Chlorhexidine gluconate use to prevent hospital acquired infections—a useful tool, not a panacea

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In recent years, increased awareness of the morbidity and potential mortality of hospital acquired infections (HAIs) has led to concerted prevention efforts. In addition to wanting to avert these complications for our patient's benefit, many countries—the United States included—have taken a very rigid stance that HAIs should be, essentially, "never events". In pursuit of this ideal, we have made tremendous progress in HAI prevention, using evidence-based "bundles" consisting of education related to insertion and removal of devices, checklists, empowerment of nursing and other care team members, protocolized use of sedatives and, as described in the article under discussion, use of chlorhexidine gluconate (CHG) baths (1).

According to data from the Centers for Disease Control and Prevention (CDC), there were an estimated 721,800 HAIs in the US in 2011, including 93,300 catheter-associated urinary tract infections (CA-UTIs), 157,500 hospital acquired pneumonias (HAPs), 71,900 primary bloodstream infections (BSIs), and 157,500 surgical site infections (SSIs). Among patients with these iatrogenic complications, 75,000 died, either with, or from, their HAIs (2). While the number of BSIs and SSIs decreased by, respectively, 50% and 17%, there was no change in that of CA-UTI (3). These numbers continue to represent a sizeable burden of morbidity and should, ideally, be reduced to near zero.

How is this to be accomplished? Current literature suggests very strongly that CHG baths prevent HAIs. The topical agent has excellent antimicrobial activity against gram-positive organisms, rapid onset and prolonged residual effect. Abundant evidence demonstrates that daily CHG baths in the ICU prevents central line associated BSI (CLA-BSI), BSI, CA-UTI, ventilator associated pneumonia (VAP) and SSI. Additionally, an established oral care protocol, including use of 0.12% CHG oral rinse twice daily, prevents VAP. Daily CHG bathing and CHG-based mouth care have now become standard of care in most ICUs, and are incorporated into many expert guidelines.

Many previous trials examining CHG's effectiveness in HAI prevention used a "before and after" design, meaning the infection rates measured before CHG baths were instituted were compared with those calculated after implementation of CHG bathing. These trials generally showed lower infection rates after institution of CHG. Vernon *et al.* noted decreased acquisition of vancomycin resistant *Enterococci* with use of 2% CHG-saturated cloths (4). Bleasdale and colleagues demonstrated, in medical ICU patients, decreased primary BSI infection rates in the CHG intervention group compared to standard treatment, respectively, 4.1 *vs.* 10.4 infections per 1,000 patient days (5). Munoz-Price *et al.* reported a 99% reduction in the CLA-BSI rate in long-term acute care hospital patients bathed daily with CHG (6). O'Horo's 2012 meta-analysis of one randomized and 11 non-randomized trials showed daily bathing with CHG reduced the incidence of BSIs in medical ICU patients (7); the optimal frequency and method of application were to be determined. A single-

center, observational study, reported in 2013 by Climo and colleagues, established that BSI was 4.78 with CHG bathing *vs.* 6.60 cases per 1,000 patient days with non-antimicrobial washcloths (P=0.007) (8).

Genuit *et al.* demonstrated, in mechanically ventilated surgical ICU patients, CHG 0.12% oral rinse administered twice daily led to a 37% reduction of VAP (9). A before and after trial by Evans and associates found CHG-impregnated cloth bathing was associated with lower rates of CLA-BSI and MRSA VAP (10). Sona *et al.* also in the surgical ICU, noted that an oral care protocol consisting of twice-daily 0.12% chlorhexidine rinses resulted in 46% reduction in VAP; the most common side effect of CHG, staining of teeth, was not noted (11).

The prospective cohort study performed by Rao found that, in outpatients, preoperative decolonization with mupirocin or CHG decreased the SSI rate from 2.7% in pre-intervention controls to 1.2% in intervention patients (12).

The present study—CHG-BATH—is unique in many regards. It is one of the few randomized controlled trials performed to investigate the efficacy of CHG bathing. While it was not possible to carry out this trial in a double-blinded fashion, single blinded-ness was achieved as the investigators determining efficacy and safety outcomes were blinded. Further, the majority of previous trials were carried out in medical ICU patients, evaluating for CA-UTI, VAP and CLA-BSI. CHG-BATH was one of the few conducted in surgical ICU patients, and evaluating for SSI, in addition to other HAIs. The trial confirmed previous evidence that CHG bathing prevents the most common infections acquired in the ICU.

Several issues of interest should be noted. Firstly, extant literature suggests CHG baths should be done daily, yet the CHG-BATH trial showed similar results with every other day CHG bathing. The rationale for this was CHG decolonizes the skin, with recolonization taking about 5 days. With this line of thinking, every other day bathing should be just as effective as daily bathing, potentially decreases adverse skin effects, and is less costly; this seemed to hold true.

Secondly, patients randomized to the control group received soap and water bath every other day, whereas those randomized to the experimental group received CHG every other day. However, the methods describe patients receiving "*ad hoc* baths" with soap and water on an as-needed basis. For example, if a patient needed to be cleansed of feces, urine or blood, a bath was performed with soap and water. How many of these *ad hoc* baths were performed in the soap and water *vs.* the CHG group was not documented. If patients in the CHG group received many *ad hoc* baths, the lowered infection rate in that group may not be attributable to the effect of CHG alone. It is more likely that both groups received a comparable number of *ad hoc* baths, but one cannot be sure. It is surprising to us that the *Critical Care Medicine* editors/reviewers did not comment upon this potentially confounding factor.

Thirdly, the trial protocol calls for disposal of the washbasin after each use. However, compliance with this instruction was not observed. Thus, it is possible that washbasins were used for a second or third time after the initial bath. One could easily imagine that the soap and water-only basin might be more likely to be colonized with bacteria than the one in which CHG was used. Again, it is likely this non-compliance, if it occurred at all, occurred equally in both arms, but there is no way to know for certain.

The case against CHG baths largely rests in the argument that CHG may compromise the skin. This appears to be untrue. In Popp *et al.*'s study—a before and after design—of thermally injured patients, 0.9% CHG baths twice daily decreased the HAI rate to near-zero, and no integumentary difficulties or delayed wound healing were found (13). We would argue that in the context of risk-benefit, CHG is safe and effective.

The implications of the study under discussion are tremendous: every other day CHG baths should be performed in all ICU patients, perhaps in all hospital patients. The number needed to treat (NNT) is 11; that is, for every eleven patients we bathe with CHG, one HAI is prevented. Spending $33 every other day, we can save $6,000 to $60,000 per HAI (less expensive for CA-UTI and more expensive for VAP).

The cost of the bathing product is not an issue of consideration: CHG-BATH used CHG diluted in water in a washbasin instead of the relatively more expensive CHG impregnated cloths. The former manner of bathing entails a cost of $3.18 per bath; without any doubt, CHG solution baths are cost effective.

But should we end the story here? We think not.

Quality is not a checklist, nor is it an antiseptic solution or a new device. The provision of high quality, patient and family centered care can only be achieved if we work in teams, pay careful attention to each aspect of the patient's care, and utilize best practice and evidence-based medicine as much as possible. In this context, the recommendations of CHG-BATH are but one of several measures which, if implemented thoughtfully, should lead to better quality

care, improved outcomes and decreased iatrogenic infectious complications. The benefit we obtain through all of these measures is due to attention to detail.

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None.

Footnote

Conflicts of Interest: The authors have no conflicts of interest to declare.

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