

Conflict of Interest Statement

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

Objectives

- Discuss the burden associated with surgical site infection (SSI)
- Discuss the importance of nasal carriage of S. aureus and MRSA as they relate to surgical site infections
- Describe interventions in preparation of the patient for surgery that may reduce the risk of SSI
- Identify relevant clinical studies that support these measures
- Implement a strategy to preoperatively reduce nasal and skin bacteria







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 U.S. population determined to have a BMI 30-40 (obesity) Projected increased in obesity rate – will result in an increase of 796,840 arthroplasties 2020–2030.

Burden of SSI – Unavoidable Facts

w.hret.hen.org/topics/ss/13-34/2014-SSIChangePackage508.pdf Hord, 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

- Surgical Site Infection (SSI)
 - One of the most expensive HAI based on costs during index hospital stay1
 - Mean cost without SSI = \$36,253; additional cost due to SSI = \$32,1871
 - Aggregate cost = \$31.6 million¹
 - + 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 rates²
 - 60%-70% of arthroplasties and SSIs occur in 65 and older age group²
 - Projected burden = 77,653 SSIs (15,820,475 primary and revision procedures)²
 - Hip arthroplasties contributed 54% of total SSIs²

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





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%

	Hospital	National Patient	Safety Goals	Effective	e January 2018
NPSG.0	7.05.01				
Implement	evidence-based practices	for preventing surgical	site infections.		
3. Implen policie: guidelii organiz	ent policies and practices and practices meet regu nes (for example, the Cen ation guidelines).	aimed at reducing the latory requirements and ters for Disease Contro	risk of surgical site infe d are aligned with evider and Prevention (CDC)	ctions. These nce-based and/or professional	R
R indicate	s an identified risk area				









Clipping Guidelines

CDC	WHO	NICE	AORN
Published 2017	Published 2016	Published 2008	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 <u>single- use head</u> 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 <u>clipping or</u> <u>depilatory</u> methods in a manner that minimizes injury to the skin. <u>Single-use</u> clipper heads should be used and disposed of after <u>each patient</u> 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 <u>outside</u> the operating room or procedure room.



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

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Distribution of Top	Ranking	Pathogens
2009-2010	-	

ert DM, et al. Antimicrobial-Resistant Pathogens As:

Pathogens	Frequency
Staphylococcus aureus	30.4%
Coagulase negative staphylococci (CNS)	11.7%
Escherichia coli	9.4%
Enterococcus faecalis	5.9%
Pseudomonas aeruginosa	5.5%
Enterobacter spp.	4%
Klebsiella pneumoniae	4%
Enterococcus spp.	3.2%
Proteus spp.	3.2%

ated with Health care-Associated Infections: Summary of Data Reported to the National Health Care Safety Network at the Centers for Disease Control and Prevention, 2009–2010. Infect Control Hosp Epidemiol 2013; 34(1):1-14



Chlorhexidine Gluconate (CHG)

- Skin antisepsis
 - · Used for disinfection of hands
 - Surgical scrub
 - Hand hygiene
 - · Pre-op 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







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Chlorhexidine Reduces Infections in Knee Arthroplasty

Purpose

• The purpose of this study was to evaluate the incidence of surgical site infections in total knee arthroplasty patients using a preadmission cutaneous skin preparation protocol compared with a cohort of patients undergoing standard in-Hospital perioperative preparation only.

2007-2010					
Risk Category	Preparation	Total Joints Operated	Number of Infected Joints	Incidence (%)	Ρ
Low	No CHG	639	7	1.1	
	CHG	212	2	0.9	1.0
	No CHG	795	19	2.4	
weatum	CHG	184	1	0.5	0.15
High	No CHG	301	12	4.0	
	CHG	82	0	0	0.08

nson, A.J., Kapadia, B.H., Daley, J.A., Molina, C.B. and Mont, M.A., 2013. Chlorhexidine reduces infections in knee arthroplasty. Journal of Knee Surgery, 26(03), pp.213-218.

Conclusion

 This study demonstrated a significant reduction in surgical site infection rate in total knee arthroplasty patients with the use of an advance preoperative 2% chlorhexidine gluconate cloth protocol applied the night before and the morning of surgery.







Considerations for Selection of Preps

- The most commonly used patient skin preps must meet regulatory criteria for immediate microbial kill and persistent antimicrobial activity
- It is important to look at other factors that may affect performance when choosing a prep for surgical patients
- There is NO one prep that will meet all prepping needs

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 #224	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

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

Anderson, D.J.et al. Strategies to Prevent Surgical Site Infection in Acute Care Hospitals: 2014 Update. Retrieved from www.jstor.org
 Dol: 10.1086/676022
 CDC HICPAC Guideline for the Prevention of Surgical Site Infection. JMMA, May 2017. https://jamanetwork.com/journals/jamasurgery/fullarticle/2623725
 AONN. Guideline for the Prevention of Surgical Site Infection. JMMA May 2017. https://www.jstor.org
 AonNo. Guideline for the Prevention of Surgical Site Infection. JMMA May 2017. https://www.jstor.org
 AonNo. Guideline for the Prevention of Surgical Site Infection. JMMA May 2017. https://www.jstor.org
 AonNo. Guideline for the Prevention of Surgical Site Infection. JMMA May 2017. https://www.jstor.org
 AonNo. Guideline for the Prevention of Surgical Site Infection. https://www.jstor.org
 Antonal Quality Forum 2010 safe practice #22 on surgical site Infection. https://www.jstor.org
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Baseline Considerations

Location / Type of procedure

Size of Area Being Prepped
Use an appropriately sized

Patient Factors

Allergies / sensitivities

Age of patientSkin condition

Active Ingredients

Aqueous solution

applicator

· Dual active solution

Things to Consider when Choosing a Surgical Prep

- · 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?
- What are the active ingredients in the prep?
- Does the procedure involve prepping a large surface area?

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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



MRSA carriage

- Patients at high risk
 - · History of MRSA colonization
 - Intensive care units (ICUs)
 - Immunocompromised
 - · Residents of long-term care facilities
 - · Hemodialysis
 - · Hospitalized in the previous 12 months
 - · Received antibiotic therapy in the last three months
 - · Skin or soft tissue infection at admission

Nasal Decolonization

- · S. aureus colonization
 - · Carriage is the most important independent risk factor for developing an SSI²
 - 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 HAIs¹
- Swabbing the nares identifies 80%-90% of MRSA carriers²
- · 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 risk⁴
 - · ASHSP report mupirocin should be used intranasally for all patients with documented colonization with Staph aureus (Strength of evidence for prophylaxis = A)³

Bode, Lonneke G. M. et. al. Preventing Surgical-Site Infections in Nasal Carriers of Staphylococcus oureus. N Engl J Med 362;1 January 7, 2010 Prokuski, Juara. Prophylactic Antibiotics in Orthopaedic Surgery. J Am Acad Orthop Surg 2008;15:283-293 Factar D, Dellinger, E. Patchet, et. al.Cinical parcite guidelines for antimicrobial prophylasis in surgery. Am J Health Syst Pharm.2013; 70:195-283 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 Carriage of S. aureus

- Three S. aureus nasal carriers
 - Persistent carriers ~20%
 - · Colonized with higher amounts of S. aureus
 - · Greater risk of developing S. aureus infection
 - Intermittent carriers ~30%
 - · Inconsistently test positive for S. aureus
 - · May miss being decolonized
 - Non-carriers ~50%

Wood, Amber. AORN Journal September 2017; 106 (3):255-259

Nasal Carriage of S. aureus is a Major Risk Factor for SSI

- Kalmeijer MD, et al. Infection Control and Hospital Epidemiology 2000;21:319-323. Nasal Carriage of Staphylococcus aureus as a Major Risk Factor for Surgical Site Infections in Orthopedic Surgery
- Kluytmans JAJW, et al. Journal of Infections Diseases 1995;171:216-219. Nasal Carriage of Staphylococcus aureus as a Major Risk Factor for Wound Infections after Cardiac Surgery
- Levy PY, Ollivier M, Drancourt M, et al. Relation between nasal carriage of Staphylococcus aureus and surgical site infection in orthopedic surgery: The role of nasal contamination. A systematic literature review and meta-analysis. Orthopaedics & Traumatology: Surgery & Research 2013; 99(6): 645-51.
- Kalra L, Camacho F, Whitener CJ, et al. Risk of methicillin-resistant Staphylococcus aureus surgical site infection in patients with nasal MRSA colonization. AJIC 2013; 41: 1253-7.

Guidelines and Recommendations

2014 SHEA/IDSA Practice Recommendation

on, 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

- 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.







- Supports antimicrobial stewardship
 - 27%-50% resistance found to topical antibiotics for MRSA

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Simor Antimicrobial Agents in Chemotherapy 2007
Rotger Journ of Clin Micro 2005
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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 Sage® 2% CHG cloths were randomized to: • One time treatment of 3M[™] Skin and Nasal Antiseptic or five days of Bactroban Nasal® mupirocin ointment prior to surgery · The primary end point was deep SSI within 3 months of surgery Conclusion: Overall Infection Rate S. aureus Infection Rate asal Anti 5% nasal PI may be considered as an alternative to mupirocin in a multifaceted approach to reduce SSI 2.0 0.8 0.7 0.6 0.5 0.4 a 1.5 Other observation: .0 ft • Compared to mupirocin in terms of cost and 0. efficacy, 5% nasal PI provides more value, 0.1 defined as quality of outcomes divided by cost 0.0 0.0 Application of 5% nasal PI by the patient care • Significantly more adverse events were reported by patients in group (1.8%) (p<0.05 for all treatment related symptoms) team just prior to surgery may ensure greater compliance ns: A randomized, open-label trial of nasal mupirocin ointment and nasal povidone-iodine solution. Infect Control Hosp Epidemiol 2014; 35(7): 826-832 lips M., et al. Preventing Surgical Site Infec

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)
- 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

ind cost-effective as standard methicillin-resistant Staphylococcus aureus scree

- 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:

res EG, Lindmair-Snell JM, Langar

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



ng protocol in total joint arthroplasty? | Arthroplasty, 2016: 31: 215-218









CHG – Oral Decolonization

- · 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

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.



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

Your Next Steps – Engage Experts

- 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

- · 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 process across all service lines
 - Develop a computerized orderset
- Standardize, where possible, the indications for use across all service lines

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

Your Next Steps 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
- Audit, audit, audit for compliance and make adjustments as needed

