Surgeons - Information Statement, 1997

- Patients who are about to have a total joint arthroplasty should be in good dental health prior to surgery and should be encouraged to seek professional dental care if necessary

- Patients who already have had a total joint arthroplasty should perform effective daily oral hygiene procedures to remove plaque

Antibiotic Prophylaxis for Dental Patients with Total Joint Replacements
http://www2.aaos.org/aaos/archives/bulletin/jul97/dental.htm
Preoperative Reduction of *S. aureus* in the nares
Approximately 30% of the population are colonized with *S. aureus* in the nares and 1% carry MRSA
## Nasal Colonization


- National Center for Infectious Diseases and National Center for Health Statistics, Centers for Disease Control and Prevention, Atlanta, Georgia
- **Note:** Study did not type for HA-MRSA vs. CA-MRSA

### Table 1. Prevalence of *Staphylococcus aureus* and methicillin-resistant *S. aureus* (MRSA) nasal colonization, by demographic characteristics—National Health and Nutrition Examination Survey, 2001–2002.

<table>
<thead>
<tr>
<th>Category, characteristic</th>
<th>Tested, no.</th>
<th>Colonization prevalence, % (95% CI)</th>
<th>Colonized persons, estimated no. in millions (95% CI)</th>
<th>Colonization prevalence, % (95% CI)</th>
<th>Colonized persons, estimated no. in millions (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>All participants (≥1 year old)</td>
<td>9622</td>
<td>32.4 (30.7–34.1)</td>
<td>89.4 (84.8–94.1)</td>
<td>0.8 (0.4–1.4)</td>
<td>2.3 (1.2–3.8)</td>
</tr>
<tr>
<td><strong>Sex</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>4685</td>
<td>37.0 (34.0–40.1)</td>
<td>49.8 (45.7–53.9)</td>
<td>0.5 (0.2–0.9)</td>
<td>0.7 (0.3–1.2)</td>
</tr>
<tr>
<td>Female</td>
<td>4937</td>
<td>28.0 (26.2–29.8)</td>
<td>39.7 (37.1–42.2)</td>
<td>1.2 (0.6–1.9)</td>
<td>1.6 (0.9–2.7)</td>
</tr>
<tr>
<td><strong>Race/ethnicity</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-Hispanic white</td>
<td>3990</td>
<td>33.0 (31.2–34.9)</td>
<td>61.7 (58.3–65.1)</td>
<td>0.9 (0.5–1.5)</td>
<td>1.7 (0.9–2.7)</td>
</tr>
<tr>
<td>Non-Hispanic black</td>
<td>2395</td>
<td>26.9 (24.5–29.2)</td>
<td>9.0 (8.2–9.8)</td>
<td>1.1 (0.6–1.9)</td>
<td>0.4 (0.2–0.6)</td>
</tr>
<tr>
<td>Mexican American</td>
<td>2417</td>
<td>30.3 (27.9–32.6)</td>
<td>7.2 (6.7–7.8)</td>
<td>0.3 (0.1–0.6)</td>
<td>0.07 (0.03–0.15)</td>
</tr>
<tr>
<td><strong>Age</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1–19 years</td>
<td>4772</td>
<td>36.9 (34.6–39.2)</td>
<td>28.2 (26.5–30.0)</td>
<td>0.6 (0.1–1.4)</td>
<td>0.4 (0.08–1.0)</td>
</tr>
<tr>
<td>20–59 years</td>
<td>3290</td>
<td>31.4 (29.3–33.5)</td>
<td>48.7 (45.4–51.9)</td>
<td>0.6 (0.3–1.1)</td>
<td>1.0 (0.4–1.7)</td>
</tr>
<tr>
<td>≥60 years</td>
<td>1560</td>
<td>27.7 (24.7–30.7)</td>
<td>12.4 (11.1–13.7)</td>
<td>2.2 (1.2–3.6)</td>
<td>1.0 (0.5–1.6)</td>
</tr>
</tbody>
</table>
S. aureus is the leading cause of surgical site infections
Distribution of Top Ranking Pathogens (January 2006 - October 2007)

<table>
<thead>
<tr>
<th>Pathogens</th>
<th>SSI</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Staphylococcus aureus</em></td>
<td>30.01%</td>
</tr>
<tr>
<td><em>Coagulase Negative Staph (CNS)</em></td>
<td>13.74%</td>
</tr>
<tr>
<td><em>Enterococcus spp.</em></td>
<td>11.21%</td>
</tr>
<tr>
<td><em>Pseudomonas aeruginosa</em></td>
<td>5.55%</td>
</tr>
<tr>
<td><em>Eschericia coli</em></td>
<td>9.55%</td>
</tr>
<tr>
<td><em>Acinetobacter baumannii</em></td>
<td>0.60%</td>
</tr>
<tr>
<td><em>Enterobacter spp.</em></td>
<td>4.17%</td>
</tr>
<tr>
<td><em>Candida spp.</em></td>
<td>2.07%</td>
</tr>
</tbody>
</table>

SSIs are caused by both HA-MRSA and CA-MRSA
CA-MRSA causes SSIs

• Kourbatova, EV., et. al.,
  • Emergence of community-associated methicillin-resistant Staphylococcus aureus USA 300 clone as a cause of health care-associated infections among patients with prosthetic joint infections
  • AJIC; September, 2005
• From the Division of Infectious Diseases, Department of Medicine, Emory University School of Medicine, and Epidemiology Department, Grady Memorial Hospital, Atlanta, GA.
Kourbatova Study

- Case-control study performed to identify risk factors for prosthetic joint infections (PJI)
- Antibiograms of bacterial isolates associated with PJI were reviewed
- Molecular typing of available MRSA isolates was done using pulsed field gel electrophoresis (PFGE).
- Nasal cultures of health care providers who cared for these orthopedic patients were obtained
Kourbatova Study

• Over a 13-month period (January 2003-January 2004),
  • 9.5% of patients with prosthetic hip (THA) or knee (TKA) joint surgery developed Prosthetic Joint Infections (7 TKA and 2 THA)
    • 5 infections were caused by CA-MRSA and 3 by MSSA; one was culture negative
    • All CA-MRSA isolates had identical antibiograms
    • Molecular typing of 2 available CA-MRSA isolates revealed that these were the USA300 clone
  • CA-MRSA was not recovered from nares cultures from 31 health care providers
Kourbatova Study

- Dr. Kourbatova concludes that the CA-MRSA USA300 clone is no longer just a cause of community-acquired infections but has also emerged as a cause of health care-associated infections, causing PJI at their institution.

- This study demonstrates the emergence of the CA-MRSA USA300 clone as an important cause of health care-associated infections and, in this case, causing prosthetic joint infections that are by their very nature associated with significant morbidity and expense.

- The emergence of CA-MRSA as a frequent cause of infections in the community and now in the hospital setting presents new challenges to infection control programs in preventing nosocomial transmission of MRSA.
Preventing a single case of SSI due to MRSA can save hospitals as much as $60,000

80% of the *S. aureus* infections are caused by the patient’s own (clonal) nasal flora
Link S. aureus Nasal Carriage to Infection

• Wertheim, HFL, et al.
  • The Lancet 2004;364: 703-705.
  • Risk and Outcome of Nosocomial Staphylococcus aureus Bactaeremia in Nasal Carriers versus Non-carriers
  • Genotyping revealed that 80% of strains causing bacteremia in carriers were endogenous
    • Identical to nasal strains detected on admission
Nasal carriage of *S. aureus* is a major risk factor for SSI following cardiac open heart surgery
Link: *S. aureus* Nasal Carriage to Cardiac SSI

- Kluytmans JAJW, et al.
  - Journal of Infectious Disease 1995;171:216-9
  - Nasal Carriage of *Staphlococcus aureus* as a Major Risk Factor for Wound Infections after Cardiac Surgery
  - 10/10 pairs of pre-op nasal isolates and post-op wound isolates were identical
Nasal carriage of *S. aureus* is a major risk factor for SSI following orthopedic prosthetic joint surgery
Link: *S. aureus* Nasal Carriage to Orthopedic SSI

- Kalmeijer MD, et al.
  - *Infection Control and Hospital Epidemiology* 2000;21:319-323
  - Nasal Carriage of *Staphlococcus aureus* as a Major Risk Factor for Surgical Site Infections in Orthopedic Surgery
  - High-level nasal carriage of *S. aureus* was the most important and only significant independent risk factor for developing SSI with *S. aureus*
Nasal carriage of *S. aureus* is a major risk factor for SSI following liver transplant
Link *S. aureus* Nasal Carriage to Infection in Liver Transplant Patients

- **Abstract:** Interscience Conference on Antimicrobial Agents and Chemotherapy, 2003

- Preoperative nasal carriage of MRSA is known to be predictive of MRSA infection in liver transplants (LT), but the risk associated with MSSA nasal carriage was unknown.

- Aim of study was to compare the relationship between nasal carriage and infection with MSSA and MRSA in LT recipients.

- All patients were screened for MRSA and MSSA nasal carriage before surgery.
Link S. aureus Nasal Carriage to Infection in Liver Transplant Patients

• **Abstract:** Interscience Conference on Antimicrobial Agents and Chemotherapy, 2003

  • Of the 340 patients, 18 (5.3%) harbored MRSA and 67 (19.7%) harbored MSSA.
    • MRSA infection was more likely to occur in MRSA nasal carriers compared with MRSA non-carriers (83% vs 6%)
    • MSSA nasal carriers were more likely to develop MSSA infection than non-carriers (24% vs 5%)

  • LT recipients with preoperative MSSA nasal carriage have an increased risk of MSSA infection, in particular early-onset bacteremia, although the risk is lower than for MRSA. Candidates for LT should be screened for both MRSA and MSSA nasal carriage.
### CDC – Guideline for Prevention of Surgical Site Infections, 1999

- No recommendation to preoperatively apply mupirocin to nares to prevent SSI. *Unresolved issue.*

Discussion: “It has been known for years that the development of SSI involving *S. aureus* is definitely associated with preoperative nares carriage of the organism in surgical patients. A recent multivariate analysis demonstrated that such carriage was the most powerful independent risk factor for SSI following cardiothoracic operations. . . The effect of mupirocin on reducing SSI risk is yet to be determined. Additionally, there is concern that mupirocin resistance may emerge, although this seems unlikely when treatment courses are brief.”
### Guidelines and Recommendations

<table>
<thead>
<tr>
<th>SHEA/IDSA* – Strategies to Prevent Surgical Site Infections, 2008(14)</th>
</tr>
</thead>
<tbody>
<tr>
<td>➢ Routine screening for MRSA or routine attempts to decolonize surgical patients with an antistaphylococcal agent in the preoperative setting. <strong>Unresolved issue</strong></td>
</tr>
</tbody>
</table>

**Discussion:** “A recent double-blinded, randomized, controlled trial involving more than 4,000 patients showed that intranasal application of mupirocin did not significantly reduce the *S. aureus* SSI rate. In a secondary analysis of these data, however, the use of intranasal mupirocin was associated with an overall decreased rate of nosocomial *S. aureus* infection among the *S. aureus* carriers. Mupirocin resistance has been documented.”

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### Guidelines and Recommendations

<table>
<thead>
<tr>
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<tbody>
<tr>
<td><strong>Class I recommendation</strong></td>
</tr>
<tr>
<td>Routine mupirocin administration is recommended for all patients undergoing cardiac surgical procedures in the absence of a documented negative testing for staphylococcal colonization (Level of Evidence A).</td>
</tr>
</tbody>
</table>

Reducing *S. aureus* in the Nares Prior to Surgery

- **Limited Options:**
  - Bactroban Nasal® (mupirocin calcium ointment, 2%)—indicated for institutional outbreaks of MRSA

- **Limitations to mupirocin:**
  - Does not fit into their patient logistics
  - Long dosing (2x/day for 5 days)
  - Poor patient compliance
  - Antibiotic resistance
Mupirocin Resistance

• Jones, et al.,
  • Mupirocin Resistance in Patients Colonized with Methicillin-Resistant *Staphylococcus aureus* in a Surgical Intensive Care Unit
  • Clinical Infectious Diseases, 2007
  • Washington University School of Medicine, St. Louis, Missouri
  • Of the 302 MRSA isolates available for testing, 13.2% were resistant to mupirocin, with 8.6% having high-level resistance

• **Conclusions:** documented a high rate of mupirocin resistance in MRSA isolates from SICU patients, despite low levels of in-hospital mupirocin use
Mupirocin Resistance

• Rotger M Trumpuz A, et al.,
  • Phenotypic and Genotypic Mupirocin Resistance among Staphylococci Causing Prosthetic Joint Infection.
  • Journal of Clinical Microbiology Aug. 2005, p. 4266-68
  • Mayo Clinic, Rochester, MN

• Mupirocin resistance was found in 27% of MRSA isolates causing hip and knee PJI vs 0% for MSSA isolates

• “New strategies for MRSA nasal decolonization are warranted’’
Mupirocin Resistance

- **Emerging high-level mupirocin resistance among MRSA isolates in Ireland**
  - National Methicillin-Resistant Staphylococcus aureus (MRSA) Reference Laboratory, Saint James's Hospital, Dublin, Ireland
  - Significant increase in the proportion of high-level mupirocin-resistant isolates collected between 2006-2007 compared with isolates collected between 1999-2005
  - Prolonged, widespread or uncontrolled use, and multiple courses of mupirocin are all associated with the development of mupirocin resistance

Emerging Practice

- **Povidone iodine 5% antiseptic**
  - specially formulated to work in the unique physiology of the nares
  - applied 1 hour before surgery and provides a 99.5% reduction of *S. aureus* in the nares at 1 hour
  - Maintains this log reduction for at least 12 hours
  - Because it's an antiseptic and not an antibiotic, there is not concern of resistance like there is with mupirocin
Reducing *S. aureus* in the Nares will Help Reduce the Risk of SSI
“We exist in the bacterial world, not bacteria in ours. Unfortunately, we believe that we can rid ourselves of bacteria when, in fact, we cannot.”

Presentation from the 2000 Emerging Infectious Diseases Conference in Atlanta, Georgia
Antibacterial Household Products: Cause for Concern
Stuart B. Levy
Reducing the patients bacterial load before surgery will reduce the risk of SSI
To ask via the phone, you must unmute your phone first:
(*7 = unmute, *6 = mute)

To ask via the internet, please use the chat feature on the left hand side of your screen.
<table>
<thead>
<tr>
<th>Variable</th>
<th>Odds ratio (95% CI)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female sex</td>
<td>1.56 (1.14–2.15)</td>
<td>.006</td>
</tr>
<tr>
<td>Medical history</td>
<td></td>
<td></td>
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<tr>
<td>Diabetes</td>
<td>1.46 (0.99–2.12)</td>
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<tr>
<td>Cancer</td>
<td>1.39 (0.73–2.65)</td>
<td>.32</td>
</tr>
<tr>
<td>Sepsis</td>
<td>1.35 (0.78–2.34)</td>
<td>.28</td>
</tr>
<tr>
<td>Weight loss</td>
<td>1.28 (0.68–2.41)</td>
<td>.44</td>
</tr>
<tr>
<td>NIH wound classification</td>
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<td></td>
</tr>
<tr>
<td>Clean</td>
<td>Reference</td>
<td></td>
</tr>
<tr>
<td>Clean-contaminated</td>
<td>5.35 (3.03–9.47)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Contaminated</td>
<td>6.84 (3.31–14.1)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Dirty</td>
<td>6.59 (3.25–13.4)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>OR time, per minute</td>
<td>1.003 (1.002–1.004)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Preparation solution used</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Iodophor-based</td>
<td>Reference</td>
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</tr>
<tr>
<td>Chlorhexidine</td>
<td>1.35 (0.97–1.87)</td>
<td>.073</td>
</tr>
</tbody>
</table>

**Note.** $R^2$, 0.049; c statistic, 0.76. CI, confidence interval; NIH, National Institutes of Health; OR, operating room.