REDUCING CENTRAL LINE-ASSOCIATED BLOODSTREAM INFECTIONS IN THE INTENSIVE CARE UNIT BY IMPROVING COMPLIANCE WITH DRESSING CHANGES AND CUROS CAPS USE

A scholarly project

submitted to the

Liberty University faculty

in partial fulfillment of the

Doctor of Nursing Practice degree requirement

by

Jennifer Khaziga Kilel

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Lynchburg VA

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SECTION ONE: INTRODUCTION

Patients admitted to intensive care units (ICUs) are critically ill, often requiring complex medical treatments. Central venous catheters (CVCs) are large catheters inserted into central veins to facilitate infusion of high-volume fluids and lifesaving medications, and provide access for critical treatments (Reyes, Bloomer, & Morphet, 2017). Apart from their medical usefulness, CVCs are avenues for central line-associated bloodstream infections (CLABSIs). A CLABSI is a systemic bloodstream infection confirmed by a laboratory test that occurs forty-eight hours after insertion of a CVC (Patel et al., 2018, Reyes et al., 2017). Central venous catheter infections are hospital-acquired infections (HAIs) that are not related to prior infections elsewhere in the body. There are global and national guidelines, policies, and standards of care to prevent CLABSIs in hospitals; however, these infections still occur in many intensive care units (ICU) (The Joint Commission, 2012). The gap between the medical staff knowledge of CLABSI prevention guidelines and actual practices at the bedside may account for sporadic CLABSIs in ICUs (Edwards et al., 2012, Davey et al., 2015, Sax & Clark, 2015). The purpose of this project is to improve the compliance of CVC dressing changes and Curos cap use using a daily surveillance checklist and peer validation to reduce CLABSIs in the ICU.

Background Information

Over 100,000 deaths occur from hospital-acquired infections (HAIs) in the United States (U.S.) annually, and one third of these are CLABSI-associated (The Joint Commission, 2012). The mortality rate from CLABSIs in ICUs is estimated to be 10-25% (Reyes et al., 2017). The cost of CLABSI treatment in the United States is $16,000 per event, resulting in an annual heath care cost of over $4 billion per year (The Joint Commission, 2012).To eliminate hospital-

acquired CLABSIs, the National Healthcare Safety Network, the Agency for Healthcare Research and Quality (AHRQ), the Joint Commission (TJC), the Institute of Healthcare Improvement (IHI), and other organizations have spearheaded efforts to develop standardized guidelines and evidence-based recommendations to prevent CLABSIs during central venous catheter insertion and maintenance thereafter (The Joint Commission, 2012). This project will focus on the maintenance care bundle best practices of CLABSI prevention. The maintenance guidelines include assessment of the need for CVCs before insertion, prompt removal of existing CVC, care of the insertion site using the chlorhexidine dressing, applying Curos caps on catheter hubs and other hospital-based standardized measures (CDC, 2017). This quality improvement project will focus on chlorhexidine dressing changes and Curos cap use, which guard the most vulnerable bacterial entry ports into the bloodstream.

Studies reveal that clinical staff knowledge of CLABSI prevention guidelines, policies, and procedures in isolation are not adequate to eradicate CLABSIs in inpatient areas (McAlearly & Hefner, 2016, Richards et al., 2017). Human engineering factors and behavioral models have also been implicated in infection prevention practices (Shah et al., 2015). Evidence shows that human behaviors and practice shortcuts are associated with noncompliance to infection prevention practices. Efforts are underway to appraise the social and environmental factors that lead to those behaviors in the global infection prevention arena. Therefore, behavioral models that facilitate CLABSI knowledge acquisition, staff engagement, execution of evidence-based practice initiatives, and evaluation of outcomes must be included in the CLABSI prevention efforts.

Problem Statement

To obtain a baseline compliance of dressing changes and Curos cap use in the cardiothoracic ICU (CTICU), the project team conducted a risk assessment in the first quarter of 2019. The team utilized an audit checklist to capture the opportunity areas that the project would address. The team audited total of 34 completed dressing changes and 31 Curos cap in the baseline assessment period.

Inconsistencies were identified in basic application of the CHG dressing on CVC insertion sites. Some CHG dressings were not adhering around the CVC insertion site effectively, and the gel dressings were not well applied to completely cover the insertion site. Some dressings were soiled or saturated with blood and body fluids at the insertion site. Some insertion sites were exposed outside of the CHG gel and some dressing were overdue for routine seven days period to be changed.

The baseline risk assessment revealed a major discrepancy between the documented and actual CVC dressing change and Curos caps use compliance. Other problems included out-of-date CVC dressings and dressings peeling on the sides, or saturated with blood, serum, or saliva. The position, or presence of hair on the CVC site on the neck contributed to hanging CVC lines with peeling of the dressing sides.

The Purpose of the Project

The purpose of the project is to implement a daily surveillance checklist and utilize peer validation of the checklist use to improve dressing change and Curos cap use compliance and reduce the CLABSI rates in the ICU by 50% by June 2019.

Clinical Questions

The effectiveness of occlusive CVC dressing and CHG-impregnated Curos cap use to reduce CLABSIs is supported by high-level evidence (levels IA and II) (The Joint Commission, 2012). This project sought to answer the following questions, 1) “Can the use of a daily surveillance checklist and peer validation increase CVC dressing change and Curos cap use compliance in the ICU?” and 2) Can improving dressing change and Curos cap use compliance reduce CLABSIs in the ICU?

SECTION TWO: LITERATURE REVIEW

Search Strategy

The search strategy included an extensive review of scientific literature from the Cumulative Index to Nursing and Allied Health Literature (CINHAL), PubMed, Cochrane database, and Medline. The search terms included central venous catheter infections, CLABSI, hospital acquired infections (HAI), HAI prevention, CLABSI care bundles, surveillance checklists, compliance, CLABSI morbidity and mortality rates, CLABSI and hospital length of stay, CLABSI and peer validation. The search produced more than 500 articles from systematic reviews and meta-analyses, randomized controlled trials, quasi-experimental interventions studies, cross-sectional observation studies and pre- and post-quality improvement projects. The search was narrowed to CLABSI maintenance care bundles and behavioral mental models of CLABSI prevention.

Critical Appraisal

A systematic review of studies between 2007 and 2016 demonstrated that multiple interventions including CLABSI care bundles, adequate staffing, quality improvement initiatives, dressings, aseptic skin cleansing, closed infusion sets, and education reduced CLABSIs in the hospitals (Lavallee, Gray, Dumville, Russell, & Cullum, 2017). This systematic review and meta-analysis investigated outcome measures including CLABSI rates per 1000 CVC days, pathogens detected, hospital stay lengths, and mortality rates due to CLABSIs. The strength of the study included multi-center studies with six randomized controlled trials (RCTs) and 31 pre- and post-intervention studies. The studies showed that implementation of care bundles reduced CLABSIs by 50%. A similar systematic review of RCTs also found that in addition to maintenance care bundles, staff education, adequate staffing, compliance checklists, conference calls, and personal coaching reduced CLABSI rates and improved patient outcomes (Reyes & Hefner, 2017). This study randomized the patients who received care bundles and those who received a combination of care bundles and staff engagement. The study found that a combination of care bundles and changes in human behavioral factors, such as quality improvement initiatives and personal coaching, improved patient care outcomes. This strengthens the evidence that care bundles alone are not sufficient to eradicate CLABSIs in ICU.

The role of nursing leadership in CLABSI prevention in the ICU cannot be underestimated. Poor leadership, a stressful work environment, inefficient staffing models, and nursing shortages all contribute to poor patient outcomes (Wong, Cummings, & Ducharme, 2013). This systematic review included twenty studies from multiple health centers that examined leadership styles, competencies, behaviors, and practices relative to patient satisfaction, medication errors, restraint use, mortality rates, and hospital-acquired infections.

The reviewers also closely examined the various leadership theories and leadership concepts used by the leadership.

The strength of the review included the use of transformational leadership, resonant leadership, the Bonoma-Slevin leadership model, and relationship-oriented leadership in the participating health care organizations. The weaknesses included the small number of randomized controlled trials (only five studies were randomized), response rates of less than 60% in some studies, the presence of outliers in 60% of the studies, failure to include theoretical framework, and 35% of the studies failed to report their findings.

The review findings included positive relationship between relational leadership and patient satisfaction, and reduced adverse patient outcomes, restraint use, and hospital-acquired infections. Relational leadership in health organizations reinforces organizational strategies that improve patient outcomes. Transformational nursing leadership contributed to infection prevention efforts by creating healthy work environments, improved strategic plans for quality improvement, continuous learning opportunities, and human and material resources such as adequate staffing.

To achieve zero CLABSIs in ICUs, evidence suggests that multimodal and multidisciplinary efforts are necessary. One study reported that a combination of CLABSI care bundles, staff education, quality improvement initiatives, surveillance, compliance checklists, conference calls, and personal coaching improved patient care outcomes (Reyes et al., 2017). This randomized controlled study compared CLABSI outcomes between patients who were treated only with the care bundles and those who were treated using care bundles plus staff engagement and human behavioral factors. The relative risk (RR) of negative patient outcomes between the RCT bundle groups and control groups was 0.97 (2049 participants, 95% CI 0.7 to

1.32). The RR of pre- and post-studies and negative patient outcomes was 0.66 (119,178 participants, 95% CI 0.59 to 0.75). This low result was attributed to inconsistencies in bundle implementation, bias risk, and outcome indirectness. The ICUs in the study used audits and feedback strategies in the nonrandomized studies, and behavior changes and engagement levels were not reported (Lavallee et al., 2017). The inconclusive assumption was that measuring the engagement and behavioral change effects in addition to checklist might have produced positive results.

The systematic reviews of RCTs revealed that guidelines and checklists reduce CLABSI in the inpatient setting, while the collaborative and multimodal approach to CLABSI prevention remained the superior model of HAI. Only one review had an alternative evidence that showed low-quality evidence that patients treated with care bundles had less risk of negative outcomes than those who received the usual care; however, the authors determined that the evidence was not sufficient to conclude that the care bundles reduced the risk of negative outcomes (Lavallee et al., 2017).

One quasi-experimental study that analyzed the use Curos disinfectant caps on catheter hubs showed that the Curos caps reduced infection by 40% (Merrill et al., 2014). The Curos caps contain 70% isopropyl alcohol and are effective after three minutes on the CVC hub. The CHG in the Curos cap are bacteriostatic and prevent residence of contaminants on the catheter hub. This reduces the likelihood of injection of external contamination into the catheter lumen. According to the above study, in addition to the 40% infection reduction, the Curos caps also reduced hospital stays by six to eight days and prevented one death. The limitations were that the study was conducted in a single trauma center that had a small 13-bed ICU. Therefore, these findings cannot be extrapolated to other ICUs of varying hospital populations and ICU beds.

Effective CLABSI control includes an interdisciplinary team effort to discuss infection risks and remove all medically unnecessary CVCs in the ICU. A prospective national quality improvement collaborative study examined ICUs that participated in the comprehensive unit-based safety protocol and evidence-based protocol to eliminate bloodstream infection (CUSP: STOP BSI) (Weeks et al., 2014). The study analyzed data from 792 hospitals and 1,071 ICUs from 44 states in the U.S. A linear regression of 9,225 ICU quarter's worth of data was examined for the effect of interventions from 2008 to 2012 using random intercepts. The interventions focused on improving communication among the interdisciplinary team (IDT) members to improve appropriate CVC placement, acceptable CVC use, and removal of CVC that were not medically necessary.

The CUSP study first identified the CLABSI hazards, educated the staff, assigned an executive leadership member to every team, and implemented tools that enhanced communication among all the teams and team members (Weeks et al., 2014). The study used education of patient safety, teamwork, use of care bundles, and feedback about CLABSI rates. The clinical staff implemented the CLABSI prevention care bundle using chlorhexidine skin preparation, barrier precautions, effective hand hygiene, removal of unnecessary lines, and avoidance of CVC placement in the femoral area. The third intervention was to record the scores of unit-level patient safety and CLABSI rates and provide feedback to the leadership and unit-improvement team.

In this study the CLABSI rate was reduced by 43%. Total CVC days were 4-7% less at the beginning of the fourth quarter than during the pre-intervention period, and this decrease was sustained through the sixth quarter. On average, each ICU experienced 21.7 fewer line days by the sixth quarter than were seen in the pre-intervention period. The average review of line

necessity rose from 4.01 to 4.49 on the five-point Linkert scale, and CVL use in ICUs declined by the fourth quarter.

The direction of CLABSI prevention is changing to reflect the role of organizational safety culture, transformational leadership, and human behavioral factors that encourage compliance to infection-prevention practices (Barnes, Rearden, & McHugh, 2016, Richards et al., 2017, Shah et al., 2015, Wilder et al., 2017). Barnes and colleagues (2016) explored the relationship between magnet status and CLABSI rates. This was a prospective observational study of 291 magnet and 291 non-magnet hospitals. Hospitals are designated as Magnet status accreditation when they achieve high-quality nursing care and achieve lower HAI rates among other national safety measures. The framework for magnet includes transformational leadership, exemplary professional practice, structural empowerment, new knowledge, innovation, improvements, and empirical outcomes. The studies found that CLABSI rates in the magnet hospitals were lower than the national average, while those in the non-magnet hospitals were higher.

A study on human factors and the effects on infection prevention practices was conducted to investigate methods to reduce preventable HAIs through the "Best Care… *Always*!" campaign (Richards et al., 2018). The study was implemented in three phases. In phase one the investigators solicited for the commitment of the management team and doctors, and trained inpatient nurses on the care bundles. The standard measures were bundle compliance and infections per 1000 central line days. During phase two the study incorporated collaborative methods with multiple training and learning sessions for managers and inpatient nurses. In phase three the study continued with sustained goal setting, ongoing methods, and benchmarking of the CLABSI rates per 1000 CVL line days. A total of 1,119,558 central line days were reviewed

over the study period from 2011 to 2012. In phase one, bundle compliance increased from 73.1 to 90% and CLABSI rates decreased from 3.55 to 0.13 infections per 1000 CVL days ($p = 0.0001$). The above studies demonstrate that to be effective, evidence-based infection-prevention practices are complex and require leadership engagement and support, clinical staff motivation and education, and sustained surveillance.

The evidence indicates that surveillance checklists and line rounding, combined with care bundles, reduce ICU CLABSI rates (Wichmann et al., 2016). This prospective observational study was done in a large teaching hospital that aimed to improve compliance with IHI recommendations for strict CVL indication, hand hygiene, skin disinfection, sterility, and avoidance of femoral insertion sites. Checklists were used for 1,518 of the 4,416 CVCs placed. All patients who presented with sepsis symptoms were investigated for CLABSIs using laboratory blood culture tests. In the checklist group, 11,540 catheter days and 245 events were detected, equivalent to is 21.2 events per 1,000 catheter days, while in the non-checklist group, 21,349 catheter days and 776 events were detected, equivalent to 36.3 events per 1,000 catheter days. This difference was statistically significant ($p = 0.001$, 95% CI 0.5-0.68 and IRR of 0.58). The authors concluded that the checklist increased compliance with CVL placement protocols, reduced CLABSIs, and improved the hospital's benchmark ranking (Wichmann et al., 2018).

Daily staff rounding on all patients with CVCs can reduce ICU CLABSI rates (Wider et al., 2016). During rounds, the clinical staff observe for oozing around insertion sites, blood backed up in catheters, dressings peeling, tenting, or not correctly positioned, and exposed catheter access ports. The study advocated for two-person rounding 20 hours per day, seven days per week using a line rounding audit tool. The CLABSI rate in this study decreased from 3.9 to 0.3 per 1000-line days, a 92% reduction. This study demonstrates that peer validation at the

bedside and daily surveillance, in addition to the care bundles, reduces CLABSIs in inpatient settings.

Continuous education, engagement of frontline RNs, execution of best practices, and evaluation of system processes and patient outcomes combine to form an effective strategy for CLABSI reduction in the ICU (Dumyati, et al., 2014). The fight against CLABSI however should not be limited to the ICU settings alone, but must be extended to include all hospital inpatient settings. A prospective pre- and post-intervention collaborative study implemented in thirty-seven non-ICU units in six hospitals found that a multifaceted approach to CLABSI prevention should be extended to other non-ICU patient areas to achieve sustained CLABSI reduction. The study intervention focused on leadership and nursing staff engagement, nursing education on CLABSI maintenance practices, competency evaluations, CVC care audits, and feedback on CLABSI rates. Following these interventions, CLABSI rates were compared to those before the intervention were enacted. The CVC line-days decreased from 2.6 to 2.1 per 1000 central line days during the intervention period, and to 1.3 in the post-intervention period. The CLABSI rates in the participating units decreased by 50%.

Synthesis

Poor compliance with CLABSI prevention guidelines is a global problem, and both developed and developing countries face the same compliance challenges (Valencia et al., 2016). This worldwide online survey to investigate practices related to CVC insertion maintenance care bundles and measurement of CLABSI data was conducted in 95 countries worldwide. Twenty-seven high-income countries (HICs) and 14 middle-income countries (MICs) were included in the study. All the countries reported the presence of written CLABSI prevention guidelines. The

MICs reported 23% compliance while the HICs reported 62% compliance with the guidelines in their ICUs (Valencia et al., 2016). They all considered CLABSI prevention as a key component of patient safety and quality improvement; however, priorities in the MICs and HICs differed. The HICs reported 73% daily assessment of the need for CVCs, while the MICs reported only 60% daily assessment.

The above international survey revealed the need for ICUs worldwide to adhere to existing CLABSI prevention guidelines. Areas of improvement include the use of full barrier precautions during insertion, reduction of CVC exposure to external contaminants through daily assessment, and monitoring the progress of preventative initiatives. Because the priorities in HICs and MICs differ, each ICU should identify and address factors that encourage adoption of and compliance with the guidelines.

The Institute of Healthcare Improvement (IHI) developed care bundles in 2001 in a collective effort to improve critical care processes to improve teamwork, communication, and patient care outcomes, and decrease harm, mortality rates, and healthcare costs (ihi.org, Lavallee et al., 2017). Healthcare regulatory bodies, including the Joint Commission, Medicare, Medicaid, and healthcare advocates, require all private and public health organizations to document and report all HAIs and competitive benchmarks of quality performance improvement, which are set annually (Bornes, Readen, & McHugh, 2016). In 2014, the Centers of Medicare and Medicaid (CMS) introduced an incentive program and penalty for poor performance in HAI prevention. The hospitals that underperformed received a one percent reduction in Medicare reimbursement. These efforts have been successful but more work is needed to eradicate CLABSIs in ICUs. Health organizations advocate for multimodal interventions in addition to bundles to eradicate

HAIs. Development of supplementary compliance checklists for surveillance and collaborative face-to-face discussions reduced the risk of CLABSIs in ICUs (Wichmann et al., 2018).

Methods to promote healthcare worker ownership of infection prevention practices should be strengthened to maintain the culture of patient safety. Top-down initiatives traditionally used in healthcare to implement initiatives have been criticized because they do not support sustainability (Gould, Hale, Waters, & Allen, 2016). One study was an independent retrospective study conducted in the United Kingdom. The study conducted qualitative interviews of the healthcare workers with maximum variability sampling of employees. Twenty key informants with expertise in infection prevention were included. Among the questions were definition of ownership of infection prevention practices, what that meant for their work, and the barriers to ownership. Each interview lasted one hour.

After eighteen months of study, methicillin-resistant *Staphylococcus aureus* infection rates were below the national average, *Clostridium difficile* rates had declined by 42%, and the incidence of central line associated bloodstream infections had decreased. The above results reflected the healthcare workers' perception of ownership in the autonomy to identify infection prevention and find solutions for the problem. Creating a learning climate within the organization contributed to the positive outcomes.

The strength of the study included the use of normalization process theory (NPT), which identifies factors that promote or inhibit integration of new interventions into daily healthcare practice. Normalization process theory elements include making sense of the new intervention (coherence), engagement (cognitive participation), collective team participation (teamwork), and monitoring the cost versus benefit of the new intervention (Gould et al., 2016). Healthcare

workers desire to be empowered to achieve change rather than perceiving that leadership imposed the change.

Transformational nursing leadership plays an important role in designing sustainable evidence-based programs to reduce infections (Everett & Sitterding, 2011). The leaders carry the vision, mission, and goals of the organization by providing structure, and provide a framework for professional practice through strategic planning. The clinical leadership participates in the facilitation of evidence-based practice at the bedside by reinforcing strategies that improve patient outcomes (Hauck, Winsett, & Kuric, 2012). Nurses guide and participate in CVC insertion, maintenance, and removal, and are the best-placed advocates for patients (Shah et al., 2015, Wong, Cummings, & Ducharme, 2013). The best care and patient outcomes is achieved when the interdisciplinary teams collaborate in the efforts to reduce hospital-acquired infections.

Conceptual Framework: The Iowa Model of Evidence-based Practice

The project will utilize the Iowa Model of Evidence-based Practice (Iowa Model Collaborative, 2017). Developed in 1994, this a collaborative multi-step model used for evidence-based projects in healthcare. The clinician identifies a clinical a knowledge- or problem-focused trigger that questions whether an existing practice can be improved. The trigger problem should be a priority in the organization. The investigator formulates the questions that will be addressed by the project.

The clinician then forms a team that will develop the project, implement the intervention, and evaluate the outcomes. This process requires involvement of all stakeholders including specialists in the topic, leadership and frontline care providers who will provide input, resources,

and moral and technical support. A systematic search for evidence assembles the available studies and weighs the quantity, quality, and consistency of the evidence (Iowa Model Collaborative, 2017). If the existing evidence is insufficient, more research is preferred but in the presence of sufficient evidence, the clinician designs a pilot practice change in a specific area. The project directors consider available resources that may include people, materials, and funds, and evaluate the possible constraints. The investigator collects the baseline data, develops a local protocol, designs an implementation plan, and promotes adoption of the project. The team monitors the project, collects data, and reports the post-pilot results.

The most important step in evidence-based projects is the plan to integrate the change into the current practice and implement the practice change. In this step the investigator engages key persons to support the initiative to hardwire the change into the system. The process involves monitoring the key indicators through quality improvement and disseminating the change to other units.

Theoretical Framework: Theory of Transitions by Meleis Sawyer

The CLABSI project will utilize the theory of transitions by Meleis Sawyer (Smith and Liehr, 2014). The theory states that nursing phenomena can be explained through the lens of illness and health experiences during life transitions. The theory borrowed heavily from collaborative work in sociology, the research program, and mentoring. The origin of the theory is insufficiency that is associated with poor role performance, goal attainment, and difficulties associated with role behavior during transitions. The theory describes, explains, and predicts human behavior during transitions. Meleis explained that people can go through transitions

successfully and smoothly but sometimes concerns and problems may cause disequilibrium during these transitions.

The concepts of the theory include patterns and types of transitions, transition facilitators and inhibitors, transition experience properties, response patterns, outcome indicators, and nursing therapeutics (Smith & Liehr, 2014). Transition theory was chosen for this project because the hospital where this project was performed underwent a major transition during the project time. The transition was partially related to economic constraints, poor national ranking in infection prevention, and average patient experience. This evidence-based project was therefore highly anticipated to support efforts to lower CLABSI rates in the ICU. Preparedness and readiness to adopt a new daily process was difficult and daunting to the RNs, who were going through a major organizational change in leadership and staffing. The nurses felt understaffed and overwhelmed by heavy patient workloads. The hospital leadership and infection prevention team supported the evidence-based project through this difficult time of change.

Summary

The patients admitted to critical care units are generally critically ill, requiring complex medical treatments, and CVCs are often used as life-saving measures. To prevent CLABSIs, multidisciplinary models and a multimodal approach are required. Transition to evidence-based practice can reduce CLABSI rates in the ICU. Participation of leadership and engagement of clinical staff in the evidence-based projects, in addition to CVC insertion and maintenance care bundles, can reduce CLABSIs in the ICU. Evidence-based recommendations for dressing changes include the use of a clear window and a chlorhexidine-impregnated gel to cover the insertion site and prevent bacterial colonization (The Joint Commission, 2012). The CVC

dressing kit contains material that is applied step-by-step to prevent contamination during dressing changes. The dressing can stay in place for seven days if it remains clean, dry, and intact, but must be replaced in a sterile manner if soiled, damp, or loose. Sterile gauze should be used and changed every other day if the insertion site is oozing or the patient is diaphoretic. In addition to the dressing changes, when needleless systems are used, the CDC recommends a split septum valve (The Joint Commission, 2018). The ports are capped using chlorhexidine sponges as the disinfectant.

SECTION THREE: METHODOLOGY

Project Design

This project was a pre- and post-intervention evidence-based project. The aim of the project was to improve RN compliance with dressing change and Curos cap use on CVCs. The project obtained pre-intervention compliance assessment data for the first quarter of 2019 using a checklist. The team identified the areas of opportunity and designed a daily surveillance checklist to address those areas. The areas that needed improvement were CVC dressing change and Curos cap use protocols. The second aim was to reduce the incidence of CLABSIs in the ICU by improving compliance with CLABSI maintenance best practices.

In addition to the use of checklists, the CLABSI team included a new intervention of peer validation in which two RNs) reviewed and acknowledged that all the dressing change steps and Curos cap use were addressed during the daily surveillance. The project employed a behavioral change model known as “Engage, Educate, Execute, and Evaluate” (4Es) as an external moderator (Owings et al., 2016). The 4Es are a patient safety behavioral change model used to convert evidence into behavior (AHRQ, 2017). The engagement includes teaching, coaching,

daily surveillance, leadership rounding, executing the desired changes, and evaluating the progress (Jackson, Lowton & Griffiths, 2013, Owing et al., 2016). Leadership and staff engagement is a closed loop of actions and feedback that promotes autonomy, ownership, empowerment, and trust in the work environment. This engagement enables all stakeholders to own the care process and share outcomes. The education helps strengthen nursing practice and improve nursing knowledge and skills.

Measurable Outcomes

A pre-risk assessment was performed to determine the baseline compliance with CVC dressing changes and Curos caps use. The results were compared to those achieved after introduction of the daily surveillance checklist, which included peer validation of eye-witnessed observation of appropriate dressing changes and Curos caps use on all CVC hubs. Two RNs verified that the central line dressings were placed correctly, were occlusive, and covered the CVC insertion cite. The two RNs verified that the dressings were not saturated with blood or other body fluids and were dated, and that all CVC access ports had Curos caps. The compliance rate was calculated as the number of central lines with correctly-documented dressing changes and Curos caps divided by the total number of central lines.

Setting

This project was conducted in a CTICU in a hospital in southeastern U.S. The hospital is a 350-bed facility with a 12-bed ICU that cares for pre-and postoperative cardiac and thoracic patients. The ICU admits all patients with cardiac and thoracic illnesses requiring critical care treatment and/or surgery. Most CVCs are placed postoperatively, some preoperatively, and some

emergently, based on the patient status for hemodynamic monitoring and life-saving interventions.

Population

The study population included 50 registered nurses who work in the CTICU. All the participants were RNs 18 years of age or older with a minimum of an associate degree in nursing from a recognized school of nursing, and basic competencies in critical care nursing. Non-RNs and those without current competency in critical care experience were excluded from the study.

Ethical Considerations

The investigator completed the CITI training and obtained approval from the Liberty University Institutional Review Board (IRB) and the hospital's IRB. All RNs in the CTICU were invited to participate in the project via work e-mail and agreed voluntarily to participate (Moran, Burson, & Coran, 2014). The RNs received a 10-minute review of the evidence-based project purpose and objectives. If a CLABSI was diagnosed in the CTICU, the standard protocol for quality assurance was followed. Refusal to participate in the project did not result in punishment or bad evaluations by the unit leadership.

Data Collection

The investigator attended three ICU staff meetings and described the project to the bedside RNs and demonstrated the procedures for data collection. During the bedside huddle, the oncoming and outgoing RNs validated that the CVC dressing was correctly placed, the insertion site was clearly viewed through the transparent window, and the dressing was completely occlusive with no oozing or stagnation of body fluids or blood around the insertion site. The two

RNs also validated that Curos caps were present on all CVCs hubs. It took approximately two minutes to complete the checklist.

Tools

The investigator designed a CLABSI daily surveillance tool for data collection. The checklists had eleven questions. The questions included the type of CVC, the location of CVC, the dwell time in days, the correct application of the CHG dressing to cover the insertion site, observation of oozing or peeling, the correct placement of the CHG gel at the insertion site, labeling of the line with a date per hospital policy, application of Curos caps on all CVChubs, discussion of the CVC for necessity during the interdisciplinary rounds and the plan, and peer validation of all the questions during observation by RN.

Intervention

The CLABSI team performed a pre-intervention direct observation and chart audit in the CTICU on each CVC patient using a checklist. A total of 34 observations completed in in the first quarter revealed the areas of opportunity as deficiencies in dressing changes, Curos caps use, and overall insufficient compliance with, and documentation of, these procedures.

The intervention data was obtained by direct observation using the daily safety surveillance checklist. All RNs who had patients with CVCs received a checklist from the shift manager daily at the start of the shift. The checklist was completed at the bedside. Two RNs validated all aspects of the dressing changes and Curos cap applications on all the CVC hubs. Data obtained included the type and location of the CVC, the number of CVC dwell days, whether the dressing was intact, covering the insertion site, and dated per policy, whether Curos

caps were on all hubs, and whether the line necessity was discussed during interdisciplinary rounds. The findings were documented in the electronic health records.

To reinforce and optimize the best practice, the project utilized the 4Es behavioral change model (AHRQ, 2017). Throughout the project the unit leadership team rounded to engage and encourage the RNs in their daily work and provide feedback on the project. The RNs were educated on the importance of CLABSI prevention by maintaining the dressings intact and using Curos caps. Two RNs observed and validated correct CVC dressing placement and Curos caps on all central catheter hubs and completed the surveillance checklists. All the RNs held each other accountable for dressing changes and Curos cap use during their shift.

The timeline for this project was ten weeks. The pre-intervention risk assessment and chart review was conducted one week before the intervention. The baseline compliance rates for dressing changes and Curos cap use were obtained. The intervention officially began on May 1, 2019 and the project was completed on July 7, 2019.

Data Analysis

The Statistical Package for Social Sciences (SPSS) software version 25 was used to compute the data during the pre-and post-intervention period. The checklists were kept in the unit manager's office and provided to RNs during the huddle. The completed checklists were collected by the shift manager and given to the infection prevention clinical nurse specialist (CNL). The CNL locked the completed checklists in the infection prevention office cabinet

SECTION FOUR: RESULTS

Thirty-four catheters were observed during the pre-intervention assessment and 100 catheters during the post intervention period. The data showed that the most commonly used are non-tunneled CVC 80% of the catheters used were non-tunneled while 20% were tunneled (tunneled 8.8%, PICC lines 8.8% implanted port 2.4%). An average of 81.5% of the CVC were placed in the intrajugular area. An average of 50% of the CVC were removed during the first three days of placement (*Table 1*).

Table 1

Type, Location, Dwell Time of Central Venous Catheters

Intervention period		Pre (%)	Post (%)	Average (%)
Type of central venous catheter	Non-tunneled CVC	80	51	65
	Other	21	49	35
Location of central venous catheter	Intrajugular	82	81	81.5
	Other	18	19	18.5
Central venous catheter dwell days	Less than 3 days	32	68	50
	Greater than 4 days	32	19	25.5

Measurable Outcomes

The project measured compliance with dressing changes and Curos cap use using the daily surveillance checklist. The RN observed for compliance with the dressing change and Curos caps use during the post intervention period. The study projected that dressing changes and cap use compliance would improve by 50% by June 2019. The compliance of dressing changes improved by 55.9% (44.1% to 100%) and the Curos caps use compliance improved by 80% during the post intervention period (18% to 98%) (*Table 2*).

Table 2

Dressing Changes, Curos Caps Use and Central Venous Catheter Necessity

Intervention period	Pre (%)	Post (%)
Chlorohexidine dressing change	44	100
Chlorohexidine gel covering the insertion site	53	100
Dressing change less than seven days	56	99
Tubing labeled per policy	15	100
All central venous catheter hubs have Curos caps	18	98
Central venous catheter still medically necessary	27	96

The project also compared the CLABSI rates during the pre-and post-intervention period. During the project period, the ICU had a total of 863 central venous catheter days. The CLABSI rates during the first quarter of 2019 (January to March) in the ICU were zero. This was the pre-intervention phase. The CLABSI occurrence during the second quarter (April to June) 2019, the CLABSI occurrence was one. The CLABSI rate therefore was 0.139 within the post intervention period. After a thorough investigation and analysis, the CLABSI was attributed to environmental factors in the post anesthesia unit (PACU) during a post-operative period (*Table 3*).

Table 3

Central Line - Associated Bloodstream Infections (CLABSI)

	Pre *n*	Post *n*	Totals N
Central venous catheter days	122	619	741
Central line - associated bloodstream infections	0	1	1

SECTION FIVE: DISCUSSION

The initial risk assessment revealed that despite the well-stipulated guidelines, procedures, and protocols for CLABSI prevention, some of the bedside RNs did not apply the CHG dressings correctly, reinforced the dressing with tape, and did not apply Curos caps on all CVC ports. The compliance rates for dressing changes and Curos caps use on all CVC ports were 44.1 and 18%, respectively. The results of this study demonstrate that the checklist and peer validation improved compliance with these procedures. Change in practice can be achieved through adherence to the standardized maintenance care bundle and to other human engineering factors such as staff engagement, readiness to learn, peer validation, and leadership support.

The evidence-based practice change was the use of a daily surveillance checklist to improve compliance in dressing changes and Curos cap use. Instead of monthly audits by the infection prevention clinical nurse specialists, the project introduced a daily surveillance checklist that improved dressing change and Curos cap compliance by 55.9 and 80%, respectively. The efficacy of checklists to reduce CLABSIs has been well studied. Checklist use during CVC insertion has improved hygiene standards and reduced infection frequency during CVC insertion (Wichmann et al., 2018).

Evidence suggest that dressing changes, aseptic skin preparations, and other maintenance care bundle procedures such as the use of closed infusion sets are effective in reducing CLABSIs in ICU (Reyes, Bloomer & Morphet, 2017). The location of the CVC influences the integrity of CVC dressing due to anatomical configuration of the part of the body. Central venous catheters place on the neck (intrajugular) have a tendency to have the dressings peeling off and often get saturated by oral secretion drooling from patients on mechanical ventilations. Central venous catheters placed in the femoral areas are prone to saturation by urine and feces when the patients are incontinent. The duration of dwell time of CVC is associated with increased rates of CLABSI in ICU. Occlusive CHG dressings maintain is a physical barrier around the CVC insertion site and the CHG gel contains 70% isopropyl alcohol that is antiseptic. All CVC are labeled every after a dressing change as a reminder to the RN to change the dressing in seven days and as needed per the policy. Interdisciplinary discussion regarding CVC necessity, appropriate site choice, and early removal are critical to CLABSI prevention in ICUs. Curos caps are applied to all CVC hubs to protect the areas used for injecting intravenous medications into the central line (Merril et al., 20114). During the study, if a catheter hub was missing a Curos cap on any of the hub was counted as non-compliant. In this study, the chlorhexidine caps on CVC hubs were associated with reduced CLABSIs and treatment costs.

A study about changing healthcare workers behavior in infection prevention revealed that the change is attributed to assumption of responsibilities by the frontline staff, diligence in following the policies and procedures, and influence from improved understanding of clinical roles and work relationship (Shah et al., 2015). The interdisciplinary team is made up of the primary care RN, the medical director of the intensive care unit and all other specialties involved in the patient's care. They discuss and determine whether CVCs are necessary and when they

should be removed. RN validated that all the surveillance questions were answered correctly after the observation of dressings and Curos caps at the bedside shift report.

A systematic review revealed that the healthcare workers' behavior was congruent with institutional policies but translation of organizational policies into practice, cultural, social and environmental factors must be considered at all levels (Barnes, Rearden & MacHugh, 2016, Wong et al., 20113). The culture of safety is associated with transformational leadership and magnet status, often realized with leadership style and influence in the organization.

Peer validation practice is an added safety mechanism in which the two RNs validate the safety of patient care including medication drips and all high-alert medications before administering them to the patient. Peer validation improves patient safety, teamwork, and peer influence (McAlearney & Hefner, 2016). This study reported that peer validation is external to goal commitment and was common among high-performing health organizations. In this project, peer validation was viewed as an effort to improve day and night shift RN interactions well as a mechanism to hold each other accountable for nursing tasks. Effective maintenance practices are associated with reduced CLABSIs and better patient outcomes in ICUs.

Implication for Practice

Hospital-acquired infection prevention is a global and national priority. Patient safety and quality of care rest in the hands of the advanced practice nurses (APNs). The Institute of Medicine (IOM) 2003 report, "Transforming Healthcare Quality," found that patients often die from preventable causes, including HAIs (The Joint Commission, 2012). Collective interdisciplinary engagement, responsibility, and accountability can reduce CLABSIs in the ICU. CLABSIs are associated with sepsis, longer hospital stays, increased health care costs, and

increased morbidity and mortality rates. High HAI rates affect hospitals' national rankings, and reduce reimbursement from third party insurance companies such as Medicare and Medicaid.

Education and application of CLABSI best practices are inexpensive and improve patient safety and quality of care. Evidence shows that mere knowledge of policies, guidelines, and protocols in isolation are not sufficient to achieve the desired CLABSI prevention goals. Eradicating CLABSIs in the ICU requires a multidisciplinary and multimodal approach. It is the responsibility of the organizational leadership and interdisciplinary teams to embrace CLABSI prevention and evidence-based initiatives to eradicate CLABSIs in the hospital.

The initial risk assessment revealed that despite the well-stipulated guidelines, a fraction of bedside RNs did not apply the CHG dressing correctly, reinforced the dressing with tape, and did not apply Curos caps on CVC ports. The findings of this project indicate that best practices to improve compliance with CLABSI prevention practices can be achieved through adherence to the standardized maintenance care bundle. The objective of this project was to use the daily surveillance checklist and peer validation to improve adherence to standard dressing changes and Curos cap use. Continuous auditing of the checklist resulted in 100% compliance with dressing changes and 90% compliance with Curos cap use.

The success of the project depended on the 4Es behavioral change model, team collaboration, leadership support, and the commitment of all the ICU RNs. There was shared enthusiasm and engagement of all stakeholders including the CLABSI prevention team, physicians, nursing leadership, and bedside RNs. The leadership rounded and provided support to the bedside RNs, the CLABSI team developed and monitored the project progress, the

physicians were involved in sterile CVC placement and correct positioning, and the RNs supervised each other daily for correct dressing placement and Curos cap use.

The benefits of the project to the community include empowerment of the nurses with education in infection prevention, increased responsibility, and attitude change that led to increased patient safety. The RNs learned that reinforcement of CVC dressings and noncompliance with Curos cap use can pre-dispose patients to infections. Peer validation increased the RN's confidence and competence as the project continued and reinforced the message of infection prevention.

The project had several limitations; it was performed in a single ICU with a convenience sample of 50 RNs and was performed during a time when the organization was undergoing structural and leadership changes. The organization strategy required every department to submit a plan to reduce HAIs by 50%. During the project period, the CLABSI team learned that some RNs disliked peer validation and preferred to complete the checklists independently. This reduced the number of double RN-validated checklists. During the summer months, the ICU had few patients with CVCs; this led to an extension of the project from eight to nine weeks.

Sustainability

The plan is to maintain the project through an RN-based initiative using the designed checklist to audit CVC dressing compliance and Curos cap use. The checklist and the project outcome will be presented to the continuing quality improvement (CQI) meeting in September 2019. The CQI committee must approve all project initiatives before they are entered into the organizational infection prevention policy. The CQI committee meets every quarter. The project

recommends 100% adherence to all CLABSI prevention guidelines including limiting CVC insertion when other means of intravenous access are available.

Dissemination Plan

Evidence-based initiatives at the unit level are essential to infection prevention and improved patient outcomes. This project showed that knowledge of guidelines, procedures, and protocols in isolation is not sufficient to achieve 100% compliance in infection prevention practices. The bedside initiatives led by the RN have been shown to reduce hospital-acquired infections. Evidence from this project showed that engagement, education, execution, and evaluation of the bedside project, combined with a checklist and peer validation, improved compliance with dressing changes and Curos caps use in the ICU. The project recommends future empirical studies to show the efficacy of peer validation in eradicating CLABSI in the ICU.

The great opportunity that exists is the application of the multimodal approach by all the interdisciplinary team members to reduce infections. After approval of the checklists by the CQI committee, the changes will be incorporated into the organization infection prevention policy and the existing CVC maintenance guidelines. Phase one of the dissemination plan will include introducing the checklist into all ICUs within the organization. Phase two will extend the use to all telemetry floors and medical surgical units. The investigator will present the results of the study during the critical care nursing conference in September 2019 and submit them for publication to the Journal of Critical Care Nursing by December 2019.

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APPENDIX

Appendix A Tools

Central Line-Associated Bloodstream Infection Daily Safety Surveillance Tool (Designed by author)

1. What type of CVC does the patient have?

☐Non-Tunneled CVC

☐Tunneled CVC

☐PICC line

☐ Swan-Ganz/Cordis

☐Implanted Port

☐Dialysis Catheter

2. What is the location of the CVC?

☐ Intra-jugular

☐ Subclavian

☐Femoral

☐ Upper arm

3. What is the dwell time. Count from the day of insertion

A) ☐Day 1 B) ☐ Day 2 C) ☐Day3 D) ☐Day 4 E) ☐Day 5 ☐Other

4. Is the CHG dressing completely occlusive around the insertion site?

A) ☐Yes B) ☐No

5. Is the CHG gel covering the insertion site?

A) ☐Yes B) ☐No

6. Is the dressing date less than 7 days?

A) ☐Yes B) ☐No

7. Is the tubing labeled per policy?

A) ☐Yes B) ☐No

8. Does all the ports have CHG Curos caps?

A) ☐Yes B) ☐No

9. Is the line still medically necessary?

A) ☐Yes B) ☐No

10. Interdisciplinary CVC plan

A) ☐ Maintain CVC and reassess the next calendar day

B) ☐Obtain a PIV and remove CVL

C) ☐ Maintain CVC and remove all PIVs

11. Checking the following indicate that the above form is filled and 2 RN validates the information is correct after observation

Off going RN___A_☐_____ on coming RN_____B_☐_____

Appendix B I University IRB Approval

LIBERTY UNIVERSITY.
INSTITUTIONAL REVIEW BOARD

April 24, 2019

[redacted]

IRB Exemption 3718.042419: Reducing Central Line-Associated Blood Stream Infections (CLABSIs) in the Intensive Care Unit by Improving Compliance with Dressing Changes and Chlorhexidine Curos Cap Use on All Central Catheter Hubs and Daily Surveillance Checklist

Dear [redacted]

The Liberty University Institutional Review Board has reviewed your application in accordance with the Office for Human Research Protections (OHRP) and Food and Drug Administration (FDA) regulations and finds your study to be exempt from further IRB review. This means you may begin your research with the data safeguarding methods mentioned in your approved application, and no further IRB oversight is required.

Your study falls under exemption category 46.101(b)(2), which identifies specific situations in which human participants research is exempt from the policy set forth in 45 CFR 46:101(b):

> (2) Research that only includes interactions involving educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures, or observation of public behavior (including visual or auditory recording) if at least one of the following criteria is met:
>
> > (iii) The information obtained is recorded by the investigator in such a manner that the identity of the human subjects can readily be ascertained, directly or through identifiers linked to the subjects, and an IRB conducts a limited IRB review to make the determination required by §46.111(a)(7).

Please note that this exemption only applies to your current research application, and any changes to your protocol must be reported to the Liberty IRB for verification of continued exemption status. You may report these changes by submitting a change in protocol form or a new application to the IRB and referencing the above IRB Exemption number.

If you have any questions about this exemption or need assistance in determining whether possible changes to your protocol would change your exemption status, please email us at irb@liberty.edu.

Sincerely,

[redacted]

Administrative Chair of Institutional Research

Research Ethics Office

LIBERTY UNIVERSITY

Liberty University | Training Champions for Christ since 1971

Appendix B II Hospital IRB Approval

CENTRA HEALTH Institutional Review Board

EXEMPT RESEARCH CHECKLIST

Version 6, February 19, 2019

Date: 04/08/2019

EXEMPT

IRB of Record

Facility: Lynchburg General

Hospital Principal Investigator: Jennifer Kilel

Email address: jkilel@liberty.edu

Phone number: 4342706851

Title of Research Project/Study Title: REDUCING CENTRAL LINE-ASSOCIATED BLOOD STREAM INFECTIONS IN ICU

Supplemental documentation is required for consideration of exemption status.

	True	Not True
Criteria that must be met for the research to be determined to be consistent with IRB ethical standards.		
The research holds out no more than minimal risk to subjects.	X	
Selection of subjects is equitable.	X	
If there is recording of identifiable information, there are adequate provisions to maintain the confidentiality of the data.	X	
This study does not require an Informed Consent Form completed on the subjects. Ifyou have checked "Not True" because your study requires consent of subjects, please stop and complete the full IRB application.	X	
There are adequate provisions to maintain the privacy interests of subjects	X	

Checklist Statements	True	Not True
Cate2ory 1-For Educational Settin2s		
1. The research will only be conducted in established or commonly-accepted educational settings including but not limited to schools and colleges. (May include other sites where educational activities regularly occur.)	X	
2. The research will involve only normal educational practices, such as (i) research on regular and special education instructional strategies, or (ii) research on the effectiveness of or the comparison among instructional techniques, curricula, or classroom management methods.	X	
3. The research will not involve individuals as participants who are known to be prisoners.	X	
4. The research is not subject to FDA regulations.	X	
Category 2-For Educational Tests, Surveys, Interviews, Public Behavior Observation:		

5. The research will involve only the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures or observation of public behavior.	X	
Address.,. statement 6 only if the research will involve childre11 as participants. If children will NOT participate, state NIA anti co11tin11e with statement 7. 6. The procedures will be limited to the use of educational tests (cognitive, diagnostic, aptitude, achievement) or observation of public behavior where the investigator will NOT pa1ticipate in the activities being observed.	*NIA*	
7. The information obtained fro1n educational tests, survey procedures, interview procedures or observation of public behavior will be recorded in such a manner that human subjects CANNOT be identified, ddirectly or through identifiers linked to the subjects. *"True" to either .statement 7or 8 will qualify for exemption provided that statements 9 and 10 are true.*	X	
8. Any disclosure of the human subjects' responses outside the research could NOT reasonably place the subjects at risk of criminal or civil liability or be damaging to the subjects' financial standing, employability, or reputation.	X	
9. The research will not involve individuals as participants who are known to be prisoners.	X	
I0. The research is not subject to FDA regulations.	X	
Category 3-For Educational Tests, Surveys, Interviews, Public Behavior Observation of Public Officials:		
11. The research will involve only the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures or observation of public behavior AND the human subjects are elected or appointed public officials or candidates for public office. (Applies to senior officials such as mayor or school superintendent rather than a police officer or teacher.) *"True" to either statement 11 or 12 will qualify for exemption provided that statements 13 and 14 are true.*	X	
12. The research will involve only the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures or observation of public behavior AN D federal statute(s) require without exception that the confidentiality of the personally identifiable information will be maintained throughout the research and thereafter.	X	
13. The research will not involve individuals as participants who are known to be prisoners.	X	
14. The research is not subject to FDA refutations.	X	
Category 4-For Existing Data, Documents and Specimens:		
15. The research will involve only the collection or study of existing data, documents, records, pathological specimens, or diagnostic specimens. ("Existing" means existing before the research is proposed to the IRB to determine whether the research is exempt. All materials to be reviewed currently exist at the time of this exemption request.)		X
16. The sources of the existing data, documents, records or specimens are publicly available OR the information will be recorded by the investigator in such a manner that participants cannot be readily identified either directly or through identifiers (such as a code) linked to		X

them.		
17. The research will not. Involve individuals as participants who are known to be r:risoners.	X	
18. The research is not subject to FDA re2ulations.	X	
Cateorv 5 - For Public Benefit or Service Programs (Federal):		
19. The project is a research or demonstration project conducted by or subject to the approval of a (federal) Depart1nent or Agency head and which is designed to study, evaluate, or otherwise exa1nine: (i) public benefit or service programs; (ii) procedures for obtaining benefits or services under those programs; (iii) possible changes in or alternatives to those programs or procedures; or (iv) possible changes in methods or levels of payment for benefits or services under those public benefit or service trou:rams.	X	
20. The research will not.involve individuals as participants who are known to be 1Jrisoners.	X	
21. The research is not subject to FDA re2ulations.	X	
22. The program under study delivers a public benefit (e.g., financial or medical benefits as provided under the Social Security Act) or service (e.g., social, supportive, or nutrition services as provided under the Older Americans Act).	X	
23. The research or demonstration project will be conducted pursuant to specific federal statutorv authority.	X	
24. There is no statutory requ irement that the project be reviewed by an RB.	X	
25. The project does not involve significant physical invasions or intrusions unon the privacv of participants.	X	
26. The exemption has authorization or concurrence by the funding agency.		X
Category 6 - For Taste and Food Quality and Consumer Acceptance Studies:		
27. The research involved only a taste and food quality evaluations or a food consumer acceptance study in which (i) wholeso1ne foods without additives will be consumed **OR** (ii) food \Viii be consumed that contains a food ingredient, agricultural chemical or environmental conta1ninant that is at or below the level found to be safe by the Food and Drug Administration or is approved by the Environn1ental Protection Agency or the Food Safety and Inspection Service of the U.S. Department of Agriculture.		X
28. The research will not.involve individuals as participants who are known to be prisoners.	X	
Emergency Use **of an Unapproved Test Article (i.e., a drug, device or biologic that is not FDA-Approved)**		
The activity involves emergency use of an investigational drug, device or biologic. Such an activity is not exempt from IRB review. I-However, this emergency use may occur prior to IRB review and approval (see Category A and B in the Emergency Use Policy for details.) Note that such an emergency use must be reported to the IRB within five business days.		X
The activity does not meet with DI-II-IS definition of "research."	X	

Signature of Principal Investigator: [redacted]

Typing 1ny name on the line above constitutes an electronic signature.

Printed Name [redacted]

Date

FOR THE !RB REVIEWER ONLY:

Is the activity exempt? YES

Does the research meet the standards of ethical conduct? YES

Which exemption category or categories apply to the activity? observance of behavior

Approved by IRB Exempt committee(date):

Signature of IRB

Typing4t;;;na:meotlthe line above constitutes an electron ic signature.

Printed e [redacted]

Appendix B III: Letter of Approval From the ICU Manager

[redacted]

Nurse Manager

Cardiothoracic Intensive Care Unit Centra, Lynchburg General Hospital

1901 Tate Springs Rd.

Lynchburg, VA 24501

434.200.4073
1901 Tate Springs Road
Lynchburg, Virginia 24501

WEB: centrahealth.com

February 12, 2019

Liberty University School of Nursing

To Whom it May Concern,

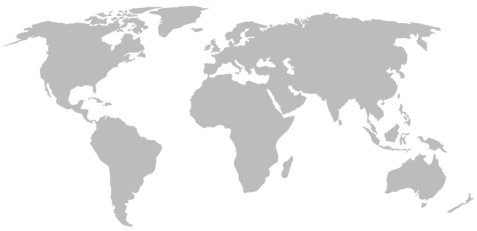
Please accept this letter as confirmation that Jennifer Kilel, FNP/DNP student, has my permission to carry out a quality improvement evidence-based practice study in my unit, Cardiothoracic Intensive Care Unit, at Centra-Lynchburg General Hospital. This project is tentatively slated to start in March 2019.

Please contact me if you need additional information.

Sincerely, [redacted]

MAGNET RECOGNIZED
AMERICAN NURSES CREDENTIALING CENTER

Appendix C CITI Certificate



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Appendix D: Permission to Use Iowa Model of Evidence-Based Practice

You have permission, as requested today, to review and/or reproduce *The Iowa Model of Evidence-Based Practice to Promote Quality Care (Revised 1998).* Click the link below to open.

The Iowa Model of Evidence-Based Practice to Promote Quality Care (Revised 1998)

Citation: Titler, M. G., Kleiber, C., Steelman, V. J., Rakel, B.A., Budreau, G., Everett, L. Q., ...Goode, C. J. (2001). The Iowa model of evidence-based practice to promote quality care. *Critical Care Nursing Clinics of North America, 13*(4), 497-509.

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Appendix E: Strength of Evidence

Table 4

Melnyk Framework Levels of Evidence

Article	**Study Purpose**	**Sample population and characteristics**	**Methods**	**Study Results**	**Level of Evidence (Use Melnyk Framework)**	**Study Limitations**	**Would Use as Evidence to Support a Change? (Yes or No) Provide Rationale.**
Barnes, H., Rearden, J., & McHugh, M. D. (2016). Magnet ® Hospital Recognition Linked to Lower Central Line-	The purpose of the study was to explore the relationship between Magnet status and CLABSI rates.	The sample included hospitals with similar characteristics and compared CLABSI rates in 291 magnet hospitals and 291 non-magnet hospitals 2006-2008.	A cross-sectional observational analysis of data from Medicare, American Heart Association annual survey, and ANCC magnet recognition program.	Magnet hospitals were larger and had higher technology than the non-magnet hospitals. A greater percentage of them were also teaching and not-for-profit than the non-magnet hospitals. The	Level VI Multicenter descriptive statistics.	The use of hospital level aggregates for rates limited the ability to draw conclusion. It was not established whether the magnet hospitals were actively implementing initiatives to reduce CLABSI	Yes

Associated Bloodstream Infection Rates. *Research in Nursing & Health*, *39*(2), 96-104. http://dx.doi.org/10.1002/nur.21709	magnet hospitals had significantly lower CLABSI rates than the non-magnet hospitals (p=0.001%).

Duffy, E. A., Rodgers, C. C., Shever, L. L., & Hockenberry, M. J. (2015). Implementing a daily maintenance care bundle to prevent central line-associated blood stream infections in pediatric oncology. *Journal of Pediatric Oncology Nursing, 32*(6), 394-400. http://dx.doi.org/10.1177/1043454214563756	The purpose of the study was to illustrate the role of the daily maintenance bundle in CLABSI prevention in pediatric oncology patients.	A 32-bed oncology unit with 100 new oncology patients per year and over 600 annual admissions.	Pre/post design study that compared CLABSI over six months after implementation.	The pre-intervention group was a convenience sample of 35 patients. The compliance for documentation and timeliness was 90%. Compliance for CHG baths was 29.6%. Compliance for dressing changes was 90%. Post intervention, the compliance for daily baths was 69.8%. The CVL maintenance bundle achieved 100% documentation and maintenance bundle care increased to 71.2%. Six months before implementation there were 10 CLABSI. 2 CLABSI were reported 6 months post implementation.	Level of evidence VI from single descriptive study.	Limitations included lack of randomization, EMAR did not measure compliance of all maintenance bundle. The nurses were not observed performing the bundle care.

Everett, L., & Sitterding, M. C. (2011). Transformational leadership required to design and sustain evidence-based practice: A system exemplar. *Western Journal of Nursing Research, 33*(3), 398–426. http://dx.doi.org/10.1177/0193945910383056	The purpose of the study was to illustrate that transformational leadership is a requirement for implementation of sustained evidence-based practice in the hospitals.	This is an exemplar that described the historical perspective of multihospital, private non-profit organization.	Three major hospitals combined research, resources, and staff to start the organization. The organization saw the first resignation of the chief nurse executive in 2006.	Nursing leadership influences operational nursing issues that impact patient outcomes. The vision and mission of transformational leadership is to build leadership around patient care research and education. The evidence-based steering committees that work under the CNE influence identification, creation, translation, and dissemination of evidence-based practice.	Level of evidence VII. Evidence from opinion of authorities and reports of experts	Limitation of the exemplar is that it is non-randomized.	Yes, I would apply the knowledge of the function of CNE in organization

Esposito, M. R., Guillari, A., & Angelillo, I. F. (2017). Knowledge, attitudes, and practice on the prevention of central line-associated bloodstream infections among nurses in oncological care: A cross-sectional study in an area of southern Italy. *PLOS ONE*. http://dx.doi.org/10.1371/journal.pone.0180473	The purpose of the study was to delineate the attitudes, knowledge, and behavior in RNs as they relate to CLABSI prevention	The population was 472 nurses working in 16 non-teaching and teaching hospitals.	This was a cross-sectional study using questionnaires with a response rate of 71%. 61.3% of responders were female and the average number of years working in the wards was 9.9.	The study demonstrated that RN have adequate knowledge about CLABSI prevention. 85.9% recognized the type of dressing and required frequency of dressing changes. 70.7 to 90% of respondents answered correctly that they had knowledge of flushing the central lines	Level evidence V large well-planned descriptive study.	Limitation include non-randomized control study.	Yes, I will use because I am looking at the behavioral model.

Merrill, K. C., Sumner, S., Linford, L., Taylor, C., & Macintosh, C. (2014). Impact of universal disinfectant cap implementation on central line-associated bloodstream infections. *American Journal of Infection Prevention, 42*, 1274-7. http://dx.doi.org/10.1016/j.ajic.2014.09.008	The purpose of the study was to analyze the use of disinfectant caps on all intravenous catheters and the rate and type of CLABSI in inpatient units	The population was a 13-bedinpatient unit in a 430-bed trauma center	A quasi - experimental intervention study.	The use of disinfectant caps reduced the CLABSI rates by greater than 40% and decreased the hospital stay by sixty-eight days and prevented one death.	Level 6 Descriptive study design	Limitation was the study was a single-center study and was non-randomized.	Yes, this was a study that implemented cap use similar to Curos cap use in my study

Lavallee, J. F., Gray, T. A., Dumville, J., Russell, W., & Cullum, N. (2017). The effects of care bundles on patient outcomes: a systematic review and meta-analysis. *Implementation Science*, *12*. http://dx.doi.org/10.1186/s13012-017-0670-0	The purpose of the study was to determine how care bundles affect patient outcomes and the relationship of healthcare workers in relationship care bundles.	A total of 5,796 abstracts for articles published between 2001 and 2017 in register for Cochrane database of controlled trials.	A systematic review and meta-analysis of both randomized and nonrandomized trials of care bundles Six randomized controlled trials (RCTs) and 31 pre- and post-intervention studies were included.	In these studies, implementation of the bundles reduced the CLABSI rate by 50%.	Level I evidence from systematic review of RCT.	Non-randomized study. The behavior change was measured retrospectively. Search terms were very broad which increased the heterogeneity and variability of the studies.	Yes, I will use the findings because the study explored the bundles in combination with staff behavioral change.

McAlearney, A. S., & Hefner, J. L. (2016). Getting to zero: Goal commitment to reduce blood stream infections. *Medical Care Research and Review*, *73*(4), 458-477. http://dx.doi.org/10.1177/1077558715616028	The purpose of the study was to demonstrate that goal setting contributes to high performance and better CLABSI outcomes.	Convenient sample of 194 key informants from eight participating hospitals	Exploratory multiple case study design	The high-performing hospitals showed that they were motivated by visible feedback about their goal, peer influence, and positive team interaction.	Level IV evidence from a well-designed cohort study	The limitations were possible reverse causality. The sample was small and there was no randomization of participants.

Reyes, D. C., Bloomer, M., & Morphet, J. (2017). Prevention of central venous line associated bloodstream infections in adult intensive care units: A systematic review. *Intensive and Critical Care Nursing*, *43*, 12-22. http://dx.doi.org/10.1016/j.iccn.2017.05.006	The purpose of the study was to identify and critique evidence for interventions used to prevent CLABSIs except antimicrobial catheters.	Nineteen studies were conducted in ICUs with adult populations. The ICUs used CDC recommendations of care bundles. The studies investigated the outcome of CLABSI rates per 1000 central line days and mortality and morbidity associated with CLABSIs. The secondary outcomes included patient ICU stay lengths and total central line days.	A systematic review of randomized controlled studies that were done from 2007 to 2016 compared CLABSI outcomes in patients that used only the care bundles and those that used care bundles and staff engagement and behavioral human factors.	The interventions used to prevent CLABSI included closed infusion sets, dressings, antiseptic skin preparations, education, care bundles and adequate staffing. This study found that a combination of the CLABSI care bundles, in addition to staff education, quality improvement initiatives, surveillance, compliance checklists, conference calls, and personal coaching improved patient care outcomes.	Level I evidence of moderate to high evidence studies RCT and observation studies.	The review excluded studies done in languages other than English.

Richards, G. A., Brink, A. J., Messina, A. P., Feldman, C., Swart, K., & Berg, D. (2017). Stepwise introduction of the "best care always" central line associated blood stream infections prevention bundle in a network of South African hospitals. *Journal of Hospital infection*, *97*, 86-92. http://dx.doi.org/10.1016/j.jhin.2017.05.013	The purpose of the study was to investigate ways to reduce preventable HAIs through best care always campaign.	The initial study included 43 private hospitals, then increased to 49 hospitals. Total ICU were 958. 439 high care beds. 1207 ICUs with 493 high care beds.	A prospective interventional study that was implemented in three phases. In phase one the investigators solicited for the commitment of the management team and doctors, and trained inpatient nurses on the care bundles. The standard measures were bundle compliance and infection per 1000 central line days. In phase two the study incorporated collaborative methods with multiple training and learning sessions for managers and inpatient nurses. In phase three the study continued with sustained goal setting, ongoing methods, and benchmarks.	A total of 1,119,558 central line days were reviewed. Bundle compliance increased from a mean of 73.1% to a mean of 90% in phase 1. The CLABSI rates decreased from a mean of 3.55 infections per 1000 CVL days to a mean of 0.13 per 1000 CVL days (p=0.0001). The study produced positive results due to leadership engagement, staff motivation, training, and the care bundles.	Level III, studies from well-designed interventional studies without randomization.	Limitation was non-randomization of the study.	The staff was very collaborative and involved the leadership, frontline staff and quality improvement teams.

Shah, N., Castro-Sanchez, E., Charani, E., Drumright, L. N., & Holmes, A. H. (2015). Towards changing healthcare workers' behavior: a qualitative study exploring non-compliance through appraisals of infection prevention and control practices. *Journal of Hospital Infection*, *90*, 126-134. http://dx.doi.org/10.1016/j.jhin.2015.01.023	The purpose of the study was to explore behaviors associated with noncompliance of infection prevention practices and efforts to appraise the social and environmental factors to improve healthcare workers compliance of infection prevention practices.	The study was a convenience sample of 10 physicians, 10 pharmacists, 18 nurses, and one midwife.	A qualitative method using interviews of clinical staff.	The non-compliance and ambiguity in infection prevention practices was attributed to responsibility, hierarchy of influence, prioritization, and risk appraisal Responsibility-the lack of collective responsibility. Hierarchy and influence - Most physicians thought that infection prevention was the responsibility of RNs because physicians don't perform certain tasks. There were hierarchical barriers between nurses, junior doctors, and physicians in communicating infection issues.	Level I of evidence VI evidence from single descriptive study.	Non-randomization of the participations. The results were subject to bias secondary to self-reported evidence.	Yes, will use some evidence because collaboration, team work and behaviors noted in the study can help design better studies to improve clinical staff behavior.

Wichmann, D., Belmar Campos, C. E., Ehrhardt, S., Kock, T., Weber, C., Rohde, H., & Kluge, S. (2018). Efficacy of introducing a checklist to reduce central venous line associated bloodstream infections in the ICU caring for adult patients. *BMC Infectious Diseases, 18,* 267. http://dx.doi.org/10.1186/s12879-018-3178-6	The purpose of the study was to investigate the use of checklists in CLABSI prevention.	The study was an observational study of 1138 participants who were assigned to the checklist group and 2898 to the control group from October 2011 to September 2012.	A prospective observational study without randomization.	A total of 4416 CVLs were placed. The results revealed that the use of checklist reduced CLABSI. The checklist group had 3.8 per 1000 catheter days while the no checklist group had 5.9 per 1000 catheter days. The use of the checklist reduced the frequency of CLABSI from 36.3 per 100 catheter days to 21.2 per 1000 catheter days.	Level III Evidence.	The limitations include lack of randomization.	Yes, will use this data. The study was done on a large population and produced results in favor of checklists.

Weeks, K. R., Hsu, Y., Yang, T., Sawyer, M., & Marsteller, J. (2014). Influence of a multifaceted intervention on central line days in intensive care units: Results of a national multisite study. *American Journal of Infection Control*, *42*(10), S197-S202. http://dx.doi.org/10.1016/j.ajic.2014.06.003	The purpose of the study was to carry out a national quality improvement collaborative studies to examine the ICUs that participated in the CUSP: STOP BSI had fewer blood stream infections compared to the pre-study period.	A linear regression of more than 100 ICUs, from 44 States 9,225 ICU quarters worth of data from 2008 to 2012 using random intercepts The study analyzed data from 792 hospitals and 1,071 ICUs were included in the analysis.	This was a prospective study with randomization. It included multiple centers. The participants were assigned to six cohorts. The interventions included education, teamwork building, leadership mentors, care bundles and feedback about CLABSI rates.	The CLABSI rate in the ICU was reduced by 43% during the study. Total CVL days decreased by 4-7% at the beginning the fourth quarter compared to the pre-intervention period and this decrease was sustained through the sixth quarter. On average, 21.7 fewer line days were seen in the sixth quarter than were seen in the pre-intervention period. The average review of line necessity rose from 4.01 to 4.49 on the five-point scale.	Level I Multicenter studies with randomization.	The limitation included missing data from some participating centers, the study had no comparison group, variation of patient population, bias with self-reporting.	Yes, I will use this evidence because the multimodal actions for CUSP: STOP BSI improved the CLABSI prevention in ICU.

Thom, K. A., Li, S., Custer, M., Preas, M. A., Rew, C. D., Cafeo, C., ... Lissauer, M. E. (2014). Successful implementation of a unit-based quality nurse to reduce central line-associated bloodstream infections. *The American Journal of Infection Prevention*, *42*, 139-143. http://dx.doi.org/10.1016/j.ajic.2013.08.006	The purpose of the study was to examine the effects of a unit-based quality RN dedicated to perform infection prevention and patient safety activities in a surgical ICU (SICU).	The study was done in a 757-bed tertiary hospital with 333 intensive care beds. The SICU is a 19 bed ICU that provides care to organ transplant patients and other surgeries.	The phase implemented a collaborative approach by nursing leadership, key clinical leaders, physicians, and the hospital epidemiologist. The best practice included the use of chlorhexidine, hand hygiene, sterile barrier precautions, avoiding femoral lines access, and promptly removing CVL. Additional measures included using the above care bundles and monthly point prevalent audits. A checklist was used for CVL insertions. Each unit identifies a quality champion who acted as a liaison between the leadership and the unit staff. The second phase recommended the use of eight senior clinical nurses that rotated the hospital to perform patient safety and infection prevention focusing on CLABSI. The senior nurse educated the staff, increased awareness of CLABSI, monitored compliance and provided feedback. She attended daily rounds.	There were 3257 admission and 25251 to all ICUs. The average CLABSI rate in all ICUs was 3.9 per 1000 CVL days. The rate decreased to 4.8% per month CI 95% 3.4%-6.2% with *p=0.001* per month. The average SICU CLABSI rate was 3.6 per 1000 CVL days compared to 5.0 per 1000 CVL days. After intervention, the reduction of the rate of CLABSI in SICU was 1.5 per 1000 CVL days (70%). The down side of this study was that the absence of the unit-based quality RN negatively affected the quality performance. An estimated $205, 200 was saved from 11.4 CLABSI during one-year study ($1800 per CLABSI)	Level of evidence 6, descriptive design.	Limitation were: The study was non-randomized and was a single-center study.	Yes, this was a clinical intervention study that used collaborative efforts from leadership, physicians and front-line clinicians.

Wilder, K., Wall, B., Haggard, D., & Epperson, T. (2016). CLABSI reduction strategy: A systematic central line quality improvement initiative integrating line-rounding principles and a team approach. *Advances in Neonatal Care*, *16*(3), 170-177. Retrieved from https://www.nursingcenter.com/cearticle?an=00149525-201606000-00005&Journal_ID=675992&Issue_ID=3505668	The purpose of the study was to introduce two-person line rounding to the existing care bundles to reduce CLABSI in neonatal ICU by 50% in one year.	The population included a 36-bed neonatal ICU in a large academic and referral medical center.	A prospective interventional qualitative study where skilled healthcare providers assessed PICC line per policy and maintained two-person rounds 24/7, seven days a week, using a line rounding audit tool.	The CLABSI rate reduced from 3.9 per 1000line days to 0.3 per 1000-line days with 92% improvement.	Level V Evidence from descriptive studies.	Limitations include non-randomized studies.	Yes, I will use the evidence because disinfectant cap changes reduced the rates of CLABSIs in neonatal ICU and the concept can apply to adult ICU.

Wong, C. A., Cummings, G. G., & Ducharme, L. (2013). The relationship between nursing leadership and	The purpose of the study was to examine the relationship between nursing leadership and patient	A systematic review of 121 studies from May 2005 to July 2012. 12 studies	This was a systematic review of published English studies that studied	The review found strong relationships between relational leadership and patient satisfaction, adverse events, patient safety and mortality outcome, patient	Level V evidence from systematic reviews of descriptive and	Some studies did not have sample representativeness, poor	Yes, relational leadership in healthcare that was studied

patient outcomes: a systematic review update. *Journal of Nursing Leadership*, *21*(5), 709-724. http://dx.doi.org/10.1111/jonm.12116	outcome.	used RCT.	leadership styles, behavior, practices, and competencies. All studies used cross-sectional design.	complications and healthcare utilization. The negative outcomes included staff expertise turnover, overtime, and absenteeism.	qualitative studies.	response rates, and outliers.	positively influences the evidence-based practice and infection prevention in the organizatio n.