SSI Prevention: The Power is in the Bundle

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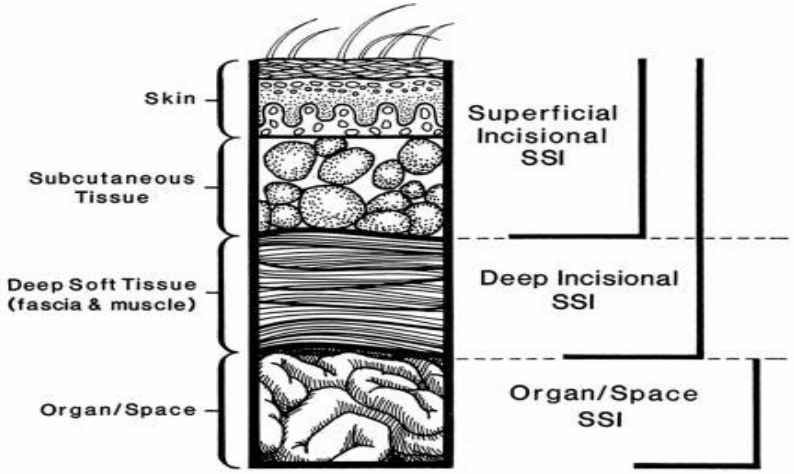


Conflict of Interest Statement

- 3M Educational Consultant
- Stryker/Sage Education Consultant
- Boston Scientific Education Consultant

Objectives

- Discuss the burden associated with surgical site infections
- Discuss the role of antimicrobial resistance in surgical site infections
- Describe three strategic interventions as part of a bundle to reduce the risk of surgical site infections

Objective 1

Discuss the burden associated with surgical site infections

Burden of Surgical Site Infection (SSI)

SSIs are the most common adverse event for surgical patients

Second most common type of adverse event occurring in hospitalized patients

2%-5% of patient undergoing inpatient surgery in the USA will have an SSI

~160,000 – 300,000 SSIs occur each year in the USA

Up to 60% of SSIs are estimated to be preventable

CDC Surgical Site Infection Event Procedure Associated Module January 2016

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)

APIC Implementation Guide. Infection Preventionist's Guide to the OR. 2018. www.apic.org/implementationguides

Ban, KA et. al. American College of Surgeons and Surgical Infection Society: Surgical Site Infection Guidelines, 2016 Update. J Am Coll Surg2017; 224(1):59-73

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)
APIC Implementation Guide. Infection Preventionist's Guide to the OR. 2018. www.apic.org/implementationguides
Ban, KA et. al. American College of Surgeons and Surgical Infection Society: Surgical Site Infection Guidelines, 2016 Update. J Am Coll Surg2017; 224(1):59-73

Burden of SSI – Unavoidable Facts

- Surgical Site Infection (SSI)
  - One of the most expensive HAI based on costs during index hospital stay[1]
  - Mean cost without SSI = $36,253; additional cost due to SSI = $32,1871
  - Aggregate cost = $31.6 million[1]
  - SSI increased the cost of an index stay by 52%[1]
  - 2020-2030 – 13% increase in arthroplasties with a 14% increase in SSI if there is no decrease in SSI rates[2]
  - 60%-70% of arthroplasties and SSIs occur in 65 and older age group[2]
  - Projected burden = 77,653 SSIs (15,820,475 primary and revision procedures)[2]
  - Hip arthroplasties contributed 54% of total SSIs[2]

1. Anand P. et al. Estimating the hospital costs of inpatient harms. Health Serv Res. 2018;1-11
2. Wolford, HM et al. The projected burden of complex surgical site infections following hip and knee arthroplasties in adults in the United States, 2020 through 2030. Infection Control & Hospital Epidemiology 2018; 39:1189-1195

Objective 2

Discuss the role of antimicrobial resistance in surgical site infections

Surgical Site Infections and Antibiotic Resistance

- Antibiotic resistance in the USA
  - ✓More than 2.8 million antibiotic-resistant infections occur each year
  - ✓More than 35,000 people die as a result
  - ✓Nearly 223,900 people required hospital care for *C. difficile*
    - ✓At least 12,800 people died in 2017.
- Jeopardizes advancements in modern health care that we have come to rely on, such as joint replacements, organ transplants, and cancer therapy
  - Have a significant risk of infection
  - Patients will not be able to receive treatment if effective antibiotics are not available

ANTIBIOTIC RESISTANCE THREATS IN THE UNITED STATES 2019. https://www.cdc.gov/drugresistance/pdf/threats-report/2019-ar-threats-report-508.pdf

Surgical Site Infections and Antibiotic Resistance

- Addressing this threat requires continued aggressive action
  - ✓Preventing infections in the first place
  - ✓Slowing the development of resistance through improved antibiotic use
  - ✓Stopping the spread of resistance when it does develop

ANTIBIOTIC RESISTANCE THREATS IN THE UNITED STATES 2019. https://www.cdc.gov/drugresistance/pdf/threats-report/2019-ar-threats-report-508.pdf

Surgical Site Infections and Antibiotic Resistance

- The Bottom Line
  - Surgery Patients who have surgery are at risk for surgical site infections.
  - Without effective antibiotics to prevent and treat surgical infections, many surgeries would not be possible today.

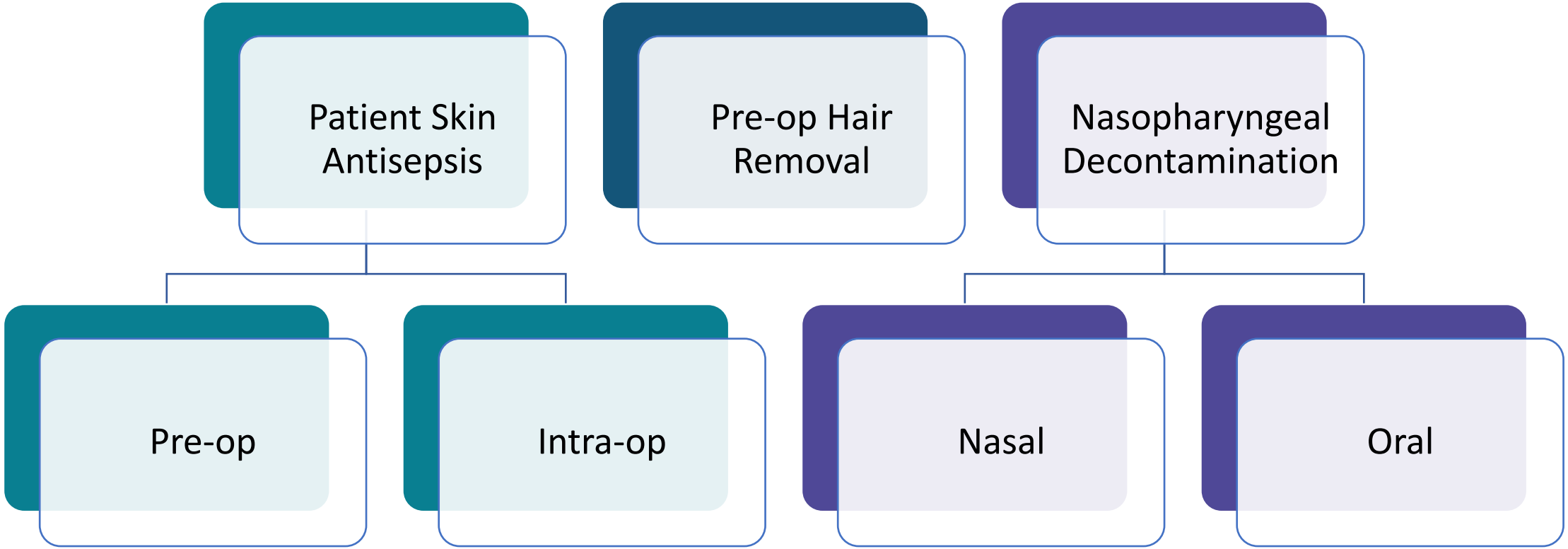
ANTIBIOTIC RESISTANCE THREATS IN THE UNITED STATES 2019. https://www.cdc.gov/drugresistance/pdf/threats-report/2019-ar-threats-report-508.pdf

Objective 3

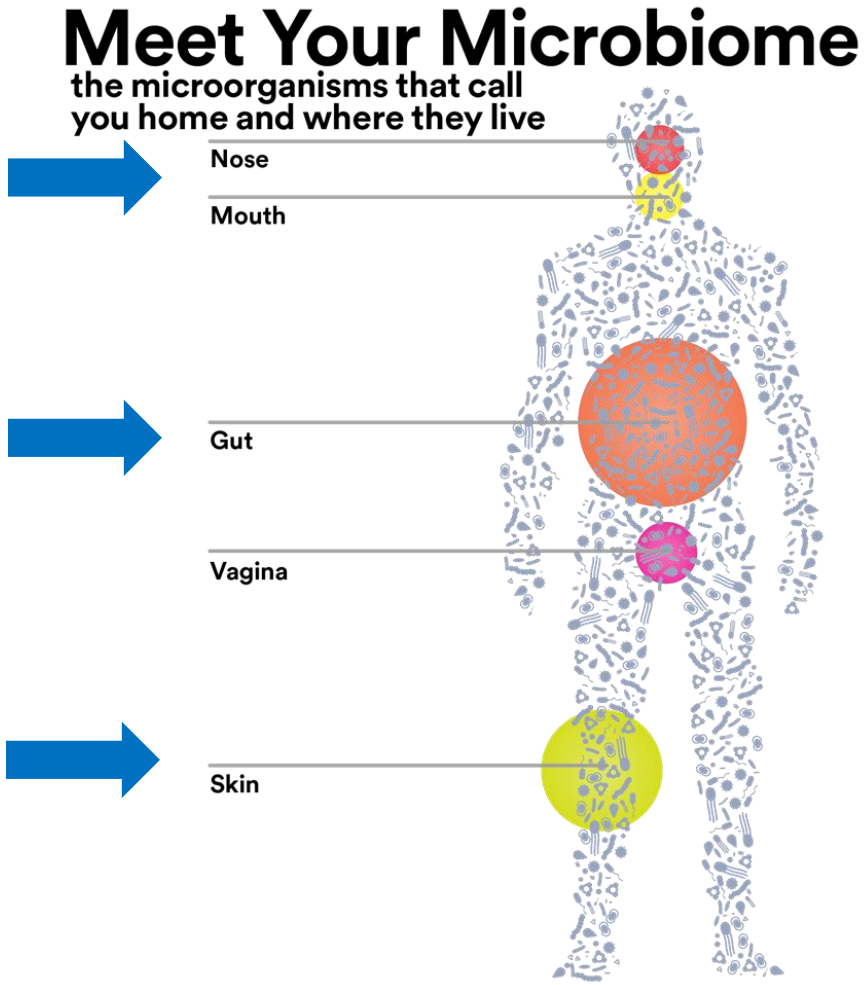
Describe three strategic interventions as part of a bundle to reduce the risk of surgical site infections

SSI Prevention Bundle Elements

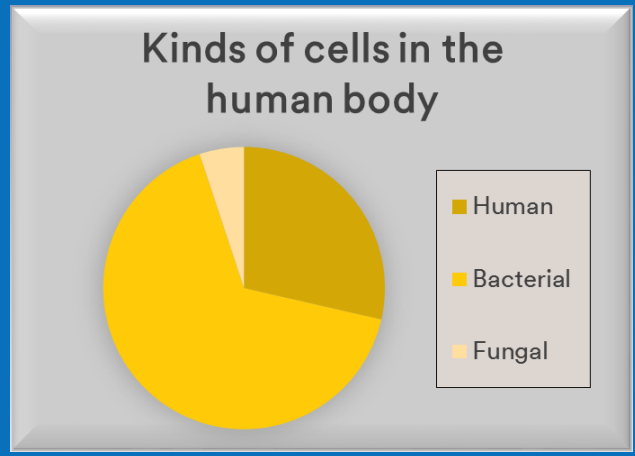
Set of evidence-based interventions that, when implemented as a whole for all patients, consistently, may result in improved patient outcomes.



Patient Skin Antisepsis



37 Trillion Human Cells
100 Trillion Microbial Cells



Antibiotic use can also disrupt the human or animal microbiome, the community of naturally occurring germs in and on the body. A healthy microbiome is important for staying healthy and preventing disease. A disrupted microbiome can put people and animals at risk for getting some types of infection, such as *C. difficile.*[2]

1. American Society for Microbiology Academy. FAQ: Human Microbiome 2014.Retrieved December 08, 2016, from http://academy.asm.org/index.php/faq-series/5122-humanmicrobiome

2. ANTIBIOTIC RESISTANCE THREATS IN THE UNITED STATES 2019. https://www.cdc.gov/drugresistance/pdf/threats-report/2019-ar-threats-report-508.pdf

Human Microbiome and Surgical Site Infection (SSIs)

Review Hypothesis

- If clinicians control the microbiome perioperatively, they might prevent SSIs
  - Control the microbiome of the skin and nasal passages, we can greatly reduce SSI rates
  - Failure to control the microbiome, surgery patient may develop an SSI

- **Key Conclusion**
  - "Almost all SSIs arise from the patient's own microbiome"
  - "The occurrence of SSIs can be viewed as a perioperative failure to control the microbiome"

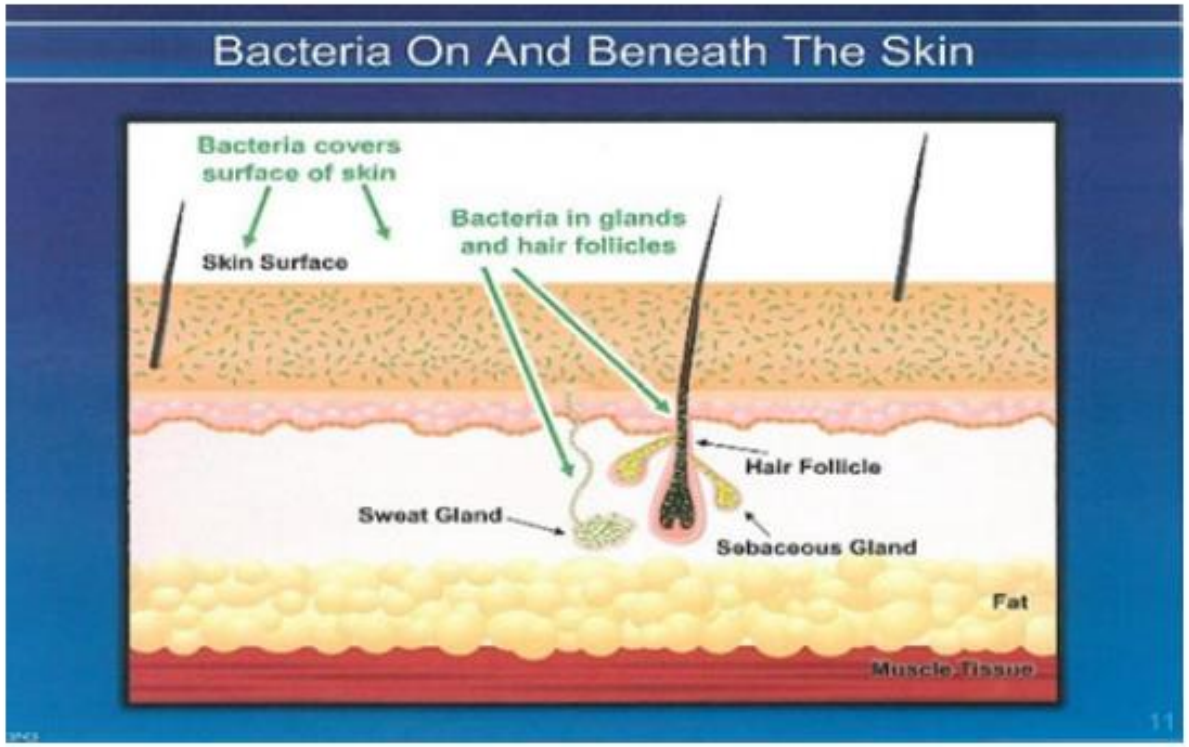


Fig. 1. The sweat glands help regulate temperature, and the sebaceous glands provide sebum which lubricates the top layers of skin and provides a waterproof surface. Importantly, bacteria of the microbiome reside not only on the skin surface (epidermis) but also on the hair follicles and in both sweat glands and sebaceous glands (dermis).

Wenzel, RP. Surgical site infections and the microbiome: An updated perspective. Infection Control & Hospital Epidemiology (2019), 40, 590-596

Distribution and Rank Order of the 15 Most Frequently Reported Adult Surgical Site Infection (SSI) Pathogens, by Surgical Category, 2015–2017

Pathogen	All Surgery Types[b] No. (%) Pathogens	Rank	Abdominal[c] No. (%) Pathogens	Orthopedic[d] No. (%) Pathogens	Ob/Gyn[e] No. (%) Pathogens	Cardiac[f] No. (%) Pathogens
Staphylococcus aureus	26,970 (17.5)	1	6,193 (7.4)	13,968 (38.6)	3,092 (15.2)	2,331 (27.0)
Escherichia coli	21,746 (14.1)	2	16,378 (19.7)	1,737 (4.8)	2,778 (13.7)	478 (5.5)
Enterococcus faecalis[g]	12,267 (8.0)	3	8,053 (9.7)	1,779 (4.9)	1,862 (9.2)	281 (3.2)
Coagulase-negative staphylococci	11,106 (7.2)	4	2,980 (3.6)	4,693 (13.0)	1,476 (7.3)	1,288 (14.9)
Pseudomonas aeruginosa	8,956 (5.8)	5	4,787 (5.7)	2,184 (6.0)	907 (4.5)	658 (7.6)
Selected *Klebsiella* spp	7,789 (5.1)	6	4,894 (5.9)	1,167 (3.2)	917 (4.5)	518 (6.0)
Bacteriodes spp	7,321 (4.7)	7	5,968 (7.2)	150 (0.4)	1,100 (5.4)	38 (0.4)
Enterobacter spp	7,178 (4.7)	8	3,691 (4.4)	1,797 (5.0)	793 (3.9)	538 (6.2)
Other *Enterococcus* spp[g,h]	5,444 (3.5)	9	4,279 (5.1)	491 (1.4)	503 (2.5)	85 (1.0)
Candida albicans[g]	4,847 (3.1)	10	4,131 (5.0)	259 (0.7)	216 (1.1)	142 (1.6)
Enterococcus faecium[g]	4,515 (2.9)	11	3,942 (4.7)	324 (0.9)	139 (0.7)	53 (0.6)
Proteus spp	4,357 (2.8)	12	1,542 (1.9)	1,356 (3.8)	888 (4.4)	400 (4.6)
Viridans group streptococci	4,267 (2.8)	13	3,112 (3.7)	323 (0.9)	601 (3.0)	101 (1.2)
Citrobacter spp	2,099 (1.4)	14	1,395 (1.7)	249 (0.7)	275 (1.4)	105 (1.2)
Serratia spp	1,904 (1.2)	15	357 (0.4)	649 (1.8)	230 (1.1)	475 (5.5)
Other	23,367 (15.2)		11,595 (13.9)	5,021 (13.9)	4,568 (22.5)	1,156 (13.4)
Total	154,133 (100.0)		83,297 (100.0)	36,147 (100.0)	20,345 (100.0)	8,647 (100.0)

Weiner-Lastinger, LM et. al. Antimicrobial-resistant pathogens associated with adult healthcare-associated infections: Summary of data reported to the National Healthcare Safety Network, 2015–2017. Infection Control & Hospital Epidemiology (2020), 41, 1–18

Pre-Op Skin Antisepsis

Preoperative Cleansing Recommended Practice

CDC – Guideline for Prevention of Surgical Site Infections, 2017[1]

- "Before surgery, patients should shower or bathe (full body) with soap (antimicrobial or non-antimicrobial) or an antiseptic agent on at least the night before the operative day" (*Category IB-strong recommendation; accepted practice.)*

SHEA/IDSA* – Strategies to Prevent Surgical Site Infections, 2014[2]

- "Preoperative bathing with chlorhexidine-containing products" (Unresolved issue). To gain the maximum antiseptic effect of chlorhexidine, adequate levels of CHG must be achieved and maintained on the skin.

AORN – Perioperative Standards and Recommended Practices, 2018[3]

- "The collective evidence supports that preoperative patient bathing may reduce the microbial flora on the patient's skin before surgery."
- "The patient should be instructed to bathe or shower before surgery with either soap or a skin antiseptic on at least the night before or the day of surgery."
- Although many studies support the use of 2% CHG cloths for preoperative bathing, additional research is needed before a practice recommendation can be made."

NICE – National Institute for Health and Care Excellence 2019[4]

- "Advise patients to shower or have a bath (or help patients to shower, bath or bed bath) using soap, either the day before, or on the day of, surgery."
- "Consider nasal mupirocin in combination with a chlorhexidine body wash before procedures in which *Staphylococcus aureus* is a likely cause of a surgical site infection."

1. Centers for Disease Control and Prevention, "Guideline for Prevention of Surgical Site Infections," *JAMA Surg*. doi:10.1001/jamasurg.2017.0904
2. Anderson, D.J., et al, Strategies to Prevent Surgical Site Infection in Acute Care Hospitals: 2014 Update. Infect Control Hosp Epidemiol 2014; 35(6): 605-627.
3. AORN. Guidelines for Perioperative Practice, Denver, Colorado: AORN, Inc : 2018
4. NICE Guidelines. Surgical site infections: prevention and treatment. 11 April 2019. https://www.nice.org.uk/guidance/ng125/resources/surgical-site-infections-prevention-and-treatment-pdf-66141660564421 Last updated: 19 August 2020

CHG Preoperative Cleansing

Clinical Evidence

CHG Preoperative Cleansing

- The patient's endogenous flora is the leading cause of SSI and antiseptics decrease bacteria present on the skin[1]
- Preoperative bathing with CHG is effective in reducing skin flora, the same effect is not achieved with the use of soap alone[2-4]
- Review by Webster[5] did not show a statistically significant reduction in SSI, the studies included were limited to use of 4% CHG
- Use of a non-rinseable form of CHG (2% impregnated cloths) results in a significantly increased reduction in skin flora compared to 4% CHG showers. This reduction was greater with repeated application[6]
- Routine pre-operative bathing with chlorhexidine (when not part of a decolonization protocol or pre-operative bundle) decreases skin surface pathogen concentrations but has not been shown to reduce SSI[7]

1. Mangram AJ, et al. Guideline for prevention of surgical site infection. *Infection Control and Hospital Epidemiology* 1999; 20(4):247-78.
2. Garibaldi RA Prevention of intraoperative wound contamination with chlorhexidine shower and scrub. *J Hosp Infect* 1988;11(Suppl B):5–9.
3. Hayek L, Emerson JM, Gardner AMN. A placebo-controlled trial of the effect of two preoperative baths or showers with chlorhexidine detergent on postoperative wound infection rates. *J Hosp Infect* 1987;10:165–72.
4. Murray MR, et al. Efficacy of preoperative home use of 2% Chlorhexidine Gluconate cloth before shoulder surgery. *J Shoulder Elbow Surg* 2011; 20: 928-33.
5. Webster J, Osborne S. Preoperative bathing or showering with skin antiseptics to prevent surgical site infection (Review). *The Cochrane Library* 2012; 9.
6. Edmiston CE Jr. 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(2):233-9.
7. Ban, KA et. al. Executive Summary of the American College of Surgeons/Surgical Infection Society Surgical Site Infection Guidelines—2016 Update. SURGICAL INFECTIONS Volume 18, Number 4, 2017

CHG Preoperative Cleansing

- Meta-analysis by Chlebicki, et al[1] did not find a significant reduction in SSI rates
  - Varying/lack of application protocols (multiple vs. single application) and CHG concentrations
- Additional studies specifically examining the effect of 2% CHG cloths demonstrate an appreciable impact on SSI[2-6]
  - Recent systematic review that included studies with consistent bathing protocols of two preoperative baths, found that the use of 2% CHG cloths significantly reduced SSI risk[7]
  - Low risk and low-cost intervention that has shown to be effective in reducing bacteria on the skin, a risk factor for SSI

1. Chlebicki MP, et al. Preoperative Chlorhexidine shower or bath for prevention of surgical site infection: A meta-analysis. *AJIC* 2013; 41:167-73.
2. Eislet D. Presurgical Skin Preparation With a Novel 2% Chlorhexidine Gluconate Cloth Reduces Rates of Surgical Site Infection in Orthopaedic Surgical Patients. *Orthopaedic Nursing* 2009; 28(3): 141-45.
3. Johnson AJ, et al. Preoperative Chlorhexidine preparation and the incidence of surgical site infections after hip arthroplasty. *J Arthroplasty* 2010; 25(Suppl 6): 98-102.
4. Zywiel MG, et al. Advance pre-operative Chlorhexidine reduces the incidence of surgical site infections in knee arthroplasty. International Orthopaedics 2011; 35(7): 1001-06.
5. Graling PR, Vasaly FW. Effectiveness of 2% CHG cloth bathing for reducing Surgical Site Infections. *AORN* 2013; 97(5): 547-51.
6. Kapadia BH, et al. Pre-admission Cutaneous Chlorhexidine Preparation Reduces Surgical Site Infections In Total Hip Arthroplasty. *J Arthroplasty* 2013; 28:490–93.
7. Karki S, Cheng AC. Impact of non-rinse cleansing with Chlorhexidine Gluconate on prevention of healthcare-associated infections and colonization with multi-resistant organisms: a systematic review. *J Hosp Infect* 2012; 82:71-84.

Summary - Preoperative Wipes or Showers

- Reduces the bacterial burden on the patient's skin prior to surgical incision
- Practical problems: patient compliance, patient's ability to bath/shower, and consistency in method of preparation
- 2% CHG impregnated cloth shown to be more effective than 4% CHG liquid detergent in multiple studies
  - Patient information regarding CHG
  - Inactivated by soaps and shampoos
  - Keep out of eyes and ears
  - Do not use lotions, powders, or creams after application

Patient Skin Antisepsis

Operating Room

Preoperative Skin Antisepsis

SHEA **IDSA[1]**	"Wash and clean skin around incision site; Use a dual agent skin preparation containing alcohol, unless contraindication exists"
CDC[2] **Guideline for the Prevention of Surgical Site Infection[2]**	"Perform intraoperative skin preparation with an alcohol-based antiseptic agent unless contraindicated. (Category IA–strong recommendation; high-quality evidence.)"
AORN[3]	Recommendation III "The collective evidence indicates that there is no one antiseptic that is more effective than another for preventing SSI."
NQF: Safe Practice #22[4]	Preoperatively use solutions that contain isopropyl alcohol as skin antiseptic preparation until other alternatives have been proven as safe and effective, and allow appropriate drying time per product guidelines
NICE **National Institute for Health and Care Excellence SSI Prevention and Treatment[5]**	Prepare the skin at the surgical site immediately before incision using an antiseptic preparation. Be aware of the risks of using skin antiseptics in babies, in particular the risk of severe chemical injuries with the use of chlorhexidine (both alcohol-based and aqueous solutions) in preterm babies. When deciding which antiseptic skin preparation to use (See options may include those in Table 1 of guidelines).

1. Anderson, D.J.et al. Strategies to Prevent Surgical Site Infection in Acute Care Hospitals: 2014 Update. Retrieved from www.jstor.org DOI: 10.1086/676022
2. CDC HICPAC Guideline for the Prevention of Surgical Site Infection. *JAMA,* May 2017. http://jamanetwork.com/journals/jamasurgery/fullarticle/2623725
3. AORN. Guideline for Preoperative Patient Skin Antisepsis. *Guidelines for Perioperative Practices*. Denver, Colorado: AORN, Inc. 2018.
4. National Quality Forum 2010 safe practice #22 on surgical site infection.
5. NICE Guidelines. Surgical site infections: prevention and treatment. 11 April 2019. https://www.nice.org.uk/guidance/ng125/resources/surgical-site-infections-prevention-and-treatment-pdf-66141660564421 Last updated: 19 August 2020

Preoperative Skin Antisepsis

- Skin Preparation
  - Alcohol-containing preparation should be used unless contraindication exists (fire hazard, surfaces involving mucosa, cornea, or ear)
  - No clear superior agent (chlorhexidine vs. iodine) when combined with alcohol
  - If alcohol cannot be included in the preparation, chlorhexidine should be used instead of iodine unless contraindications exist

Ban, KA et. al. Executive Summary of the American College of Surgeons/Surgical Infection Society Surgical Site Infection Guidelines—2016 Update.
SURGICAL INFECTIONS Volume 18, Number 4, 2017

Things to Consider when Choosing a Surgical Prep

- Safety and Efficacy should be the overarching considerations
  - Does the patient have any allergies or sensitivities?
  - Is the patient under two months of age?
  - Is the skin intact?
  - Where is the surgical procedure site (e.g., abdomen, chest, extremities, etc.)?
  - What are the active ingredients in the prep?
  - Does the procedure involve prepping a large surface area?

Baseline Considerations

Patient Factors
- Allergies / sensitivities
- Age of patient
- Skin condition / pigmentation
- Location / Type of procedure

Active Ingredients
- Aqueous solution
- Dual active solution

Size of Area Being Prepped
- Use an appropriately sized applicator to prep an area larger than the incision site

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
  - Allow to dry for recommended time
- 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

Pre-op Hair Removal

Clipping Guidelines

CDC Published 2017	WHO Published 2016	NICE Published 2008	AORN Published 2018
▪ Do not remove hair preoperatively unless the hair at or around the incision site will interfere with the operation. ▪ If hair removal is necessary, remove immediately before the operation, with clippers.	▪ For all surgery types, hair either not removed or if absolutely necessary, then use clipper. ▪ Shaving strongly discouraged.	▪ Do not use hair removal routinely to reduce the risk of surgical site infection. ▪ If hair has to be removed, use electric clippers with a single-use head on the day of surgery. ▪ Do not use razors for hair removal, because they increase the risk of surgical site infection.	▪ Hair removal at the surgical site should be performed only in select clinical situations. ▪ When necessary, hair at the surgical site should be removed by clipping or depilatory methods in a manner that minimizes injury to the skin. ▪ Single-use clipper heads should be used and disposed of after each patient use. The reusable clipper handle should be disinfected after each use. ▪ Patients should be instructed not to shave at home. ▪ Hair should be removed in a location outside the operating room or procedure room.

1. Centers for Disease Control and Prevention, "Guideline for Prevention of Surgical Site Infections," *JAMA Surg*. doi:10.1001/jamasurg.2017.0904
2. Global Guidelines for the Prevention of Surgical Site Infection https://www.who.int/teams/integrated-health-services/infection-prevention-control/surgical-site-infection
3. NICE Guidelines. Surgical site infections: prevention and treatment. 11 April 2019. https://www.nice.org.uk/guidance/ng125/resources/surgical-site-infections-prevention-and-treatment-pdf-66141660564421 Last updated: 19 August 2020
4. AORN. Guidelines for Perioperative Practice, Denver, Colorado: AORN, Inc : 2018

Pre-Operative Hair Removal

Google Images

Only remove hair at the surgical site when it is clinically necessary as determined by the procedure and patient assessment.

Clipping Guidelines

- American College of Surgeons and Surgical Infection Society
  - Hair removal should be avoided unless hair interferes with surgery
  - If hair removal is necessary, clippers should be used instead of a razor

Ban, KA, et. al.American College of Surgeons and Surgical Infection Society: Surgical Site Infection Guidelines, 2016 Update. J Amer Coll Surg 2017; 224(1):59-74

Nasal Decolonization

What does the nose have to do with it?

Nasal Decolonization

- *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.

Guidelines and Recommendations

- 2014 SHEA/IDSA Practice Recommendation
  - If unacceptably high SSI rates exist for surgical populations despite implementation of the basic SSI prevention strategies, then applying standard infection control methods for outbreak investigation and management are recommended, including:
    - Screen surgical patients for S. aureus and decolonize preoperatively for high risk procedures, including some orthopedic and cardiac procedures
  - Routine preoperative decolonization with mupirocin without screening and targeted use is not currently recommended due to concerns about evolving resistance.

Anderson, D.J., et al, Strategies to Prevent Surgical Site Infection in Acute Care Hospitals: 2014 Update. Infect Control Hosp Epidemiol 2014; 35(6): 605-627.

Guidelines and Recommendations

American College of Surgeons/Surgical Infection Society Surgical Site Infection Guidelines—2016 Update

- MRSA Screening
  - **Decision regarding whether to implement global *S. aureus* screening and decolonization protocols should depend on baseline SSI and MRSA rates**
  - Clinical practice guidelines from the American Society of Health-System Pharmacists recommend screening and nasal mupirocin decolonization for *S. aureus*-colonized patients prior to total joint replacement and cardiac procedures
  - MRSA bundles (screening, decolonization, contact precautions, hand hygiene) are highly effective if adhered to; otherwise, there is no benefit
  - No standard decolonization protocol is supported by the literature; consider nasal mupirocin alone vs. nasal mupirocin plus chlorhexidine gluconate bathing
  - **Decolonization protocols must be completed close to date of surgery to be effective**
  - Vancomycin should not be administered as prophylaxis to MRSA-negative patients

Ban, KA et. al. Executive Summary of the American College of Surgeons/Surgical Infection Society Surgical Site Infection Guidelines—2016 Update.
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Guidelines and Recommendations

2017 World Health Organization (WHO)[1]

- **Nasal decolonization with mupirocin for Cardio or Ortho surgeries:** Patients with known nasal carriage of *S. aureus* should receive intranasal application of mupirocin ointment. (Strong recommendation)
- **Nasal decolonization with mupirocin for other surgeries:** Use of nasal mupirocin ointment is suggested (Conditional recommendation)

2017 Wisconsin Division of Public Health Supplemental Guidance for Preventions of SSIs[2]

Decolonizing the Nares for MSSA and MRSA:

Although the optimal suppression regimen is unclear, the following is recommended:

- Standardized regimen of topical mupirocin (twice a day for 5-7 days) or,
- An alternative approach involving the use a nasal swab containing 5% or 10% povidone iodine applied to the nares 1 to 2 hours prior to surgery,
- Along with a 2% or 4% CHG body cleansing/shower (once a day for 2 days) prior to surgical admission.

2019 NICE – National Institute for Health and Care Excellence SSI Prevention and Treatment[3]

Decolonizing the Nares for MSSA and MRSA:

- Consider nasal mupirocin in combination with a chlorhexidine body wash before procedures in which *Staphylococcus aureus* is a likely cause of a surgical site infection. This should be locally determined and take into account:
  - the type of procedure
  - individual patient risk factors
  - the increased risk of side effects in preterm infants (see recommendation 1.3.8)
  - the potential impact of infection. [2019]
- Maintain surveillance on antimicrobial resistance associated with the use of mupirocin.

1. *Benedet et al. New WHO* recommendations on preoperative measures for surgical site infection prevention: an evidence-based global perspective. The Lancet. Published online November 2, 2016 http://dx.doi.org/10.1016/S1473-3099(16)30398-X
2. Edmiston et al, Wisconsin Division of Public Health supplemental guidance for preventions of SSIs: An evidence-based perspective. January 2017. https://www.dhs.wisconsin.gov/publications/p01715.pdf. Accessed February 22, 2017.
3. NICE Guidelines. Surgical site infections: prevention and treatment. 11 April 2019. https://www.nice.org.uk/guidance/ng125/resources/surgical-site-infections-prevention-and-treatment-pdf-66141660564421. Last updated: 19 August 2020

MRSA Decolonization

Clinical Evidence

Preventing Surgical Site Infections:

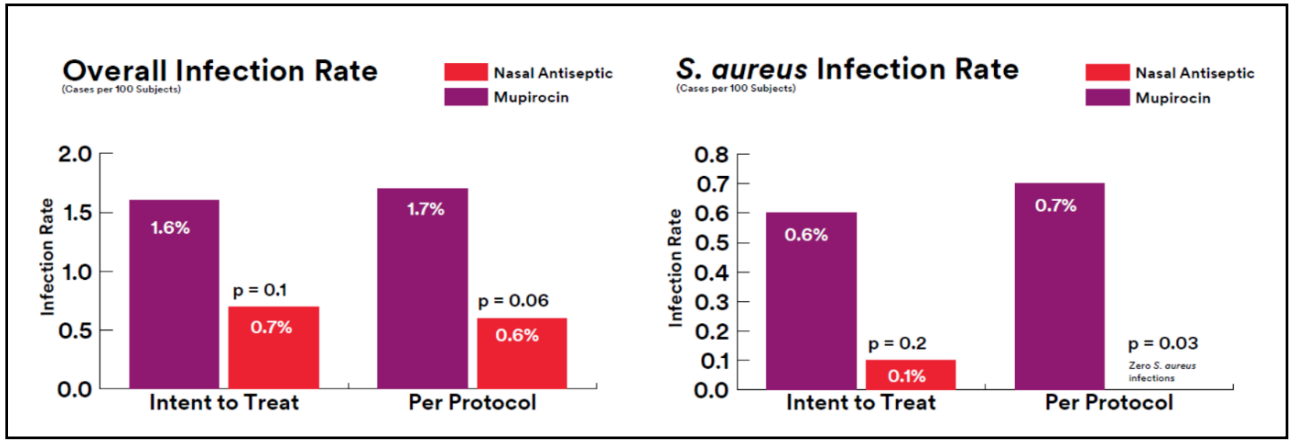
A randomized, open-label trial of nasal mupirocin ointment and nasal povidone-iodine solution

Investigator initiated, prospective randomized controlled trial comparing SSI after arthroplasty or spine fusion surgery. Patients receiving two applications of 2% CHG cloths were randomized to:

- One time treatment of 5% nasal Povidone-Iodine (PI) or five days of nasal mupirocin ointment prior to surgery
- The primary end point was deep SSI within 3 months of surgery

Conclusion:

- 5% nasal PI may be considered as an alternative to mupirocin in a multifaceted approach to reduce SSI
- Other observation:
  - Compared to mupirocin in terms of cost and efficacy, 5% nasal PI provides more value, defined as quality of outcomes divided by cost
  - Application of 5% nasal PI by the patient care team just prior to surgery may ensure greater compliance



Significantly more adverse events were reported by patients in the mupirocin group (8.9%) than patients in the 5% nasal PI group (1.8%) ($p<0.05$ for all treatment related symptoms)

Phillips M., 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): 826-832.

Mupirocin Ointment vs. Povidone – Iodine Nasal Decolonization

Maslow et. al. Patient Experience with Mupirocin or Povidone-Iodine Nasal Decolonization. ORTHOPEDICS | Healio.com/Orthopedics. JUNE 2014 | Volume 37 • Number 6; e576-e581

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

- 1,903 patients randomized to undergo preoperative nasal decolonization with either nasal MO or PI solution.
  - All were given the 2% CHG topical wipes
  - 1,679 (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

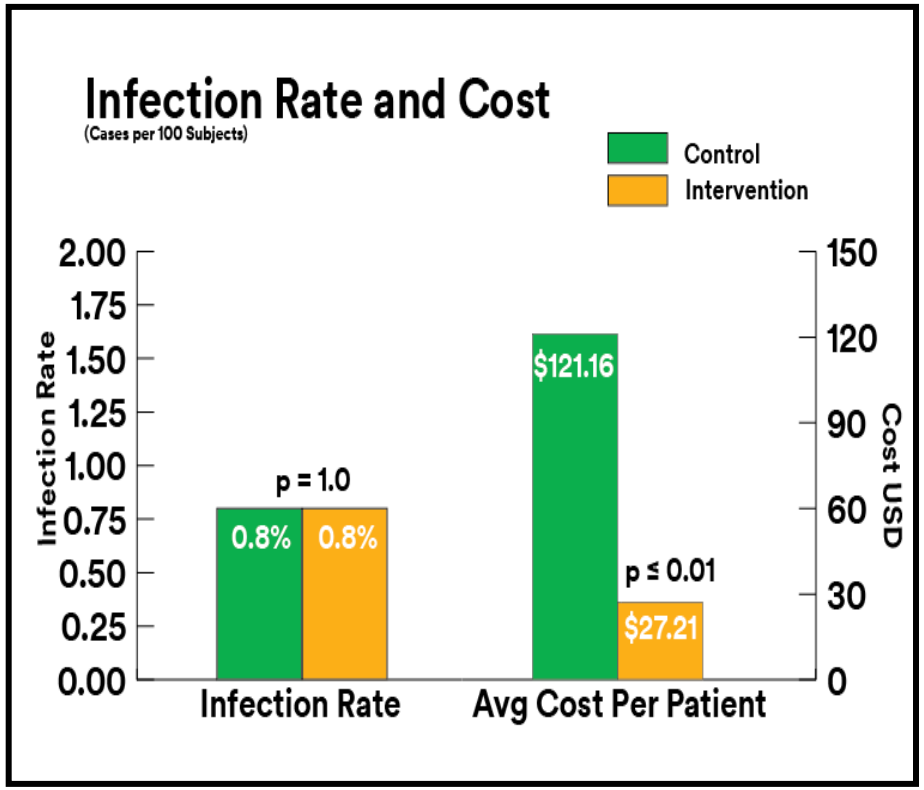
Retrospective study comparing infection rate and cost difference between two preoperative protocols in THA and TKA surgery

- 1,853 patients were included
- No difference in SSI rate between groups: 0.8% in both groups (p = 1.0)
- Significant difference in the mean cost per case: control group : $121.16 vs. intervention group: $27.21; (p≤ 0.01)
- Savings of $93.95/patient

Conclusion:

- There were significant cost savings with no difference in infection rates; therefore, the 5% povidone-iodine nasal antiseptic is financially and clinically successful.

Results

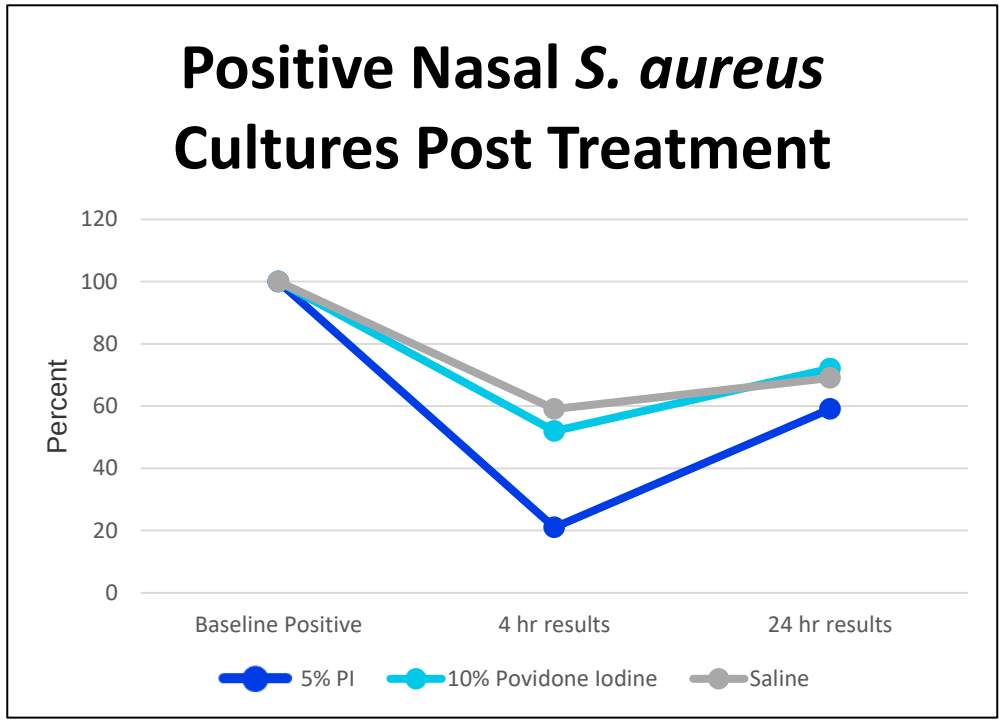


Torres EG, Lindmair-Snell JM, Langan JW, Burnikel BG. Is preoperative nasal povidone-iodine as efficient and cost-effective as standard methicillin-resistant Staphylococcus aureus screening protocol in total joint arthroplasty? J Arthroplasty. 2016; 31: 215-218.

Do iodine-based solutions differ in their effectiveness for decolonizing intranasal Staphylococcus aureus?

Investigator initiated, prospective randomized controlled trial comparing nasal S. aureus cultures at baseline, 4 and 24 hours after treatment with off the shelf 10% povidone iodine, 5% povidone iodine, or saline (control)

- 429 patients were randomized, of which 95/429 (22.1%) were positive at baseline for *S. aureus* and 13.6% of these were MRSA
- 5% PI formulation demonstrated significantly more effective intranasal decolonization of *S. aureus* over the 4 hour time interval (p=0.003)
- 10% PI no different than saline (control)



The specially formulated 5% PI solution, which contains a specific adherent polymer, remains in the nares for a longer period, which may explain its better efficacy.

Rezapoor M, Nicholson T, Tabatabaee RM, Chen AF, Maltenfort MG, Parvizi J. Povidone-Iodine–Based solutions for decolonization of nasal staphylococcus aureus: A randomized, prospective, placebo-controlled study. The Journal of Arthroplasty. 2017;32(9):2815-2819. doi://dx.doi.org/10.1016/j.arth.2017.04.039.

Summary of Clinical Evidence

- One time application of a specially formulated 5% PVP-I Nasal Antiseptic helps reduce the risk of SSI when part of a preoperative protocol[1,2,3]
- It is cost effective[1,2,3]
- It has better antimicrobial efficacy in the nose than 10% PVP-I[4]

1. Phillips M., 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): 826-832
2. Bebko SP, Green DM, Awad SS. Effect of a Preoperative Decontamination Protocol on Surgical Site Infections in Patients Undergoing Elective Orthopedic Surgery With Hardware Implantation. JAMA Surg. Published online March 04, 2015. doi:10.1001/jamasurg.2014.3480.
3. Torres EG, Lindmair-Snell JM, Langan JW, Burnikel BG. Is preoperative nasal povidone-iodine as efficient and cost-effective as standard methicillin-resistant Staphylococcus aureus screening protocol in total joint arthroplasty? J Arthroplasty. 2016; 31: 215-218.
4. Rezapoor M, Nicholson T, Patel R, Mostafavi R, Chen AF, Parvizi J. Do iodine-based solutions differ in their effectiveness for decolonizing intranasal Staphylococcus aureus? Presented at the MSIS Annual Meeting, Cleveland, OH, August 2015

Oral Decontamination

What about the oral cavity?

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 decontamination 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.

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

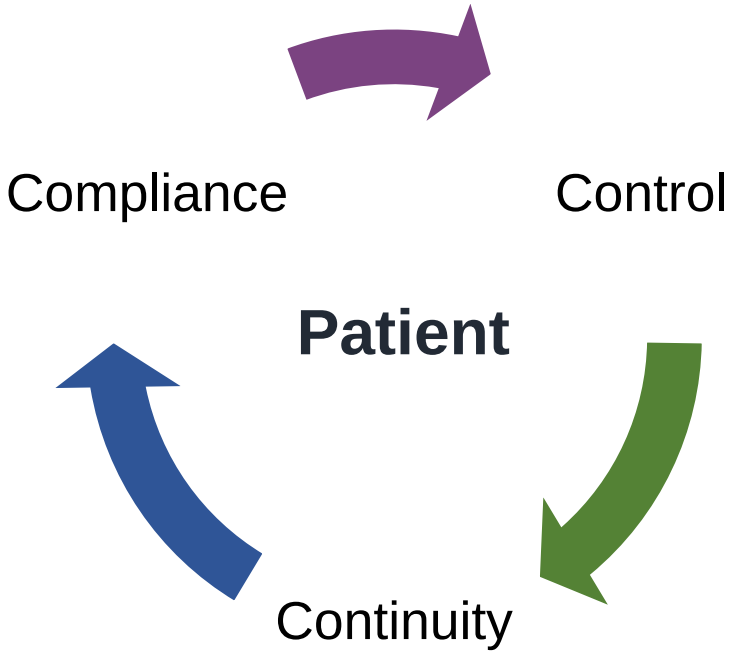
Conclusion – These findings suggest that *S. aureus* continues to be a frequent isolate in the oral cavity and perioral regions. The oral cavity should be considered a source of *S. aureus* in terms of cross-infection and dissemination to other body sites.

Summary

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



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
- Reduce risk to hospital reimbursement

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 bundled 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 risk reduction of SSIs.
- Synergism
  - Effective team work and communication will improve patient outcome

“Knowing is not enough, we must apply.
Willing is not enough, we must do.”

Goethe

Your Next Steps – Engage Experts (Collaborate)

- Develop a multidisciplinary team
  - Surgeon, IP, OR Director, Quality, Supply Chain, etc.
- Involve a champion to promote the program
  - Surgeon, Medical Director
- Seek and involve C-Suite support
  - VP of Quality, Chief Nursing Officer
- Involve frontline staff
  - OR, nursing units, educators, etc.

Your Next Steps - Evaluate the data and the evidence

- Perform a risk assessment
- Audit and provide feedback on current process
  - Walk the current process with checklist of evidence-based practice
- 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 bundle process across all service lines
  - Develop a computerized order set
- Standardize, where possible, the indications for use across all service lines

Your Next Steps - Educate on the proposed bundle intervention (Communicate)

- Process (qualitative) and outcomes (quantitative)
- Indications for use of CHG
- Indications for use of the nasal antiseptics
- User directed education
- Physician directed education
- Patient directed education

Your Next Steps - Execute the Bundle Intervention (Communicate)

- 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 order set
- Standardize, where possible, the indications for use across all service lines
- Audit, audit, audit for compliance and make adjustments as needed

Questions?

Thank you!