Commentary

Another look at CHG bathing in a surgical intensive care unit

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Healthcare associated infections (HAIs) are a cause of increased morbidity, mortality, and hospital costs (1,2). Various infection control strategies, including "bundles" of interventions, have been used to decrease the incidence of HAIs (3). Chlorhexidine gluconate (CHG), an antiseptic with broad-spectrum antimicrobial activity (4) has been shown in several studies to be an important component of infection prevention in intensive care units (ICUs) (4,5). Daily patient bathing with CHG has led to declines in central line associated bloodstream infections (BSIs) (6,7), acquisition of multi-drug resistant organisms (8), and hospital-acquired BSIs (8).

Daily CHG bathing is felt to be a means of source control. Use of CHG leads to reduced contamination of patient skin, thereby reducing environmental contamination as well as decreasing the opportunity for contamination of healthcare worker hands (9). In addition, by decreasing the burden of patient skin contamination, CHG can prevent infections due to potential pathogens on patient skin (9). These characteristics of CHG not only lead to reductions in infections due to endogenous organisms but potentially decrease the spread of pathogens to other patients. While studies of daily CHG bathing have been conducted in a variety of ICUs, the greatest impact appears to be in the medical ICU whereas data in surgical ICUs (SICU) has been more varied (10). Studies examining bathing less frequently than daily have been conducted outside of acute care settings and have not demonstrated significant declines in colonization or infection with methicillin-resistant *Staphylococcus aureus* (*MRSA*) (11,12) although other factors such as patient compliance, poor access to hygiene, lack of concomitant nasal decolonization, and unique characteristics of the patient population may have limited the success of the CHG bathing intervention (13). It is unclear if there is a role for less frequent CHG bathing in acute care settings.

The study by Swan and colleagues (14) sought to examine the effectiveness of CHG bathing in a SICU given the mixed results that have been reported in the literature for this type of ICU. They conducted a single-center, single unit, randomized trial of CHG bathing in comparison to soap and water bathing. Patients were enrolled within 48 hours of admission to the SICU and only patients expected to be in the SICU for at least 48 hours were included so as to select for those at highest risk for acquiring an HAI. Infections were categorized as "incident" (occurring more than 48 hours after randomization) versus "prevalent" (infections occurring less than this time frame), with the primary outcome being a composite of catheter-associated urinary tract infections (CAUTI), ventilator associated pneumonia (VAP), primary BSIs, and incisional surgical site infections. A unique aspect of their study was that patients were bathed every other day in the CHG arm (alternating with soap and water), not daily as has been done in other studies (5). In addition, this study did not use CHG-impregnated cloths and instead created a 2% CHG solution by mixing tap water with CHG 4% surgical scrub. No assessment of CHG concentration or bathing technique was performed by investigators and there was no monitoring for reduced susceptibility to CHG. The investigators found a significant decrease in the composite outcome of incident HAIs in the CHG arm as well as decreases in the individual infections with CHG, although the associations did not

attain statistical significance for individual infections (14). As this study (14) and others with daily bathing have shown (8,9), CHG was well-tolerated with minimal skin irritation.

Most studies in ICUs have used daily bathing with CHG (6,8,9,15) whereas this study alternated CHG bathing with soap and water yet still demonstrated a significant decline in their primary outcome. Some facilities may propose less frequent CHG bathing to reduce costs, for logistical purposes, or due to concerns for adverse effects. Daily bathing is felt to lead to a durable reduction in potential pathogens on patient skin with microbial growth increasing 1–3 days after CHG use is stopped (16). It is unclear the extent to which there is residual antiseptic activity following stopping of CHG bathing (16), a characteristic which may explain how every other day bathing in an ICU may lead to a decrease in HAIs. While zero primary BSIs were observed in the CHG arm in the study by Swan *et al.* (14), other HAIs—VAP, CAUTIs, and incisional surgical site infections—still occurred in the CHG arm, even if at a lower rate than with soap and water bathing. Prior work has not consistently demonstrated significant reductions in VAP and UTIs with daily CHG bathing (6,7,15,17) making it unclear, on the one hand, if the reductions were due to CHG bathing, and on the other hand, if greater reductions in these HAIs would have been observed in the current study if CHG bathing had been performed daily. Likely more data is needed for non-daily CHG bathing from a variety of ICUs prior to widespread implementation in acute care settings. Furthermore, factors such as less than optimal application of CHG, poor compliance with CHG bathing, and poor compliance with other infection control measures need to be considered in an assessment of non-daily CHG bathing.

An additional consideration is the study by Swan *et al.* (14) reported 84% compliance with hand hygiene from monthly undercover direct observations of clinicians in the SICU; it is not reported what the hand hygiene rate was for other healthcare personnel. It is unclear if every other day CHG bathing would have been as effective in a setting of poorer hand hygiene compliance. Likely, with less frequent bathing with CHG, other measures such as hand hygiene, other routine infection control measures including environmental cleaning, in addition to compliance and proper methodology for CHG bathing need to be optimized to ensure success.

The study by Swan and colleagues (14) did not use the CHG-impregnated cloths as has been used in several other studies but instead created a 2% CHG solution by diluting a 4% surgical scrub with water in order to reduce costs; no monitoring of CHG concentration or of bathing technique occurred. Despite these factors, the study still demonstrated a decline in the composite outcome of acquired HAIs. Climo *et al.* (18) similarly diluted 4% CHG solution with warm water for their intervention and demonstrated reductions in the acquisition of vancomycin-resistant enterococcus and MRSA. A meta-analysis of daily CHG bathing for reducing healthcare-associated BSIs suggested the benefit of CHG is seen irrespective of the method of CHG application—impregnated cloths or liquid preparation (5). However, concerns have been raised that "home brews" of CHG may not achieve the proper concentration, compliance with proper dilution may be suboptimal, and there may be risk for contamination (19-21). In addition, it is unclear whether consistent results will be achieved with all types of hospital-created CHG baths. For example, a study by Boonyasiri *et al.* (22) in Thailand created 2% CHG-impregnated washcloths in the hospital pharmacy, internally analyzed CHG concentration, and performed in vitro testing every few weeks of microbiologic activity yet did not demonstrate a significant decline in HAIs in their study; it is unclear the extent to which the hospital made CHG cloths impacted the results of this study which was conducted in a setting with a high prevalence of multi-drug resistant gram-negative colonization. Prior to facilities forgoing CHG-impregnated cloths for a less expensive solution (23), quality checks should be instituted to ensure the appropriate concentration of CHG and proper application of baths. In addition, future work examining the incremental benefits of CHG-impregnated cloths in comparison to CHG solution in ICU settings may help address this issue (21).

One notable aspect of the study by Swan and colleagues (14) is that they purposely enrolled patients expected to be in the surgical ICU for at least 48 hours, thereby selecting for sicker patients who likely would be more at risk for an HAI. The incidence of infections in the study by Swan *et al.* (14) was higher than in other studies (15) which may account for differences in findings. However, their inclusion criteria led to sicker patients being enrolled, a longer length of stay in the ICU of patients, and therefore, increased exposure to CHG bathing which may lead to a more durable reduction in contamination of patient skin and thus, a greater reduction in acquired HAIs. It should also be noted that the current study demonstrated the success of CHG bathing in the SICU, where prior studies have yielded mixed results (10). It has been hypothesized, though, that issues with classification of primary versus secondary BSIs in patients with large abdominal wounds

such as those in an SICU or in patients at risk for gut translocation may have contributed to the apparent lack of benefit of CHG previously reported (10,24,25). The study by Swan *et al*. adds to the literature supporting a role of CHG bathing in SICUs, particularly in units with complex patients and prolonged lengths of stay who are likely at increased risk for HAIs.

This single-center SICU study examined every other day CHG bathing using a hospital created CHG solution and observed a significant decline in a composite HAI outcome (14). The investigators selected for a sicker patient population and therefore patients had more exposure to CHG by virtue of longer lengths of stay in the SICU. As the authors note, studies of CHG bathing in the SICU have been varied (10) but their study supports the use of CHG in SICUs. Major questions from this study include whether there is ever a role for non-daily CHG bathing and if so, in what settings and in what patient populations. Second, while CHG-impregnated cloths minimize concerns of attaining an ideal CHG concentration or of potential contamination, the current study still attained significant declines in infections with CHG solution. While their study did not monitor CHG concentration or compliance with use of solution, it is unclear the extent to which high rates of hand hygiene or compliance with other infection control measures influenced the results. In addition, admirably low rates of bacteremia, the major HAI impacted by CHG bathing, led the investigators to use a composite endpoint that was likely more susceptible to spurious results, i.e., reductions in rates not truly due to the intervention, because of inter-current infection control measures beyond CHG bathing. Finally, it seems prudent that hospitals choosing not to use CHG cloths be vigilant in ensuring appropriate quality control measures are followed when using another form of CHG bathing.

Bottom line, this is another study demonstrating the success of CHG bathing in intensive care units and as other studies have demonstrated, it is well tolerated with few adverse effects.

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Footnote

Conflicts of Interest: The author has no conflicts of interest to declare.

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