

Implementation Strategies to Improve Evidence-Based Bathing Practices in a Neuro ICU

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ABSTRACT

Background: Evidence supports daily bathing using chlorhexidine gluconate (CHG) cloths to decrease preventable hospital-acquired central line-associated bloodstream infections (CLABSIs). However, implementation of this practice is inconsistent. Using multifaceted strategies to promote implementation is supported in the literature, yet there is a gap in knowing which strategies are most successful.

Purpose: Using the Grol and Wensing Model of Implementation as a guide, the purpose of this study was to determine whether using tailored, multifaceted strategies would improve implementation of daily CHG bathing and decrease CLABSIs in a large neuro ICU.

Methods: An observational pre-/postdesign was used.

Results: Following implementation, infection rates decreased ($P = .031$). Statistically significant improvements were also seen across all process measures: bathing documentation, nursing knowledge, and perceived importance of CHG bathing.

Conclusions: This study assists in closing the research-practice gap by using tailored, multifaceted implementation strategies to increase use of evidence-based nursing care for infection prevention practices.

Key words: chlorhexidine gluconate (CHG) cloths, evidence-based practice, implementation science, infection, nursing

In the United States, central line-associated bloodstream infections (CLABSIs) account for approximately 80 000 infections per year, with upward of 28 000 deaths annually.¹⁻³ More than half of all intensive care unit (ICU) patients in the United States will have a central venous catheter during hospitalization, accruing up to 15 million central lines per day.² Because preventable CLABSIs significantly compromise quality of care and can contribute to unnecessary antibiotic use, double patient's hospital length of stay,

as well as cost upward of \$46 000 per episode, CLABSIs are a major quality indicators in ICUs.

A national protocol for central line infection prevention was established in 2013 by the Agency for Healthcare Research and Quality (AHRQ).⁷ This protocol addresses patient and site care procedures to minimize the risk of infection using chlorhexidine gluconate (CHG) cloths for bathing. In 2013, Huang and colleagues⁸ conducted a large randomized controlled trial to study the effectiveness of daily bathing using CHG cloths per the AHRQ protocol. In addition to daily bathing with CHG cloths, this protocol recommended using CHG cloths to clean over central line dressings and up to 6 inches of the central line tubing.⁷ More than 48 000 patients were randomized to receive this bathing process, which showed a statistically significant decrease ($P < .001$) in CLABSI rates.⁸ Subsequent studies also showed significant decreases in CLABSIs after implementing similar bathing procedures.⁹⁻¹¹

Whereas daily CHG bathing in the ICU is widely supported in the literature to decrease CLABSIs, implementation of this practice varies widely. Unfortunately, this gap between research and practice is common in health care, with

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up to 50% of all patients not receiving care that is evidence-based.¹² Previous studies that have implemented CHG bathing have not described in detail the strategies used to successfully implement this practice, lending to a need for further research in the area of implementation science.⁸⁻¹¹

Per the Grol and Wensing Model of Implementation,¹² multifaceted strategies tailored to local determinants (ie, barriers and facilitators) are noted in the literature to be more effective than single strategies, such as passive dissemination.¹³ Yet, there is a gap in knowing which bundles of strategies are most successful for implementation.¹³ Wuchner¹⁴ completed an integrative review focused on implementation strategies to improve nurses' compliance with evidence-based practices, which yielded limited results. Yet, the subsequent scientific statement by Chan and colleagues¹⁵ demonstrated robust evidence for 2 effective interventions: (1) audit and feedback, and (2) educational outreach or the use of outside experts to provide educational content and perspective. Despite the recent scientific statement, variability in adoption of evidence regarding CHG bathing practices persists, resulting in preventable infections, and increased health care costs and deaths each year.

PURPOSE

CLABSI rates above the national average were noted in the fall of 2016 in a neuro ICU in a large, southeastern tertiary care center. Whereas CHG cloths were available, use of the cloths for daily bathing per the AHRQ protocol was inconsistent. The purpose of this study was to evaluate strategies used to improve nurses' knowledge of and compliance with the evidence-based AHRQ protocol for bathing in a large neuro ICU; these strategies included educational outreach, audit and feedback, local opinion leaders, and printed educational materials. In addition, the goal was to decrease CLABSI rates after implementation of CHG bathing. This study was approved by the university's institutional review board as meeting criteria for exemption, and constituted minimal risk for the protection of human subjects.

The research questions were: (1) Do tailored, multifaceted implementation strategies improve nurses' knowledge/perceptions of CHG bathing in a neuro ICU? (2) Do tailored, multifaceted implementation strategies improve compliance with documentation of daily CHG bathing

among neuro ICU nurses? (3) Does daily CHG bathing improve CLABSI rates in a neuro ICU?

METHODS

A paired pre-/posttest design was used to evaluate the effects of the implementation strategies on nurses' knowledge/perceptions and compliance to CHG bathing. Nurses' knowledge/perceptions of CHG bathing were measured via a previously used survey (adapted from Hines et al¹⁶). Ten demographic questions as well as 8 questions measuring nurses' knowledge and perceptions (ie, how important they felt CHG bathing was) around daily CHG bathing were included. Hard copies of the surveys were printed on brightly colored paper and put into the nurses and nursing assistants' mailboxes. Completed surveys were put into an envelope located in the nursing breakroom. Nurses and nursing assistants were given approximately 10 days to complete the presurvey in October 2016. Education was provided in November 2016. Postsurveys were given after the education was provided in December 2016.

Protocol compliance was measured using documentation audits of the electronic health record. The neuroscience clinical nurse specialist (CNS) leading the project completed weekly CHG bathing documentation audits before and after implementation of the intervention (August 2016 to August 2017).

An observational pre-/postdesign was used to evaluate the incidence of CLABSIs. Data were provided to the unit by the hospital's infection prevention team and measured based on guidelines set by the National Healthcare Safety Network.¹⁷ Infections are reported on a monthly basis, with rates measured by number of CLABSIs per 1000 central line days.

Implementation procedures

The Grol and Wensing¹² Model of Implementation provided overall guidance for this study. This model indicates that implementation strategies may be more effective if they are guided by determinants (ie, barriers and facilitators) to implementation. For this study, determinants to implementation were identified through informal discussions with nursing staff. A knowledge deficit related to the appropriate procedure for bathing per the AHRQ protocol was identified. Other barriers included a lack of motivation and perceived importance of CHG

bathing. However, staff was eager to implement evidence-based practices that would improve patient care, which served as a strong facilitator to change. Implementation strategies were based on these determinants and included educational outreach, local opinion leaders, printed educational materials, and audit and feedback.¹⁵

Educational outreach intervention

Chan and colleagues¹⁵ describe educational outreach as visits whereby trained people, in this case the neuroscience CNS, provide face-to-face visits with clinicians where they practice to inform and educate them on evidence-based practice changes. For this study, educational outreach sessions included a short, 10- to 15-minute, PowerPoint presentation highlighting evidence supporting CHG bathing and the step-by-step procedure for CHG bathing per the AHRQ protocol. A short 2-minute video from the CHG cloth manufacturer was shown, detailing how to use the cloths. In each of these sessions, CHG bathing was presented as an “antimicrobial treatment” provided to patients, similar to providing antibiotics. Demonstration of correct CHG bathing documentation in the electronic health record was provided.

The CNS scheduled time on both day and night shifts for the education to occur, particularly around shift change. A total of 11 sessions were offered and incentives were provided for participation. Approximately 1 to 4 nurses attended each session at a time. Out of the 85 staff members, 49 (58%) were able to attend an in-person educational outreach session. For those unable to attend, the PowerPoint presentation and video were sent to staff, with a “read receipt” attached to the e-mail for verification of receipt and viewing of materials. A total of 8 staff members responded to the “read receipt;” as such, a total of 57 staff members (67%) were trained on CHG bathing procedures.

Local opinion leader intervention

Per Powell et al,¹³ local opinion leaders include those who are seen as experts by their peers and can influence others’ behaviors to improve their practice through motivation and role modeling. Two experienced nurses who served as “hospital-acquired infection champions” for the neuro ICU also served as the local opinion leaders for this project. These individuals were well versed on

use of CHG bathing and served as helpful resources and role models for CHG bathing.

Printed educational materials intervention

Printed educational materials, in the forms of flyers, were developed by the CNS and local opinion leaders. Information was retrieved from the AHRQ and CHG cloth manufacturers and modified for this unit’s context. Printed educational materials are meant to improve clinicians’ knowledge, awareness, and ultimately their practice.¹⁸ As such, these educational materials were disseminated and included pertinent information regarding the use and importance of daily CHG bathing per the AHRQ protocol, a picture showing how each of the cloths included in a CHG package should be used, and contact information for the CNS for any questions.

Audit and feedback intervention

Audit and feedback mechanisms are perhaps the strongest evidence-based method to improve professionals’ performance.¹⁵ This strategy may be most effective when an expert is responsible for the audit and feedback and it is provided iteratively, allowing the staff to see improvement over time.¹⁹ The neuroscience CNS began auditing daily CHG bathing 2 months before implementation of the education. After implementation, audits were completed on a weekly basis for 6 months. To provide consistency, the neuroscience CNS was the only person conducting audits. Only patients who had been admitted to the unit for more than 24 hours were included in the audits, with a goal set at 90% compliance to CHG bathing documentation. Feedback was disseminated to staff via e-mail, and included a run chart noting the staff’s compliance to daily CHG bathing documentation. A “kudos” section listing nurses/nursing assistants’ names who documented the bathing activity was also included.

Analysis

We used parametric and nonparametric statistics for describing the demographics of the 2 cohorts. We evaluated the difference in counts and rates of total CLABSIs pre- and postintervention using a *t* test for comparison of 2 independent groups. We used the paired *t* test to compare pre- and postsurvey scores for the nurse knowledge and audit data. We used statistical process control mapping to assess the magnitude of bathing process variability at baseline, and to determine the

effect (stability) of the systematic change in practice on the postintervention CLABSI rates over time.²⁰

RESULTS

Nursing knowledge/perceptions outcome

A total of 85 nurses and nursing assistants were employed on the neuro ICU during implementation. Response rates for completing both the pre- and postsurveys were 25% ($n = 21$). On average, participating staff had 5.3 years of nursing experience, with 3 years of experience in the neuroscience ICU. Most nurses held a bachelor's degree (71.4%), with 31.6% holding a national nursing certification (eg, CCRN, CNRN, or SCRN) (Supplemental Digital Content, Table, available at: <http://links.lww.com/JNCQ/A460>).

Postsurvey results showed a statistically significant improvement in nurses' knowledge of CHG bathing, $t(20) = 3.873$, $P = .001$. The perception of priority nurses and others gave to CHG bathing also increased significantly, $t(20) = 3.532$, $P = .002$. There was a significant positive correlation between months of experience and importance of CHG bathing on the presurvey ($n = 21$; $r = 0.453$, $P = .039$).

CHG bathing documentation compliance

Prior to implementation, documentation audits revealed an average of 57% compliance to CHG bathing. Following implementation, this average increased to 80%, showing a statistically significant improvement, $t(30) = -5.811$, $P = .013$. The largest improvement occurred immediately

following implementation and leveled off at approximately 80%.

CLABSI rates

All CLABSI rates are measured per 1000 central line days per Centers for Disease Control and Prevention guidelines.²¹ From November 2015 to October 2016 (12 months prior to implementation), the neuro ICU's CLABSI rate was 2.81. During the 2 months of implementation (November and December 2016), CLABSIs spiked to a rate of 7.13. In the 12 months following implementation (January to December 2017), CLABSI rates decreased to 1.12, a statistically significant decrease from the 12 months prior to implementation, $t(22) = 2.094$, $P = .031$ (Figure). Central line days remained consistent throughout this period.

DISCUSSION

Implementation strategies

Translation of evidence-based protocols into practice has historically been difficult, leading to a consistently large research-practice gap.^{15,22} The importance of using multifaceted implementation strategies that are tailored to perceived determinants (ie, barriers and facilitators) has been cited in the literature.^{12,15} This study used 4 implementation strategies of educational outreach, audit and feedback, local opinion leaders, and educational materials to mitigate the perceived barriers of lack of knowledge, motivation, and perceived importance of CHG bathing. Previous studies have documented improvements in nursing knowledge and compliance with evidence-based practices using educational outreach and

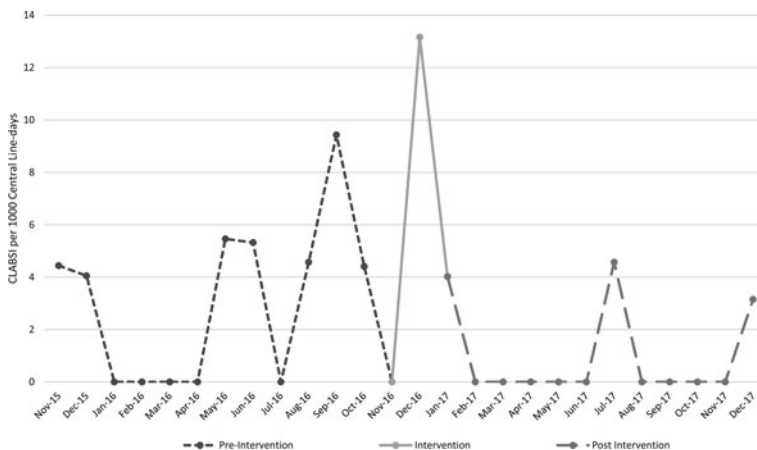


Figure. CLABSI rate pre- and postimplementation. CLABSI indicates central line-associated bloodstream infection.

printed educational materials.²³⁻²⁵ Several other studies have found success with audit and feedback strategies to improve nursing compliance with evidence-based practices.^{23,26,27} Using local opinion leaders in conjunction with other active implementation strategies has also showed a positive effect in improving use of evidence-based practices by nurses.^{24,25,28} Despite evidence supporting the implementation strategies used in this study, descriptions of how these strategies have been operationalized in other studies is limited, making it difficult to adequately compare their effectiveness.^{14,29}

Nursing knowledge/perception outcomes

After implementation, a statistically significant improvement was noted in nursing knowledge and perceived importance of daily CHG bathing. Similarly, Reynolds et al²⁴ noted an increase in nursing knowledge of stroke guidelines and spinal cord injury guidelines²⁵ in neuro ICU nurses following similar implementation strategies. Congruent with other findings,^{24,25} nurses with more experience had significantly higher scores on the presurvey related to the priority they gave to CHG bathing. These nurses may have been exposed to more evidence around the importance of CHG bathing through their experience.

Compliance documentation outcomes

Compliance to daily CHG bathing was measured through documentation audits of the electronic health record. Although documentation does not always reflect nursing practice, a component of the educational outreach was to improve nursing documentation. That is, during the educational outreach sessions, nurses were shown where documentation of CHG bathing was to occur in the electronic health record. Whereas compliance did not reach the 90% goal for daily bathing using CHG, audits did show a significant improvement in documentation.

Previous studies have also used documentation audits to measure nursing compliance with evidence-based practices. Reynolds et al²⁴ following implementation strategies of educational outreach, printed educational materials, and local opinion leaders found an increase in nurses' documentation of evidence-based stroke practices, although findings were not statistically significant. Likewise, Olsen et al³⁰ found an increase in documentation compliance with an

ICU pain management algorithm following educational meetings. In contrast, documentation compliance to quality measures for adults with Crohn's disease following educational meetings and audit and feedback was not found to be statistically significant by Greene and colleagues.³¹

Inconsistent reporting of how implementation strategies were used could attribute to variations in findings. Differences in which implementation strategies were used together make it difficult to identify which strategies are most effective for improving documentation compliance. Also, this study sought to implement infection-related evidence-based practices whereas previous studies focused on other health care guidelines, which could have contributed to variations among findings.

CLABSI outcomes

CLABSI rates initially spiked immediately following implementation; however, in the 12 months following, CLABSI rates significantly decreased. This decrease noted in the 12 months pre- versus 12 months postimplementation (removing the spike during the implementation period) could be associated with an approximate \$184,000 savings. It is unknown why rates initially spiked after implementation; these results have not been found in other, similar studies. Many other studies have shown contrasting findings, with a significant decrease in CLABSI rates following implementation of daily CHG bathing.⁸⁻¹¹

Implications

Research on tailored, multifaceted implementation strategies to improve evidence-based nursing practices is warranted, as there is incomplete evidence to "guide choice of knowledge translation targeting healthcare professionals."^{22(p14)} Evidence on the effectiveness of implementation interventions to improve uptake of evidence-based nursing practices and clinical outcomes is lacking, adding to the research-practice gap.^{13,15}

Limitations

Several limitations to this study exist. As CLABSIs are considered a high priority for the institution and are publically reported measures, other coinciding quality improvement initiatives may have contributed to the decrease in CLABSI rates. For example, ongoing education on hand hygiene and CLABSI bundle components was being provided around the same

time as implementation of the CHG bathing education. Furthermore, this study was conducted on one neuro ICU, which may limit generalizability.

CONCLUSIONS

Nursing practices can dramatically reduce hospital-acquired infections such as CLABSIs. Successful implementation of infection prevention practices found in the AHRQ protocol can improve nursing knowledge/perceptions and compliance with daily CHG bathing, resulting in a decrease in CLABSI rates. Moving forward, strategies should be focused on limiting drift in practice and reeducate as needed, especially as new staff nurses are hired. Findings from this study assist in closing the research-practice gap by using tailored, multifaceted implementation strategies to increase use of evidence-based nursing care for infection prevention practices.

REFERENCE

- Haddadin Y, Regunath H. Central line associated blood stream infections (CLABSI). In: *StatPearls*. Treasure Island, FL: StatPearls Publishing; 2017.
- Kornbau C, Lee KC, Hughes G, et al. Central line complications. *Int J Crit Illn Inj Sci*. 2015;5(3):170-178.
- O'Grady NP, Alexander M, Burns LA, et al. Guidelines for the prevention of intravascular catheter-related infections. <https://www.cdc.gov/hai/pdfs/bsi-guidelines-2011.pdf>. Published 2011. Accessed March 1, 2018.
- Agency for Healthcare Research and Quality. Tools for reducing central line-associated blood stream infections. <https://www.ahrq.gov/professionals/education/curriculum-tools/clabsitools/index.html>. Published 2017. Accessed March 1, 2018.
- Centers for Disease Control and Prevention. Central line-associated bloodstream infection. <https://www.cdc.gov/hai/bsi/bsi.html>. Published 2016. Accessed March 1, 2018.
- Woodward B, Umberger R. Review of best practices for CLABSI prevention and the impact of recent legislation on CLABSI reporting. *Sage Report*. 2016;6(4):1-7.
- Agency for Healthcare Research and Quality. *Universal ICU Decolonization: An Enhanced Protocol*. Rockville, MD: Agency for Healthcare Research and Quality; 2013.
- Huang SS, Septimus E, Kleinman K, et al. Targeted versus universal decolonization to prevent ICU infection. *N Engl J Med*. 2013;368(24):2255-2265.
- 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.
- Montecalvo MA, McKenna D, Yarrish R, et al. Chlorhexidine bathing to reduce central venous catheter-associated bloodstream infection: impact and sustainability. *Am J Med*. 2012;125:505-511.
- O'Horo JC, Silva GLM, Muoz-Price S, et al. The efficacy of daily bathing with chlorhexidine for reducing healthcare-associated bloodstream infections: a meta-analysis. *Infect Control Hosp Epidemiol*. 2012;33(3):257-267.
- Grol R, Wensing M. Effective implementation of change in healthcare: a systematic approach. In: Grol R, Wensing M, Davis D, eds. *Improving Patient Care: The Implementation of Change in Healthcare*. 2nd ed. Oxford, UK: John Wiley & Sons; 2013:40-63.
- Powell BJ, Waltz TJ, Chinman MJ, et al. A refined compilation of implementation strategies: results from the expert recommendations for implementing change (ERIC) project. *Implement Sci*. 2015;10(21):1-14.
- Wuchner SS. Integrative review of implementation strategies for translation of research-based evidence by nurses. *Clin Nurse Spec*. 2014;28(4):213-223.
- Chan WV, Pearson TA, Bennett GC, et al. Clinical practice guidelines implementation strategies: a summary of systematic review by the NHLBI implementation science work group. *J Am Coll Cardiol*. 2017;69(8):1076-1092.
- Hines AG, Nuss S, Rupp ME, et al. Chlorhexidine bathing of hospitalized patients: beliefs and practices of nurses and patient care technicians, and potential barriers to compliance. *Infect Control Hosp Epidemiol*. 2015;36(8):993-994.
- National Healthcare Safety Network. Surveillance for bloodstream infections. <https://www.cdc.gov/nhsn/acute-care-hospital/clabsi/index.html>. Published 2017. Accessed March 13, 2018.
- Giguere A, Legare F, Grimshaw J, et al. Printed educational materials: effects on professional practice and healthcare outcomes. *Cochrane Database Syst Rev*. 2012;2012(10):1-199.
- Ivers N, Jamtvedt G, Flottorp S, et al. Audit and feedback: Effects on professional practice and healthcare outcomes. *Cochrane Database Syst Rev*. 2012;(6):1-229.
- Benneyan JC, Lloyd RC, Plsek PE. Statistical process control as a tool for research and healthcare improvement. *Qual Saf Health Care*. 2003;12(6):458-464.
- Centers for Disease Control and Prevention. Bloodstream infection event. https://www.cdc.gov/nhsn/pdfs/pscmanual/4psc_clabscurrent.pdf. Published 2018. Accessed April 13, 2018.
- Grimshaw JM, Eccles MP, Lavis JN, et al. Knowledge translation of research findings. *Implement Sci*. 2012;7(50):1-17.
- Beekman D, Clays E, Van Heck A, et al. A multi-faceted tailored strategy to implement an electronic clinical decision support system for pressure ulcer prevention in nursing homes: a two-armed randomized controlled trial. *Int J Nurse Stud*. 2013;50(4):475-486.
- Reynolds SS, Murray LL, McLennon SM, et al. Implementation of a stroke competency program to improve nurses' knowledge of an adherence to stroke guidelines. *J Neurosci Nurs*. 2016;48(6):328-334.
- Reynolds SS, Murray L, McLennon S, et al. Implementation of a spinal cord injury program to improve nursing knowledge and adherence. *Rehabil Nurs*. 2018;43(1):52-61.
- Fuller C, Michie S, Savage J, et al. The feedback intervention trial (FIT)—improving hand-hygiene compliance in UK healthcare workers: a stepped wedge cluster randomized controlled trial. *PLoS One*. 2012;7(10):1-10.
- Huis A, Schoonhoven L, Grol R, et al. Impact of a team and leaders-directed strategy to improve nurses' adherence to hand hygiene guidelines: a cluster randomized trial. *Int J Nurse Stud*. 2013;50(4):464-474.
- McLeod RS, Aarts M, Chung F, et al. Development of an enhanced recovery after surgery guideline and implementation strategy based on the knowledge-to-action cycle. *Ann Surg*. 2015;262(6):1016-1025.
- Proctor EK, Powell BJ, McMillen JC. Implementation strategies: recommendations for specifying and reporting. *Implement Sci*. 2013;8(139):1-11.
- Olsen BF, Rustoen T, Sandvik L, et al. Implementation of a pain management algorithm in intensive care units and evaluation of nurses' level of adherence with the algorithm. *Heart Lung*. 2015;44(6):528-533.
- Greene L, Sapir T, Moreo K, et al. Impact of quality improvement educational interventions on documented adherence to quality measures for adults with Crohn's disease. *Inflamm Bowel Dis*. 2015;21(9):2165-2171.