Sustaining SLUG Bug CLABSI Reduction: Does Sterile Tubing Change Technique Really Work?

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abstract

OBJECTIVES: To evaluate the ability to sustain and further reduce central line–associated bloodstream infection (CLABSI) rates in NICUs participating in a multicenter CLABSI reduction collaborative and to assess the impact of the sterile tubing change (TC) technique as an important component in CLABSI reduction.

METHODS: A multi-institutional quality improvement collaborative lowered CLABSI rates in level IV NICUs over a 12-month period. During the 19-month sustain phase, centers were encouraged to monitor and report compliance measures but were only required to report the primary outcome measure of the CLABSI rate. Four participating centers adopted the sterile TC technique during the sustain phase as part of a local Plan-Do-Study-Act cycle.

RESULTS: The average aggregate baseline NICU CLABSI rate of 1.076 CLABSIs per 1000 line days was sustained for 19 months across 17 level IV NICUs from January 2013 to July 2014. Four centers transitioning from the clean to the sterile TC technique during the sustain phase had a 64% decrease in CLABSI rates from the baseline (1.59 CLABSIs per 1000 line days to 0.57 CLABSIs per 1000 line days).

CONCLUSIONS: Sustaining low CLABSI rates in a multicenter collaborative is feasible with team engagement and ongoing collaboration. With these results, we further demonstrate the positive impact of the sterile TC technique in CLABSI reduction efforts.

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Dr Pallotto provided leadership for the design and analytics of the collaborative and drafted the initial manuscript; Drs Piazza and Brozanski provided leadership for the design and analytics of the collaborative and reviewed and revised the manuscript; Drs Smith, Grover, and Chuo and Ms Mingrone, Holston, Moran, and Morelli participated in the design and management of the collaborative and critically reviewed the manuscript; Mr Provost provided data analytics and reviewed and revised the manuscript; Dr Zaniletti provided data analytics and critically reviewed the manuscript; and all authors approved the final manuscript as submitted.

DOI: https://doi.org/10.1542/peds.2016-3178

Accepted for publication Jul 19, 2017

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To cite: Pallotto EK, Piazza AJ, Smith JR, et al DNP, NNPd, LNCCi. Sustaining SLUG Bug CLABSI Reduction: Does Sterile Tubing Change Technique Really Work?. *Pediatrics*. 2017;140(4):e20163178

Central line–associated bloodstream infection (CLABSI) rate reduction is an ongoing quality expectation for hospitals and critical care units. CLABSIs are a potentially preventable cause of morbidity, mortality, and health care costs.[1,2] Seeking zero harm is an important patient care safety and quality issue for all hospital populations, especially for our smallest, most critically ill patients, who are managed in the NICU.[3,4] In 2011, the Children's Hospitals Neonatal Consortium (CHNC) began the Standardizing Line care Under Guideline recommendations (SLUG Bug) collaborative to reduce preventable bloodstream infections in neonatal patients.[5]

Benchmarking across member hospitals identified variation in CLABSI rates. During the collaborative, teams were able to decrease rates by nearly 20% from 1.33 CLABSIs per 1000 line days to 1.076 CLABSIs per 1000 line days.[5] Orchestrated testing was used in this SLUG Bug project to evaluate the effect(s) of 4 specific CLABSI prevention interventions (tubing change [TC] technique, hub

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care compliance, central venous catheter [CVC] access policy, and central line removal assessment) on CLABSI prevention.[5,6] Among the 4 factors studied, the sterile TC technique decreased CLABSI rates by an average of 0.51 CLABSIs per 1000 line days. The addition of hub care compliance monitoring produced the strongest effect (interaction of sterile TC with hub care monitoring), with an average decrease in CLABSI rates of 1.25 per 1000 line days.[5] Replication is an important methodology to confirm the contribution of a specific factor for process improvement in factorial design.[6]

In this sustain phase of the SLUG Bug collaborative, we sought to determine if centers were able to maintain low CLABSI rates after the conclusion of regularly scheduled collaborative monthly meetings. In addition, 4 centers elected to implement the sterile TC technique on the basis of the results of orchestrated testing. CLABSI reduction initiatives commonly report on important bundle components. To our knowledge, this is the first report to validate the impact of an individual bundle component. The specific aims of this analysis are to (1) report the ability of centers to sustain low rates and (2) describe the impact of the change from clean to sterile TC techniques in the 4 centers over the subsequent months of the sustain phase beginning in January of 2013.

METHODS

Setting

Seventeen level IV Children's Hospital NICUs completed participation in a quality collaborative from 2011 to 2012 to reduce CLABSIs across their NICUs.[5,7] Several key components of the Institute for Healthcare Improvement breakthrough series collaborative framework were used to facilitate a successful project.[8] During the collaborative study phase, activities included learning sessions, monthly webinars, a listserv, and quality improvement advisors.[5,9] The Institute for Healthcare Improvement extranet was used for central reporting of the CLABSI outcome and was the central repository for project documents (www.ihi.org). The sustain phase of this project was a 19-month period from January 2013 to July 2014. During the sustain phase, centers were encouraged to monitor and report compliance measures but were required to report CLABSI outcomes. Three additional webinars were held during the sustain phase to continue collaboration and team sharing (March 2013, June 2013, and January 2014).

Intervention

The TC technique during the study phase and sustain phase is presented in Table 1. Hospital G was removed because of nonadherence to assignment.[5] Teams with the sterile TC technique in place shared local process, training, and implementation recommendations via webinar. The 4 centers planning to adopt sterile TC asked questions and gained insight to strategies and barriers for successful local implementation. These centers defined processes and completed local team education by February 2013. Three of these 4 centers had hub care compliance monitoring in place at the start of the study.

Outcome Measure

The primary outcome measure, CLABSI rate, was defined by the National Healthcare Safety Network definition of CLABSI.[10] The SLUG Bug collaborative CLABSI prevention clinical practice recommendations were available to teams at the start of the collaborative.[5] Each team implemented the practice changes appropriate for their local systems on the basis of this document.

TABLE 1 Center TC Technique Over Time

SLUG Bug Identifier	TC Technique	
	Study Period	Sustain Period
B	Clean	Clean
C	Sterile	Sterile
D[a]	Clean	Sterile
E	Clean	Clean
F	Sterile	Sterile
H[a]	Clean	Sterile
A	Clean	Clean
K[a]	Clean	Sterile
I	Sterile	Sterile
J	Sterile	Sterile
L[a]	Clean	Sterile
N	Clean	Clean
O	Sterile	Sterile
P	Sterile	Sterile
Q	Sterile	Sterile
R	Sterile	Sterile

[a] Denotes the centers that changed TC technique from clean to sterile.

Before the sustain phase, the results of the orchestrated testing, which included the benefits of the sterile TC method, were reviewed and discussed with participating teams. The implementation of the sterile TC technique was voluntary and determined at the local level. The sterile TC technique was defined as the inclusion of sterile gloves and a mask with the use of a sterile barrier under the CVC. The clean TC technique was defined as the inclusion of clean gloves with sterile gauze barriers under the CVC. Local units developed multiple learning strategies for sterile tubing, such as mandatory video demonstrations and/or simulation skill sessions.

Ethical Considerations

The Children's Mercy Hospital, Kansas City, Missouri, pediatric institutional review board reviewed the SLUG Bug project and determined that it did not to meet the definition of research involving human subjects. Data submitted and analyzed were unit-based data and contained no patient identifiers.

Data Analysis

The monthly CLABSI rate ([CLABSI events / central line days] × 1000)

for each participating NICU was analyzed as a time series outcome variable by using control charts (Shewhart U charts) for the described groupings of centers.[11] The limits were calculated for both baseline and study phases, and the limits for the study phase were extended into the sustain phase. After standard signals were used to indicate special causes, the limits were recalculated for the sustain phase to have direct comparisons of the CLABSI rate for each group.[12]

RESULTS

The 19.3% collaborative CLABSI rate reduction (baseline rate of 1.333 to study phase rate of 1.076 CLABSIs per 1000 line days) was sustained for the subsequent 19 months (January 1, 2013–July 31, 2014) after the initial project period was completed. The sustain phase included 189 866 central line days. Figure 1 shows the centerline for the study phase extended into the sustain phase. The lack of an additional special cause signal denotes sustained results. Figure 2 shows the centerline and limits for each project phase for the entire collaborative.

To facilitate comparisons among the 3 TC groups, the centerline and control limits for each phase of the project were calculated to be consistent with Fig 2 (Fig 3). Special cause signals during the sustain phase showing higher rates would reveal that the results were not sustained. The absence of special cause signals would indicate sustainability. Special cause signals showing lower rates would reveal additional improvement beyond the study phase.

The control chart for the 8 centers that practiced the sterile TC technique in the study phase of the project is shown in Fig 3A. These centers had a 29% decrease from baseline to the study phase (1.52 CLABSIs per 1000 line days to

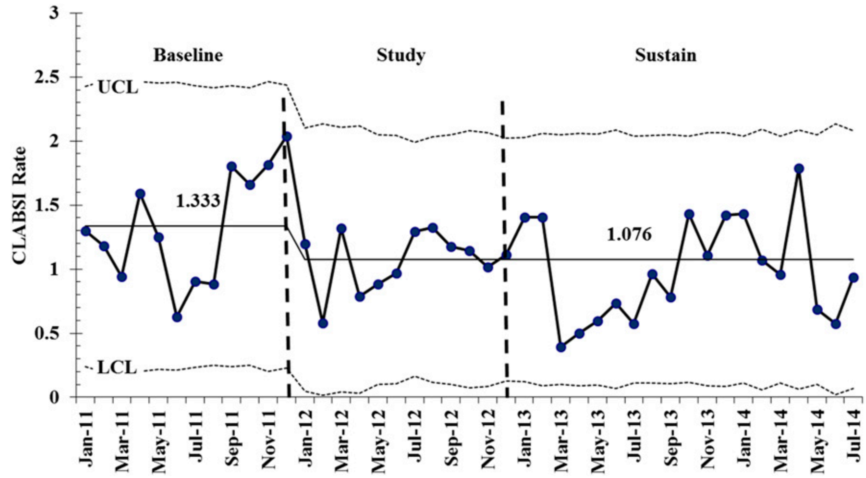

FIGURE 1
Collaborative control chart. The centerline reflects the study period special cause and is extended through the sustain period. No additional special cause was detected. The period from January to April 2014 includes 16 of 17 centers; the period from May to July 2014 includes 15 of 17 centers. LCL, lower control limit; UCL, upper control limit.

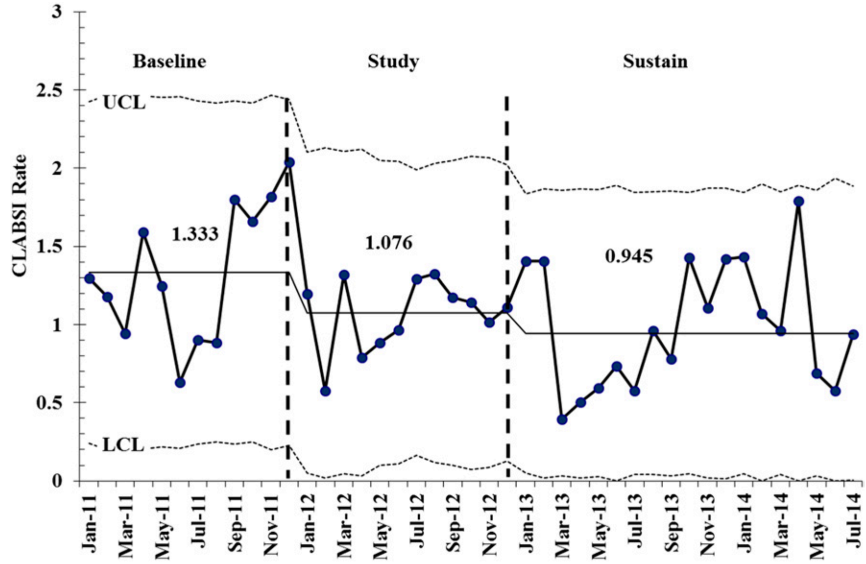

FIGURE 2
Collaborative control chart. The centerline was adjusted for each phase of the collaborative. No special cause was detected. The period from January to April 2014 includes 16 of 17 centers; the period from May to July 2014 includes 15 of 17 centers. LCL, lower control limit; UCL, upper control limit.

1.08 CLABSIs per 1000 line days). There was a special cause signal at the beginning of December 2012, suggesting a rate change. Recalculation of the centerline during the sustain phase, for comparison purposes, revealed 1.15 CLABSIs per 1000 central line days (a rate 24% lower than the baseline). Figure 3B shows that the 4 centers that continued to practice the clean TC method had low baseline CLABSI rates, which were maintained throughout the project.

The 4 centers implementing the sterile TC practice during the sustain phase of the project were the only group that achieved a rate reduction in both the study phase and the sustain phase. CLABSI rates

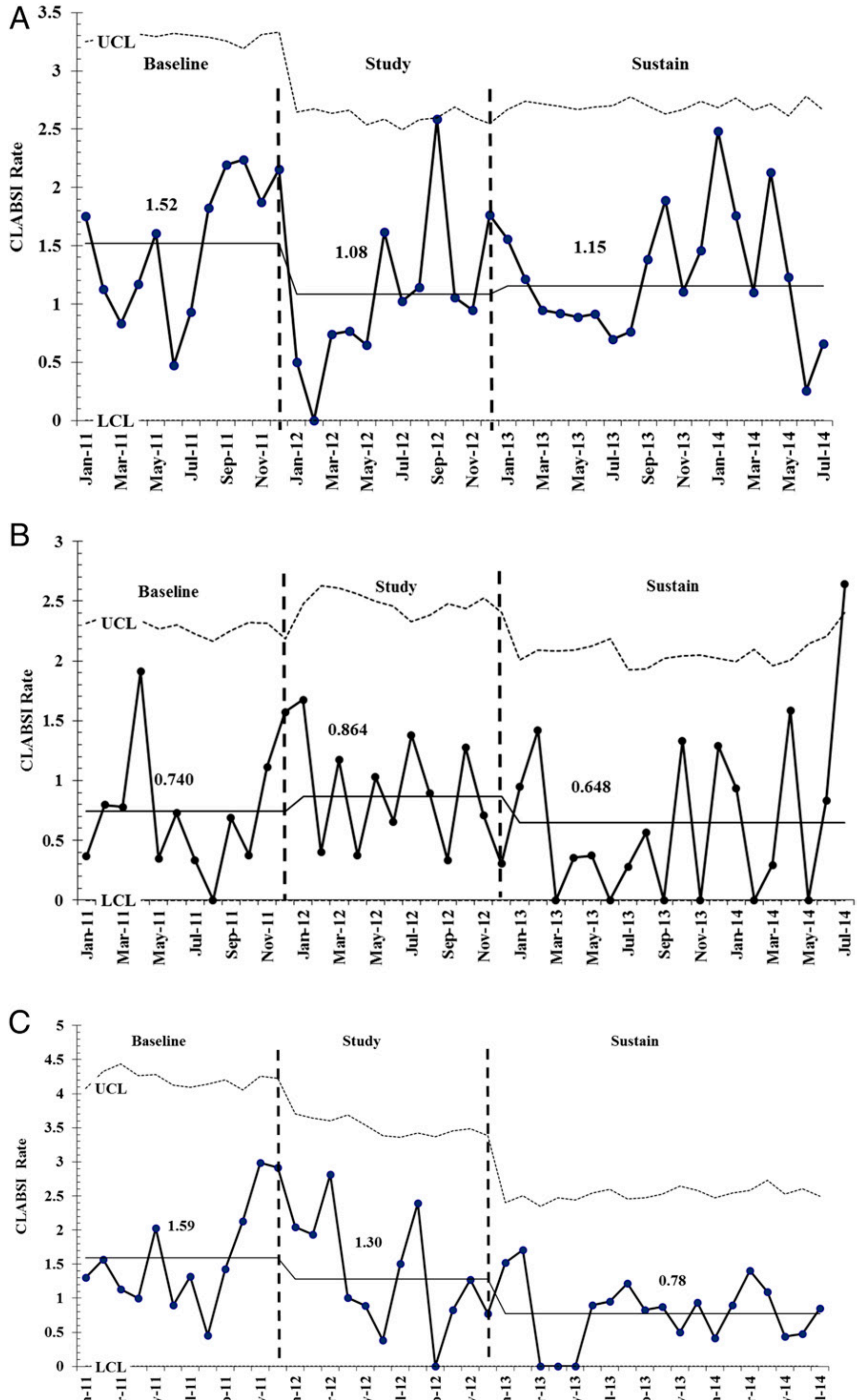

FIGURE 3

A, Control chart for 8 centers with sterile TC practice throughout the project. The centerline was adjusted for each phase of the collaborative. A special cause was detected with 6 points in consecutive decreasing direction, starting in December 2012. B, Control chart for 4 centers with clean TC practice throughout the project. The centerline was adjusted for each phase of the collaborative. No special cause was detected. C, Control chart for 4 centers changing from clean TC to sterile TC practice during the sustain period. The centerline was adjusted for each phase of the collaborative. A special cause was detected, starting in March 2013. LCL, lower control limit; UCL, upper control limit.

decreased by 18% from the baseline to the study phase (1.59 CLABSIs per 1000 line days to 1.30 CLABSIs per 1000 line days). During the sustain phase, there was a decrease by 40% (1.30 CLABSIs per 1000 line days to 0.78 CLABSIs per 1000 line days) (Fig 3C). The special cause signal detected, starting in March 2013, results indicating a rate decrease of 64% to 0.57 CLABSIs per 1000 line days from the baseline phase.

DISCUSSION

The low NICU CLABSI rate of 1.076 CLABSIs per 1000 line days noted during the study phase was sustained for 19 months across participating level IV NICUs. Furthermore, centers that integrated the sterile TC method into their CLABSI prevention practice during the sustain phase achieved an additional CLABSI rate reduction. With these results, we provide validation of the sterile TC technique, identified by orchestrated testing, as important for CLABSI reduction.[5,6]

This level IV NICU collaborative demonstrated the feasibility of sustaining a low CLABSI rate in the setting of high device use. The average device use (line days per 100 patient days) during the baseline and study phase across participating CHNC centers was 0.40 to 0.44 (unpublished observations), compared with 0.27, as reported for level III NICUs in a 2012 National Healthcare Safety Network report.[13] There were a total of 425 856 line days (116 987 in the baseline phase, 119 003 in study phase, and 189 866 in the sustain phase) across sites. The mean rate of infection at just over 1 CLABSI per 1000 line days at the end of the 19-month sustain phase (33 months postimplementation) reveals a remarkable ability of teams to improve practice. Pronovost et al,[14] in a setting of 90 ICUs, 300 310 line days, and an 18-month sustain phase in Michigan, were able to show

similar results in sustaining low rates.

Implementation of the sterile TC method by 4 centers during the sustain phase of this project was associated with further CLABSI rate reduction in this subgroup of hospitals. With these results, we provide confirmation of the importance of this practice in this type of intensive care setting. By replicating findings, we provide the effect validation needed to confirm the importance of specific practices identified by orchestrated testing.[6] Sustaining CLABSI rate reductions over time has been reported with multiple interventions in the University of North Carolina hospital system.[15] However, our ability to identify the effect of a specific practice is unique to our work and can help direct efforts in hospitals that are still trying to achieve rate reduction targets.

Sustaining change can be a challenge in any system. Evidence-based bundle elements deemed as "best practices" are insufficient as the sole methods to alter practitioner behavior.[16,17] To change behavior, the beliefs and values of individual stakeholders and local interdisciplinary teams must align with one another, the proposed change effort, and, ultimately, organizational goals.[18] Well-functioning interdisciplinary teams are crucial to transform care in any health system. Implementing and sustaining change require a culture that supports adoption not only of innovation but also of adaptability to innovate for both individuals and teams.[18,19]

Periodic collaborative calls during the sustain phase were used to check in with teams and to encourage sustainable practices and principles. Faculty advisors continued to track progress reports and provided ongoing support for local teams. Local participants in this collaborative were exposed to serial monitoring and continuous feedback from their own site and from the entire collaborative. This framework of transparency raised awareness that achieving low CLABSI rates is possible. Sharing barriers and successes to attain these results supports an all-teach, all-learn system.[14] An infrastructure to continue compliance monitoring and provide ongoing feedback to staff is beneficial. The trend toward higher rates in last few months of the collaborative, without a special cause, is consistent with common cause variation and suggests that constant vigilance and ongoing team engagement is required for continued success in constantly changing systems.

Our collaborative results must be interpreted by using the premise that sustaining improvement is usually associated with an intrinsic change in culture. The impact of local culture on process improvement in a multicenter collaborative is difficult to assess. In fact, sites practicing the clean TC method maintained a low CLABSI rate throughout the project, suggesting that there are additional practices that contribute to infection reduction. People are motivated to change when the desired behavior aligns with their beliefs and values.[20] Leaders create a culture that motivates by delivering an inspiring vision with clear expectations of the team's purpose. Each individual's potential to contribute to that vision will cultivate a successful implementation climate.[21] These teams and leaders may have cultivated an environment that effectively promoted a culture that contributed to the sustained success. The sterile TC technique may not decrease CLABSI rates in isolation, but it may complement other CVC practices and unit-based cultures of safety. Sites practicing the sterile TC method throughout both the study and sustain phases had an increase in their CLABSI rates during sustain phase. Each individual system should continue to examine evidenced-based infection prevention practices, compliance with practices, and unit culture to reveal pertinent factors that decrease or sustain low CLABSI rates.[5]

Microsystems are ever-changing. As a collaborative, we did not have the resources to monitor all of the potential practice and/or unit culture changes in each participating system over time. Centers may have added, removed, or changed practices that could have impacted CLABSI rates, resulting in either higher or lower rates. Factors that were not monitored or reported to the collaborative may impact the ability to sustain CLABSI reduction. Centers practicing the clean TC method had low rates at the start of the collaborative. This may deserve additional analysis to provide insight into key cultural factors that result in low CLABSI rates.

One center in the "always" sterile TC group supplied CLABSI data through December 2013. A second center, in the clean TC group, provided data through March 2014. It is possible that this missing data may have affected the CLABSI rate. However, the direction of this change may have resulted in a higher or lower CLABSI rate for the overall collaborative for an individual month during this time period. All centers in the clean to sterile TC group reported rates until the end of the sustain phase.

CONCLUSIONS

Low CLABSI rates can be sustained in NICUs with high device use. Vigilance, team engagement, and transparency in a collaborative network may contribute to success. With this report, we validate the importance of the sterile TC technique in CLABSI rate reduction. Our replication of results is an important step in orchestrated testing analysis. We speculate that the CLABSI reduction

practices used in this collaborative may be generalizable to other clinical care settings.

ACKNOWLEDGMENTS

Jeanette M. Asselin, MS, RRT-NPS, David J. Durand, MD, Francine D. Dykes, MD, Jacquelyn R. Evans, MD (Chair), Karna Murthy, MD, Michael A. Padula, MD, MBI, Eugenia K. Pallotto, MD, MSCE, Kristina M. Reber, MD, and Billie Lou Short, MD, are members of the CHNC. The CHNC (http://www.thechnc.org) has partnered with the Children's Hospital Association, Inc (Overland Park, KS) to design, launch, and maintain the Children's Hospitals Neonatal Database. The Children's Hospital Association provided administrative and analytic support for the Children's Hospitals Neonatal Database. We express our gratitude to Rick McClead, MD, for providing mentoring. We are indebted to the following institutions serving infants and their families that participated in this collaborative:

Children's Healthcare of Atlanta at Egleston, Atlanta, Georgia (Francine Dykes, MD; Cheryl Hulbert, BSN, RN);

Children's Healthcare of Atlanta at Scottish Rite, Atlanta, Georgia (Gregory Sysyn, MD; Kathy Tucker, BSN, RN; Robin Bagby, RN);

Le Bonheur Children's Hospital, Memphis, Tennessee (Bobby Bellflower, DNSC, NNP-BC; Mary Gatson, RN; Ramsubbareddy Dhanireddy, MD);

Boston Children's Hospital, Boston, Massachusetts (Celeste Chandonnet, BSN, RN, CCRN; Hillary Bishop Kuzdeba, MPH; Michele DeGrazia, PhD, RN, NNP-BC);

Nationwide Children's Hospital, Columbus, Ohio (Margaret R. Holston, RN, BSN; Kris R. Reber, MD);

Children's Medical Center Dallas, Dallas, Texas (Rashmin C. Savani, MBChB; Kerry Wilder, RN, BSN, MBA; Becky Ennis, MD);

Children's Hospital Colorado, Aurora, Colorado (Sheila Kaseman, RNC; Tera Carter, RN);

Texas Children's Hospital, Houston, Texas (Yvette Johnson, MD; Stacey Norris Hudspeth, BSN, RNC-NIC, VA-BC; Kathy Ware, RN, BSN, CIC);

Children's Mercy Kansas City, Kansas City, Missouri (Nesha Park, RN, BSN; Yolanda Ballam, BS, CIC; Eugenia Pallotto, MD, MSCE);

Children's Hospital Los Angeles, Los Angeles, California (Julie Evans, RN; Nancy McNeil, RN; Sharon Fichera, RN, MSN, NNP-BC);

Children's Hospital of Philadelphia, Philadelphia, Pennsylvania (John Chuo, MD, MS; Theresa O'Connor, BSN, RNC, CPHQ; Jacquelyn Evans, MD);

Children's Hospital of Pittsburgh of the University of Pittsburgh Medical Center, Pittsburgh, Pennsylvania (Beverly Brozanski, MD; Teresa Mingrone, MSN; Becky Gaves, CRNP);

St Louis Children's Hospital, St Louis, Missouri (Joan Smith, PhD, NNP-BC; Amy Distler, RN; Tasnim Najaf, MD);

All Children's Hospital, St Petersburg, Florida (Carine Stromquist, MD; Stacey Stone, MD);

Children's National Medical Center, Washington, District of Columbia (Lamia Soghier, MD; Tracie Harris, MT (ASCP), CIC; Kimberly Nelson MSN/MHA, RNC-NIC);

Children's Hospital of Wisconsin, Milwaukee, Wisconsin (Michael Uhing, MD; Tzong-Jin Wu, MD; Vijender Karody, MD); and

Children's Hospital & Medical Center, Omaha, Nebraska (Jamie McClintic, RN; Kindra Ndebele, APRN-NNP-BC; Jessica Fitzgerald, MSN, RN, CCRN).

ABBREVIATIONS

CHNC: Children's Hospitals Neonatal Consortium
CLABSI: central line–associated bloodstream infection
CVC: central venous catheter
SLUG Bug: Standardizing Line care Under Guideline recommendations
TC: tubing change

PEDIATRICS (ISSN Numbers: Print, 0031-4005; Online, 1098-4275).

FINANCIAL DISCLOSURE: Mr Provost was a paid consultant for the Children's Hospital Association, Ms Morelli and Dr Zaniletti were employees of the Children's Hospital Association throughout this project, and the other authors have indicated they have no financial relationships relevant to this article to disclose.

FUNDING: No external funding.

POTENTIAL CONFLICT OF INTEREST: The authors have indicated they have no potential conflicts of interest to disclose.

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