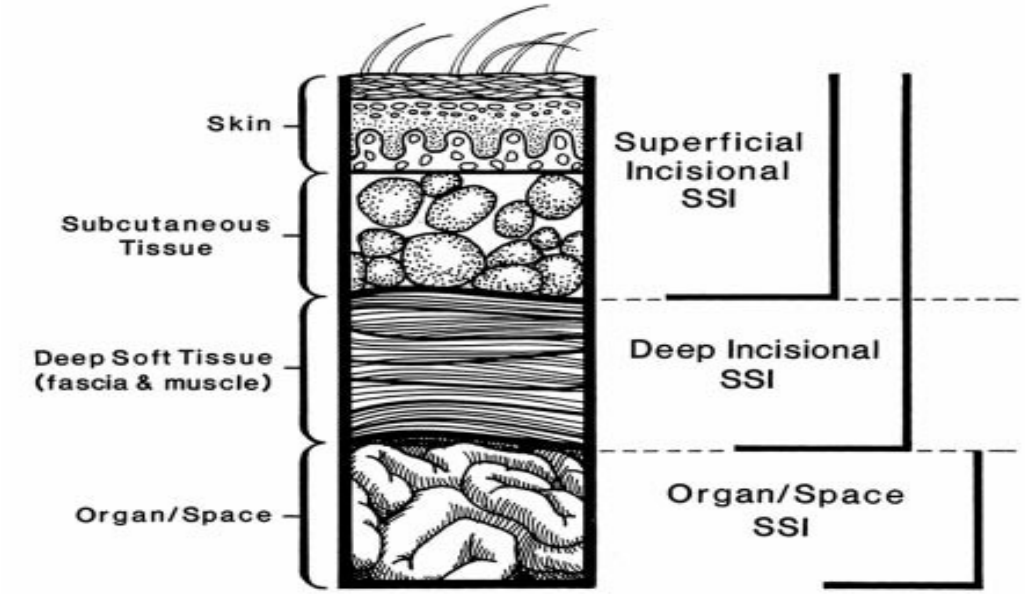
Best Practices to Prevent Surgical Site Infections



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Conflict of Interest Statement

- 3M Educational Consultant
- Speaker's Bureau Sage Products

Learning Objectives

1. Summarize the financial and people burden of surgical site infection.
2. List 3 best practices for reducing the risk of surgical site infections.
3. List 3 outcomes resulting from implementing best practices.

Hospital Errors

“The Worst Place to Be When You’re

Sick

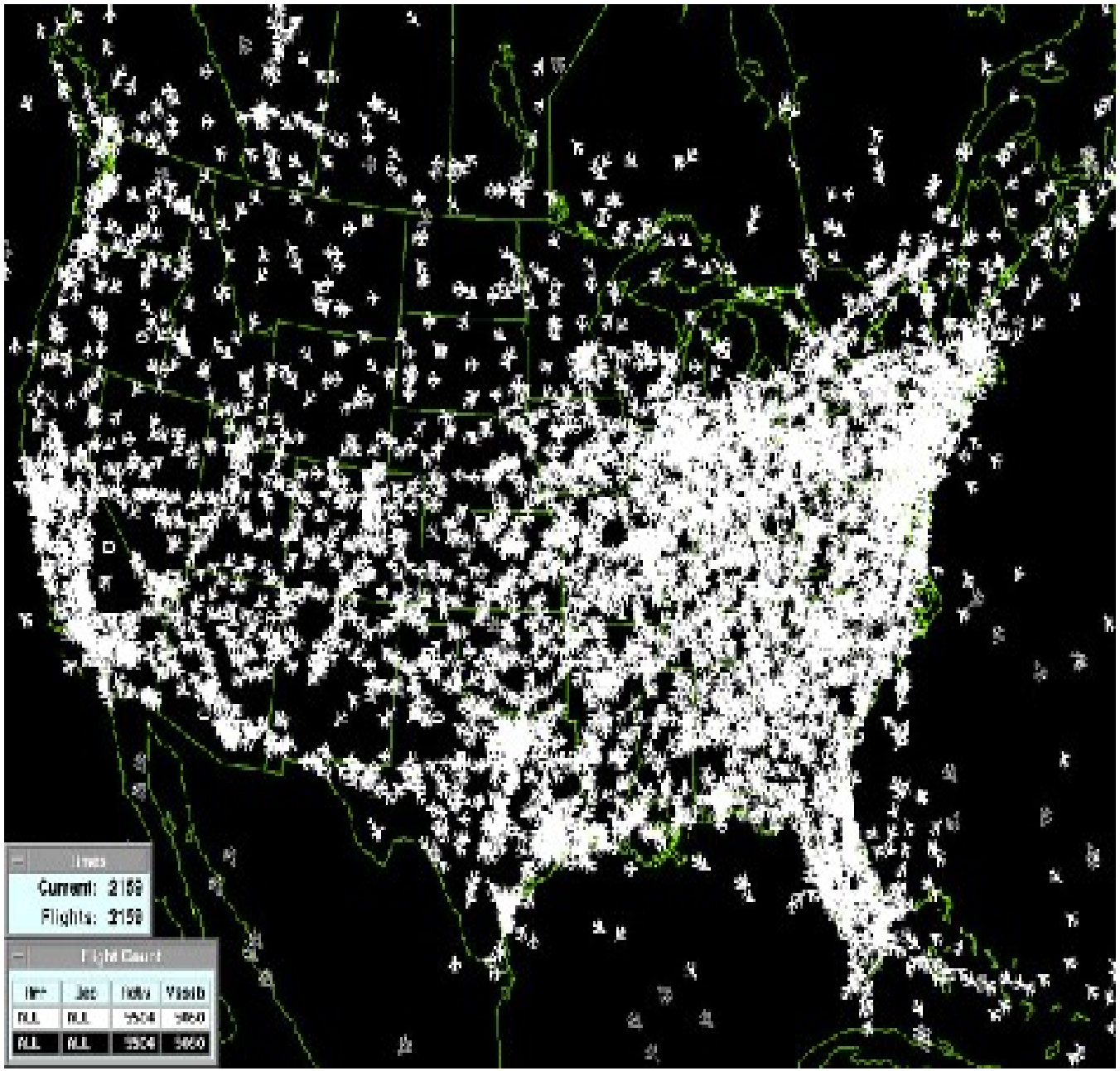
And How to Protect Yourself”

(AARP Bulletin March 2012; Vol 52 (No. 2))

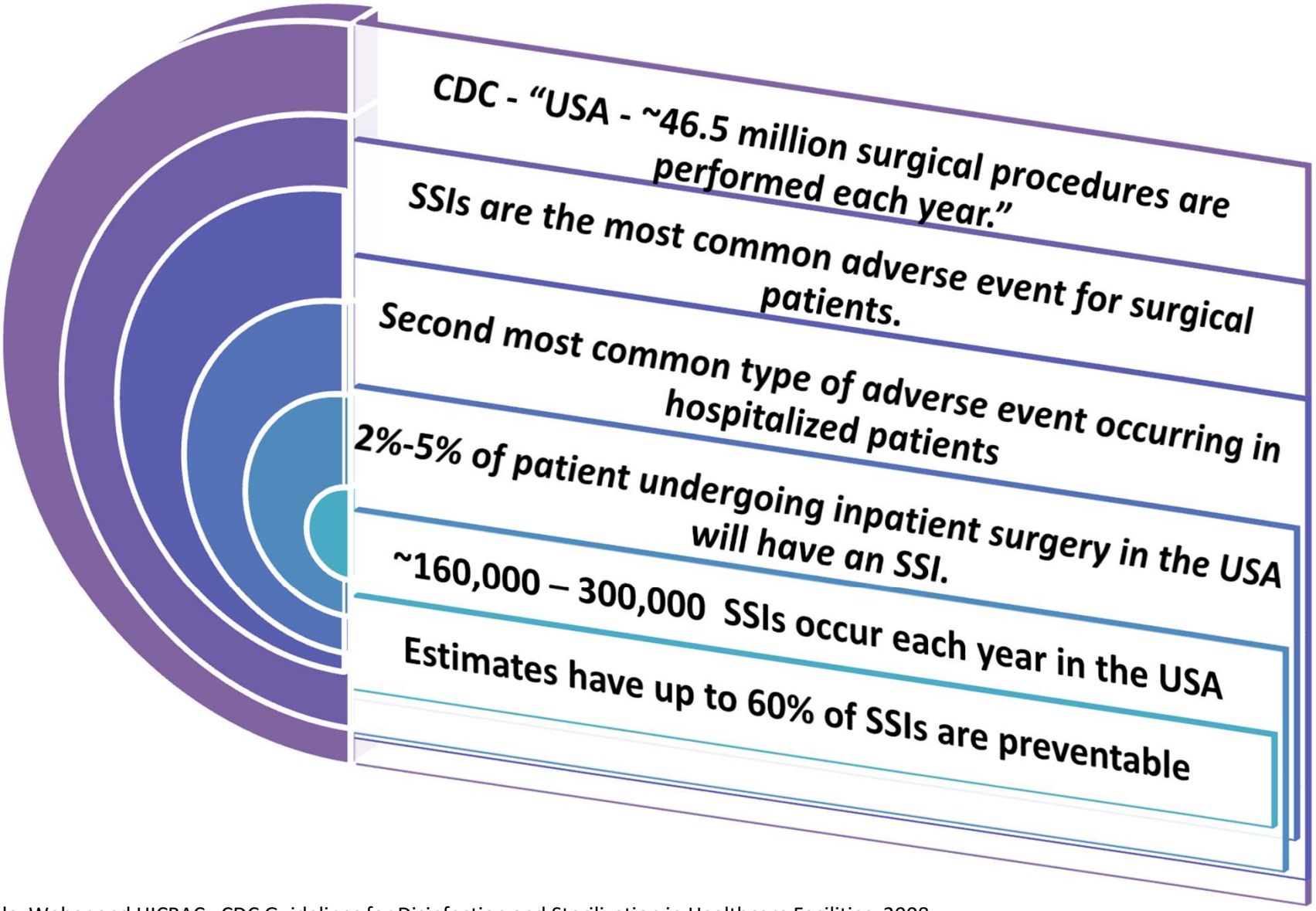
“The number of patients who die each year from hospital errors is equal to 4 jumbo jets crashing each week!”

“One study of Medicare patients found that 1 in 7 died or were harmed by their hospital care”

There are around 7,000 aircraft in the air over the United States at any given time… https://www.faa.gov/air_traffic/briefing/



Burden of Surgical Site Infection (SSI)



Rutala, Weber and HICPAC. CDC Guidelines for Disinfection and Sterilization in Healthcare Facilities, 2008

5 Million Lives Campaign. Getting Started Kit:: Prevent Surgical Site Infections How to Guide. Cambridge, MA: Institute of Health Care Improvement; 2008

Anderson, DJ, Podgorny, K et al. Strategies to Prevent Surgical Site Infections in Acute Care Hospital: 2014 Update. SHEA/IDSA Practice Recommendations Kurtz, Steven, Lau, Edmund et. al. Infection Burden for Hip and Knee Arthroplasty in the United States. The Journal of Arthroplasty. 2008; 23(7):984-991)

Unavoidable Facts

Aging and vulnerable population

- All the risk factors for developing a surgical site infection

2020 - “Silver Tsunami”

- 25% of the working population will be age 55 or older

8.3% of the U. S. population has diabetes

- Estimated 7 million undiagnosed diabetics
- 79 million people in the U. S. are pre-diabetic

2010 – 35.7% of the US population determined to have a BMI 30-40 (Obesity)

Burden of Surgical Site Infections (SSI)

Outcomes Associated with SSI

- approx. 7-10 additional post-op hospital days (deep and organ-space infection much longer)
- Are 5 times more likely to be re-admitted
- Have a 60% increase in ICU admissions
- 2-11 times higher risk of death
- 77% of deaths among patients with SSI are directly attributable to SSI.
- Attributable cost estimates range from $3,000-$29,000 (maybe more for deep and organ-space infections)
- SSIs are believed to account for up to $10 billion annually in healthcare expenditures.

Estimated that up to 60% of SSIs are preventable!

Anderson, DJ, Podgorny, K et al. Strategies to Prevent Surgical Site Infections in Acute Care Hospitals: Update 2014. SHEA/IDSA Practice Recommendations
The Joint Commission's Implementation Guide for NPSG.07.05.01 on Surgical Site Infections (SSIs)

CMS Medicare Program - Proposed Rule - FY 2015 – Cost Impact

- Reports 1.4 million total hip and knee arthroplasties - Medicare fee for service (FFS) patients aged 65 or older 2008 - 2010
- Proposed rule - THA / TKA measure in the Hospital Readmissions Reduction Program beginning in FY 2015
- Medicare costs are very high
  - THA and TKA procedures, combined - largest procedural cost in the Medicare budget.
- Median 30-day risk -standardized readmission rate patients aged 65 or older undergoing THA/TKA 2008 - 2010 - 5.7 percent; ranged from 3.2% - 9.9% across 3,497 hospitals.

42 CFR Parts 412, 418, 482, et al. Medicare Program; Hospital Inpatient Prospective Payment Systems for Acute Care Hospitals and the Long Term Care Hospital Prospective Payment System and Proposed Fiscal Year 2014 Rates; Quality Reporting Requirements for Specific Providers; Hospital Conditions of Participation; Medicare Program; FY 2014 Hospice Wage Index and Payment Rate Update; Hospice Quality Reporting Requirements; and Updates on Payment Reform; Proposed Rules Medicare Program; Hospital May 10 *Federal Register* (PDF), Vol. 78, No. 9

Burden of Orthopedic SSIs

- Findings
  - Annual cost of Joint Replacement is $250 million
  - Cost of revision due to infection is 2.8x higher than aseptic loosening and 4.8x higher than the cost of a primary total hip arthroplasty
  - Total cost of a total knee arthroplasty revision due to infection ranges from $15,000 to $30,000
  - Total hip arthroplasty revision due to infection as compared to aseptic loosening results in:
    - Increase hospitalizations
    - Increase length of stay
    - Increase number of operative procedures
    - Increase outpatient visits and charges
- CDC NHSN 2006-2008
  - Knee replacement postoperative infections rates ranged from 0.68% - 1.60% based on patient risk
  - Hip replacement postoperative infection rates ranged from 0.67% - 2.4%

Guide to the Elimination of Orthopedic Surgical Site Infections. APIC Elimination Guide 2010.

Readmission Rates

Merkow, et al. Underlying Reasons Associated With Hospital Readmission Following Surgery in the United States. JAMA February 3, 2015.

Readmission Rates for 498,875 surgical operations

SSI #1 cause for readmission at 19.5%

Readmission Rates by surgery type

- GI-Colectomy & Proctectomy – 25.8%
- Ventral Hernia repair – 26.5%
- Hysterectomy – 28.8%
- Arthroplasty (total hip and knees) – 18.8%
- Lower extremity vascular bypass – 36.4%

The Joint Commission and SSI

2015 National Patient Safety Goal 7

Reduce the risk of health care-associated infections (HAI)

NPSG.07.05.01 Implement evidence-based practices for preventing surgical site infections

- Implement policies and practices aimed at reducing the risk of surgical site infections. These policies and practices meet regulatory requirements and are aligned with evidence-based guidelines (e.g. CDC and/or professional organization guidelines)

- www.jointcommission.org

NPSG.07.05.01 Elements of Performance

- Educate staff and licensed independent practitioners involved in surgical procedures about SSIs and the importance of prevention.
- Educate patients, and their families as needed, who are undergoing a surgical procedure about SSI prevention.
- Implement policies and procedures aimed at reducing the risk of SSIs.
- Conduct periodic risk assessments for surgical site infections in a time frame determined by the hospital.
- Select surgical site infection measures using best practices or evidence-based guidelines.
- Monitor compliance with best practices or evidence-based guidelines.
- Evaluate the effectiveness of prevention efforts.
- Measure surgical site infection rates for the first 30 days following procedures that do not involve inserting implantable devices and for 90 days following procedures involving implantable devices.

NPSG.07.05.01 Elements of Performance (Cont'd)

- Provide process and outcome (for example, surgical site infection rate) measure results to key stakeholders.
- Administer antimicrobial agents for prophylaxis for a particular procedure or disease according to evidence-based practices.
- When hair removal is necessary, use a method that is cited in the scientific literature or endorsed by professional organizations.

Operative Risk Factors

Skin

- **Duration of scrub - hands**
- **Skin antisepsis**
- **Pre-op hair removal**
- **Patient pre-op skin preparation**

Surgeon/Surgical Team

- Surgical technique
- Duration of surgery (exceeding 75th percentile or >3 hours)
- Foreign material in site
- Use of drains
- Antibiotic prophylaxis

Environment

- OR ventilation
- Traffic control
- Doors open

Sterilization of instruments

- Immediate use steam sterilization (IUSS)
- Loaner instrumentation
- IUSS of implants
- Release of load before the results of biological indicator

Mangram, Alicia J. et. Al. Guideline For Prevention of Surgical Site Infections, 1999
Bratzler D, Dellinger, E. Patchen, et. al.Clinical practice guidelines for antimicrobial prophylaxis in surgery. Am J Health-Syst Pharm. 2013; 70:195-283

Exogenous sources of SSI pathogens

People = shedding; 4,000 – 10,000 particles/minute[1]

Surgical personnel

Primarily Gram positive organisms (staph, strep)

Air, OR traffic, doors propped open

Wind current carry particles to the sterile field resulting in wound contamination

Tools, instruments, equipment, materials brought into sterile field

1. Berry & Kohn's, Operating Room Technique, 11th ed., p. 252
2. Mangram, AJ, Horan, TC et al. Guideline for Prevention of Surgical Site Infection, 1999

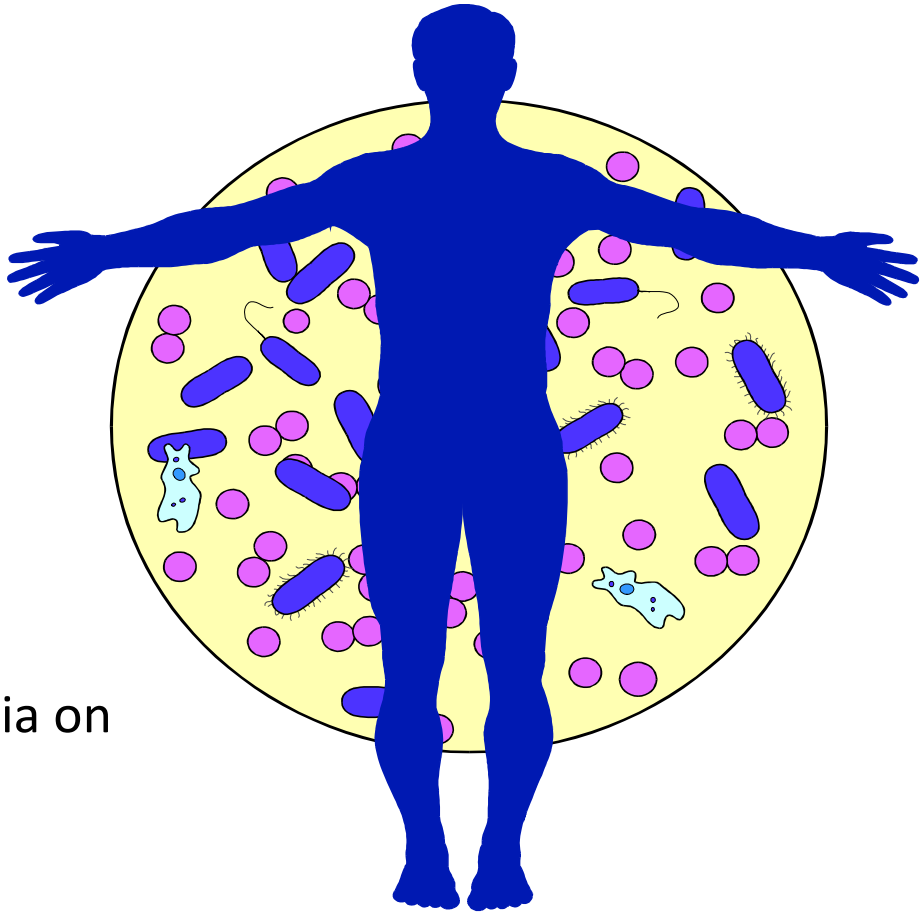
SKIN FLORA FACTS

Number of bacteria necessary to induce post surgical infection:

- Without a foreign body-----1,000,000
- With foreign body------100

Mostly from patient's own skin flora: 60%

On average, a person carries **2 to 5 logs** microorganisms per square centimeter of their skin



HIGH COUNTERS

- There are people with high count of bacteria on their skin.
- It is difficult to kill or remove all of them.
- We don't know who they are.

PRE-OP - Evidence-based Practices

- Hair removal as close to surgery as possible
  - Option for depilatory or clippers
- Antiseptic showering – night before and morning of surgery
  - Decrease bioburden on skin at time of surgery
  - Clean linen and clean clothing
- Patient skin prep in the OR
  - Use according to manufacturer's instructions and allow prep to dry
- Pre-op nasal decontamination

Mangram, AJ, Horan, TC et al. Guideline for Prevention of Surgical Site Infection, 1999

PRE-OP - Evidence-based Practices

- IHI Project JOINTS SSI Bundle
  - appropriate antibiotic use
  - appropriate hair removal
  - alcohol containing skin prep (CHG and alcohol)
  - 3 days of preoperative CHG bathing (4% CHG shower in evening and 2% CHG cloth on day of surgery)
  - *Staphylococcus aureus* screening and decolonization with mupirocin

Hair Removal

- Tanner (2006)
  - Cochrane review of shaving, clipping, depilatory cream, and no hair removal
  - Meta-analysis
  - 11 randomized controlled trials

→ Incidence of infection higher with shaving versus clipping
RR=2.02 (CI 1.21-3.36)

CDC recommends no hair removal unless hair at or around the incision site would interfere with the operation (CDC 1A) (AII)

Tanner et al. Preoperative hair removal to reduce surgical site infection. *Cochrane Database of Systematic Reviews* 2011.

Surgical Site Infection

Pathogenesis

- Microbial contamination of surgical site
  - Incising skin creates a portal of entry for bacteria
  - Contamination with >105 organisms/gram of tissue increases risk of infection
  - Dose of organism is less if foreign material/body in place, 100 organisms/gram of tissue

Skin Antisepsis

- Patient – Pre-op Antiseptic Showers
- Skin prep needs to be used to reduce endogenous flora and reduce the risk of SSI
- Patient – Antiseptic Skin Prep prior to incision
- Surgical Team – Hand Antisepsis

Skin Antisepsis - Professional Guidelines Recommendations?

CDC - Strongly Recommended (Category 1B) that patients shower with an antiseptic agent before undergoing an elective surgical procedure.

2015 AORN Guidelines for Preoperative Patient Skin Antisepsis - Patients should be instructed to bathe or shower before surgery with soap or a skin antiseptic on at least the night before or the day of surgery.

SHEA/IDSA Compendium: SSI Prevention Practice Recommendation - To gain maximum antiseptic effect of Chlorhexidine, it must be allowed to dry completely and not be washed off.

Guidelines Surgical Site Skin Antisepsis

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

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

1. Anderson, D.J.et al S 51 Strategies to Prevent Surgical Site Infection in Acute Care Hospitals. *Infection Control and Hospital Control Epidemiology,* Oct. 2008, Vol. 29, Suppl. 1.
2. Centers for Disease Control and Prevention, "Guideline for Prevention of Surgical Site Infections," *Infection Control and Hospital Epidemiology,* Vol 20, No 4, April 1999
3. AORN. Recommended Practices for Preoperative Patient Sin Antisepsis. Perioperative *Standards, Recommended Practices*. Denver, Colorado: AORN, Inc. 2013.

Chlorhexidine Gluconate (CHG)

- Skin antisepsis
  - Used for disinfection of hands
    - Surgical scrub
    - Hand hygiene
  - Pre-op whole body skin disinfection of patients undergoing surgery
    - Cumulative effect with repeated applications
  - Combined with alcohol for skin disinfection
- Effective in the presence of blood or serum protein
- Effective against vegetative Gram negative and positive organisms, some yeasts and viruses

Denton, Graham Chlorhexidine. in Block, Seymour, editor. Disinfection, Sterilization, and Preservation 5th ed. 2001 Chapter 15 pp321-336

Chlorhexidine Gluconate (CHG) Toxicity

- Oncogenicity
  - No evidence of carcinogenicity
- Dermal absorption
  - Minimal absorption through the skin, if at all
- Skin irritation and sensitization
  - Low incidence when used at recommended concentrations according to the manufacturer's instructions
  - Local skin irritation reactions are occasionally reported
- Ototoxicity
  - High probability of total deafness, therefore not used in surgery of the middle or inner ear
  - Enhanced in the presence of high concentrations of alcohol or detergent
- Neurotoxicity
  - Toxic to nerve tissue
  - Avoid contact with brain and meninges
- Ocular toxicity
  - Kept away from eyes
  - Concentrations >2% toxic to the corneal epithelium and conjunctiva
  - Irritation due to splashes to eye during hand hygiene with high concentrations of CHG (4%)

Denton, Graham Chlorhexidine. in Block, Seymour, editor. Disinfection, Sterilization, and Preservation 5th ed. 2001 Chapter 15 pp321-336

Skin Antisepsis - Professional Guidelines Recommendations?

- According to the Musculoskeletal Infection Society (MSIS) (Ortho Surgeon) Guidelines … (International Consensus Conference Meeting on Periprosthetic Joint Infection, Philadelphia. July 31, 2013 and August 1, 2013)

Question 1B: What type and when should preoperative skin cleansing with an antiseptic be implemented?

Consensus: We recommend that whole-body skin cleansing should start at least the night prior to elective arthroplasty. It is a consensus that after bathing, patients are advised to sleep in clean garments and bedding without the application of any topical products.

Whole body cleansing vs localized surgical site-specific cleansing: one large RCT showed that whole-body cleansing was more effective at reducing the rate of SSI than surgical site-specific washing.[13] We recommend that whole body preoperative skin cleansing be undertaken preoperatively.

Prevent Surgical Site Infection:

Early Skin Prepping Starting at Home

- Pre-Operative Antiseptic Showering
- Decreases skin microbial count
- Two pre-op showers - CHG vs. povidone-iodine vs. triclocarban medicated soap = 7 fold vs. 1.3 vs 1.9 respectively
- CHG maximum antibacterial benefit with repeated applications – binds to skin
  - Cumulative effect
  - Residual effect
  - Effective against Gram positive and Gram negative organisms

OR…

Mangram, AJ, Horan, TC et al. Guideline for Prevention of Surgical Site Infection, 1999

Early Prepping

- Shower vs. Cloth
  - Poor compliance with liquid
  - Ryder et al. (2009)
    - More chlorhexidine left on skin after application with cloth than when applied as a liquid
  - Possibility that chlorhexidine may preferentially bind to cotton in washcloth
- Why 2 Applications?
  - Cumulative effect
  - Maki (2009)
    - Advance prep at 12 AND 3 hours prior to surgery significantly reduced microorganisms at surgical site
  - Ryder et al. (2009)
    - More chlorhexidine left on skin when applied in PM and AM, as opposed to just AM

Thanks to Dr. Aaron Johnson and Dr. Michael Mont for making this slide available for use.

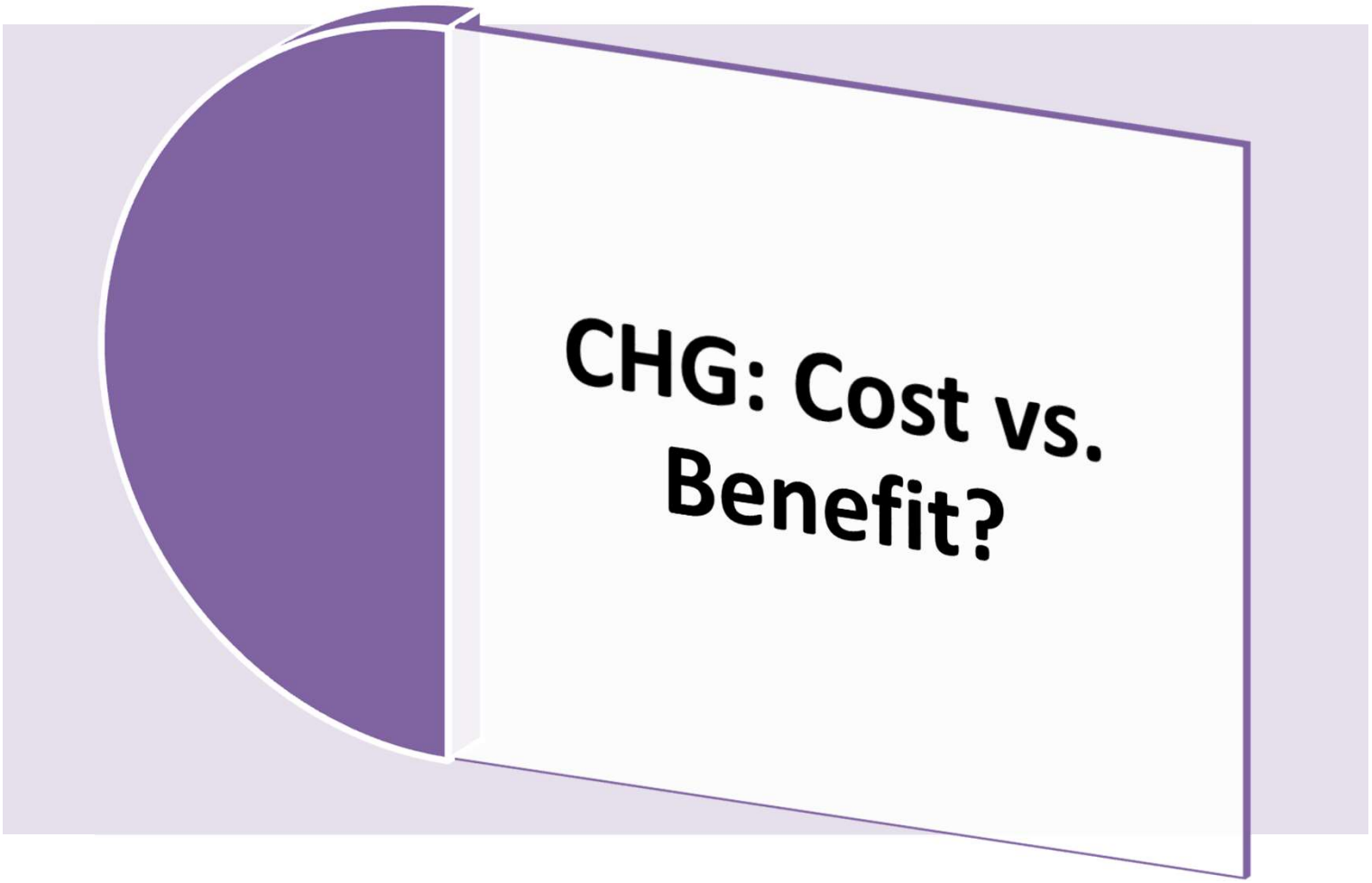
Skin Prep in the Pre-Op Unit

- Pre-Op Skin Prep with CHG
- CHG is persistent, active for up to 6 hours [1]
- Edmiston et. al showed that use of a 2% CHG cloth resulted in higher skin concentrations compared to 4% liquid CHG [5]
- Literature shows repeat applications will maximize antimicrobial effect [2]
- CHG has rapid bactericidal action[3]
- Excellent activity against Gram-positive as well as excellent residual activity [4]

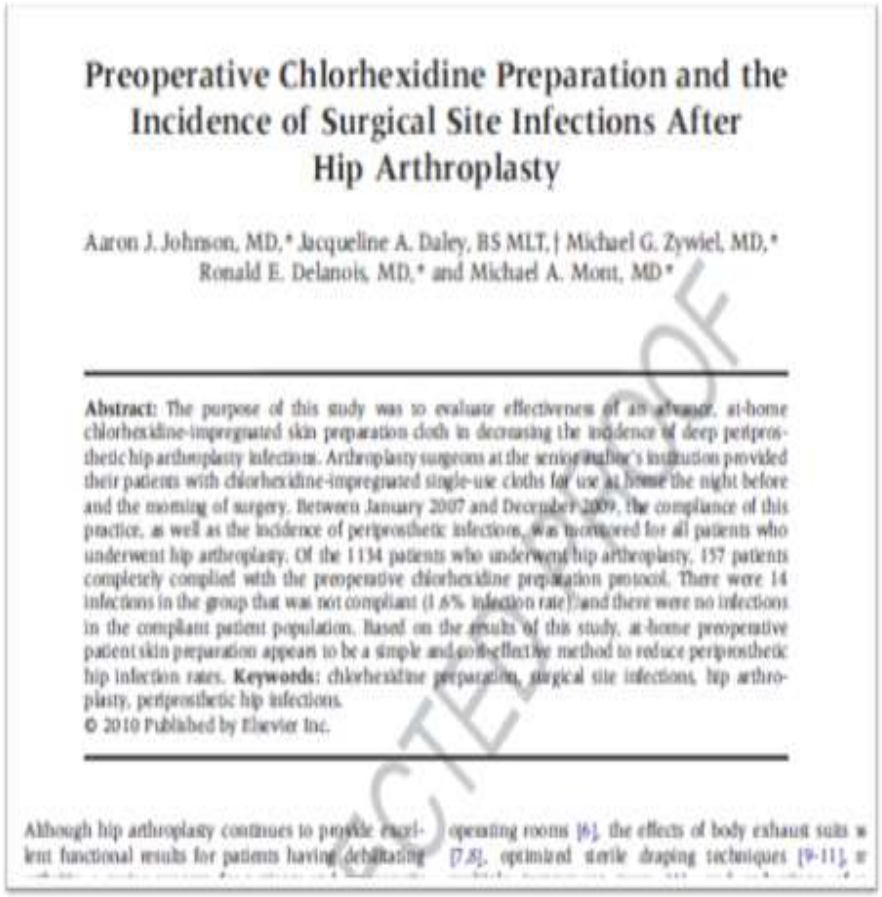
1. Larson E, APIC guidelines for infection control practice: guideline for use of topical antimicrobial agents. Am J Infect Control. 1988;16(6):253-65.

2. Paulson D, Am J Infect Control. 1993;21:205-9. 3. Denton GW, Chlorhexidine. In Seymour S. Block (Ed.) Disinfection, sterilization, and preservation. 4th Ed., Lea & Febiger, Williams & Wilkins, Media PA, 1991:279. 4. Mangram AJ, et al., Guideline for prevention of surgical site infection, 1999. Centers for Disease Control and Prevention, Hospital Infection Control Practices Advisory Committee, Atlanta GA. 5. Edmiston, Charles et. al. Preoperative Shower Revisited: Can High Topical Antiseptic Levels Be Achieved on the Skin Surface Before Surgical Admission? J Am Coll Surg 2008;207:233-239

Edmiston, Charles, Okoli, Obi et. al. Evidence for Using Chlorhexidine Gluconate Preoperative Cleansing to Reduce the Risk of Surgical Site Infection. AORN Journal November 2010; 92(5):509-518


CHG: Cost vs.
Benefit?

Results: Total Hip Arthroplasty
Johnson, Daley, Zywiel, Mont; J Arthroplasty, 2010



Preoperative Chlorhexidine Preparation and the Incidence of Surgical Site Infections After Hip Arthroplasty

Aaron J. Johnson, MD,* Jacqueline A. Daley, BS MLT,† Michael G. Zywiel, MD,* Ronald E. Delanois, MD,* and Michael A. Mont, MD*

Abstract: The purpose of this study was to evaluate effectiveness of an advance, at-home chlorhexidine-impregnated skin preparation cloth in decreasing the incidence of deep periprosthetic hip arthroplasty infections. Arthroplasty surgeons at the senior author's institution provided their patients with chlorhexidine-impregnated single-use cloths for use at home the night before and the morning of surgery. Between January 2007 and December 2009, the compliance of this practice, as well as the incidence of periprosthetic infection, was monitored for all patients who underwent hip arthroplasty. Of the 1134 patients who underwent hip arthroplasty, 157 patients completely complied with the preoperative chlorhexidine preparation protocol. There were 14 infections in the group that was not compliant (1.6% infection rate) and there were no infections in the compliant patient population. Based on the results of this study, at-home preoperative patient skin preparation appears to be a simple and cost-effective method to reduce periprosthetic hip infection rates. **Keywords:** chlorhexidine preparation, surgical site infections, hip arthroplasty, periprosthetic hip infections.

Although hip arthroplasty continues to provide excel- operating rooms [6], the effects of body exhaust suits w lent functional results for patients having debilitating [7,8], optimized sterile draping techniques [9-11], a

Group A: Advance Skin Prep

157 patients

0 infections

Group B: No advance skin prep

897 patients

14 infections

1.6% infection rate

Thanks to Dr. Aaron Johnson and Dr. Michael Mont for making this slide available for use.

Updated Results: Cases to end of 2010 AAOS 2011

	Advance skin prep	***No advance skin prep***	
KNEES	• 468 procedures • 2 infections • 0.5%	• 1,676 procedures • 34 infections • 2.2% infection rate	**p=0.029**
KNEES + HIPS	• 1,040 procedures • 6 infections • 0.5%	• 3,571 procedures • 56 infections • 1.6% infection rate	**p=0.022**

Thanks to Dr. Aaron Johnson and Dr. Michael Mont for making this slide available for use.

Is it worth the cost? – YES!

A deep total hip / knee infection

Major morbidity for the patient (multiple operations, tremendously-increased mortality, substandard outcomes)

Estimated economic impact of one deep SSI in hospital costs alone[1]

- Total hip arthroplasty = $100,000
- Total Knee arthroplasty = $60,000

Financial Justification

2% CHG cloth: $6 X 2 → $12 per use

- → ~8,300 patients treated with CHG cloth
- Hospital: 400 joints per year
  (1 infection saved would pay for CHG Cloth for > 20 years!)

Thanks to Dr. Aaron Johnson and Dr. Michael Mont for making this slide available for use.

1. Bratzler D, Dellinger, E. Patchen, et. al.Clinical practice guidelines for antimicrobial prophylaxis in surgery. Am J Health-Syst Pharm. 2013; 70:195-283

Financial Impact

- Infection Rates
  - with CHG: 0.5% (1 out of 200 cases)
  - Without CHG: 1.6% (1 out of 62 cases)
    - 62nd case → $100,000 in infection treatment
    - 62 cases with CHG Cloth: $744
- With CHG Cloth
  - 1 infection in 200 ($100,000)
  - Versus 3 infections without CHG Cloth ($300,000)
  - Cost of CHG Cloth: $2,400
  - Net difference: ~$200,000

- Based on data between 2005 and 2006
  - ~15,000 revision TKA for infection (Bozic et al., CORR 2010)
  - ~7,500 revision THA for infection (Bozic et al., JBJS 2009)
  - 1.5% infection rate
  - → ~22,500 revisions for infection per year
  - ~$100,000 per revision

$2.2 billion per year

Reduce to 0.5% with CHG Prep (reduce by 2/3)

→ Save $1.5 billion per year

Thanks to Dr. Aaron Johnson and Dr. Michael Mont for making this slide available for use.


Patient Skin Antisepsis
Operating Room

Patient Skin Antisepsis in the Operating Room

- Most commonly used to prep the operative site
  - Iodophors (e.g., povidone-iodine)
  - Alcohol containing products
    - Ethyl alcohol (60%-95%)
    - Isopropyl alcohol (50%-91.3%)
    - Two types of skin prep available for use appear to have superior efficacy (iodine povacrylex in 74% w/w isopropyl alcohol (IPA) and 2% CHG w/v in 70% IPA
    - Issues with flammability
  - Chlorhexidine gluconate (CHG)
    - Greater residual activity after a single application
    - Not inactivated by blood or serum proteins compared to Iodophors

Mangram, AJ, Horan, TC et al. Guideline for Prevention of Surgical Site Infection, 1999
APIC Elimination Guide. Guide to the Elimination of Orthopedic Surgical Site Infections. 2010

Patient Skin Antisepsis in the Operating Room

- Method of application on the skin – follow the manufacturer's written instructions for use
  - Concentric circles vs. back and forth motion
- Other skin prep
  - Removing or wiping off the skin prep after application
  - Using an antiseptic impregnated drape
  - Painting the skin with antiseptic
  - Using a clean vs. sterile surgical skin prep kit

Mangram, AJ, Horan, TC et al. Guideline for Prevention of Surgical Site Infection, 1999
APIC Elimination Guide. Guide to the Elimination of Orthopedic Surgical Site Infections. 2010

Additional Considerations – Skin Preparation

- Application Instructions
  - The efficacy of an antimicrobial product is based on proper application
- Characteristics of a surgical procedure
  - Irrigation/ blood, body fluids
- Drape Adhesion
  - Certain aqueous based preps and antiseptic agents interfere with the adhesion of drapes and tapes
- Patient Safety
  - Product warnings and contraindications; may increase personal and institutional liability if warnings and contraindications are disregarded

Nasal Decontamination

What does the nose have to do with it?

Nasal Decontamination

- *S. aureus* colonization
  - Carriage is the most important independent risk factor for developing an SSI[2]
  - Usually associated with the nares (~70%)
  - Other sites includes the skin, axilla, groin / perineal space
  - Carriers of high numbers of *S. aureus* have 3-6 times the risk of HAIs[1]
- Swabbing the nares identifies 80%-90% of MRSA carriers[2]
- Patients may have *S. aureus* on the skin and other sites and not in the nose
- Decolonization of nasal and extranasal sites may reduce infection risk[4]
  - ASHSP report - mupirocin should be used intranasally for all patients with documented colonization with *Staph aureus (Strength of evidence for prophylaxis = A)*[3]

1. Bode, Lonneke G. M. et. al. Preventing Surgical-Site Infections in Nasal Carriers of *Staphylococcus aureus.* *N* Engl J Med 362;1 January 7, 2010
2. Prokuski, Laura. Prophylactic Antibiotics in Orthopaedic Surgery. J Am Acad Orthop Surg 2008;16:283-293
3. Bratzler D, Dellinger, E. Patchen, et. al.Clinical practice guidelines for antimicrobial prophylaxis in surgery. Am J Health-Syst Pharm.2013; 70:195-283
4. Courville, Xan, Tomek, Ivan et. al. Cost-Effectiveness of Preoperative Nasal Mupirocin Treatment in Preventing Surgical Site Infections in Patients Undergoing Total Hip and Knee Arthroplasty: A Cost-Effectiveness Analysis.ICHE February 2012; 33(2):152-159.

Nasal Decontamination

- Skin and Nasal Antiseptic
  - Reduces 99% of *S. aureus* in the nares according to the company's literature
  - Effective in one hour
  - Persistent for up to 12 hours
  - Active ingredient is an antiseptic, not an antibiotic
- Supports antimicrobial stewardship
  - 27%-50% resistance found to topical antibiotics for MRSA

Simor Antimicrobial Agents in Chemotherapy 2007
Rotger Journ of Clin Micro 2005

Mupirocin Ointment vs. Povidone – Iodine Nasal Decolonization

Maslow et. al. Patient Experience with Mupirocin or Povidone-Iodine Nasal Decolonization. Healio.com/Orthopedics

Purpose: Evaluate and compare patient experiences and satisfaction with nasal decolonization with either nasal povidone-iodine (PI) or nasal mupirocin ointment (MO)

- 1903 patients randomized to undergo preoperative nasal decolonization with either nasal MO or PI solution.
  - All were given the 2% CHG topical wipes
  - 1679 (88.1%) interviewed prior to discharge
  - PI group – 3.4% reported unpleasant or very unpleasant experience compared to the MO group, 38.8%.
  - **Patients receiving PI solution preoperatively reported significantly fewer adverse events than the nasal MO group (p<.01)**
- *Pre-operative nasal decolonization with either nasal PI or MO was considered somewhat or very helpful by more than two-thirds of patients*

Does the Iodine-based Solution Matters?

Rezapoor, M et al Do Iodine-based Solutions Differ in Their Effectiveness for Decolonizing Intranasal *Staphylococcus aureus?*

- Hypothesis – Off-the-shelf 10% iodine is as effective as manufactured 5% PI solution for S. aureus nasal decolonization.

Study – Prospective randomized controlled trial from April 2014 to July 2015

- 429 primary TJA patients – randomized to 3 groups (Off-the-shelf 10% PI; 5% PI for decolonization; Saline swabs (control) of 143 each
- Baseline cultures of the nares done immediately pre-op followed by decolonization twice both nares for 2 minutes with 4 applicators
  - Swabbed for culture at 4 and 24 hours after decolonization

- Baseline Results – 95/429 (22.1%) + for *S. aureus (*13/95 *MRSA) (13.6%)*

Negative S. aureus	10% Off-the-shelf PI (34/95)	5% PI (For Decolonization) (34/95)	Saline Control (27/95)
4-Hours Post Decolonization	48% (16/34)	79% (27/34)	41% (11/27)
24-Hours Post Decolonization	28% (10/34)	41% (14/34)	31% (8/27)

Findings – Off-the-shelf PI is not as effective as 5% PI for intranasal *S. aureus decolonization.* 5% PI contains a specific adherent polymer that remains in the nares for a longer period which may explain efficacy.

Evidence for Nasal Antiseptic

Phillips et. al. Preventing Surgical Site Infections: A Randomized, Open-Label Trial of Nasal Mupirocin Ointment and Nasal Povidone-Iodine Solution. Infect Control Hosp Epidemiol 2014;35(7).

TABLE 2. Number of Subjects with Deep Surgical Site Infection (SSI) and SSI Rates

		Overall			*Staphylococcus aureus* infection		
Analysis	No. of subjects	No. of cases	Rate, cases per 100 subjects	P^a	No. of cases	Rate, cases per 100 subjects	P^a
Intent to treat							
Mupirocin	855	14	1.6	.1	5	0.6	.2
Povidone-iodine	842	6	0.7		1	0.1	
Per protocol							
Mupirocin	763	13	1.7	.06	5	0.7	.03
Povidone-iodine	776	5	0.6		0	0	

[a] By χ^2 test.

- In the modified intent to treat analysis, there were fewer infections in the PI group, but the results were not statistically significant.
- In the per protocol analysis, deep S. aureus SSI developed in 0 of 776 surgeries in the PI group and 5 of 763 surgeries in the mupirocin group (p=0.03)
- Significantly more adverse events reported by patients in the mupirocin group (8.9%) than patients in the PI group (1.8%) ($p<0.05$ for all treatment related symptoms)

Evidence for Nasal Antiseptic

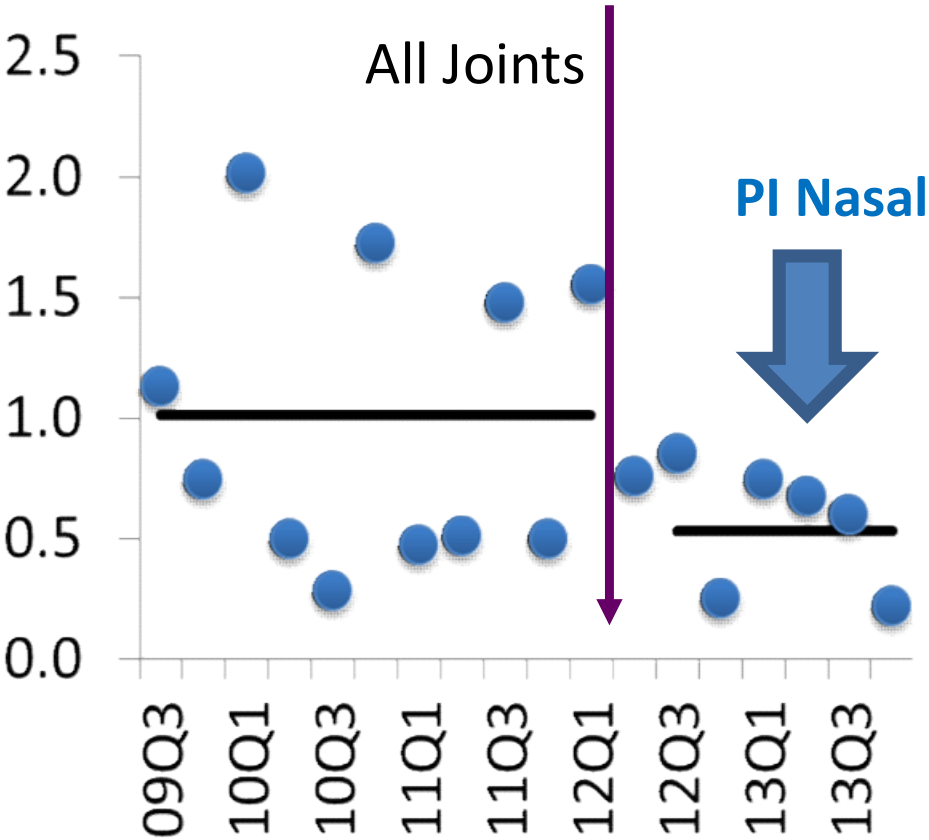
Brown, et. al. The Effect of Universal Intranasal Povidone Iodine Antisepsis on Total Joint Replacement Surgical Site Infection

Total Hip and Knee Arthroplasty Before – 6/2009 – 3/2012; After – 5/2012 – 1/2014

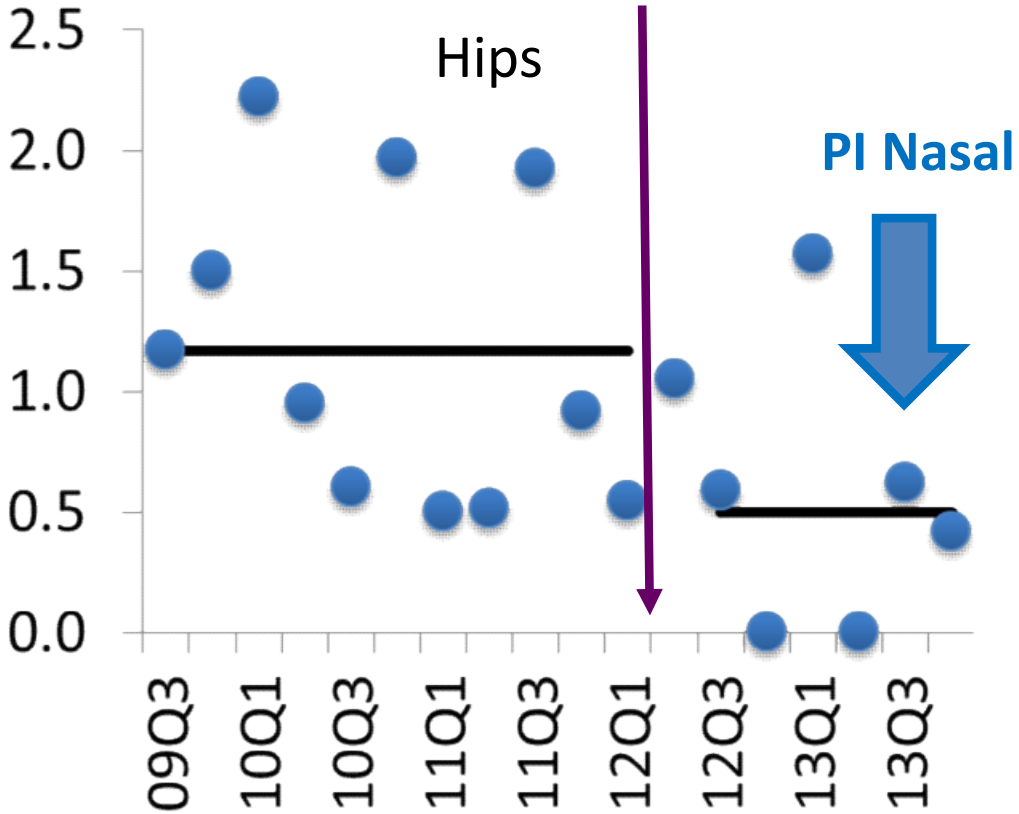
- Barriers – Nasal Mupirocin
  - Barriers identified to implementation of this last piece of the bundle:
  - Increased time required (need an additional preoperative appointment to get screening results and mupirocin treatment)
  - Potential for mupirocin resistance
  - Increased cost
- Benefits – Nasal Antiseptic
  - Universal/horizontal approach for all patients and all pathogens
  - Does not contribute to antibiotic resistance
  - Less costly
  - Less time required (do not need an additional preoperative appointment)

All Pathogen Surgical Site Infections

Overall hip and knee declined from 1.01% (44/4366) to 0.53% (8/2837) (P=0.03)



Hip SSI decreased from 1.17% (25/2130) to 0.50% (7/1378) (P=0.045) (Statistically significant)



Arthroplasty SSI (all pathogens)

Joint		Before	After	
Hip		7/2009 to 3/2012	5/2012 to 6/2014	
	Infections	26	7	
	Cases	2130	1741	
	Rate	1.22%	0.40%	P = 0.0074
	(95% Confidence Interval)	(0.80 to 1.78)	(0.16 to 0.83)	
Knee		7/2009 to 3/2012	5/2012 to 6/2014	
	Infections	18	9	
	Cases	2236	1767	
	Rate	0.81%	0.51%	P = 0.3316
	(95% Confidence Interval)	(0.48 to 1.27)	(0.23 to 0.96)	
Hips & Knees		7/2009 to 3/2012	5/2012 to 6/2014	
	Infections	44	16	
	Cases	4366	3508	
	Rate	1.01%	0.46%	
	(95% Confidence Interval)	(0.73 to 1.35)	(0.26 to 0.74)	P = 0.0058

Arthroplasty SSI (*Staphylococcus aureus* only)

Joint		Before	After	
Hip		7/2009 to 3/2012	5/2012 to 6/2014	
	Infections	13	3	
	Cases	2130	1741	
	Rate	0.61%	0.17%	P = 0.0427
	(95% Confidence Interval)	(0.33 to 1.04)	(0.04 to 0.50)	
Knee		7/2009 to 3/2012	5/2012 to 6/2014	
	Infections	6	5	
	Cases	2236	1767	
	Rate	0.27%	0.28%	P = 1.0000
	(95% Confidence Interval)	(0.10 to 0.58)	(0.09 to 0.66)	
Hips & Knees		7/2009 to 3/2012	5/2012 to 6/2014	
	Infections	19	8	
	Cases	4366	3508	
	Rate	0.44%	0.23%	P = 0.1257
	(95% Confidence Interval)	(0.26 to 0.68)	(0.10 to 0.45)	

Effect of a Preoperative Decontamination Protocol

Bebko et al. Effect of a Preoperative Decontamination Protocol on Surgical Site Infections in Patients Undergoing Elective Orthopedic Surgery with Hardware Implantation. JAMA Surg. doi:10.1001/jamasurg.2014.3480. Published online March 4, 2015

Intervention: CHG + Oral Rinse + Nasal Povidone-Iodine Solution

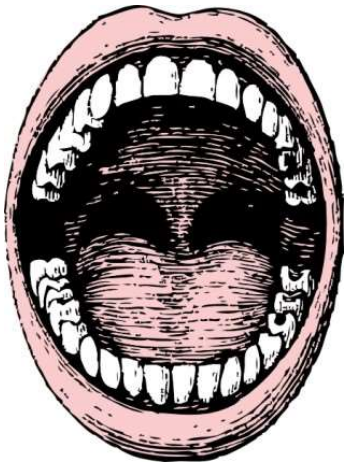
Population	Total # Patients	SSI Rate	P-value
Decolonized Patients	365	1.1% (4/365)	P=.02
Control	344	3.8% (13/344)	P=.02

Multivariate logistic regression identified MRSA decontamination as an independent predictor of not developing an SSI (adjusted odds ratio, 0.24 [95% CI, 0.08-0.77]; p=.02).

Conclusion and Relevance – Our study demonstrates that preoperative MRSA decontaminnaton with chlorhexidine washcloths and oral rinse and intranasal povidone-iodine decreased the SSI rate by more than 50% among patients undergoing elective orthopedic surgery with hardware implantation.

Oral Decontamination

What about the oral cavity?



CHG – Oral Decontamination

- Concerns with the oral cavity
  - Formation of dental plaque – biofilm (thin resistant layer of microorganisms such as bacteria
  - Biofilm can break apart and travel in oral secretions to other sites
- Oral Hygiene with CHG (0.12%) addresses the issue of biofilm
- Advantages
  - Absorbs to oral surfaces (e.g., tooth, mucosa, restorative material)
  - Preoperative and postoperative use of CHG mouthwash reduces oral microflora
- Disadvantages
  - Documented hypersensitivity to CHG – DO NOT USE
  - May cause tooth staining (tooth surfaces, restoration, dorsum of tongue) especially with heavy plaque accumulation
  - Increase in calculus formation
  - Alteration with taste perception with long use times

CHG - Oral Decontamination

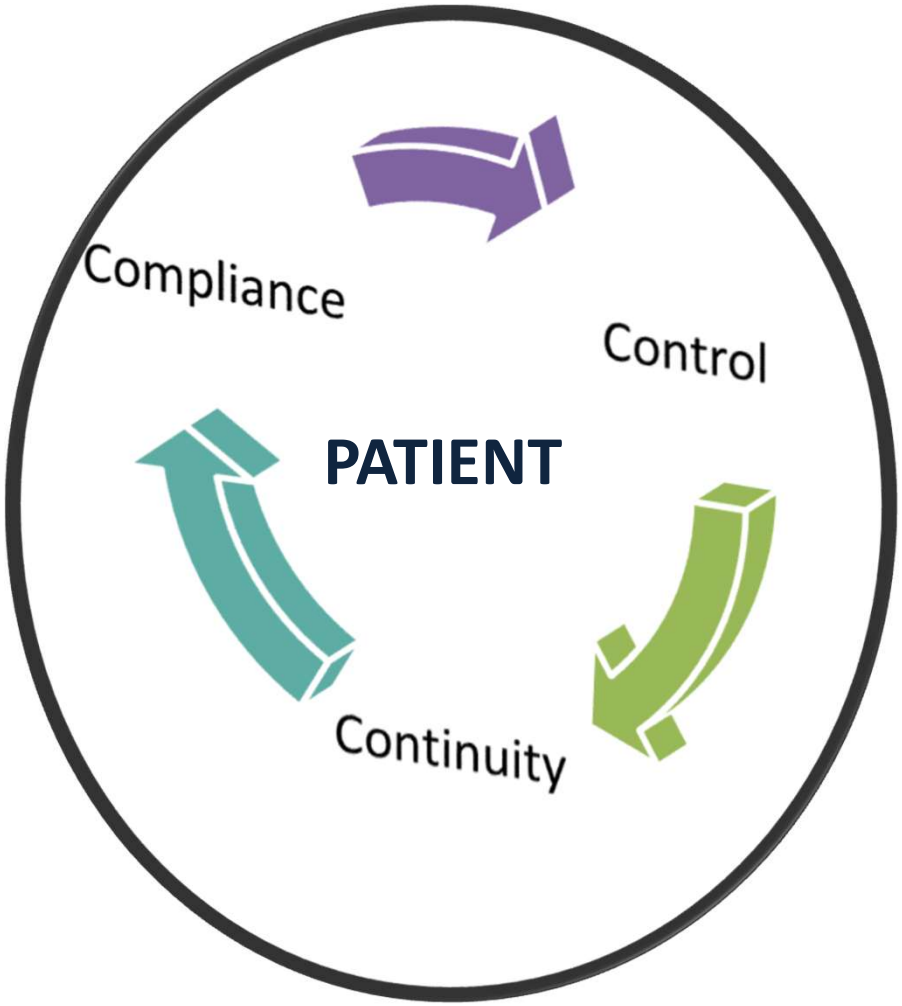
McCormack et. al. Staphylococcus aureus and the oral cavity: An overlooked source of carriage and infection? American Journal of Infection Control 2015; 43:35-37

- *Staphylococci* found in the oral flora
  - Carriage rates for *Staphylococcus aureus – 24% - 84%* in healthy adult oral cavities
  - Incidence in denture wearers – 48%
- Chlorhexidine gluconate used in low doses in the oral cavity
  - Eliminates plaque
  - Antimicrobial activity

- **Conclusion – *These findings suggest that S. aureus continues to be a frequent isolate in the oral cavity and perioral regions. The oral cavity should be considered a source of S. aureus in terms of cross-infection and dissemination to other body sites.***

Optimize SSI Prevention – 3Cs

Do not leave it up to the patient



- Did the patient absorb the SSI prevention message and do what is expected?
- Caregivers need to take **CONTROL** of the process
- Maintain **CONTINUITY** of prevention strategies
  - Apply 2% CHG in Pre-Op Holding
  - Apply nasal antiseptic in Pre-Op Holding
- Ensure **COMPLIANCE**
  - Takes 3 - 4 minutes

Perioperative Strategies

- ✓ Antibiotic Prophylaxis
- ✓ Proper insertion of central lines
- ✓ Aseptic technique during Foley placement
- ✓ Glycemic control
- ✓ Prevent wound contamination by practicing the principles of aseptic technique
- ✓ Decrease the length of surgery
- ✓ Prevent hypothermia
- ✓ Use closed drainage system when needed
- ✓ Incision closure – surgical staples vs. subcuticular sutures

Mangram, et al. The Hospital Infection Control Practices Advisory Committee (HIPAC).
Guideline for the Prevention of Surgical Site Infection. *Infect Control Hosp Epidemiol* 1999;20:247-80.
Dunbar, Michael and Richardson, Glen. Minimizing Infection Risk: Fortune Favors the Prepared Mind. Abstract. Full article at OrhtoSuperSite.com Search 2010714-31

Other Recommended Best Practices

- Surgical hand scrub
- Clean surgical attire, including scrub suits, shoes, head covering (caps/hoods), masks, gloves, gowns and jackets
- Restrict use of Immediate-Use Sterilization
- Environment
  - minimum of 20 air changes per hour with 4 minimum outdoor air changes/hour (20% must be fresh air)
  - Relative humidity of 30% - 60%
  - Temperature - 20°C - 24°C (68°F - 75°F)
  - OR traffic kept to a minimum (<9 people) and doors closed

Outcome of SSI Prevention Strategies

- ✓ Reduce risk for surgical site infections
- ✓ Reduce morbidity and mortality
- ✓ Reduce costs associated with SSI
  - – Reduce length of stay
  - – Reduce readmissions
- ✓ Reduce development of multi-drug resistant organisms (MRSA, VRE, etc.)
- ✓ Improved patient satisfaction / quality of life
- ✓ Reduce the risk of litigation

Summary – Keys to Success

- Weigh the risk vs. benefit and the cost vs. benefit based on your institution's goals for process improvement to reduce SSIs.
- Properly and consistently applied prevention strategies can reduce the risk of surgical site infections and ensuing morbidity and mortality
- Prevention requires multiple interventions applied as part of a horizontal strategy
  - Pre-operative antiseptic shower
  - Skin antisepsis before incision
  - Management of the oral and nasal flora
- Chlorhexidine gluconate plays a key role in the prevention of SSIs.
- Synergism
  - Effective team work and communication will improve patient outcome

Your Next Steps

- Engage your experts
  - Develop a multidisciplinary team (Surgeon, IP, Quality, Supply Chain, etc.)
  - Involve a champion to promote the program
  - Seek and involve C-Suite support
  - Involve frontline staff (OR, nursing units, etc.)
- Evaluate the data and the evidence
  - Quantitative data sources
    - SSI rates, SIR, TAP Reports (CAD)
    - Qualitative
      - Observations
      - Process flows
      - Staff feedback on current process
  - Obtain ROI templates from vendors
  - Gather and review the evidence-based prevention literature
  - Provide feedback
    - Outcome
    - Process gaps
    - Cost vs. cost of an SSI

Your Next Steps

- Educate on the proposed intervention
  - Process (qualitative) and outcomes (quantitative)
  - Indications for use of CHG cloth
  - Indications for use of the nasal antiseptics
  - User directed education
  - Physician directed education
  - Patient directed education
- Execute the new intervention
  - Communicate clearly the intent – posters, meetings, etc. across all providers and staff (pre-, intra-, and post- op)
  - Active participation of the key stakeholders
  - Standardize the process across all service lines
    - Develop a computerized orderset
  - Standardize, where possible, the indications for use across all service lines


Thank you!

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