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# Reducing CLABSI Rate Among ICU Patients

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This is to certify that the doctoral study by

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Abstract

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## Abstract

Approximately 55% of intensive care unit (ICU) patients require the use of a central venous catheter (CVC). CVCs are often an essential component of care; however, CVCs can create avenues for pathogens to enter the bloodstream and cause a central line-associated bloodstream infections (CLABSI), which can lead to increased mortality and morbidity, prolonged length of stay, increased cost of care, decreased patient satisfaction, and increased workload. In 2017, the CLABSI rate at the project site was 4.3 per 1,000 catheter days as compared to the national rate of 0.8 per 1,000 catheter days. Based on Piaget's theory of constructivism, a simulation-based staff educational program was developed and implemented by ICU staff ($n$=20). Following the implementation of the simulation-based program, adherence to CVC maintenance guidelines improved from 41.5% to 87.9%. A sample $t$-test showed that this improvement was statistically significant and the CLABSI rate declined to 1.24 per 1,000 catheter days in the 4-week period following implementation of the program. Findings show that introducing a simulation-based training program might help to reduce CLABSI rates in the ICU setting and contribute to positive social change by improving health outcomes in ICU patients with a CVC.

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Section 1: Introduction

## Introduction

The practice problem addressed in this project was Central Line-Associated Blood Stream Infection (CLABSI) among intensive care unit (ICU) patients. CLABSI is a bloodstream infection in patients with a central venous catheter (CVC) or who were diagnosed with an infection within 48 of having a CVC (The Agency for Health Research and Quality, 2015). The majority of CLABSI cases are preventable through observing proper CVC insertion and maintenance practices. The goal of this project was to design and implement, on a pilot-basis, a simulation-based training program to improve nurses' adherence to CVCs maintenance best practice. It was envisaged that implementing the program would enhance nurse's adherence to CVC maintenance guidelines and consequently reduce the CLASBI rate at the ICU.

## Problem Statement

CVC is a significant part of the plan of care for patients in the ICU setting. These devices play a critical role in delivering nutrients and medications to critically-ill patients. The study by Theodoro et al. (2015) found that within 28 months, physicians in a tertiary care center had inserted 994 CVCs in 940 ICU patients with most of the CVCs remaining in place for more than two days. About 55% of ICU patients require a CVC during their hospital stay. Since having a catheter in place is the most significant risk factor for

developing CLABSI, patients in the ICU are at high risk of developing this hospital-acquired infection. CLABSI rates in U.S. ICU's are estimated at 0.8 per 1000 central line days (Haddadin & Regunath, 2017). In the project site, CLASBI rate stands at 4.3 per 1000 central line days.

CLABSI has a significant implication for healthcare. First, this infection is a major cause of mortality among critically ill patients. "The mortality rate for patients who developed CLASBI is estimated to be between 12% and 25%" (Haddin & Regunath, 2017). Stevens et al. (2014) also found that "CLASBI increased the risk of mortality 2.27-fold even after adjusting for other hospital-acquired infections and severity of the patient's original illness." Secondly, CLABSI increases the cost of care which, according to Haddadin and Regunath (2017), "the cost of treating CLABSI is $46,000 per case." Stevens et al. (2014) found that on average the cost incurred by patients with CLASBI is $32,000 higher than that incurred by patients without CLASBI. CLASBI is associated with other negative outcomes including patient dissatisfaction, increased workload, staff burnout, decreased patronage, and reduced hospital revenues (Woodward & Umberger, 2016).

Practice guidelines have been developed to prevent CLASBI. Despite the project site adopting the *2011 CDC Guideline for the Prevention of Intravascular Catheter-Related Infection*, CLABSI cases have remained prevalent especially in the ICU. In early

2017, the hospital commissioned a study to examine adherence to this guideline. The study established that there was 91.6% adherence to practices related to CVC insertion and 41.5% adherence to practices associated with care and maintenance of CVCs and insertion sites. Several factors can be attributed to low adherence to CVC maintenance best practices. One of these is staff training (Jardim et al., 2013). Currently, CVC maintenance training is done using the traditional lecture and demonstration method. This project was designed to change the training strategy from lecture and demonstration-based (passive learning) to simulation-based training (active learning).

## Purpose

Over the past decade, stakeholders in the healthcare sectors have developed CVC bundle policies and other practices that are aimed at reducing CLABSI rates. These policies and practices focus on improving insertion and maintenance strategies. Many hospitals that have managed to implement these evidence-based policies and practices have seen a reduction in CLASBI rate of about 60% (Edwards et al., 2015). However, there are hospitals such as the project site that are still recording high CLASBI rates. This problem is largely attributed to poor adherence to policies and best practices regarding maintenance and care following insertion of the catheter. The purpose of this project was to change the method of training nurses to enhance their adherence to CVC maintenance strategies.

Specifically, the project sought to introduce simulation-based training with the goal of improving the transfer of knowledge and skills regarding CVC maintenance. A study by Botma (2014) found that simulation-based training supports nurses' ability to transfer theoretical knowledge to the clinical setting, builds nurses' confidence, increases their learning motivation, and strengthens communications.

## Practice-Focused Questions

The following problem-focused questions guided the project:

1. What is the effect of implementing a simulation-based training program on ICU nurses' adherence to CVC maintenance policies and best practices?
2. What is the effect of implementing a simulation-based nurse training program on the CLASBI rate within the ICU context?

The first objective of the project was to design the training program including defining the content, developing training materials, determining the duration of the program, determining the specific simulation method that should be used, and specifying methods of evaluating outcomes. The second objective of the project was to implement the designed program on a pilot basis. I worked together with other stakeholders in the ICU setting to implement a trial version of the training program. The final objective was to evaluate the outcomes of the pilot program.

It was expected that implementing the simulation-based training method would improve nurses' adherence to CVC maintenance policies and best practices which would, in turn, reduce the CLABSI rate. The lower CLASBI rate would yield multiple results: lower mortality rates, reduced cost of care, low workload, and staff burnout increased patient satisfaction, improved patronage, and increased revenue for the healthcare facility.

## Nature of the Doctoral Project

This doctoral project focused on collecting and implementing best evidence that would address the clinical issue. Specifically, the project sought to determine if simulation-based training was effective in transferring skills to nurses, what the program should entail, and the best practices for evaluating the outcomes of the program. The source of evidence for this project was published work including systematic reviews, practice guidelines, randomized control studies, quasi-experimental studies, descriptive studies, qualitative studies, and knowledge base surveys (i.e., evaluate the staff's knowledge s of CVC insertion and maintenance before and after the training). Observations and hospital records were used to provide evidence regarding the effectiveness of the program. The training entailed the use of simulators to allow nurses to practice various CVC maintenance procedures.

A literature search was conducted using the following series of databases: PubMed Central, EBSCOhost, CINAHL, MEDLINE, Nursing Reference Center, and Health Source. Various combinations of keywords were used in the search process: '*simulation-based training in nursing,' 'simulation-based education in nursing,' 'simulation-based training and CVC maintenance,' 'simulation-based training and CLABSI prevention,' and 'implementing simulation-based training in nursing.'* The search was limited to English, (last 5 years), and full text availability. Articles identified through this search process were appraised according to their relevance to the project, level of evidence, internal validity, external validity and sample size (Critical Appraisal Skills Programme, 2017). The appraisal process led to the identification of articles whose evidence was included in the project. Evidence from the selected articles was combined and synthesized to form guidelines for designing, implementing, and evaluating simulation-based Staff Education Program.

## CLABSI Bundle Staff Educational Program

### Planning

Although CLABSIs kill thousands of people annually and add billions of dollars to health care costs, they are preventable. Effective management of the condition depends on the knowledge and skills of staff caring for these patients (American Nurses Association, 1976). Training of health care providers can lead to the reduction of

CLABSIs. With new research evidence on the treatment of CLABSI emerging regularly, there is a need to ensure members of staff update their skills regularly. The following questions can be used to determine whether a CLABSI Staff Education program is needed (Gormley, 2013):

1. Do the members of staff perform hand hygiene before insertion?

2. Do the members of staff adhere to aseptic technique?

3. Do the members of staff use maximal sterile barrier precautions (that is a mask, cap, gown, sterile gloves, and sterile full body drape).

4. Do the members of staff choose the best insertion site to minimize infections and noninfectious complications based on individual patient characteristics? For instance, do the members of staff avoid femoral site in obese adults?

5. Do the members of staff always place a sterile gauze dressing over the insertion site?

6. Do members of staff use sterile devices only while accessing catheters?

7. Do members of staff routinely change patient dressing using aseptic techniques?

8. Do members of staff bathe critically (ICU) patients with a chlorhexidine preparation daily?

9. Do members of staff audit daily the patient situation to determine whether the central line is still needed?

The goal of the educational program was to enable members of the nursing staff to handle and maintain central lines appropriately. Support from organizational leadership was gained by ensuring that staff members continued to improve their performance effectiveness.

Generally, the educational program was delivered practically, with few theoretical lessons. Nursing staff were trained on various issues including skin cleansing, use of disinfectants, maximal sterile barrier precaution, hand hygiene, change of sets, obtaining blood samples, and dressing the catheter site. The simulator training required 2 weeks. The resources needed were CVC maintenance simulators and training manuals and were secured by lobbying the hospital's management.

**Implementation**

Among the 23 nurses at the project site, only 20 were available during the implementation phase. The nurses were divided into groups of four with each group undertaking the simulation sessions at different times. Dividing the staff was essential

because the evidence showed that small groups enhance the effectiveness of simulation training programs by giving all members an opportunity to actively participate in the simulation tasks (Lim et al., 2014). As planned, I held a brief introductory meeting with all members of staff to explain the details of the program and to deliver the training material. This was done to ensure that every member of the staff went into the actual training when he or she was adequately prepared for it. Each group underwent three simulation sessions/ scenarios within the 2-week training period.

**Evaluation**

The staff education program was evaluated to measure its effectiveness. The evaluation process focused on two main outcomes: (a) nurse's adherence to CVC maintenance guidelines and (b) CLASBI rates in the ICU. Nurses' adherence to CVC best practices was evaluated through the observation method. An evaluation checklist was used to examine the nurses' compliance with the CVC maintenance guidelines for four weeks before and after the implementation of the training program. Average compliance score for the 4-week period before and after the training were compared using the paired sample *t* test method to determine whether there was a positive and statistically significant change in the nurses' compliance with CVC maintenance guidelines. The Statistical Packages for Social Sciences (SPSS) was used to facilitate this analysis.

CLABSI rates were measured in terms of the number of infection cases per 1000 catheter days for the 1-month period after the implementation of the training program. The goal was to reduce CLABSI rates to below 1 per 1000 catheter days. The CLABSI rate for the four-week period was compared to this target using the one sample *t* test. The program was considered successful if this reduction attained in the 4-week period after implementation of the training program was equal to, or less than, the targeted 1 per 1000 catheter days. This project has the potential to contribute to social change by decreasing CLABSI rates in patients with CVCs and improving patient outcome.

## Significance

ICU patients are the most important stakeholders in this project. By reducing the CLABSI rate, this project could reduce the mortality risk for ICU patients. According to Haddadin and Regunath (2017), between 12% and 25% of patients who developed a CLABSI die. Consequently, developing a program that is effective in reducing the CLABSI rate will minimize the number of deaths due to this condition. Reducing the CLABSI rate will also reduce patients' length of hospital stay, as well as, the cost incurred in obtaining treatment and the indirect costs associated with lost productivity. The project will also have major implications for ICU nurses. First, the project could help reduce the workload for ICU nurses by reducing the number of patients who required a prolonged hospital stay or who are readmitted due to CLABSI. A reduction in workload

will minimize burnout and increase work-life balance. Second, reducing the amount of suffering occasioned by CLABSI will have a positive impact on the nurses' confidence and satisfaction.

Another group of stakeholders that will be impacted by this project is the hospital administration team. This project has the potential to improving patients' satisfaction leading to the improved image, increased patronage, and consequently a rise in revenues. The project might also help the administration to reduce the financial burden associated with treating CLABSI. In 2008, the US Congress passed the Deficit Reduction Act of 2005, which sought to prevent eight conditions including CLABSI termed "never events" (Waters et al., 2015). According to this policy, these high-cost events can be prevented through the application of evidence-based guidelines; hence, hospitals should not be compensated for treating them. The policy transfers the financial burden of treating CLASBI to healthcare institutions. This project will also be of interest to the administration because it could reduce the rate of nurse turnover by increasing their satisfaction level, which, in turn, would reduce the cost incurred in recruitment and training.

## Summary

CLABSI is among the most common healthcare acquired infection among ICU patients mainly because about 55% of patients in the ICU require the use of a CVC. In

the project site, the CLASBI rate stood at 3.2 infections per 1000 catheter days. This rate was significantly higher than the national average of 0.8 infections per 1000 catheter days (Haddadin & Regunath, 2017). CLABSI has a negative implication for patients, including increased risk for mortality, prolonged length of stay, and increased cost of care. It also harms nurses by increasing workload and burnout (Woodward & Umberger, 2016). In addition, CLABSI harms the healthcare facilities by creating a negative image, reduced patronage, loss of revenues, and increased nurse turnover.

This project was designed to reduce CLABSI among ICU patients by introducing simulation-based training of nurses on CVC maintenance. Studies have demonstrated that hospitals that manage to implement CVC insertion and maintenance policies successfully reduce CLASBIs by 60% (Edwards et al., 2016). It was anticipated that using the simulation-based training approach would improve nurses' adherence to CVC maintenance best practices and thus yield a reduction in infection rate. This DNP project had three main objectives: to design the training program, direct the implementation of the program on a pilot basis, and to evaluate outcomes of the pilot program. In Section 2, the following topics will be discussed: background, conceptual framework, significance of the study and role of the DNP student.

Section 2: Background and Context

## Introduction

This project sought to reduce the CLASBI rate among ICU patients in the targeted clinical setting by introducing simulation-based training of nurses on CVC maintenance. The following questions guided the project:

1. What is the effect of implementing a simulation-based training program on ICU nurses' adherence to CVC maintenance policies and best practices?

2. What is the effect of implementing a simulation-based nurse training program on the CLASBI rate within the ICU context?

The purpose of this doctoral project was to design the simulation-based education program, implement the program at the targeted clinical setting on a pilot basis, and evaluate outcomes of the pilot program. This section discusses the concepts, models, and theories that guided the project; relevance of the project to nursing practice, the local background and context, the role of the DNP student, and the role of the project team.

## Concepts, Models, and Theories

### Staff Education

One of the central concepts in the project was staff education: the planned and systematic efforts aimed at changing behavior through learning (Falenchuk et al., 2017; Chagari et al., 2017). It is closely related to notion that education is the concept of training, which refers to the process of developing knowledge for varied activities (Price & Reichert; Chagari et al., 2017). However, training is more practical and aimed at developing specific skills while education is more theoretical and seeks to provide general knowledge (Chagari et al., 2017). In an organizational setting, training refers to planned efforts that are aimed at improving performance in a specific activity or range of activities (Masadeh, 2013). Training is also closely related to the concept of learning.

Training has attracted varied definitions from different fields. However, this project applied the definitions by cognitive psychologists who view learning as an internal process that is characterized by a change in an individual capacity and capability to respond (Aliakbari et al., 2015). Training has become a critical function in healthcare organizations because it promotes the development of staff and the realization of organizational goals (Chagari et al., 2017; Falenchuk et al., 2017). Staff training also contributes to the improvement of patient care by improving the theoretical knowledge, technical capacity, and innovation among staff (Price & Reichert, 2017). Training also helps to inculcate new skills, competencies, and modes of doing things among employees.

**Simulation as an Instructional Method**

Simulation, another main concept in this study, is an instructional method that entails imitating real-world processes or system (Botma, 2014; Patel, 2014). Simulation-based education is an instructional technique that seeks to replicate real-patient encounters and substantial aspects of real-world situations within the training context (Patel, 2014). It is an active and interactive form of learning that imparts practical experiences and skills. There are various types of simulation including role-playing, standardized patients, partial task trainers, full task trainers, full mission simulators, and debriefing (Galloway, 2009). Simulation-based training programs are commonly applied in the medical field to provide practitioners with opportunities to deliberate and practice safely, thus leading to the development of essential skills. Barsuk, Cohen, Feinglass, McGaghie, and Wayne (2009) found that the use of simulation-based training among doctors reduced CLABSI cases by 84.5%.

Although simulation-based education is commonly used in medical disciplines, evidence shows that this training model can also be applied in nursing (Wolf, 2008; Cant & Cooper, 2010). In his study, Wolf (2008) found that emergency department nurses who completed simulation sessions completed accurate triage between 70 to 100% of the time as compared to an average of 40% accuracy for all nurses. In their systematic review, Cant and Cooper (2010) also found there was evidence linking simulation-based training

to added gain in knowledge, confidence, satisfaction, and critical thinking ability when compared with other teaching strategies. Gerolemou et al. (2014) also found that nurses sterile techniques improved significantly after the implementation of simulation-based training program among critical care unit nurses.

In another study, Jansson, Kaariainen, and Kyngas (2013) found that simulation-based education increased commitment to recommendations about safe medication practices among critical care nurses leading to improved quality of care and patient safety. However, the study noted that evidence was inadequate as only one study was included in the review. Dalton Levett-Jones, and Gee (2015) also noted that the acuity and complexity of the modern practice environment require a nursing workforce that was competent and flexible. They argued that simulation-based nursing education offers an opportunity for nurses to create and expand their clinical reasoning skills by exposing them to unpredictable and routine patient scenarios in the safety of a training environment. This training model was more challenging and fulfilling than traditional models that are based on lectures and demonstrations. Simulation-based training has strong education effects particularly in areas that require application of psychomotor skills (Kim et al., 2016; Gerolemou et al., 2014).

**Piaget's Theory of Constructivist Learning**

Piaget's theory of constructivist learning posits that learners develop new understanding from what they already know from their past experiences (Paiget, 1957). The previous knowledge influences the kind of new knowledge that the learner will construct. This premise implies that educators must understand the prior knowledge possessed by the learners and create an environment that fills the gap between the learners' current knowledge/ skills and the desired knowledge/ skills. It also implies that different learners may need different learning activities as their prior knowledge/ skills might not be similar (Aliakbari et al., 2015).

Piaget's theory of constructivist learning encourages the active engagement of learners in the process of constructing knowledge through collaborative activities such as group work (Aliakbari et al., 2015). It also emphasizes the provision of manipulative learning materials and creation of interactive learning environments. This theory often supports the use of ICT in learning as way of making the learning environment more interactive. The constructivist theory also emphasizes on formative methods of assessments. According to this theory, the learning process is just as important as the outcomes.

Simulation training was consistent with the Piaget's theory of constructivist learning, which contends that human construct knowledge from the experiences

(Aliakbari et al., 2015). This theory considers learning as an active contextualized process of constructing knowledge rather than a passive process where knowledge was transferred from the educator to the learner (Piaget, 1957). Learners develop knowledge and skills through what they actively encounter. This theory emphasizes a student-centered approach where the learner takes a leading role with the educators assuming a facilitating role. The educator presents problems and guides learners towards finding their solutions. Their role was viewed as that of providing guidance that will help learners to test the adequacy of their understanding and skills.

The theory of constructivism cites evidence that students form meaning and gain knowledge-based experiences they encounter. Contemporary curriculum design and implementation require the use of appropriate educational practices to enhance positive teaching and learning outcomes. Accommodation and assimilation are two components that construct an individual's new knowledge.

Piaget's theory of constructivism addresses how learning occurs. In Piaget's theory, teachers function as facilitators to aid students' understanding of a concept, instead of lecturing about the concept. This enforces the student's learning and deletes the focus of the lecture. The resources and lesson plans that are initiated related to the learning theory takes an approach that's different from traditional learning. The approaches include: (a) instead of telling, the instructor must begin asking. (b) Instead of

answering questions that only align with the curriculum, the instructor allows the student to come to conclusions on their own, and (c) instructors converse with the students, creating a learning experience that is open to new directions. Instructors following Piaget's theory of constructivism must challenge the student by making them effective critical thinkers and not being merely an "instructor" but a mentor, a consultant, and a coach as well (Piaget, 1957).

**Strategies:**

1. Have students work in together and assist in answering one another's questions.
2. Designate one student as the "expert" on a subject and have them teach the class.
3. Allow students to work in groups or pairs and research the topic (Piaget, 1957).

**MUSIQ Model**

The model for understanding success in quality (MUSIQ) is relevant in guiding the application of Quality Improvement (QI) methods in the Central line-associated bloodstream infections (CLABSIs) project. First, the MUSIQ guides the QI methods in the CLABSI. Second, the MUSIQ guides focus research. In the CLABSIs project, the MUSIQ offers the specificity necessary for the development of the project. Furthermore, the MUSIQ delineates the relationships among factors, thus allowing an understanding of action mechanisms (Kaplan et al. 2012). Also, the MUSIQ enables the researcher to develop a foundation for other studies, which is essential in testing and refining the

theory. In sum, MUSIQ is important in maintaining quality improvement of a project. The model ensures that the researcher checks if the project meets the required quality. If the project does not meet the required quality, the researcher adjusts the project to address the intended objectives.

The MUSIQ model is the most appropriate to the CLABSIs project because it focuses on quality improvement during the simulation process. On nurses' adherence to CVC maintenance policies and best practices, the implementation of simulation-based training program improves the quality of central venous catheter (CVC) maintenance. Within the ICU context, implementation of a simulation-based nurse program effectively reduces the rate of CLABSI. This is because simulation-based training program enables the nurses to implement multidisciplinary infection control intervention (Atilla et al. 2016). The use of the MUSIQ model improves the quality of the care bundle in the prevention of the CLABSIs. Furthermore, MUSIQ model allows the physicians to implement the simulation-based training program, thus improving the nurses' adherence to CVC maintenance. Also, the MUSIQ enables the physicians to reduce the rate of CLABSI because of the focus on quality improvement.

## Relevance to Nursing Practice of CLABSI

CLABSI are among the most common type of hospital-acquired infections in ICUs due to widespread use of CVC within this setting (Edwards et al., 2015; Haddadin

& Regunath, 2017). An estimated 55% of ICU patients in the United States require the insertion of CVC which may remain in place for weeks or months (Haddadin & Regunath, 2017). Although CVCs are essential for administration of medicine and fluids resuscitations, their insertion creates room for pathogens to move from the skin and enter the bloodstream cause infections (Stevens et al., 2014). The majority of CLASBI cases are caused by Gram-positive microorganisms such as Staphylococci, Candida spp, and enterococci (Scatliffe et al., 2015; Basinger, 2014). These infections result in increased mortality, prolonged hospital stay, increased healthcare cost, greater workload, and patient dissatisfaction (Theodoro et al., 2015; Scatliffe et al., 2015). In addition, CLASBI subject's healthcare organizations to significant economic burden as it increases patients' hospitalization by approximately seven days (Basinger, 2014).

Sets of evidence-based practices popularly known as 'care bundles' have been developed with the view of preventing CLABSI (Basinger, 2014). The recommended practices can be classified into two broad categories: insertion practices and maintenance practices (Ling et al., 2016). Insertion recommendations are mainly directed to physicians who are responsible for inserting the CVCs while CVC maintenance recommendations are directed to nurses who are responsible for maintaining the CVC (Cornejo-Juarez et al., 2016). Due to concern over the high CLABSI rate in the ICU, the hospital commissioned a study to examine adherence to CVC insertion and maintenance best practices in January 2017. The study showed 91.6% adherence to practices related to

CVC insertion and 41.5% adherence to practices associated with care and maintenance of CVCs and insertion site.

CVC maintenance best practices include but not limited to hand hygiene and aseptic techniques, catheter site dressing, patient cleansing, change of administration sets, and monitoring of CVCs (Ling et al., 2016). Low adherence to CVC maintenance best practices can be attributed to training (Jardim et al., 2013). The 2011 *CDC Guideline for Prevention of Intravascular Catheter-Related Infections* also recommends the education of staff regarding proper procedures for maintenance of CVC and proper infection control measures (Grady et al., 2011). It also recommends periodic assessment of knowledge of and adherence to guidelines for all staff involved in the insertion and maintenance of CVCs and designation of staff who demonstrate competence.

Currently, training on CVC maintenance in the ICU is done using the traditional lecture and demonstration method. This project sought to change these training practices in order to improve nurses' adherence to CVC maintenance best practices. Within the workplace, transfer of knowledge and skills is largely a function of the learner's ability and motivation to learn and to apply newly constructed knowledge (Aliakbari et al., 2015). Botma (2014) found that simulation-based training improves nurses' motivation to learn. According to Hallin et al. (2016), simulation enables nurses to demonstrate skills in complex clinical situations without the risk of harming the patient. This method of

training not only transfer practical skills but also improves the nurses' clinical judgment by exposing them to complex clinical scenarios.

The effectiveness of simulation-based training in improving CVC management was demonstrated in Barsuk et al. (2014) where the passing score on internal jugular CVC insertion improved from 35.5% to 93% after the implementation of a simulation-based training program among residents at the ICU at Mercy Hospital and Medical Center. The subclavian CVC insertion score improved from 23% to 96.1% after the implementation of the program while CLABSI rates reduced from 3.82 per 1000 catheter days in the 23 months before the intervention to 1.29 per 1000 catheter days in the 21 months after the education intervention. Although CVC insertion is largely the responsibility of physicians, the fact that the simulation-based training was able to enhance performance suggests that this training approach can also improve CVC maintenance by nurses.

## Local Background and Context

CLASBI is a major problem in the targeted clinical setting. In this hospital in 2016, the CLASBI rate among ICU patients stands at 4.3 per 1,000 catheter days, which is significantly higher than the national average of 0.8 per 1,000 catheter days (Haddadin & Regunath, 2017). The high CLABSI rate has had major negative consequences on patient, staff, and the hospital. High CLASBI rates have increased the risk of mortality

for ICU patients. It is worth noting that the condition of ICU patients is usually very delicate; hence, the development of a hospital-acquired infection such as CLABSI leads to a significant increase in the risk of mortality (Edwards et al., 2016). CLABSI also lead to prolonged hospital stay that not only affect the experiences of the patient but also increase cost and reduce the availability of ICU resources to other patients who may need them (Haddadin & Ragganath, 2017).

CLASBSI infections have also had an adverse effect on staff including nurses. CLABSI often lengthen the patient's stay at the ICU or lead to readmission of patients within 30-days after discharge (Haddadin & Regunath, 2017). As results, ICU nurses are subjected to significant workload. Cases of CLABSI that result in the deaths of the patient also demoralize staff and could easily lead to compassion fatigue and burnout (Woodward & Umberger, 2016). The healthcare facility has also suffered from the high rate of CLABSI in the ICU. First, this situation affects the level of satisfaction especially among patients who develop this infection. Most of these patients leave the hospital with a negative impression regarding the quality of services. Others are transferred to other facilities without having recovered fully. This situation was taking a toll on the image of the hospital and could affect future patronage, and consequently, future revenues (Woodward & Umberger, 2016).

The hospital also incurs significant financial burden associated with the treatment of CLABSI. More than 50% of patients receiving care at the hospital ICU are Medicare and Medicaid beneficiaries. The Center for Medicare and Medicaid Services has a policy of not reimbursing the cost incurred in the treatment of hospital-acquired infections such as CLABSI (Waters et al., 2015). As a result, the hospital bears most of the cost of treating CLABSI cases.

## Role of the DNP Student

I was a nurse in the hospital's ICU. In this doctoral project, I assumed the role of the project leader and was largely responsible for the design, implementation, and evaluation of the new education program. I oversaw the collection, analysis, and translation of evidence into an action plans that guided the design, implementation, and evaluation of the simulation-based training program. I was also responsible for mobilizing all the resources required for this project including material, equipment, and time. I created the project team, designated tasks and responsibility to team members, and coordinated the activities of the team. I also directed the process of implementing the pilot program and evaluating outcomes.

My interest in this project was driven by my desire to improve outcomes for ICU patients. I have worked as an ICU nurse for over five years and during this period; I have witnessed how a significant number of patients and families experience immense

suffering due to preventable events such as CLABSI. I hope that the outcomes of this project will make a difference by reducing the incidence of CLABSI in ICU patients.

## Role of the Project Team

A doctoral project team was formed to spearhead the planning and implementation of the project. The project team comprised of five members including myself. The first member was the project mentor from the practicum site. The project mentor played a critical role in guiding me in the process of conceptualizing the project, collecting and synthesizing evidence, designing and implementing the training program, and evaluating outcomes. Background information was communicated to the mentor through a written project proposal. I also held meetings with the mentor to discuss the project.

The second team member was the nursing director at the hospital ICU. The nursing director played a critical role particularly in the implementation of the training program. First, the director helped me to secure essential resources such as training materials and equipment, training venues, and time for designing and implementing the program. The nursing director also assisted me to get buy-in from all nurses within the unit. Background information was communicated to nursing director through a written proposal. I also held an informal meeting with the director to explain the project.

The team also comprised of two ICU nurses, who provided input regarding challenges and issues that they encounter during CVC maintenance. They also provided their perspective regarding existing training processes and procedures and highlighted areas for improvement. This input played a significant role in the design of the program. The nurses also assisted me to get buy-in from stakeholders, fellow nurses and other staff. Background information was communicated to the nurses through informal meetings.

## Summary

CLABSI was a major problem in my clinical setting. The CLASBI rate among ICU patients is 4.3 per 1000 catheter days as compared to a national average of 0.8 per 1000 catheter days (Haddadin & Regunath, 2017). Evidence shows that it was possible to reduce CLABSI rate by implementing a set of CVC insertion and maintenance strategies. The CDC guidelines also recommend training of staff regarding these insertion and maintenance strategies. In my clinical setting, training of nurses on CVC maintenance is done using traditional instructional methods such as lectures and demonstration. Consequently, there was poor adherence to CVC maintenance policies and best practices. This project sought to address this problem by changing the strategy used to train nurses on CVC maintenance. Specifically, the project was designed to introduce simulation-based training with the view of improving the transfer of knowledge and skills on CVCs maintenance. Section 3 discusses the process that was used to collect and analyze

evidence that guided the development and implementation of the new program. In Section 3, the following will be discussed: collection of evidence, analysis and synthesis of evidence, and sources of evidence.

# Section 3: Collection and Analysis of Evidence

## Introduction

CLABSI has become a significant problem in the project site. The CLASBI rate in this setting stood at 4.3 per 1000 catheter days as compared to a national average of 0.8 per 1000 catheter day (Haddadin & Regunath, 2017). A study conducted early in 2017 showed that there was low adherence to practices associated with CVC and insertion site maintenance and care. This project sought to address this problem by introducing simulation-based training of nurses on CVC maintenance. The objectives of the project were to design the new education program, implement a pilot version of the program, and evaluate the outcomes. This section covers the following topics: the methods and procedures for collecting and analyzing evidence, the practice-focused question, sources of evidence, and analysis and synthesis.

## Practice-Focused Question

There was a high rate of CLASBI among ICU patients in the targeted clinical setting. This problem has been traced back to low adherence to CVC maintenance policies and best practices. Evidence suggested that one of the reasons that could explain it was low adherence to evidence-based practices in staff training. The training process was not only important in transferring knowledge and skills to the learner, but also play a role in changing the attitude of the learners towards the training subject. In this clinical

setting, CVC maintenance training is done using traditional lecture and demonstration method. According to Sadeghi, Sedaghat, and Ahmadi (2014), 80% of the content presented through lectures and demonstrations is forgotten within 8 weeks. It was in this light that this project sought to change the training strategy. Specifically, the project sought to replace the traditional training methods with simulation-based training. The following practice-focused questions guided the project:

1. What is the effect of implementing a simulation-based training program on ICU nurses' adherence to CVC maintenance policies and best practices?

2. What is the effect of implementing a simulation-based nurse training program on CLASBI rate within the ICU context?

Collection, analysis, and synthesis of evidence were a critical aspect of this project. I identified, analyzed, and synthesized evidence-based practices related to the development and implementation of simulation-based training in the nursing context.

## Sources of Evidence

### Planning Phase

A literature search was conducted using the following series of databases: PubMed Central, EBSCOhost, CINAHL, MEDLINE, Nursing Reference Center, and

Health Source. Various combinations of keywords were used in the search process: '*simulation-based training in nursing,' 'simulation-based education in nursing,' 'simulation-based training and CVC maintenance,' 'simulation-based training and CLABSI prevention,' and 'implementing simulation-based training in nursing.'* The search was limited to English, (last 5 years), and full text availability. Articles identified through this search process were appraised according to their relevance to the project, level of evidence, internal validity, external validity and sample size (Critical Appraisal Skills Programme, 2017). The appraisal process led to the identification of articles whose evidence was included in the project. Evidence from the selected articles was combined and synthesized to form guidelines for designing, implementing, and evaluating simulation-based Staff Education Program. The search was limited further by geographical area where only studies conducted in the United States were considered.

**Implementation Phase**

During the implementation phase, the observation method was used to collect data regarding the nurses' experiences and adherence to CVC management guidelines. This data was essential in evaluation the effectiveness of the program design, as well as, effect of the program on nurses' adherence to CVC maintenance guidelines.

**Evaluation phase**

During the evaluation phase, hospital records were used as source of evidence regarding impact of the program on CLABSI rate. The records were largely be used to provide data regarding CLASBI rates before and after the implementation of the training program.

## Analysis and Synthesis

### Planning Phase

Articles identified during search process were appraised to determine whether they should be used to inform the project's design, implementation, and evaluation. The Critical Appraisal Skills Program (CASP) (2017) checklist was used to provide a systematic approach to the appraisal process. Generally, the CASP checklists determine the appropriateness of a given article by examining three major issues: (1) validity of the study, (2) clinical importance of results, and (3) relevance of results to practice question. Validity refers to the trustworthiness of the methods and procedures that were used in the study. This includes the intervention design and implementation, sample size and selection, and data analysis (CASP, 2017).

The study was deemed to be valid, the student then considered the clinical importance of the results. For instance, the student considered whether a significant difference was observed between nurses trained using simulation-based approach and

those trained using traditional method. The student also considered the certainty of the results as expressed by p-values and confidence intervals. Studies whose results were deemed to be clinically important went to the third step, which entailed examining whether the results were relevant to the practice questions. Articles that passed all the three steps were included in the project where they were used as evidence for guiding the design, implementation and evaluation of the simulation-based training program.

Evidence from the selected articles was extracted and combined to form guidelines for designing, implementing, and evaluating simulation-based training. A Table of Evidence was used to summarize information from each of the selected article including details about the objective, research question, the population, sample, design of study, and results. The process of synthesizing evidence was descriptive where the evidence was discussed in a narrative summary. A qualitative synthesis was also conducted to convey a deeper understanding of the interventions that work best for the ICU setting (Oh, 2016).

**Implementation Phase**

The observation data collected during the implementation phase was analyzed using descriptive and qualitative methods. Descriptive statistics were used to assess the time taken for learners to complete tasks and levels of learners' satisfaction with the program. Descriptive statistics were also used to quantify the nurses' adherence with the

CVC maintenance guidelines. Qualitative analysis was used to assess learners' experiences and challenges during the program.

### Evaluation Phase

Two types of data were used in the evaluation. The first is the data collected by observing nurse's adherence to CVC maintenance guidelines. Observation of nurses' adherence to CVC maintenance guidelines continued for a four-week period after the training was completed and the nurses returned to their routine duty. The continuation was aimed at assessing whether the program had a lasting effect on nurses' practices. Data on adherence was compared to the 45% adherence rate observed during a study conducted in January of 2017. The second source of data was the hospital records regarding CLASBI. The records were used to compute CLASBI rate for the four-week period after the implementation of the training program.

## Summary

This doctoral project was designed to introduce simulation-based training to improve nurses' adherence to CVC maintenance best practices and eventually reducing CLABSI rates among ICU patients. The specific objectives of the project were to design the new program, implement it on a pilot basis, and evaluate outcomes. The project relied on evidence from published sources such as systematic reviews, RCT, and quasi-

experimental studies. The search was conducted on PMC and EBSCOhost system and involved several nursing databases. The search was filtered based on date of publication, language, and availability of full text. Articles that were identified were appraised using CASP checklists resulting to the decision on whether they should be included in the project. Evidence was extracted from articles that passed the inclusion criteria and synthesized using descriptive and qualitative approaches. In Section 4, the following topics will be discussed: findings and implications, recommendations, contribution of the doctoral project team, and strength and limitation of the project.

# Section 4: Findings and Recommendation

## Introduction

The CLABSI rate at the project site was 4.3 per 1000 catheter days. This rate is significantly higher than the national average of 0.8 per 1000 catheter days (Haddadin & Regunath, 2017). The problem was traced to low adherence to CVC maintenance best practices, which was rated at 41.5% by study conducted early in 2017 (Haddadin & Regunath, 2017). This project was designed to improve nurses' adherence to CVC maintenance guideline by developing a simulation-based training program. The project relied on published materials, hospital records, and observation as the source of evidence.

## Findings and Implications

### Planning Phase

A literature search was conducted in various databases using predetermined keywords. It led to the identification of 76 articles, which were appraised using the critical appraisal skills program (CASP) to determine those that should be included in the project. Seventeen studies met the inclusion criteria and were included in the project. The following section presents a summary of evidence obtained from these articles.

### Content of CLABSI Educational Programs

The first goal of literature review was to determine competency areas that should

form the focus on the proposed training program. One of the identified areas is compliance catheter site dressing guidelines. The study by O'Neil et al. (2016) found that "compliance with optimal catheter site dressing best practices was correlated with a 43% decline in CLASBI rate." In their systematic review, Perin et al. (2016) found that most education program on CVC maintenance focused on five main areas: hand hygiene, patient cleansing, catheter site dressing, change of administrator set, and CVC monitoring. Esposito et al. (2017) found that hand washing, aseptic techniques, use of sterile transparent gauze to dress catheter sites, and disinfection of connectors before fluid or medicine administration were among the major gaps in knowledge and practice of CLABSI prevention. The study recommended that education interventions should focus on these gaps.

**Components of the Staff Training**

The second goal of the review was to determine specific details of the programs including instructional procedures, number of sessions, duration of each session, and number of nurses in each session. According to Kim et al. (2016), the degree of realism in simulation-based training range from completely artificial to actual real-life situations. The extent to which the simulation exercise reflects reality is referred to as fidelity. Xu (2016) found that a simulation-based education program is more effective in transferring required competencies when it is a high-fidelity simulation. Kelly et al. (2016) pointed out that to enhance the fidelity of the simulation exercise, scenarios that reflect real world

problems and challenges must be developed. The scenarios should be relevant to the day-to-day activities in the nurses' clinical setting. Huffman et al. (2016) recommended that simulation exercises should be made more realistic by incorporating distractions. In this study, it was noted that the actual clinical settings are often complex and characterized by numerous variables that distract practitioners from their main duties.

Chemutai and Kirui (2017) emphasized the need to develop multicultural simulation program. The program should create equal opportunities for all students including those of different racial, ethnic, age, and social class. Huffman et al. (2016) also pointed out that culturally sensitive education programs promote faster transfer of skills by ensuring that all learners are comfortable with the learning activities. Seckman and Diesel (2013) pointed out that not only should simulation scenario be sensitive to the nurse's cultural backgrounds but should also incorporate activities that promote cultural competence among the nurses. The study noted that modern day nurses deal with an increasingly diverse American population hence the need to equip them with the skills that the need to interact with patients from different cultural backgrounds.

According to Xu (2016), all simulation exercises should also begin with a briefing session. He referred to this session as prebriefing. The prebriefing session should inform participants what skills they need to learn and task that they are expected to complete. Gray et al. (2016) recommended four main components that should be incorporated in the

prebriefing session: simulation environment orientation, clarifying roles of participants, defining time and objectives, and providing patient information. Incorporating these components helps to increase participation and motivation. Cant & Cooper (2015) also emphasized the need to inform participants about the simulation technology, how it works, and its limitation as this improves fidelity by eliminating the need for instructors to interrupt scenario in order to provide further directions. Bryant (2014) stressed the need to alert learners that they are equal participants in the simulation exercise during the prebriefing session. This practice will make the learners feel free to exercise they skills and share their experiences and challenges.

In their study, Zhu and Wu (2016) stressed the need hold a debriefing and feedback session at the end of each scenario with the aim of providing feedback to learners regarding their performance in the simulation task. This session should be used to correct misinformation and improper practices that were observed during the simulation, answer questions about the simulation, and establishing a connection between knowledge gained and real-life situations. Lorello et al. (2014) added that apart from informing students about their performance, the debriefing and feedback session should also ask participants to reflect on the experiences including what they have learned, the challenges they have encountered, emotions that the experienced, what they liked about the session, and areas they would like improved. In addition, instructors should examine perceptions and attitude that have resulted from the simulation activities. Burns (2015)

found holding a debriefing and feedback session after simulation scenario helps learners to reflect on their experiences, conceptualized abstract ideas, and actively explore the newly acquired skills. In most simulation program, debriefing and feedback is done orally at the end of the session. Lee et al. (2017) found that the feedback process could be further enhanced by asking participants to document their experiences through journals or any other form of writing. Noting down experience facilitate deeper exploration resulting in development of in-depth insights.

**Size of the Simulation Team**

The size of the simulation group/ team was also an important consideration during the design of the simulation-based training program. Lim, Steinemann, and Berg (2014) examine the effect of team size on acquisition of non-technical skills during a simulation training program. Results showed that learners in small teams (n=5) had higher scores on non-technical skills than those on large teams (n>8). In addition, participants in small teams were able to complete greater number of tasks per team member increasing the accuracy and efficiency of the simulation exercise. No significant differences between large and small team in terms of time taken to complete the simulation tasks. Burns (2015) also found that a small group facilitates constructive discussions and interaction as well as assist learners to feel relaxed. The issue of group size is also important during pre-briefing and debriefing sessions. In their study, Tosterud et al. (2014) found that

debriefing in small groups provided the best condition for learning as it created an environment of trust, safety, and security. Debriefing in large group was largely hampered by the presence of many unknown students. Learners expended a lot of energy to hide and avoid being exposed; it was difficult for participants to express themselves.

**Number of Simulation Scenarios**

Another important consideration was the number of scenarios. According to Tosterud et al. (2014), when it comes to simulation, repeated training is important in achieving the desired competency. This implies that to promote effective learning, nurses should participant in several simulation scenarios. However, Burns (2014) pointed-out that the number of sessions or/ scenarios should be determined by the complexity of the competencies that the participants are expected to learn. It should also be determined by the gap in competency exhibited by the target group.

**Length/ duration of the simulation scenarios**

The final consideration was the length/ duration of the simulation scenarios. Munroe et al. (2016) found that assigning little time for a simulation scenario hampers the participants experiences as they tend to feel rushed and pressured for time. On the other hand, allocating too much time lowers the fidelity of the simulation as real clinical environment are often characterized by severe time constraints. The study recommended

that the duration of a scenario should largely be determine by the type of tasks and should balance between provide meaningful experiences to learners and enhancing the fidelity of the exercise.

## Implementation Phase

There was a total of 23 nurses at the project site but only 20 were available during the project implementation phase. Table 1 presents the demographic characteristics of the participants:

**Table 1**

***Demographic Characteristics of Participants***

| Characteristics | Frequency | Percent | Mean |
|---|---|---|---|
| **Age in years** | | | **37 years** |
| **Age bracket** | | | |
| Below 30 years | 7 | 35% | |
| 30-39 years | 9 | 45% | |
| 40-49 years | 4 | 20% | |
| **Gender** | | | |
| Male | 4 | 20% | |
| Female | 16 | 80% | |
| **Number of Years as Registered Nurse** | | | |
| Less than 5 years | 7 | 35% | |
| 5-9 years | 9 | 45% | |
| 10-14 years | 3 | 15% | |
| 15- 19 years | 1 | 5% | |
| **Number of Years as an ICU nurse** | | | |
| Less than 5 years | 11 | 55%% | |

| | | |
|---|---|---|
| 5-9 years | 5 | 25% |
| 10-14 years | 3 | 15% |
| 15- 19 years | 1 | 5% |
| | | |
| **Highest Nursing Education** | | |
| Associate Degree | 5 | 25% |
| Baccalaureate Program | 13 | 65% |
| Masters' Degree | 2 | 10% |

As Table 1 illustrates, the mean age of those who participated in the training program was 39 years. The majority of the participants (45%) were between the ages of 30 and 39 years. The majority of the participants were also female (80%), had worked as a registered nurse for 5 to 9 years (45%) and had worked in the ICU setting for less than 5 years (55%). The majority of the participants (65%) had the baccalaureate level of nursing education.

The nurses were divided into groups of four with each group undertaking the simulation sessions at different times. Dividing the staff was essential because evidence show that small groups enhance the effectiveness of simulation training programs by giving all members an opportunity to actively participate in the simulation tasks (Lim et al., 2014). Expectedly, the educator held a brief introductory meeting with all members of staff to explain details of the program and deliver the training material. This was done to ensure that every member of staff goes into the actual training when he or she is adequately prepared for it.

Each group underwent three simulation sessions/ scenarios within the two-week training period. Each scenario captured all the competency areas identified in the planning stage. Before each scenario, the participants in each group were engaged in a pre-briefing session where the educators informed them about the task at hand, what is expected from them, and what they should expect to learn.

Nurses experienced some challenges completing tasks in the initial simulation exercise but grew in confidence and exhibited the required competencies in the second and final scenarios. Participants expressed personal appreciation for the new training approach during the debriefing sessions. Most of the feedback they provided was positive. Although the scenarios were designed to last for 60 minutes (15 minutes pre-briefing, 30 minutes for actual simulation tasks, and 15 minutes for debriefing), most session took an addition 20 minutes. The addition time was mainly needed in the debriefing session where the learners seemed to have a lot of share and many questions to ask. This observation promoted the project team to consider revising the timeline for the simulation scenarios.

**Evaluation Phase**

The project was interested in two outcome variables: nurses' adherence to CVC maintenance guidelines and CLABSI rates. To evaluate effect of the education program on CVC maintenance guidelines, data on CVC maintenance was collected from nurses

who participated in the program through the observation method. Each of the 20 nurses who participated in the program was observed when performing CVC maintenance guidelines three times during the four-week period after the completion of the training program. The DNP student conducted the observation making it easy to blind the participants given that the student is also a staff in the Unit.

Although the nurses were informed that they were going to be observed at some point after the training and were asked to give consent, they were not informed of the timing of the intervention. Keeping the information regarding the timing of the observation was essential as it ensured that the nurses do not change their behavior as result of being aware that they were being observed. A total of 60 observations were made and recorded during the four weeks period. The observations were standardized and included the following criteria: (1) whether the nurse observed hand hygiene and aseptic techniques, (2) whether the nurse observed catheter site dressing guidelines, (3) whether the nurse observed patient cleansing guidelines, (4) whether the nurse observed change of administration sets guidelines, and (5) whether the nurse observed monitoring of CVCs guidelines. These measures were used to compute the overall CVC maintenance adherence score, with observations that fulfilled all the five criteria being labeled as 100% compliant.

Since each nurse was observed three times, all nurses had three observation scores. Therefore, there were a total of 60 observation scores. These scores were entered into the Statistical Packages for Social Sciences (SPSS) where an average score for all nurses was computed. The average score for all nurses was 87.9%, which is quite an improvement from the study conducted in January 2017 where it was found that adherence rate was 41.5%. The one sample *t* test was used to examine whether this improvement is statistically significant. Results are presented in Table 4.2:

**Table 2**

***One-Sample Test Comparing Change in Adherence Score***

| | t | df | Sig. (2-tailed | Mean Difference | Lower | Upper |
|---|---|---|---|---|---|---|
| Score | 24.083 | 59 | .000 | 46.41253 | 43.5437 | 49.6229 |

Test value = 41.5

As illustrated in Table 2, the one-sample *t* test gave a p-value of 0.000 suggesting that the change from 41.4% adherence in January 2017 to 87.9% average adherence in the four weeks after the training intervention was statistically significant. The 41.5% was used as the test-value because this is the score that was used as a comparison for the postintervention adherence score.

To evaluate effect of the training on CLABSI rate, data on patients with CVC in the four weeks period was obtained from the hospital electronic medical records. The total number of catheter days was calculated. There were 1613 catheter days during the four-week period. Two CLABSI cases were recorded during the four-week post intervention period. These cases translated to a CLABSI rate of 1.24 per 1,000 catheter days down from 4.3 per 1,000 catheter days. However, the goal of reducing CLABSI rate to below 1 per 1,000 catheter days was not realized.

## Recommendations

Based on the findings above, the project recommends that the simulation-based training program should focus on five main competency areas: hand hygiene and aseptic techniques, catheter site dressing, patient cleansing, change of administration sets, and monitoring of CVCs. The program should utilize high-fidelity simulation technology as opposed to intermediate or low-fidelity technologies.

The project also recommends the development of three scenarios to ensure adequate transfer of the required competence and address time limitation. The content of the scenario should enhance the fidelity of the simulation exercises. The scenarios should be relevant to the nurses' day-to-day activities for the simulation exercise to be effective. Scenarios should be cultural appropriate. This implies that their content should be sensitive to the cultural background and preferences of all nurses. The learners should

feel valued, respected, and free to learn. Content and experiences that may damage the learners' sense of self-worth should be avoided.

To ensure that all nurses get adequate opportunity to exercise their knowledge and skills, each simulation session will comprise of 3 nurses. A supportive climate that enables the nurses to demonstrate their skills and share their experiences in a frank and open manner should be created. Active learning cannot take place in an environment where learners feel stressful and intimidated.

Appropriate pre-briefing and debriefing should be done before each scenario. In the first scenario, the nurses should be introduced to the simulation technology and informed of how it works. Apart from informing the learners of what is expected of them, the debriefing exercise should be used to cultivate trust between the learners and the instructor. The sense of trust will encourage the learners to express themselves more openly and freely. The debriefing exercise should accommodate learners with different styles of learning.

The time for each scenario should be increased from the 60 minutes that were allocated during the pilot program to 90 minutes. More time should be allotted to the debriefing session to allow participants more time to share their experiences and ask questions.

## Contribution of the Doctoral Project Team

The doctoral project team made valuable contribution towards the development of the recommendations. For instance, the project mentor played a critical role in the conceptualization of the project. She also provided valuable advice that helped in the collection and synthesizes of evidence and the design of the training program. The nursing director at the hospital ICU provided crucial information regarding logistical issues that should be incorporated into the training program. For instance, she provided appropriate advice on how the training sessions should be scheduled to minimize disruption of unit's activities. The two ICU nurses provided input regarding challenges and issues that they encounter during CVC maintenance. They also provided their perspective regarding existing training processes and procedures and highlighted areas for improvement. This input played a significant role in the developed of the recommendations.

## Strength and Limitation of the Project

A significant strength of the project is that it has a strong theoretical foundation. Piaget's Theory of Constructivist Learning that backs Simulation-based training has be subjected to numerous empirical tests (Aliakbari et al., 2015). Another point of strength in this project is that the recommendations were developed through active consultation with key stakeholders including the nursing director and the ICU nurses. Active

involvement of key stakeholders will aid the implementation process as it has created a sense of ownership of the program among the nurses and other stakeholders (Harris et al., 2016). Stakeholder involvement also ensured better identification of critical components that should be included in the program.

A significant limitation of the study was that due to time constraints, the project relied on 1-month data to evaluate the effectiveness of the training program in improving nurses' adherence to CVC maintenance guidelines and reducing CLASBI rates. This evaluation procedure was able to measure the short-term effect on the program on nurses' adherence but could not establish its impact in the long-term. This observation period might also have been too short for the project to observe significant change in CLABSI rate.

The project also lacked a control group. Therefore, it was not possible to determine whether the change observed in CVC adherence and CLABSI rate was as result of other factors besides the training program. The project was also implemented at a single site (intensive care unit). This may limit the generalization of findings to other ICU settings.

## Summary

This project was designed to introduce a simulation-based training program on CVC maintenance. A systematic review of articles was conducted with the view of identified evidence to inform the design, implementation, and evaluation of the program. The program was also implemented on a pilot basis and outcome evaluated to determine its effectiveness. The evaluation process focused on two main outcomes: nurses' adherence program, adherence score improved from 41.5% to 87.9%. The one-sample *t*-test determined that this improvement is statistically significant. CLABSI rate also declined from 4.0 to 1.24 per 1,000 catheter days. Despite failing to attain, the target of less than 1.0 per 1,000 catheter days, the program is deemed to be fairly successful because there was a notable decline in CLASBI rate. There was also a significant improvement in CVC adherence. In Section 5, the following topics will be discussed: dissemination plan and analysis of self.

# Section 5: Dissemination Plan

## Introduction

Dissemination means the targeted distribution of information and program material to the clinical practice audience (Novins et al., 2013). The goal is to diffuse knowledge and the developed intervention to facilitate widespread implementation. In this case, the goal of the dissemination exercise is to convey the proposed training program and the project recommendations to stakeholders in the hospital's ICU setting.

According to Curtis et al. (2016), dissemination is more effective when active, rather than passive, strategies are used. One of the strategies that will be used to disseminate the work of this project is opinion leaders, individuals who have a strong influence on the opinions of people around them. They may or may not have a formal leadership position. In this case, I was able to obtain buy-in from individuals in the ICU who have a strong influence on other staff and can convert them into project champions. I asked the opinion leaders to talk to other nurses and staff regarding the new project and to enlist their support.

Another proposed strategy will be to disseminate the work of this project at educational meetings. I plan to organize educational meetings and interact with other staff of the ICU and educate them about the new intervention. This strategy provides me with an opportunity to engage directly with the target audience. The stakeholders will get

the opportunity to ask question and express their concern about the program. I also plan to present the findings at local a professional nursing organizational meeting, and at regional nursing conferences. I intend to write an executive summary and present it to the nursing administrators in other units in order to support the implementation of this program on a wider scale.

## Analysis of Self

This project has provided me with valuable learning experiences. As scholar, the project has helped me to enhance my search and evaluation skills. I learned how to search and locate relevant evidence through various search technologies and strategies. I also learned how to evaluate evidence, particularly using the CASP tools systematically. Using the CASP tool also helped me to develop an in-depth understanding of the various designs that are used in nursing research as well as the strength and limitation of each design.

As practitioner, the project helped me to improve evidence translation skills, a vital skill in advanced nursing. There is mounting pressure for nurses and other healthcare professions to integrate the best available evidence in decision-making and practice. Through this project, I learned how to search and review evidence and translate it into a product that can be applied directly in the clinical setting. Acquiring this skill is a huge milestone in my nursing career.

This project has enhanced my skills as a project manager. Through the project, I have learned how to design a project by defining tasks and assigning responsibilities. I learned how to schedule tasks to ensure that a project is completed within the desired timeframe. I also learned other competencies that are critical in project management, such as budgeting and stakeholder involvement.

The project was not without challenge. One of the most significant challenge entailed managing time. The project task required high dedication of my time and effort. I had to learn how to balance between completing the project tasks and fulfilling family and work responsibilities. I was, however, able to manage time constraints by negotiating with colleagues at work and family members who agreed to free up some time for me to complete the project.

## Summary

This project aims to improve nurses' adherence to CVC maintenance guideline by developing a simulation-based training program. CLABSI rate stands at the site where took place stands at 4.3 per 1000 catheter days. This rate is significantly high where compared to the national average of 0.8 per 1000 catheter days. The problem was traced to low adherence to CVC maintenance best practices, which was rated at 41.5% by study conducted early in 2017. After systematic review of evidence, several recommendations have been developed for the new training program. Apart from identifying the five

competency areas that the program should focus on, the project recommends the utilization of high-fidelity technology and scenarios, development of scenarios that are culturally sensitive, and creation of supportive climate. It is envisaged that the implementation of this program would increase nurses' adherence to CVC maintenance guidelines and thereby reduce CLASBI rates within the ICU setting.

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