A regular feature of the *American Journal of Critical Care,* **Clinical Evidence Review** unveils available scientific evidence to answer questions faced in contemporary clinical practice. It is intended to support, refute, or shed light on health care practices where little evidence exists. To send an eLetter or to contribute to an online discussion about this article, visit **www.ajcconline.org** and click "Respond to This Article" on either the full-text or PDF view of the article. We welcome letters regarding this feature and encourage the submission of questions for future review.

Chlorhexidine Gluconate Bathing: Does it Decrease Hospital-Acquired Infections?

By Deana Sievert, RN, MSN, CCRN, Rochelle Armola, RN, MSN, CCRN, and Margo A. Halm, RN, PhD, ACNS-BC

As pay for performance becomes more prevalent, hospitals struggle to improve processes, especially those for preventing hospital-acquired infections (HAIs). Many hospital programs seek out evidence-based "best practices" to keep patients safe from deadly and costly HAIs. Critical care nurses have begun examining even the most rudimentary tasks, such as bathing patients, and the processes inherently associated with them.

It has been suggested that a bathing procedure that focuses on decolonization may decrease HAI rates. This procedure routinely includes administration of a nasal antibacterial agent and then bathing patients with a solution of 2% to 4% chlorhexidine gluconate, each for a series of days. It has also been suggested that bath basins may be a source of bacterial transmission. Further, use of a bath basin may lead to contamination of other items such as the sink for hand washing.[1] These suggestions bring into focus several important steps that nurses must take to help keep patients safe from HAIs, although we cannot assume that these few steps are the complete answer for prevention.

The Society for Healthcare Epidemiology of America and the Infectious Diseases Society of America have developed a compendium of recommendations to prevent transmission of multidrug-resistant organisms and HAIs in acute care hospitals.[2-6] The idea is that if procedures outlined in the compendium are performed, HAIs such as ventilator-associated pneumonia,[6] central line–associated bloodstream infections (CLABSI), and transmission of multidrug-resistant organisms can be limited.[4] Some researchers working with the Centers for Disease Control and Prevention[7] and the authors of the compendiums believe hygiene regimens that use chlorhexidine gluconate are a formidable weapon for reducing HAIs. In this review, we summarize current evidence on the effect of bathing with chlorhexidine gluconate on reducing colonization, surgical site infection (SSI), and CLABSI.

doi: 10.4037/ajcc2011841

Methods

MEDLINE, CINAHL, and Cochrane databases were searched by using the terms *chlorhexidine bathing, central venous catheter infections, catheter-related infections, CLABSI, methicillin-resistant* Staphylococcus aureus *(MRSA) or vancomycin-resistant enterococcus (VRE) colonization/acquisition, gram-positive bacteria infections,* or *SSI.* Only meta-analyses, randomized controlled trials (RCTs), and experimental studies from the past 10 years were included.

Results

CLABSI

No RCTs have addressed bathing with chlorhexidine gluconate and CLABSI reduction. Four quasi-experimental studies[8,10-12] and 1 cross-over study[9] in a pre-post study design were retrieved (Table 1). Most studies were set in an intensive care unit, but one study[8] was conducted in a long-term acute care hospital. In 4 of the 5 studies, results indicated a significant reduction in CLABSI for subjects in the

Table 1
Studies on chlorhexidine bathing

Reference	No. of patients/ population	Design/ Intervention(s)	Central catheter–associated blood-stream infections	Acquisition/ decolonization	Surgical site infections
Munoz-Price et al[8]	405/long-term acute care	Quasi-experimental	+ Weekly 2% CHG baths (vs soap/water)		
Bleasdale et al[9]	836/MICU	Cross-over (concurrent control group)	+ CHG (after 5 days) vs soap/water		
Popovich et al[10]	318/MICU	Quasi-experimental	+ 2% CHG cloths (vs soap/water)		
Climo et al[11]	5320/MICU, SICU, MICU, CCU, CVSICU	Quasi-experimental	+ 4% CHG (vs soap/water) reduced VRE bacteremia	+ MRSA decreased 32% + VRE decreased 50%	
Popovich et al[12]	254/SICU	Quasi-experimental	0 CHG vs soap/ water bathing		
Ridenour et al[13]	1581/CCU, MICU	Prospective interventional cohort		+ 4% CHG bathing for 7 days and 2% mupirocin ointment twice daily for 5 days	
Vernon et al[14]	1787/MICU	Prospective sequential group (single arm) cohort		+ 2% CHG impregnated cloths (vs soap/water)	
Wendt et al[15]	114/university hospital nursing homes	Randomized controlled trial		0 4% CHG solution in water (vs placebo); all received mupirocin nasally and CHG oral rinse + CHG for groin area eradication	
Sandri et al[16]	2200/general ICU (364 general ICU inpatients with positive MRSA screens)	Retrospective cohort with consecutive patients		+ CHG solution in water (no % specified) daily for 3 days and 2% mupirocin intranasally 3 times daily for 5 days	
Batra et al[17]	4570/general ICU	Quasi-experimental		+ 1% CHG to nostrils, around mouth and tracheostomy site 4 times a day; 1% CHG acetate powder to groin, axillae, and skinfolds 2 times daily, and 4% CHG in water bathing	
Darouiche et al[18]	849/general surgery (clean-contaminated)	Randomized controlled trial			+ CHG-alcohol[a] (vs povidone-iodine)
Veiga et al[19]	150/plastic surgery (clean)	Randomized controlled trial			0 CHG shower (vs placebo/control)
Paocharoen et al[20]	500/general surgery (clean; clean-contaminated, contaminated)	Randomized controlled trial			+ CHG (vs povidone iodine)
Eiselt[21]	1463/orthopedics	Quasi-experimental			+ 2% CHG no-rinse cloth (vs povidone-iodine)

Continued

Table 1
(Continued)

Reference	No. of patients/ population	Design/ Intervention(s)	Central catheter–associated blood-stream infections	Acquisition/ decolonization	Surgical site infections
Dizer et al[22]	82/abdominal	Experimental (non-randomized)			+ CHG bath/clippers (vs routine preoperative skin preparation/shaving)
Swenson et al[23]	3209/general surgery	Randomized controlled trial			0 2% CHG (vs povidone-iodine, 70% isopropyl alcohol, or isopropyl alcohol)
Edmiston et al[24]	30/healthy volunteers	Randomized controlled trial			+ 2% CHG-impregnated cloth (vs 4% CHG skin preparation)
Webster and Osborne[25]	10,157/7 randomized controlled trials	Systematic review			0 4% CHG showering (vs placebo)

Abbreviations: CCU, coronary intensive care unit; CHG, chlorhexidine gluconate; CVSICU, cardiovascular intensive care unit; MICU, medical intensive care unit; MRSA, methicillin-resistant *Staphylococcus aureus*; SICU, surgical intensive care unit; VRE, vancomycin-resistant enterococci.
Key: 0 = no effect ($P > .05$); + = beneficial effect ($P < .05$).
[a]Superficial and deep incisional infections.

chlorhexidine gluconate arm.[8-11] In the fifth study,[12] which was of patients in surgical intensive care units, significant differences were not found.

Acquisition/Decolonization

In 1 RCT,[15] 2 quasi-experimental studies,[11,17] and 3 nonrandomized trials[13,14,16] acquisition or decolonization of multidrug-resistant organisms was examined. Cloths impregnated with 2% or 4% chlorhexidine gluconate were compared with plain cleansing cloths and/or soap and water. In 4 studies,[13,15-17] use of either mupirocin or nasal chlorhexidine gluconate was added, and in 1 study,[17] chlorhexidine gluconate powder was added in skin folds. All of the studies showed significant reduction in multidrug-resistant organisms, except for 1 study[15] in which MRSA was not significantly decreased.

About the Authors
Deana Sievert is an administrative director of critical care, intermediate care, and the emergency center at The Toledo Hospital in Toledo, Ohio. **Rochelle Armola** is the trauma nurse manager/clinical nurse specialist at The Toledo Hospital. **Margo A. Halm** is a clinical nurse specialist and director of nursing quality and research at the Salem Hospital in Salem, Oregon, where she leads and mentors staff in the principles of clinical research and evidence-based practice.

Corresponding author: Margo A. Halm, RN, PhD, ACNS-BC, Salem Hospital, Salem, OR 97301 (e-mail: margo.halm@salemhealth.org).

SSI

One nonrandomized trial,[22] 1 quasi-experimental study,[21] 5 RCTs,[18-20,23,24] and 1 systematic review[25] of surgical site infections were retrieved. Chlorhexidine gluconate was compared with povidone-iodine, 70% isopropyl alcohol, isopropyl alcohol (DuraPrep), or routine skin preparation/shaving. More than half of the studies[18,20-22,24] revealed significant effects of chlorhexidine gluconate on SSI rates in general surgery patients (ie, clean, clean-contaminated, or contaminated abdominal, orthopedic, plastic surgery).

Recommendations

The available studies on CLABSI reduction by bathing with chlorhexidine gluconate provide class IIb evidence (Table 2). No RCTs have been completed at this time; however, good evidence, mainly from quasi-experimental studies, exists to consider this intervention an option to reduce CLABSI, especially in patients in medical intensive care units. Additional research is needed to determine the effectiveness of chlorhexidine gluconate in CLABSI reduction in surgical intensive care units and other settings.

In the reduction of acquisition or decolonization of multidrug-resistant organisms, current studies also support a rating of class IIb evidence (Table 2). The only RCT that did not show a significant reduction in MRSA eradication did find a decrease at the groin site after day 3 of treatment, but that reduction was no longer apparent at day 5. The

remaining studies, although less rigorous in design, showed reductions in MRSA/VRE colonization.

SSI reduction after the use of chlorhexidine gluconate bathing had mixed research findings and would be considered a class IIb level of evidence (Table 2). Although results of 2 large RCTs[18,20] and other experimental trials[21,22,24] favored the intervention, the systematic review[25] of 7 RCTs that involved more than 10 000 patients did not favor chlorhexidine gluconate bathing for SSI reduction.

Although strong evidence (class I) for chlorhexidine gluconate bathing does not currently exist, this technique may be considered a potential option for the reduction of HAIs. The few adverse effects of bathing with chlorhexidine gluconate are mainly related to contact dermatitis or irritation that subsides when use of chlorhexidine gluconate is stopped. However, rare reports of anaphylaxis and extreme allergic reactions exist.[27] More serious adverse effects reported are related to accidental application of chlorhexidine gluconate to an organ or mucous membranes.[27]

Chlorhexidine gluconate must be allowed to dry on the skin before a dressing can be placed to prevent an adverse skin reaction. Pediatric and neonatal research related to use of chlorhexidine gluconate is lacking and needs further investigation. More rigorous research with adult patients outside of intensive care units is also clearly needed to document the efficacy of chlorhexidine gluconate interventions in reducing CLABSI, colonization of MRSA or VRE, and SSI rates in hospitalized patients.

Table 2
Evidence grading

Class	Criteria	Definition
I Definitely recommended	Supported by excellent evidence, with at least 1 prospective randomized controlled trial	Interventions always acceptable, safe, and effective; considered *definitive standard of care*
IIa Acceptable and useful	Supported by good to very good evidence; weight of evidence and expert opinion strongly in favor	Interventions acceptable, safe, and useful; considered *intervention of choice* by most experts
IIb Acceptable and useful	Supported by fair to good evidence; weight of evidence and expert opinion not strongly in favor	Interventions also acceptable, safe, and useful; considered *optional or alternative* by most experts
Indeterminate Promising, evidence lacking, premature	Preliminary research stage; evidence shows no harm but no benefit; evidence insufficient to support final class decision	*Treatment of promise* but limited evidence
III May be harmful; no benefit documented	Not acceptable or useful; may be harmful	Interventions with *no evidence of any benefit*; often *some evidence of harm*

Adapted from "Part 1: Introduction to the International Guidelines 2000 for CPR and ECC,"[26] with permission.

FINANCIAL DISCLOSURES
None reported.

REFERENCES

1. Johnson D, Lineweaver L, Maze L. Patients' bath basins as potential sources of infection: a multicenter sampling study. *Am J Crit Care.* 2009;18:31-40.
2. Yokoe D. Improving patient safety through infection control: a new healthcare imperative. *Infect Control Hosp Epidemiol.* 2008;29:S3-S11.
3. Marschall J, Mermel L, Classen D, et al. Strategies to prevent central line-associated bloodstream infections in acute care hospitals. *Infect Control Hosp Epidemiol.* 2008;29(1):S22-S30.
4. Calfee D, Salgado C, Classen D, et al. Strategies to prevent transmission of methicillin-resistant staphylococcus aureus in acute care hospitals. *Infect Control Hospital Epidemiol.* 2008;29:S62-S80.
5. Anderson D, Daye K, Classen D, et al. Strategies to prevent surgical site infections in acute care hospitals. *Infect Control Hosp Epidemiol.* 2008;29:S51-S61.
6. Coffin S, Klompas M, Classen D, et al. Strategies to prevent ventilator-associated pneumonia in acute care hospitals. *Infect Control Hosp Epidemiol.* 2008;29:S31-S40.
7. Jernigan J, Kallen A. Methicillin-resistant *Staphylococcus aureus* (MRSA) infections. Activity C: ELC prevention collaboratives. http://www.premierinc.com/quality-safety/tools-services/safety/topics/HAI/downloads/MRSA_toolkit-white-11910.pdf. Accessed January 6, 2011.
8. Munoz-Price L, Hota B, Stemer A, et al. Prevention of bloodstream infections by use of daily chlorhexidine baths for patients at a long-term acute care hospital. *Infect Control Hosp Epidemiol.* 2009;30(11):1031-1035.
9. Bleasdale S, Trick W, Gonzalez I, et al. Effectiveness of chlorhexidine bathing to reduce catheter–associated bloodstream infections in medical intensive care unit patients. *Arch Intern Med.* 2007;167(19):2073-2079.
10. Popovich K, Hota B, Hayes R, et al. Effectiveness of routine patient cleansing with chlorhexidine gluconate for infection prevention in the medical intensive care unit. *Infect Control Hosp Epidemiol.* 2009;30(10):959-963.
11. Climo M, Sepkowitz K, Zuccotti G, et al. The effect of daily bathing with chlorhexidine on the acquisition of methicillin-resistant *Staphylococcus aureus*, vancomycin-resistant enterococcus, and healthcare-associated bloodstream infection: results of a quasi-experimental multicenter trial. *Crit Care Med.* 2009;37:1858-1865.
12. Popovich K, Hota B, Hayes R, et al. Daily skin cleansing with chlorhexidine did not reduce the rate of central-line associated blood stream infection in a surgical intensive care unit. *Intensive Care Med.* 2010;36:854-858.
13. Ridenour G, Lampen R, Pederspiel J, et al. Selective use of intranasal mupirocin and chlorhexidine bathing and the incidence of methicillin-resistant staphylococcus aureus colonization and infection among intensive care unit patients. *Infect Control Hosp Epidemiol.* 2007;28:1155-1161.
14. Vernon M, Kayden M, Trick W, et al. Chlorhexidine gluconate to cleanse patients in a medical intensive care unit: the effectiveness of source control to reduce the bioburden of vancomycin-resistant enterococci. *Arch Intern Med.* 2006; 166:306-312.
15. Wendt C, Schinke S, Wurttemberger M, et al. Value of whole-body washing with chlorhexidine for the eradication of methicillin-resistant staphylococcus aureus: a randomized, placebo-controlled, double-blind clinical trial. *Infect Control Hosp Epidemiol.* 2007;28:1036-1043.
16. Sandri A, Dalarosa M, Ruschel de Alcantara L, et al. *Infection Control Hosp Epidemiol.* 2006;27:185-187.
17. Batra R, Cooper B, Whiteley C, et al. Efficacy and limitation

of a chlorhexidine-based decolonization strategy in preventing transmission of methicillin-resistant staphylococcus aureus in an intensive care unit. *Clin Infect Dis.* 2010; 50:210-217.
18. Darouiche R, Wall M, Itani K, et al. Chlorhexidine-alcohol versus povidone-iodine for surgical-site antisepsis. *N Engl J Med.* 2010;362(1):18-26.
19. Veiga D, Damasceno C, Viega-Filho J, et al. Randomized controlled trial of the effectiveness of chlorhexidine showers before elective plastic surgical procedures. *Infect Control Hosp Epidemiol.* 2009;30:77-79.
20. Paocharoen V, Mingmalairak C, Apisarnthanarak A. Comparison of surgical wound infection after preoperative skin preparation with 4% chlorhexidine and povidone iodine: a prospective randomized trial. *J Med Assoc Thai.* 2009;92(7): 898-902.
21. Eiselt D. Presurgical skin preparation with a novel 2% chlorhexidine gluconate cloth reduces rates of surgical site infection in orthopaedic surgical patients. *Orthop Nurs.* 2009; 28(3):141-145.
22. Dizer B, Hatipoglu S, Kaymakcioglu N, et al. The effect of nurse-performed preoperative skin preparation on postoperative surgical site infections in abdominal surgery. *J Clin Nurs.* 2009;18:3325-3332.
23. Swenson B, Hedrick T, Metzger R, et al. Effects of preoperative skin preparation on postoperative wound infection rates: a prospective study of 3 skin preparation protocols. *Infect Control Hosp Epidemiol.* 2009;30:964-971.
24. Edmiston C, Seabrook G, Johnson C, et al. Comparative of a new and innovative 2% chlorhexidine gluconate-impregnated cloth with 4% chlorhexidine gluconate as topical antiseptic for preparation of the skin prior to surgery. *Am J Infect Control.* 2007;35:89-96.
25. Webster J, Osborne S. Preoperative bathing or showering with skin antiseptics to prevent surgical site infection. *Cochrane Database Syst Rev.* 2007;2:CD004985.
26. Classes of recommendations 2000. Part 1: Introduction to the international guidelines 2000 for CPR and ECC. *Circulation.* 2000;102:I-1.
27. Stokowski L. Chlorhexidine in Healthcare: Your Questions Answered. http://www.medscape.com/viewarticle/726075. Accessed January 6, 2011.