CONFLICT OF INTEREST

- I hereby certify that, to the best of my knowledge, no aspect of my current personal or professional situation might reasonably be expected to affect significantly my views on the subject on which I am presenting, other than the following.

  Speakers Bureau:
  - Ethicon
  - CareFusion
  - Cepheid
Most important pathogen in SSI and also a key pathogen in CLABSI

Most SSI caused by strains carried by patient into hospital

Anterior nares main niche


Why We Should Screen for MRSA and MSSA Prior to Surgery and Screen for MRSA Before Admission?
MRSA vs. MSSA

- Infection associated with higher mortality
  [Melzer et al, Clin Infect Dis 2003]

- Survive in dry conditions & on inanimate surfaces up to 20 days or longer
  [Clarke et al, Ir Med J 2001]

- Prevalence increasing

History of MRSA

- Resistance to PCN within 1 yr
  - By 1950’s, 3/4 of S. aureus strains PCN-resistant
  - Today, 90-95% clinical strains PCN-resistant

- 1959—methicillin (1st antistaph PCN) introduced
  - 1st MRSA strain within 2yrs
  - 60% of clinical S. aureus strains isolated from ICU’s are MRSA
Resistance to New and Older Antibiotics Increasing

- Recognized after almost 40 yrs
- High level resistance appeared in Detroit in 2002
  - vanA gene complex acquired from VRE [Centers for Disease Control and Prevention, MMWR Morb Mortal Wkly Rep 2002]
- 2nd strain in Philadelphia
- 3rd strain in New York

Vancomycin Resistance
MIC Creep toward resistance

- Increases in vancomycin MIC in both MRSA & MSSA over time [Rhee et al, Clin Infect Dis 2005]
- Largest study of >6000 S. aureus isolates over 5 yrs in California university hospital
  - Drift towards reduced susceptibility
  - ↑ing percentage of isolates with MIC ≥ 1.0 μg/mL
    - 19.9% in 2000
    - 70.4% in 2004 [Wang et al, J Clin Microbiol 2006]

MIC Creep

- ↑’d Vancomycin failure rate in MRSA infections in setting of ↑’d MICs
  - [Sakoulas et al, J Clin Microbiol 2005]
**Linezolid (Zyvox)**

- Introduced in 2000 for MRSA

  Resistant strain reported within 1 year
  
  **Tsiodras et al, Lancet 2001**

**Daptomycin (Cubicin)**

Introduced in 2003 for MRSA

Daptomycin-Resistant, Methicillin-Resistant *Staphylococcus aureus* Bacteremia

A. Mangili, I. Bica, D. R. Snydman, and D. H. Hamer*

Division of Geographic Medicine and Infectious Diseases, Department of Medicine, Tufts–New England Medical Center and Tufts University School of Medicine, Boston, Massachusetts

- Resistant strain reported within 2 years
  
  **Mangili et al, Clin Infect Dis 2005**
Relative Economic Burden Associated with HAIs

<table>
<thead>
<tr>
<th></th>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>SSI (Surgical Site Infections)</td>
<td>290,485 (~17% of HAIs)</td>
<td>$34,670</td>
<td>~12 days</td>
<td>4%</td>
</tr>
<tr>
<td>CLA-BSI (Central-Line Associated Blood Stream Infections)</td>
<td>248,678 (~14% of HAIs)</td>
<td>$29,156</td>
<td>~10-24 days</td>
<td>26%</td>
</tr>
<tr>
<td>VAP (Ventilator Associated Pneumonia)</td>
<td>250,205 (~15% of HAIs)</td>
<td>$28,508</td>
<td>~9-13 days</td>
<td>24%</td>
</tr>
<tr>
<td>CA-UTI (Catheter-Associated Urinary Tract Infections)</td>
<td>561,667 (~32% of HAIs)</td>
<td>$1,007</td>
<td>1 day</td>
<td>1%</td>
</tr>
<tr>
<td>Other / MDROs* (Multi-Drug Resistant Organisms e.g. (~22% of HAIs) MRSA, C. difficile, VRE, etc.)</td>
<td>386,090</td>
<td>~$30,000</td>
<td>~9.1 days</td>
<td>~4%</td>
</tr>
</tbody>
</table>

* NOTE: MDRO often cause other infection types (e.g., SSI, BSI, VAP, UTI); MDRO statistics reflect CDC estimates for methicillin-resistant Staphylococcus aureus (MRSA) only.


Pathogens survive on surfaces

<table>
<thead>
<tr>
<th>Organism</th>
<th>Survival period</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clostridium difficile</td>
<td>35- &gt;200 days.2,7,8</td>
</tr>
<tr>
<td>Methicillin resistant Staphylococcus aureus (MRSA)</td>
<td>14- &gt;300 days.1,5,10</td>
</tr>
<tr>
<td>Vancomycin-resistant enterococcus (VRE)</td>
<td>58- &gt;200 days.2,3,4</td>
</tr>
<tr>
<td>Escherichia coli</td>
<td>&gt;150- 480 days.7,9</td>
</tr>
<tr>
<td>Acinetobacter</td>
<td>150- &gt;300 days.7,11</td>
</tr>
<tr>
<td>Klebsiella</td>
<td>&gt;10- 900 days.6,7</td>
</tr>
<tr>
<td>Salmonella typhimurium</td>
<td>10 days- 4.2 years.7</td>
</tr>
<tr>
<td>Mycobacterium tuberculosis</td>
<td>120 days.7</td>
</tr>
<tr>
<td>Candida albicans</td>
<td>120 days.7</td>
</tr>
<tr>
<td>Most viruses from the respiratory tract (eg: corona, coxsackie, influenza, SARS, rhino virus)</td>
<td>Few days.7</td>
</tr>
<tr>
<td>Viruses from the gastrointestinal tract (eg: astrovirus, HAV, polio- or rota virus)</td>
<td>60- 90 days.7</td>
</tr>
<tr>
<td>Blood-borne viruses (eg: HBV or HIV)</td>
<td>&gt;7 days.5</td>
</tr>
</tbody>
</table>

2. BIOQUELL trials, unpublished data.
### Prior room occupancy increases risk

<table>
<thead>
<tr>
<th>Study</th>
<th>Healthcare associated pathogen</th>
<th>Likelihood of patient acquiring HAI based on prior room occupancy (comparing a previously ‘positive’ room with a previously ‘negative’ room)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Martinez 2003¹</td>
<td>VRE – cultured within room</td>
<td>2.6x</td>
</tr>
<tr>
<td>Huang 2006²</td>
<td>VRE – prior room occupant</td>
<td>1.6x</td>
</tr>
<tr>
<td></td>
<td>MRSA – prior room occupant</td>
<td>1.3x</td>
</tr>
<tr>
<td>Drees 2008³</td>
<td>VRE – cultured within room</td>
<td>1.9x</td>
</tr>
<tr>
<td></td>
<td>VRE – prior room occupant</td>
<td>2.2x</td>
</tr>
<tr>
<td></td>
<td>VRE – prior room occupant in previous two weeks</td>
<td>2.0x</td>
</tr>
<tr>
<td>Shaughnessy 2008⁴</td>
<td>C. difficile – prior room occupant</td>
<td>2.4x</td>
</tr>
<tr>
<td>Nseir 2010⁵</td>
<td>A. baumannii – prior room occupant</td>
<td>3.8x</td>
</tr>
<tr>
<td></td>
<td>P. aeruginosa – prior room occupant</td>
<td>2.1x</td>
</tr>
</tbody>
</table>


### Risk of SSI Increased in Nasal Carriers

- Nasal carriage only independent risk factor for S. aureus SSI in orthopaedic implant surgery
  - Kalmeijer et al, Infect Control Hosp Epidemiol 2000

- SSI rate 2-9x higher in carriers
  - Perl et al, Ann Pharmacother 1998
  - Wenzel et al, J Hosp Infect 1995

- In S. aureus SSI, S. aureus isolates from wound match nares 85% of time
Risk Factors for *S. Aureus* SSI

- Observational study of 357 cardiac surgery patients
- 27% nasal carriers
- SSI rate 6.4%
  - *S. aureus* in 64%
  - 8/16 (50%) infections in nasal carriers
- Independent risk factors
  - Diabetes (RR 5.9)
  - Re-operation (RR 3.1)
  - *S. aureus* nasal carriage (RR 3.1)

[Muñoz et al, J Hosp Infect 2008]

Risk of MRSA Nasal Carriage

- Case-control study of 308 vascular surgery pts (nasal swabs)
  - 11.4% MSSA carriers
  - 4.2% MRSA carriers
    - 2.9% on admission
    - 1.3% acquired in hospital
- Transfer from another dept or facility risk factors for MRSA carriage
- **MRSA infection rate**
  - 30.8% in MRSA carriers
  - 0.68% in non-carriers

Recent MRSA epidemiology

“Our findings suggest that the referral of patients to different hospitals is a major cause of MRSA transmission around the country. This knowledge could help in finding ways to prevent the spread of infections.”

– Researchers also found that the MRSA strain studied evolved from antibiotic-sensitive bacteria that existed more than 100 years ago.


MRSA Increase Mortality Rate by 50%

– 1265 intensive care units in 75 countries
– 13,796 hospitalized patients.
– 999 patients were infected with Staphylococcus aureus
  • 494 (49%) with MRSA. The subjects were reassessed 60 days later.
• Patients infected with MRSA:
  – slightly older, cancer and chronic renal failure
  – once the results were adjusted for these and other factors in multivariate analysis, it became evident that infections with resistant staphylococci accounted for nearly a 50% increase in mortality

Environmental Reservoirs

- MRSA infected/colonized pts contaminate rooms, contribute to endemic MRSA

- Prospective study of 25 MRSA pts

- Sampling of isolation rooms
  - 53.6% of surface samples positive
  - 28% of air samples
  - 40.6% of settle plates

- Isolates identical or closely related in **70% of patients**

[Sexton et al, J Hosp Infect 2006]

Decolonization of Carriers

- Intranasal mupirocin (Bactroban)
- Eradicates nasal colonization in most patients
- Reduces S. aureus infections
Mupirocin and the Risk of *S. Aureus* (MARS) Study

- University of Iowa Mupirocin Study
- Prospective randomized double-blind placebo-controlled
  - 4020 enrolled, 3864 analyzed
    - Elective cardiothoracic, general, oncologic, gyn, neuro surgery
- Rate of *S. aureus* SSI (primary endpoint)
  - 2.3% in mupirocin pts
  - 2.4% in placebo pts
- Among nasal carriers, risk of nosocomial *S. aureus* infection decreased by half (7.7% to 4.0%)
  
  *Perl et al, N Engl J Med 2002*

Preoperative Decolonization

- University of Pittsburgh
- Prospective observational study
- Total joint arthroplasty
- 1966 patients
  - 636 screened (nasal)
    - 23% MSSA (147/636)
    - 3% MRSA (17/636)
  - 1330 control (not screened)

  *Rao et al, Clin Orthop Relat Res 2008*


- 74 surgeons and 61 residents screened
  - Surgeons: MRSA 2.7% and MSSA 23.3%
  - Residents: MRSA 0% and MSSA 59%
  - Control Group of Patients: MRSA 2.17% and MSSA 35.7%

- Previous studies: 3% of MRSA outbreaks are caused by asymptomatic colonized health-care workers.

---

New England Baptist Hospital
Boston, MA

Experience with a MRSA and MSSA Elimination Program for Orthopedic Surgery
February 2006--133 anonymous nares cultures after patient anesthetized

Results:

- S. aureus (29%)
- MRSA (4%)
- All previously undiagnosed

*No contact precautions were used in OR, PACU or nursing units
*Cefazolin used for antibiotic prophylaxis – instead of Vancomycin for MRSA patients

---

Developed Screening Proposals

- February 2006 - prepared three screening proposals with costs
  - $245,000.00
  - $337,338.00
  - $259,990.00

- March 2006 - Board approved Cepheid GeneXpert equipment purchase
March – October 2006
  - Weekly meetings:
    - Surgical services, infection control, micro, administration, & medical staff members
  - July 2006 – letter to surgeons
  - July 17, 2006 – initiated pilot on Spine Service
  - August 2006 – letter to medical staff
  - September 2006 – initiated universal program for all inpatient surgery

Protocol developed for all departments & units affected
  - OR Scheduling
  - Patient Access
  - Prescreening Unit
  - Pre-surgical unit
  - OR
  - PACU
  - Nursing Units
  - Microbiology Lab
  - Ancillary Departments: Housekeeping, Central Transport, Radiology, etc.
Instruct staff on how to obtain a nares specimen with proper swabs
- Lab differentiation of the colonized nasal screens from routine clinical cultures.
- Molecular lab up and running in a short time frame with cross-training of staff to Cepheid GeneXpert
- **1 hour result for MRSA and MSSA**
- Reporting system and broadcast to appropriate departments and individuals

**Topical Decolonization Protocol**

- Patients called by PASU to initiate treatment protocol
- Repeat call to document compliance
- MRSA carriers **re-screened** prior to surgery
- Contact precautions if 2nd MRSA screen positive
- **Vancomycin** for surgical prophylaxis - all patients with history of MRSA carrier status or positive PCR for MRSA
Implement Decolonization Protocol

- 5-day application of intranasal 2% mupirocin - applied twice daily - for MRSA and Staph aureus positive patients
- Daily body wash with chlorhexidine

Institutional Prescreening for Detection and Eradication of MRSA in Patients Undergoing Elective Orthopedic Surgery

PRESCREENING UNIT (PASU)

Patient is screened for Staph aureus and Methicillin-resistant Staph aureus (MRSA)

- **Staph aureus**
  - Treated with 2% mupirocin (Bactroban) for five days and five days of body bathing with chlorhexidine (e.g. Hibiclean)
  - No further screens or precautions are necessary

- **MRSA +**
  - Flagged in Meditech as MRSA-SCR
  - Placed on the MRSA list on N Drive
  - Treated with 2% mupirocin (Bactroban) for five days and five days of body bathing with chlorhexidine (e.g. Hibiclean)
  - Second nasal screen obtained before surgery

- **MRSA -**
  - MRSA-SCR flag is removed from Meditech
  - Vancomycin administered as surgical prophylaxis - prepared in Bond Center one hour before surgery
  - No precautions or additional nasal screens are necessary

- **MRSA +**
  - MRSA-SCR flag changed to MRSA
  - Vancomycin administered as surgical prophylaxis - prepared in Bond Center one hour before surgery
  - Contact Precautions are implemented and used throughout the hospitalization
  - Three negative cultures required to be removed from precaution list
Pre-op MRSA and S. aureus Decolonization

- **Results:**
  - **Timeframe:** July 17, 2006 through September 2010
  - **Infection rate:** 20,065 patient screened
    - 5,988 (23%) positive for Staph aureus
    - 1,027 (4%) positive for MRSA
  - **Effectiveness:** Repeat nasal screens on MRSA patients revealed 77% elimination

### Institutional Prescreening for Detection and Eradication of MRSA in Patients Undergoing Elective Orthopedic Surgery (cont’d)

<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td><strong>n</strong></td>
<td>7019</td>
<td>5293</td>
<td></td>
</tr>
<tr>
<td>MRSA infection</td>
<td>4 (0.06%)</td>
<td>10 (0.19%)</td>
<td>0.0315</td>
</tr>
<tr>
<td>MSSA infection</td>
<td>9 (0.13%)</td>
<td>14 (0.26%)</td>
<td>0.0937</td>
</tr>
<tr>
<td>Total SSIs</td>
<td>13 (0.19%)</td>
<td>24 (0.45%)</td>
<td>0.0093</td>
</tr>
</tbody>
</table>
First Year Results: 60% Reduction in MRSA SSIs, 50% Reduction in MSSA

Despite Decolonization and Vancomycin - Increased Risk

- MRSA colonized patients had an increased risk of SSI
- Seven (7) Staph aureus infections in 2712 positives 0.19%
- Seven (7) MRSA infections in the 576 positives 1.21%
- Statistically significant difference p=<.05
Intangible Benefits

- Viewed by patients and community as positive pro-active infection control measure by staff, patients, family members & media

- Allows additional patient education
  - on importance of hand hygiene
  - prevention of SSI measures
  - infection control measures in home to reduce transmission of MRSA & S. aureus
Recent Mupirocin Research

- Korea: 27/193 (14%) MRSA clinical isolates

- US: low level resistance, 13/131 (6.8%)

- China: low level resistance in CA-MRSA, 2.3%

- US: 3.4% of MRSA carriers, and high-level MR was noted to occur in 0.62% of carriers

Bundled Approach to Work Toward Zero HAIs
Bundles to Reduce HAIs

- **Ventilator Associated Pneumonia Bundle (VAP)**
  - CHG oral rinse and care q2-4 hrs
  - Increase head of bed
  - Daily assessment – weaning vacation
  - Proton pump inhibitors
  - VAP Checklist

- **Central Line Associated Blood Stream Infection Bundle (CLABSI)**
  - CL Check list
  - Maximal Barrier Kits
  - Alcohol cap hub protectors
  - Daily line necessity assessment

- **Catheter Associated Urinary Tract Infections (CAUTI)**
  - Bundle approach – closed systems, antimicrobial catheter, daily catheter needs assessment

MRSA Bundle

- Rapid diagnostics with PCR for MRSA before admission and surgery
- Good hand hygiene and equipment disinfection
- CHG bathing in patients with central lines, foleys and on ventilators
- CHG pre-op bathing/showers
- CHG skin prep
- Antibiotic stewardship
- Contact Precautions
- Enhanced environmental cleaning
Clostridium Difficile

- Rapid diagnostics for C difficile with PCR
- Hand hygiene = hand washing
- Special Contact Precautions
- Environmental disinfection with bleach
- Enhanced environmental disinfection with high rates (ultraviolet lights, vaporized hydrogen peroxide)
- Antibiotic stewardship
- Disinfection of equipment with bleach wipes
- Use of probiotics and fecal implants

Hand Hygiene – Sanitize vs Wash

- Important to make product easily accessible and visible
- Develop hand hygiene observation process – use “secret shoppers” concept to collect data
- Electronic hand hygiene systems now available
- Reinforcement must be consistent
- Encourage more hand washing – less sanitizing so they are just sanitizing the bioburden
Make it Fun, Consistent and Reinforced

Hand Hygiene Educational Program FY03-FY10

Infection Control – Educational Foundation: Social Learning Theory

- Role Modeling (A. Bandura)
- Self-Efficacy (A. Bandura)
- Reinforcement (BF Skinner)
- Contracting (BF Skinner)
- Reciprocity (BF Skinner)
Unit Based Champions: Infection Control Liaisons
Role Models, Positive Deviance, Empowerment of Staff

- Unit- and Department-based liaisons or champions
  - Role Models and Responsibilities enhance self-efficacy
  - Participate in educational activities
  - Hand hygiene observations
  - Direct care observations
  - Communicate information to staff
  - Assist in implementing practice change
  - “Call-out” breaks in techniques
  - Attend monthly meetings
  - Contribute to an annual “Bug Beat Fair”
  - Participate in Performance Improvement Studies
  - Clinical ladder for professional advancement

National Association of Orthopedic Nurses, May 2006  Poster Presentation:

Engage Your Staff: Got Soap?

- Engaged the OR staff in a Got Soap? Campaign
  - OR Nurses
  - Surgeons
  - Administration
  - Used shaving cream for soap and used medical photographer
Creative Themes and Posters

Foam In - Foam Out
F.O.A.M. - Fight Organisms And Microbes

I am *C. DIFFICILE*
I cause colitis.

Call me Beta
*S. AUREUS*
Group A I can give you strep throat.

I am *KLEBSIELLA*
I can cause wound infections.

Hi I am *S. AUREUS*
I cause skin infections and can get resistant (MSSA).

I am *PSEUDOMONAS AERUGINOSA*
I infect wounds and produce a blue-green pus.

My name is *Norovirus*
I cause diarrhea.

Boo I am *R. RATTI*
short for *DENGUE VIRUS*.
I can cause dengue or eye/skin tract infections.

I'm known as *INFLUENZA*
How to give you pneumonia.

Don't spread these germs to others.
Wash hands often.
Wash before going to the bathroom.
Wash after eating.
Washing your hands is the single most important thing you can do to stop the spread of infection.

LOVE = WASH*

Hand Hygiene Fair
February 7, 2009
11:35 a.m. - 1:30 p.m.
in the Cafeteria
Free Gifts!

F.I.E.S.T.A.
Bug Beat Fair
June 21st
11:00 a.m. - 2:00 p.m.
Cortyard Conference Room
Games, Educational Displays, and Raffles Prizes!

Please join us for

Don't Catch the Flu or Bear Blues
December 10, 2009
11:30 a.m. - 1:30 p.m.
Cafeteria Display
Free Holiday Bear and Hand Sanitizer Teddy Bear Raffle

U.S.S.A.

Bug Beat Fair
June 24, 2001
11:00 a.m. - 1:00 p.m.
Cortyard Conference Room
Visit our booth and get a free prize

B.A.T.S.

Thursday, October 16, 2008
11:30 a.m. - 1:30 p.m.
Raffles & Prizes

E.L.F.
Everyone Loves Foam
December 10, 2008
11:30 a.m. - 1:30 p.m.
Raffle Prizes

R.E.D.

February 11, 2009
11:30 a.m. - 1:30 p.m.
Cafeteria

S.O.C.K.S.

Friday November 11
11:30 a.m. - 1:30 p.m.
Cortyard Conference Room
Take a journey through the departments and learn how they prevent infection.

M.R.S.A. Fair
Make Resistance Stay Away

F.O.A.M.

Hand Hygiene Fair
October 19-21, 2009

The G.H.O.S.T.

Infection Prevention Week
October 19-21, 2009

Hand Hygiene Fair
11:30 a.m. - 1:30 p.m.
Cafeteria
Prevention of Orthopaedic Perioperative Infection

Nicholas Fletcher, MD, D’Mitri Sofianos, BS, Marschall Brantling Berkes, BS, and William T. Obremskey, MD, MPH Vanderbilt Orthopedic Trauma, Nashville, TN

- **Antibiotics to reduce SSIs**
  - Preoperatively
  - Postoperatively (elective surgery/surgical treatment closed fractures): continue antibiotics no longer than 24 hours

- **Preoperative antisepsis (patient and surgeon): chlorhexidine gluconate**

- **Elective total joint replacement**
  - Closed suction drainage is not warranted and is associated with an increased relative risk of transfusions
  - Drains left in situ for more than 24 hours are at an increased risk for bacterial contamination

- **Occlusive dressings**

- **Control blood glucose levels, oxygenation, and the temperature of the patient**

Fletcher JBJS 2007

---

7 “S” Bundle to Prevent Surgical Site Infections

- **SAFETY - IN THE OPERATING ROOM**
  - **SCREEN** - FOR RISK FACTORS, PRESENCE OF MRSA & MSSA
  - **SHOWERS** - PRE-OP WITH CHLORHEXIDINE SOLUTION OR
  - **SKIN PREP** WITH CHLORHEXIDINE AND 70% ALCOHOL
  - **SOLUTION** TO POLLUTION IS DILUTION - WITH CHLORHEXIDINE IRRIGANT (0.05%)
  - **SUTURES** - ANTIMICROBIAL (WITH TRICLOSAN)
  - **SKIN CLOSURE** - TOPICAL SKIN ADHESIVES OR ANTIMICROBIAL DRESSINGS: (PHMB), SILVER
#1 – Safe Operating Room?

*traffic control, number in room
*air handling systems, filtration, grills
*SCIP: hair clipping, warmers, oxygenation,
surgical prophylaxis, Foley catheter removal 48 hrs
*room turnover and terminal cleaning
*instrument cleaning/sterilization process
*surgical prophylaxis – timing, duration
*storage of supplies, clean supply bins, carts, tables, stationary equipment

AORN Recommended Practices

*Preoperative Patient Skin Antisepsis. AORN, 2008:537-553.
*High Level Disinfection. AORN, 2008:303-309.
*Cleaning and Processing Anesthesia Equipment. AORN, 2008:275-284
*Sterilization in the Perioperative Setting. AORN, 2008:575-284
*Hand Hygiene in the Perioperative Setting. AORN, 2011;p. 73–8
* Surgical attire AORN, 2011;p. 57–72
Surgical Care Improvement Project (SCIP) - a national quality partnership committed to improving patient safety by driving down postoperative complications by 25% by 2010

Estimated that hospitals can prevent an estimated 13,000 patient deaths and 271,000 surgical complications each year (AORN J 86 (July 2007)94-101)

SCIP is a national priority of the
- Institute of Healthcare Improvement (IHI) 10,000 lives Campaign
- The Joint Commission
- The Centers for Medicare and Medicaid Services (CMS).

### SCIP Core Measure Set

<table>
<thead>
<tr>
<th>Set Measure ID No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>SCIP Inf-1</td>
<td>Prophylactic antibiotic received within 1 hour prior to surgical incision</td>
</tr>
<tr>
<td>SCIP Inf-2</td>
<td>Prophylactic antibiotic selection for surgical patients</td>
</tr>
<tr>
<td>SCIP Inf-3</td>
<td>Prophylactic antibiotics discontinued within 24 hours after surgery end time</td>
</tr>
<tr>
<td>SCIP Inf-4</td>
<td>Cardiac surgery patients with controlled 6 AM postoperative blood glucose</td>
</tr>
<tr>
<td>SCIP Inf-6</td>
<td>Surgery patients with appropriate hair removal(^a)</td>
</tr>
<tr>
<td>SCIP Inf-9</td>
<td>Urinary catheter removed on postoperative Day 1 or postoperative Day 2 with day of surgery being Day 0(^a)</td>
</tr>
<tr>
<td>SCIP Inf-10</td>
<td>Surgery patients with perioperative temperature management(^a)</td>
</tr>
<tr>
<td>SCIP Card-2</td>
<td>Surgery patients on beta-blocker therapy prior to arrival who received a beta-blocker during the perioperative period</td>
</tr>
<tr>
<td>SCIP VTE-1</td>
<td>Surgery patients with recommended venous thromboembolism prophylaxis ordered</td>
</tr>
<tr>
<td>SCIP VTE-2</td>
<td>Surgery patients who received appropriate venous thromboembolism prophylaxis within 24 hours prior to surgery to 24 hours after surgery</td>
</tr>
</tbody>
</table>

\(^a\)Accountability evaluation

Centers for Medicare & Medicaid and The Joint Commission. *Specifications Manual for National Hospital Inpatient Quality Measures*
7 “S” Bundle to Prevent SSI

**SAFETY** - IN THE OPERATING ROOM

**SCREEN** - FOR RISK FACTORS, PRESENCE OF MRSA & MSSA

**SHOWERS** - PRE-OP WITH CHLORHEXIDINE SOLUTION OR BATH CLOTHS

**SKIN PREP** WITH CHLORHEXIDINE AND 70% ALCOHOL

**SOLUTION** TO POLLUTION IS DILUTION - WITH CHLORHEXIDINE IRRIGANT (0.05%)

**SUTURES** - ANTIMICROBIAL (WITH TRICLOSAN)

**SKIN CLOSURE** - TOPICAL SKIN ADHESIVES OR ANTIMICROBIAL DRESSINGS: (PHMB), SILVER

---

**Screen for SSI Risk Factors: Intrinsic/Extrinsic**

- Duration of operation
- Duration of surgical scrub
- Preoperative shaving, skin preparation
- Inadequate OR ventilation
- Inadequate sterilization of instruments
- Skin antisepsis
- Antimicrobial prophylaxis
- Surgical drains

- Surgical technique
  - Poor hemostasis
  - Failure to obliterate dead space
  - Tissue trauma

- Obesity
- Diabetes


Tissue kept moist with saline heals better

Tissue allowed to air dry does not heal as well
# Reducing Risk of SSIs – W.H.O.

<table>
<thead>
<tr>
<th>Risk factors for surgical site infections</th>
<th>Prevention</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Patient</strong></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>Avoid operating on very old or very young as they are at higher risk for developing infections</td>
</tr>
<tr>
<td>Nutritional status</td>
<td>Build a good nutritional status</td>
</tr>
<tr>
<td>Diabetes</td>
<td>Control and maintain blood sugar levels</td>
</tr>
<tr>
<td>Smoking</td>
<td>Cessation of smoking at least one month prior to surgery</td>
</tr>
<tr>
<td>Obesity</td>
<td>Reduce weight prior to surgery</td>
</tr>
<tr>
<td>Co-existent infections in a remote body site</td>
<td>Treat adequately before operation</td>
</tr>
<tr>
<td>Colonization with micro-organisms</td>
<td>Screen and treat carriers; avoid pre-operative shaving</td>
</tr>
<tr>
<td>Altered immune response</td>
<td>Boost immunity if possible</td>
</tr>
<tr>
<td>Length of preoperative stay</td>
<td>Avoid long stay in hospital</td>
</tr>
<tr>
<td><strong>Operational procedures</strong></td>
<td><strong>Guidelines</strong></td>
</tr>
<tr>
<td>Duration of surgical scrub</td>
<td>2 minutes as effective as 10 minutes</td>
</tr>
<tr>
<td>Skin antisepsis</td>
<td>Use povidone-iodine / chlorhexidine gluconate</td>
</tr>
<tr>
<td>Pre-operative shaving</td>
<td>Avoid if possible or shave immediately prior to operation</td>
</tr>
<tr>
<td>Preoperative skin preparation</td>
<td>Allow drying of antiseptic</td>
</tr>
<tr>
<td>Duration of operation</td>
<td>Keep procedures as short as possible</td>
</tr>
<tr>
<td><strong>General factors</strong></td>
<td><strong>Guidelines</strong></td>
</tr>
<tr>
<td>Antimicrobial prophylaxis</td>
<td>Give suitable antimicrobial cover</td>
</tr>
<tr>
<td>Operating room ventilation</td>
<td>Adhere to specifications below</td>
</tr>
<tr>
<td>Inadequate sterilization of instruments</td>
<td>Monitor CSSD processes</td>
</tr>
</tbody>
</table>

## 7 “S” Bundle to Prevent SSI

- **SAFETY** - IN THE OPERATING ROOM
- **SCREEN** - FOR RISK FACTORS, PRESENCE OF MRSA & MSSA
- **SHOWERS** - PRE-OP WITH CHLORHEXIDINE SOLUTION OR BATH CLOTHS
- **SKIN** PREP WITH CHLORHEXIDINE AND 70% ALCOHOL
- **SOLUTION** TO POLLUTION IS DILUTION – WITH CHLORHEXIDINE IRRIGANT (0.05%)
- **SUTURES** - ANTIMICROBIAL (WITH TRICLOSAN)
- **SKIN CLOSURE** - TOPICAL SKIN ADHESIVES OR ANTIMICROBIAL DRESSINGS: (PHMB), SILVER
Decolonization of Skin Prior to Surgery

- Distribution of 4 oz chlorhexidine
- CHG impregnated washcloths

Evidence for Preoperative Skin Cleansing with CHG

Preoperative Skin Antiseptic Preparations for Preventing Surgical Site Infections: A Systematic Review
Authors: Chris Kanel, MSc; Lynda McGahan, MSc; Julie Polisena, MSc; Manika Mierzwa-Urban, MLS; John M. Esmail, MD, FHKCPS
Revised March 2012
Source: Infection Control and Hospital Epidemiology, Vol. 33, No. 6 (June 2012), pp. 609-617
Published by: The University of Chicago Press on behalf of The Society for Healthcare Epidemiology of America
Available URL: http://www.jshader.org/doi/10.1086/665723
Accessed: 10/07/2012 11:26
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SOLUTION TO POLLUTION IS DILUTION - WITH CHLORHEXIDINE IRRIGANT (0.05%)

SUTURES - ANTIMICROBIAL (WITH TRICLOSAN)

SKIN CLOSURE - TOPICAL SKIN ADHESIVES OR ANTIMICROBIAL DRESSINGS: (PHMB), SILVER

Antisepsis with Chlorhexidine

- 2% CHG/70% alcohol skin preparation
  - Has a lasting effect on the skin
    - ~ 2 days post-op
  - Iodophors are fast kill but no long term residual effect like CHG
- CHG dry time is 3 minutes (to prevent fires)
- Evidence that chlorhexidine/alcohol achieves better skin antisepsis than iodophor

Darouiche et al NEJM 2010
Ostrander et al JBJS Am 2005
Saltzman et al JBJS Am 2009
Evidence for Use of CHG/Alcohol Skin Prep versus Iodine to Prevent SSIs

Systematic Review and Cost Analysis Comparing Use of Chlorhexidine with Use of Iodine for Preoperative Skin Antisepsis to Prevent Surgical Site Infection:

Authors: Ingi Lee, MD, MSCE; Rajender R. Agarwal, MD, MPH; Bruce Y. Lee, MD, MBA; Neil O. Fishman, MD; Craig A. Umscheid, MD, MSCE

Reviewed work:
Source: Infection Control and Hospital Epidemiology, Vol. 31, No. 12 (December 2010), pp. 1219-1229
Published by: The University of Chicago Press on behalf of The Society for Healthcare Epidemiology of America
Stable URL: http://www.jstor.org/stable/10.1086/657134
Accessed: 18/07/2012 12:07

The NEW ENGLAND JOURNAL of MEDICINE

ORIGINAL ARTICLE

Chlorhexidine–Alcohol versus Povidone–Iodine for Surgical-Site Antisepsis

Rabih O. Darouiche, M.D., Matthew J. Wall, Jr., M.D., Kamal M. F. Itani, M.D., Mary F. Otterson, M.D., Alexandra L. Webb, M.D., Matthew M. Carrick, M.D., Harold J. Miller, M.D., Samir S. Awad, M.D., Cynthia T. Crosby, B.S.,

N ENGL J MED 362:1  NEJM.ORG  JANUARY 7, 2010
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New Chlorhexidine Irrigation Solution

- Meets American College of Emergency Physicians (ACEP) guidelines for wound irrigation volume and pressure
- Proprietary SplatterGuard protects healthcare workers, patients and the environment from biohazard contamination
- Chlorhexidine Gluconate 0.05% demonstrated antimicrobial efficacy and persistence in laboratory testing
- The mechanical action effectively loosens and removes wound debris
- Safe for mucous membranes – approved by FDA
- [www.irrisept.com](http://www.irrisept.com)
**RESULTS:** In-vitro analysis revealed >99.999993% log-reduction in MDR isolates (MRSA, E. faecium, K. pneumoniae, E. aerogenes, E. coli and A. baumannii) following 1-min exposure to 0.05% CHG. There was a significant (p=0.001) reduction in the number of in-vivo infected mesh segments in the 0.05% CHG irrigated group (1/8, mean 1.91 log_{10} cfu/mesh segment) compared to the saline group (8/8, mean 5.51 log_{10} cfu/mesh segment).

**CONCLUSIONS:** At a concentration of 0.05% CHG is a potent biocide resulting in a significant log-kill of selective MDR surgical pathogens. Furthermore, irrigation of contaminated (MRSA) mesh with 0.05% CHG was effective (p=0.001) in reducing the risk of device-related infection in an in-vivo animal model. Further clinical studies are warranted documenting the efficacy of this practice as an effective risk reduction strategy prior to wound closure.

Edmiston, Abstract Presentation - ACS 2012

**Impact of Intraoperative Irrigation on Resolution of Mesh Contaminated Animal Model**

<table>
<thead>
<tr>
<th>Study Group</th>
<th>Irrigation Fluid</th>
<th>Bacterial Isolates</th>
<th>Initial Challenge</th>
<th>Study Population, N = animals at 7 days</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Saline (Control)</td>
<td>MRSA</td>
<td>~3.7 log_{10} CFU</td>
<td>8</td>
</tr>
<tr>
<td>2</td>
<td>0.05% CHG</td>
<td>MRSA</td>
<td>~3.7 log_{10} CFU</td>
<td>8</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Study Group</th>
<th>Positive Recovery at 7 days (log_{10} CFU)</th>
<th>Negative Recovery at 7 day (log_{10} CFU)</th>
<th>Biofilm Formation (log_{10} CFU)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Saline</td>
<td>8/8, 4.26 log_{10} CFU</td>
<td>No, 0/8</td>
<td>8/8, 6.3 log_{10} CFU</td>
</tr>
<tr>
<td>0.05% CHG</td>
<td>1/8, 1.8 log_{10} CFU, p&lt;0.001</td>
<td><strong>Yes, 7/8</strong></td>
<td>2/8, 2.6 log_{10} CFU, p&lt;0.01</td>
</tr>
</tbody>
</table>

*a Irrisept®

Edmiston CE, et al., In Press 2012 Am J Infect Control
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---

**Uncontrolled Risk Factor: Bacterial colonization of the suture**

- Like all foreign bodies, sutures can be colonized by bacteria:
  - Implants provide nidus for attachment of bacteria\(^1\)
  - Bacterial colonization can lead to biofilm formation\(^2\)
  - Biofilm formation increases the difficulty of treating an infection\(^2\)

*On an implant, such as a suture, it takes only 100 staphylococci per gram of tissue for an SSI to develop*\(^3\)

---

Potential for Contamination of Sutures at End of Case

Suture with Staphylococcus colonies

Air settling plates in the operating room at the last hour of a total joint case

Antibacterial Sutures: Impact in a Real-World Setting

- Antimicrobial sutures not only kill bacteria on the suture, but also create an inhospitable environment around the suture

- NEBH studied the “zone of inhibition” around the suture
  - A pure culture—0.5 MacFarland Broth—of S. aureus was prepared on a culture plate
  - An antibacterial suture was aseptically cut, planted on the culture plate, and incubated for 24 hrs
NEBH: One Year Prospective Study of 3786 Total Joints and Antimicrobial Sutures

- In July 2005, full-year evaluation of antibacterial sutures
- Changed product over July 4th holiday and did not tell all surgeons (only those involved with study)

At the end of the year-long trial period:
- **45% reduction in SSIs** caused by Staph aureus and MRSA
- Infection rate dropped from **0.4% to 0.3%** with three less infections
- Cost effective reduction for small increased cost of sutures

NAON Poster Presentation - 2010

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SUTURES - ANTIMICROBIAL (WITH TRICLOSAN)

SKIN CLOSURE - TOPICAL SKIN ADHESIVES OR ANTIMICROBIAL DRESSINGS: (PHMB), SILVER
Post-op Skin Issues in Orthopedics

- Anterior fusion with tape burns
- Posterior fusion with contaminated steri-strips
- Incision collects fluid – serum, blood - growth medium for organisms
- Spine fusions -incisions close to the buttocks or neck
- Heavy perspiration common
- Body fluid contamination from bedpans/commodes
- Friction and sliding - skin tears and blisters
- Itchy skin - due to pain medications - skin breakdown

Obesity and Surgical Incision
Clinical Use of Incisional Adhesive in Orthopedic Total Joints

Knee: Sealed with incisional adhesive, covered with Telfa and a transparent dressing for incision protection

Hip: Sealed with adhesive covered with gauze and transparent dressing for incision protection

Healed incision

Incisional Adhesive and Total Shoulder Replacements

- Propionibacterium acnes related total shoulder replacement infections (TSR)
- Eliminated the use of staples for TSR
- Instituted the use of incisional adhesive
- Covered dressing until day of discharge for protection
Increase in CA-MRSA admissions and decrease in HA-MRSA
### Reducing Risk Factors for SSIs: Real World Success

- Results of comprehensive approach to addressing SSI risk factors at New England Baptist Hospital in Boston

<table>
<thead>
<tr>
<th>GENERAL SSI</th>
<th>FY03</th>
<th>FY04</th>
<th>FY05</th>
<th>FY06</th>
<th>FY07</th>
<th>FY08</th>
<th>FY09</th>
<th>FY10</th>
</tr>
</thead>
<tbody>
<tr>
<td># Infections</td>
<td>6</td>
<td>1</td>
<td>3</td>
<td>4</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td># Procedures</td>
<td>1073</td>
<td>920</td>
<td>780</td>
<td>692</td>
<td>567</td>
<td>467</td>
<td>425</td>
<td>0</td>
</tr>
<tr>
<td>Infection Rate</td>
<td>0.6</td>
<td>0.1</td>
<td>0.4</td>
<td>0.5</td>
<td>0.3</td>
<td>0.3</td>
<td>0.2</td>
<td>0</td>
</tr>
<tr>
<td>ORTHOPEDIC SSI</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td># Infections</td>
<td>83</td>
<td>60</td>
<td>49</td>
<td>46</td>
<td>39</td>
<td>37</td>
<td>28</td>
<td>32</td>
</tr>
<tr>
<td># Procedures</td>
<td>8837</td>
<td>9669</td>
<td>9216</td>
<td>8986</td>
<td>9027</td>
<td>8884</td>
<td>8890</td>
<td>9839</td>
</tr>
<tr>
<td>Overall Infection Rate</td>
<td>0.7</td>
<td>0.6</td>
<td>0.5</td>
<td>0.5</td>
<td>0.4</td>
<td>0.4</td>
<td>0.3</td>
<td>0.3</td>
</tr>
<tr>
<td># Hip Infections</td>
<td>14</td>
<td>5</td>
<td>4</td>
<td>7</td>
<td>5</td>
<td>5</td>
<td>10</td>
<td>9</td>
</tr>
<tr>
<td>Hip Prosthesis Rate</td>
<td>1.0</td>
<td>0.3</td>
<td>0.2</td>
<td>0.4</td>
<td>0.3</td>
<td>0.3</td>
<td>0.5</td>
<td>0.4</td>
</tr>
<tr>
<td># Knee Infections</td>
<td>21</td>
<td>14</td>
<td>11</td>
<td>7</td>
<td>7</td>
<td>11</td>
<td>9</td>
<td>9</td>
</tr>
<tr>
<td>Knee Prosthesis Rate</td>
<td>1.5</td>
<td>1.0</td>
<td>0.7</td>
<td>0.4</td>
<td>0.3</td>
<td>0.5</td>
<td>0.4</td>
<td>0.3</td>
</tr>
<tr>
<td># Laminectomy Infections</td>
<td>6</td>
<td>9</td>
<td>7</td>
<td>7</td>
<td>12</td>
<td>4</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>Laminectomy Rate</td>
<td>0.7</td>
<td>0.9</td>
<td>0.6</td>
<td>0.8</td>
<td>1.3</td>
<td>0.5</td>
<td>0.0</td>
<td>0.5</td>
</tr>
<tr>
<td># Spinal Fusion Infections</td>
<td>5</td>
<td>15</td>
<td>12</td>
<td>12</td>
<td>5</td>
<td>5</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Spinal Fusion Rate</td>
<td>0.8</td>
<td>2.0</td>
<td>1.4</td>
<td>1.1</td>
<td>0.4</td>
<td>0.4</td>
<td>0.3</td>
<td>0.3</td>
</tr>
<tr>
<td>Other Infections</td>
<td>17</td>
<td>15</td>
<td>13</td>
<td>12</td>
<td>10</td>
<td>6</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>Other Infection Rate</td>
<td>0.4</td>
<td>0.4</td>
<td>0.4</td>
<td>0.3</td>
<td>0.2</td>
<td>0.2</td>
<td>0.2</td>
<td>0.2</td>
</tr>
</tbody>
</table>