Spring 5-5-2022

The Impact of Simulation-Based Mastery Learning for Central Venous Catheter Dressing Changes With Staff Nurses at a Nebraska Critical Access Hospital

Paige Pavlik
University of Nebraska Medical Center

Michaela Haddock
University of Nebraska Medical Center

University of Nebraska Medical Center

College of Nursing

DOCTOR OF NURSING PRACTICE (DNP)

FINAL DNP PROJECT

THE IMPACT OF SIMULATION-BASED MASTERY LEARNING FOR CENTRAL VENOUS CATHETER DRESSING CHANGES WITH STAFF NURSES AT A NEBRASKA CRITICAL ACCESS HOSPITAL

by

Paige Pavlik and Michaela Haddock

The final DNP project presented to the Faculty of the University of Nebraska Medical Center College of Nursing

In Partial Fulfillment of the Requirements for the Degree

April 2022

DNP Project Faculty Advisors

Diane Brage Hudson, PhD, RN

Abstract

Purpose

The purpose of this pilot feasibility study was to assess if a simulation-based mastery learning (SBML) intervention on central venous catheter (CVC) dressing changes by staff nurses at Nemaha County Hospital could further develop staff nurses' central line care skills by increasing their knowledge of a central line dressing change, improving their comfort level and learning self-efficacy with central line care, determining if there is a relationship between knowledge, learning self-efficacy and comfort in the clinical area, and assessing nurses' satisfaction on the SBML intervention. The clinical research questions being explored are, "Will nurses in a Nebraska critical access hospital in Auburn, Nebraska who engage in a SBML intervention on central venous access dressing changes and cares develop their skills and increase their knowledge, comfort level, and learning self-efficacy with such cares after the intervention? Will they increase their satisfaction and positive attitude learning via the SBML format?

Methods

A SBML workshop for central line dressing changes was implemented at Nemaha County Hospital's yearly skills fair. The proposed study design was a pretest-posttest, educational pilot intervention. The staff nurses used live SBML to demonstrate a CVC dressing change for internal jugular venous catheters. A 19-point checklist devised from the Center for Disease Control and the hospital's policy was used to evaluate their performance. Participants completed a knowledge assessment, comfortability rating assessment, and self-efficacy assessment pre and post

intervention. An assessment of satisfaction and attitude was completed at the end of the intervention. Demographic data was collected for descriptive purposes. The theoretical framework used in the study included the behavioral learning theory as it focuses on behavior change and improvement, with behavior change being indicative of knowledge, learning, and competence acquisition. Learning in simulated social environments contributes strongly to learner knowledge, behavior change, competence, and personal development.

Results

A sample size of 11 registered nurses (RN) and 3 licensed practical nurses (LPN) participated. There was a significant positive Pearson correlation between change in comfort and change in self-efficacy pre and post intervention. There was a significant difference on change in comfort between day and night shift with night shift having a larger increase in comfort compared to the day shift nurses. Skill development was measured once immediately post demonstration. It was found that there were no significant differences on the outcome measures between LPNs and RNs.

Conclusions

Clinical staff at critical access hospitals may have little opportunity to experience seldom performed nursing tasks. Overall, the comfortability and self-efficacy for central line dressing changes improved after the SBML intervention. Participants reported a positive attitude towards utilizing SBML during education of central line dressing changes. The disadvantage of this study was the small sample size and the lack of opportunity to redemonstrate the skills assessment. Ideally, a larger sample size with more clinical staff or staff from multiple hospitals could offer more insight into the benefits of utilizing SBML for training skills.

The Impact of Simulation-Based Mastery Learning for Central Venous Catheter Dressing Changes with Staff Nurses at a Nebraska Critical Access Hospital

Central line-associated bloodstream infections (CLABSI) continue to be a severe problem in the United States healthcare system, resulting in thousands of avoidable deaths and costing billions of unnecessary dollars (Scott et al., 2014). By definition, a CLABSI is a "laboratory-confirmed bloodstream infection not related to an infection at another site that develops within forty-eight hours after a central line was placed" (Center for Disease Control and Prevention, 2011, p. 2). These infections are often preventable with good central line care, and this care is the responsibility of the nurse. A breach in central line care may be caused by nurses' lapse of judgement, discomfort with complex dressing changes, poor skill behaviors, neglect of policies, rushed and inconsistent care, and lack of knowledge on what is needed to maintain central line integrity (Aloush et al., 2018; Bell & O'Grady, 2017).

Problem Statement

Despite evidence-based practices for central line care, CLABSI have the potential to occur at Nemaha County Hospital in Auburn, Nebraska where dressing changes are skills that were seldom performed. While the usage of central lines is minimal, it is still pertinent that nurses should be competent in skills that coincide with central lines. With less exposure to central lines, nurses at this institution may require periodic teaching and practice in their care and maintenance. This lack of exposure indicates improvements in staff education are needed to prevent central line infections in this institution.

Barsuk et al. (2015) found central line maintenance skills for nurses must be reviewed and tested periodically to avoid noncompliance and drift from evidence-based protocols over time. After further investigation we found gaps in nurses' learning and practice opportunities with central venous catheter (CVC) dressing changes in a Nebraska critical access hospital's outpatient/inpatient unit. There was no formal training or reviews available for nurses outside of their general orientation. They also did not use central lines frequently enough to stay up to date on their training.

Clinical Research Questions

The clinical research questions for this pilot feasibility study will help to determine if a change in clinical education could impact the nursing staff and their central line care. Would nurses in a Nebraska critical access hospital in Auburn, Nebraska who engage in a SBML intervention on central venous access dressing changes and cares improve their knowledge, skills, comfort level, and learning self-efficacy with such cares after the intervention? Would they increase their satisfaction and positive attitude learning via the SBML format?

Purpose Statement and Aims

The purpose of this pilot feasibility study was to determine if a simulation-based mastery learning (SBML) intervention on central line care including CVC dressing changes by staff nurses in a Midwestern, critical access hospital increases nurses' knowledge and skill level with the procedure, improves learning self-efficacy and comfort in the clinical area and increases satisfaction and positive attitudes with the learning intervention. The aims of this study were to:

(a) Develop and test a SBML intervention to improve staff nurses central line care skills and increase their knowledge of a central line dressing change and the organization's CVC care protocol.

(b) Assess the impact of the SBML intervention on nurses' comfort level and learning self-efficacy in the clinical area with central line care.

(c) Determine if there is a relationship between knowledge, learning self-efficacy, and comfort in the clinical area.

d) Describe the nurses' satisfaction level and suggestions to improve the intervention. Describe nurses' attitudes to support a future, similar, hospital-wide intervention to decrease CLABSI rates.

Review of the Literature

The literature review included studies that used SBML with health care providers in different scenarios with central lines (Barsuk et al., 2015; Bell & O'Grady, 2017; Dahlen et al., 2019; Dante et al., 2021; Hebbar et al., 2015; McGaghie et al., 2015; Scholtz et al., 2013). Dressing changes alone were evaluated in three studies (Dahlen et al., 2019; Hebbar et al, 2015; Scholtz et al, 2013). Medication administration, injection cap (needleless connector) changes, tubing changes, blood drawing, and dressing changes were tested (Barsuk et al.,2015).

McGaghie et al. (2015) used SBML for medical residents performing CVC insertions. They reported the goal of SBML is for the participant to fully "master" the skill and perform the task without faults in a simulated environment on mannequins (McGaghie et al., 2015). In each study listed above, the use of SBML was beneficial in the development and mastery of skills. SBML was found to be helpful in studies with

medical professionals in acquiring a variety of procedural skills and clinical judgment goals (Barsuk et al., 2015; Bell & O'Grady, 2017; Dahlen et al., 2019; Dante et al., 2021; Hebbar et al., 2015; McGaghie et al., 2015; Scholtz et al., 2013).

The studies regarding the outcomes of SBML with CVC dressing changes have been reported with each of the studies following a similar course (Barsuk et al., 2015, Dahlen et al., 2019, Dante et al., 2021, Hebbar et al., 2015, McGaghie et al., 2015, Scholtz et al., 2013). Typically, participants complete a pretest before the simulation to assess their current comfort with the skill. They perform the simulation in the presence of trained individuals who use prefabricated checklists or point systems to grade their proficiency with the skill set. Next, the participants debrief, and mistakes are identified and clarified. Lastly, participants take a post-test to evaluate if new levels of self-efficacy and comfort with the skill have been achieved. Each study has variance in the tests and scoring system, but they each have the same overarching goals, that the individuals achieve mastery learning by the end of the session.

The simulations in each of the studies allowed participants to perform dressing changes on mannequins in a controlled environment (Barsuk et al., 2015, Dahlen et al., 2019, Dante et al., 2021, Hebbar et al., 2015, McGaghie et al., 2015, Scholtz et al., 2013). Simulation hardware varied from study to study. CentralLineMan® was used to aid in CVC intra-jugular and subclavian dressing changes along with PeterPicc®, which helped aid in cubital peripherally inserted central catheters (Barsuk et al., 2015). The researchers in the study by Scholz et al. (2013) utilized central venous catheter skill trainer mannequins Chester Chest ® and IV arm® by Laerdal Medical Incorporated. Regardless of which type of hardware was used, improvement in competency and

increased comfort level were reported, but not always on the first attempt (Barsuk et al., 2015, Dahlen et al., 2019, Dante et al., 2021, Hebbar et al., 2015, McGaghie et al., 2015, Scholtz et al., 2013).

Cardiovascular intensive care unit nurses were administered a pretest, allowing them to disclose perceived barriers to a successful dressing change. The barriers included maintaining sterility and remembering to place a mask on the patient. None of the participants were successful in achieving mastery on their first try. Mastery was achieved by 55% of the participants in the second attempt and 89% in the third attempt (Dahlen et al., 2019). The participants were not given prior educational materials to prepare them for the simulation but were expected to perform based on their prior experience. Following the simulation, the participants were debriefed on mistakes made during the simulation and were allowed additional opportunities to perform the simulation again until the skill was mastered.

Four studies (Barsuk et al., 2015; Mcgaghie et al., 2015; Hebbar et al., 2015; Dante et al., 2021) reported researchers using an SBML with participants, but offered pre-recorded videos and lectures for the participants to review and dedicated practice time before performing the simulation as opposed to undergoing the simulation with their current skill set. The results of these studies revealed a higher satisfaction rate than others who were not participating and resulted in increased skill retention over time.

As with all skills, "skill decay" may occur over time. In one study, participants were split into intervention and control groups (Hebbar et al., 2015). The control group performed the simulation with trained observers silently assessing and no feedback or

remediation, while the intervention group performed the simulation with concurrent instruction and immediate remediation. Both groups repeated the simulation at various times to assess for "skill decay." The groups were evaluated at three months, six months, and twelve months. The results from this study revealed a significant level of "skill decay" at the three-month checkpoint and later checkpoints in the control group but not the intervention group. It also revealed a significantly higher compliance score at 12 months within the intervention group compared to the control group.

Researchers encouraged nurses to participate in a simulation-based "dress rehearsal" program two to four times a week over a 6-month period and were given immediate feedback on their performance (Scholtz et al., 2013). However, they were only required to complete additional cognitive remediation as opposed to additional hands-on practice. CLABSI rates decreased after this study was concluded, and those who took part in the dress rehearsals reported increased self-confidence and psychomotor skills.

Lastly, a study evaluated the impact of the SBML curriculum on central line maintenance and care among nurses (Barsuk et al., 2015). This study aimed to demonstrate the need for more effective means of preventing and mitigating errors due to human factors during central line insertion and maintenance. In the simulation testing portion, skills were measured based on a checklist of best practice guidelines and infection prevention guidelines. Three aspects of the checklist, if done incorrectly or deleted, resulted in an automatic failure. Automatic failures included failure to perform hand hygiene, failure to scrub the injection hub for 15 seconds and allowing it to dry for 15 seconds, and any violation of sterile field. The results of the study revealed that most

nurses could not consistently perform CVC maintenance. An inverse relationship between years of nursing and overall CVC maintenance performance showed that nurses with more experience had lower performance ratings. The lower performance ratings may indicate that experienced nurses are not updating their skills, and their technique drifts from standard practice over time. Conclusions from this study highlight the possibility that there may be multiple factors attributing to increased CLABSI rates.

Theoretical Framework

For this study, a combination of two theoretical frameworks was used, the constructivist theory framework and the behavioral learning theory framework (Elliott et al., 2000, Pritchard & Woollard, 2012).

Constructivism is “an approach to learning that holds people actively construct or make their own knowledge and that reality is determined by the experiences of the learner” (Elliott et al., 2000, p. 256). The constructivist learning theory framework focuses on the perceptions, interpretations, mental processes, conceptual constructs, understandings, and practical knowledge of learners that influence their decision-making and action (McGaghie et al., 2015). Constructivist learning goals include not only knowledge, skill acquisition, and data interpretation but also self-direction, mindfulness, and reflective practice (Prichard & Woollard, 2012). These learning goals were exemplified in the SBML in our study. The nurse first reviewed the task to be performed before physically performing it, providing the chance for the learner to develop a mental representation of what needed to be done to be successful. The review period allowed for consideration of more than one right way to proceed with the skill if all the safety rules are maintained.

The behavioral learning theory is focused on behavior change and improvement, with behavior change being indicative of knowledge, learning, and competence acquisition (Pritchard & Woollard, 2012). Learning in simulated social environments contributes strongly to learner knowledge, competence, and personal and professional development (McGaghie et al., 2013). Additionally, a significant component of self-efficacy is included in the behavioral learning theory. Learning Self-Efficacy as defined by Kang et al., (2019) is the confidence one has in his/her skills to perform a task. According to McGagie et al. (2013) people are proactive, self-regulating, and self-reflecting in learning situations and will perform tasks at a higher level of competency the more comfortable they are with the task. Using SBML provides nurses with opportunities to become more competent and comfortable in the CVC dressing change task. They improve when allowed to practice their skills in a safe environment.

Simulation appeared to be a superior method to learn and evaluate nurses in a broad range of clinical skills (Barsuk et al., 2015) in comparison to the more current teaching/learning strategy, "See one, do one, teach one," that was often implemented at the bedside. Nurses cannot fully master a skill if time for remediation and teaching points is not allowed. The simulation was also done in real-life situations instead of a controlled simulated environment that limited constructive dialogue between the learner and the teacher and did not leave much room for mistakes. Key findings noted throughout all the studies mentioned above demonstrate that SBML has helped increase healthcare providers' self-efficacy and psychomotor skills in certain situations, such as central line dressing changes. By implementing SBML at Nemaha County

Hospital, bedside nursing self-efficacy and comfort with this skill increased. With an expansion of the project, CLABSI rates may also improve in the future.

Methodology

Study Design

The study design for this Doctor of Nursing Practice (DNP) project was a pretest-posttest, educational pilot intervention. The staff nurses utilized live, SBML to demonstrate a CVC dressing change for internal jugular venous catheters using best-practice protocols at the critical access hospital. This testing intervention covers material all participants previously learned during orientation to the facility. All participants were queried pre-intervention and post-intervention on outcome variables (knowledge, skill level, learning self-efficacy, comfort level with the skill, satisfaction with the educational intervention, and positive attitude with a potential future, hospital-wide intervention). Demographic data were collected for descriptive purposes.

Participants

Study participants were selected from registered nurses currently working full-time or part-time on outpatient/inpatient units at Nemaha County Hospital. The sample-of-convenience expected size was fifteen participants, the number needed to find differences with pair-wise comparisons (see Statistical Analysis section). Fourteen nurses participated in the study. The nurses not available or not consenting to this study had ongoing access to the standard practice policy and CVC dressing change procedure.

Setting

The SBML intervention took place on-site at Nemaha County Hospital in a private conference room during their annual skills fair. The space was large enough for the participants and DNP students, with a table available for the dressing change supplies and the Chester Chest Model®.

Proposed Intervention

Potential participants were asked to participate. After verbal consent was obtained, data collection, and the intervention were completed. The intervention/testing was conducted with the subject and two researchers. During the simulation, participants performed a CVC dressing change under the observation of the researchers. Their performances were evaluated against the 19- Point Checklist with any errors noted for a post-assessment briefing. During this briefing, the researchers discussed what the participant did correctly and gave feedback on what checklist items were done incorrectly. The participants had the opportunity to perform the CVC dressing change again under the researcher's observation. Each participant's SBML intervention took approximately 15 minutes, with the completion of data collection instruments utilizing another 5 to 10 minutes.

Research Tools

The tools used in this study were administered to determine the efficacy of the SBML intervention to prepare staff nurses to complete CVC dressing changes focused on evidence-based criteria. The five tools used were the (a) Demographic Data Tool, (b) Pre/Post Assessment Tool, (c) Central Line Dressing Change 19-Point Skills Checklist, (d) Learning Self-Efficacy Scale (L-SES) For Clinical Skills, and (e) Satisfaction and Attitude Assessment for CVC Dressing Change Intervention**.** Minor revisions were made

in some of the instruments to improve clarity. All tools were tested for face validity by four practicing nurses before the intervention began.

Demographic Data Tool. The Demographic Data Tool enabled researchers to gather valuable information about study participants. The demographics of interest were gender identification, age, length of career as a nurse, current full-time equivalent (FTE) status, the highest level of education, licensure obtained, areas of practice, preceptor experience, and the number of nurses trained as a preceptor (see Appendix A). The Demographic Data Tool had eight items and took approximately two minutes for the participants to complete.

Pre/Post Assessment Tool. Using the Pre/Post Assessment Tool (see Appendix B), the nurse subjects' knowledge of central line care was assessed twice (pre and post intervention). On the tool there was a **Knowledge of CVC cares and Dressing Changes** test consisting of ten questions that were graded as correct or incorrect. Total scores could range from 0 to 10. Nurse participants were given a **Comfort Assessment** to assess their comfortability with CVC dressing changes on a Likert scale of zero to one hundred with "0" on the scale representing "not comfortable," "50" representing "moderately comfortable," and "100" will represent "highly comfortable." The tasks evaluated the nurses' level of comfort in (a) making a decision to change a CVC dressing outside of 7-day guidelines, (b) performing a sterile dressing change (c) explaining to patients why a dressing must remain sterile, (d) knowing what to do if a sterile field becomes dirty, and (e) stopping the dressing change when there is a breach in protocol. Total scores ranged from 0 to 500. The tool was administered before and immediately after the SBML training. This tool took five to ten minutes to complete.

Central Line Dressing Change 19-Point Skills Checklist. During the SBML intervention, the researchers used this checklist to evaluate the nurse participants' performance with the CVC dressing change. The Central Line Dressing Change 19-Point Skills Checklist (see Appendix C) consisted of the evidence-based steps needed to complete the skill successfully, according to best practice standards and CDC guidelines. The 19 points encompassed essential steps in the procedure that the subjects were required to complete to pass the evaluation. Potential total scores ranged from 0 to 19. The missed checklist items were discussed with the subject. Due to time constraints, subjects were unable to complete the process again to meet all 19 points of the checklist.

The Learning Self-Efficacy Scale (L-SES) for Clinical Skills. The L-SES original items were developed using Bloom's taxonomy and expert consensus (Kang et al., 2019). The scale was tested on 235 medical students attending an introductory clinical skills course. The content validity index was between 0.88 and 1.00, indicating high content validity. Cronbach's alpha coefficients varied between 0.922 and 0.928 for each question, 0.931 for the full scale indicated strong reliability (Kang et al.). The L-SES has three subscales, but only two subscales are relevant to this study, the cognitive and psychomotor subscales (see Appendix D). The cognitive subscale had four items related to logic and knowledge of the skill. An example of a cognitive item is "I can verbally explain the sequence and interrelationship between each step." The psychomotor subscale had four items related to the performance of the skill. Examples of psychomotor items are "I can precisely imitate steps and actions of a central access dressing change" and "I try to monitor my central access dressing

change operations and make proper adjustment as needed." The L-SES had eight items and took approximately two minutes to complete. Total scores could range from 8 to 50.

Satisfaction and Attitude Assessment for CVC Dressing Change Intervention. The Satisfaction with the CVC Dressing Change Intervention included three process evaluation items assessing the participant's satisfaction with the SBML method of learning and asking for suggestions for intervention improvement (see Appendix E). A question determining participants' positive attitude with SBML was included here. The questions took approximately two minutes to complete.

Data Collection

The following sections on recruitment, inclusion and exclusion criteria, steps for confidentiality and consent were required for the data collection process.

Recruitment Process. Nemaha County Hospital hosted an annual skills fair where researchers conducted the study with nursing staff. All staff nurses who met eligibility requirements were recruited to participate in this UNMC Doctor of Nursing Practice study. Nurses were informed of the study by NCH administration. Researchers approached staff nurses during their skills fair and determined if they met the inclusion/exclusion criteria for the study.

Inclusion and Exclusion Criteria. Inclusion Criteria for the study were nurses who were, at the time of the study, (a) working as a staff nurse on the inpatient units at Nemaha County Hospital in Auburn, Nebraska, (b) working full-time, part-time, or prn, (c) on the unit for at least four weeks before their enrollment, and (d) have been previously trained to do central line dressing changes during their orientation to the

health care facility. Exclusion criteria were (a) nurses not able to perform central line maintenance (undergraduate student nurses), and (b) temporary or traveling staff nurses.

Subjects Confidentiality and Consent. Subject participation was voluntary and confidential. Informed consent followed IRB guidelines, and participants were identified via an arbitrary research ID number. Data was only reported in summary form. This research project was identified as a minimal risk for the participants, with only time and effort required. Benefits for participants were improved knowledge and self-efficacy with the central line dressing change procedure.

IRB Approval

The study proposal was submitted to the University of Nebraska Medical Center's (UNMC) Internal Review Board (IRB). The Office of Regulatory Affairs (ORA) resolved the proposed study was an educational and quality improvement endeavor. The study proposal did not meet the definition of research and did not require IRB review or oversight. The application was withdrawn, and the study was continued.

Statistical Analysis

Power Analysis

The sample for this pilot study was based on a statistical power analysis performed for sample size estimation. Using a Cohen's *d* of 0.50, a medium effect, was used in the a priori power calculation of within-person changes only, the mean difference between two dependent means (pre-post design). With an alpha = .05 and power = 0.95, the analysis was completed with G*Power 3.1 (Faul, Erdfelder, Lang, & Buchner, 2007); the projected sample size needed with this effect size is N =54. As a

pilot study a sample size of 15 (46%) was chosen to be attainable and be within the range of sizes suggested by Hertzog (2008) to obtain estimates precise enough for these pilot study aims.

Statistical Analysis

Each statistical test was conducted at the p=.05 level. All data was cleaned and checked for errors. All variables were examined for meeting the assumptions of the statistical tests used. Descriptive statistics were reported as counts, percentage and means with standard deviations. Boxplots were used to visualize the data. Instruments were scored per the instrument manual. For aims a and b a paired *t*-test was used to assess the change in knowledge of the central line dressing change and the impact of the intervention on the nurses' self-efficacy. Aim c was assessed with a Pearson correlation and aim d was explored with descriptive statistics. Additional analyses between the demographic variables and the outcomes were assessed with Chi-square and correlational methods, as appropriate.

Findings

The study included a sample size of 14 nurses, with 11 being registered nurses (RNs) and three licensed practical nurses (LPNs). Demographic data was collected prior to the study and included gender, age, years of experience as a nurse, current FTE status, level of education, number of nurses precepted, areas worked, and shift worked. Thirteen of the participants were female, with only one male participating in the study. Nursing ages ranged from 27 to 64, a mean of 42.6 with a standard deviation of 13.3. Mean career length of participants was 18.2 years, with a standard deviation of 13. 9 years, the shortest career being one year and the longest at 44 years. All

participants were full time staff nurses. Three levels of nursing education were found from the demographic collection: five participants had their diploma, three nurses had their associates degree (ADN), and six nurses had their baccalaureate degree. Participants worked primarily in emergency, medical/surgical, and outpatient nursing. Nine of the thirteen nurses had preceptor experience, ranging from 3 to 20 preceptees. Six of the fourteen participants worked on the night shift, and the remainder were day shift nurses.

Pertinent findings from the study included a significant positive correlation between knowledge, skill level, and comfort for central line dressing changes after the simulation. A pre/post intervention assessment (Appendix B) was administered to evaluate the participants knowledge of the clinical skill. Using a paired *t*-test to evaluate the participant's pre-intervention and post-intervention scores, a significant *p* value of less than 0.0001 was found, revealing a significant increase in knowledge before and after the simulation. Skill level was assessed under observation during the simulation using the 19-point skills checklist (Appendix C) with an incorrect action accounting for one point. The study resulted in a mean of 0.87 and a standard deviation of 0.1. A pre and post comfort assessment was administered along with the pre/post intervention assessment (Appendix B) to evaluate the participants comfort of the clinical skill. Using a paired *t*-test to evaluate the participant's pre-intervention and post-intervention scores, a significant *p* value of 0.027 was found, revealing a significant increase in comfort. A significant positive correlation was found between comfort and self-efficacy with a Pearson correlation of 0.855 and *p* value of 0.0001.

There was, however, no significant change in self-efficacy after evaluation of pre and post scores from the learning self-efficacy scale (Appendix D). A paired t-test was also used to evaluate these results and revealed a *p* value of 0.179. A significant change in comfort was found between the day shift and the night shift with the night shift resulting in a larger increase in comfort after the intervention compared to the day shift. Using a paired *t*-test, a *p* value of 0.007 was found. There were no differences in knowledge score, levels of comfort, and levels of self-efficacy found between RNs and LPNs.

Nurses reported a high satisfaction and support rate with the SBML intervention overall. Using the attitude assessment (Appendix E) at the end of the intervention, participants rated the simulation using a Likert scale of zero to 100. The resulting mean and standard deviation were 96.8 and 7.2, respectively. Results from participants completing a satisfaction and attitude assessment (Appendix E) revealed a mean of 4.8 and standard deviation of 0.4.

Discussion

Limitations of this pilot feasibility study included a small sample size and infrequent use of central lines at the facility. While all the RNs and LPNs employed at this facility were able to perform the simulation, a larger sample size would have been more beneficial to yield more significant results. The larger sample size could be achieved by implementation of SBML at a larger institution that employs a larger number of nurses. Implementation at a larger institution that utilizes more central lines would benefit the study in several other ways as it would allow for nurses to practice the skills in real-life situations after mastering it with the SBML intervention. With more use of central lines,

the overall CLABSI rate can be tracked within the institution to gather information about the need for further education on central line care and retention of skills.

Conclusions

With an overall increase in knowledge of central line cares and comfort with central line dressing change skills and positive perspectives, SBML is a beneficial method of teaching for nurses at Nemaha County Hospital. Moving away from traditional teaching that does not allow room for error and implementing SBML for other clinical skills besides central line dressing changes will benefit both the facility and patients by decreasing the risk for costly infections and longer hospital stays.

Significance and Implications

Recurrent CLABSI infections remain a problem throughout the world in clinical settings. While Aloush et al (2018) found a 46% reduction in CLABSI rates between the years 2008 and 2013 in the United States, there still were a considerable number of new cases reported and associated deaths. By reducing the number of cases, we will not only reduce morbidity and mortality of those who fall victim to a bloodstream infection but will also greatly reduce the cost that healthcare facilities encounter when treating CLABSIs. Each CLABSI case increases the cost of a hospital admission by $33,000 dollars and extends the length of stay by three weeks (Aloush et al., 2018). The Center for Disease Control and Prevention put guidelines into place to prevent CLABSI for those working with central lines, although it is unclear to what extent these guidelines are implemented, taught, and complied with (Aloush et al., 2018).

The initial teaching on CVC dressing changes at Nemaha County Hospital is currently occurring only during real life situations and only during new employee

orientation. The lack of opportunities due to low volume of central lines and lack of updated skills may cause CLABSIs to occur at the institution. The staff nurses may have inadequate skill verification and procedural drift from the evidence-based protocol over time. The SBML intervention with this study may be needed to improve nursing care and prepare the hospital for a similar hospital- wide intervention to decrease the potential for CLABSIs.

Recommendations

This pilot feasibility study has provided a baseline for the application of SBML in a small sample size. Future research would be the implementation of the study at a larger organization to yield a larger sample size. In addition to a larger sample size, future researchers should attempt to use dressing kits for the simulation that model kits that staff nurses utilize in their organization to promote the best success for the study data.

For Nemaha County Hospital, the researchers found that LPNs and RNs had no difference in knowledge or practice scores. It is within the LPN's scope of practice in Nebraska to change a CVC dressing. The hospital may benefit in amending their policy to allow both LPNs and RNs to practice this skill.

References

Aloush S., Al-Sayaghi K., Tubaishat A., Dolansky M., Abdelkader F., Suliman M., Bashtawy M., Alzaidi A., Twalbeh L., Sumaqa Y., & Halabi M. (2018). Compliance of Middle Eastern hospitals with central line associated bloodstream infection guidelines. *Applied Nursing Research 43,* 56-60*.* https://doi.org/10.1016/j.apnr.2018.06.018

Bell, T., & O'Grady, N. (2017). Prevention of central line-associated bloodstream infections. *Infectious Disease Clinics of North America*, *31(3), 551-559.* http://dx.doi.org/10.1016/j.idc.2017.05.007

Barsuk J., Cohen, E., Mikolajczak A., Seburn S., Slade M., & Wayne D.B. (2015). Simulation-based mastery learning improves central line maintenance skills of ICU nurses. *Journal of Nursing Administration, 45*(10), 511-7. http://doi.org/10.1097/NNA.0000000000000243

Center for Disease Control and Prevention (CDC). (2011). Checklist for prevention of central line associated blood stream infections. Retrieved from https://www.cdc.gov/hai/pdfs/bsi/checklist-for-CLABSI.pdf

Dahlen, B., Finch, M., & Lambton, J. (2019). Simulation-based mastery learning for central venous line dressing changes. *Clinical Simulation in Nursing, 27*, 35-38. https://doi.org/10.1016/j.ecns.2018.10.010

Dante, A., Bruni, E., La Cerra, C., Caponnetto, V., Masotta, V., Vittorio, M., Petrucci, C.Alfes, C., & Lancia, L. (2021) Graduate student outcomes following critical care simulation. *Nursing Education Perspectives*, Published ahead of print – no

volume, issue, or page number available. http://doi.org/10.1097/01.NEP.0000000000000804

Faul, F., Erdfelder, E., Lang, A., & Buchner, A. (2007). GPower3: A flexible statistical power analysis program for the social, behavioral and biomedical sciences. *Behavior Research Methods, 39*(2), 175-191. http://doi.org/10.3758/BF03193146

Hebbar, K. B., Cunningham, C., McCracken, C., Kamat, P., & Fortenberry, J. D. (2015). Simulation-based paediatric intensive care unit central venous line maintenance bundle training. *Intensive and Critical Care Nursing, 31*(1), 44-50. https://doi.org/10.1016/j.iccn.2014.10.003

Hertzog, M. (2008). Considerations in determining sample size for pilot studies. *Research in Nursing & Health*, *31*, 180-191. http://doi.org/10.1002/nur.20247

Kang, Y. N., Chang, C. H., Kao, C. C., Chen, C. Y., & Wu, C. C. (2019). Development of a short and universal learning self-efficacy scale for clinical skills. *PLOS One*,*14*(1), e0209155. https://doi.org/10.1371/journal.pone.0209155

McGaghie, W. C., Barsuk, J. H., Cohen, E. R., Kristopaitis, T., & Wayne, D. B. (2015). Dissemination of an innovative mastery learning curriculum grounded in implementation science principles: A case study. *Academic Medicine, 90*(11), 1487-1493. http://doi.org/10.1097/ACM.0000000000000907

Olusegun, S. (2015). Constructivism learning theory: A paradigm for teaching and learning. *IOSR Journal of Research & Method in Education,* 5(6), 66-70. http://doi.org/10.4172/2151-6200.1000200

Pritchard, A., & Woollard, J. (2012). *Psychology for the classroom: Constructivism and social learning.* Routledge.

Saman, D. Kavanagh, K. Abusalem, S. (2013). Redefining the standardized infection ratio to aid in consumer value purchasing. *Journal of Patient Safety, 9*(2), 55-58. http://doi.org/10.1097/PTS.0b013e3182809f31

Scholtz, A. K., Monachino, A. M., Nishisaki, A., Nadkarni, V. M., & Lengetti, E. (2013). Central venous catheter dress rehearsals: Translating simulation training to patient care and outcomes. *Simulation in Healthcare: Journal of the Society for Simulation in Healthcare, 8*(5), 341–349. http://doi.org/10.1097/SIH.0b013e3182974462

Scott, R.D., Sinkowitz-Cochran, R., Wise, M.E., Baggs, J., Goates, S., Solomon, S.L., McDonald, C., & Jernigan, J.A. (2014). CDC central-line bloodstream infection prevention efforts produced net benefit of at least $640 million during 1090-2008. *Health Affairs, 33*(6), 1040-1047. http://doi.org/10.1377/hlthaff.2013.0865

Appendix A

Demographic Data Form

Research ID #:_____ *Date and Time: _____*

Area of Nemaha County Hospital:_____ *Researcher's Initials: _____*

Please check/mark the applicable boxes or fill in the blank with correct information.

1) Do you identify as male or female?

- Male (1)
- Female (2)
- Prefer not to answer (3)

2) What is your age in years? _____years

3) How long have you been a nurse in years? _____years

4) What is your current FTE status?

- Full-time (1)
- Part-time (2)
- PRN (3)

5) What is your highest level of education?

- Diploma (1)
- ADN (2)
- Baccalaureate (3)
- Masters (4)
- Doctorate (5)

6) What areas have you worked in since graduation from nursing school? (check all that apply)

- Emergency (1)
- ICU (2)
- PCU (3)
- Med/Surg (4)
- Surgical Services (5)
- Outpatient (6)
- OB (7)
- PEDS (8)
- PSYCH (9)

- School nursing (10)
- Community (11)
- Other areas of nursing (fill in the blank)_____ (12)
- Other areas outside of nursing (fill in the blank)_____ (13)

7) Have you ever precepted a new employee or student nurse?

- Yes (1)
- No (2)

8) If yes, how many nurses, or student nurses have you helped precept? _____ (1)

9) Currently, what shift do you typically work?

- Day shift 7a-7p (1)
- Night shift 7p-7a(2)
- A mix of day and night shifts (3)
- None of the above (please explain) _____(4)

Appendix B

Pre/Post Intervention Assessment

Research ID #: _____ Pre-Intervention _____

Date and Time: _____ Post Intervention _____

Researcher's Initials: _____

<u>Knowledge Test of CVC Cares & Dressing Changes</u>: *Please mark the one BEST answer.*

1) When do central line dressings need to be *immediately* replaced?

- A) When wet
- B) When soiled
- C) When dislodged
- D) When you can no longer see the insertion site
- E) A & B & C responses
- F) All of the above

2) How often is the need for continuation of central lines assessed?

- A) Once a shift
- B) Daily
- C) Weekly
- D) Never

3) How often do dressings need to be changed if dressing is intact and not damaged?

A) (fill in the blank)_____

4) If an incorrect dressing, such as a non-CHG gel dressing, is applied during insertion when does the dressing need to be changed?

- A) Immediately
- B) Within 1 hour
- C) Within 12 hours
- D) Within 24 hours

5) If a gauze dressing is present under a transparent CHG dressing, how often does the dressing need to be changed?

- A) Every 48 hours
- B) When loose, wet, or soiled
- C) Every 24 hours
- D) A & B responses
- E) B & C responses
- F) A & C responses

6) Stretching the transparent dressing should not occur as it will cause mechanical skin trauma.

- A) True
- B) False

7) How long does the insertion site need to be cleansed during a dressing change?

- A) 10 seconds
- B) 30 seconds
- C) 1 minutes
- D) Until site is visibly clean

8) A mask has to be placed over the patient's nose and mouth prior to performing a dressing change.

- A) True
- B) False

9) How long does the insertion site have to airdry after being cleansed with >0.5% chlorohexidine solution with alcohol and before the new dressing is applied?

- A) 10 seconds
- B) 30 seconds
- C) 1 minute
- D) 2 minutes

10) How long does the insertion site have to airdry after being cleansed with povidone iodine before the new dressing is applied?

- A) 10 seconds
- B) 30 seconds
- C) 1 minute
- D) 2 minutes

<u>Comfort Assessment</u>: ***Please rate your current comfort level in performing these tasks in the clinical area by placing any number from 0 to 100 by each of the four statements below.***

0 10 20 30 40 50 60 70 80 90 100

Not comfortable Moderately Comfortable Highly comfortable

_____ I feel comfortable making the correct decision to change a dressing, in addition to the *"every seven days"* guidelines. (1)

_____ I feel comfortable performing a sterile dressing change. (2)

_____ I feel comfortable explaining why sterile technique is used by nurses with dressing changes. (3)

_____ I feel comfortable that I know what to do if the sterile field becomes dirty. (4)

_____ I feel comfortable stopping the dressing change when there is a breach in protocol. (5)

Appendix C

Central Line Dressing Change 19-Point Skills Checklist

Research ID #:_____ Score/Time 1)___/___2) ___/___3) ___/___4)___/___

Date: _____

Researcher's Initials: _____

Time began: _____

Time concluded: _____

==========

- Place mask on patient to cover nose and mouth. (1)
- Perform hand hygiene. (2)
- Apply mask and non-sterile gloves. (3)
- Remove old dressing. (4)
- Remove gloves and clean hands. (5)
- Open central line kit, maintaining sterile field. (6)
- Apply sterile gloves. (7)
- If area is visibly soiled clean with alcohol swab. (8)
- Prepare insertion site with >0.5% chlorhexidine with alcohol, back and forth for 30 seconds (airdry 30 seconds) / Povidone iodine use circular motion inside to out (airdry 2 minutes). (9)
- Apply no-sting barrier film, avoiding area immediately surrounding insertion site (10)
- Place securement device, arrows pointing to insertion site. (11)
- Use chlorhexidine impregnated dressing. (12)
- Place transparent dressing with CHG gel pad covering insertion site, smoothing the dressing from center out. (13)
- Remove sterile securement tape strip from paper liner. (14)
- Lift catheter lumens and apply notched end of the securement tape strip under the catheter lumens and over the dressing edge. Push tape strip notch forward, aligning against the catheter lumens. (15)
- Remove frame of securement tape strip. (16)
- Remove gloves and clean hands. (17)
- Document date of dressing change on the dressing. (18)
- Document site assessment, dressing change date/time, and date of next dressing change in EHR. (19)

(Adapted from CDC (2011)).

Appendix D

The Learning Self-Efficacy Scale (L-SES) For Clinical Skills

Research ID #: _____ Date: _____

PRE_____ POST____ Researcher Initials: _____

Please circle the correct number that corresponds to the degree of your agreement with each statement at this point in time.

	Disagree ←-------→ Agree				
1) I can recall how to perform a central access dressing change.	1	2	3	4	5
2) I understand the content of a central access dressing change and can demonstrate it to others.	1	2	3	4	5
3) I can verbally explain the purpose and principle of operating a central access dressing change.	1	2	3	4	5
4) I can verbally explain the sequence and interrelationship between each step.	1	2	3	4	5
5) I can precisely imitate steps and actions of a central access dressing change.	1	2	3	4	5
6) I can smoothly complete the operation steps of a central access dressing change.	1	2	3	4	5
7) I try to monitor my central access dressing change for improvements.	1	2	3	4	5
8) I try to monitor my central access dressing change operations and make proper adjustments as needed.	1	2	3	4	5

Total Score: _____ (9&10)

(Adapted from Kang et al. (2019), two Subscales of the Self-efficacy Scale for Clinical Skills)

Appendix E

Satisfaction and Attitude Assessment for CVC Dressing Change Intervention
(post intervention only)

Research ID #: _____ Date: _____

Researcher Initials: _____

Please circle the correct number that corresponds to the degree of your agreement with each statement at this point in time.

	Disagree <----------> Agree				
1) I am satisfied with the Simulation Based Mastery Learning training overall.	1	2	3	4	5
2) Simulation Based Mastery Learning increased my knowledge of performing a CVC dressing change.	1	2	3	4	5
3) I would recommend Simulation Based Mastery Learning for CVC dressing changes training to other nurses.	1	2	3	4	5

Please provide a short response to the following question:

How can Simulation Based Mastery Learning for CVC dressing changes be improved?_____
_____
_____
_____
_____

<u>Positive Attitude Assessment</u>: *After completing the Intervention, please rate your current feelings or attitude with learning by the simulated, mastery-based format for clinical skills by placing any number from 0 to 100 by the following statement below with* ***0 = No support for this statement and 100 = the highest support for this statement.***

_____ I would support a hospital wide intervention to decrease CLABSI rates by using Simulation Based Mastery Learning during education of central line dressing changes.

Comments: _____
_____