

Chlorhexidine Gluconate Bathing Program to Reduce Health Care–Associated Infections in Both Critically Ill and Non–Critically Ill Patients

Leigh Chapman, MS, RN, CIC
Lisa Hargett, MPH, CIC
Theresa Anderson, MS, RN, CIC
Jacqueline Galluzzo, MS, RN, CIC
Paul Zimand

BACKGROUND Critical care nurses take care of patients with complicated, comorbid, and compromised conditions. These patients are at risk for health care–associated infections, which affect patients’ lives and health care systems in various ways.

OBJECTIVE To gauge the impact of routinely bathing patients with 4% chlorhexidine gluconate solution on the incidence of health care–associated infections in a medical-surgical intensive care unit and a post-operative telemetry unit; to outline the framework for a hospital-wide presurgical chlorhexidine gluconate bathing program and share the results.

METHODS A standard bathing protocol using a 4% chlorhexidine gluconate solution was developed. The protocol included time studies, training, monitoring, and surveillance of health care–associated infections.

RESULTS Consistent patient bathing with 4% chlorhexidine gluconate was associated with a 52% reduction in health care–associated infections in a medical-surgical intensive care unit. The same program in a post-operative telemetry unit yielded a 45% reduction in health care–associated infections.

CONCLUSION A comprehensive daily 4% chlorhexidine gluconate bathing program can be implemented with standardized protocols and detailed instructions and can significantly reduce the incidence of health care–associated infections in intensive care unit and non–intensive care unit hospital settings. (*Critical Care Nurse*. 2021;41[5]:e1-e8)

On any given day, 1 in 25 hospitalized patients has a health care–associated infection (HAI) despite increased attention paid to hygiene and patient care, resulting in the loss of hospital reimbursement. A single inpatient case of *Clostridium difficile* infection can cost a hospital more than \$35 000, and the total estimated financial cost for *C difficile* infections in health care settings is more than \$3 billion.¹

As part of the Affordable Care Act, the Hospital-Acquired Condition Reduction Program mandates a 1% downward adjustment in Medicare reimbursement rates for hospitals that perform in the bottom quartile of institutions, according to hospital-acquired condition quality measures. In Maryland, infections associated with hospital stays hold additional financial consequences. As a waiver state from many national Medicare quality programs, including the Hospital-Acquired Condition Reduction Program, Maryland has its own quality pay-for-performance program, Quality-Based Reimbursement. Approximately \$61 million (in penalties or rewards) is at stake for health care organizations in Maryland.²

Practice standardization can help bring new rigor to HAI reduction efforts. Many hospitals are using horizontal strategies such as improved hand hygiene, environmental cleanliness, and daily patient bathing to address HAIs. A daily bath with soap and water has been shown to positively affect patient outcomes and satisfaction.

The antimicrobial CHG soap kills vegetative cells, and manual removal of soap and water eliminates *C difficile* spores in a way that disposable wipes cannot.

Skin antiseptics is the primary goal, but bathing also provides an opportunity to evaluate skin integrity, improve patient self-image and comfort, stimulate circulation, and promote range of motion.³ Daily patient bathing with a 4% chlorhexidine gluconate (CHG) solution increases patient comfort and may reduce HAIs.

opportunity to evaluate skin integrity, improve patient self-image and comfort, stimulate circulation, and promote range of motion.³ Daily patient bathing with a 4% chlorhexidine gluconate (CHG) solution increases patient comfort and may reduce HAIs.

Authors

Leigh Chapman is the director of surgical nursing, rehabilitation, and vascular access, University of Maryland St. Joseph Medical Center, Towson, Maryland.

Lisa Hargett is the director of infection prevention, University of Maryland St. Joseph Medical Center.

Theresa Anderson is a senior coordinator for infection prevention, University of Maryland St. Joseph Medical Center.

Jacqueline Galluzzo is an infection preventionist, University of Maryland St. Joseph Medical Center.

Paul Zimand is a data scientist, University of Maryland Medical System, Baltimore, Maryland.

Corresponding author: Leigh Chapman, MS, RN, CIC, University of Maryland St. Joseph Medical Center, 7601 Osler Drive, Towson, MD 21204 (email: leighs@umm.edu).

To purchase electronic or print reprints, contact the American Association of Critical-Care Nurses, 27071 Aliso Creek Rd, Aliso Viejo, CA 92656. Phone, (800) 899-1712 or (949) 362-2050 (ext 532); fax, (949) 362-2049; email, reprints@aacn.org.

Bathing patients with a 4% CHG solution has been shown to decrease the incidence of central catheter-associated bloodstream infections and infections with multidrug-resistant organisms (MDROs) and *C difficile*. The antimicrobial CHG soap kills vegetative cells, and manual removal of soap and water eliminates *C difficile* spores in a way that disposable wipes cannot.⁴ Decreasing hospital infection rates by using a 4% CHG solution has been linked to significant economic gain.⁵ The purpose of this project was to determine if implementing a standardized bed bath using 4% CHG solution could reduce the incidence of HAIs in the medical-surgical intensive care unit (MSICU) and in a less acute patient population.

Methods

University of Maryland St. Joseph Medical Center, founded in 1864, is a 232-bed nonprofit regional medical center in Towson, Maryland, and a member of the 12-hospital University of Maryland Medical System. Approximately 11 500 surgeries are performed annually at the hospital.

A search of the CINAHL and MEDLINE databases for the terms *chlorhexidine* AND *bathing* AND *infections* yielded 621 results. Limitation of the results to full-text articles published between 2014 and 2019 yielded 90 results. Further limitation to only academic journals produced 81 results.

Interventions

Daily inpatient bathing with 4% CHG began in the MSICU in January 2010. The program was expanded to include the postoperative telemetry unit in February 2014 and was implemented throughout the facility (except for the neonatal intensive care, psychiatric, pediatric, and maternal and child health units) in August 2015.

Receiving the necessary approvals and implementing the new program in the MSICU was a multistep process that required considerable effort. The executive team had to approve the additional cost for the 4% CHG product, a cost that would be offset with a reduction of HAIs. The team decided to use liquid CHG packaged in 4-oz containers, which carried a total annual cost of just more than \$10 000. In comparison, a single incidence of central catheter-associated bloodstream infection costs an average of \$45 814.⁵

The standardized bathing protocol uses a multiple-washcloth, multiple-towel process (Figure 1). This

protocol specifically avoids unnecessary contamination because used washcloths are not placed back in the basin. The process starts with either 10 washcloths and 3 towels (for patients with urinary catheters) or 8 washcloths and 2 towels (for all other patients). Warm water and clean washcloths are placed in the basin. Undiluted 4% CHG solution is applied to a clean, wet washcloth and applied to the patient. Once a washcloth has been used, it is placed in the hamper for soiled linen. The solution is not applied to areas where it is not indicated, including the face, hair, open wounds, and internal genitalia. The protocol includes changing the patient's gown, linen, and electrocardiogram leads if applicable. Procedures regarding perineal care and catheter care are also standardized. The final steps include wiping down the basin with an approved disinfectant and recording the bath in the patient's electronic medical record.

Measures

We collected complete monthly infection counts and numbers of patient-days for the period of January 2009 through March 2017 for the MSICU and postoperative telemetry unit. Our aim was to compare HAI incidence rates (the count of infections per 1000 patient-days) in each unit before and after implementation of 4% CHG patient bathing to determine whether incidence rates significantly declined. In the MSICU, the preintervention period was January 2009 through December 2009 and the postintervention period was January 2010 through March 2017. In the postoperative telemetry unit, the preintervention period was January 2009 through January 2014 and the postintervention period was February 2014 through March 2017.

Statistical Analysis

To account for sampling error, different reporting intervals in the preintervention and postintervention periods, and random variation, we conducted exact rate ratio tests assuming Poisson distribution. We conducted the analysis using R software,⁶ comparing rates within each unit for methicillin-resistant *Staphylococcus aureus* (MRSA), vancomycin-resistant enterococci (VRE), *C difficile*, and MDRO infections and for the combined total of these infections. All other gram-negative, drug-resistant organisms were included in the MDRO category.

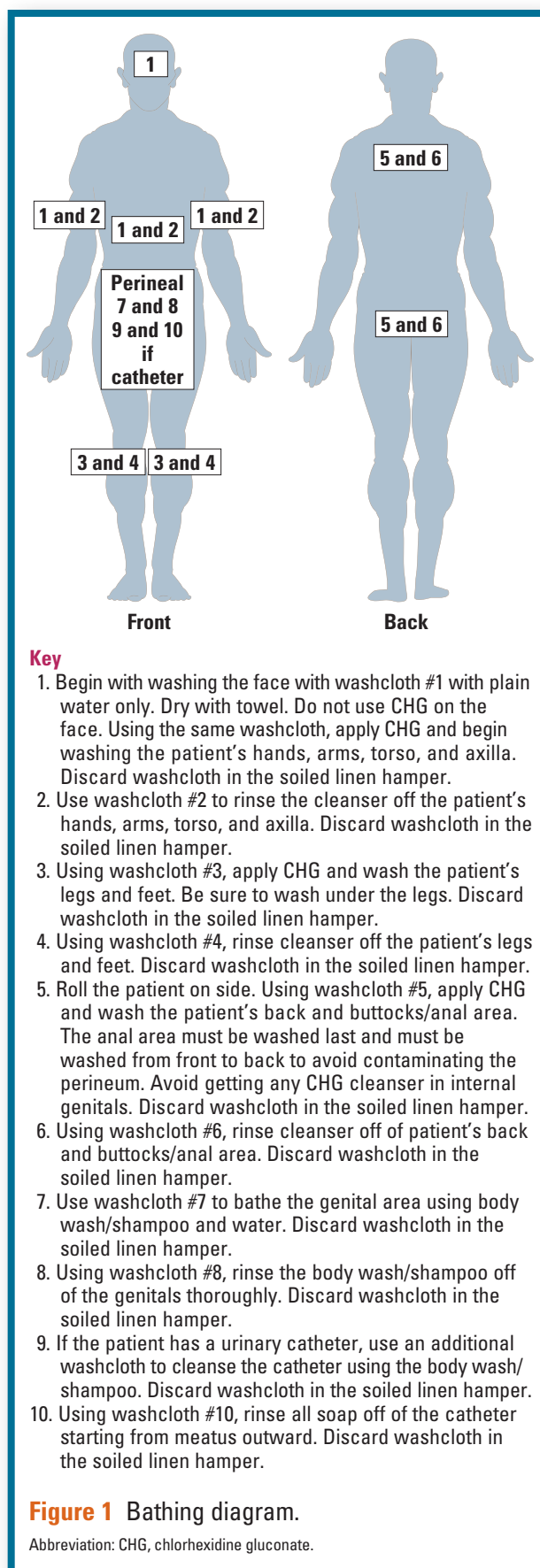


Table 1 Infection rates before and after implementation of the 4% chlorhexidine gluconate bathing program in the medical-surgical intensive care unit (before intervention, January through December 2009; after intervention, January 2010 through March 2017)

Infection	Before intervention (9339 patient-days)		After intervention (48 114 patient-days)		P
	No. of infections	Rate ^a (95% CI)	No. of infections	Rate ^a (95% CI)	
MRSA	11	1.2 (0.5-1.8)	35	0.7 (0.4-1.0)	.23
VRE	11	1.2 (0.5-1.8)	22	0.5 (0.2-0.7)	.02
<i>Clostridium difficile</i>	28	3.0 (2.4-3.6)	53	1.1 (1.9-5.2)	<.001
MDRO	11	1.2 (0.5-1.8)	40	0.8 (0.5-1.1)	.39
Total	61	6.5 (5.9-7.2)	150	3.1 (2.8-3.4)	<.001

Abbreviations: MDRO, multidrug-resistant organisms; MRSA, methicillin-resistant *Staphylococcus aureus*; VRE, vancomycin-resistant enterococci.

^a Infections per 1000 patient-days.

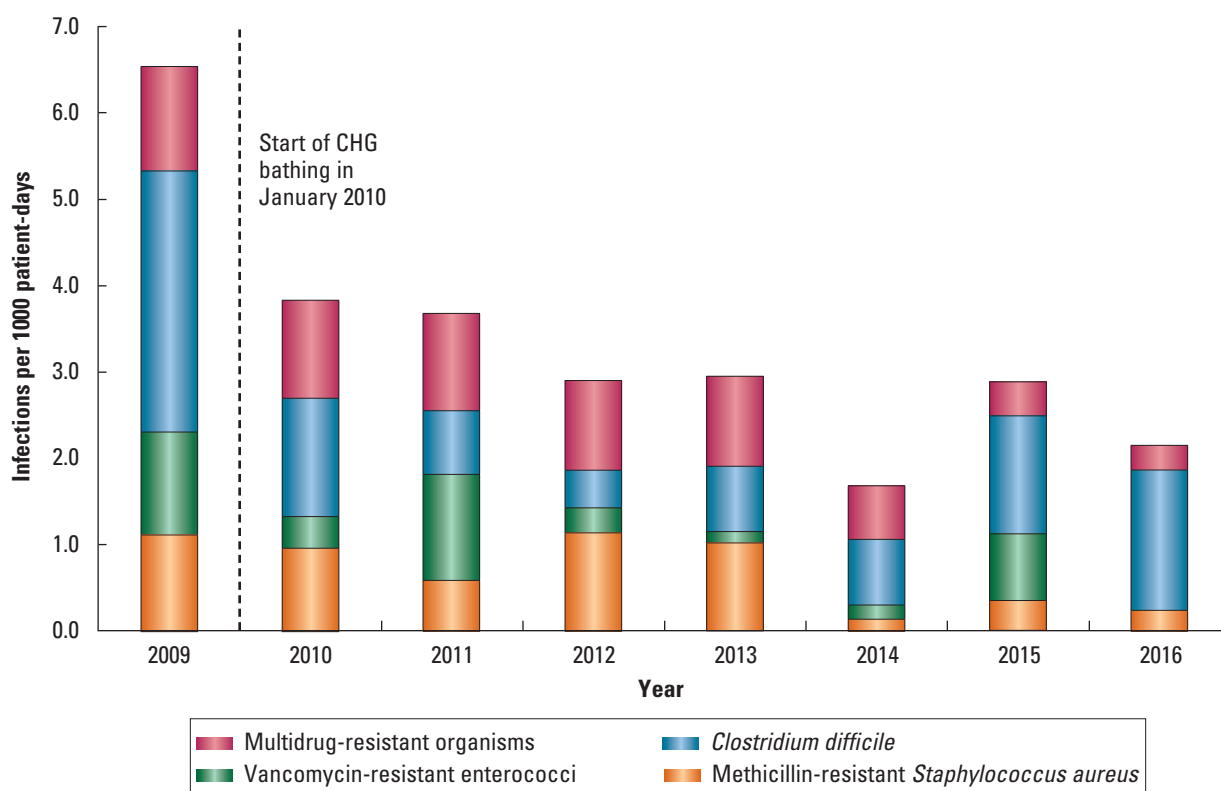


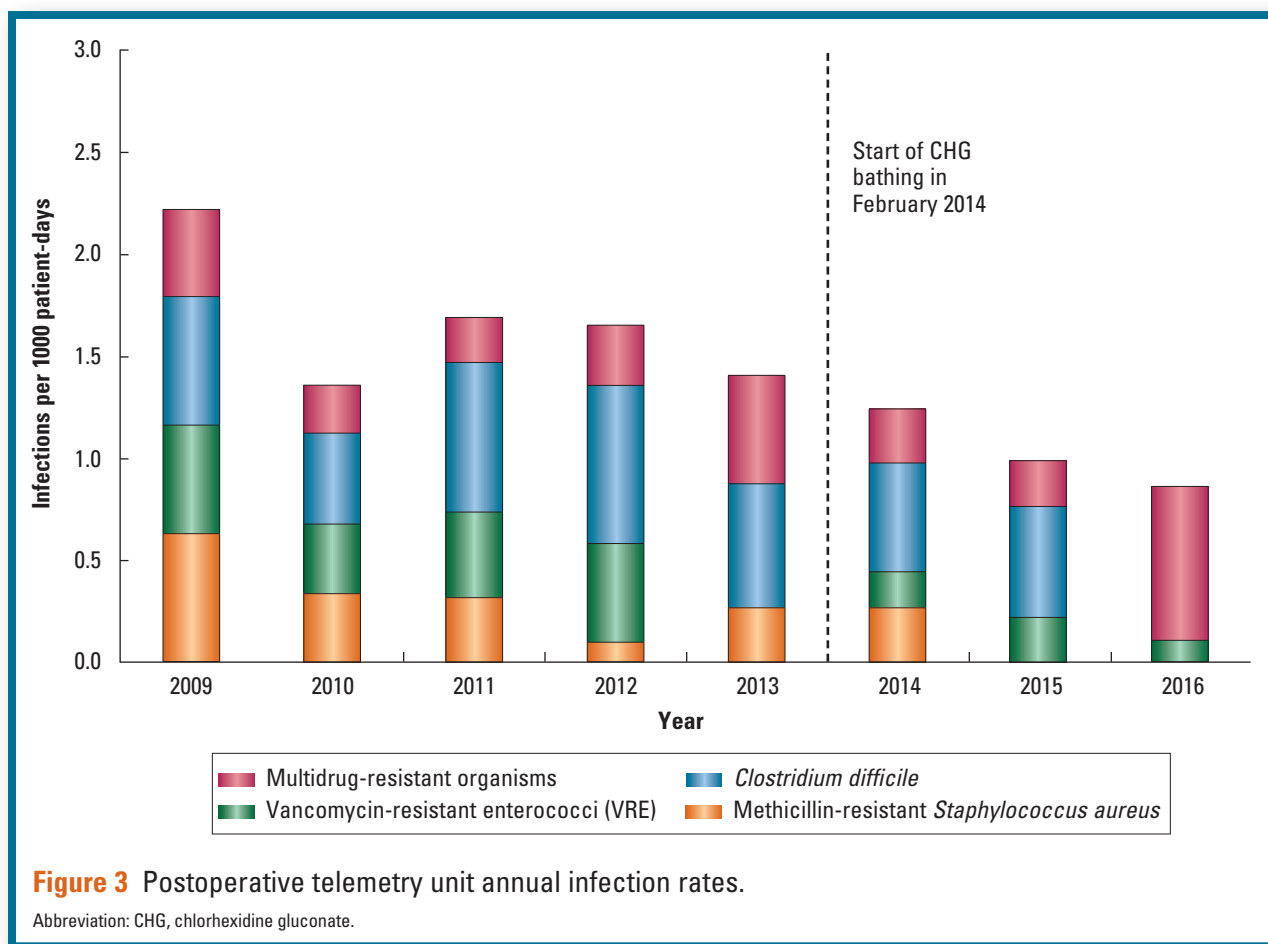
Figure 2 Medical-surgical intensive care unit annual infection rates.

Abbreviation: CHG, chlorhexidine gluconate.

Results

Consistent patient bathing with 4% CHG was associated with a 52% reduction in HAIs in the MSICU. Table 1 compares infection incidence rates in the MSICU for each of the 4 documented organisms before and after adoption of the 4% CHG bathing program, and Figure 2

shows the annual infection incidence rates over time. During the preintervention period (January through December 2009), the MSICU had 61 infections over 9339 patient-days, an incidence rate of 6.5 infections per 1000 patient-days (95% CI, 5.9-7.2). In the postintervention period (January 2010 through March 2017), the



unit had 150 infections over 48 114 patient-days, an incidence rate of 3.1 infections per 1000 patient-days (95% CI, 2.8-3.4). The 95% Poisson CI of the ratio of pre- and postintervention incidence rates was 1.6 to 3 ($P < .001$). Because a ratio of 1, which signifies equal rates, is below the CI, the statistical conclusion is that the postintervention rate is significantly lower than the preintervention rate. The annual total infection rate for the MSICU showed an immediate reduction once CHG bathing was implemented. The rate fell by 42% from 2009 to 2010, the largest observed year-to-year decrease (bathing started in January 2010). Although the infection rate has increased in recent years, it remained below half of the preintervention rate throughout the study period.

The MRSA incidence rate fell from a preintervention rate of 1.2 infections per 1000 patient-days (95% CI, 0.5-1.8) to a postintervention rate of 0.7 infections per 1000 patient-days, a drop that, although not significant (rate ratio, 1.6; 95% CI, 0.7-3.3; $P = .23$), is directionally encouraging and noteworthy. The VRE incidence rate decreased significantly from 1.2 (95% CI, 0.5-1.8) to 0.5 (95% CI,

0.2-0.7) infections per 1000 patient-days, a 61% decrease (rate ratio, 2.6; 95% CI, 1.1-5.5; $P < .02$). The *C difficile* incidence rate also had a significant decrease of 63% (rate ratio, 1.7; 95% CI, 1.7-4.4; $P < .001$), from 3.0 infections (95% CI, 2.4-3.6) to 1.1 infections (95% CI, 1.9-5.2) per 1000 patient-days. The MDRO infection rate fell 29%, from 1.2 (95% CI, 0.5-1.8) to 0.8 (95% CI, 0.5-1.1) infections per 1000 patient-days (rate ratio, 2.1; 95% CI, 1.5-2.8; $P = .39$).

In the postoperative telemetry unit, the 4% CHG bathing program yielded a 45% reduction in HAIs. Figure 3 shows the annual infection rates over time in the postoperative telemetry unit. During the preintervention period, the telemetry unit had 85 infections in 50 483 patient-days, an incidence rate of 1.7 infections per 1000 patient-days (95% CI, 1.4-2.0; Table 2). In the postintervention period, the unit had 29 infections in 31 197 patient-days, an incidence rate of 0.9 infections per 1000 patient-days (95% CI, 0.6-1.3). The overall decrease in the rate was significant (rate ratio, 1.8; 95% CI, 1.2-2.9; $P < .01$). The decrease was largest during

Table 2 Infection rates before and after implementation of the 4% chlorhexidine gluconate bathing program in the postoperative telemetry unit (before intervention, January 2009 through January 2014; after intervention, February 2014 through March 2017)

Infection	Before intervention (50 483 patient-days)		After intervention (31 197 patient-days)		P
	No. of infections	Rate ^a (95% CI)	No. of infections	Rate ^a (95% CI)	
MRSA	17	0.3 (0.1-0.6)	2	0.1 (0.0-0.4)	.02
VRE	17	0.3 (0.1-0.6)	5	0.2 (0.0-0.5)	.20
<i>Clostridium difficile</i>	34	0.7 (0.4-0.9)	17	0.5 (0.2-0.9)	.57
MDRO	17	0.3 (0.1-0.6)	5	0.2 (0.0-0.5)	.20
Total	85	1.7 (1.4-2.0)	29	0.9 (0.6-1.3)	.01

Abbreviations: MDRO, multidrug-resistant organisms; MRSA, methicillin-resistant *Staphylococcus aureus*; VRE, vancomycin-resistant enterococci.

^a Infections per 1000 patient-days.

the year after the intervention; the number of infections dropped from 14 in 2014 to 9 in 2015.

The most noteworthy reduction in the postoperative telemetry unit was in the MRSA infection rate. The incidence rate decreased from 0.34 (95% CI, 0.1-0.6) to 0.06 (95% CI, 0-0.4) infections per 1000 patient-days, a significant rate ratio of 5.3 (95% CI, 1.2-46.9; $P < .02$). No MRSA infections occurred in the postoperative telemetry unit in 2015 and 2016. Although only MRSA infections were significantly reduced, infections with all of the documented organisms decreased following initiation of CHG bathing. The VRE and MDRO infection incidence rates decreased by more than 50% after the protocol was implemented, and the postoperative telemetry unit had only 5 cases each of

VRE and MDRO infection from February 2014 through March 2017 (as compared with 17

The annual total infection rate for the MSICU showed an immediate reduction once CHG bathing was implemented; the rate fell by 42% from 2009 to 2010.

cases from January 2009 through February 2014). Although the *C difficile* infection incidence rate decreased the least, the rate was 19% lower after the intervention. Although the reductions in VRE, MDRO, and *C difficile* infections were not significant, they are anecdotally noteworthy and indicate continued success in the future.

Discussion

Patient bathing is one of the cornerstones of hospital care. Bathing provides a chance to check in with a patient, both physically during the bathing process and emotionally

by providing a level of comfort. Benefits for the patient include comfort, evaluation of skin integrity, promotion of range of motion, improved venous return, and infection prevention.

The results of studies of CHG bathing are mixed partially because of the variety of ways CHG is manufactured. Chlorhexidine gluconate bathing product options include impregnated wipes and 2% and 4% CHG products. Two studies are closely related to our work described in this article. Petlin et al⁷ detailed a basin bathing program that reduced MRSA infections in the ICU. The team also evaluated the most cost-effective way to bathe and found that liquid CHG was 74% less expensive than impregnated wipes.⁷ Reagan and colleagues⁸ used a mathematical model to assess the impact of CHG bathing on HAIs. Their work showed that as compliance with bathing increased, HAIs decreased, further supporting the added benefit of cost savings of the CHG program.⁸

At the beginning of our bathing initiative, the infection prevention team acknowledged a wide disparity in bathing practices, challenging the belief that everyone knew the proper way to provide a bath. Developing a step-by-step, standardized bathing protocol takes much of the disparity out of the process. Kohm and colleagues⁹ emphasized the importance of a detailed, standardized bathing process in their evidence-based practice work. In addition to studying the reduction in HAIs, Kohm and colleagues implemented the standard CHG bathing protocol first hospital-wide and then systemwide.⁹

Our institution has used the same 4% CHG bathing solution since the beginning of the bathing initiative

but has switched between liquid and foam products. The MSICU initially used foam CHG and switched to liquid. After noting a slight increase in infection rates, the unit returned to using foam CHG. A possible explanation for the disparity between the foam and liquid forms of CHG is that the foam may provide a helpful visual check of appropriate product coverage that is not evident with the liquid product (ie, where the foam goes, the CHG goes). In an article published in 2019, Jusino-Leon et al⁹ acknowledged a limitation of CHG-impregnated wipes. They noted that wipe application left patients feeling sticky, making patients uncomfortable and therefore more apt to refuse the application. Our goal was to bring a positive bath experience to patients, improving their safety and comfort.¹⁰

Chlorhexidine gluconate is a broad-spectrum antimicrobial product with excellent activity against gram-positive and gram-negative bacteria.¹¹ Although study results vary, CHG bathing has been shown to significantly decrease HAIs, including *C difficile* infections, catheter-associated urinary tract infections, surgical site infections, and many others.¹²

On the basis of the success of daily CHG patient bathing in the MSICU, the program was expanded to include the postoperative telemetry unit in February 2014. This unit houses higher-acuity, non-critical care patients who undergo complex and invasive procedures. The unit had a small but consistent number of *C difficile* infections that the facility wanted to address.

Although hospital staff in general agreed that reducing HAIs was a worthwhile goal, obtaining full agreement from the nursing department was difficult at first because of the perception of additional work. It was critical to develop a systematic method of delivering patient baths to standardize the delivery of care and increase the chances of success and sustainability. We developed a standardized bathing method that did not increase the length of the bathing process and took approximately 15 minutes per bath. We recognized that users of the new protocol would become more proficient with time. The new protocol helped demonstrate to the nursing staff that standardized patient bathing could reduce HAIs and save caregiver bathing time.

The financial decision to expand the standardized CHG bathing protocol to the rest of the hospital became much easier when the management team could see the infection reductions that occurred during implementation

in the MSICU and the postoperative telemetry unit. The estimated cost of the additional linens and 4% CHG bathing solution required for the expansion was \$19 000 a year, a figure that was offset by nearly \$114 000 in savings by reducing the incidence of HAIs, for an estimated cost avoidance of \$95 000 every year. This cost avoidance was separate from the savings realized from the earlier implementation.

In August 2015, 4% CHG patient bathing was introduced in all inpatient units except for the neonatal intensive care, psychiatric, pediatric, and maternal and child health units (unless the patient had a central catheter or was older than 2 months of age). These units were initially excluded because of internal risk assessment results and the relatively low incidence of HAIs, but implementation is being considered in these areas, particularly the maternal and child health unit.

The University of Maryland Medical System has also addressed specific horizontal strategies to further address HAIs. The system's nurse practice council and the infection prevention team continue to collaborate on a systemwide standard of daily CHG bathing.

Results from the hospital-wide 4% CHG bathing effort are ongoing but encouraging. University of Maryland St. Joseph Medical Center had multiple extended periods without central catheter-associated bloodstream infections through December 2020. Despite these positive developments, the hospital did not experience the dramatic drop

in HAIs that occurred in the MSICU and the postoperative telemetry unit. We believe that the smaller reduction in HAIs in the hospital-wide program may be the result of continuing variations in bathing protocols. These variations can be addressed by monitoring and additional training where necessary. The program continues to evolve as hospital staff members develop a self-care guide for patients who are able to participate in activities of daily living such as bathing.

It was critical to develop a systematic method of delivering patient baths to standardize the delivery of care and increase the chances of success and sustainability.

Limitations

A limitation of our findings is that they are based on an observational study using unadjusted data, a fact that does not invalidate the results but indicates that the results

should be interpreted appropriately. The observational nature of the data means that a causal relationship between standardized CHG bathing and a drop in infection rates cannot be firmly established. However, we believe the results are important and justify the suggestion that the CHG bathing protocol described in this article could benefit other hospitals. Our analysis demonstrated that a significant reduction in infection rates coincided with the adoption of CHG bathing, a reduction that is hard to imagine occurring without some type of focused intervention.

Conclusion

Using a 4% CHG solution as part of a standardized bathing protocol reduced HAIs by 50% or more among high-acuity hospitalized patients. In many units in our hospital, the reductions have been dramatic. Providing daily bathing with linen and 4% CHG solution carries up-front costs that are easily recouped through cost avoidance from the reduction in HAIs. Hospitals continue to focus on patient satisfaction as well as HAIs, and daily bathing with 4% CHG has been a necessary and successful part of our toolkit to provide the highest quality of care to the patients we serve. [CCN](#)

Financial Disclosures
None reported.

See also

To learn more about chlorhexidine gluconate bathing, read “Safety of Biweekly Chlorhexidine Gluconate Bathing in Infants 36 To 48 Weeks’ Postmenstrual Age” by Chandonnet et al in the *American Journal of Critical Care*, 2019;28(6):451-459. Available at www.ajconline.org.

References

1. Zhang S, Palazuelos-Munoz S, Balsells EM, Nair H, Chit A, Kyaw MH. Cost of hospital management of *Clostridium difficile* infection in United States—a meta-analysis and modelling study. *BMC Infect Dis*. 2016;16(1):447. doi:10.1186/s12879-016-1786-6
2. Health Services Cost Review Commission. Final recommendations for updating the quality-based reimbursement program for rate year 2018 and 2019. February 8, 2017. Accessed July 6, 2021. https://hsrc.maryland.gov/Documents/Quality_Documents/QBR/Ry2018/FINAL-Recommendation-QBR-Ry2018-and-2019.pdf
3. Umscheid CA, Mitchell MD, Doshi JA, Agarwal R, Williams K, Brennan PJ. Estimating the proportion of healthcare-associated infections that are reasonably preventable and the related mortality and costs. *Infect Control Hosp Epidemiol*. 2011;32(2):101-114.
4. Rupp ME, Cavalieri RJ, Lyden E, et al. Effect of hospital-wide chlorhexidine patient bathing on healthcare-associated infections. *Infect Control Hosp Epidemiol*. 2012;33(11):1094-1100.
5. Zimlichman E, Henderson D, Tamir O, et al. Health care-associated infections: a meta-analysis of costs and financial impact on the US health care system. *JAMA Intern Med*. 2013;173(22):2039-2046. doi:10.1001/jamainternmed.2013.9763
6. The R Foundation website. The R project for statistical computing. Accessed July 21, 2021. <https://www.R-project.org>

7. Petlin A, Schallom M, Prentice D, et al. Chlorhexidine gluconate bathing to reduce methicillin-resistant *Staphylococcus aureus* acquisition. *Crit Care Nurse*. 2014;34(5):17-26. doi:10.4037/ccn2014943
8. Reagan KA, Chan DM, Vanhoozer G, et al. You get back what you give: decreased hospital infections with improvement in CHG bathing, a mathematical modeling and cost analysis. *Am J Infect Control*. 2019;47(12):1471-1473. doi:10.1016/j.ajic.2019.07.003
9. Kohm D, Thompson C, Sloane R, et al. 2014 National Teaching Institute evidence-based solutions and chapter best practices abstracts. EB129 Use of chlorhexidine gluconate to bathe patients in intensive care units. *Crit Care Nurse*. 2014;34(2):e43.
10. Jusino-Leon GN, Matheson L, Forsythe L. Chlorhexidine gluconate baths: supporting daily use to reduce central line-associated bloodstream infections affecting immunocompromised patients. *Clin J Oncol Nurs*. 2019;23(2):E32-E38. doi:10.1188/19.CJON.E32-E38
11. Chen W, Cao Q, Li S, Li H, Zhang W. Impact of daily bathing with chlorhexidine gluconate on ventilator associated pneumonia in intensive care units: a meta-analysis. *J Thorac Dis*. 2015;7(4):746-753. doi:10.3978/j.issn.2072-1439.2015.04.21
12. Strouse AC. Appraising the literature on bathing practices and catheter-associated urinary tract infection prevention. *Urol Nurs*. 2015;35(1):11-17.