

2021

An Educational Intervention to Reduce Central Venous Catheter Infection Rates

Bolanle Olajuyigbe
Walden University

Follow this and additional works at: <https://scholarworks.waldenu.edu/dissertations>



Part of the [Medicine and Health Sciences Commons](#)

This Dissertation is brought to you for free and open access by the Walden Dissertations and Doctoral Studies Collection at ScholarWorks. It has been accepted for inclusion in Walden Dissertations and Doctoral Studies by an authorized administrator of ScholarWorks. For more information, please contact ScholarWorks@waldenu.edu.

Walden University

College of Nursing

This is to certify that the doctoral study by

Bolanle Olajuyigbe

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.

Review Committee

Dr. Edna Hull, Committee Chairperson, Nursing Faculty

Dr. Susan Hayden, Committee Member, Nursing Faculty

Dr. Mary Rodgers, University Reviewer, Nursing Faculty

Chief Academic Officer and Provost

Sue Subocz, Ph.D.

Walden University

2021

Abstract

An Educational Intervention to Reduce Central Venous Catheter Infection Rates

by

Bolanle Olajuyigbe

MS, Walden University

BS, University of Ibadan

Project Submitted in Partial Fulfillment
of the Requirements for the Degree of
Doctor of Nursing Practice

Walden University

February 2021

Abstract

Central venous catheters (CVC) are essential in both critical and noncritical care settings. Despite benefits such as the administration of medications, blood products, and parenteral nutrition, CVCs are also associated with infections known as central–line associated blood stream infections (CLABSI). Linked to knowledge deficit and noncompliance in following evidence-based care bundles by nurses, it is important that nurses are empowered through education to provide quality care to reduce CLABSI rates. Thus, a staff education program was developed to answer the practice-focus question: if an organized education program increases the knowledge of medical-surgical nurses on central line care and management procedures for reducing CLABSI. The project was guided by Rogers' theory of diffusion, adult learning theory, and the John Hopkins evidence-base practice model. Following a literature review to identify current, best practices for managing CVCs, the staff education program was implemented on the target nursing unit using a 10-item pretest/posttest exam to answer the practice-focused question. With a participant group of 40 staff nurses attending the program, a *t* test showed a statistically significant increase in pretest mean score from 64.19 to a posttest mean of 81.38. The program supports the education needs of nurses working with and managing CVCs. The potential for positive social change includes promoting advocacy in nurses who aspire to make a difference in achieving positive patient outcomes. Last, results can also be added to the existing body of knowledge on translating project findings to clinical practice.

An Educational Intervention to Reduce Central Venous Catheter Infection Rates

by

Bolanle Olajuyigbe

MS, Walden University

BS, University of Ibadan

Project Submitted in Partial Fulfillment
of the Requirements for the Degree of
Doctor of Nursing Practice

Walden University

February 2021

Dedication

This project is dedicated to all patients who suffered from CLABSI and to all the nurses at the forefront of preventing CLABSI.

Acknowledgement

I give God all the praise for seeing me through it all without him, this DNP program would never have been possible. May His name be praised.

To my project committee chair Dr. Edna Hull, I cannot thank you in enough for your listening ears, guidance, patience, and tolerance. Also, to my DNP committee member Dr. Hayden, thank you for your guidance and corrections in ensuring that this project met the required standards.

I would like to say a big thank you to my husband, Dr. Olayemi for his support and giving me the wings to fly. To my children Oluwadamilola, Oreoluwa and Oluwakayode, I appreciate you for your patience, tolerance, and love.

To my mother Kehinde Raji (Iya Adura), thank you for your prayers and support and for following through with legacy (It is either education or nothing) left by my deceased father (Jimoh Raji). To my father-in-law, thank you for your prayers and understanding. To my spiritual parents Pastor Ayo and Pastor Remi, you are highly appreciated for your prayers, guidance and follow-up.

To my sister Stella Ogoko, I cannot thank you enough. Thank you for lending me your shoulder to cry on when the journey seemed impossible and rough.

To my siblings, nieces and nephews, I say a big thank you for your prayers and support.

Table of Contents

List of Tables	iv
List of Figures	v
Section 1: Nature of the Project	1
Introduction.....	1
Problem Statement	4
Purpose Statement.....	6
Nature and Scope of the Doctoral Project.....	6
Significance to Stakeholders.....	7
Significance and Relevance to Practice	9
Summary	11
Section 2: Background and Context	12
Introduction.....	12
Concepts, Models and Theories	12
Application of Key Concepts from Rogers’ Theory to the DNP Project	14
Adult Learning Theory	18
Application of Adult Learning Theory to the DNP Project.....	19
John Hopkins Evidence-based Practice Model.....	20
Application of John Hopkins Model to the DNP Project	21
Relevance to Nursing Practice	23
Summary of Evidence.....	24
Local Background and Context	29

Role of the DNP Student.....	30
Role of the DNP Project Team	31
Summary	32
Section 3: Collection and Analysis of Evidence.....	33
Introduction.....	33
Practice-Focused Question.....	33
Sources of Evidence.....	34
Evidence Generated for the Doctoral Project	35
Analysis and Synthesis	37
Summary	38
Section 4: Findings and Recommendations	39
Introduction.....	39
Findings and Implications.....	39
Implications.....	48
Recommendations.....	49
Contribution of the Doctoral Project Team	51
Project Limitations.....	52
Plans for Sustainability	53
Summary	54
Section 5: Dissemination Plan	55
Introduction.....	55
Dissemination Steps/Approaches.....	55

Analysis of Self.....	57
Summary.....	59
References.....	60
Appendix A: Pre/Posttest Examination	71
Appendix B: Educational Flyer	74
Appendix C: Best Practices for Managing Central Venous Catheters and Preventing CLABSI.....	75
Appendix D: Findings.....	76

List of Tables

Table 1. Working with the Adult Learner.....	19
Table 2. Descriptive Statistics: Pretest Scores ($N = 40$)	42
Table 3. Descriptive Statistics: Posttest Scores ($N = 40$).....	43
Table 4. Breakdown of Improvement in Exam Questions Pre-test and Post-test.....	44

List of Figures

Figure 1. Concept from Rogers Theory of Diffusion	17
Figure 2. Concepts from Knowles Adult Learning Theory	20
Figure 3. The John Hopkins Nursing Evidence Based Practice Model	22
Figure 4. Graph Showing Pretest Score Groups	46
Figure 5. Graph showing Posttest Score Groups	47

Section 1: Nature of the Project

Introduction

Central venous catheters (CVC), commonly referred to as central lines, are essential in the care of adult patients in critical care and noncritical care settings (Kleper & De Almeida, 2015). These devices provide vascular access to administer fluids, medications, blood products, and parenteral nutrition (Kleper & De Almeida, 2015). Despite the benefits of these devices, there are associated risks including central-line associated bloodstream infections (CLABSI) (Haddadin & Regunath, 2018). According to Woodward and Umberger (2016), CLABSIs are a common source of healthcare-associated infections (HAI). They occur when microbes colonize the surface of the CVC or the fluid pathway when inserting the device, or while using the CVC (Weeks et al., 2014). CLABSIs lengthen hospital stay and increase costs and mortality rates (Haddadin & Regunath, 2018). Experts estimate that between 300,000 and 500,000 CLABSIs occur annually with a mortality rate ranging between 15 to 30% (Perin et al., 2016). With an average treatment cost of \$16,500 to \$45,000 per infection, billions are spent in healthcare dollars treating infections that are preventable (Lissauer et al., 2012).

The problem of CLABSIs is not limited to the United States. Bloodstream infection is a key cause of mortality and morbidity of people globally (Johnson et al., 2014; Mishra et al., 2017). Valencia et al. (2016), in an extensive review of CLABI in 95 countries found that this problem is pervasive in low, middle, and high-income countries. Although the priority areas of interventions needed varied depending on the economic

resources of the country, an overwhelming number of countries had CLABSI rates that were much higher than their nationally recommended standards (Valencia et al., 2016).

The placement of a venous central catheter is an influencing factor in central line-related bloodstream infections. While pervasive in critical care settings, CLABSI incidence is also experienced in noncritical care settings (Marschall et al., 2014). Minimization of catheter-related complications is one of the healthcare safety challenges issued by the Centers for Disease Control and Prevention and the National Health Safety Network (as cited in Haque et al., 2018).

National initiatives to curb CLABSI rates have been implemented over the past few years including central line maintenance bundles, insertion bundles, chlorhexidine bathing, daily assessment of necessity for the central line, hand hygiene, and aseptic technique (Woodward & Umberger, 2016). Evidence shows that CLABSIs are largely preventable and there are opportunities to implement evidence-based practice (EBP) interventions to reduce the burden associated with these nosocomial infections (Marshall et al., 2014). Despite implementation of CLABSI bundles in many practice settings, CLABSI rates remain prevalent in healthcare settings. One of the reasons for this reality is poor translation of evidence into practice which is tied to healthcare provider's knowledge (Acharya et al., 2019). Studies to assess nursing knowledge on catheter care with the intention of reducing CLABSI rates reveal a knowledge deficit among the nursing and healthcare provider population regarding this topic (Acharya et al., 2019; Aloush & Alsarairh, 2018).

Additionally, there remains a disconnect between the knowledge of the bundles at both the institutional level and individual practitioner level as well as a lack of bundle adherence noted in the same practice settings. Furuya et al. (2012) indicated that many institutions do not routinely monitor adherence with best practices to reduce CLABSI rates or implement measures to track and encourage adherence. There are also rare penalties for providers who do not adhere to the clinical guidelines and implemented bundles (Furuya et al., 2012).

Therefore, the purpose of this Doctor of Nursing Practice (DNP) project was to develop and implement a staff education program for nurses to address the persistent problem of rising CLABSI rates. This intervention aimed to reduce the rising rates of CLABSI in both intensive and non-intensive care units, thereby reducing cases of mortality and morbidity. Additionally, implementation of this intervention had the potential for impacting positive social change within the local, state, and national healthcare systems by promoting advocacy in nurses who aspire to make a difference in achieving positive patient outcomes. Finally, this capstone project was designed to align with the American Association of Colleges of Nursing (AACN, 2006) DNP Essentials I and II which include scientific underpinnings for practice and organizational and systems leadership for quality improvement and systems thinking. The project was also consistent with DNP Essentials III and VIII, clinical scholarship and analytical methods for evidence-based practice and advanced nursing practice (AACN, 2006).

Problem Statement

CVCs are essential in the care of adult patients in critical care and noncritical care settings (Kleper & De Almeida, 2015). These devices provide vascular access to administer fluids, medications, blood products and parenteral nutrition (Kleper & De Almeida, 2015). However, despite the benefits of these devices, there are associated risks, including CLABSI (Haddadin & Regunath, 2018). Due to the devastating effects of CLABSI, it becomes important to maintain a culture of safety to prevent additional HAIs for patients in healthcare settings.

The project was conducted in an acute care teaching hospital located in the northwest region of the United States. In the facility of focus there had been an increase in central line infections in the noncritical care unit (non-ICU) areas. This finding was especially true in patients admitted from nursing homes or those admitted with permacaths for dialysis (CLABSI Reduction and Prevention Committee Chair, personal communication, September 11, 2019). The current infection rate exceeded the established target rate of 0.9% as set by the network of hospitals including the project facility. Reviews of monthly reports released by the CLABSI Reduction and Prevention Committee showed central-line infection rates for non-ICU areas have increased steadily by 0.5% for January 2019, 0.9% for March 2019, 0.4% for April 2019 and a 1.4% for May 2019 (CLABSI Reduction and Prevention Committee Co-chair, personal communication, July 2019).

Despite implementation of central line bundles and ongoing monitoring of patient response, central line infection rates have increased significantly (CLABSI Reduction

and Prevention Committee Co-chair, personal communication, July 30, 2019). Neither the ICU nor non-ICU units met the 0.9% standardized rates for CLABSI in accordance with the network of healthcare facilities of which it is a member. Additionally, the facility had fallen short in meeting the national standards which are the standardized guidelines for preventing CLABSI as set by the Centers for Disease Control and Prevention (CDC), and the National Health and Safety Network (NHSN) benchmarks (Haddadin & Regunath, 2018).

The gap between research evidence and practice identified in this clinical setting was that there is no uniform training or information provided to nurses as the main providers of care on CLABSI prevention (Haddadin & Regunath 2018). As a participant on the CLABSI Reduction and Prevention Committee, what was noted was lack of compliance in monitoring compliance with existent bundles—an additional factor revealing inconsistent application and adherence to current bundles. With nurses working in critical and noncritical care units and serving as the target audience for this project, the proposed education program focused on current evidence-based practices and interventions in managing patients with central lines. Included in the project is a review of the literature on the central line care bundle used by the clinical setting to address central line infections. The review evaluated current evidence-base practice guidelines for bedside nurses and intravenous teams with the overall intent of preventing and reducing the incidence and prevalence of CLABSI in the practice setting.

Purpose Statement

The primary purpose of this DNP project was to develop and implement an educational program for nurses as an intervention to prevent and lower CLABSI rates in a teaching hospital located in the northwest region of the United States. With rising CLABSI rates in this facility, providing a targeted intervention to enhance the knowledge of the nursing staff could lower the infection rates. Two major steps were conducted to answer the practice-focused question: Will an organized education program increase the knowledge of facility nurses on central line care management? These steps included a literature review on best practices for preventing central line infections. The second step was the development and implementation of an organized education program for nurses on central line care management along with continued monitoring of CLABSI rates.

The project was conducted to meet the following objectives to improve patient outcomes:

1. Design and implementation of an evidence-based nursing staff educational program with the intention of improving the knowledge of nurses on CVC management and preventing CLABSI.
2. Development of a valid test given before and after the staff education program to evaluate effectiveness of the educational offering.

Nature and Scope of the Doctoral Project

Using the library resources, a review of the literature was done on current best practices for preventing and reducing CLABSI in clinical settings. Major databases searched included Medline, PubMed, CINAHL, and Google Scholar. Both primary and

secondary sources were included in the review. Primary sources are defined as information received directly from the authors (Al-Jundi & Sakka, 2017). Examples are scholarly articles, research studies, clinical reports, dissertations, and case studies. Secondary sources included information gathered from sources other than directly from the author. Examples of secondary sources included articles, expert opinions, biographies, eBooks, and literature reviews (Setia, 2016). A staff education program was developed using the best evidence in the literature to increase nursing knowledge on how to manage vascular access devices to reduce CLABSI. Delivered as a PowerPoint presentation, the education program included pretest/posttest exams and a consent form for anonymous questionnaire.

The target population identified in this project were registered nurses and nurse practitioners working on the medical-surgical unit of the facility who provide direct care to patients with CVCs. The decision to limit the education program to nurses was based on the reality that in this facility, nurses are the primary care providers responsible for direct care of patients. While physicians, physician assistants, and respiratory therapists also interact with these patients, they are not responsible for catheter care directly. Thus, this decision was in congruence with the organizational protocol on CVC management.

Significance to Stakeholders

Several stakeholders will benefit from this DNP project including nurses, patients, family members, the healthcare facility, and the nursing profession. First, the patients as recipients of care are the most significant stakeholders. A project of this kind will empower nursing staff with the knowledge needed to make confident and evidence-based

decisions in the care of their patients. The outcome is the improvement in the quality of care patients receive and a reduction in all the adverse effects associated with the development of an infection.

Secondly, nurses are also major stakeholders in this project. Nurses make up the largest component of healthcare providers in this facility and are responsible for direct care of patients. As managers of central venous catheters, nurses will benefit through knowledge acquisition which will in turn translate in the delivery of quality healthcare to patients. Acharya et al. (2017) explained that training helps improve nurses' knowledge and efficacy in providing CVC maintenance care.

Other healthcare providers would benefit from working with nurses who are highly skilled and trained in minimizing and preventing CLABSI incidence. Providers such as physicians, physician assistants, pharmacists, respiratory technicians, quality and safety specialists, and other ancillary or support staff are all stakeholders. When patients are diagnosed with CLABSI, all providers are impacted by the complications of the infection (Kornbau et al., 2015). The evidence-based findings disseminated through the education program will add to the pool of knowledge within this institution.

The hospital will also benefit from the project and the results. The reduction of CLABSI rates will contribute positively to reimbursement by private insurers as well as Medicare and Medicaid. The project will also have cost saving implications for the organization by preventing extended hospitalizations and complications due to infection. Thus, the reduction in risks and complications would, in turn, reduce the probability of mortality, care costs, and lengthy stays in hospitals (Gahlot et al., 2014).

The external stakeholders include the CDC (CDC, 2020), professional healthcare organizations, hospital associations, as well as local and state legislators. Government agencies have continued to push for a reduction of all nosocomial infections including CLABSI. This push has been tied to various initiatives, regulations, and payment incentives (Martseller et al., 2015). Largely responsible for protecting America from health and threats, applying and following CDC procedures using the central line care bundle will help minimize these infections and possibly free up resources. Additionally, reducing CLABSI rates in this facility will contribute meaningfully to efforts to reduce nosocomial infections within the local, state, and national healthcare systems.

Significance and Relevance to Practice

Conducting a review of the literature has the potential for identifying best practices that can be integrated into the current practice setting leading to a practice change. The focus is both on improving quality of care and patient outcomes, but also as a cost-effective initiative. Haddadin and Regunath (2017) indicated that CLABSIs are the most expensive HAIs and can cost an estimated \$46,000 per case. Considering the preventable nature of most CLABSI cases, the cost for treating these conditions is not justifiable in a healthcare environment that is already overspending compared to patient outcomes. Haddadin and Regunath also noted that the issue of CLABSI is not limited to intensive care units (ICU) as there are many central lines used in non-critical care settings.

Secondly, Galeon and Romero (2014) indicated that despite evidence-based interventions to reduce CLABSI rates through education, training, and hand hygiene

techniques during insertion of the central line and maintenance of the central lines, CLABSI remains prevalent in clinical practice. The success of this project will demonstrate that implementation of an education intervention resulted in the project goal of reducing CLABSIs on the medical-surgical units within the facility. Therefore, as a quality improvement measure, outcomes resulting from this project will lead to improved practice and ongoing reduction in this quality and safety problem.

Third, a DNP project focusing on reducing central line infection rates by increasing nursing knowledge on central line care and management can improve the quality of care rendered to patients. The need for evidence-based interventions that ultimately improve patient outcomes is critical in the evolving healthcare environment. Thus, findings from this project can validate future use and replication of a systematic approach using a literature review and staff education program to facilitate other quality improvement initiatives in this organization. The results can serve as a catalyst for other nurses and healthcare providers to participate and start their own evidence-based practice projects tackling other systemic issues.

Lastly, the project has the potential for impacting social change by addressing the issue of infection and the ramifications of not effectively managing an infection. Tentative plans include dissemination of results from the project at local, state, and national levels which will in turn inspire other healthcare facilities to consider a similar intervention. The national health department is focused on the health of the populace and is constantly evaluating the healthcare system for effectiveness and safety in the delivery of quality healthcare. Nursing indicators, including the rates of CLABSI incidence, are

indicators of efficiency in ICU and non-critical units (Bayoumi & Mahmoud, 2017).

Educational intervention programs about CVC maintenance care will reduce the rates of CLABSI, which in turn will help advance the healthcare results of patients with a central venous catheter (Bayoumi & Mahmoud, 2017).

Summary

Section I presented an introduction to the problem of CLABSI as a substantial cause of morbidities and mortalities in patients in ICU and non-ICU units. An evidence-based educational intervention was used to advance the knowledge of nurses and minimize the incidence of CLABSI. The prevention of CLABSI in healthcare organizations such as this is complex and challenging due to multiple factors involved. Prevention of infection needs collaboration and dedication of internal and external stakeholders. The emphasis on an educational program to prevent central line infections and lower CLABSI rates is to build the capacity, knowledge, and confidence of nurses. This project was designed to address two broadly stated objectives to design and implement a quality improvement program to improve nurses' knowledge on CVC management and CLABSI prevention and develop an educational program and test to evaluate nursing knowledge. The outcome of this project should influence practice change and contribute meaningfully to nursing and ultimately healthcare. Section 2 of this project addresses the models used to guide this project and the relevance of my role as a DNP student in carrying out the project.

Section 2: Background and Context

Introduction

Central-line infections are major complications occurring in many healthcare settings with CLABSI defined as a compromising factor impacting patient outcomes. As such, selecting and implementing interventions to address this health concern is essential. The purpose of this DNP project was to initiate a quality improvement initiative focusing on educating clinical staff on enhancing understanding and compliance of best practices in preventing central line infections and in turn, reducing CLABSI rates. This section of the project addresses the theoretical support utilized in this project including a discussion of Rogers' diffusion of innovation theory, adult learning theory, and the Johns Hopkins nursing evidence-based practice model. Furthermore, there will be a discussion on the local context and background to better frame the conditions surrounding this project. Lastly, the project's overall relevance to nursing practice, the role of the DNP student and team members are detailed in this section.

Concepts, Models and Theories

The chosen theory to support this project was Rogers' diffusion of innovation theory (Dearing, 2009). Rogers' theory was developed to explain how, why, and at what rate new ideas or innovations spread or diffuse through a specific system or population (Kaminski, 2011). The result of this diffusion or spread of the novel idea is that individuals who are part of system adopt a new idea, behavior, or production (Kaminski, 2011). Adoption means that there is a difference in action before and after implementation of the innovation (Dearing, 2009). The key to understanding Rogers'

theory is that impacted individuals must see the idea, behavior, or action as new or innovative. It is through this novelty that adoption occurs, and diffusion can happen. The theory emphasizes that all individuals in the organization do not adopt the innovation at the same level, rather, there are different tiers of adopters (Dearing, 2009).

Rogers' diffusion of innovation theory holds that scientific discovery and innovation play a significant role in both prevention and control of infection (Zimmerman et al., 2015). Despite the ubiquity of evidence and research studies to support prevention and reduction of infection modalities, an update of these innovations and advances remains suboptimal in clinical practice (Gahlot et al., 2014). The diffusion of innovation theory gives a framework for understanding and addressing the gaps that exist between the optimal use of evidence-based practices in clinical settings and actual use (Sreeramoju, 2019).

Rogers' theory focuses on the social and behavioral factors that can influence moving the best evidence in the literature into clinical practice (Sreeramoju, 2019). This transition from discovery into everyday practice is essential for quality improvement with consideration of factors in an organization and its environment that would influence the adoption and implementation of the innovation. Adoption begins when individuals in the organization identify a problem or performance gap (Zimmerman et al., 2015). In this practice situation, there is a notable problem in the organization with CLABSI rates, despite the introduction of CLABSI bundles; the infection rate has not significantly dropped over sustained periods. Therefore, there is a need to look for an innovative approach to deal with the problem.

Additionally, Rogers' diffusion of innovation theory requires a deep analysis of the organizational context including the decision makers, the environment, and the social context in which this organization operates (Sreeramoju, 2019). It is not enough to recognize that adoption of a change or innovation is necessary. In addition, the evaluation of these factors is necessary for successful implementation (Sreeramoju, 2019). As such, in preparation for the project, the DNP student conducted an informal needs assessment using interviews with key personnel, informal discussions with nursing staff, and review of the organizational data. The DNP student also met with pertinent stakeholders to determine if there was enough support within the organizational culture to facilitate an educational intervention based on the best evidence in the literature to address the practice problem.

Application of Key Concepts from Rogers' Theory to the DNP Project

Rogers' diffusion of innovation theory (Figure 1) has several key concepts which have relative advantage, compatibility, complexity, trialability, and observability (Smith et al., 2018). Relative advantage speaks to the extent to which the innovation is better than the current state it intends to replace (Smith et al., 2018). Currently, in the teaching hospital where the intended project will occur, there is no standardized education provided to nurses on CLABSI prevention and reduction for enhancing their knowledge and reducing infection rates. Additionally, the responsibility for implementing the current bundles lies with healthcare providers. To date there are no known measures to evaluate and enforce compliance with the CLABSI bundles. Thus, the alternative of providing

evidence-based training to staff nurses shows relative advantage of the proposed innovation over current practice.

The second concept of Rogers' theory is the compatibility of the innovation and speaks to whether the innovation aligns with the values, experiences, and needs of the target audience or potential adopters (Smith et al., 2018). The organization values safety and quality care with the implementation of best practices as supported by high quality research. There is evidence within the organization to show support of an educational intervention by clinicians and by hospital leadership. A brief review of several root cause analyses documents from CLABSI incidents within the organization showed that nurses did not rate their skills with CVC care and CLABSI prevention bundles high (CLABSI Reduction and Prevention Committee Co-chair, personal communication, July 30, 2019). Additionally, the formal skills assessment tool used in the organization showed that nurses wanted more training on preventing nosocomial infections as a priority topic for professional development and competency. Therefore, the intervention was also compatible with the needs of those who will be beneficiaries of the education program

Complexity is the third concept in Rogers' theory. The concept of complexity addresses the difficulty of the innovation to be understood or used in the clinical setting (Smith et al., 2018). The aim of the educational intervention was to use an instructional approach that emphasizes learning instead of teaching (Barr & Tagg, 1995). Defined as a learner-centered approach, the goal is to focus on participant involvement in the educational activity instead of teaching by lecture only (Barr & Tagg, 1995). I believed that this instructional approach would make learning more inviting, encourage

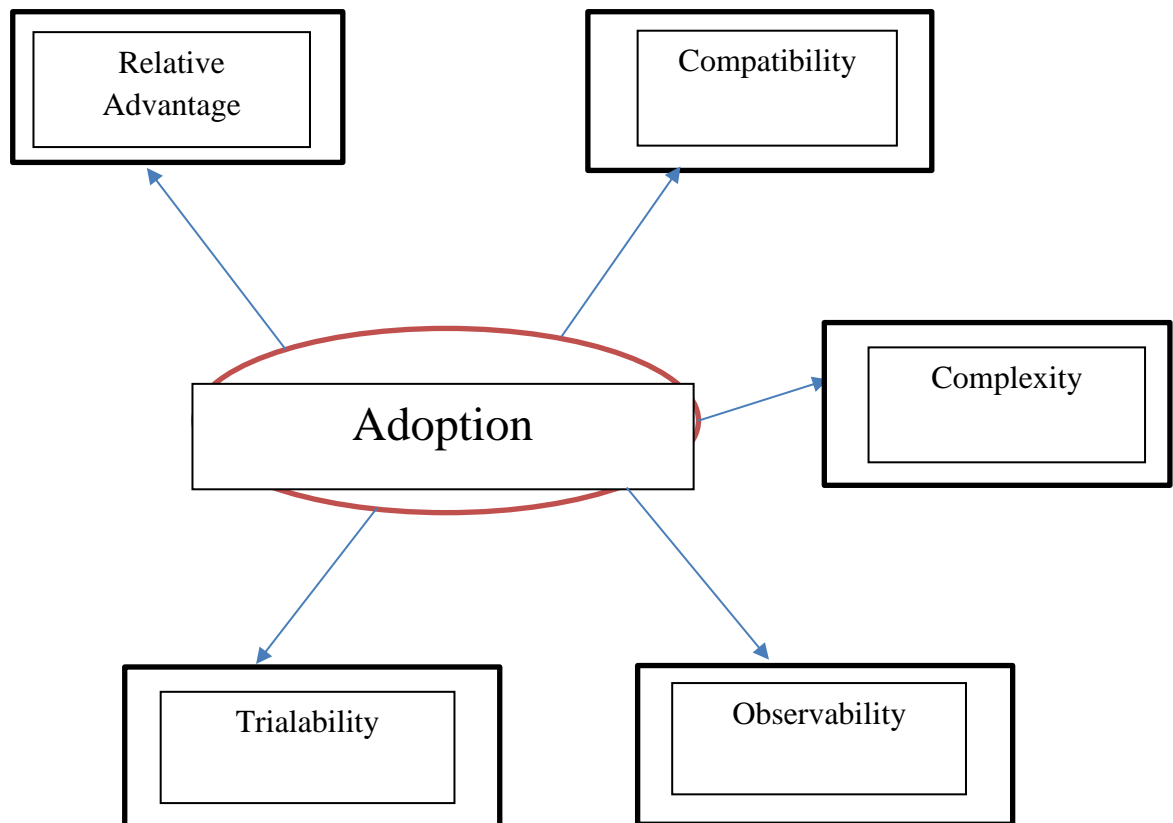
participation, and allow nurses to focus on the aspects of CVC use and CLABSI prevention and reduction where they are deficient.

Trialability refers to whether the innovation can be tested (Smith et al., 2018). In the case of this project, the viability of the intervention was tested by evaluating the nurses' knowledge with CVCs and CLABSI prevention and reduction before and after the educational intervention. Nurses' compliance with existing CLABSI bundles will also serve as a measure to determine if knowledge translates into better use of the bundles.

Lastly is observability which is the extent in which the innovation generates results (Smith et al., 2018). The DNP project objectives included measurable outcomes to evaluate the success of the educational intervention. The pretest and posttest were used to evaluate knowledge acquisition. Additionally, the CLABSI Reduction and Prevention Committee will continue monitoring CLABSI rates to determine if there has been a significant reduction in CLABSI in the units where nursing staff participated in the intervention. Based on the results, an educational program focusing on preventing CLABSI can be integrated into the organization's protocols for annual or semi-annual training for nurses and other healthcare providers.

Figure 1

Concepts from Roger's Theory of Diffusion



Adapted from (Dearing, 2009); Developed by Bolanle Olajuyigbe

Adult Learning Theory

The second theory guiding this DNP project was Malcolm Knowles' theory on adult learning (Knowles (1980). According to Knowles adults learn in ways that are different to how children learn. Historically, Knowles is credited with coining the phrase andragogy, a term associated with adult learning. In contrast to andragogy, pedagogy refers to the education of children. Adult learning theory has grown over the years to include concepts, principles, guidelines, and learning characteristics focused on understanding how adults learn.

Depicted in Figure 2, characteristics of adult learners include an approach to learning that includes self-direction, readiness to learn, internal motivation, problem orientation and learning based on previous experience. For example, adult learners tend to be less content-centered but instead problem-oriented (McEwen & Wills, 2014). Adults are more likely to learn if they view the information relevant and important (McEwen & Wills, 2014). Another characteristic is that adult learners are self-directed and tend to relate learning to previous experiences. Motivated to learn, adults also refer to be actively involved in the learning experience. Active involvement in learning can include self-pacing and assuming ownership for monitoring progress toward completion of goals. For years nurses teaching in both the clinical and academic settings have used concepts and principles from adult learning to plan, teach, coach, and facilitate the adult learner (Table 1).

Table 1*Working with the Adult Learner*

Nurse Educator Role	Adult Learner Role
Create a collaborative learning environment	Accept responsibility for learning
Encourage active involvement of the adult learner	Actively participate in the learning experience
Acknowledge previous learner experience	Monitor progress

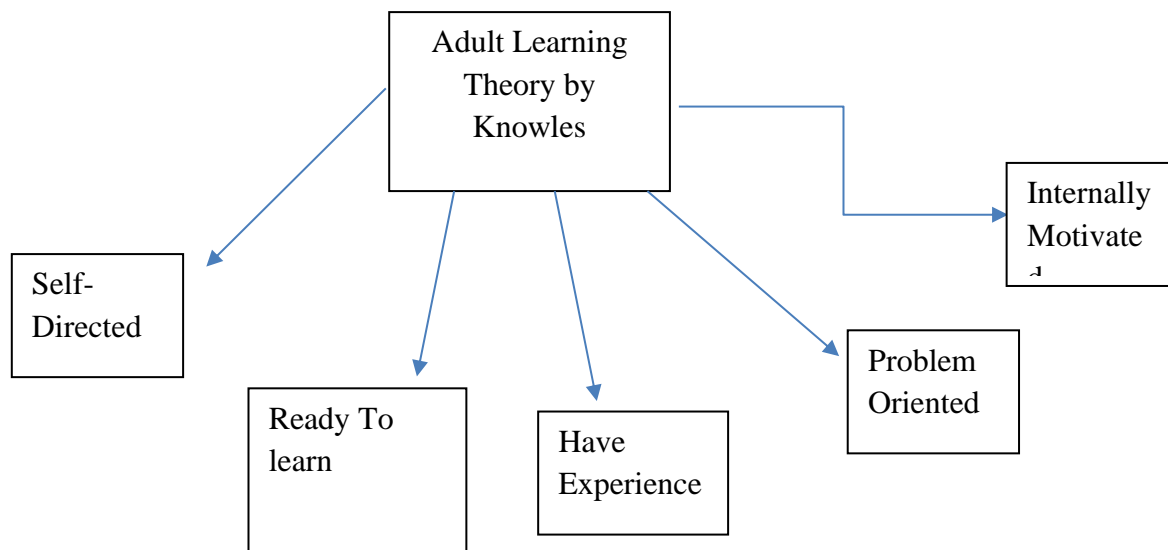
Adapted from Knowles (1980); Developed by Bolanle Olajuyigbe

Application of Adult Learning Theory to the DNP Project

For this DNP project, it was important to connect the latest CVC care and maintenance evidence to improve the knowledge of the nurses. Thus, concepts and principles from Knowles' (1980) adult learning theory were used to develop an educational program on CVC care, maintenance, and reduction of CLASBI rates. Guided by the adult learning theory, specific steps included nurse participation in evaluating the educational program. Tactics employed included interactive activities during presentation of the staff educational program. Building on previous knowledge and experiences of participants, nurses were given an opportunity to discuss problems in managing central venous catheters. Additionally, a comfortable environment was provided for participants. In summary, recognizing the unique needs of nurse participants, concepts and principles from adult learning were used as a guide in planning, implementing, and evaluating the staff educational program for this DNP project.

Figure 2

Concepts from Knowles' Adult Learning Theory



Adapted from Knowles (1980); Developed by Bolanle Olajuyigbe

John Hopkins Evidence-based Practice Model

An additional EBP model for this project was the Johns Hopkins Nursing evidence-based practice model (JHNEBP; Figure 3). This model is widely used by nurses and leverages a stepwise problem-solving approach to empower nurses to make the best clinical decisions. JHNEBP has three steps– practice question, evidence, and translation (Ryan et al., 2017). The goal of this EBP model was to promote nurses' implementation of quality improvement projects in the practice setting by searching the literature to identify best practice initiatives for translation into daily patient care.

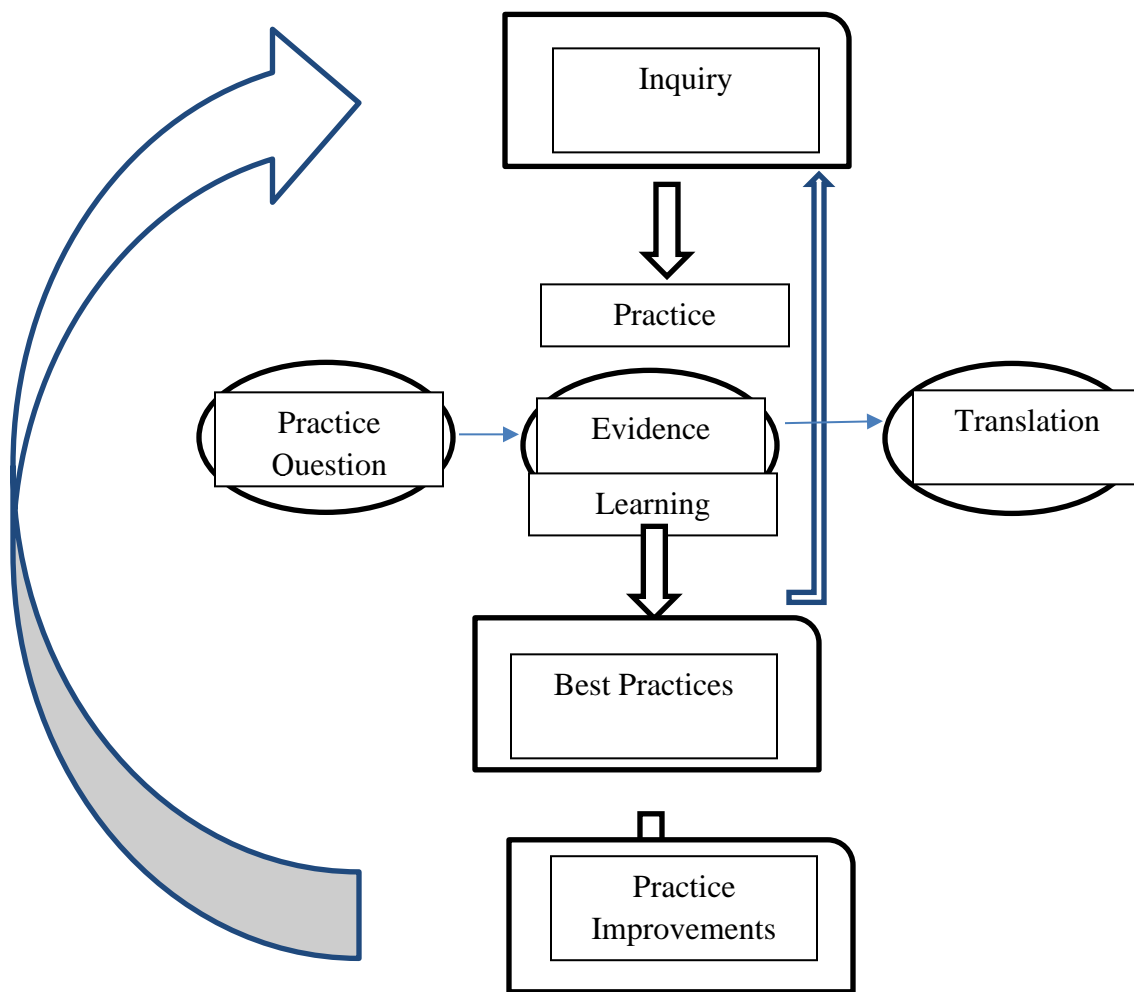
Application of John Hopkins Model to the DNP Project

For the first step, I, in collaboration with key stakeholders, identified the problem and crafted a practice question. The question also reflected patient needs, organizational data, and the resources available in the facility. The second step was gathering evidence. The JHNEBP model also provided a rating system used to grade the quality of evidence supporting the EBP project. The included studies that were grade 1 or B and mostly level I or II studies. A few exceptions were made to include qualitative studies which provide additional contextual information on CLABSI prevention and reduction protocols and strategies.

The gap in translation of best evidence to prevent CLABSI was validated in the literature. Per Ryan et al. (2017), exploration of the evidence is critical to identify the best evidence strategies to address a practice problem. The model also has tools and resources to appraise, summarize, and synthesize the evidence. After a synthesis of the literature, I developed and implemented an educational intervention using the best evidence available that fits the practice setting.

Figure 3

Johns Hopkins Nursing Evidence-based Practice Model; Ryan et al. (2017)



Note. Adapted from Ryan et al. (2017); Developed by Bolanle Olajuyigbe.

Relevance to Nursing Practice

This DNP project was designed to answer the practice-focused question: will an organized education program increase the knowledge of facility nurses on central line care and management? More precisely, the project was designed to develop a staff education program. Recognizing this goal, a review of the literature was conducted. Locating literature to answer the practice question, databases searched included Cochrane Database of Systematic Reviews, Cumulative Index to Nursing and Allied Health Literature (CINAHL), PubMed (National Library of Medicine and National Institute of Health), Medical Literature Analysis and Retrieval System Online (MEDLINE) with Full Text, and ProQuest Nursing and Allied Health Source Plus with Full Text. Additionally, a subsequent search was performed using Google Scholar with the purpose of locating primary and secondary sources.

Search terms used to review current sources included *central line-associated bloodstream infection (CLABSI)*, or *healthcare associated infections (HAIs)*, *nosocomial infections*, and *prevention or reduction*. With the goal of achieving currency of research findings, the search was limited to studies published between 2010 and 2020. Studies were excluded if they were not published in English and did not meet the requirement as a systematic review, meta-analysis, randomized controlled trials, cohort study, descriptive study, or observational research.

Results from the search were reviewed to identify and remove duplicates. The abstracts of studies meeting the inclusion criteria were reviewed to ensure relevance to the topic. The next step involved reviewing full text of the articles that were relevant, and

their reference lists were also reviewed for potential studies that were not captured in the original search. Additionally, the studies were appraised for validity using the JNEBP appraisal tools for grading and rating the evidence. The average quality of the included evidence was good, albeit the rating varied as the qualitative studies ranked lower. Collection and analysis of this literature served as the foundation of the education content that was presented to nurse participants attending the staff education program.

Summary of Evidence

Literature review indicated that sources of evidence to address CLABSI fell under four major themes: catheter insertion bundles, catheter maintenance bundles, compliance, and adherence to bundles and nurse/clinician education interventions. The following summary addresses each theme. Overall, much of the evidence on CLABSI prevention focused on the ICU, however, devices are placed in noncritical care units and in outpatient settings which contribute to the CLABSI burden (Yokoe et al., 2014). Nevertheless, there were a few studies that showed that the evidence used in ICUs may be applicable to other settings. More studies are needed to address CLABSI incidence and to create bundles specific to settings other than critical care. Patel et al. (2018) indicated that facilities should consider a tiered approach to preventing CLABSI beginning with the most researched recommendations and slowly delving into novel and newer EBP measures that have not been studied as extensively.

Catheter Insertion Bundles

In terms of catheter insertion bundles, the evidence highlighted the importance of determining the appropriateness of vascular catheter use before placing the device

(Chopra et al., 2015). Avoiding inappropriate vascular catheter insertion is an essential first step to preventing infection. The Michigan Appropriateness Guide for Intravenous Catheters (MAGIC) is an EBP approach that has been studied to help care providers determine when a CVC is warranted (Chopra et al., 2015; Moureau & Chopra, 2016; Woller et al., 2016). MAGIC is an algorithmic, evidence-based approach that providers can use to select a vascular catheter and determine the appropriateness of vascular access devices including CVCs, and defines duration of use, patient characteristics, and the nature of the infusate the patient is receiving (Chopra et al., 2015).

Some of the recommendations for catheter insertion include flushing with normal saline rather than heparin, appropriate catheter tip positioning, and using the minimum number of lumens possible for the device (Bozaan et al., 2019; Shaw et al., 2017).

Implementing MAGIC is effective in reducing CLABSIs as well as other complications like catheter-related thrombosis events and catheter occlusion (Chopra, 2015; Moureau & Chopra, 2016). Use of single-lumen and the MAGIC approach can also have cost-saving implications in hospitals (Ratz et al., 2016). Furthermore, avoiding unnecessary use of CVCs and opting for less invasive devices may also be options to consider, such as midline catheters or the use of ultrasonography-guided intravenous access. The latter approach could be beneficial to patients with difficult access (Deutsch et al., 2014; Pathak et al., 2018).

Catheter site selection is also critical and can impact the potential for infectious complications. Lai et al. (2016) in their systematic review, found that the femoral site was associated with the highest risk for catheter-related infections and thrombosis making this

site not recommended for initial choice for CVC insertion. Also, the jugular cite is considered to be high-risk and associated with disruptions. The subclavian site is highly recommended for initial placement and other sites should be considered if this site is not feasible (Hakko et al., 2015; Parienti et al., 2015). To facilitate some of the bundle elements, there are organizations that focused on a dedicated staff for central line insertion and in how to train other providers (Lai et al., 2016; Pathak et al., 2018).

The final component of the catheter insertion bundle is the need for proper aseptic insertion. Catheters must be inserted using the best process to prevent CLABSI. These techniques have been collated into evidence-based CVC bundles and interventions that should be implemented to maximize aseptic technique. The main components of these insertion bundles to ensure aseptic technique are hand hygiene, maximal sterile barrier, and the use of chlorhexidine skin antiseptis (Marschall et al., 2014; Saks et al., 2014). The evidence also supports availability of insertion guidelines and the use of checklists as part of the catheter insertion bundle (Lai et al., 2016; Patel et al., 2018).

Catheter Maintenance Bundles

There were not as many high-quality studies providing guidance on catheter maintenance compared to evidence on catheter insertion. Ray-Barruel et al. (2019) reported that maintenance bundles often have three to seven components which include daily review of catheter and reminder systems to facilitate the removal of catheters. Additionally, some of the recommended practices include flushing, implementing appropriate device care, maintaining the integrity of the dressing, and prompt removal of catheters (Isla et al., 2016; Patel et al., 2018).

Additional recommendations pertaining to catheter maintenance include prompt removal of unnecessary lines, disinfection prior to manipulating the line, disinfecting the catheter hubs, ports and connectors as appropriate (Grigonis et al., 2016; Marschall et al., 2014). Most maintenance bundles also include hand hygiene and some included surveillance of performance and feedback on CLABSI rates. There were also recommendations about selection of dressings with transparent and semi-permeable dressings with chlorhexidine sponge dressings preferred (Grigonis et al., 2016; Isla et al., 2016).

A part of maintenance that was sparsely addressed in the literature was the removal of the central line catheter; in some situations, removal was part of a separate bundle. The literature showed many patients did not have documented indication for placement or instructions for removal (Patel et al., 2018; Yokoe et al., 2014). Reducing dwell time for a CVC is important in reducing CLABSI risk (Lin et al., 2017; Yokoe et al., 2014). Central venous catheter care should be included in shift handoff discussions and documentation and part of clinical rounding to ensure all providers caring for patients can monitor the CVC and determine when it should be removed (Chopra et al., 2014).

The lack of standardized bundle components makes it difficult to make meaningful comparisons in some of the systematic reviews and meta-analyses. Additional research is needed to identify how each bundle component contributes to the overall effectiveness of the bundle in reducing infection and complications.

Compliance and Adherence to Bundles

A comprehensive study of 984 adult ICUs and non-ICUs found that a decrease in CLABSI was not associated with CLABSI bundle implementation alone. Rather, the organizations that experienced significant reductions in CLABSI did so when there was compliance with the components of the bundle (Furuya et al., 2012). Another study on compliance by Hakko et al. (2015) found that as part of implementing any CLABSI bundle, there should be a plan in place to monitor and reward compliance. Where feasible, integrating the CLABSI bundle into the electronic health records (EHR) system was critical to measuring compliance (Furuya et al., 2016; Hakko et al., 2015)

There may be organizational culture concerns that can affect the success of CLABSI bundle implementation and compliance. One recommendation to address this hurdle is that facilities have a self-check to guide implementation efforts. Two models appeared in the literature. The first is the CLABSI guide to patient safety (GPS) and the other is the Target Assessment for Prevention (TAP) by the CDC (as cited in Chopra et al., 2014). Both are self-assessment tools that help the organization identify gaps in their current practices, the hospital infrastructure, insertion and maintenance practices, and supplemental prevention strategies (Chopra et al., 2014). GPS is interactive and provides the stakeholder with feedback that can be used to address existing gaps (Chopra, 2014).

Nurse/Clinician Education Interventions

In an education intervention, Acharya et al. (2019) found that educating nurses reduced CLABSI rates significantly and improved nursing knowledge scores. Education also improved compliance with hand hygiene practices by 51.75% (Acharya et al, 2019).

Similarly, Aloush and Alsaireh (2018) found that nursing compliance was enhanced with education and training. Nurses were also more likely to follow the guidelines when there was ongoing training rather than a one-time only training opportunity (Aloush & Alsaireh, 2018). Furthermore, Humphrey (2015) explained that nurses' knowledge of care and maintenance of central lines were improved significantly with an education intervention. When nurses are knowledgeable about the measures necessary to reduce infections, CLABSI rates and complications are reduced (Humphrey, 2015).

In summary, current sources addressing CVC management and strategies for preventing CLABSI indicated that application of these bundles will help minimize the incidence of CLABSI. These sources and others that were collected and reviewed during development of the project will be used to narrow the gap between what nurses currently know and practice in managing CVC care and current evidence-based measures used in minimizing the risk of developing CLABSI.

Local Background and Context

The project took place in a teaching hospital that has experienced increasing CLABSI incidents over the past few years with no signs of slowing down. Despite the implementation of CLABSI bundles, CLABSI rates continued to increase and are higher than the national benchmark. Organizational data indicated that CLABSI rates for non-ICU areas have increased steadily by 0.5% for January 2019, 0.9% for March 2019, 0.4% for April 2019 and a 1.4% for May 2019 (CLABSI Reduction and Prevention Committee Co-chair, personal communication, July 2019). The rate in the non-ICU setting was 2.3 per 1,000 catheter days (CLABSI Reduction and Prevention Committee Co-chair,

personal communication, July 2019). The organizational aim is to eliminate CLABSI from both critical and noncritical care settings as a long-term goal. However, the short-term target was to have CLABSI rates in accordance with the CDC and National Health and Safety Network recommendations which is 0.7% per 1,000 catheter days (Haddadin & Regunath, 2017).

An evaluation of the setting using informant interviews and discussions with pertinent stakeholders and the CLABSI Reduction and Prevention Committee revealed that there were failures in the application of EBP bundles. Notably, there had been inconsistent application and compliance on various units in the hospital. There was no measure in place to evaluate and drive consistent compliance with EBP recommendations for CVC insertions (CLABSI Reduction and Prevention Committee Co-chair, personal communication, July 2019). There had also been a report from clinical staff, especially nurses, that they need more training on the bundles and best practice guidelines to reduce and eliminate CLABSI. Therefore, there was a disparity between what nurses need to know to implement the bundles successfully and the current knowledge they have and are using to care for patients using CVCs. Implementing a comprehensive and effective EBP intervention based on best available evidence was considered a way to improve clinician knowledge of CLABSI and promote a concerted effort to decrease CLABSI rates in this practice setting.

Role of the DNP Student

As the DNP student, I served as the project coordinator and worked collaboratively with a librarian to search for and identify best evidence suited to reduce

CLABSI rates in non-ICU settings. Additionally, I appraised and synthesized the evidence and translated the information into creating an educational program that was shared with the target population. As project coordinator, the application for approval with the pertinent Institutional Review Boards (IRB) and recruitment of team members to be on the project team were part of my role. I was also responsible for selecting a date and putting together the materials and resources necessary for the educational program.

As an advanced practice nurse in a teaching hospital, I have a direct stake in the improvement of CLABSI rates. This issue has been a source of concern compromising nursing indicators for quality and safe care. The project has the potential for improving patient outcomes related to the use of CVCs, reducing cost to the organization, and empowering nurses to practice to their full capacity.

Role of the DNP Project Team

I recruited an implementation team whose primary role was in the administrative planning process for the educational program. The team was composed of nurses, nurse practitioners, and an infection control specialist. This team worked collaboratively with me and the hospital's administrative staff to select a date and advertise the education program. They also identified needed resources including audio visual equipment and working with the organization's leadership to cover all financial costs relevant to this project.

I also worked directly with the facility's CLABSI Reduction and Prevention Committee whose primary role is to continue seeking out innovative ways to reduce CLABSI rates. The role of the CLABSI committee was to evaluate the proposed

education curriculum and offer recommendations for improving program content. The committee will also continue its role in monitoring CLABSI rates after project completion. Additionally, I collected and analyzed exam data pre- and post-intervention to evaluate the nurses' change in knowledge as well as the CLABSI rates in the pertinent units.

Summary

In conclusion, this section deals with the background and context for the DNP project. The theoretical support for the project, Rogers' diffusion theory, adult learning theory, and the JHNEBP model, were detailed including why each approach supports this project. Additionally, the project took place in a teaching hospital, specifically tailored to the nurses in the noncritical care units. The project is relevant to nursing practice as infections and specifically CLABSI are nursing care indicators. Therefore, implementing an intervention to reduce CLABSI in this practice setting contributes to a large body of knowledge on this topic and to nursing scholarship. The outcomes of this project also have implications for social change by reducing adverse effects on patients. Section 3 will include information regarding the collection and analysis of evidence that was used to answer the practice-focus question.

Section 3: Collection and Analysis of Evidence

Introduction

Central venous catheter (CVC) related infections have long been associated with rising healthcare cost and lengthy hospital stays (Haddadin & Regunath, 2018). Due to its devastating effects, it is essential that nurses be empowered through staff education on how to care and maintain central venous catheters. Therefore, with a focus on CVC, the purpose of this DNP project was to develop and implement a staff education program for nurses to address the persistent problem of rising CLABSI rates.

Section 3 of the project provides details on the collection and analysis of data. Beginning with the practice-focus question, this section includes an overview of the sources of evidence to answer the practice question. This section ends with a discussion on generating evidence for the project including specific information related to participants, procedures, and measures to address ethical issues.

Practice-Focused Question

Central line infections, in particular CLABSI, can be defined as major challenges faced by healthcare institutions and the nation as a whole (Johnson et al., 2014; Mishra et al., 2017). There are best practices in the literature aimed at reducing CLABSI (Haddadin & Regunath, 2018). However, despite this knowledge, there is a gap between available evidence and clinical practice. There are no current interventions in the host organization to educate nurses on measures for reducing existing CLABSI rates. There is also no measure or tracking of compliance with the existing bundles, nor have these measures been reviewed or revised in the past 5 years. Therefore, the purpose of the DNP

project was to develop and implement a teaching intervention to help close the gap and increase the knowledge and awareness of nurses on CLABSI prevention through EBP on central line management.

The project was designed to answer the following practice-focused question: will an organized education program increase the knowledge of facility nurses on central line care management? By implementing this staff education program, it is anticipated that the facility's central line infections, in particular CLABSI infection rates, will be reduced. Additionally, length of hospital stay will be decreased, which can minimize the risk of developing secondary infections and other complications (Haddadin & Regunath, 2018).

Sources of Evidence

This DNP project was designed to answer the practice-focused question: will an organized education program increase the knowledge of facility nurses on central line care and management? More precisely, the project was designed as a means to develop a staff education program. Recognizing this goal, a review of the literature was conducted. Locating literature to answer the practice question, sources of evidence originated from the Cochrane Database of Systematic Reviews, Cumulative Index to Nursing and Allied Health Literature, PubMed (National Library of Medicine and National Institute of Health), Medical Literature Analysis and Retrieval System Online (MEDLINE) with Full Text, and ProQuest Nursing and Allied Health Source Plus with Full Text.

Additionally, a subsequent search was performed using Google Scholar with the purpose of locating primary and secondary sources. Collection and analysis of this literature served several purposes. First, data collected was used to develop a staff

education program on evidence-based practices for managing central lines and preventing CLABSI. Second, findings generated from the literature review were used to develop the pretest /posttest exam. Finally, comparison of the scores from the pretest and posttest exams were used to answer the practice-focus question.

Evidence Generated for the Doctoral Project

Evidence and data for this DNP project will be presented and discussed under the headings of participants, procedures, and protections.

Participants

The participants involved in this project were registered nurses (RN) working on two different medical-surgical units in the target hospital. The two units selected have approximately 40 RNs. These two units were selected because of reported elevated CLABSI rates (CLABSI Reduction and Prevention Committee Chair, personal communication, September 11, 2019). Additionally, the nurses assigned to both units have direct contact and are responsible for inserting and managing the care of patients with central venous catheters.

Procedures

The process used for implementation of this educational program was as follows:

I worked with the facility's research coordinator, nurse educators, and the nurse managers of the two identified units to agree on specific dates and times for presenting the educational program. I designed a flyer (Appendix B) that was distributed to create awareness of the upcoming educational program and presented to the team for approval. After approval, the flyer was posted in strategic areas located on the medical-surgical

units, including the staff locker room, break room, staff bathroom, and by the unit time clock. The flyer was also handed out and emailed to the nurses on these two units. The presentation (Appendix C) that contained the educational program was designed based on the evidence from the literature. Before the presentation, a pretest was distributed to test the nurses' knowledge of CVC care and maintenance (Appendix A), after which the educational program was presented. The posttest, a repeat of the pretest, was given to nurse attendees immediately following the education program. The pretest and posttest scores were compared to evaluate effectiveness of the educational intervention.

The pretest and posttest exam scores were used to answer the practice-focused question 'will an organized educational program increase the knowledge of facility nurses on central line care management?' Designed by me, a doctorate-prepared medical-surgical, oncology nurse reviewed and assessed the pretest/posttest to ensure face validity was met. The exam included 10 multiple choice questions. A total of 10 points were assigned to each question for a maximum exam score of 100 points awarded.

Protection

The CLABSI prevention program was a voluntary educational program designed for nurses working on the two medical-surgical units in an acute care hospital. Site permission to carry out the project was granted by the host institution's research coordinator. University IRB approval was obtained following proposal approval by the DNP project committee with approval number 09-18-20-04440486. The education program was open to medical-surgical nurses on the assigned two units with anonymity

maintained as no personal data was collected on the pretest/posttest exams. Participants also completed a consent form.

To maintain confidentiality, the DNP project data was saved on a password protected computer. The project did not involve collecting any personal or demographic information. Participants received a participant identification number in lieu of name or employee identification. Additionally, data generated from the project was reported in aggregate format. Finally, exam scores will be stored in a locked file cabinet at my home and subsequently disposed of in 5 years.

Analysis and Synthesis

A DNP project is defined as a data driven process (American Association of Colleges of Nursing [AACN], 2015). Hence, data is collected, analyzed, and synthesized to answer the practice-focused question. Data collection included both numerical and a narrative summary. The data that was collected for this project included pretest and posttest exam scores.

Pretest and posttest exam scores were collected and entered in a Microsoft Excel Data tool to answer the practice- focused question. Subsequently, test exam scores were analyzed using the Statistical Package for Social Sciences (SPSS) version 26 software. Assignment of points were used to evaluate individual pretest/posttest exam scores of the medical-surgical nurses participating in the education program. To evaluate the effectiveness of the overall education intervention, t-test statistic was used to compare the pretest and posttest scores. This comparison helped determine that the educational intervention had a statistically significant impact in improving knowledge of the nurses.

Final synthesis of test scores and comparison of pretest and posttest exams was reported in a narrative summary and in table format in the results section of this document.

Summary

In conclusion, this section provided details of the evidence that was collected and analyzed to answer the practice-focused question. The intervention was a staff education program developed in partnership with the hospital's CLABSI team. Using a pretest/posttest design, the knowledge of the nurses towards CLABSI prevention were evaluated. Section 4 of this project presents the findings and recommendations generated from the project.

Section 4: Findings and Recommendations

Introduction

A rise in central venous catheter infection rates served as the gap in practice and problem occurring in this acute care hospital. Defined as central-line associated blood stream infections (CLABSIs), the purpose of this DNP project was to develop and implement a staff education program on current evidence-based strategies for managing central venous catheters and preventing CLABSIs. More specifically, the project was designed to answer the practice-focused question: will an organized education program increase the knowledge of facility nurses on central line care management? Using a pretest/posttest approach, sources of evidence for this project were collected before and after a presentation (Appendix A) focusing on managing central venous catheters and preventing CLABSIs. Exam scores were analyzed using SPSS, version 26, with results reported using descriptive statistics.

Section 4 of the project highlights findings generated from data collection and analysis. This section includes findings, implications, and recommendations. The section ends with contributions of the project team along with strengths and limitations of the DNP project.

Findings and Implications

Findings

To accommodate the rotating schedules of participants, the education program was delivered over 2 days and to four different groups. In total, 40 nurses from two medical-surgical units participated in the staff education program. Each nurse participant

reviewed and signed the University administered consent form for anonymous questionnaires prior to the start of the education program.

As stated previously, a pretest/posttest exam approach (Appendix A) served as the source of evidence to answer the practice-focused question guiding the DNP project. The exam consisted of 10 questions of different formats including multiple choice and multiple response/select all that apply. All pretest exams were collected before the staff education program commenced. With a score of 10 points for each correct answer, a grade of 100% was the maximum grade that could be earned for the exam. The posttest, a repeat of the pretest, was distributed at the completion of the staff education program.

Following completion of the staff education program, data from the pretest and posttest for all exams were entered in a Microsoft Excel spreadsheet and then SPSS to begin comparison reviews of both exams. In the pretest outcomes, 8 out of 10 questions had at least one participant who did not earn any points and scored a zero (0) for the exam. In the posttest, five out of the eight questions were answered with at least one participant earning no points for not answering question 5 correctly.

The questions with the lowest scores on the pretest were questions 5 and 10. Question 5 focused on correctly identifying elements of the central line bundle while question 10 required clarification on interventions to reduce CLABSI. There was a slight improvement in question 5 of a mean posttest score of 5.0 compared to 3.9 on the pretest. Improvement was noted in question 10 from a mean pretest score of 3.0 to a mean posttest score of 5.0, showing statistical significance.

The question with the highest pretest score was question 9, addressing patient criteria for CVC use in a multiple-choice format. The mean pretest score was 9.4. This trend carried into the posttest with the mean posttest score for question 9 at 10, the only question that all participants answered correctly with all 10 points awarded for the question. Additionally, the mean test scores improved for all questions except Question 3 which had the same mean score of 6.25 on the pretest and posttest. There was a significant improvement in question 10 regarding educational interventions to improve CLABSI.

Tables 2, 3 and 4 provide a breakdown of individual question responses by minimum earned score, maximum earned score, mean, and standard deviation. Reported in percentages (%), Table 4 reflects changes in pretest scores in comparison to posttest scores per question. In the pretest, the range of scores for questions 1, 2, 3, 5, 6, 8, 9, and 10 showed a range of 0-10, while questions 4 and 7 showed a range of scores from 2-10. In the posttest, the range for questions 3, 4, 5, 6, and 8 showed a range of scores of 0-10 while questions 1, 2, 7, 9 and 10 showed a range of scores from 2-10.

Table 2*Descriptive Statistics: Pretest Scores (N = 40)*

Question	Minimum	Maximum	Mean	Std. Deviation
Question 1	.00	10.00	7.0250	2.98490
Question 2	.00	10.00	6.7500	2.66747
Question 3	.00	10.00	6.2500	4.90290
Question 4	2.50	10.00	6.1875	2.33339
Question 5	.00	10.00	3.0000	4.64095
Question 6	.00	10.00	8.2500	3.84808
Question 7	2.00	10.00	8.3500	2.39176
Question 8	.00	10.00	6.5000	2.81935
Question 9	.00	10.00	9.4375	2.07916
Question 10	.00	10.00	3.9375	2.82432

Table 3*Descriptive Statistics: Posttest Scores (N = 40)*

Question	Minimum	Maximum	Mean	Std. Deviation
Question 1	2.50	10.00	9.1625	2.26565
Question 2	5.00	10.00	9.6250	1.33373
Question 3	.00	10.00	6.2500	4.90290
Question 4	.00	10.00	8.6250	2.46449
Question 5	.00	10.00	5.0000	5.06370
Question 6	.00	10.00	5.5000	5.03831
Question 7	4.00	10.00	9.6500	1.18862
Question 8	.00	10.00	7.6250	2.77061
Question 9	10.00	10.00	10.0000	.00000
Question 10	7.50	10.00	9.9375	.39528

Table 4*Breakdown of Improvement in Exam Questions Pretest and Posttest*

Question	Pretest Mean	Posttest Mean	Improvement (%)
Question 1	7.0250	9.1625	30.42%
Question 2	6.7500	9.6250	42.59%
Question 3	6.2500	6.2500	0%
Question 4	6.1875	8.6250	39.39%
Question 5	3.0000	5.0000	66.67%
Question 6	8.2500	5.5000	50%
Question 7	8.3500	9.6500	15.57%
Question 8	6.5000	7.6250	17.31%
Question 9	9.4375	10.0000	5.96%
Question 10	3.9375	9.9375	152%

Pass/Fail of Assessment

Further analyzes of exam scores was completed and reported by groups (Group 1 and Group 2). The pass score for the pretest/posttest was set at 70%. Thus, individuals who scored an exam grade above 70% on the posttest were considered to have completed the assessment with a passing score. In contrast, participants scoring less than 70% did not pass the exam. When the participants were grouped based on scores 70 or higher (Group 2) and <70 (Group 1)), the results showed that in the pretest only 35% (14 out of 40) of the participants passed the CLABSI knowledge assessment. However, after the intervention, 82.5% (33 out of 40) of the participants had passing scores. Figures 4 and 5 depict the passing score by groups pre- and post-intervention.

Figure 4

Graph showing Pretest Score Groups

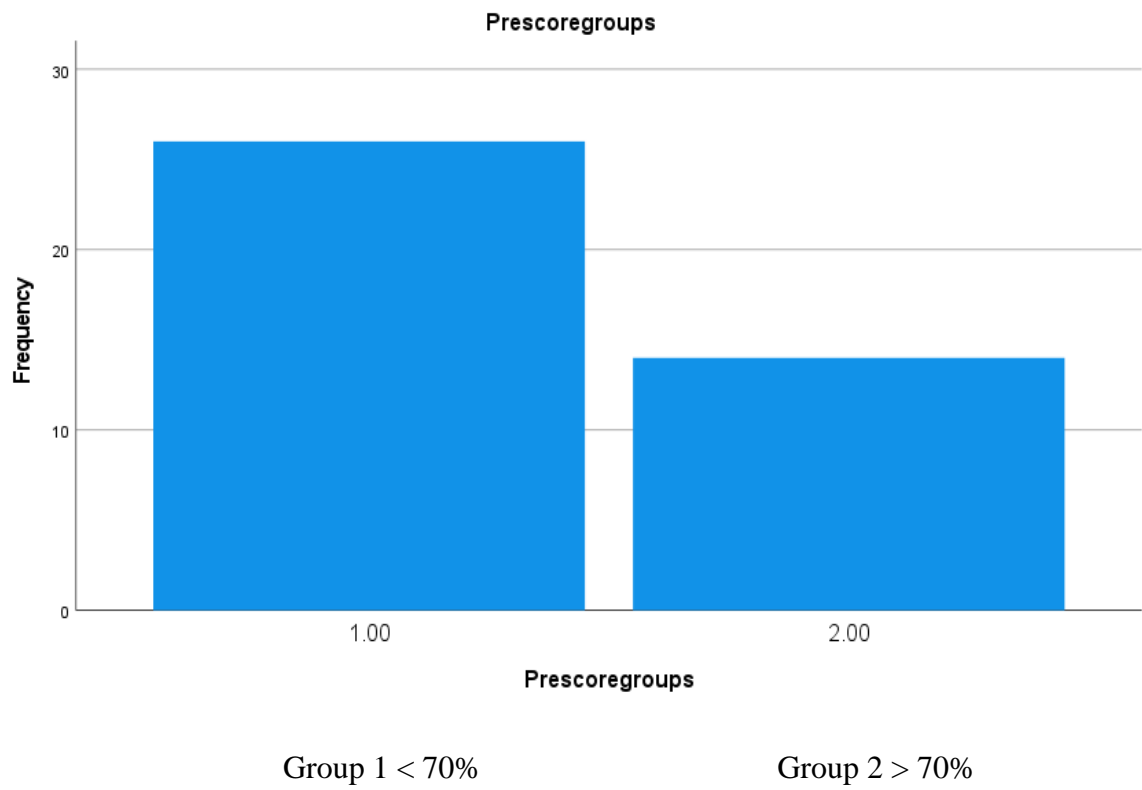
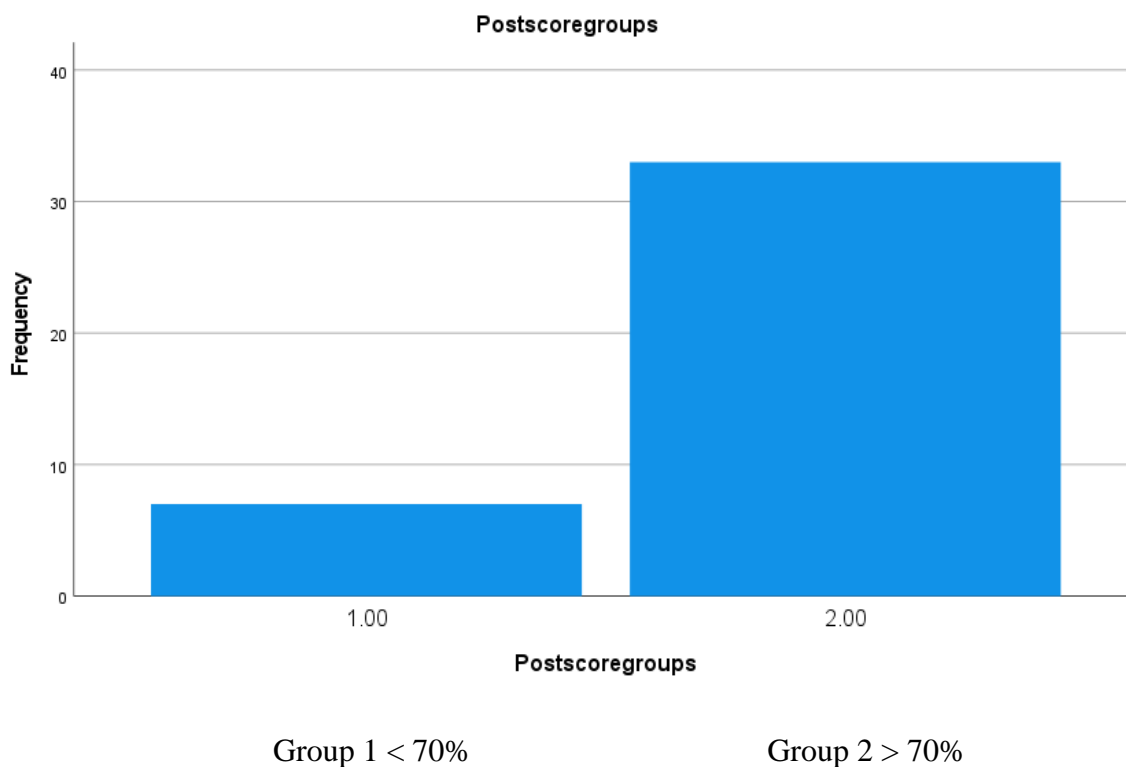


Figure 5

Graph Showing Posttest Score Groups



A paired *t* test was performed comparing the pretest and posttest scores to evaluate if there was a statistically significant improvement in nurses' knowledge from the staff education intervention. The mean pretest total score for the 40 participants was 64.19 (*SD* = 13.02). In comparison, the mean posttest total score was 81.38 (*SD* = 10.96). The paired *t*-test showed a statistically significant improvement in mean total scores of participants $p = 0.000$. Thus, at a significance level of $p=0.005$, the outcome was statistically significant. The entire SPSS *t*-test analysis can be found in Appendix D. Implications based on these findings support the need for continuing education of nurses

in this and other clinical settings. Hence, education that is planned and implemented improves nursing knowledge which in-turn affects patient care.

Implications

Findings from this DNP project have important implications for patients, education, nursing practice, policy, and social change. First, the benefit of this project extends to patients in the noncritical care settings who undergo central line catheter insertion. Having nurses who are trained and equipped to provide quality care can optimize patient safety and reduce the potential for central line-related complications including CLABSI (Haddadin & Regunath, 2018). Secondly, the nursing staff benefitted from an educational intervention that significantly improved their CLABSI and central line care knowledge. To lower CLABSI rates, the evidence highlighted the use of multimodal efforts. These efforts include staff education, implementation of CLABSI care and central line bundles, and efforts to monitor compliance (Barnes et al., 2016; Reyes et al., 2017; Weeks et al., 2014). The project findings highlight the knowledge deficit among providers and the need to effectively address nurses' knowledge of central line care and CLABSI. The educational intervention not only increased staff knowledge but piqued interest in care bundles and encouraged staff engagement. Using the adult learning theory (Knowles, 1980) leveraged human behavioral factors that enhance learning.

The project outcomes are also helpful to the hospital. CLABSI has been a pressing issue compromising care and elevating costs for both the critical care and noncritical care units. While CLABSI bundles exist, there has been no prior effort to

educate nurses intentionally on CLABSI prevention methods. This intervention can mitigate the costs associated with central line infections and complications and can also be a starting place for systematic change to reduce CLABSI on all units in this hospital.

The project highlighted that hospitals must have intentional CLABSI prevention efforts beyond having guidelines or bundles. The benefits of these bundles are diminished if staff are not trained to leverage the bundles. Lack of knowledge can lead to lack of compliance with CLABSI bundles which can diminish the quality of care the patient is receiving (Shah et al., 2015; Wilder et al., 2017). The lack of knowledge is also a safety concern for patients with increased risk of adverse effects, rehospitalization, and potential mortality (Weeks et al., 2014). Implementing an educational intervention to reduce CLABSI can enhance patient and organizational outcomes.

Finally, this project will impact positive social change beyond the patients, providers, and the hospital. Sharing outcomes with the sister network of other healthcare facilities and publishing the DNP project outcomes can add to the existing body of knowledge of how to translate findings into practice which can lead to effective measures to reduce CLABSI. Staff education is one such intervention that is supported by evidence to improve nurses' knowledge and improve the overall quality of care patients receive in this and other organizations.

Recommendations

The DNP project resulted in a statistically significant improvement in nurses' knowledge. However, upon reflection, there are some recommended solutions to address the practice problem of CLABSI. The first recommendation is to incorporate staff

education on central line care and CLABSI and provide multiple training opportunities year-round. The relevance of this recommendation is that, despite the improvement in exam scores, there were still nurses who did not pass the posttest evaluation with over 70%. Nurses with differences in years of experience and offering multiple opportunities for updates on a topic that affects patient care is a quality indicator of nursing care in this facility is critical. Continuing education and engagement of frontline RNs will help with execution of best practices and can be an effective strategy to reduce CLABSI in noncritical units and on other units in the hospital.

The second recommendation is to expand the education program to other units in the hospital, including critical care nurses. This project focused on noncritical care settings since there has been a noted lag in knowledge in this setting. However, there is an opportunity to explore the case of CLABSI on other units in the hospital and implement similar training opportunities for nurses. If this project is conducted again, collection of data, such as benefits of the education program, from the participants after the training would be recommended. Their feedback can be integrated into subsequent offerings of staff education.

The next recommendation is to consider interdisciplinary training. While training nurses was paramount as a starting place, there may be opportunities to train other providers such as physician assistants about central lines and CLABSI prevention. This approach can create a more informed clinical staff that can support existing CLABSI and central line bundles. Wider et al. (2016) recommended training clinical staff and using daily rounding for patients who are on central lines. The daily rounding can allow for

communication about patients who have catheters, discussions on proper positioning, insertion techniques, and other maintenance approaches.

Finally, recommendations should be considered in regards to data collection and outcomes. There should also be ongoing monitoring of CLABSI rates to determine if staff education, in addition to improving nursing knowledge, reduced overall infection rates in the unit and facility. This outcome measure, while beyond the scope of this DNP project, can help determine whether there are other interventions that can be used to augment staff education.

Contribution of the Doctoral Project Team

The DNP project team helped with the advertising and promotion of the staff education program by informing nursing staff of the intervention in meetings and other forums. The team consisted of individuals with expertise in quality improvement projects and provided support in securing time and location for the intervention and liaising with me to ensure that the project protocol would work given the COVID-19 pandemic that hit unexpectedly. One of the primary concerns was ensuring safety of participants while empowering staff learning.

The team also helped with ensuring participant exams were completed and collected. Since I was providing the instructions, there was a need for assistance with distributing program handouts and obtaining documents after program completion. Lastly, the team also supported me with future dissemination efforts within the hospital and outside including securing opportunities for a virtual and in-person presentation to some of the facility leadership and administrators.

Project Strengths

There were several areas of strengths with this project. The first is that I designed and implemented an educational intervention that leveraged best evidence and theoretical support. Leveraging best evidence practices suited to the place of implementation improves the chances of success of a quality improvement initiative (Ryan et al., 2017). The project was also cost-effective and efficient with time. Education and application of CLABSI best practices are inexpensive and can enhance patient safety and quality of care.

Another strength was with the data collection protocol. A pretest/posttest exam was created and validated for use for this DNP project. The data collection method was confidential and secure. The pretest score allowed for direct comparison of knowledge before and after the intervention was implemented. Furthermore, there was organizational support and stakeholder engagement throughout the project. When the COVID-19 pandemic persisted, I met with the evidence-based practice team who offered recommendations for the project to continue. As such, the project provides a template for future quality improvement projects in this facility relating to infection reduction and prevention.

Project Limitations

Despite project strengths there were limitations. The first was that it was performed using participants from two medical-surgical units within the hospital with a convenience sample. Jager et al. (2017) indicated that, while convenience sampling is ideal for data collection focused on a specific cohort within a location, it can limit

application of the results. The relatively small sample size and recruitment from one location may affect generalizability of the findings to other practice settings.

Secondly, there was no assessment of long-term retention of the instructional content given the duration of the project and limits of time. In the future, evaluating whether the knowledge persisted weeks or even months after the intervention may be beneficial. Additionally, the evaluation used only one data collection method. Assessing impact with another measure, such as infection rates before and after the project, or behavior of participants, such as compliance with CLABSI bundles, would have been beneficial.

Plans for Sustainability

The project outcomes were welcomed by facility leadership with nurse leaders suggesting opportunities for sustainability of the education program. Given the reception and the positive results, there is an opportunity for future training on CLABSI prevention and reduction strategies within these two medical-surgical units and for other units. Since I am an employee of the organization, I will be meeting with the educational committee to offer recommendations from this initial training that can be refined and used for subsequent training. Furthermore, the cost-effective and cost-saving nature of the project contributes to its sustainability. No additional expenses were incurred to execute this project. The staff education program did not require additional infrastructure outside the facility. With existing support from nurses and leadership, plans are to implement a long-term clinician education strategy to improve central line care and reduce CLABSIs.

Summary

Section 4 addresses findings from the DNP project. Forty RNs participated in a staff education intervention to improve CLABSI and central line care management. No demographic or other identifiable data were collected. The pretest/posttest results showed an improvement in 9 out of 10 questions following implementation of the education program. There was a statistically significant improvement in RN knowledge shown with the t-test statistic. There was also an increase in the number of nurses with a passing score of 70% or higher following completion of the education program. The implications for the findings include opportunities to enhance nursing knowledge, patient care, and organizational outcomes such as cost and quality indicators. The recommendations for the facility are presented including making training ongoing and expanding it to other units and other disciplines. The project has its merits and demerits. The merits include a cost-effective, easy to implement educational program. Demerits pertain to the sampling and data collection procedures.

Section 5: Dissemination Plan

Introduction

According to Milner (2016), advanced practice nurses have a professional obligation to actively disseminate evidence-based practice and results from quality improvement initiatives. Sharing this information is a way to advance the nursing profession and is creating the change in practice that can enhance quality of care, reduce cost, and optimize patient outcomes and satisfaction. Therefore, Section 5 focuses on the dissemination of the DNP project to the appropriate audience including internal and external stakeholders. Finally, section 5 ends with an analysis of self as well as challenges, insights, and opportunities for growth and improvement throughout the DNP project.

Dissemination Steps/Approaches

The first way to ensure all appropriate audiences get the information is to identify the intended audience. The purpose of the project was to improve nurses' knowledge on central lines and prevent CLABSI in a noncritical setting. This project will impact patients, caregivers, clinicians, administrators, and the hospital management and executive staff. While the project focused on nurses in noncritical care units, other nurses, advanced practice nurses, physicians, and physician assistants can all benefit from an update on the topic of central line care and the prevention of CLABSI.

The second approach is to leverage multiple ways to disseminate the information. I will use traditional approaches to share the evidence, such as podium or oral presentations as well as panel and roundtable discussions (Milner, 2016). The project has

been presented to the project team who in turn provided recommendations before the final presentation to the hospital leadership, clinicians, and administrators. That presentation is in the process of being scheduled after the successful approval of the project for formal submission. The presentation will be in the format of a PowerPoint that shows the project process, results, and implications for the facility.

Another method for disseminating findings from the project is through a published paper or article that appears in professional and peer review outlets including journals, magazines, newsletters, and other such publications in print and online (Milner, 2016). I have identified three potential journals that accept quality improvement projects in nursing, infection control, management, and patient safety. My intention is to submit a manuscript to the *Journal of Infusion Nursing* for publication after the final DNP project has been accepted and approved by committee members.

The project will also be disseminated through another traditional format-posters. Williams and Cullen (2016) indicated that poster presentations can be effective and used in diverse settings including clinical practice, seminars, and conferences. Content from a poster presentation can also be disseminated electronically. With the COVID pandemic, I have had to consider nontraditional dissemination platforms. For example, there are websites for professional nursing organizations that seek out quality improvement projects. This is another avenue that I can use to raise awareness of a cost-effective intervention to address the issue of CLABSI infections as a significant patient safety and quality of care issue in healthcare.

Analysis of Self

The DNP project was an opportunity for growth and development and the application of the Essentials of DNP practice recommended by the AACN (American Association of Colleges of Nursing, 2006). DNP-prepared nurses are leaders who can supervise, support, and encourage staff to participate in a beneficial practice change. I learned to use theories and models to underscore the methods for selecting an intervention, implementing it, and evaluating project outcomes. I also conducted a comprehensive search of the literature using tools to identify best evidence available that can be applied to the practice problem. Additionally, I needed to leverage the systematic approach for data collection and analysis following the scientific process for inquiry and investigation. In lieu of collecting personal data including demographic information, ethical considerations to protect human rights of the participants were adhered to.

I served as a leader of the project working collaboratively with the facility leadership, administration, and infection control team to advocate in support of the project. In this role, I had to assess resources needed for the project, create a project team and bring the different stakeholders together to support the project. I also met with facility administrators to determine the extent of the problem and crafted an intervention that could lead to lasting change. The results of these meetings have led to the organizational leadership considering ongoing staff education to improve infection rates.

Reflecting back, I also grew in clinical scholarship by using a meticulous approach to finding evidence, appraising the evidence, and translating the findings into a proposed quality improvement initiative. Scholarship was also displayed in selecting a

clinical question, project objectives, strategy for evaluation, and data analysis. As project leader, I also identified and used appropriate statistical tests to answer the practice-focused question.

Upon reflection, the project took place in the middle of a global pandemic. There were challenges with how the project would be successful with the recruitment of sufficient participants. Reflecting back, I displayed initiatives by offering the use of remote training opportunities for the project as well as recommending smaller participant groups to meet the social distance requirements within the facility. Additionally, I played the role of an advocate by emphasizing the patient perspective on the importance of getting CLABSI rates under control in this facility with a sustainable solution through education.

A DNP prepared nurse must leverage advanced nursing practice in the planning and implementation of a quality improvement project. Advanced nursing practice requires one to be able to identify clinical issues, exam the scope of the issue, and propose a solution that is actionable (AACN, 2006). The project required selection of an intervention that could be executed within the time and resource confines of the project. I was able to overcome the barriers related to the pandemic and to identify opportunities for improvement for future rounds of staff education and recommend expanding the CLABSI knowledge training to other providers.

Summary

Quality improvement project efforts began with identification that CLABSIs is a significant problem in the work facility. Although there are CLABSI bundles, systemic and organized efforts have been put forth to address the problem. A staff education program was implemented to improve RN knowledge. This section identified different dissemination strategies including podium presentation and written submission in peer reviewed journals for publication. A poster presentation will also be used to disseminate the findings to the facility staff and external stakeholders at a conference. The project required me as a leader to grow in scholarly pursuit of using theories, crafting a quality improvement project including use of evidence-based approaches, leveraging support from stakeholders and overcoming barriers related to the COVID-19 pandemic.

References

- Acharya, R., Mishra, S. B., Ipsita, S., & Azim, A. (2019). Impact of nursing education on CLABSI Rates: An experience from a tertiary care hospital in Eastern India. *Indian Journal of Critical Care Medicine*, 23(7), 316-319.
<https://doi.org/10.5005/jp-journals-10071-23205>
- Al-Jundi, A., & Sakka, S. (2017). Critical appraisal of clinical research. *Journal of Clinical and Diagnostic Research*, 11(5), 1–5.
<https://doi.org/10.7860/JCDR/2017/26047.9942>
- Aloush, S. M., & Alsaraireh, F. A. (2018). Nurses' compliance with central line associated blood stream infection prevention guidelines. *Saudi Medical Journal*, 39(3), 273–279. <https://doi.org/10.15537/smj.2018.3.21497>
- American Association of Colleges of Nursing. (2006). *The essentials of doctoral education for advanced nursing practice*.
<https://www.aacnnursing.org/DNP/DNP-Essentials>
- American Association of Colleges of Nursing. (2015). The doctor of nursing practice. Current issues and clarifying recommendations. *Report from the task force on the implementation of the DNP*. <https://www.aacnnursing.org/Portals/42/DNP/DNP-Implementation.pdf>
- Barnes, H., Rearden, J., & McHugh, M. D. (2016). Magnet hospital recognition linked to lower central line-associated bloodstream infection rates. *Research in Nursing & Health*, 39(2), 96-104. <https://doi.org/10.1002/nur.21709>

- Barr, R. B. & Tagg, J. (1995). From teaching to learning. A new paradigm for undergraduate education. *Change: The Magazine of Higher Learning*, 27(6), 12-26. <https://doi.org/10.1080/00091383.1995.10544672>
- Bayoumi, M. H., & Mahmoud, N. F. (2017). Effect of an education program on nurses' knowledge and practice regarding care of central venous line in pediatric hemodialysis: Evidence-based practice guidelines. *Egyptian Nursing Journal*, 14(2), 87-99. https://doi.org/10.4103/ENJ.ENJ_16_17
- Boozan, D., Skicki, D., Brancaccio, A., Snyder, A., Friebe, S. & Tupps. (2019). Less lumens-less risk: A pilot intervention to increase the use of single-lumen peripherally inserted central catheters. *Journal of Hospital Medicine*, 14(1), 42-46. <https://doi.org/10.12788/jhm.3097>
- Centers for Disease Control and Prevention. (2020). *Bloodstream infection event (Central line associated bloodstream infection and non-central line associated bloodstream infection)*. www.cdc.gov/nhsn/PDFs/pscManual/4PSC_CLABScurrent.pdf.
- Chopra, V., Govindan, S., Kuhn, L., Ratz, D., Sweis, R. F. & Melin, N. (2014). Do clinicians know which of their patients have central venous catheters?: A multicenter observational study. *Annals of Internal Medicine*, 161(8), 562–567. <https://doi.org/10.7326/M14-0703>
- Chopra V., Flanders, S. A., Saint S., Woller, S. C., O'Grady, N. P. & Safdar, N. (2015). The Michigan appropriateness guide for intravenous catheters (MAGIC): Results

- from a multispecialty panel using the RAND/UCLA Appropriateness Method. *Annals of Internal Medicine*, 163: S1–S40. <https://doi.org/10.7326/M15-0744>
- Dearing, J. W. (2009). Applying diffusion of innovation theory to intervention development. *Research on Social Work Practice*, 19(5), 503-518. <https://doi.org/10.1177/1049731509335569>
- Deutsch, G. B., Sathyanarayana, S. A., Singh, N. & Nicasro, J. (2014). Ultrasound-guided placement of midline catheters in the intensive care unit: A cost-effective proposal for timely central line removal. *Journal of Surgical Research*, 191(1), 1-5. <https://doi.org/10.1016/j.jss.2013.03.047>
- Furuya, E. Y., Dick, A. W., Herzig, C. T., Pogorzelska-Maziarz, M., Larson, E. L., & Stone, P. W. (2012). Central line-associated bloodstream infection reduction and bundle compliance in intensive care units: A national study. *Infection Control and Hospital Epidemiology*, 37(7), 805–810. <https://doi.org/10.1017/ice.2016.67>
- Gahlot, R., Nigam, C., Kumar, V., Yadav, G., & Anupurba, S. (2014). Catheter-related bloodstream infections. *International Journal of Critical Illness and Injury Science*, 4(2), 162-167. <https://doi.org/10.4103/2229-5151.134184>
- Galeon, C. & Romero, I. (2014). Best practice journey to zero central line associated bloodstream infection (CLABSI). *American Journal of Infection Control*, 42(6), S136. <https://doi.org/10.1016/j.ajic.2014.03.292>
- Grigonis, A. M., Dawson, A. M., Burkett, M., Dylag, A., Sears, M. & Helber, B. (2016). Use of central catheter-maintenance bundle in long-term acute care hospitals.

American Journal of Critical Care, 25(2), 165-172.

<https://doi.org/10.4037/ajcc2016894>.

Haddadin, Y. & Regunath, H. (2018). *Central line associated bloodstream infections (CLABSI)*. <https://www.ncbi.nlm.nih.gov/books/NBK430891>

Hakko, E., Guvenc, S., Karaman, I., Cakmak, A., Erdem, T. & Cakmakci, M. (2015).

Long-term sustainability of zero central-line associated bloodstream infections is possible with high compliance with care bundle elements. *East Mediterranean Health Journal*, 21(4), 293-298. <https://doi.org/10.26719/2015.21.4.293>

Haque, M., Sartelli, M., McKimm, J., & Bakar, M. A. (2018). Healthcare-associated infections—an overview. *Infection and Drug Resistance*, 11(1), 2321–2333.

<https://doi.org/10.2147/IDR.S177247>

Heslop, L. & Lu, S. (2014). Nursing sensitive indicators: A concept analysis. *Journal of Advanced Nursing*, 70(11), 2469-2482. <https://doi.org/10.1111/jan.12503>

Humphrey, J. S. (2015). Improving registered nurses knowledge of evidence-based practice guidelines to decrease the incidence of central line associated bloodstream infections: An educational intervention. *Journal of the Association for Vascular Access*, 20(3), 143-149. <https://doi.org/10.1016/j.java.2015.05.003>

Isla, E., Van Der Hoven, B., Kornelisse, R. F., Van der Starre, C., Vos, M. C. &

Boersma, E. (2016). Effectiveness of insertion and maintenance bundles to prevent central-line-associated bloodstream infections in critically ill patients of all ages: A systematic review and meta-analysis. *Lancet Infectious Disease*, 16(6), 724-734. [https://doi.org/10.1016/S1473-3099\(15\)00409-0](https://doi.org/10.1016/S1473-3099(15)00409-0)

- Jager, J., Putnick, D. L., & Bornstein, M. H. (2017). More than just convenient: The scientific merits of homogenous convenience samples. *Monographs of the Society for Research in Child Development*, 82(2), 13–30.
<https://doi.org/10.1111/mono.12296>
- Johnson, N. B., Hayes, L. D., Brown, K., Hoo, E. C., & Ethier, K. A. (2014). CDC National Health Report: leading causes of morbidity and mortality and associated behavioral risk and protective factors—the United States, 2005–2013. *Morbidity and Mortality Weekly Report*, 63(4), 3-27.
<https://www.cdc.gov/mmwr/preview/mmwrhtml/su6304a2.htm>
- Kaminski, J. (2011). Diffusion of innovation theory. *Canadian Journal of Nursing Informatics*, 6(2). <https://cjni.net/journal/?p=1444>
- Kleper, N. & De Almeida, F. (2015). Insertion site for central venous catheters. *JAMA Internal Medicine*, 175(5), 861-865.
<https://doi.org/10.1001/jamainternmed.2015.39>
- Kornbau, C., Lee, K. C., Hughes, G. D., & Firstenberg, M. S. (2015). Central line complications. *International Journal of Critical Illness and Injury Science*, 5(3), 170-8. <https://doi.org/10.4103/2229-5151.164940>
- Knowles, M. S. (1980). *The modern practice of adult education*. Practice Regents.
- Lai, N. M., Lai, N. A., O’Riordan, E., Chaiyakunapruk, N., Taylor, J. E. & Tan, K. (2016). Skin antisepsis for reducing central venous catheter-related infections. *Cochrane Database Systematic Reviews*, 7(7), CD010140.
<https://doi.org/10.1002/14651858.CD010140.oub2>

- Lee, K. H., Cho, N. H., Jeong, S. J., Kim, M. N., Han, S. H., & Song, Y. G. (2018). Effect of central line bundle compliance on central line-associated bloodstream infections. *Yonsei Medical Journal*, 59(3), 376–382.
<https://doi.org/10.3349/ymj.2018.59.3.376>
- Lin, K. Y., Cheng, A., Chang, Y. C., Hung, M. C., Wang, J. T. & Sheng, W. H. (2017). Central line-associated bloodstream infections among critically ill patients in the era of bundle care. *Journal of Microbiology, Immunology, and Infection*, 50(3), 339-348. <https://doi.org/10.1016/j.jmii.2015.07.001>
- Lissauer, M. E., Leekha, S., Preas, M. A., Thom, K. A., & Johnson, S. B. (2012). Risk factors for central line-associated bloodstream infections in the era of best practice. *Journal of Trauma*, 72(5), 1174–1180.
<https://doi.org/10.1097/TA.0b013e31824d1085>
- Marschall, J., Mermel, L. A., Fakhri, M., Hadaway, L., Kallen, A. & O’Grady, N. P. (2014). Strategies to prevent central line-associated bloodstream infections in acute care hospitals: 2014 update. *Infection Control & Hospital Epidemiology*, 35(S2), S89-S107. <https://doi.org/10.1086/676533>
- Marsteller, J. A., Hsu, Y. J. & Weeks, K. (2015). Evaluating the impact of mandatory public reporting on participation and performance in a program to reduce central-line-associated bloodstream infections: Evidence from a national patient safety collaborative. *American Journal of Infection Control*, 42, 209-215.
<https://doi.org/10.1016/j.ajic.2014.06.001>

- McEwen, M. & Wills, E. M. (2014). *Theoretical basis for nursing* (pp. 402-408).
Lippincott Williams & Wilkins.
- Milner, K. A. (2016). Sharing your knowledge: Getting your idea published. *The Art and Science of Infusion Nursing*, 39(5), 297-305.
<https://doi.org/10.1097/NAN.00000000188>
- Mishra, S. M., Misra, R., Azim, A., Baronia, A. K., Prasad, N., Dhole & T. N. (2017).
Incidence, risk factors and associated mortality of central line-associated
bloodstream infections at an intensive care unit in northern India, *International
Journal for Quality in Health Care*, 29(1), 63–67,
<https://doi.org/10.1093/intqhc/mzw144>
- Moureau, N. & Chopra, V. (2016). Indications for peripheral, midline and central
catheters: Summary of the MAGIC recommendations. *British Journal of Nursing*,
25(8), 15-24. <https://doi.org/10.129868/bjon.2016.25.8.S15>
- Parienti, J. J., Mongardon, N., Megarbane, B., Mira, J. P., Kalfon, P. & Gros, A. (2015).
Intravascular complications of central venous catheterization by insertion site. *The
New England Journal of Medicine*, 373(13), 1220-1229.
<https://doi.org/10.1056/NEJMoa1500964>
- Park, S. W., Ko, S., An, H. S., Bang, J. H., & Chung, W. Y. (2017). Implementation of
central line-associated bloodstream infection prevention bundles in a surgical
intensive care unit using peer tutoring. *Antimicrobial Resistance and Infection
Control*, 6, 103-109. <https://doi.org/10.1186/s13756-017-0263-3>

- Patel, P. K., Gupta, A., Vaughn, V. M., Mann, J. D., Ameling, J. M. & Meddings, J. (2018). Reviews of strategies to reduce central line-associated bloodstream infection (CLABSI) and catheter-associated urinary tract infection (CAUTI) in adult ICUs. *Journal of Hospital Medicine*, 13(2), 105-116.
<https://doi.org/10.12788/jhm.285>
- Pathak, R., Gangina, S., Jairam, F. & Hinton, K. (2018). A vascular access and midlines program can decrease hospital-acquired central line-associated bloodstream infections and costs to a community-based hospital. *Therapeutic Clinical Risk Management*, 14, 1453-1456. <https://doi.org/10.2147/TCRM.S171748>
- Perin, D. C., Erdmann, A. L., Higashi, G. D., & Sasso, G. T. (2016). Evidence-based measures to prevent central line-associated bloodstream infections: a systematic review. *Revista Latino-Americana de Enfermagem*, 24(8), e2787.
<https://doi.org/10.1590/15188345.1233.2787>
- Ratz, D., Hofer, T., Flanders, S. A., Saint, S. & Chopra, V. (2016). Limiting the number of lumens in peripherally inserted central catheters to improve outcomes and reduce cost. *Infection Control and Hospital Epidemiology*, 37(7), 811-817.
<https://doi.org/10.1017/ice.2016.55>
- Ray-Barruel, G., Xu, H., Marsh, N., Cooke, M. & Rickard, C. M. (2019). Effectiveness of insertion and maintenance bundles in preventing peripheral intravenous catheter-related complications and bloodstream infection in hospital patients: A systematic review. *Infectious Diseases and Health*, 24(3), 152-168.
<https://doi.org/10.1016/j.idh.2019.03.001>

- 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>
- Ross, B., Eyler, A., Harris, J., Moore, J. & Tabak, R. (2018). Getting the word out. New approaches for disseminating public health service. *Journal of Public Health Management and Practice*, 24(2), 102-111.
<https://doi.org/10.1097/PHH.000000000673>
- Ryan, P. L., Mamaril, M., Shope, B., Rodriguez, J., Garey, T. & Obedoza, L. (2017). The Johns Hopkins evidence-based practice (EBP) model: Learning the process and appraising the evidence. *Journal of Perianesthesia Nursing*, 32(4) e29-e30.
<https://doi.org/10.1016/j.opan.2017.06.098>
- Saks. G. D., Diggs, B. S., Hadjizacharia, P., Green, D., Salim, A. & Malinsoki, D. J. (2014). Reducing the rate of catheter-associated bloodstream infections in a surgical intensive care unit using the Institute of Healthcare Improvement Central Line Bundle. *American Journal of Surgery*, 207(6), 817-823.
<https://doi.org/10.1016/j.amjsurg.2013.08.041>
- Setia M. S. (2016). Methodology series module 5: Sampling strategies. *Indian Journal of Dermatology*, 61(5), 505–509. <https://doi.org/10.4103/0019-5154.190118>
- Shah, N., Castro-Sánchez, 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>

Shaw, C. M., Shah, S., Kapoor, B. S., Cain, T. R., Caplin, D. M. & Farsad, K. (2017).

Appropriateness criteria: Radiologic management of central venous access.

Journal of American College of Radiology, 14(11), 506-529.

Smith, R. A., Kim., Y., Zhu, X., Doudou, D. T., Sternberg, E. D. & Thomas, M. B.

(2018). Integrating models of diffusion and behavior to predict innovation

adoption, maintenance and social diffusion. *Journal of Health Communication*,

23(3), 264-271. <https://doi.org/10.1080/10810730.2018.1434259>

Sreeramaju, P. (2019). Reducing infections together: A review of socioadaptive

approaches. *Open Forum Infectious Diseases*, 6(2), 348-357.

<https://doi.org/10.1093/ofid/ofy348>

Valencia, C., Hammami, N., Agodi, A., Lepape, A., Herrejon, E. P. & Blot, S. (2016).

Poor adherence to guidelines for preventing central line-associated bloodstream

infections (CLABSI): Results of a worldwide survey. *Antimicrobial Resistance*

and Infection Control 5(49). <https://doi.org/10.1186/s13756-016-0139-y>

Weeks, K. R., Hsu, Y. J., Yang, T., Sawyer, M., & Marsteller, J. A. (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. <https://doi.org/10.1016/j.ajic.2014.06.003>

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.

<https://doi.org/10.1097/ANC.0000000000000259>

Williams, J. L. & Cullen, L. (2016). Evidence into practice: Disseminating an evidence-based practice project as a poster. *Journal of Perianesthesia Nursing*, 31(5), 440-445. <https://doi.org/10.1016/j.jopan.2016.07.002>

Woller, S. C., Stevens, S. M. & Evans, S. R. (2016). The Michigan appropriateness guide for intravenous catheters (MAGIC) Initiative: A summary and review of peripherally inserted central catheter and venous catheter appropriate use. *Journal of Hospital Medicine*, 11(4), 306-310. <https://doi.org/10.1002/jhm.2525>

Woodward, B. & Umberger, R. (2016). Review of best practices for CLABSI prevention and the impact of recent legislation on CLABSI reporting. *SAGE Open*, 6(4), 1-7. <https://doi.org/10.1177/2158244016677747>

Yokoe, D. S., Anderson, D. J., Berenholtz, S. M., Calfee, D. P., Dubberke, E. R., Ellingson, K. (2014). Society for Healthcare healthcare Epidemiology of America (SHEA). A compendium of strategies to prevent healthcare-associated infections in acute care hospitals: 2014 updates. *Infection Control and Hospital Epidemiology*, 35(8), 967–977. <https://doi.org/10.1086/677216>

Zimmerman, P. A., Yeatman, H., Jones, M. & Murdoch, H. (2015). Success in the South Pacific: A case study of successful diffusion of an infection prevention and control program. *Healthcare Infection*, 20, 54-61. <https://doi.org/10.1071/HII4036>

Appendix A: Pre/Posttest Examination

CLABSI Knowledge Assessment Test

- 1. Which of these indicators is the primary reason a patient undergoes CVC insertion? Check all that apply (10 points)**
 - a. Hemodialysis_____
 - b. Parenteral nutrition _____
 - c. Chemotherapy medications _____
 - d. Hydration _____

- 2. What is a central line associated blood stream infection (CLABSI)?(Select all that apply)**
 - a. A laboratory confirmed infection at a CVC site that starts 48 hours after insertion.
 - b. Is a catheter associated infection.
 - c. Any infection in any part of the body.
 - d. A post-surgical wound infection

- 3. A 49-year-old woman with worsening back pain is admitted to the hospital and found to have methicillin Sensitive Staph Aureus (MSSA) vertebral osteomyelitis. Infectious Disease Department recommends a total of six weeks of IV cefazolin. She currently has only one peripheral IV catheter. Which type of CVC will be the most appropriate for her antibiotic course? (10 points)**
 - a. Internal jugular CVC
 - b. Peripheral IV catheter
 - c. Subclavian CVC
 - d. Midline catheter
 - e. PICC

- 4. What are the conditions for clinical definition of central blood steam line blood stream infection (CLABSI) (Circle all that apply)? (10 points)**
 - a. Clinical signs of an infection
 - b. No alternate source for bloodstream infection
 - c. Positive blood culture from a peripheral vein
 - d. Central Line must be in place for at least one day

5. **What is the most commonly used site for CLABSIs? (10 points)**
- Jugular
 - Subclavian
 - Femoral
 - PICC line
6. **Which skin preparation is the best to prevent CLABSI? (10 points)**
- Chlorhexidine-gluconate aqueous
 - Chlorhexidine-gluconate alcohol-containing
 - Povidone-iodine
 - Alcohol preparation without iodine or chlorhexidine.
 - Hydrogen Peroxide
7. **The Central line bundles consist of five elements. Which of the elements is essential for a CLABSI bundle (Circle all that apply)? (1 mark each for correct answer)**
- Hand hygiene prior to catheter insertion
 - Use of maximal sterile barrier precautions
 - Use of alcohol-containing Chlorhexidine for skin antiseptics before insertion
 - Avoiding the femoral site
 - Removal of unnecessary catheters as soon as possible
8. **Select two complications associated with improper maintenance of IV connectors (10 points)**
- Infection_____
 - Occlusion_____
 - Infiltration_____
 - Ecchymosis_____
 - Hemorrhage_____
9. **Which patient meets criteria for CVC use? (10 points)**
- Patient on TPN
 - Patient on IV antibiotics for 3 days
 - Patient on IV Potassium
 - Patient on 1 pack RBC transfusion
 - Patient on 2 bags of 0.9NS

10. What are the approaches mentioned in the educational intervention to reduce CLABSI? (10 points)

- a. Catheter Insertion Bundles
- b. Catheter maintenance Bundles
- c. Compliance and Adherence Bundles
- d. Removal Bundles

Appendix B: Educational Flyer

Course Offering:
An Education Program to Reduce CLABSI



Date: TBA

Time: TBA

Location TBA:

Program Facilitator: Bolanle Olajuyigbe, MSN, RN

Cell Number: [REDACTED]

Email Address: bolanle.olajuyigbe@waldenu.edu
[REDACTED]

Appendix C: Best Practices for Managing Central Venous Catheters and Preventing
CLABSI

Best Practices for Managing Central Venous Catheters and Preventing CLABSI

Major Theme	Evidence-based Strategies
Catheter Insertion Bundles	<ul style="list-style-type: none"> • Appropriateness of vascular catheter • Use of aseptic technique during insertion Flushing with normal saline rather than heparin • Positioning catheter tip appropriately • Using minimum number of lumens
Cather Maintenance Bundles	<ul style="list-style-type: none"> • Daily review if catheter needed • Flushing line every shift • Maintaining the integrity of the dressing • Prompt removal when catheter is no longer needed
Cather Maintenance Bundles Compliance, and Adherence to Bundles	<ul style="list-style-type: none"> • There should be a reward for compliance • Integrating CLABSI bundle into the electronic health records to monitor and evaluate compliance.
Nurse/Clinician Education Interventions.	<ul style="list-style-type: none"> • Education of nurses to improve knowledge • Educating nurses will reduce CLABSI rates • Educating on hand hygiene practices will reduce infection.

Appendix D: Findings

Paired Samples Statistics					
		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	TOTALPRESCORE	64.1875	40	13.00280	2.05592
	TOTALPOSTSCORE	81.3750	40	10.95489	1.73212

Paired Samples Correlations				
		N	Correlation	Sig.
Pair 1	TOTALPRESCORE & TOTALPOSTSCORE	40	.452	.003

Paired Samples Test									
		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	TOTAL PRE SCORE TOTAL POST SCORE	-17.18750	12.66313	2.00222	-21.23737	-13.13763	-8.584	39	.000

Paired Samples Effect Sizes						
			Standardizer ^a	Point Estimate	95% Confidence Interval	
					Lower	Upper
Pair 1	TOTALPRESCORE - TOTALPOSTSCORE	Cohen's d	12.66313	-1.357	-1.784	-.921
		Hedges' correction	12.78654	-1.344	-1.767	-.912

a. The denominator used in estimating the effect sizes.
Cohen's d uses the sample standard deviation of the mean difference.
Hedges' correction uses the sample standard deviation of the mean difference, plus a correction factor.