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Staff Education to Reduce the Incidence of Central Line Infections in the Pediatric Intensive Care Unit

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This is to certify that the doctoral study by

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has been found to be complete and satisfactory in all respects,
and that any and all revisions required by
the review committee have been made.

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Dr. Barbara Niedz, Committee Chairperson, Nursing Faculty
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Chief Academic Officer and Provost
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Walden University
2025

Executive Summary: Staff Education Project

Staff Education to Reduce the Incidence of Central Line Infections in the Pediatric Intensive Care Unit

by

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Executive Summary Submitted in Partial Fulfillment

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Summary

This Doctor of Nursing Practice (DNP) staff education project aimed to reduce the incidence of central line-associated bloodstream infections (CLABSI) in the Pediatric Intensive Care Unit (PICU) by educating clinical staff on the importance of hand hygiene and bundle compliance. Despite established guidelines, CLABSI remains a significant issue in healthcare, particularly in PICUs, where patients are at higher risk for infections. The practice-focused question guiding the project was: How does staff education on hand hygiene and CLABSI bundle compliance impact the prevention of CLABSI in the PICU?

Twenty-five PICU nurses participated in the educational sessions. Analytical strategies included pretests and posttests to assess knowledge and attitudes. Results showed significant improvements in knowledge, $t(19) = -6.00$, $p < .001$, and attitudes $t(19) = -3.93$, $p < .001$, supporting the effectiveness of the intervention. Education on CLABSI prevention improved staff awareness and adherence to infection control protocols. Integrating the training into staff orientation, offering periodic refreshers, and using real-time feedback could further strengthen compliance. This approach can reduce CLABSI rates, enhance patient safety, and improve infection control practices. Expanding the program across other units and facilities may promote consistency in infection prevention protocols. The project supports nursing practice by fostering a culture of safety, promoting equity in training access, and improving patient outcomes through better infection control practices. Furthermore, the project supports positive social change by promoting equitable access to educational opportunities for staff, contributing to a safer, more inclusive healthcare environment.

Background

Hospital-acquired infections (HAIs) are a significant concern in healthcare, especially in high-risk environments like pediatric intensive care units (PICUs), where vulnerable patients are at higher risk for severe complications. The purpose of this project was to evaluate how a staff education project affects knowledge, skills and attitudes among staff in the PICU regarding hand hygiene and bundle compliance. The long-term outcome will be to ultimately improve the rate of HAIs in the PICU. The practice-focused question guiding this project was: Will a staff education program on CLABSI prevention including hand hygiene and bundle compliance result in improved knowledge and skills as well as more positive attitudes in PICU staff?

Hand hygiene is widely recognized as one of the most effective strategies for preventing the transmission of infectious agents. However, studies have consistently shown that compliance rates among healthcare workers remain suboptimal, especially in PICUs. Mouajou et al. (2022) underscored the critical role of hand hygiene compliance in preventing HAIs, showing a direct correlation between improved hand hygiene practices and a reduction in infection rates. Despite this recognition, many healthcare settings, including PICUs, continue to face challenges in consistently implementing hand hygiene protocols.

In the PICU, several factors contribute to this gap, including inconsistent hand hygiene practices, insufficient educational interventions, and the lack of standardized monitoring systems. Lohiya et al. (2014) found that although hand hygiene compliance improved from 33% to 56% in a pediatric ICU setting following a multimodal intervention, compliance remained below optimal levels. Furthermore, Kopsidas et al.

(2022) highlighted that the lack of unified surveillance mechanisms across multiple PICUs in Europe contributed to the variability in compliance and infection control measures.

The purpose of this project was to provide education to improve knowledge, skills and attitudes towards the effectiveness of hand hygiene improvement strategies and bundle interventions in reducing HAIs in the PICU. Bundled interventions typically include a combination of education, reminders, feedback, and easy access to hand hygiene supplies. Previous studies have demonstrated the efficacy of such strategies, especially when applied in a structured, multimodal approach.

A comprehensive synthesis of the literature reveals strong evidence supporting the effectiveness of improved hand hygiene and bundled interventions in reducing HAIs in PICUs. The systematic review by Schweizer et al. (2014) emphasized that interventions incorporating education, reminders, and feedback substantially increased hand hygiene compliance, leading to a reduction in infection rates. Furthermore, an observational study by Murugesan et al. (2022) demonstrated significant improvements in hand hygiene compliance when a bundle of care interventions was implemented in an ICU setting.

The evidence highlights that while individual strategies can improve compliance, combining them into a cohesive bundle is especially effective. For example, a quality improvement study by Albert et al. (2019) found that a structured approach involving continuous feedback and education resulted in sustained hand hygiene compliance rates above 90% in a PICU setting. The study by Belela-Anacleto et al. (2019) directly supports robustness of the evidence for hand hygiene interventions in PICUs. This study falls under the category of a Level III observational study (Dang et al., 2022).

Despite the promising results, several challenges remain, including observer bias, short study durations, and a lack of standardized monitoring. The synthesis conducted by Graf et al. (2013) found that variability in compliance rates across different PICUs could be attributed to differing surveillance systems and practices. This highlights the importance of standardized monitoring systems in achieving consistent results. In their study, Belela-Anacleto et al. (2019) compared hand hygiene compliance before and after implementing structured interventions, which included education and feedback. The results indicated a significant improvement in hand hygiene compliance rates, supporting the effectiveness of these multimodal interventions. This aligns with the point that interventions involving education and real-time feedback are effective in improving compliance and reducing infection rates in PICUs. Thus, Belela-Anacleto et al.'s study contributes to the overall strength of evidence, reinforcing that multimodal interventions (e.g., education, feedback) are effective in improving hand hygiene compliance, which in turn helps reduce infection rates in PICUs

In summary, the body of evidence strongly supports the notion that improving hand hygiene compliance through bundled interventions can significantly reduce the incidence of HAIs in PICUs. This evidence base provides a compelling rationale for implementing structured hand hygiene programs and quality improvement initiatives in the PICU to achieve better patient outcomes.

Staff Education Project Development

This project aimed to improve adherence to hand hygiene practices as part of a strategy to prevent CLABSI in the PICU. The development began with a needs assessment that included reviewing HAI data related to CLABSI. Based on this, an

educational intervention was developed which provided a depth of understanding as to the effectiveness of hand hygiene and the bundle (see Appendix). The education project was conducted in the PICU setting, targeting 25 PICU nurses, ensuring a focused and interactive learning experience. The education was offered in three 15-minute modules at the change of shift, which emphasized the importance of hand hygiene and provided a forum for staff members to describe barriers and facilitators to CLABSI prevention. This approach ensured minimal disruption to nursing duties while engaging staff in meaningful discussions about infection prevention.

A pretest and posttest assessment regarding staff knowledge and attitudes about hand hygiene, bundle use and CLABSI prevention were measured before and after the intervention to evaluate the impact of the education. A PowerPoint presentation was created to educate the PICU team on the importance of hand hygiene in preventing CLABSI and the proper techniques for both hand hygiene and CLABSI prevention. The presentation served as a quick refreshment on current protocols used within the PICU and is offered to staff during their shifts as a concise and effective educational tool.

The pretest was administered to assess baseline knowledge with six questions and attitudes regarding hand hygiene and CLABSI prevention (see Appendix). The same tests were given after the educational sessions to measure changes in knowledge and attitudes. Knowledge questions were scored based on correct answers, while attitudes were assessed with five questions using a 5-point Likert scale, where a score of 5 indicated negative attitudes and a score of 25 indicated positive perspectives. A unique numbering system was used to link pretest and posttest responses, ensuring anonymity and confidentiality of the staff.

The data collected from the pretest and posttest were analyzed using SPSS (Version 31). Descriptive statistics were used to compare pretest and posttest scores, and statistical tests (e.g., paired *t* tests) were employed to assess significant improvements in knowledge and attitudes.

Results

The results of this staff education project were evaluated through pre- and post-assessments of staff knowledge and attitudes regarding the intervention, as well as a statistical analysis of the improvement observed. A paired *t* test was performed to compare the pre- and post-test scores on knowledge and attitude measures.

For knowledge scores, the analysis revealed a significant increase from pretest ($M = 4.40$, $SD = 1.14$) to posttest ($M = 5.60$, $SD = 0.60$). The improvement was statistically significant, $t(19) = -6.00$, $p < .001$, indicating a meaningful improvement in the participants' factual understanding of the CLABSI prevention strategies. Similarly, for attitude scores, the results showed a statistically significant improvement from pretest ($M = 20.00$, $SD = 5.28$) to posttest ($M = 24.30$, $SD = 1.34$), $t(19) = -3.93$, $p < .001$. These findings underscore the effectiveness of the educational intervention in enhancing both knowledge and attitudes toward infection control and patient safety practices.

The significant improvement in staff knowledge and attitudes suggests that the intervention was successful in increasing awareness and adherence to the CLABSI prevention bundle. The results highlight that regular education and training in infection control practices, specifically hand hygiene and central line bundle compliance, can substantially reduce the incidence of healthcare-associated infections in PICUs.

The improvements in both knowledge and attitudes directly impact patient safety and the quality of care provided in the PICU. By fostering a culture of safety and adherence to infection prevention protocols, the project contributes to better patient outcomes and a reduction in the incidence of CLABSI. Additionally, by improving staff compliance with infection control practices, the project aligns with organizational goals to enhance infection prevention efforts across the hospital.

One limitation of the project was the small sample size ($N = 20$), which may affect the generalizability of the results. Although the findings show a statistically significant improvement in knowledge and attitudes, the limited number of participants suggests that future studies should involve a larger sample size for more robust conclusions. Moreover, the project focused only on the PICU, and further research is needed to determine whether similar results could be achieved in other hospital units or healthcare settings.

This project not only contributes to improving infection control in the PICU but also has broader implications for nursing practice. The findings suggest that regular education, particularly on hand hygiene and bundle compliance, is crucial for reducing healthcare-associated infections across various healthcare settings. By ensuring that infection control practices are standardized and adhered to, this project has the potential to improve patient safety and healthcare outcomes on a larger scale.

Furthermore, the project supports positive social change by promoting equitable access to educational opportunities for staff, contributing to a safer, more inclusive healthcare environment. The promotion of best practices in infection control aligns with

efforts to ensure that healthcare services are effective, accessible, and equitable for all patients.

Conclusions

This DNP staff education project demonstrated that providing clinical staff with targeted education on infection control practices, specifically hand hygiene and Central Line Bundle compliance, significantly improves knowledge, attitudes, and adherence to infection prevention protocols. The intervention resulted in statistically significant improvements in both staff knowledge and attitudes, aligning with organizational priorities such as enhancing patient safety, reducing healthcare-associated infections, and promoting compliance with regulatory standards. By equipping nurses with the necessary tools to prevent CLABSI, the project fosters a culture of safety and patient-centered care.

The findings highlight the effectiveness of staff education in improving both the practical skills and the underlying attitudes necessary to reduce CLABSI rates in high-risk environments like the PICU. Moving forward, integrating this education into routine staff training and orientation programs will be crucial in maintaining long-term improvements in infection control practices. Offering periodic refresher courses will further solidify the changes in behavior, address staff turnover, and ensure that all team members are competent and confident in applying infection control protocols.

Additionally, fostering peer support and collaboration among staff will help reduce resistance to change and build a stronger commitment to maintaining high standards of care. Incorporating hands-on demonstrations and simulations during training can further enhance staff's ability to apply knowledge in real-world situations, ensuring skill retention and improving clinical decision-making in high-pressure environments.

This project reinforces the importance of continuous education and multidisciplinary collaboration in achieving sustained improvements in healthcare outcomes.

Ultimately, this initiative supports the potential for nursing-led interventions to promote social change by ensuring equitable access to high-quality care, enhancing patient safety, and creating a safer, more effective healthcare environment. The project underscores the critical role of nursing in advancing infection prevention strategies and highlights the significant impact that education and training can have on reducing healthcare-associated infections and improving patient outcomes.

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Appendix

Staff Education Planning Grid Project Materials

Improving Hand Hygiene and Central Line Bundle Compliance to Reduce Hospital-Acquired Infections (HAIs) and CLABSI in the Pediatric Intensive Care Unit (PICU)

Practice-Focused Question:

Among nurses in the Pediatric Intensive Care Unit (PICU), will an educational initiative on hand hygiene and Central Line Bundle compliance improve knowledge, skills, and adherence to infection prevention protocols, thereby reducing hospital-acquired infections (HAIs) and Central Line-Associated Bloodstream Infections (CLABSI)?

Educational Plan:

Target Audience:

PICU nurses, including registered nurses (RNs), and nurse practitioners (NPs), totaling approximately 20-25 staff members.

Learning Outcome(s):

Nursing Professional Development: Enhance the knowledge, skills, and confidence of PICU nurses to adhere to hand hygiene and central line bundle protocols, thereby improving infection control practices.

Patient Outcome: Significantly reduce the incidence of hospital-acquired infections (HAIs) and central line-associated bloodstream infections (CLABSI) in the Pediatric Intensive Care Unit (PICU), improving patient safety and quality of care.

Organizational Outcome: Improve overall compliance with infection prevention protocols, aligning with hospital safety standards, reducing healthcare-associated costs, and enhancing organizational performance metrics.

Topical Content Outline	Time frame	References	Teaching method/learner engagement and Evaluation method
Module 1: Introduction to Hand Hygiene in the PICU: Understanding the role of hand hygiene in preventing HAIs, with a focus on its critical impact in a pediatric intensive care setting. Proper techniques for hand hygiene: The WHO's "Five Moments for Hand Hygiene" and when and how to perform hand washing and alcohol-based hand sanitization.	**Training Duration:** 15 min educational session, twice per week for 3 weeks (three different modules, 30" each))	World Health Organization. (2021). *WHO guidelines on hand hygiene in health care*. https://www.who.int/gpsc/5may/tools/en/	**Interactive Lectures:** Engage staff in the learning process with PowerPoint presentations, case studies, and examples specific to the PICU environment. **Learner Engagement: Active Participation:** Learners will participate in live demonstrations and real-time peer feedback, ensuring they gain both theoretical knowledge and practical application.
Module 2: Understanding and Implementing the Central Line Bundle (CLABSI Prevention): Detailed breakdown of the CLABSI bundle components: hand hygiene, aseptic technique for line insertion, daily review of line necessity, and proper dressing and tubing maintenance.	**Follow-Up Support:** Monthly peer reviews and feedback sessions to reinforce compliance.	Centers for Disease Control and Prevention. (2020). *CLABSI prevention: A summary of the Centers for Disease Control and Prevention (CDC) guidelines*. https://www.cdc.gov/hai/pdfs/bsi/CLABSI-prevention-summary-508.pdf	**Hands-On Demonstrations:** Demonstrate proper hand hygiene techniques and central line care, followed by supervised return demonstrations. **Learner Engagement:**

Best practices and protocols for maintaining central lines, identifying common mistakes, and preventing contamination.			**Scenario-Based Learning:** Nurses will be provided with case scenarios that require them to problem-solve and apply the CLABSI bundle steps in real clinical situations.
Module 3: Strategies for Improving Adherence to Infection Prevention Protocols: Understanding barriers to hand hygiene and CLABSI bundle compliance (e.g., time pressure, understaffing, lack of proper equipment). Creating a culture of safety: Role of leadership in fostering a supportive environment, empowering staff with continuous education, and ensuring accountability. Peer reviews, role-playing, and active learning methods to enhance compliance among nurses and staff.	**Ongoing Evaluation:** Quarterly audits of hand hygiene and CLABSI compliance to assess long-term impact.	Journal of Pediatric Nursing. (2023). *Impact of infection control protocols in pediatric intensive care units: Improving patient outcomes*. *Journal of Pediatric Nursing, 40*, 25-34. https://doi.org/10.1016/j.pedn.2023.04.002.	**Group Discussions:** Address real-world challenges and barriers to compliance, fostering peer support and shared problem-solving. **Learner Engagement: Post-Training Action Plan:** Nurses will develop an action plan with personal goals for improving hand hygiene and CLABSI bundle compliance in their practice.

Evaluation Method:

1- In the context of preventing CLABSI, what is the rationale behind performing hand hygiene with alcohol-based hand rub (ABHR) before and after manipulating a central line, even if gloves are worn during the procedure?

- A. Alcohol-based hand rub kills microorganisms more effectively than gloves alone.
- B. Gloves cannot provide 100% protection against all pathogens.
- C. ABHR increases the sterility of the line dressing.
- D. None of the above.

2- Which of the following scenarios best aligns with the evidence-based practice for preventing CLABSI in a patient with a central line?

- A. The central line is inserted under sterile technique, and hand hygiene is performed before insertion and after any manipulation.
- B. The central line dressing is changed every 48 hours regardless of condition, and only alcohol-based hand rub is used for hand hygiene.
- C. A central line is kept in place for a week without being assessed for necessity, with sterile gloves used but no hand hygiene.
- D. Hand hygiene is performed before inserting a central line but not after manipulating the line afterward.

3- A 70-year-old patient in the ICU has had a central line inserted for 5 days. The patient has a mild fever and no visible signs of infection at the insertion site. The medical team is reviewing the patient's line for necessity. What is the appropriate course of action based on CLABSI prevention practices?

- A. The line should remain in place as long as the patient's vital signs remain stable.
- B. The line should be removed immediately since the patient is not exhibiting infection symptoms.
- C. The line should be removed after a daily review and if deemed unnecessary, as prolonged catheterization increases the risk of infection.
- D. The line should be replaced with a new one every 72 hours to minimize infection risk.

4- According to the CLABSI prevention bundle, which of the following practices is critical for ensuring aseptic technique during central line insertion and maintenance?

- A. Use of chlorhexidine for skin antisepsis, strict sterile barrier precautions, and optimal hand hygiene.
- B. Wearing sterile gloves alone, with minimal hand hygiene before insertion.
- C. Administering prophylactic antibiotics before the insertion of every central line.
- D. Changing the central line dressing every 24 hours regardless of contamination.

Select All That Apply:
5- Which of the following are recommended components of the CLABSI prevention bundle?

- A. Hand hygiene before and after manipulating the central line
- B. Chlorhexidine for skin antisepsis
- C. Routine administration of antibiotics after insertion
- D. Use of sterile barrier precautions during line insertion
- E. Daily review of the necessity of the central line

Select All That Apply:
6- What actions should be taken to prevent CLABSI during the maintenance phase of a central line?

- A. Change the central line dressing every 72 hours or sooner if wet, loose, or soiled
- B. Perform hand hygiene before and after manipulating the line
- C. Perform a full sterile technique each time the dressing is changed
- D. Use alcohol-based hand rub only if hands are visibly soiled
- E. Review the need for the central line daily and remove it if no longer necessary

Attitude Questions (5-Point Likert Scale):

1. I am confident in explaining the “Five Moments for Hand Hygiene” in the PICU.
   ☐ Strongly Disagree ☐ Disagree ☐ Neutral ☐ Agree ☐ Strongly Agree

2. I consistently adhere to all components of the CLABSI bundle with no exceptions during patient care.
   ☐ Strongly Disagree ☐ Disagree ☐ Neutral ☐ Agree ☐ Strongly Agree

3. I believe that proper hand hygiene is crucial in preventing healthcare-associated infections (HAIs) in pediatric patients.
   ☐ Strongly Disagree ☐ Disagree ☐ Neutral ☐ Agree ☐ Strongly Agree

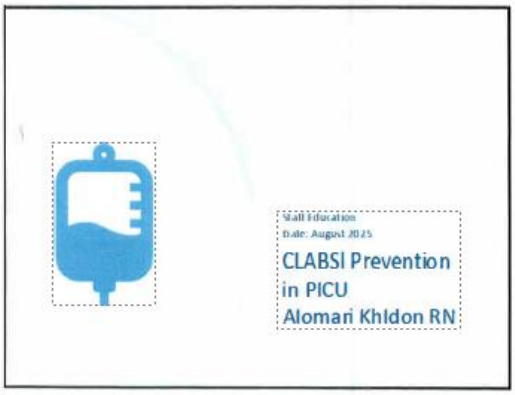
4. I believe that staffing issues or time constraints may affect my ability to fully comply with CLABSI bundle protocols.
   ☐ Strongly Disagree ☐ Disagree ☐ Neutral ☐ Agree ☐ Strongly Agree

5. I believe that regular education sessions would help improve my adherence to infection control protocols and reduce the risk of CLABSI.
   ☐ Strongly Disagree ☐ Disagree ☐ Neutral ☐ Agree ☐ Strongly Agree

answer key:

1 **B**, 2 **A**, 3 **C**, 4 **A**, 5 **ABDE**, 6 **ABCE**

PowerPoint Used in Training



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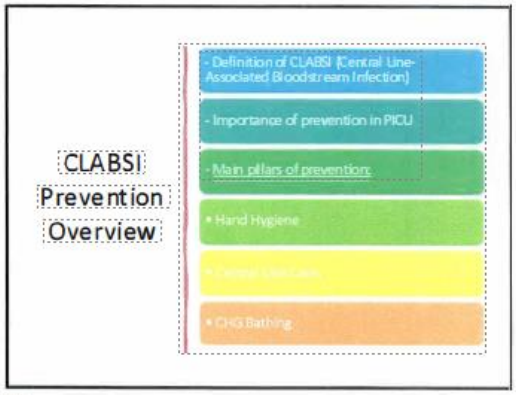

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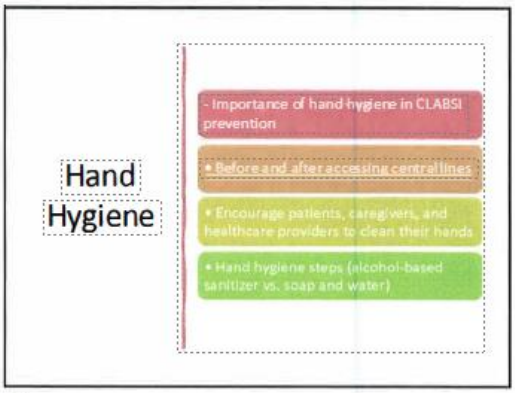

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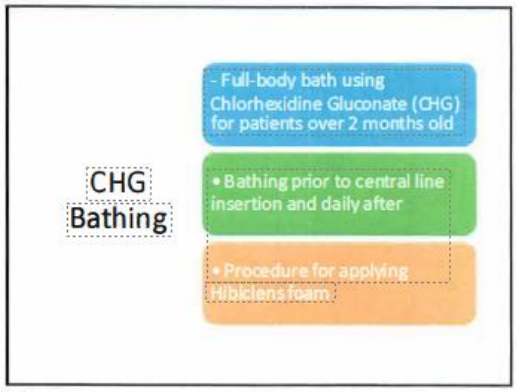

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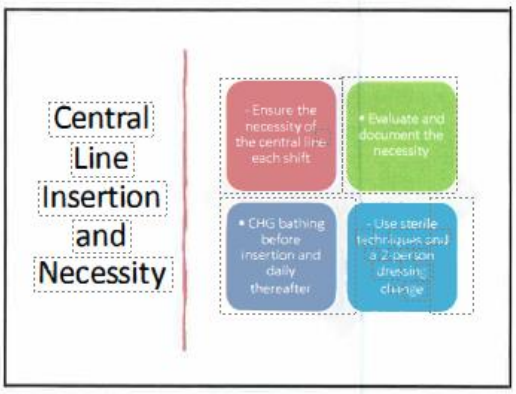

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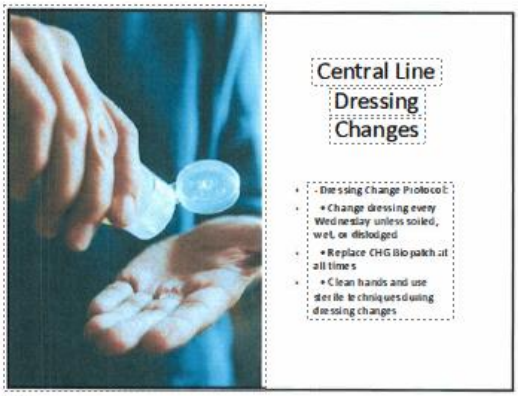

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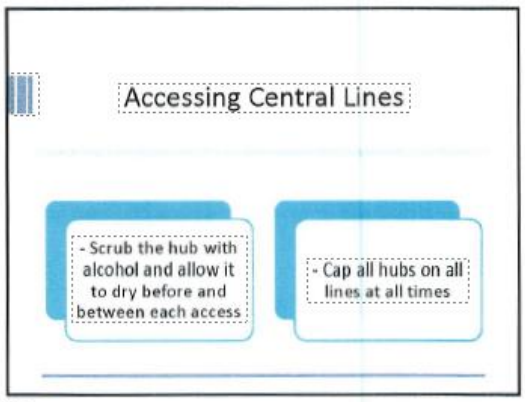
Accessing Central Lines
- Scrub the hub with alcohol and allow it to dry before and between each access
- Cap all hubs on all lines at all times

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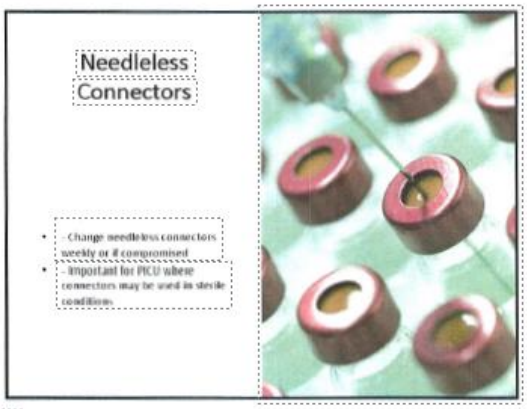
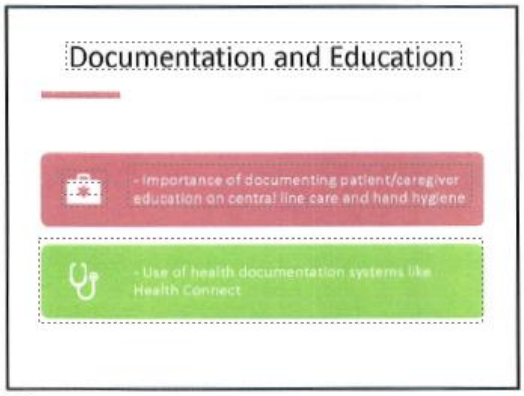

Needleless Connectors
- Change needleless connectors weekly or if compromised
- Important for PICU where connectors may be used in sterile conditions.

8


Hemodialysis Catheters
- CHG bathing and dressing changes for patients with HD catheters
- Only HD nurses can access HD catheters

9


Documentation and Education
- Importance of documenting patient/caregiver education on central line care and hand hygiene
- Use of health documentation systems like Health Connect

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Summary of CLABSI Prevention Strategies

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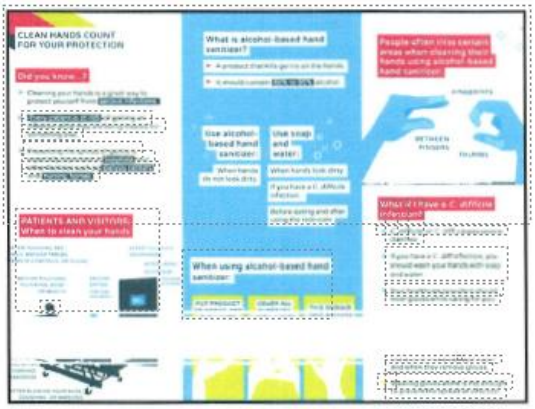
Prevent Central Line Associated Blood Stream Infections
Date of last CLABSI
1. Daily Necessity
Get it out!
Evaluated and documented each shift
2. CHG Bathing
3. Cap all hubs with alcohol-containing caps
ALL hubs on ALL lines at ALL times
4. CHG-Biopatch
ALL sites at ALL times
5. Document patient/caregiver education
6. Clean hands
Always perform hand hygiene prior to palpating site or handling dressing/tubing
7. 2-Person insertion & dressing change
Central lines
Sterile technique
Let's Nail it!

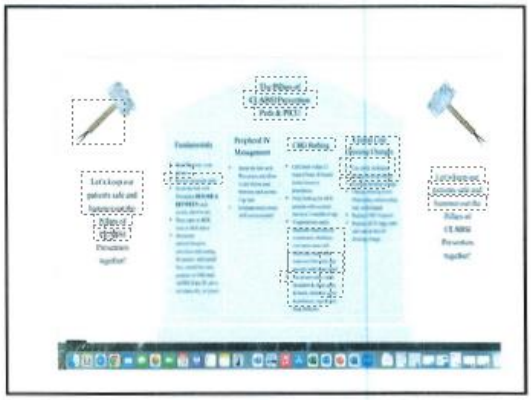
12


YOU HAVE A VOICE
PATIENTS AND VISITORS
CLEAN HANDS COUNT
CLEAN HANDS COUNT
www.cdc.gov/handhygiene
CDC
PROTECT YOURSELF FROM

13


CLEAN HANDS COUNT FOR YOUR PROTECTION
Did you know...?
What is alcohol-based hand sanitizer?
Use alcohol-based hand sanitizer
Use soap and water
When hands look dirty
If you have a C. difficile infection
Before eating and after using the restroom
People often miss certain areas when cleaning their hands using alcohol-based hand sanitizer!
BETWEEN FINGERS
THUMBS
What if I have a C. difficile infection?
PATIENTS AND VISITORS: When to clean your hands
When using alcohol-based hand sanitizer:

14



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