Should preoperative showering or cleansing with chlorhexidine gluconate (CHG) be part of the surgical care bundle to prevent surgical site infection?

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Abstract

Showering preoperatively with chlorhexidine gluconate is an issue that continues to promote debate; however, many studies demonstrate evidence of surgical site infection risk reduction. Methodological issues have been present in many of the studies used to compile guidelines and there has been a lack of standardisation of processes for application of the active agents in papers pre-2009. This review and commentary paper highlights the potential for enhancing compliance with this low-risk and low-cost intervention and provides some guidance for enhancing implementation of preoperative showering with both chlorhexidine in solution and impregnated wipes.

Keywords

Chlorhexidine, preoperative shower, antiseptic, surgical site infection

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The use of a pre-admission shower with 2% or 4% aqueous chlorhexidine gluconate (CHG), to reduce skin contamination prior to surgery, has been addressed in the 1999 US Centers for Disease Control and Prevention (CDC) Hospital Infection Control Practices Advisory Committee (HICPAC) document, Guideline for the Prevention of Surgical Site Infection (Mangram et al., 1999). In this guideline, the process was designated as being ‘strongly recommended’. There is general agreement that a 2% or 4% CHG pre-admission whole-body bath or shower or cleaning can reduce bacterial colonisation of the skin but there are no definitive data to show that bathing or showering is effective in reducing surgical site infection (SSI) (Mangram et al., 1999; Paulson, 1993). The National Institute of Health and Care Excellence (NICE) of the UK, in its guideline on prevention and treatment of SSI, has not strongly recommended bathing or showering with CHG for this reason, reasoning that the wide availability of soap may suffice for pre-admission skin preparation prior to surgery (NICE, 2008). Some evidence-based analysis, including that presented in the NICE guideline, does not support the routine use of pre-admission whole-body cleansing or showering with CHG. However, two surrogate key factors should be

considered when evaluating this low-risk and low-cost intervention which may prevent SSI:

- microbicidal concentrations of CHG accumulate on the skin with repetitive application and a single application may not approach concentrations sufficient to inhibit skin flora (Edmiston et al., 2007, 2008, 2010).
- CHG binding to skin protein is influenced by the amount of CHG exposed to the skin and the duration of exposure prior to rinsing (Edmiston et al., 2007, 2008, 2010).

Internationally, most hospitals promote an antiseptic pre-admission bathing or skin cleansing protocol, as part of a

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perioperative care bundle, to reduce the microbial burden on the skin of patients prior to elective surgery with the aim of reducing the risk of SSI. This has been endorsed by national and international organisations including the HICPAC, Association for Professionals in Infection Control and Epidemiology (APIC), Association of periOperative Registered Nurses (AORN) and Institute for Healthcare Improvement (IHI), all of which recommend bathing or cleansing with an antiseptic agent prior to surgery as a component of a care bundle to reduce SSIs (AORN, 2015; Greene et al., 2010; Mangram et al., 1999; Project JOINTS, 2014). The Cochrane Collaborative has reported that no benefit can be derived by taking a series of pre-admission showers with an antiseptic agent to prevent SSIs (Webster and Osborne, 2007, 2015). However, most of the studies cited in these Cochrane Collaborative reviews were published over 20 years ago and further analysis of these early publications reveals appreciable methodological and operational bias. For example, several studies cited in the Cochrane analysis represent study populations that were highly heterogeneous (Class 1, 2 and 3) and involved a broad base of surgical disciplines; no effort was made to measure patient compliance to a standardised protocol. Studies published in this field since 2009 include retrospective, sequential and prospective cohort analyses, case-control studies, prospective observational and interventional clinical trials, as well as randomised control trials, and have addressed many of these variables such as patient compliance (Bode et al., 2010; Chen et al., 2013; Chien et al., 2014; Dizer et al., 2009; Eiselt, 2009; Grayling and Vasaly, 2013; Johnson et al., 2010, 2013; Kapadia et al., 2013; Kim et al., 2010; Lipke and Hyott, 2010; Rao et al., 2011; Thompson and Houston, 2013). The fundamental problem associated with the findings from studies conducted prior to 2009 using either the 4% CHG liquid formulation or the 2% CHG coated polyester cloth is a lack of a standardised process. This limitation is significant because researchers and investigators have only recently started to appreciate the importance of process standardisation. For example, that includes a standardised process for applying 4% aqueous CHG to the surface of the skin (e.g. leaving lather on the skin for 1–2 min prior to rinsing) (Edmiston et al., 2015, 2016).

A 2015 study, published in *JAMA Surgery*, evaluated the benefit of a pre-admission shower with 4% CHG from a pharmacokinetic perspective, defining the appropriate dose, timing and duration (Edmiston et al., 2015). An unresolved question, associated with the use of CHG for pre-admission bathing remains: what is the optimal number of applications of CHG to ensure a maximum skin surface concentration prior to surgery? Most protocols recommend two to three separate applications of CHG prior to surgery because it is accepted that skin surface antimicrobial activity is enhanced following multiple applications. However, there is no clinical or pharmacologic data suggesting that

three, rather than two, CHG showers result in a higher skin surface concentration of CHG.

The *JAMA* study concluded that taking a 1- or 2-min pause (timing component), prior to rinsing off the 4% CHG after showering, was associated with a statistically significant higher skin surface concentration of CHG at five separate skin sites compared with immediately rinsing off the antiseptic agent. The five skin sites known to have a higher microbial bioburden are the groin, axilla, perineum, and antecubital and popliteal fossae. The findings were equally valid whether two or three 4% CHG showers were taken. The findings of the study also found that using a 4-oz. (118 mL) volume of CHG per shower, in addition to a minimum 60-s pause prior to rinsing, resulted in saturated binding of CHG to the proteins on the surface of the skin. As a result, the higher and sustainable skin surface concentrations of CHG were found to be significantly higher than the minimal inhibitory concentration required to inhibit or kill 90% (MIC⁹⁰) of gram-positive or gram-negative surgical wound pathogens.

Based on the current accumulated evidence, a standardised pre-admission shower regimen using 4% aqueous CHG, as part of a care bundle to prevent SSI, should be used as outlined in Table 1.

The objective of such a standardised pre-admission shower regimen is to achieve a high and sustainable level of skin antisepsis on the surface of the skin to further reduce the risk of intraoperative wound contamination. While these surrogate findings do not directly link the use of a 4% CHG pre-admission shower with a reduction in the incidence of SSI, this standardised approach provides a technique which achieves high, sustainable concentrations of CHG on the skin that exceed 1000 ppm, which is 10 to > 100 times the MIC⁹⁰ of most anticipated gram-positive and gram-negative surgical pathogens. The associated health-care costs of providing two, 4-oz. (118 mL) bottles of CHG and an electronic alert system (SMS texting, email or voicemail to remind the patient to complete the pre-admission shower process) to improve compliance costs less than \$US9 (Edmiston et al., 2014, 2015).

An alternative to using 4% aqueous CHG is to use 2% CHG that is embedded (coated) into the fibres of a highly polished polyester cloth. This process can also be standardised as indicated in Table 2 (Edmiston et al., 2016).

The use of the 2% CHG polyester cloth is beneficial for those patients who are limited in their physical activity, finding it difficult to take a shower (Edmiston et al., 2008; Kapadia et al., 2013). If the patient is unable to cleanse him or herself, the process should be undertaken by a caregiver or family member.

The modern approach to pre-admission antiseptic skin preparation aims to reduce the microbial burden at the proposed incisional site, thereby protecting the wound from contamination by resident and transient skin flora. However, the presence of a higher microbial burden on skin surface sites such as the groin, axilla, perineum, or antecubital and

Table 1. Steps of implementing chlorhexidine showers with solution.

1.	Patient education, emphasising the benefit of the pre-admission antiseptic shower as an element of the pre-surgical checklist
2	Oral and written showering instructions to the patient
3	Use of a standard 4-oz. (118 mL) amount of 4% aqueous CHG for each shower
4	The taking of a minimum of two showers
5	A 1-min pause per shower to be observed prior to the rinsing of CHG from the skin surface
6	Instruction to patients not to apply lotions, creams or emollients following CHG showering as they may mask or adversely (pharmacologically) effect antimicrobial activity
7	Avoidance of CHG contact with eyes or ears, and if exposed, advice to rinse immediately
8	Advice to undertake immediate and copious rinsing if significant burning or itching occurs after application of CHG with reporting of the occurrence to the healthcare provider
9	Provision of appropriate CHG showering materials to the patient by the healthcare institution or provider
10	Enhancement of patient compliance to completing the showering using an SMS texting, email or voicemail alert system (all commercial vendors of 4% aqueous CHG support a computer-based alert system)

Table 2. Steps to implement CHG bathing with impregnated cloths.

1.	Oral and written instructions are provided to the patients
2.	Cleanse gently – the polyester cloth will gently exfoliate the skin as the CHG is applied to the skin surface A total of 12 cloths should be used for the cleansing process – six cloths the night before surgery and six cloths the morning of surgery
3.	Use both sides of the cloth – this will maximize the release of CHG onto the surface of the skin
4.	Enhancement of patient compliance can be improved when using the 2% CHG cloths by using a vendor-produced Internet-based reminder system that allows SMS texting, email or a voicemail alert system
5.	As with the 4% aqueous formulation, patients should be instructed not to apply lotions, creams or emollients following application of the CHG cloths since this may mask or pharmacologically negate the antimicrobial activity on the surface of the skin
6.	Remember to CLEANSE GENTLY

popliteal fossae increases the risk of postoperative infection. It has been shown that inexpensive, standardised, pre-admission antiseptic cleansing, using a defined volume of 4% aqueous CHG, for a defined two showers, each with a minimum 60-s pause prior to rinsing, results in high sustainable antiseptic levels on the surface of the skin. This antiseptic action is effective against both gram-positive and gram-negative microorganisms associated with SSI. This methodology, which results in fewer microorganisms on the skin surface adjacent to the site of a surgical incision, ought to be considered as a key component of perioperative surgical care bundles.

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