A Bath a Day Keeps the Germs Away: Chlorhexidine Gluconate Bathing Expansion Quality Improvement Project

Mahrukh Choudhary[1†], Kenneth Lam[1†], Connor M. Magura[1†], Jasmine Santos[1†], Julia Shamis[1†], Navindra Tajeshwar[1†], Hina Farrukh[2], and Joseph Santora[2]
[1]Geisinger Commonwealth School of Medicine, 525 Pine St, Scranton, PA 18509
[2]Atlanticare Regional Medical Center, 1925 Pacific Ave, Atlantic City, NJ 08401
[†]Doctor of Medicine Program
Correspondence: cmagura@som.geisinger.edu

Abstract

Health-care-associated infections (HAI) among patients admitted to the hospital are on the rise, particularly for patients in the intensive care unit (ICU) (1). These infections are difficult to treat and often require potent antibiotics. Infection control protocols put out by The Centers for Disease Control and Prevention (CDC) include routine chlorhexidine gluconate (CHG) baths for high-risk patients. Daily bathing with CHG has been proven, in several prior studies, to reduce the risk of infection in this patient population. To lower the high possibility of these patients developing resistant infections, a CHG protocol was added to the appropriate order sets at two AtlantiCare Regional Medical Centers, and the corresponding staff were trained accordingly and compliance was measured by ICU vs PCU units and Mainland vs Atlantic City locations. The purpose of this quality improvement project was to look at these implementations and assess compliance and completion rates after the intervention. Results showed significant differences between average percentage of eligible days CHG ordered, average percentage of completed CHG protocol, and average percentage of completed CHG protocol per days ordered between Mainland PCU and Mainland ICU ($p < 0.0001$), City PCU and City ICU ($p < 0.0001$), and Mainland PCU and City PCU ($p < 0.01$). There were no significant differences between Mainland ICU and City ICU. In the future, utilizing this data we hope to target and improve the low-compliance areas of the hospital via an integrated education plan.

Introduction

Multidrug-resistant organisms (MDROs), like methicillin-resistant *Staphylococcus aureus* (MRSA) and vancomycin-resistant enterococcus (VRE), have become endemic to hospitals, particularly in higher-acuity care units. Such infections are associated with significant morbidity and mortality, particularly in intensive care units (ICUs), and linked with the use of medical instrumentation like central lines and venous catheters (1). Furthermore, these infections have been shown to significantly extend the length of stay for patients, and subsequently result in high attributable costs per infection ranging from $25,000 to $56,000 (2). Many of these costs, in some cases, are no longer reimbursed by third-party payers like the Centers for Medicare and Medicaid Services (3).

Reduction of health-care-associated infections is thereby a top priority for hospitals. The Center for Disease Control and Prevention (CDC) has created a variety of strategies, such as hand hygiene and the use of isolation precautions in order to limit the spread of MDROs among patients, but such strategies require consistent adherence from all members of the healthcare team during frequent patient encounters, and can thus be difficult to sustain (4).

Targeted interventions, like the use of antiseptic agents for patient bathing, can significantly decrease the risk of hospital-acquired bloodstream infections. Chlorhexidine gluconate (CHG) is an antiseptic agent with broad-spectrum activity against many organs, particularly MDROs, and has residual antibacterial activity that can decrease both the microbial colonization on patients' skin and prevent secondary contamination from the health care environment (5). There have been many studies that found significant rate reductions in the acquisition of both VRE and MRSA in ICU and central line patients following the implementation of daily CHG bathing protocols, with reductions ranging from 36–74% (5-9). While compliance was variable throughout these studies, the effects of implementation were still considerable, significantly impacting morbidity and mortality of patients, hospital costs, and length of stay (5–9).

ICUs are generally reserved for the most acutely ill patients, those that are unstable, in critical condition, and who require very intensive care and monitoring, and thus more concentrated staffing for each individual patient. Progressive care units (PCUs) are considered to be intermediate or transitional care units, essentially implying that these patients are an intermediary step between the ICU and the medical or surgical floor. They can be used for either providing a higher level of care for patients deteriorating on a ward, or rather a lower level of care for those transitioning out of intensive care (10).

AtlantiCare Regional Medical Center has two divisions; the City Division is located in Atlantic City, NJ, and the Mainland Division is located in Pomona, NJ. The City Division is a level II Trauma Center that serves a large, diverse population in an urban environment. It has a total of 26 ICU beds and 181 acute-care beds. The Mainland Division is a Primary Stroke and Advanced Cardiac Surgery Center that serves a suburban area surrounded by many skilled nursing facilities. It has a total of 22 ICU beds, and 255 acute-care beds.

The purpose of this quality improvement project was to expand daily CHG bathing of hospitalized patients at both AtlantiCare Regional Medical Center City Division and Mainland Division to include patients with invasive devices (central lines, chest tubes, nephrostomy tubes), those who are going to surgery, and all patients in the ICU and PCU settings for the betterment of infection control. To implement this change, the order sets and protocols for these groups of patients were changed, all members of the health care team were educated in these changes and the importance of daily CHG bathing, and adherence was audited and assessed throughout the various hospital units to ensure an increase following the intervention.

Methods

The CHG project sought to assess the level of compliance with CHG washing of patients in the selected clinical settings and determine their baseline before performing a programmatic initiative to increase compliance. Our pre-intervention data included patients eligible from January 1, 2019, to January 31, 2019. Our various patient cohorts included PCU and ICU patients who required CHG bathing at our city and mainland hospitals. The patients' data was extracted by reviewing their charts and included: their hospital, their unit, their floor, their days of eligibility for CHG bathing, their early discontinuation, the ordering provider, and a reason for termination of bath if applicable.

Data analysis

Compliance data was analyzed retrospectively using chart review. De-identified data was then stored using Google Drive. All other data such as compliance statistics were derived from this initial chart review and compiled using Microsoft Excel. We then stratified our data by patient location in PCU or ICU, and their hospital. Our main outcomes were to look at compliance in three different ways. First, compliance of completing washes when they are ordered. Second, having orders entered for washing on eligible days. Third, for completing washes for all eligible days. We were able to compare the different departments for their integrated performance for each eligible day of each encounter and we were also able to look at different department data stratified by each patient visit. These results were then compared and analyzed using a t-test found on graphpad.com where appropriate.

Results

Mainland eligibility for the intervention was noted at 1,868 indicated days. Data showed that 704 (37.69%) of these occasions were ordered appropriately and 414 (22.16%) of these indications were completed. Of the number of orders placed 58.81% were fulfilled. From Mainland PCU there were 1,248 (66.81%) days where CHG orders were eligible, 350 (28.04%) where eligible CHG orders were placed, and 193 days (15.46%) where eligible CHG orders were completed. Of the number of orders placed, 55.14% were fulfilled. From Mainland ICU, there were 620 days (33.19%) eligible for CHG orders, 354 days (57.10%) where eligible CHG orders were placed, and 221 days (35.64%) where eligible CHG orders were completed. Of the number of orders placed, 62.43% were fulfilled.

Examination of Mainland data showed that the average percentage of eligible days where CHG was ordered was 38.21% and the average percentage of eligible days where CHG orders were completed was 22.61%. The average percentage of fulfilled orders per day was 33.36%. From Mainland PCU, the average percentage of eligible days where CHG was ordered was 22.16% and the average percentage of eligible days where CHG orders were completed was 12.68%. The average percentage of fulfilled orders per day was 21.54%. From Mainland ICU, the average percentage of eligible days where CHG was ordered was 62.54% and the average percentage of eligible days where CHG orders were completed was 41.03%. The average percentage of fulfilled orders per day was 54.88%.

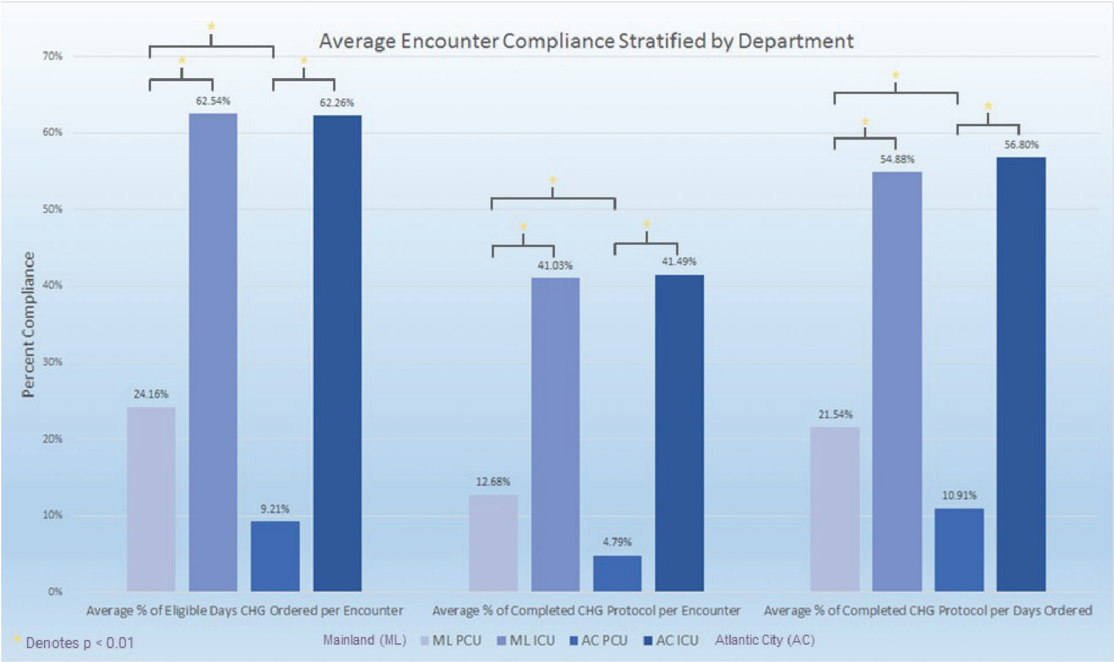

Figure 1. Average patient encounter compliance of chlorhexidine gluconate (CHG) ordering and washing, stratified by department.

Analysis of Mainland data showed a significant difference in the average percentage of eligible days CHG ordered per encounter between Mainland PCU and Mainland ICU (24.16% vs 62.54% [$p < 0.0001$]), average percentage of completed CHG protocol per encounter (12.68% vs 41.03% [$p < 0.0001$]), and average percentage of completed CHG protocol per days ordered (21.54% vs 54.88% [$p < 0.0001$]), as shown in Figure 1.

At City, there were a total of 2,144 days where CHG orders were eligible, 808 days (37.69%) where eligible CHG orders were placed, and 519 days (24.21%) where eligible CHG orders were completed. Of the number of orders placed, 64.23% were fulfilled. From City PCU, there were 1,052 days (49.06%) where CHG orders were eligible, 152 days (14.44%) where eligible CHG orders were placed, and 80 days (7.06%) where eligible CHG orders were completed. Of the number of orders placed, 52.63% were fulfilled. From City ICU, there were 1,092 days (50.93%) where CHG orders were eligible, 656 days (60.07%) where eligible CHG orders were placed, and 439 days (40.2%) where eligible CHG orders were completed. Of the number of orders placed, 66.92% were fulfilled.

In examining City data at an individualized level, the average percentage of eligible days where CHG was ordered was 33.52% and the average percentage of eligible days where CHG orders were completed was 21.61%. The average percentage of fulfilled orders per day was 31.93%. From City PCU, the average percentage of eligible days where CHG was ordered was 9.21% and the average percentage of eligible days where CHG orders were completed was 4.79%. The average percentage of fulfilled orders per day was 10.91%. From City ICU, the average percentage of eligible days where CHG was ordered was 62.26% and the average percentage of eligible days where CHG orders were completed was 41.49%. The average percentage of fulfilled orders per day was 56.80%.

Analysis of City data showed a significant difference in the average percentage of eligible days CHG ordered per encounter between City PCU and City ICU (9.21% vs 62.26% [$p < 0.0001$]), average percentage of completed CHG protocol per encounter (4.79% vs 41.49% [$p < 0.0001$]), and average percentage of completed CHG protocol per days ordered (10.91% vs 56.80% [$p < 0.0001$]), as shown in Figure 1.

There were significant differences between Mainland PCU and City PCU in the average percentage of eligible days CHG ordered per encounter (24.16% vs 9.21% [$p < 0.0001$]), average percentage of completed CHG protocol per encounter (12.68% vs 4.79% [$p < 0.0002$]), and average percentage of completed CHG protocol per days ordered (21.54% vs 10.91% [$p < 0.0055$]). There were no significant differences between Mainland ICU and City ICU, as shown in Figure 1.

Discussion

Research has shown that daily CHG bathing is linked to significant reduction in hospital-acquired infections among patients (5). Adherence to CHG bathing protocol is vital in order to ensure infection risk is minimized for our patients. As with any change in protocol or methodology, the shift towards CHG baths and the use of CHG poses several concerns to be further evaluated, including effectiveness of the new CHG protocol, provider compliance with the new protocol, and financial implications for the hospital systems.

The effectiveness of CHG baths has been proven to result in a statistically significant reduction in infections in multiple studies. A study at McGill University Health Center compared central-line-associated blood infections (CLABSI) with and without CHG usage in the neonatal intensive care unit, with findings that showed that the rate of infections decreased in the experimental (i.e., CHG usage) but remained the same in the control group (no CHG usage) (11). These findings were also reproduced in an adult population. A study comparing the efficacy of 0.5% CHG, 1% CHG and 10% aqueous povidine-iodine (PVI) in prevention of CLABSI showed more than double the rate of infections in the PVI group. There were no significant differences in the rate of infections when the 0.5% and 1% CHG groups were compared (12). Another study comparing CHG with PVI also concluded that CHG was more effective in prevention of CLABSI, particularly for infections caused by gram-positive bacteria (13). There have been many studies conducted to assess the effectiveness of CHG usage in CLABSI prevention. Most of these have shown it to be superior to other antiseptics, such as PVI (11, 12, 13). These findings suggest that CHG usage should be used in patients, particularly those at high risk of developing an infection due to a central line insertion or a surgical procedure.

Implementation of any protocol requires thorough evaluation of financial implications that may result from the intervention. A meta-analysis evaluating the costs associated with CHG implementation showed a less than $5 increase to make the switch from a non-medicated bathing cloth to a 2% CHG bathing cloth. While this may seem high when considered in a larger scale of a hospital system, the same study reports that the cost associated with a single CLABSI is more than 10 times the cost to switch to a medicated CHG bathing cloth (14). Another study performed within a neurosurgery department evaluated the implementation of a new protocol along with a provider intervention where each provider was informed of their individual infection rates among spinal surgery patients. They were also informed of the success of the new protocol and the financial implications associated with surgical infections. The authors found not only a greater than 40% reduction in the number of infections, but also found that this intervention resulted in an estimated annual cost savings of almost $300,000 (15). Although we were unable to consider and find the cost savings associated with CHG use within our own hospital systems, the findings from the studies above suggest that proper CHG and infection prevention protocol can result in improvement in overall costs within a department or a hospital.

Although the effectiveness of CHG has been evaluated by many researchers and there are many studies that have shown CLABSI reduction with CHG usage, provider compliance continues to be an area of concern. The goal of this study was to evaluate compliance rates between two different hospitals as well as between two different units within the hospitals, the PCU and ICU. Overall, within the 4 units that were assessed in this study, the provider compliance average was below 33%. The completion average was below 25%. The findings did show a higher compliance and completion rate among providers in the ICU when compared to the PCU. This finding could be attributed to two different reasons. Firstly, the ICU protocol includes a CHG bath when a patient is admitted to the unit, whereas the PCU requires that a provider manually order the CHG bath. Additionally, we believe that the higher acuity of patients in the ICU may have also played a role in the higher provider compliance rates.

During our investigation, we uncovered a multitude of reasons why CHG baths were not completed. Limited understanding of CHG protocol and utility of EHR order sets may have played a role in provider ordering compliance during this timeframe. We also discovered various reasons why a CHG bath may have been ordered but not given to a patient at bedside, which included findings such as: medication not available, patient downgraded, not tolerated, not appropriate, provider canceled, and patient refused. Overall, gaining an understanding of CHG bathing protocol compliance in January 2019 helps us to better target provider and patient education, streamline EHR ordering, and improve access to the medication for eligible patients. This information will be vital to improve future CHG bathing compliance within AtlantiCare hospitals and minimize future hospital infection risk for these vulnerable ICU/PCU patients.

Limitations of our data include selection and sampling error. Patient lists were generated by pulling data from the electronic health records. Our selection of patients was not randomized and sample size limited to eligible ICU/PCU patients with the January 2019 timeframe. In addition, although we aimed to standardize the data collection process among investigators with the creation of a data collection protocol, there exists an inherent amount of measurement error given the limitations of our data collection tools and collection process.

Future direction for our project will aim to address the drastic differences in the compliance and completion rates between the PCU and ICU at both hospitals. Implementing a new PCU order set, which will include a CHG protocol, similar to those found in the ICU, then reassessing after the intervention can elucidate how technology affects compliance and completion rates. From there, further steps can focus on provider and patient education to assess their impact on compliance and completion rates in both hospitals' PCUs and ICUs.

References

1. Vincent JL, Rello J, Marshall J, et al. International study of the prevalence and outcomes of infection in intensive care units. *JAMA*. 2009;302(21):2323-9. doi: 10.1001/jama.2009.1754.
2. Dixon JM. The effects of daily 2% CHG cloth bathing on catheter-related bloodstream infection rates in a surgical intensive care unit. *Am J Infect Control*. 2009;37(5):E57.
3. Stone PW, Glied SA, McNair PD, et al. CMS changes in reimbursement for HAIs: setting a research agenda. *Med Care*. 2010;48:433-9. doi: 10.1097/MLR.0b013e3181d5fb3f.
4. Siegel JD, Rhinehart E, Jackson M, Chiarello L. 2007 Guideline for Isolation Precautions: preventing transmission of infectious agents in health care settings. *Am J Infect Control*. 2007;(35):S65- S164. doi: 10.1016/j.ajic.2007.10.007.
5. Climo MW, Yokoe DS, Warren DK, et al. Effect of daily chlorhexidine bathing on hospital-acquired infection. *N Engl J Med*. 2013;368(6):533–542. doi:10.1056/NEJMoa1113849
6. Vernon MO, Hayden MK, Trick WE, Hayes RA, Blom DW, Weinstein RA. 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;166:306-12. doi: 10.1001/archinte.166.3.306.
7. Bleasdale SC, Trick WE, Gonzalez IM, Lyles RD, Hayden MK, Weinstein RA. Effectiveness of chlorhexidine bathing to reduce catheter-associated bloodstream infections in medical intensive care unit patients. *Arch Intern Med*. 2007;167:2073-9. doi: 10.1001/archinte.167.19.2073.
8. Milstone AM, Elward A, Song X, et al: Daily chlorhexidine bathing to reduce bacteraemia in critically ill children: a multicentre, cluster-randomised, crossover trial. *Lancet*. 2013; 381:1099-1106. doi: 10.1016/S0140-6736(12)61687-0.
9. Septimus E, Hickok J, Moody J, et al: Closing the translation gap: toolkit-based implementation of universal decolonization in adult intensive care units reduces central line-associated bloodstream infections in 95 community hospitals. *Clin Infect Dis*. 2016;63:172-177. doi: 10.1093/cid/ciw282.
10. Prin M, Wunsch H. The role of stepdown beds in hospital care. *Am J Respir Crit Care Med*. 2014;190(11):1210-1216. doi:10.1164/rccm.201406-1117PP
11. Quach C, Milstone AM, Perpête C, Bonenfant M, Moore DL, Perreault T. Chlorhexidine bathing in a tertiary care neonatal intensive care unit: impact on central line-associated bloodstream infections. *Infect Control Hosp Epidemiol*. 2014;35(2):158-163. doi:10.1086/674862
12. Yasuda H, Sanui M, Abe T, et al. Comparison of the efficacy of three topical antiseptic solutions for the prevention of catheter colonization: a multicenter randomized controlled study. *Crit Care*. 2017;21(1):320. Published 2017 Dec 21. doi:10.1186/s13054-017-1890-z
13. Mimoz O, Pieroni L, Lawrence C, et al. Prospective, randomized trial of two antiseptic solutions for prevention of central venous or arterial catheter colonization and infection in intensive care unit patients. *Crit Care Med*. 1996;24(11):1818-1823. doi:10.1097/00003246-199611000-00010
14. Shah HN, Schwartz JL, Luna G, Cullen DL. Bathing with 2% chlorhexidine gluconate: evidence and costs associated with central line-associated bloodstream infections. *Crit Care Nurs Q*. 2016;39(1):42-50. doi:10.1097/CNQ.0000000000000096
15. Agarwal N, Agarwal P, Querry A, et al. Implementation of an infection prevention bundle and increased physician awareness improves surgical outcomes and reduces costs associated with spine surgery. *J Neurosurg Spine*. 2018;29(1):108-114. doi:10.3171/2017.11.SPINE17436