Zero HAIs: Is This a Reality?

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CONFLICT OF INTEREST

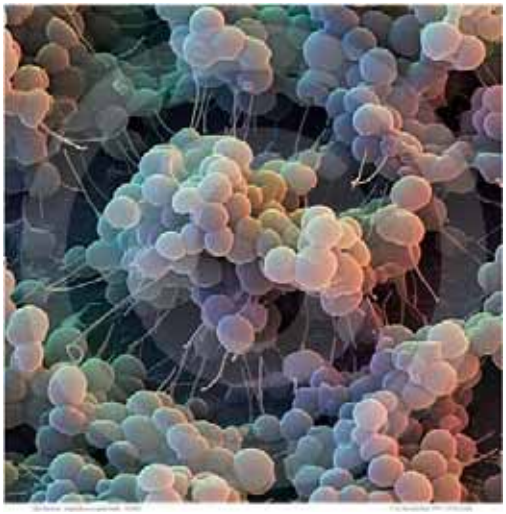
- I hereby certify that, to the best of my knowledge, no aspect of my current personal or professional situation might reasonably be expected to affect significantly my views on the subject on which I am presenting, other than the following.

Speakers Bureau:

- Ethicon
- CareFusion
- Cepheid

Staphylococcus Aureus

- 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
- Nasal carriage of *S. aureus* is risk factor for SSI *[Kluytmans et al, Clin Microbiol Rev 1997]*

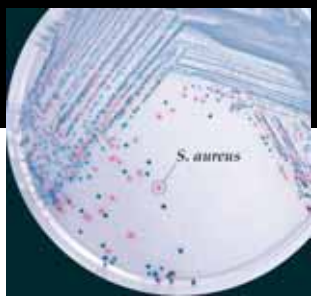


Why We Should Screen for MRSA and MSSA Prior to Surgery and Screen for MRSA Before Admission?

MRSA vs. MSSA

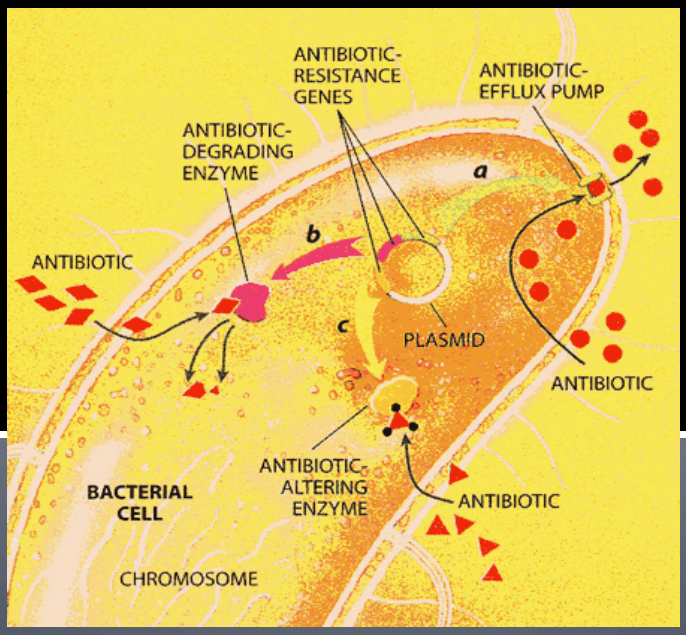
- Infection associated with higher mortality
  [Melzer et al, Clin Infect Dis 2003]
- Survive in dry conditions & on inanimate surfaces up to 20 days or longer
  [Clarke et al, Ir Med J 2001]
- Prevalence increasing
  [McAdam, et al. Proceedings of the Nat Academ of Sciences, 2012]

History of MRSA



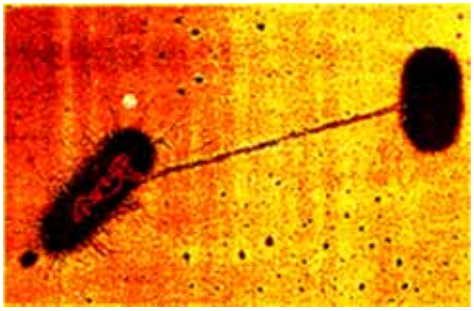
- Resistance to PCN within 1 yr
  - By 1950's, 3/4 of *S. aureus* strains PCN-resistant
  - Today, 90-95% clinical strains PCN-resistant
- 1959—methicillin (1st antistaph PCN) introduced
  - 1st MRSA strain within 2yrs
  - 60% of clinical *S. aureus* strains isolated from ICU's are MRSA

Resistance to New and Older Antibiotics Increasing



Vancomycin Resistance

- Recognized after almost 40 yrs
  - 1st glycopeptide-intermediate *S. aureus* (GISA) isolated in Japan in 1996 *[Hiramatsu et al, J Antimicrob Chemother 1997]*
- 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



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]*

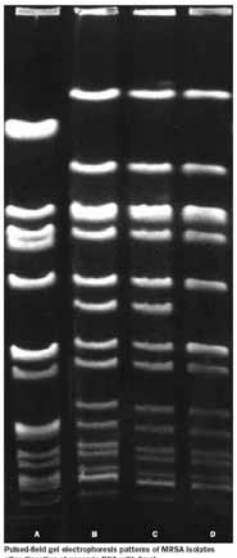
Linezolid (Zyvox)

- Introduced in 2000 for MRSA

Research letters

Linezolid resistance in a clinical isolate of *Staphylococcus aureus*

Sotirios Tsiodras, Howard S Gold, George Sakoulas, George M Eliopoulos, Christine Wennersten, Lata Venkataraman, Robert C Moellering Jr, Mary Jane Ferraro



Pulsed-field gel electrophoresis patterns of MRSA isolates after digestion of genomic DNA with SmaI

–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

	Est. Annual # of Infections	Direct Cost per Patient (2007$)	Avg. Increased Length of Stay	Attributable Mortality
• SSI Surgical Site Infections	290,485 (~17% of HAIs)	$34,670	~12 days	4%
• CLA-BSI Central-Line Associated Blood Stream Infections	248,678 (~14% of HAIs)	$29,156	~10-24 days	26%
• VAP Ventilator Associated Pneumonia	250,205 (~15% of HAIs)	$28,508	~9-13 days	24%
• CA-UTI Catheter-Associated Urinary Tract Infections	561,667 (~32% of HAIs)	$1,007	1 day	1%
• Other / MDROs* Multi-Drug Resistant Organisms (e.g., MRSA, C. difficile, VRE, etc.)	386,090 (~22% of HAIs)	~$30,000	~9.1 days	~4%

* 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.

SOURCES: Klevens, et al., "Estimating Health Care-Associated Infections and Deaths in U.S. Hospitals, 2002," *Public Health Review*, 2007; CDC: "The Direct Medical Cost of HAIs in U.S. Hospitals and the Benefits of Prevention", March 2009; Kirkland, et al., "The Impact of Surgical Site Infections", Infect Control Hosp Epidemiol, 1999; Arch Internal Med, 1988; Arch Internal Med, 1974; Infect Control Hosp Epidemiol, 2002; CareFusion MedMined Analysis, 2009.

Pathogens survive on surfaces

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

1. Beard-Pegler et al. 1988.. *J Med Microbiol*. **26**:251-5.
2. BIOQUELL trials, unpublished data.
3. Bonilla et al. 1996. *Infect Cont Hosp Epidemiol*. **17**:770-2
4. Boyce. 2007. *J Hosp Infect*. **65**:50-4.
5. Duckworth and Jordens. 1990. *J Med Microbiol*. **32**:195-200.
6. French et al. 2004. *ICAAC*.
7. Kramer et al. 2006. *BMC Infect Dis*. **6**:130.
8. Otter and French. 2009. *J Clin Microbiol*. **47**:205-7.
9. Smith et al. 1996. *J Med*. **27**: 293-302.
10. Wagenvoort et al. 2000. *J Hosp Infect*. **45**:231-4.
11. Wagenvoort and Joosten. 2002. *J Hosp Infect*. **52**:226-7.

Prior room occupancy increases risk

Study	Healthcare associated pathogen	Likelihood of patient acquiring HAI based on prior room occupancy (comparing a previously 'positive' room with a previously 'negative' room)
Martinez 2003[1]	VRE – cultured within room	2.6x
Huang 2006[2]	VRE – prior room occupant	1.6x
	MRSA – prior room occupant	1.3x
Drees 2008[3]	VRE – cultured within room	1.9x
	VRE – prior room occupant	2.2x
	VRE – prior room occupant in previous two weeks	2.0x
Shaughnessy 2008[4]	*C. difficile* – prior room occupant	2.4x
Nseir 2010[5]	*A. baumannii* – prior room occupant	3.8x
	P. aeruginosa – prior room occupant	2.1x

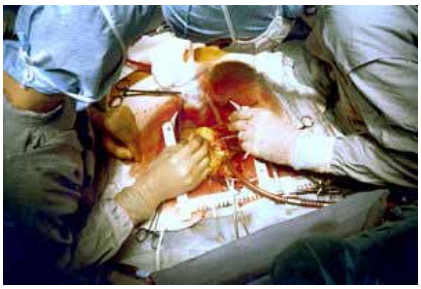
1. Martinez *et al. Arch Intern Med* 2003; 163: 1905-12.
2. Huang *et al. Arch Intern Med* 2006; 166: 1945-51.
3. Drees *et al. Clin Infect Dis* 2008; 46: 678-85.
4. Shaughnessy. ICAAC/IDSA 2008. Abstract K-4194.
5. Nseir et al. Clin Microbiol Infect 2010 (in press).

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
  - Kluytmans et al, Clin Microbiol Rev 1997
  - 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
  - Perl et al, N Engl J Med 2002

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)**

[Munoz 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**

[Morange-Saussier et al, Ann Vasc Surg 2006]

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.*

Reference: McAdams, et al. Molecular tracing of the emergence, adaptation, and transmission of hospital-associated methicillin-resistant Staphylococcus aureus. *Proceedings of the National Academy of Sciences*, 2012

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**

Reference: Hanberger H, et al. Increased mortality associated with meticillin-resistant Staphylococcus aureus (MRSA) infection in the Intensive Care Unit: results from the EPIC II study. International Journal of Antimicrobial Agents, 2011

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
  - Herwaldt, J Hosp Infect 1998; Kluytmans et al, Infect Control Hosp Epidemiol 1996; Tacconelli et al, Clin Infect Dis 2003 (**dialysis**)
  - Cimochowski et al, Ann Thorac Surg 2001; Kluytmans et al, Infect Control Hosp Epidemiol 1996 (**Cardiovasc**)
  - Gernaat-van der Sluis et al, Acta Orthop Scand 1998 (**ortho**)
  - Perl et al, N Engl J Med 2002 (**mixed**)

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]

Rate of MRSA and MSSA in Surgeons and Residents

- Schwarzkopf, et al: MRSA and MSSA in nares of physicians at the Hospital for Joint Diseases in New York.
  - Ran Schwarzkopf, Richelle C. Takemoto, Igor Immerman, James D. Slover, and Joseph A. Bosco **Prevalence of *Staphylococcus aureus* Colonization in Orthopaedic Surgeons and Their Patients: A Prospective Cohort Controlled Study** J Bone Joint Surg Am. 2010;92:1815-1819
- 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%

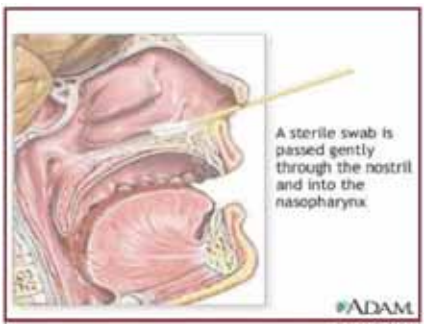
  - Previous studies - 3% of MRSA outbreaks are caused by asymptomatic colonized health-care workers.
  - Vonberg RP, Stamm-Balderjahn S, Hansen S, Zuschneid I, Ruden H, Behnke M, Gastmeier P. How often do asymptomatic healthcare workers cause methicillin-resistant Staphylococcus aureus outbreaks? A systematic evaluation. Infect Control Hosp Epidemiol. 2006;27:1123-7

New England Baptist Hospital Boston, MA

Experience with a MRSA and MSSA Elimination Program for Orthopedic Surgery

First Thing We did at NEBH
Obtained Anonymous Nasal Swabs

- 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
  - 1) Traditional nasal cultures - 3 day results
  - $245,000.00
  - 2) Purchase rapid PCR equipment
  - $337,338.00
  - 3) Lease rapid PCR equipment
  - $259,990.00
- March 2006 –Board approved Cepheid GeneXpert equipment purchase

Implementation – 8 Months

- 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

Policy & Procedure Development

- 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.

Pre-Screening Best Done with Rapid Technology: Polymerase Chain Reaction (PCR)

- 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 (eg Hibiclens)

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 (eg Hibiclens)

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

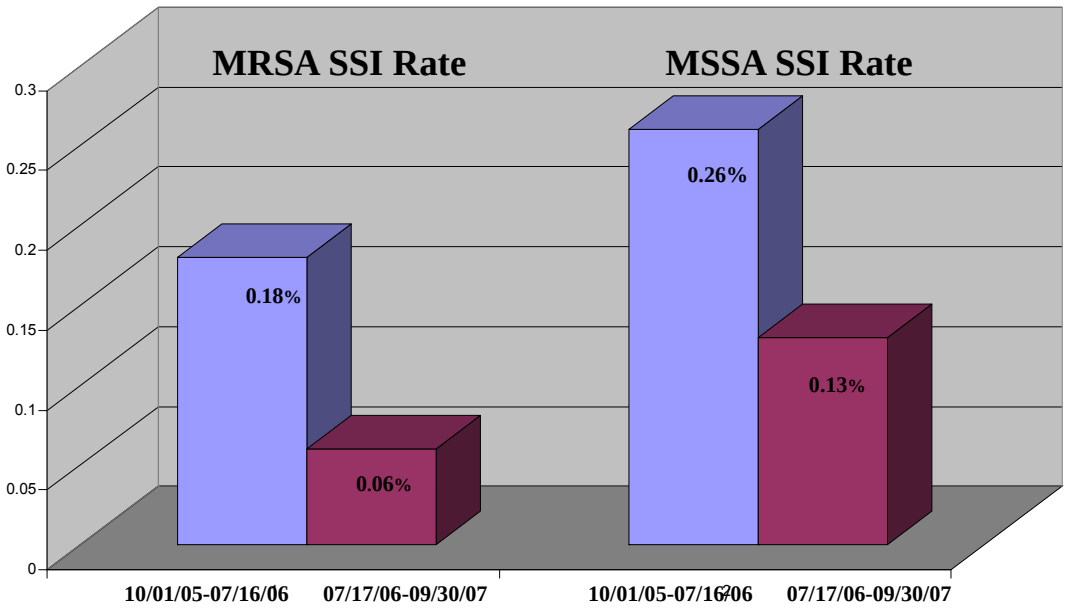
- **Results:**
  - **Timeframe**: July 17, 2006 through September 2010
  - **Infection rate**: 20,065 patient screened

    5,988 (23%) positive for Staph aureus
    1,027 (4%) positive for MRSA
  - **Effectiveness**: Repeat nasal screens on MRSA patients revealed **77% elimination**

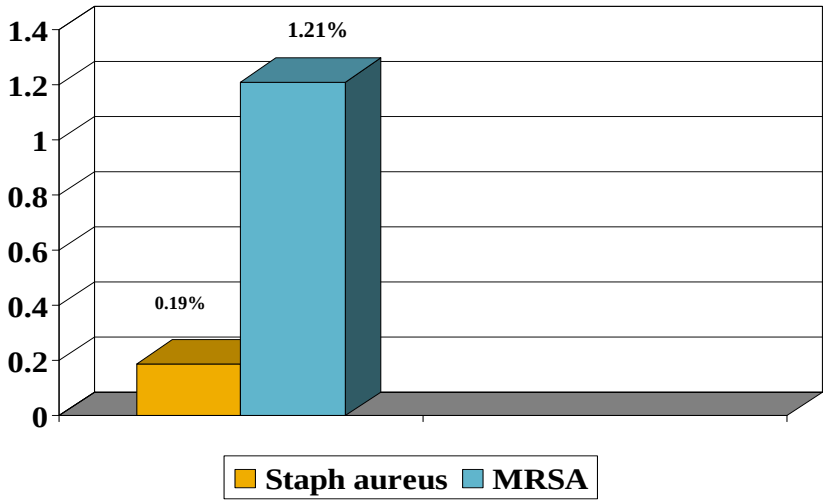
Institutional Prescreening for Detection and Eradication of MRSA in Patients Undergoing Elective Orthopedic Surgery (cont'd)

	Study Period 7/2006-9/2007	Control Period 10/2005-7/2006	*P* Value
n	7019	5293	
MRSA infection	4 (0.06%)	10 (0.19%)	**0.0315**
MSSA infection	9 (0.13%)	14 (0.26%)	0.0937
Total SSIs	**13 (0.19%)**	**24 (0.45%)**	***0.0093***

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*

Concern: Mupirocin Resistance

Recent Mupirocin Research

- Korea: 27/193 (14%) MRSA clinical isolates
  [Ann Dermatol 2012 Feb;24(1):32-8. Epub 2012 Feb 2]
- US: low level resistance, 13/131 (6.8%)
  [J Clin Microbiol 2011 Jan;49(1):95-100. Epub 2010 Nov 17]
- China: low level resistance in CA-MRSA, 2.3%
  [J Med Microbiol 2012 May 17]
- US: 3.4% of MRSA carriers, and high-level MR was noted to occur in 0.62% of carriers
  [J Clin Microbiol. 2009 Jul;47(7):2279-80. Epub 2009 May 27]

Bundled Approached 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

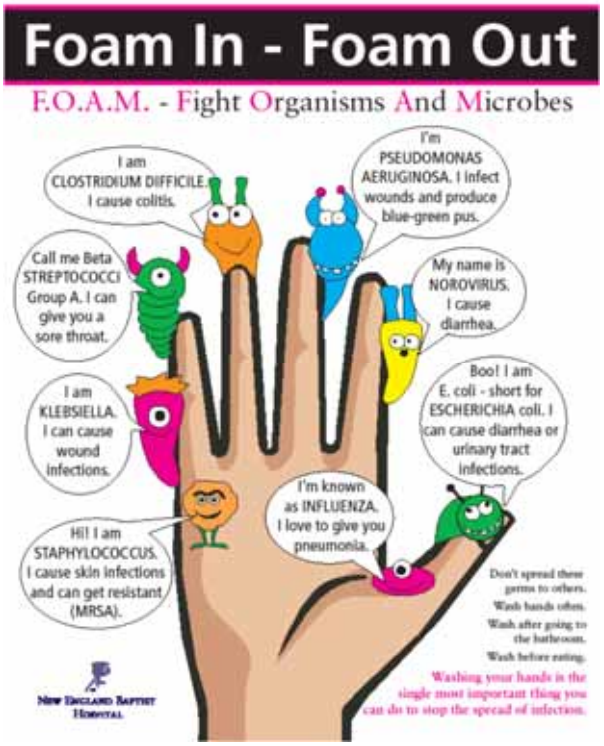
National Association of Orthopedic Nurses, May 2006 Poster Presentation:

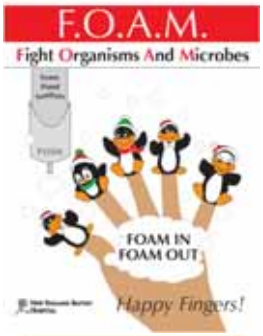
Spencer, et al: The Bug Beat Fair: An Innovative Infection Control Educational Campaign in An Orthopedic Specialty Hospital

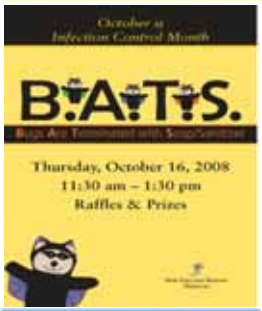
Engage Your Staff: *Got Soap?*

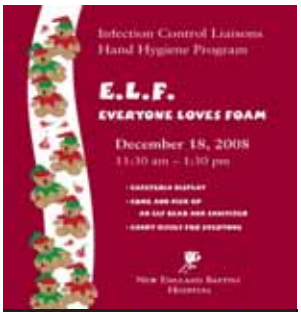
- Engaged the OR staff in a *Got Soap?* Campaign
  - OR Nurses
  - Surgeons
  - Administration
- Used shaving cream for soap and used medical photographer

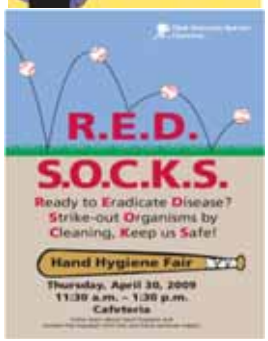
Creative Themes and Posters











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.
*Environmental Cleaning in the Perioperative Setting. In: AORN, 2012: 237-250.
*Surgical Tissue Banking. In: AORN, 2008:599-613.
*Surgical Hand Antisepsis. In: AORN, 2008:397-406.
*Cleaning and Care of Instruments and Powered Equipment: AORN, 2008:421-445.
*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
*Perioperative Management of Multiple Drug Resistant Organisms. AORN Journal, Volume 86, Issue 3, Pages 361-372, September 2007
* Surgical attire AORN, 2011;p. 57–72

US: Surgical Care Improvement Program (SCIP)

- 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

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

[a]Accountability evaluation

Centers for Medicare & Medicaid and The Joint Commission. *Specifications Manual for National Hospital*

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

Mangram et al. *Infect Control Hosp Epidemiol.* 1999;20(4):250-278.

Tissue kept moist with saline heals better

Tissue allowed to air dry does not heal as well

Reducing Risk of SSIs – W.H.O.

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

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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

CHICAGO JOURNALS

SHEA The Society for Healthcare Epidemiology of America

Preoperative Skin Antiseptic Preparations for Preventing Surgical Site Infections: A Systematic Review
Author(s): Chris Kamel, MSc; Lynda McGahan, MSc; Julie Polisena, MSc; Monika Mierzwinski-Urban, MLIS; John M. Embil, MD, FRCPC
Reviewed work(s):
Source: *Infection Control and Hospital Epidemiology*, Vol. 33, No. 6 (June 2012), pp. 608-617
Published by: The University of Chicago Press on behalf of The Society for Healthcare Epidemiology of America
Stable URL: http://www.jstor.org/stable/10.1086/665723
Accessed: 18/07/2012 11:26

American Journal of Infection Control xxx (2012) 1-7

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journal homepage: www.ajicjournal.org

ELSEVIER

AJIC American Journal of Infection Control

Review Article

Preoperative chlorhexidine shower or bath for prevention of surgical site infection: A meta-analysis

Maciej Piotr Chlebicki MD[a], Nasia Safdar MD, PhD[b,c,d,*], John Charles O'Horo MD[e], Dennis G. Maki MD[b,c]

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[b] Section of Infectious Diseases, Department of Medicine, University of Wisconsin Medical School, Madison, WI
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SUTURES – ANTIMICROBIAL (WITH TRICLOSAN)

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

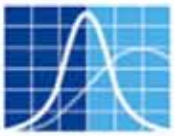
Antisepsis with Chlorhexidine

- 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

CHICAGO JOURNALS



SHEA
The Society for Healthcare Epidemiology of America

Systematic Review and Cost Analysis Comparing Use of Chlorhexidine with Use of Iodine for Preoperative Skin Antisepsis to Prevent Surgical Site Infection •
Author(s): Ingi Lee, MD, MSCE; Rajender K. Agarwal, MD, MPH; Bruce Y. Lee, MD, MBA; Neil O. Fishman, MD; Craig A. Umscheid, MD, MSCE
Reviewed work(s):
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.,

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SUTURES – ANTIMICROBIAL (WITH TRICLOSAN)

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

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

Effectiveness of 0.05% Chlorhexidine Gluconate (CHG) Against Selective Multidrug Resistant (MDR) Surgical Pathogens: An *In-vitro* and *In-vivo* Analysis

- **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

Study Group	Irrigation Fluid	Bacterial Isolates	Initial Challenge	Study Population , N = animals at 7 days
1	Saline (Control)	MRSA	~3.7 $\log_{10}$ CFU	8
2	0.05% CHG[a]	MRSA	~3.7 $\log_{10}$ CFU	8

Study Group	Positive Recovery at 7 days ($\log_{10}$ CFU)	Negative Recovery at 7 day ($\log_{10}$ CFU)	Biofilm Formation ($\log_{10}$ CFU)
Saline	8/8, 4.26 $\log_{10}$ CFU	No, 0/8	8/8, 6.3 $\log_{10}$ CFU
0.05% CHG	**1/8 ,1.8 $\log_{10}$ CFU** ***p<0.001***	**Yes, 7/8**	**2/8**, 2.6 $\log_{10}$ CFU *p<0.01*

[a] *Irrisept®*

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

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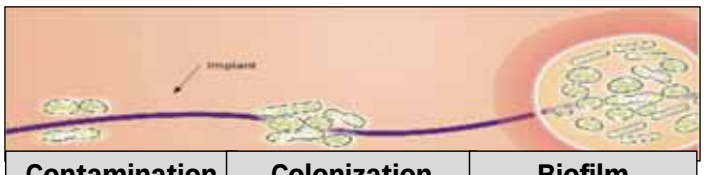
Uncontrolled Risk Factor: Bacterial colonization of the suture

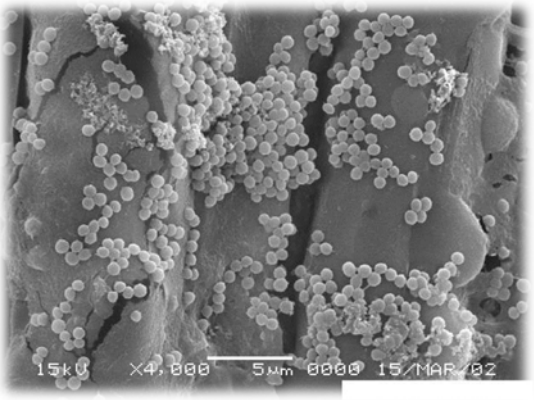
- Like all foreign bodies, sutures can be colonized by bacteria:
  - Implants provide nidus for attachment of bacteria[1]
  - Bacterial colonization can lead to biofilm formation[1]
  - Biofilm formation increases the difficulty of treating an infection[2]



On an implant, such as a suture, it takes only 100 staphylococci per gram of tissue for an SSI to develop[3]

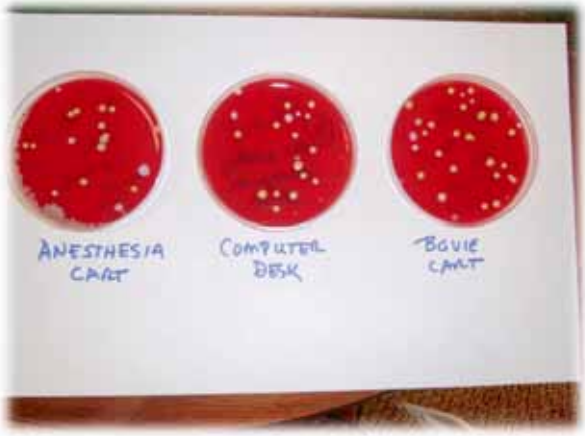
1. Ward KH et al. J Med Microbiol. 1992;36: 406-413.
2. Kathju S et al Surg infect. 2009;10:457-461
3. Mangram AJ et al. Infect Control Hosp Epidemiol.1999;27:97-134..

Potential for Contamination of Sutures at End of Case



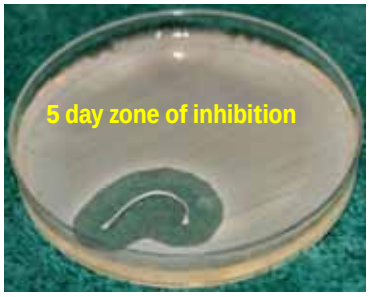
Suture with Staphylococcus colonies

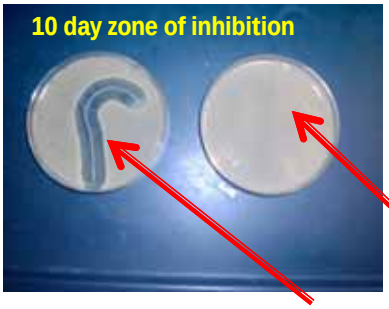
Air settling plates in the operating room at the last hour of a total joint case



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





Traditional suture

Antimicrobial suture

Plus Antibacterial Sutures: Prospective Independent Evaluation

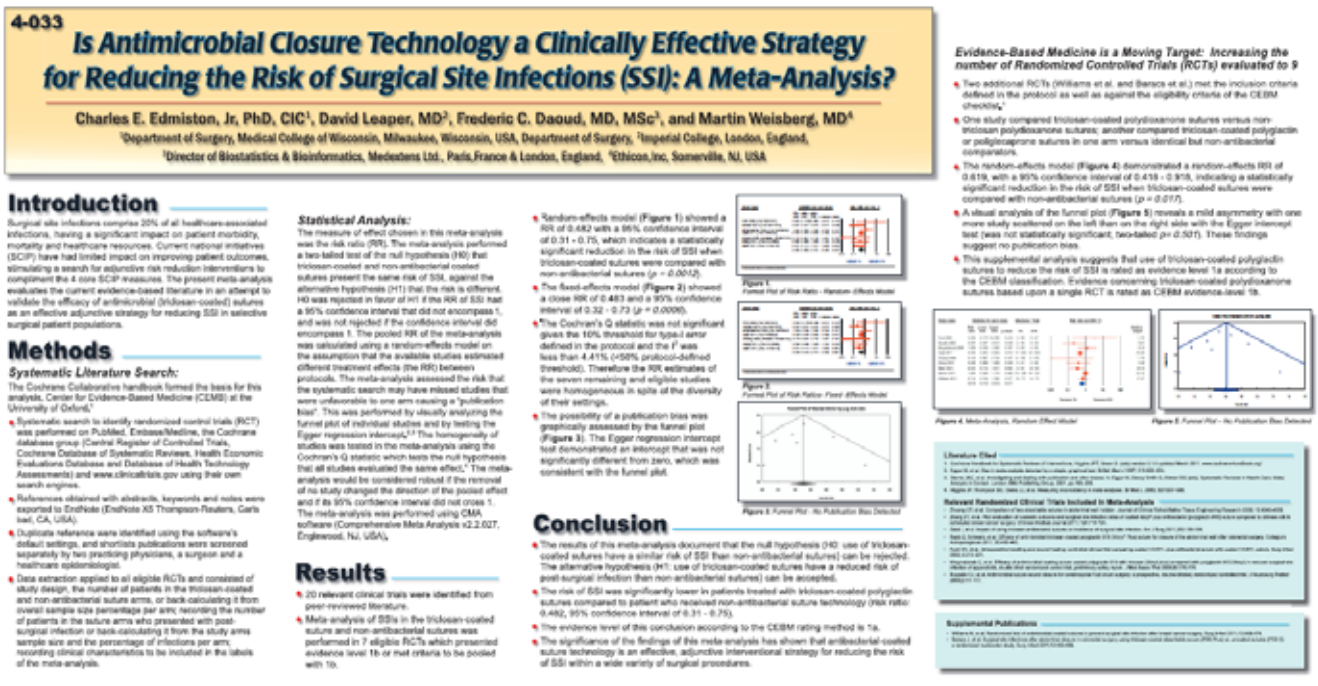
- NEBH : One Year Prospective Study of 3786 Total Joints and Antimicrobial Sutures
  - In July 2005, full-year evaluation of antibacterial sutures
  - Changed product over July 4th holiday and did not tell all surgeons (only those involved with study)

- 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

- Spencer M, et al: Reducing the Risk of Orthopedic Infections: The Role of Innovative Suture Technology[77]

Meta-Analysis



4-033

Is Antimicrobial Closure Technology a Clinically Effective Strategy for Reducing the Risk of Surgical Site Infections (SSI): A Meta-Analysis?

Charles E. Edmiston, Jr, PhD, CIC[1], David Leaper, MD[2], Frederic C. Daoud, MD, MSc[3], and Martin Weisberg, MD[4]
[1]Department of Surgery, Medical College of Wisconsin, Milwaukee, Wisconsin, USA, Department of Surgery, [2]Imperial College, London, England,
[3]Director of Biostatistics & Bioinformatics, Medesteen Ltd., Paris,France & London, England, [4]Ethicon,Inc, Somerville, NJ, USA

Introduction

Surgical site infections comprise 20% of all healthcare-associated infections, having a significant impact on patient morbidity, mortality and healthcare resources. Current national initiatives (SCIP) have had limited impact on improving patient outcomes, stimulating a search for adjunctive risk reduction interventions to complement the 4 core SCIP measures. The present meta-analysis evaluates the current evidence-based literature in an attempt to validate the efficacy of antimicrobial (triclosan-coated) sutures as an effective adjunctive strategy for reducing SSI in selective surgical patient populations.

Methods

Systematic Literature Search:

The Cochrane Collaborative handbook formed the basis for this analysis. Center for Evidence-Based Medicine (CEMB) at the University of Oxford.[2]

- Systematic search to identify randomized control trials (RCT) was performed on PubMed, Embase/Medline, the Cochrane database group (Central Register of Controlled Trials, Cochrane Database of Systematic Reviews, Health Economic Evaluations Database and Database of Health Technology Assessments) and www.clinicaltrials.gov using their own search engines.
- References obtained with abstracts, keywords and notes were exported to EndNote (EndNote X5 Thompson-Reuters, Carlsbad, CA, USA).
- Duplicate reference were identified using the software's default settings, and shortlists publications were screened separately by two practicing physicians, a surgeon and a healthcare epidemiologist.
- Data extraction applied to all eligible RCTs and consisted of study design, the number of patients in the triclosan-coated and non-antibacterial suture arms, or back-calculating it from overall sample size percentage per arm; recording the number of patients in the suture arms who presented with post-surgical infection or back-calculating it from the study arms sample size and the percentage of infections per arm; recording clinical characteristics to be included in the labels of the meta-analysis.

Statistical Analysis:

The measure of effect chosen in this meta-analysis was the risk ratio (RR). The meta-analysis performed a two-tailed test of the null hypothesis (H0) that triclosan-coated and non-antibacterial coated sutures present the same risk of SSI, against the alternative hypothesis (H1) that the risk is different. H0 was rejected in favor of H1 if the RR of SSI had a 95% confidence interval that did not encompass 1, and was not rejected if the confidence interval did encompass 1. The pooled RR of the meta-analysis was calculated using a random-effects model on the assumption that the available studies estimated different treatment effects (the RR) between protocols. The meta-analysis assessed the risk that the systematic search may have missed studies that were unfavorable to one arm causing a "publication bias". This was performed by visually analyzing the funnel plot of individual studies and by testing the Egger regression intercept.[11] The homogeneity of studies was tested in the meta-analysis using the Cochran's Q statistic which tests the null hypothesis that all studies evaluated the same effect.[1] The meta-analysis would be considered robust if the removal of no study changed the direction of the pooled effect and if its 95% confidence interval did not cross 1. The meta-analysis was performed using CMA software (Comprehensive Meta-Analysis v2.2.027, Englewood, NJ, USA).

Results

- 20 relevant clinical trials were identified from peer-reviewed literature.
- Meta-analysis of SSIs in the triclosan-coated suture and non-antibacterial sutures was performed in 7 eligible RCTs which presented evidence level 1b or met criteria to be pooled with 1b.
- Random-effects model (**Figure 1**) showed a RR of 0.482 with a 95% confidence interval of 0.31 - 0.75, which indicates a statistically significant reduction in the risk of SSI when triclosan-coated sutures were compared with non-antibacterial sutures ($p = 0.0012$).
- The fixed-effects model (**Figure 2**) showed a close RR of 0.483 and a 95% confidence interval of 0.32 - 0.73 ($p = 0.0000$).
- The Cochran's Q statistic was not significant given the 10% threshold for type-I error defined in the protocol and the I^2 was less than 4.41% (<50% protocol-defined threshold). Therefore the RR estimates of the seven remaining and eligible studies were homogeneous in spite of the diversity of their settings.
- The possibility of a publication bias was graphically assessed by the funnel plot (**Figure 3**). The Egger regression intercept test demonstrated an intercept that was not significantly different from zero, which was consistent with the funnel plot.

Conclusion

- The results of this meta-analysis document that the null hypothesis (H0: use of triclosan-coated sutures have a similar risk of SSI than non-antibacterial sutures) can be rejected. The alternative hypothesis (H1: use of triclosan-coated sutures have a reduced risk of post-surgical infection than non-antibacterial sutures) can be accepted.
- The risk of SSI was significantly lower in patients treated with triclosan-coated polyglactin sutures compared to patient who received non-antibacterial suture technology (risk ratio: 0.482, 95% confidence interval of 0.31 - 0.75).
- The evidence level of this conclusion according to the CEBM rating method is 1a.
- The significance of the findings of this meta-analysis has shown that antibacterial-coated suture technology is an effective, adjunctive interventional strategy for reducing the risk of SSI within a wide variety of surgical procedures.

Evidence-Based Medicine is a Moving Target: Increasing the number of Randomized Controlled Trials (RCTs) evaluated to 9

- Two additional RCTs (Williams et al. and Barsics et al.) met the inclusion criteria defined in the protocol as well as against the eligibility criteria of the CEBM checklist.[4]
- One study compared triclosan-coated polydioxanone sutures versus non-triclosan polydioxanone sutures; another compared triclosan-coated polyglactin or polyglecaprone sutures in one arm versus identical but non-antibacterial comparators.
- The random-effects model (**Figure 4**) demonstrated a random-effects RR of 0.619, with a 95% confidence interval of 0.418 - 0.918, indicating a statistically significant reduction in the risk of SSI when triclosan-coated sutures were compared with non-antibacterial sutures ($p = 0.017$).
- A visual analysis of the funnel plot (**Figure 5**) reveals a mild asymmetry with one more study scattered on the left than on the right side with the Egger intercept test (was not statistically significant, two-tailed $p = 0.501$). These findings suggest no publication bias.
- This supplemental analysis suggests that use of triclosan-coated polyglactin sutures to reduce the risk of SSI is rated as evidence level 1a according to the CEBM classification. Evidence concerning triclosan-coated polydioxanone sutures based upon a single RCT is rated as CEBM evidence-level 1b.

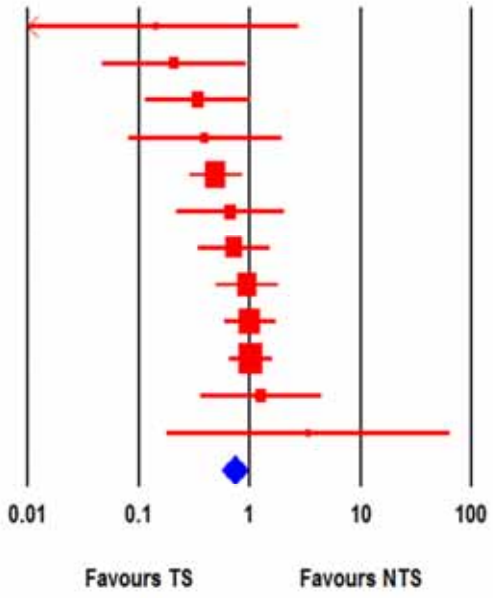
Edmiston, et al. APIC June 2012

Meta-analysis of 12 eligible RCTs

Study name	Risk ratio	Lower limit	Upper limit	p-Value	TS	NTS	Relative weight
Zhuang 2009	0.143	0.007	2.742	0.197	0 / 150	3 / 150	0.88
Rozelle 2008	0.207	0.047	0.915	0.038	2 / 46	8 / 38	3.27
Rasic 2011	0.341	0.114	1.017	0.054	4 / 91	12 / 93	5.68
Zhang 2011	0.392	0.080	1.928	0.249	2 / 51	5 / 50	2.89
Galal 2011	0.493	0.283	0.858	0.012	17 / 230	33 / 220	15.86
Isik 2012 (sternal)	0.667	0.218	2.036	0.477	4 / 170	12 / 340	5.48
Williams 2011	0.714	0.339	1.506	0.377	10 / 75	14 / 75	10.57
Seim 2012	0.941	0.493	1.798	0.854	16 / 164	17 / 164	12.96
Baracs 2011	1.004	0.588	1.716	0.988	23 / 188	24 / 197	16.57
Turtainen 2012	1.018	0.654	1.586	0.935	31 / 139	30 / 137	20.49
Mingmalairak 2009	1.250	0.356	4.385	0.727	5 / 50	4 / 50	4.46
Ford 2005	3.394	0.179	64.396	0.416	3 / 98	0 / 47	0.89
	0.734	0.554	0.971	0.030			

Statistics for each study

Risk ratio and 95% CI



Pooled Risk Ratio - Random Effects Model

7 "S" Bundle to Prevent SSI

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

Post-op Skin Issues in Orthopedics

Anterior fusion with tape burns

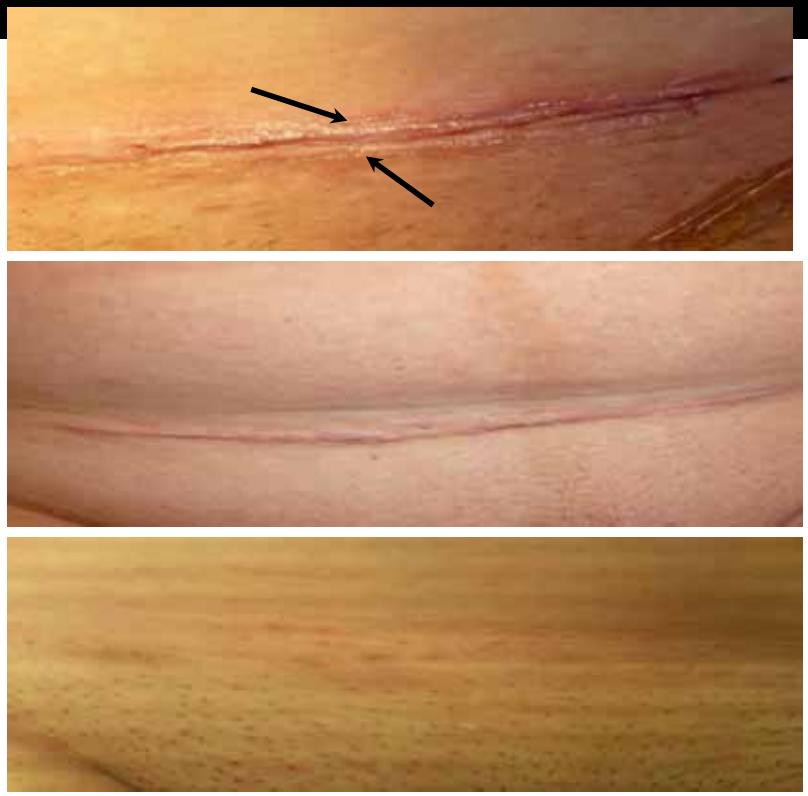
Contaminated steri-strips

Posterior fusion with contaminated steri-strips

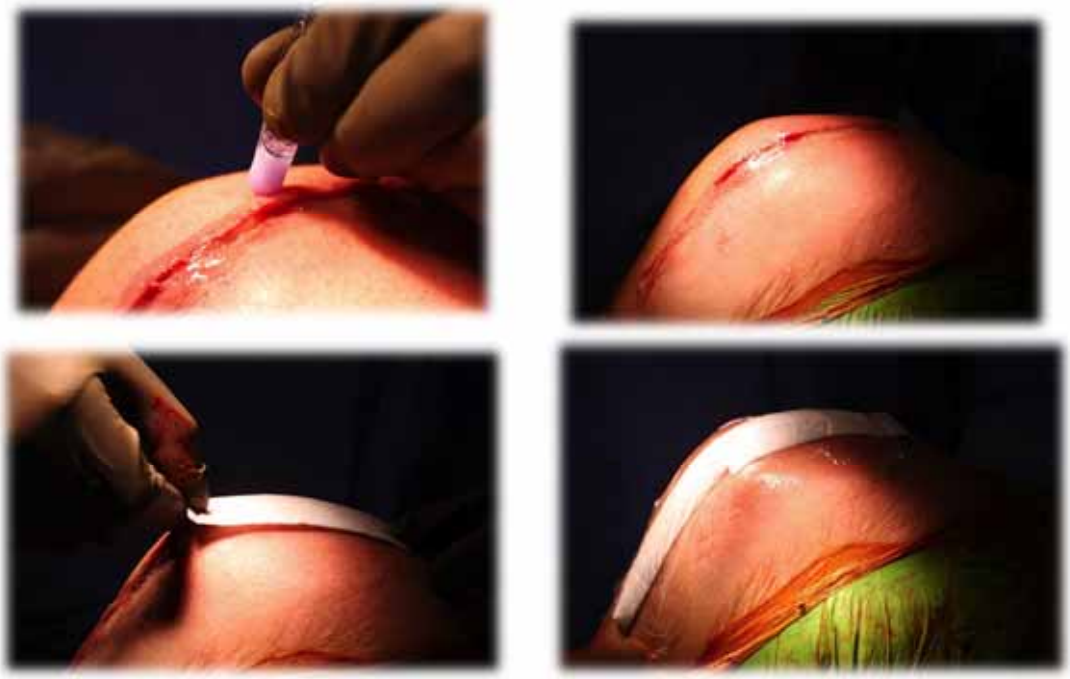
Obesity and Surgical Incision

- 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

Incisional Adhesive Border and Healing - 6 Weeks Post-op and Beyond



Incisional Adhesive on Total Knee Incision



Clinical Use of Incisionial Adhesive in Orthopedic Total Joints

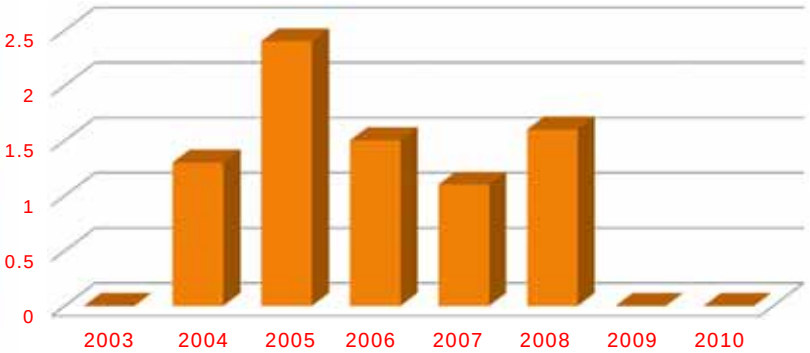
Hip: Sealed with adhesive covered with gauze and transparent dressing for incision protection

Healed incision

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

Incisional Adhesive and Total Shoulder Replacements

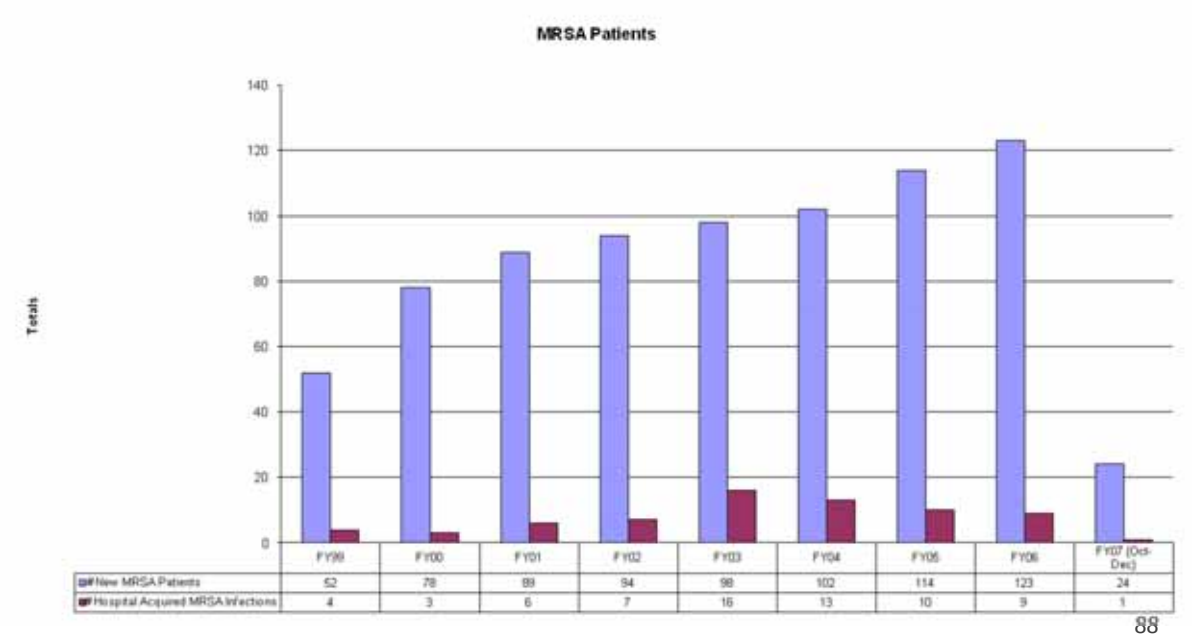
NEBH Total Shoulder Rates



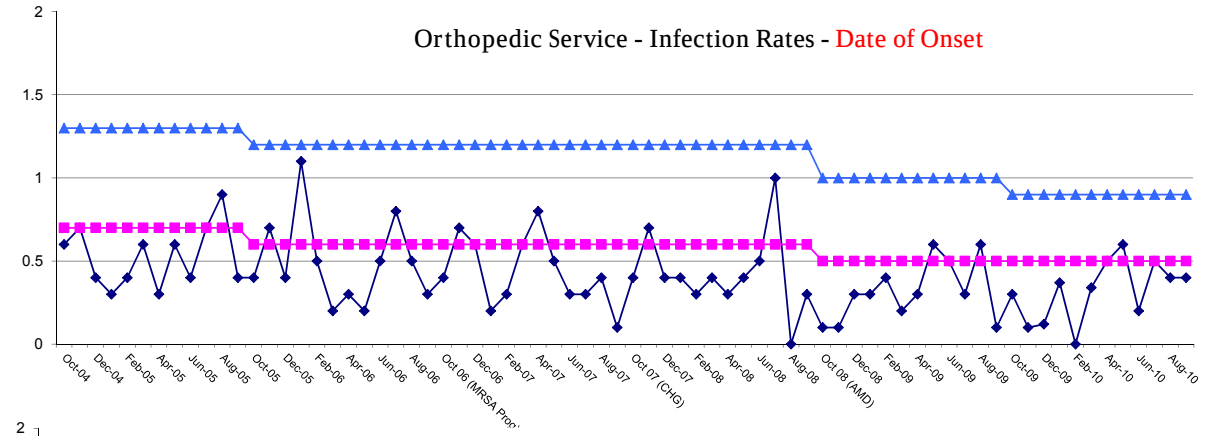
- Propionibacterium acnes related total shoulder replacement infections (TSR)
- Eliminated the use of **staples** for TSR
- Instituted the use of incisional adhesive
- Covered dressing until day of discharge for protection

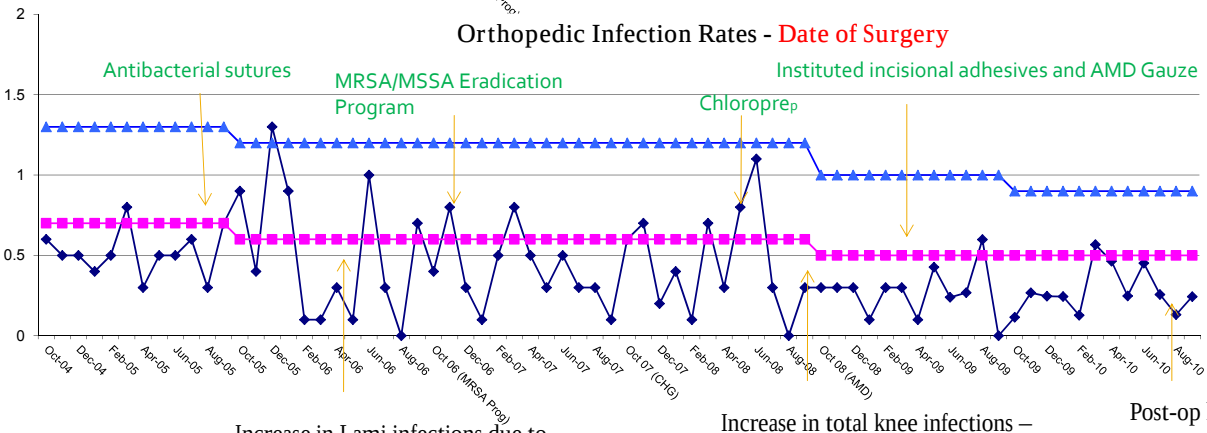
RESULTS – SURVEILLANCE DATA

Increase in CA-MRSA admissions and decrease in HA-MRSA



	FY99	FY00	FY01	FY02	FY03	FY04	FY05	FY06	FY07 (Oct-Dec)
New MRSA Patients	52	78	89	94	98	102	114	123	24
Hospital Acquired MRSA Infections	4	3	6	7	16	13	10	9	1





Increase in Lami infections due to locally administered steroids

Increase in total knee infections – due to improper use of needles for OR pain meds

Post-op hematomas being investigated

Reducing Risk Factors for SSIs: Real World Success

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

GENERAL SSI	FY03	FY04	FY05	FY06	FY07	FY08	FY09	FY10
# Infections	6	1	3	4	2	2	1	0
# Procedures		1073	920	780	692	567	467	425
Infection Rate	0.6	0.1	0.4	0.5	0.3	0.3	0.2	0
ORTHOPEDIC SSI								
# Infections	63	60	49	46	39	37	28	32
# Procedures	8837	9669	9216	8986	9027	8884	8890	9839
Overall Infection Rate	0.7	0.6	0.5	0.5	0.4	0.4	0.3	0.3
#Hip Infections	14	5	4	7	5	5	10	9
Hip Prosthesis Rate	1.0	0.3	0.2	0.4	0.3	0.3	0.5	0.4
#Knee Infections	21	14	11	7	7	11	9	9
Knee Prosthesis Rate	1.6	1.0	0.7	0.4	0.3	0.5	0.4	0.3
#Laminectomy Infec.	6	9	7	7	12	4	0	3
Laminectomy Rate	0.7	0.9	0.6	0.8	1.3	0.5	0.0	0.5
#Spinal Fusions Infec.	5	15	12	12	5	5	3	3
Spinal Fusion Rate	0.8	2.0	1.4	1.1	0.4	0.4	0.3	0.3
Other infections		17	15	13	12	10	6	8
Other infection rate			0.4	0.4	0.4	0.3	0.2	0.2

Thank You