
Surgical Site Infections: A Pain Medicine Specialist Perspective

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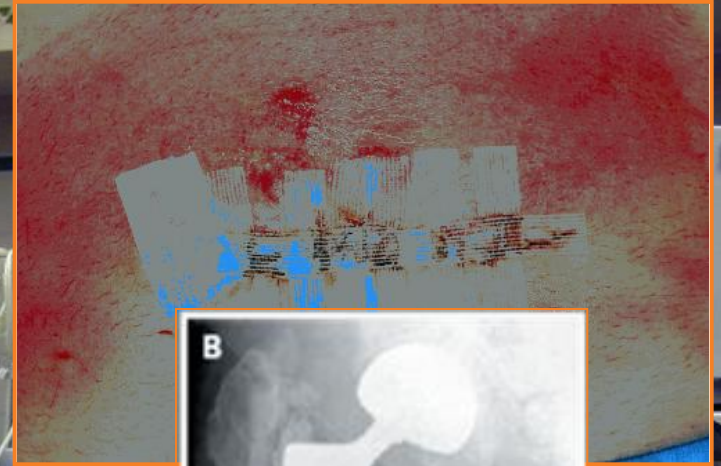
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Surgical Site Infection



Case Study #1

- 45 year old male veteran referred from orthopedics for a left L4-5 transforaminal epidural steroid injection performed uneventfully with omnipaque and 4 mg dexamethasone.
- 5 days later he presents to the ER with severe back pain and left lower extremity weakness.
- CT scan shows a large fluid collection in the left iliopsoas muscle suspicious of an abscess.

Case Study #2

- 40 year old male IDDM with an insulin pump undergoes an uneventful intrathecal pump replacement for failed battery.
- 1 week post op check unremarkable with good wound healing.
- 3 week post op, the patient presents to the clinic with swollen, red, warm and painful wound.
- 60 cc of pus percutaneously drained from wound.

Case Study #3

- 35 year old male with low back pain and radiculopathy referred for discogram.
- Discogram performed uneventfully at L4-5 and L5-S1 using omnipaque 240
- 2 weeks later, the patient presents with severe back pain and fever
- MRI suggests L4-5 discitis

Case Study #4

- 44 year old female with lumbar postlaminectomy pain syndrome with back and left leg pain.
- Percutaneous spinal cord stimulator lead placed for a trial of stimulation.
- Lead secured with benzoin, steri strips, guaze and op site.
- Patient undergoes an outpatient trial and returns to the clinic at day 5 with swelling, erythema and drainage around lead at insertion site.

Risk of SSI after Interventional Therapies for Pain

Device reimplants

Discograms

Primary implants

Catheter trials

Stimulator trials

Single injections

Agency for Healthcare Research and Quality

- **AHRQ:** lead Federal agency charged with improving the quality, safety, efficiency, and effectiveness of health care for all Americans
- **2009 National Healthcare Quality Report:**
 - Improvements in patient safety continue to lag behind expectations
 - Little progress has been made on eliminating health care-associated infections (HAIs)
 - Rates of postoperative sepsis increased by 8 percent over the previous year

Surgical Site Infection Overview

- A SSI develops in 2% to 5% of patients undergoing surgical procedures each year in the United States.¹
- Institute of Healthcare Improvement has estimated that 40-60% of all SSIs are preventable.²



1. Anderson DJ et al. Strategies to Prevent Surgical Site Infections in Acute Care Hospitals. *Infection Control and Hospital Epidemiology* 2008;29:S51-S61.

2. Scott RD, The Direct Medical Costs of Healthcare-Associated Infections in US Hospitals and the Benefits of Prevention. Available at http://www.cdc.gov/ncidod/dhqp/pdf/Scott_CostPaper.pdf. Accessed April 20, 2010.

SSI Overview (cont)

- Costs of Preventable SSIs are no longer covered by Medicare.¹ These include:
 - Vascular Catheter-Associated Infection
 - Coronary Artery Bypass Graft (CABG) Mediastinitis
 - Bariatric Surgery
 - Orthopedic Procedures

Epidemiology of SSI

- Approximately 500,000 SSIs annually¹
- Each SSI adds approximately 7-10 postoperative hospital days¹
- Mortality is 2-11 times greater with an SSI¹
- \$11,874 - \$34,670: average attributable per patient cost of SSI, adjusted to 2007 dollars²
- Preventing a single SSI due to MRSA can potentially save hospitals as much as \$60,000³

1. Anderson DJ et al. Strategies to Prevent Surgical Site Infections in Acute Care Hospitals. *Infection Control and Hospital Epidemiology* 2008;29:S51-S61.
2. Scott RD, The Direct Medical Costs of Healthcare-Associated Infections in US Hospitals and the Benefits of Prevention. Available at http://www.cdc.gov/ncidod/dhqp/pdf/Scott_CostPaper.pdf. Accessed April 20, 2010.
3. Anderson DJ et al. Clinical and Financial Outcomes Due to Methicillin Resistant Staphylococcus aureus Surgical Site Infection: A Multi-Center Matched Outcomes Study. *Plos One*; 4(12);1-8; December 2009.

Clinical & Economic Impact

Procedure/Device	Devices/yr*	Infections/yr	Avg. cost	Mortality*
CARDIO				
Heart valves	85,000	3,400	\$50,000	High
Vascular grafts	450,000	16,000	\$40,000	Moderate
Pacemaker/ICD	300,000	12,000	\$35,000	Moderate
LV assist dev.	700	280	\$50,000	High
NEURO				
CNS shunt	40,000	2400	\$50,000	Moderate

Adapted from:

1. Darouiche RO. Treatment of infections associated with surgical implants. *N Engl J Med.* 2004;350(14):1422-429.
2. *Darouiche RO. Device-associated infections: a macro problem that starts with microadherence. *Clin Infec Dis.* 2001;33(9)38:1567-1572.

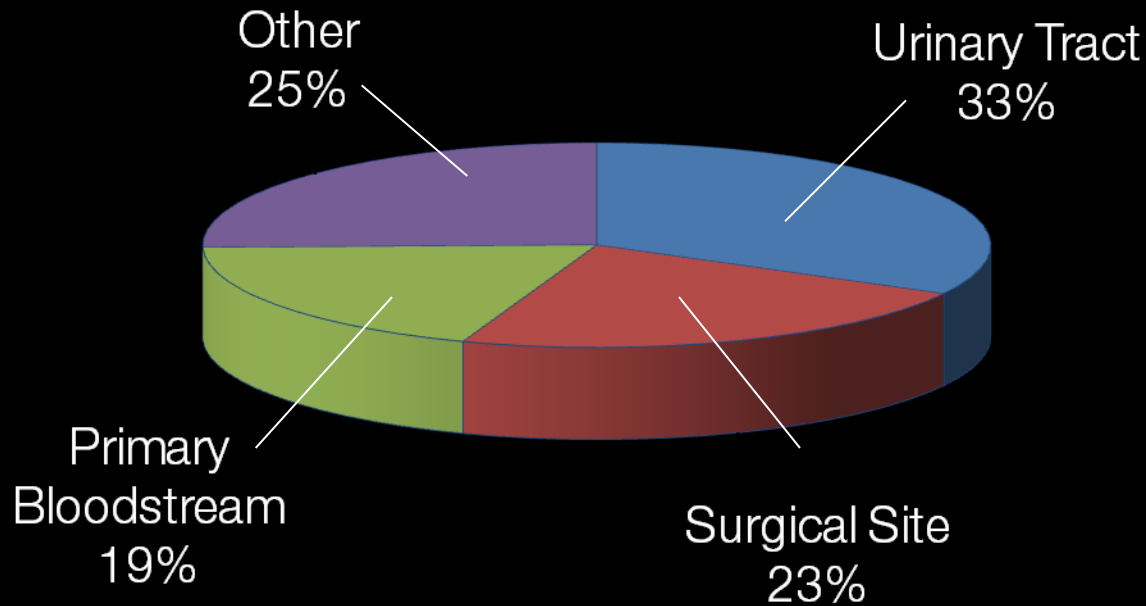
Clinical & Economic Impact

Procedure/Device	Devices/yr*	Infections/yr	Avg. cost	Mortality*
ORTHOPEDIC				
Joint prosthesis	600,000	12,000	\$30,000	Low
Fracture fixator	2,000,000	100,000	\$15,000	Low
PLASTIC				
Breast implant	130,000	2600	\$20,000	Low
UROLOGICAL				
Penile implant	15,000	450	\$35,000	Low

Adapted from:

1. Darouiche RO. *N Engl J Med.* 2004;350:1422-429.
2. *Darouiche RO. *Clin Infec Dis.* 2001;38:1567-1572.

Nosocomial Infections



1. Weinstein RA. Nosocomial Infection Update. *Emerg Infect Dis.* 1998;4(3):416-420.
2. CDC, NHSN Semiannual Report. December 2007.

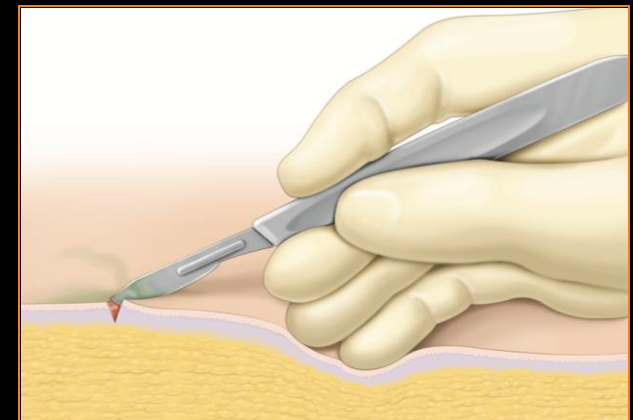
SSI: Primary Risk Factors

- Endogenous microorganisms
 - Skin-dwelling microorganisms
 - Most common source
 - *S aureus* most common isolate
- Exogenous microorganisms
 - Surgical personnel
 - OR environment
 - All tools, instruments, and materials

S aureus



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Modifiable SSI Risk Factors

- *Intrinsic Factors*

- Age
- Glucose control
- Obesity
- Smoking cessation
- Immunosuppressive medications

- *Extrinsic Factors*

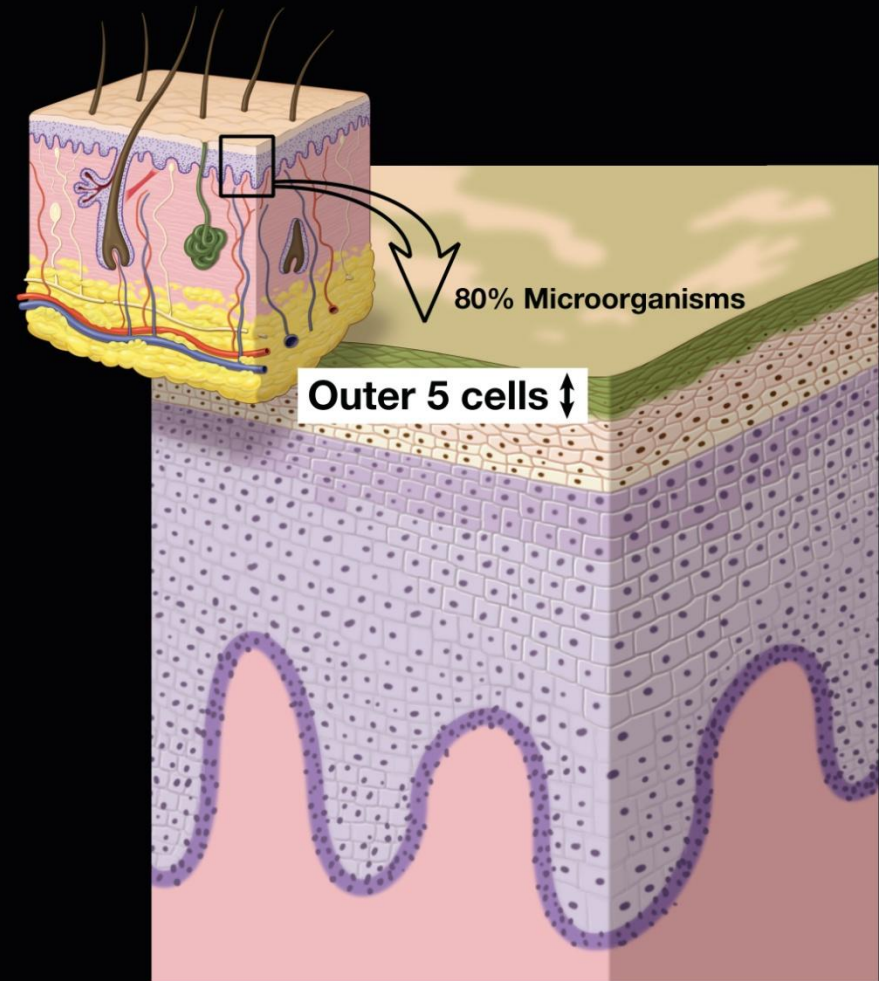
- Hair removal*
- Preoperative infection
- Surgical scrub
- **Skin preparation**
- Antimicrobial prophylaxis
- Surgical technique
- OR ventilation
- Traffic control
- Equipment sterilization

*Category A-II recommendation by both the CDC and the SHEA Compendium Workgroup

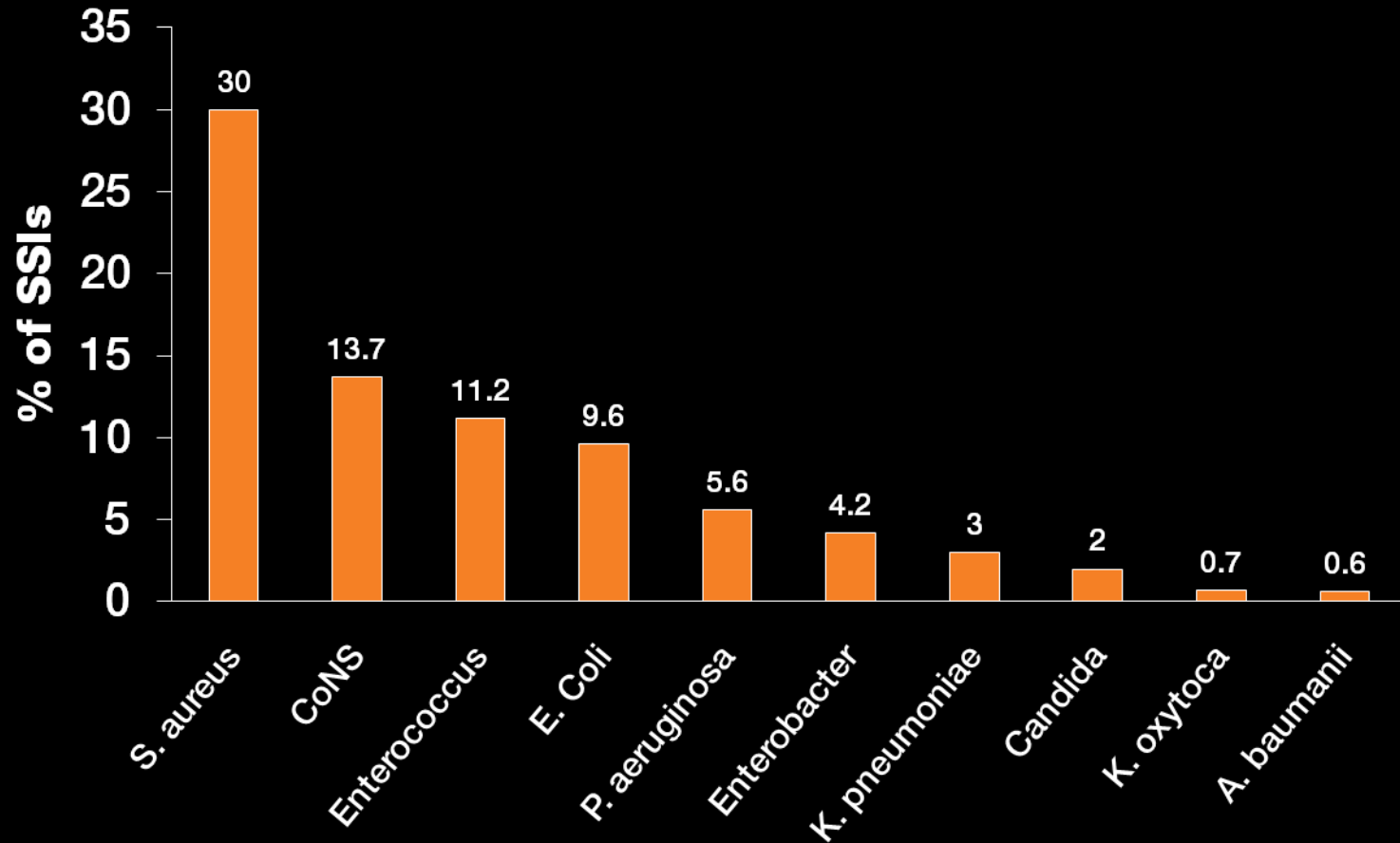
Importance of Skin

Primary Function: Protective Barrier

- Microorganisms
 - 80% in first 5 cell layers of epidermis
- When skin is perforated
 - Integrity is compromised
 - ↑ infection risk



Percent of SSIs Associated With Selected Pathogens: January 2006-October 2007



SSI: Modifiable Risks

Glucose control

Preoperative CHG shower

Appropriate hair removal

Hand hygiene

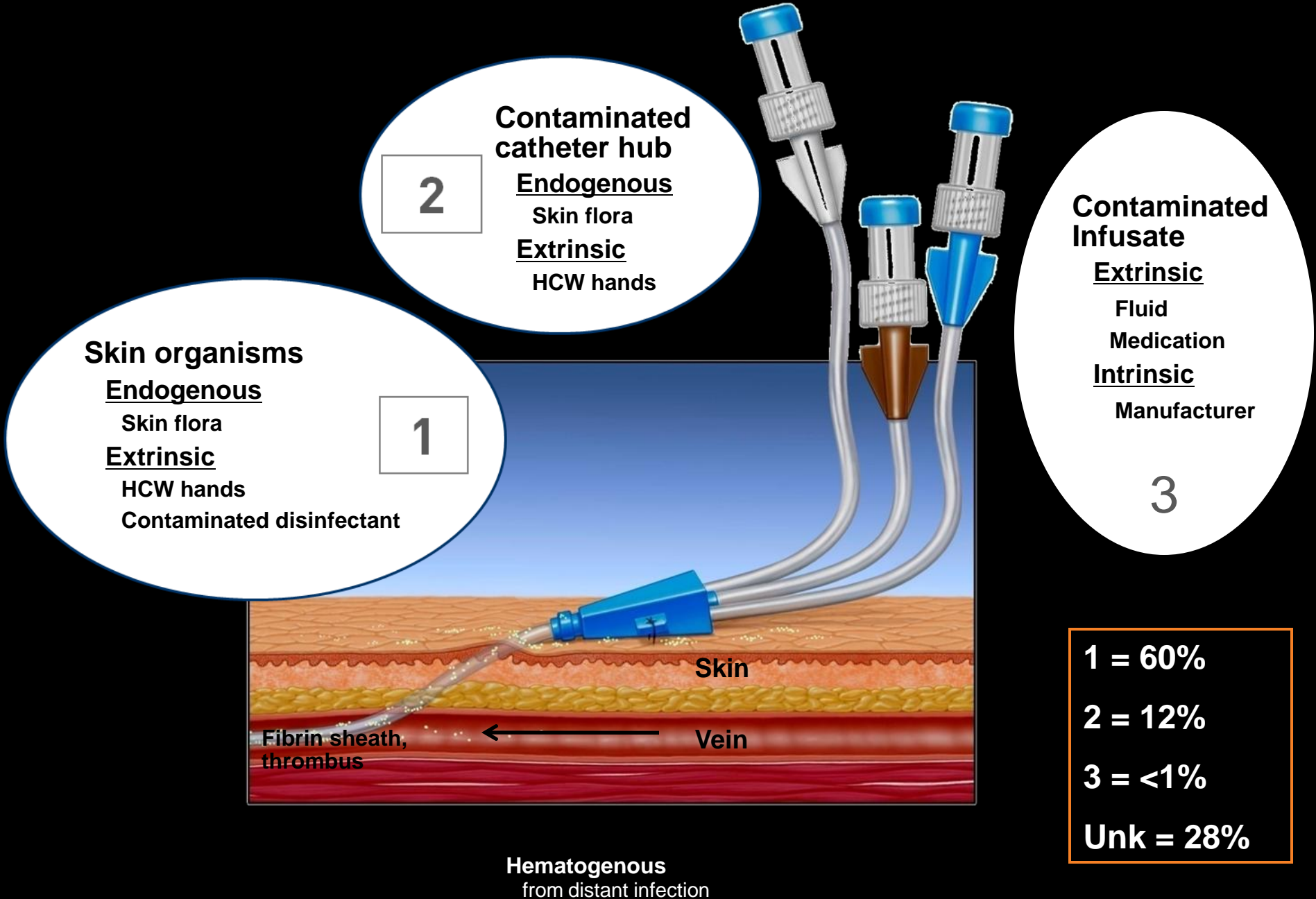
Skin antisepsis

Antimicrobial prophylaxis

Normothermia

1. Mangram AJ, et al. The hospital infection control practices advisory committee. Guidelines for prevention of surgical site infection. *Infect Control Hosp Epidemiol.* 1999;20(4):250-278.

2. 5 Million lives. Institute for Healthcare Improvement. Available at: <http://ihi.org/IHI/Programs/Campaign/Campaign.htm>. Accessed on April 19, 2010.



Safdar N, Maki DG. The pathogenesis of catheter-related bloodstream infection with noncuffed short-term central venous catheters. *Int Care Med.* 2004;30:62-67.

The Ideal Skin Antimicrobial

- The “*ideal*” antimicrobial agent for skin should have the following properties:
 - Broad spectrum
 - Rapid bactericidal activity
 - Persistence or residual properties on the skin
 - Effective in the presence of organic matter
 - Non-irritating or have low allergic and/or toxic responses
 - None or minimal systemic absorption

Antimicrobial Skin Preparations

- Alcohol
- Tincture of iodine
- Povidone-iodine (PVP-I) (Iodophor)
- Chlorhexidine Gluconate (CHG)
- Combination products
 - 2+ active agents



Single Solution Comparison

Active Agents	Traditional Iodophors	Alcohol	CHG
Broad Spectrum	X	X	X
Rapid Activity		X	
Residual Activity			X
Activity in Blood/Organic material			X
Non-Irritating/Non-toxic	X (+/-)		X (+/-)
Toxic/Minimal Absorption			X

Combined Agents: Comparison

Active Agents	Tincture of Iodine	Iodophors & Alcohol	CHG/Alcohol
Broad Spectrum	X	X	X
Rapid Activity	X	X	X
Residual Activity			X
Activity in Blood/Organic			X
Non-Irritating/Non-toxic			X (+/-)
Toxic/Minimal Absorption			X

Why Focus on Chlorhexidine?

- Highly effective in studies of:
 - Hand washing^{1,2,3}
 - Preoperative bathing, preoperative scrub²
 - Intravascular device catheters, blood cultures^{2,4}
- CHG has a broad spectrum of activity
 - Rapid
 - Persistent
 - Active in the presence of organic material
 - Recommended in more than 15 **evidence-based guidelines**

1. Centers for Disease Control and Prevention. Guideline for Hand Hygiene in Health-Care Settings. Hand Hygiene Task Force. *MMWR* 2002;51
2. Milstone AM, et al. *CID*. 2008; 46:274-281.
3. Boyce JM, Pittet D. *Morbidity Mortality Weekly Report*. 2002;51:1–44.
4. Maki DG, et al. *Lancet*. 1991;338:339-343.

Evidence Supporting Preoperative Chlorhexidine Showers

CHLORHEXIDINE HAND HYGIENE

Bacteriological Results of Surgical Hand Rubbing

	Time*	Povidone-iodine	Chlorhexidine gluconate	P value
Positive Bacteria	0 hrs	12 (48%)	4 (16%)	0.032
	3 hrs	18 (72%)	8 (32%)	0.010
Change in Bacterial Count +3 hrs	No change	8 (32%)	17 (68%)	0.001
	Increased [†] Avg increased bacteria	17 (68%) 0.78	8 (32%) 0.36	0.020

*Time = lapse of time from completion of hand wash

[†]Increased bacteria = log (number of bacteria) 3 hrs/0 hrs

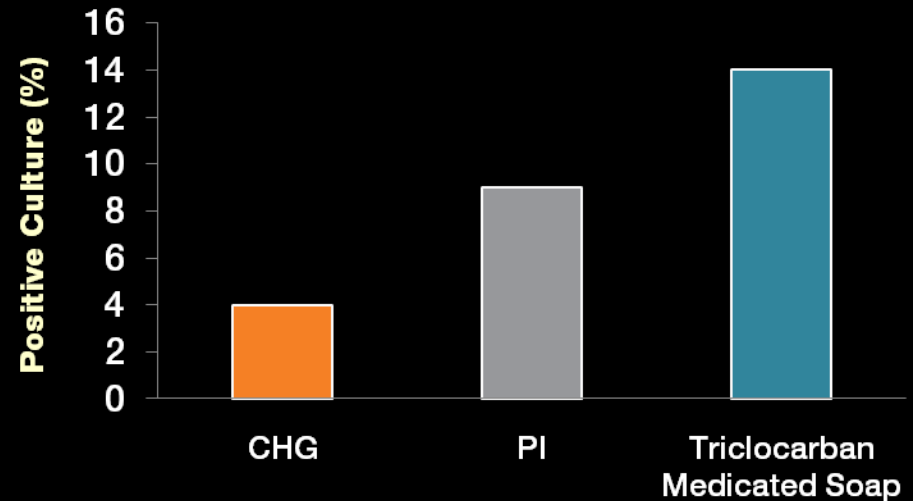
1. Furukawa K, et al. A new surgical hand washing and hand antisepsis from scrubbing to rubbing. *J Nippon Med Sch.* 2004;71(3):190-197.
2. Boyce JM. Guideline for hand hygiene in health-care settings Recommendations of the Healthcare Infection Control Practices Advisory Committee and the HICPAC/SHEA/APIC/IDSA Hand Hygiene Talk Force. *MMWR Recomm Rep.* 2002 Oct25;51:1-45.

Healthcare Infection Control Practices Advisory Committee: Guidelines for Prevention of SSI

Preoperative Showers

- CHG more effective than PI & triclocarban
- Lower rates of intraoperative wound contamination
- CDC recommends preoperative showering with CHG¹

Frequency of Positive Intraoperative Wound Cultures²



1. Mangram AJ et al. The hospital infection control practices advisory committee. Guidelines for prevention of surgical site infection. *Infect Control Hosp Epidemiol.* 1999;20(4):250-278.

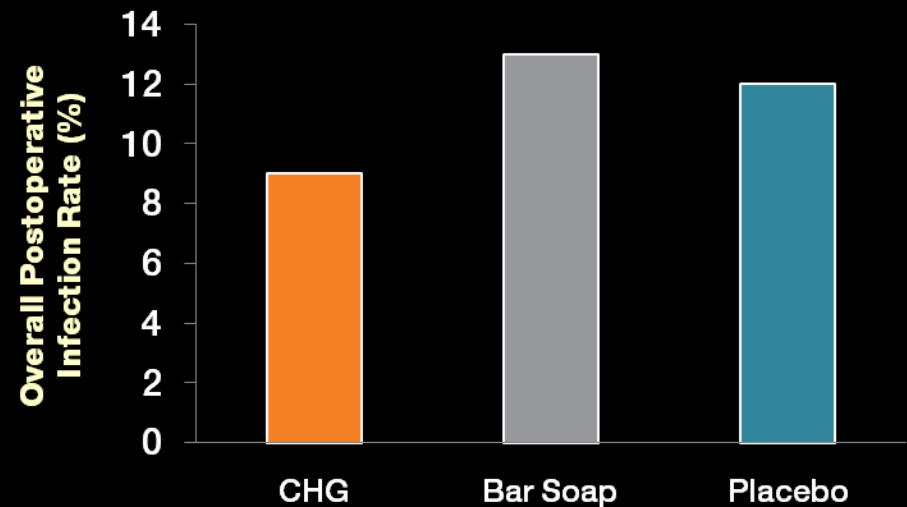
2. Garibaldi RA. Prevention of intraoperative wound contamination with chlorhexidine shower and scrub. *J Hosp Infect.* 1988;11(suppl B):5-9.

Placebo-controlled Trial of the Effect of Two Preop Baths/Showers with CHG on Postop Wound Infection Rates

Preoperative Showers

Patients who had 2 preoperative showers with CHG 24 hours before surgery had reduced rates of wound infection compared to patients who showered with soap.

Overall Postoperative Infection Rates With Two Preoperative Baths or Showers



Educational Intervention, Revised Instrument Sterilization Methods, and Comprehensive Preoperative Skin Preparation Protocol Reduce Cesarean Section Surgical Site Infections

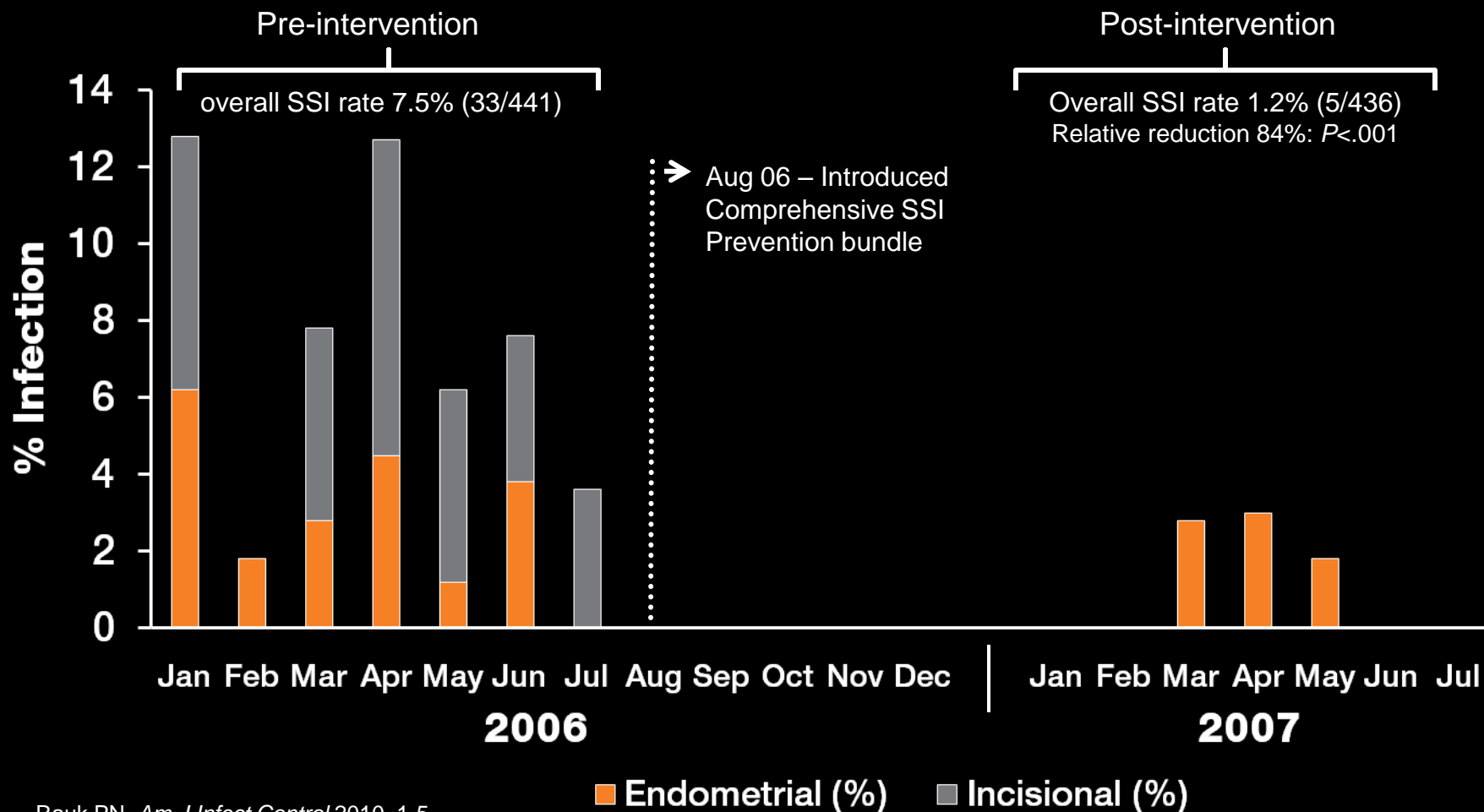
Rauk PN. *Am J Infect Control* 2010;Feb 18:1-5.

Study Overview

- **Objective:** Reduce rates of SSI after C-section using changes based on recommended care initiatives.
- **Design:** Multidisciplinary team developed staff education, preop skin prep protocol including CHG no-rinse cloths and 2% CHG/70% IPA, and modified instrument sterilization techniques.

Statistical Analysis Pre-intervention vs. Post-Intervention

Overall C-section SSI Rates

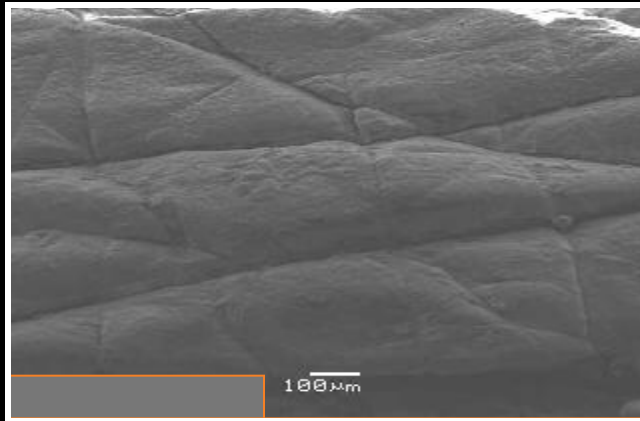


Study Summary

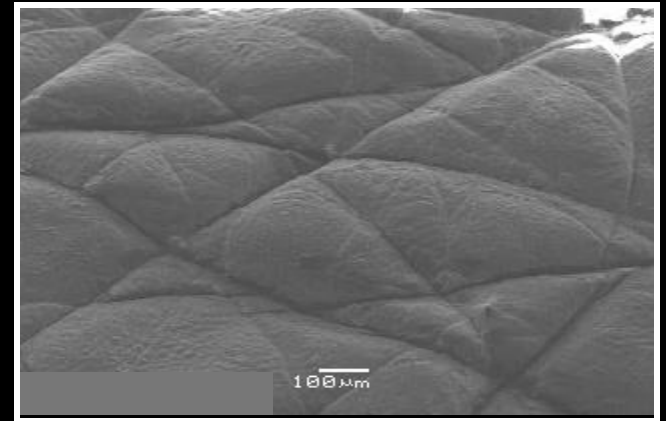
- **Results:** Reduction in SSI rate from 7.5% to 1.2%, $P < .001$, relative reduction of 84%.
- **Conclusion:** Interventions including staff education, use of preop CHG no-rinse cloths and CHG/IPA, and appropriate instrument sterilization management led to reductions in SSI rates in patients undergoing C-section at University of MN Medical School.

HAIR REMOVAL: Clippers vs Razor

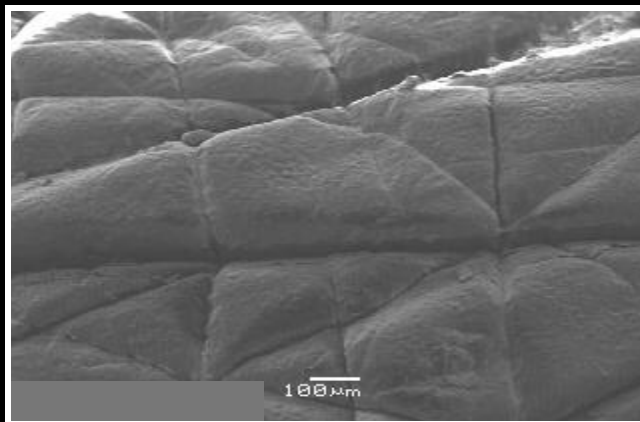
Before Clipping



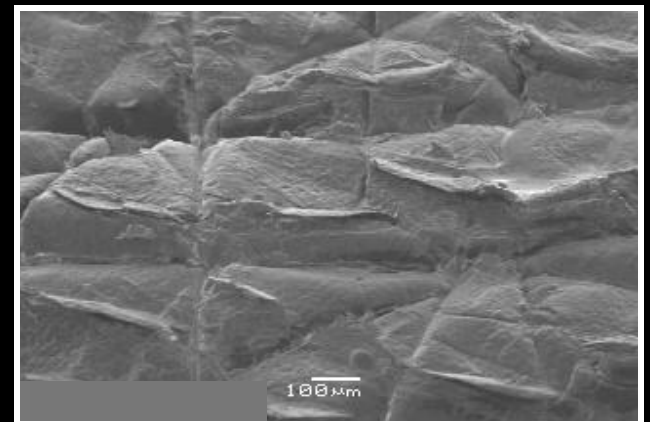
After Clipping



Before Shaving



After Shaving



ORGANIZATIONS RECOMMENDING 2% CHG or 2% CHG/70% IPA

1. American Association of Critical care Nurses (AACN)
2. American Academy of Pediatrics (AAP)
3. Centers for Disease Control (CDC)
4. Evidence-Based Practice in Infection Control (UK epic2 National Guidelines)
5. Institute for Healthcare Improvement (IHI)
6. National Kidney Foundation (NKF)
7. National Quality Forum (NQF)
8. Registered Nurses' Association of Ontario (RNAO)
9. Safer Healthcare Now! Campaign (SHN)
10. Society of Interventional Radiology (SIR)
11. Society for Cardiovascular Angiography and Interventions (SCAI)

REGIONAL ANESTHESIA and PAIN MEDICINE

Recommendations:

Alcohol-based chlorhexidine antiseptic solutions significantly reduce the likelihood of catheter and site colonization and maximize the rapidity and potency of bactericidal activity when compared to other solutions. Therefore, alcohol-based chlorhexidine solutions should be considered the antiseptic of choice before regional anesthetic techniques (Grade A).

Guidelines for Reducing Surgical Site Infections

Joint Commission

- GOAL: Implement best practices for preventing surgical site infections
- One-year phase-in period (2009)
- Full implementation by January 1, 2010

Joint Commission

1. Educate health care workers about SSI
2. Measure SSI rates, monitor compliance with best practices, evaluate effectiveness of prevention efforts
3. Provide SSI rate data
4. Implement policies and practices that are aligned with evidence-based standards
5. Educate patients about SSI prevention
6. Deliver IV antibiotics within 1 hour before incision; discontinue within 24 hrs after surgery
7. Use clippers for hair removal (no shaving)
8. Maintain optimal of blood glucose levels

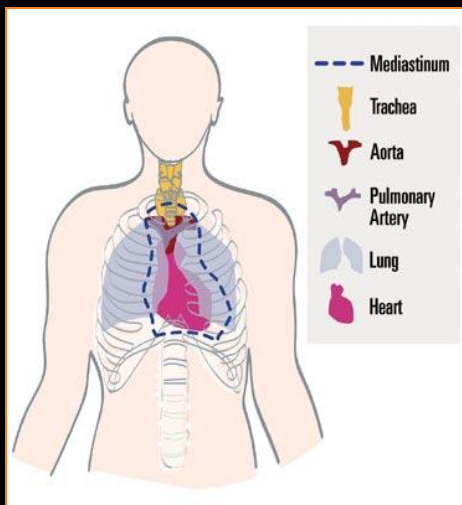
CMS Guideline Overview

- October 1, 2008 marked the beginning of a Medicare policy that eliminates certain payments to hospitals for increased costs related to hospital-acquired conditions not present on admission.¹
- The specific conditions were selected because they're not only common, high-risk and high-cost, but they are also preventable with the application of some simple evidence-based practices.²

1. CMS proposes to expand quality program for hospital inpatient services in FY 2009 [press release]. CMS Office of Public Affairs. April, 14, 2008.
<http://www.cms.gov/apps/media/press/release.asp?Counter=3041&intNumPerPage=10&checkDate=&checkKey=&srchType=1&numDays=3500&srchOpt=0&srchData=&keywordType=All&chkNewsType=1%2C+2%2C+3%2C+4%2C+5&intPage=&showAll=&pYear=&year=&desc=false&cboOrder=date>. Accessed April 27, 2010.
2. DEPARTMENT OF HEALTH AND HUMAN SERVICES Centers for Medicare & Medicaid Services. 42 CFR Parts 411, 412, 413, 422, and 489 [CMS-1390-F]; [CMS-1531-IFC1]; [CMS-1531-IFC2] [CMS-1385-F4] RIN 0938 AP15; RIN 0938-AO35; RIN 0938-AO65 Medicare Program; Changes to the Hospital Inpatient Prospective Payment Systems and Fiscal Year 2009 Rates. 171-226.

Surgical Site Infection

- Surgical site infections specifically mentioned by CMS include:
 - Mediastinitis (infection in the chest) after coronary artery bypass graft surgery
 - Bariatric surgery for morbid obesity (Laparoscopic Gastric Bypass, Gastroenterostomy, Laparoscopic Gastric Restrictive Surgery)
 - Selected orthopedic procedures (spine, neck, shoulder, elbow)



How Will This Change Things?

- The full impact of the CMS guidelines won't likely be seen for 12-18 months, however the time to make changes is now.
- These changes don't have to be big. Some fairly simple changes can make a big difference.
- The CMS acknowledges that the systems for tracking these infections isn't perfect...yet, but the agency is committed to enforcing these rules.
- Other insurers will most certainly follow.

Cost of Antiseptic Products in the US

- Mean cost of PI prep tray per patient: ~\$3
- Mean cost of one CHG/IPA applicator: \$7
- Mean no. of CHG/IPA applicators/patient: 2
- Mean cost of CHG/IPA applicators per patient: \$14
- Extra cost of CHG/IPA vs. PI/1,000 patients:
\$11,000

Potential Cost-Savings Per 1,000 Clean-Contaminated Surgeries

	Cost of Superficial SSI (\$1,000/case)	Cost of Deep SSI (\$20,000/case)	Cost of 75:25 mix SSI (\$4,400/case)
ChloroPrep group (95 SSIs / 1000 surgeries)	\$95,500	\$1,900,000	\$546,250
Povidone- Iodine group (161 SSIs / 1000 surgeries)	\$161,000	\$3,220,000	\$925,750
Difference between ChloroPrep & Povidone-Iodine	\$66,000	\$1,320,000	\$379,500
Potential Cost Savings using ChloroPrep (ChloroPrep vs. Povidone-Iodine)	\$55,000	\$1,309,000	\$368,500

Cost of Antiseptic Products in the US:

- Mean cost of ChloroPrep per patient: \$14 (\$7 per applicator x 2)
- Mean cost of Povidone Iodine prep tray per patient: ~\$3
- Extra cost of ChloroPrep vs. Povidone Iodine = \$11,000 ($\$14 - \$3 = \11 x 1,000 surgeries)

SKIN PREP FOR CATHETER OR STIMULATOR TRIALS RECOMMENDED PRACTICES

Assess surgical site

Remove hair with clippers if needed

Hand wash

Clean site and surrounding area

Apply skin antiseptics

Preserve skin integrity

Chlorohexedine patch at insertion site

Document skin prep

SKIN PREP FOR SURGICAL IMPLANTS RECOMMENDED PRACTICES

Assess surgical site

Remove hair with clippers if needed

Hand wash

Clean site and surrounding area

Apply skin antiseptics

Preserve skin integrity

Use Ioban

Redrape edge of wound prior to
implant insertion

Document skin prep

SKIN PREP FOR INJECTIONS RECOMMENDED PRACTICES

Assess surgical site

Leave hair intact

Hand wash

Clean site and surrounding area

Apply skin antisepsis

Preserve skin integrity

Document skin prep

Conclusion

“The weight of evidence suggests that chlorhexidine-alcohol should replace povidone-iodine as the standard for preoperative surgical scrubs.”

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