Evidence for Using Chlorhexidine Gluconate Preoperative Cleansing to Reduce the Risk of Surgical Site Infection

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ABSTRACT

Surgical site infections are associated with significant patient morbidity and mortality and are the third most frequently reported health care-associated infection. A suggested risk reduction strategy has been the preadmission shower or skin cleansing with chlorhexidine gluconate (CHG). Although older clinical trials question the clinical efficacy of cleansing with CHG, recent evidence-based scientific and clinical studies support two types of CHG application (ie, a 2% CHG-coated cloth or 4% CHG soap) using a standardized, timed process before hospital admission as an effective strategy for reducing the risk of postoperative surgical site infection. *AORN J* 92 (November 2010) 509-518. © AORN, Inc, 2010. doi: 10.1016/j.aorn.2010.01.020

Key words: *surgical site infection, health care-associated infection, skin antisepsis, chlorhexidine gluconate, preoperative shower, preoperative cleansing.*

Surgical site infections (SSIs) are associated with significant patient morbidity and mortality. It is estimated that between 750,000 and 1 million SSIs occur in the United States each year, extending hospital stays by 3.7 million extra days and generating more than $1.6 billion in excess hospital charges each year.[1] Surgical site infections are the third most frequently reported health care-associated infection (HAI) based on data derived from the Centers for Disease Control and Prevention's National Healthcare Safety Network.[1] Historically, timely and appropriate antimicrobial prophylaxis, perioperative skin antisepsis, and meticulous surgical technique

have been seen as essential for reducing the risk of SSI. Unfortunately, myriad patient comorbidities and other intrinsic and extrinsic patient risk factors complicate institutional efforts to improve patient outcomes through focused interventional practices (Table 1).

An intervention that is regaining momentum among clinical practitioners involves the use of an antiseptic showering or cleansing process before the patient's admission for elective surgery. Before the era of ambulatory, or outpatient, surgery, patients were admitted to the hospital in some cases days before surgery and prescribed an antiseptic shower the night before the surgery. This

TABLE 1. Selected Patient and Procedural Characteristics Associated With Increased Risk of Surgical Site Infections[1]

Patient (intrinsic)	Procedural (extrinsic)
■ Age	■ Lack of a preoperative shower
■ Diabetes (metabolic disease)	■ Site shaving the night before surgery
■ Perioperative hyperglycemia	■ Extended operative time
■ Tobacco use	■ Flawed skin antisepsis
■ Concurrent infection (distant)	■ Flawed surgical prophylaxis
■ Obesity	■ Effects of the OR environment (eg, hypothermia)
■ Malnutrition	
■ Immunocompromise	■ Break in aseptic technique
■ Low preoperative serum albumin level	■ Hypothermia or hypoxia
■ Corticosteroid use	■ Perioperative blood transfusion
■ Prolonged hospitalization before surgery	■ Surgical technique
■ Prior radiation to surgical field tissue	■ Hemostasis
	■ Tissue trauma
■ *Staphylococcus aureus* colonization	

1. Mangram AJ, Horan TC, Pearson ML, Silver LC, Jarvis WR. *Guidelines for the prevention of surgical site infections, 1999. Hospital Infection Control Practices Advisory Committee.* Am J Infect Control. 1999;27(2):97-132.

common practice was viewed as beneficial for reducing the concentration of transient and resident bacteria on the skin, thereby limiting the risk of wound contamination. The presurgical shower was considered an adjunctive risk reduction strategy and was not a replacement for the traditional perioperative skin prep that remains a component of every surgical procedure. What was once viewed as a standard of practice, however, has been relegated by some to a questionable clinical ritual in an era of evidence-based medicine.[2] This article addresses the role of chlorhexidine gluconate (CHG) as an effective and safe topical agent for skin antisepsis, evidence supporting the use of preadmission showers or cleansing processes, and use of specific interventional CHG showering or cleansing strategies before elective surgery.

WHY CHG?

The ritual of perioperative skin prepping can be traced back to 1867, when Joseph Lister used a carbolic acid aerosol to disinfect the skin before surgical incision and documented a significant reduction in postoperative morbidity and mortality.[3] The goal of skin antisepsis in the surgical patient is to reduce the microbial burden on the surface of the skin to a subpathogenic level before surgical incision, thereby reducing the risk of wound contamination. An effective preoperative skin antiseptic, as defined in the US Food and Drug Administration document "Tentative Final Monograph for Healthcare Antiseptic Products," is an agent that rapidly (ie, within 10 minutes of application) reduces the number of transient and resident microorganisms in the surgical field before wound incision and suppresses rebound growth for six hours after application.[4]

Chlorhexidine gluconate has been available as a topical antiseptic for more than 50 years and has an excellent record for both patient safety and clinical efficacy involving a wide number of clinical applications, including skin prepping for insertion of vascular access devices,[5] hand washing,[6] oral hygiene,[7] vaginal lavage,[8-10] and preadmission and perioperative skin antisepsis.[11,12] As an antiseptic agent, it exhibits a broad spectrum of antibacterial activity that is effective against both gram-positive and gram-negative non-spore-forming bacteria. The antiviral activity of CHG encompasses selective enveloped viruses, including HIV.[11] Its spectrum of activity against microbial pathogens appears to be similar to that of povidone iodine; however, unlike povidone iodine, CHG is not inactivated by blood or serum protein and exhibits a residual antimicrobial activity on the surface of the skin, suppressing microbial growth for several hours after application.[12] Commercially, CHG is available in concentrations ranging from 0.12% to 4%, and select formulations have been combined with isopropyl alcohol or ethanol to provide enhanced bactericidal and viricidal components.

TABLE 2. In Vitro Susceptibility of Staphylococcus Isolates From Postoperative Surgical Site Infections to Chlorhexidine Gluconate[a]		
Organism	Number of clinical isolates	MIC_{90} (range mcg/mL)
Methicillin-sensitive *Staphylococcus aureus*	15	5.0 (0.312-10)
Methicillin-resistant *Staphylococcus aureus*	20	2.5 (0.312-5)
Methicillin-sensitive *Staphylococcus epidermis*	20	5.0 (0.625-10)
Methicillin-resistant *Staphylococcus epidermis*	15	5.0 (0.312-5)

MIC_{90} = minimal inhibitory concentration required to inhibit or kill 90% of staphylococcal clinical isolates.
a. In vitro susceptibility testing performed by broth microdilution.[1]

1. *Clinical Laboratory Standards Institute.* Methods for Dilution Antimicrobial Susceptibility Tests for Bacteria That Grow Aerobically; Approved Standard - Eighth Edition & Performance Standards for Antimicrobial Susceptibility Testing. *CLSI Document M07-A8. Wayne, PA: Clinical and Laboratory Standards Institute; 2009.*

Method of Action

The bactericidal effect of CHG is a result of the binding of the CHG cationic molecules to negatively charged bacterial cell walls and extramicrobial complexes. At low concentrations, CHG causes an alteration of bacterial cell osmotic equilibrium, resulting in leakage of potassium and phosphorus, and inhibits growth (ie, it is bacteriostatic). At high concentrations, CHG produces a rapid bactericidal effect by causing the cytoplasmic contents of the bacterial cell to precipitate, resulting in cell death.[13]

Effectiveness

Although the widespread use of CHG in both clinical and commercial applications has led to a growing concern about the emergence of microbial resistance, a study involving more than 1,100 gram-positive and gram-negative clinical isolates, including strains of methicillin-resistant *Staphylococcus aureus* (MRSA) and vancomycin-resistant enterococci, showed a low incidence of resistance among clinically significant strains, with no isolates expressing high-level resistance to CHG.[14] Researchers in Taiwan analyzed 240 MRSA isolates recovered during a 15-year period (1990-2005) and found that the minimal inhibitory concentration (MIC) required to inhibit or kill 90% of MRSA isolates (MIC_{90}) ranged from 1 mcg/mL to 4 mcg/mL in 1990, 0.5 mcg/mL to 8 mcg/mL in 1995, 1 mcg/mL to 8 mcg/mL in 2000, and

1 mcg/mL to 16 mcg/mL in 2005.[15] In a study conducted in the Department of Surgery at the Medical College of Wisconsin in Milwaukee, staphylococcal isolates (ie, methicillin-sensitive and -resistant strains of *S aureus* and *S epidermidis*) obtained from incisional and device-related SSIs from 2000 to 2009 were found to have CHG MIC_{90} values ranging from 2.5 mcg/mL to 5.0 mcg/mL (Table 2). Three of 70 strains (4.3%) had MIC values equal to 10 mcg/mL. These MIC values are well below CHG skin surface concentrations after application of either a 2% or 4% formulation of CHG.[16] Current findings suggest that microbial resistance to CHG appears to be relatively low, especially among clinically significant gram-positive and gram-negative isolates associated with postoperative SSI; however, microbial resistance requires periodic surveillance.

PATIENT SAFETY AND THERAPEUTIC EFFICACY

Patient safety is of paramount importance, and therefore any risk of adverse events associated with a skin antiseptic agent should fall in the range of rare to infrequent. The incidence of skin hypersensitivity associated with use of CHG has been reported in several studies to be rare.[12,17] Results of a clinical trial investigating the skin surface concentrations of CHG after application using either 4% CHG soap or 2% CHG-coated polyester cloths found that minor skin irritations

occurred in 4.2% and 3.3% of study participants, respectively.[12]

A labeling contraindication that often causes confusion associated with the perioperative use of CHG involves application around mucosal surfaces, meninges (ie, neural tissues), middle ear, and areas adjacent to the eyes. Selected animal models have documented meningeal toxicity after application of CHG directly onto neural tissues.[18] In situations in which neural tissue exposure is possible, CHG, when allowed to dry thoroughly, has been shown to be a safe and efficacious skin disinfectant (eg, for epidural blocks).[19,20] A CHG mouthwash oral hygiene formulation (0.12%) has been shown to be safe to oral mucosal surfaces and efficacious for reducing the risk of ventilator-associated pneumonia.[7] Vaginal application of CHG in concentrations ranging from 0.05% to 1% has been shown to be safe with minimal adverse events.[8,9] Results of a randomized trial comparing 10% povidone iodine with 4% CHG for vaginal hysterectomy found CHG to be as safe as povidone iodine for vaginal tissues.[10] These combined clinical studies have clearly documented that CHG is safe when used around or near mucosal surfaces. Furthermore, when allowed to dry after application, there is no reason why CHG cannot be used for epidural access or cranial or spinal neurosurgical procedures, especially given the excellent antimicrobial activity of CHG and the intrinsic risk of gram-positive contamination associated with these procedures. Selected patient case reports, however, have documented CHG to be risky to use near the eye and to be ototoxic (ie, toxic to the nerves of the ear); therefore, direct use of CHG solution on periorbital sites, eyelids, and the inner ear should be avoided.[6,21,22]

AN EVIDENCE-BASED APPROACH TO PREOPERATIVE CLEANSING

A recent publication in the Cochrane Collaboration database reviewed seven clinical trials involving 10,157 patients, in which patients bathed preoperatively with CHG (4%) compared with a placebo, bathed with a bar of soap, or performed no preoperative cleansing at all.[2] The studies that the researchers chose for evaluation in this review were published during a 26-year period from 1983 to 2009. The conclusion of their analysis suggested that preoperative bathing or cleansing with CHG does not result in a significant reduction in infection involving clean surgical procedures (ie, class I). It should be noted that in the discussion of their analysis, the authors state, "One of the limitations of the review was the quality of some of the studies."[2(p21)] A careful review of the studies selected for analysis in this report reveals several problematic issues involving study design, implementation, and analysis:

- In the seven studies cited, there was no documentation of a uniform standard of practice (ie, some patients showered multiple times, other patients showered only once with an antiseptic soap).
- There is no evidence that an attempt was made to standardize a timed duration of the antiseptic shower or cleansing process.
- The surgical population was highly heterogeneous and included patients undergoing elective clean, clean-contaminated, and contaminated surgical procedures.
- There was no indication whether an effort was made to assess patient compliance with the study protocols.
- The authors of the review point out that community (ie, postdischarge) follow-up did not occur in three of seven of the studies reviewed,[23-25] which, from a surveillance perspective, makes it difficult if not impossible to accurately assess the benefit of any SSI interventional practice if the numerator or denominator component is lacking or inaccurate.
- Finally, skin antisepsis (ie, preadmission bathing, perioperative skin prepping) is an adjunctive component of an overall thoughtful interventional process; the Cochrane analysis provides

no data as to what other interventional practices may or may not have been in place at the time the surgical procedures were performed.[2]

Five[23-27] of the seven studies cited in the Cochrane analysis were conducted before 1990 and thus did not include advances in patient care technology (ie, surgical technique, wound management) and standardization of surgical and nursing practices (ie, evidence based) that have occurred in the intervening 20 years. Other more recent evidence suggests that cleansing of the skin surface with an effective antiseptic agent will result in a significant reduction in HAIs.

The value of CHG as an effective perioperative skin antiseptic agent has been well documented in both the medical and surgical literature. In 1978, a surgical practitioner demonstrated that application of CHG to the skin surface resulted in a greater microbial log reduction compared with povidone iodine.[16] Furthermore, the antimicrobial activity of CHG as measured by skin surface microbial log reduction persisted several hours after application compared with povidone iodine.[16] Three recent surrogate skin culture studies of obstetric/gynecologic and foot, ankle, and shoulder surgical procedures have documented the benefit of a CHG formulation with or without alcohol to reduce skin surface microbial colonization at the surgical site before surgery compared with iodine containing comparative agents.[10,28,29]

More than 20 years ago, Kaiser et al[30] and Garibaldi et al[31] demonstrated in two separate randomized, prospective clinical trials of surgical patients that bathing with 4% CHG was more effective at reducing staphylococcal skin colonization than using povidone iodine or antiseptic bar soap. It is interesting to note that although neither study was sufficiently powered to evaluate SSI reduction, both studies documented that repeat application of 4% CHG was superior to a single shower ($P < .05$) in reducing staphylococcal skin (ie, wound) contamination. In a recent study involving implantation of artificial urinary sphinc-

ters in men after radical prostatectomy, a preoperative five-day cleansing regimen (ie, five-minute cleansing of perineal and abdominal skin) with 4% CHG immediately before placement of an artificial urinary sphincter resulted in a four-fold reduction in perineal bacterial colonization at the time of surgery compared with cleansing with nonantiseptic soap and water.[32] The authors suggested that "reduction in perioperative skin colonization by use of a chlorhexidine scrub may result in a lower rate of artificial urinary sphincter colonization at implantation and subsequent infection."[32(p1328)]

Unfortunately, surrogate culture studies do not directly address the infection prevention risk reduction benefit of CHG showering or cleansing before surgery. Several prospective, evidence-based studies conducted in a high-risk patient population, however, documented the infection prevention benefits of bathing or cleansing the patient's skin with a 2% formulation of CHG on a polyester cloth to reduce the risk of catheter-related HAIs in the medical intensive care unit or long-term care patient population.[5,33-35] The evidence-based benefit observed in each of these well-designed clinical studies was associated with establishing a uniform standard of practice, which was then applied to all patients at risk for catheter-associated infections.

In a recent surgical study involving orthopedic patients undergoing total joint replacement, researchers gave patients 2% CHG-impregnated polyester cloths with written instructions describing the process the patient should use to cleanse the surgical site the night before surgery. On the patient's admission to the hospital, holding area staff members helped the patient cleanse the operative and adjacent site a second time before he or she went to the OR.[36] The researchers included a total of 1,464 patients undergoing total joint procedures in their analysis: 727 in a three-month preintervention period and 737 in the three-month postintervention implementation period. Significantly, in the preintervention period, the standard

TABLE 3. Mean Chlorhexidine Gluconate (CHG) Skin Surface Concentrations (mcg/mL) Compared With MIC$_{90}$ (5 mcg/mL) for Staphylococcal Surgical Isolates Including Methicillin-Resistant *Staphylococcus aureus* (N = 90)

	CHG subgroups[a]				
	Pilot[b] (4% CHG soap)	A[c] (4% CHG soap)	B[c] (2% CHG wipes)	[C^{CHG}/MIC$_{90}$][d]	P[e]
Group 1[f]	3.7 ± 2.5	24.4 ± 5.9	436.1 ± 91.2	0.7 v 4.9 v 87.2	< .001
Group 2[g]	7.8 ± 5.6	79.2 ± 26.5	991.3 ± 58.2	1.5 v 15.8 v 198.3	< .0001
Group 3[h]	9.9 ± 7.1	126.4 ± 19.5	1745.7 ± 204.3	1.9 v 25.3 v 349.1	< .0001

CHG = chlorhexidine gluconate; MIC$_{90}$ = minimal inhibitory concentration required to inhibit or kill 90% of staphylococcal clinical isolates.

a. Mean CHG concentrations (±standard deviation) = mcg/mL, derived from 5 separate anatomic sites including right and left arms (ie, antecubital fossa), right and left legs (ie, popliteal fossa), and abdomen.

b. In the pilot study, 4% CHG group (n = 30) randomized to groups 1-3, 10 participants per group; no showering or cleansing instructions were given to volunteers.

c. N = 60 participants randomized to groups 1-3, 20 participants per group.

d. [C^{CHG}/MIC$_{90}$] = ratio of skin surface mean CHG concentrations [ie, C^{CHG}] in the pilot study; subgroups A and B compared with CHG concentration [ie, MIC$_{90}$] required to inhibit or kill 90% of staphylococcal skin or surgical isolates, including methicillin-resistant *S aureus* (MIC$_{90}$ = 5 mcg/mL); data obtained from Table 2.

e. P value = comparison of CHG skin surface concentration between pilot study groups and subgroups A and B (ie, two sample *t* test and analysis of variance).

f. Showering/cleansing with CHG once (ie, evening before surgery).

g. Showering/cleansing with CHG once (ie, morning of surgery).

h. Showering/cleansing with CHG twice (ie, evening before surgery, morning of surgery).

Adapted with permission from Edmiston CE Jr, Krepel CJ, Seabrook GR, Lewis BD, Brown KR, Towne JB. Preoperative shower revisited: can high topical antiseptic levels be achieved on the skin surface prior to surgical admission? J Am Coll Surg. 2008;207(2):233-239.

of practice involved providing the patient with a povidone iodine solution for cleansing the skin surface the night before surgery. An audit of the SSI rate for the three-month preintervention period revealed a total joint infection rate of 3.19%, whereas the SSI rate was 1.59% in the postintervention period, representing a 50% reduction compared with the preintervention control interval.[36] This is an important finding justifying, in part, the rationale for a preadmission shower or cleansing strategy in patients undergoing elective surgical procedures.

EVIDENCE-BASED PREADMISSION CLEANSING STRATEGIES

Chlorhexidine gluconate is documented as being superior to povidone iodine in reducing the microbial skin burden of transient/resident microbial flora and improving clinical outcomes.[10-13,28-32,36] A 2008 study conducted in healthy volunteers at the Medical College of Wisconsin demonstrated that by using a thoughtful, standardized practice of preadmission showering with 4% CHG or cleansing the skin surface with 2% CHG on a polyester cloth, skin surface concentrations of CHG can be achieved that greatly exceed the CHG concentration (MIC$_{90}$) required for inhibiting or killing staphylococci skin or surgical site isolates, including MRSA.[16] We constructed Table 3 in this article from the original published study data by combining the mean concentrations of skin surface CHG at five different anatomic sites (ie, right and left antecubital fossae, right and left popliteal fossae, abdomen). In the original analysis, data from groups of selected pilot participants (N = 10) who showered once in the morning with 4% CHG without benefit of specific instructions (ie, pilot group 2) were compared with data from groups of participants who received specific standardized showering instructions (group A used 4% CHG soap and group B used 2% CHG wipes). Our analysis here includes

the mean skin concentrations of CHG from participants in pilot group 1 who showered once in the evening and participants in pilot group 3 who showered in the evening and morning (ie, twice) with 4% CHG. Although the data from this study were obtained from healthy volunteers, mean skin surface concentrations should be viewed as representative of concentrations found in patients undergoing elective surgery when following the same systematic standardized showering protocol.

The researchers observed a significant difference ($P \leq .001$) in mean skin surface concentrations of CHG in the 4% or 2% CHG study groups compared with individuals in the pilot study. A separate analysis of the ratio of mean skin surface concentrations of CHG compared with MIC_{90} for staphylococcal skin and surgical site isolates revealed that a single shower with 4% CHG without specific instructions (ie, pilot group 1) in the evening resulted in a ratio of 0.7 [C^{CHG}/MIC_{90}] and represents subtherapeutic skin levels of CHG. Chlorhexidine gluconate skin surface values in group 3 pilot participants who showered twice (ie, morning, evening) revealed a mean skin surface concentration of CHG that was 1.9 times the MIC_{90} (5 mcg/mL) for staphylococcal skin and clinical isolates. Conversely, individuals who showered twice (ie, morning, evening) using a standardized process with either 4% (aqueous) or 2% (polyester cloth) CHG demonstrated a mean C^{CHG}/MIC_{90} skin surface ratio ranging respectively from 25.3 to almost 350 times the concentration required to inhibit or kill staphylococci skin and clinical isolates, including MRSA.[16]

This study documented that a thoughtful, standardized preadmission showering strategy was effective in achieving high concentrations of CHG on the skin surface sufficient to inhibit skin colonizing staphylococcal strains, including MRSA. It should be pointed out that documentation of high CHG concentrations on the skin by itself is not a surrogate for infection reduction. Previous evidence-based clinical studies, however, have documented the benefit of repeat applications of

CHG as a significant risk reduction strategy for HAIs.[10,19,33-36]

The Centers for Disease Control and Prevention and AORN have endorsed the practice of preadmission showering or skin cleansing, with both organizations recommending CHG as the antiseptic agent of choice.[37,38] Furthermore, AORN and perioperative investigators have recommended a minimum of two CHG applications before hospital admission.[38,39] From the evidence-based clinical literature, it would appear that a 4% CHG soap formulation and the 2% CHG-coated polyester cloths are equally effective for infection prevention if health care providers give patients a standardized set of instructions to guide application of the antiseptic agents.

Figure 1 lists a generalized set of patient instructions, describing the process of CHG administration using 4% soap or a 2% coated polyester cloth before hospital admission. Written instructions describing the application process for either the 4% or 2% formulation should be given to all patients undergoing an elective surgical procedure. Although CHG has a safety profile similar to that of povidone iodine, health care providers should instruct patients to immediately cease use of the antiseptic agent and liberally rinse the area with water if they experience a burning sensation or irritation after application.

CONCLUSION

In 2010, the current scientific and evidence-based (Level 1) clinical literature supports use of a 2% CHG-coated cloth or 4% CHG soap with a standardized, timed process before hospital admission as an effective infection prevention strategy for reducing the risk of postoperative SSI. In light of the recent documentation of the failure of the Surgical Care Improvement Project to reduce the risk of SSIs, it is evident that other adjunctive risk reduction strategies are warranted if health care providers are to significantly decrease the morbidity and mortality related to postoperative SSIs in the elective surgical patient population.[40,41]

Preadmission Instructions for Showering or Cleansing with Chlorhexidine Gluconate

Taking an antiseptic preadmission shower/cleansing before elective surgery can reduce the risk of surgical site infection. To make the process easier, your physician has chosen to provide you with a 4% chlorhexidine gluconate (CHG) antiseptic soap solution for showering or disposable cloths moistened with a rinse-free 2% CHG antiseptic solution for cleansing the skin surface before visiting the hospital. The steps below outline the shower/cleansing process and should be followed carefully. **Your physician will indicate what process (A or B) should be followed**

Process A: 4% CHG antiseptic soap
Night before admission to hospital
- Place a quarter to fifty cent piece size volume of CHG solution onto a clean washcloth and apply the solution to all body surfaces, especially the groin, underarms, and genital areas. **Caution: Do not allow the solution to come in contact with the eyes, ears, or mouth. If you accidently get some of this material on those areas, rinse immediately.**

- Add additional CHG soap to your washcloth as needed to cover all body surfaces. **Note: If you experience any burning or irritation on the skin, rinse immediately and do not reapply.**

- Repeat this process a second time, waiting two minutes to thoroughly rinse the soap-like material off the skin surfaces.

- Do not apply any lotion or deodorant after the antiseptic shower.

Morning before hospital admission (repeat process as outlined above)

Process B: 2% CHG antiseptic cloths
Night before admission to hospital
- Open the CHG cloth package as directed. Use one cloth to completely wet the site where the surgery will be performed and adjacent areas. Gently wipe the skin for approximately 30 seconds. **Caution: Avoid touching the cloths to the eyes, ears, or mouth. If you accidently get some of this material on those areas, rinse immediately.**

- Discard the used cloth and with a second cloth, wash the same areas for an additional 30 seconds. A broad area should be covered. For instance, if surgery is being performed on the knee, an area from the hip to the ankle should be wiped. **Note: If you experience any burning or irritation on the skin, rinse immediately and do not reapply.**

- Allow the washed areas to dry for one minute. Do not rinse with water. It is normal for the skin to have a "tacky" feeling for several minutes after the antiseptic solution is applied.

- Do not apply any lotion or deodorant after application of the antiseptic cloth.

Morning before hospital admission (repeat process outlined above)

Figure 1. Preadmission patient instructions for showering or cleansing with chlorhexidine gluconate to reduce the risk of postoperative surgical site infection.

Reducing resident bacterial flora on the skin preoperatively by using preoperative cleansing with CHG is a simple, effective means to reduce the risk of SSIs for patients, and available literature suggests that it is safe as well. AORN

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