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Carmen McLamb

Gardner-Webb University, cmclamb@gardner-webb.edu

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Ultrasound-Guided Peripheral Intravenous Catheter Insertion Training

by

Carmen McLamb

A project submitted to the faculty of
Gardner-Webb University Hunt School of Nursing
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Submitted by:

Approved by:

Carmen McLamb
Carmen McLamb

Candice Rome
Candice Rome, DNP, RN, CNE

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Date

12/06/2023
Date

Abstract

Achieving peripheral venous access in patients is one of the first steps in most treatment protocols. Delays or even failures to obtain peripheral venous access can delay lifesaving treatments, prolong hospital stays, and affect patient outcomes. Peripheral venous access can be difficult due to chronic disease processes, scarring of valves from frequent cannulation, limitation due to dialysis fistulas, or due to acute conditions such as hypovolemia and hypotension. Studies have found the use of ultrasound-guided techniques can achieve peripheral venous access quickly and prevent the need for more aggressive procedures (Skulec et al., 2020). However, there is a gap between evidence-based practice and clinical practice when the technique is not utilized in clinical practice due to a lack of knowledge and training.

The DNP project intervention included the development, implementation, and assessment of a recorded training video. Pre- and post-intervention surveys were conducted to determine if the training video increased participant's knowledge and confidence in the technique. Forty-one of the 46 employees (89%) participated in the project. The pre-and post-intervention scores were compared and indicated the intervention was successful in increasing participants' knowledge and confidence in the technique. Of the participants, 2% were confident in their knowledge and confidence enough to adopt the technique in the pre-intervention survey. This increased to 51% in the post-intervention survey. This exceeded the goal of increasing the participant's knowledge and confidence in the technique by 25%.

Keywords: ultrasound-guided peripheral venous access, peripheral venous access, knowledge, confidence.

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Problem Recognition

Difficult Peripheral Venous Access

Achieving peripheral venous access in ill patients is one of the first steps in most treatment protocols. Delays or even failures to obtain peripheral venous access can delay lifesaving treatments, prolong hospital stays, and affect patient outcomes. Studies have found the use of ultrasound-guided techniques can achieve peripheral venous access quicker and prevent the need for more aggressive procedures such as central line placement (Skulec et al., 2020).

Difficult peripheral venous access is an issue faced by nurses in all hospital settings. In emergency departments and intensive care units, obtaining peripheral access in a timely manner is often required to prevent the patient's decline or demise. However, nurses working on the medical and surgical floors have also expressed concern regarding lost peripheral access during ongoing treatments.

Peripheral venous access can be difficult due to chronic disease processes, scarring of valves from frequent cannulation, limitation due to dialysis fistulas, or due to acute conditions such as hypovolemia and hypotension. In these cases, when peripheral venous access is not obtained, the patients miss scheduled treatments such as antibiotics, steroids, and antivirals. Some patients then require central venous access, increasing their risk of hospital-acquired infection.

Ultrasound-guided placement of central venous catheters is a standard of practice. Ultrasounds are used to increase accuracy, decrease potential risks, and decrease discomfort for the patient (Schoenfeld et al., 2011). The same technique has

been used to place peripheral intravenous catheters with the same success rate. In fact, evidence-based practice studies have shown the use of ultrasound to place peripheral intravenous catheters reduced the need for central venous line placement in almost 80% of patients (Gottlieb et al., 2017).

There appears to be a gap between evidence-based practice and clinical practice. The evidence-based practice supports the use of ultrasound-guided peripheral intravenous catheter insertion in patients with difficult or limited access, but the technique is not being utilized in present clinical practice due to a lack of knowledge and lack of training. This DNP project aimed to introduce the method of ultrasound-guided techniques to nursing staff. The project worked within the hospital's current policy on peripheral intravenous catheter insertion.

Needs Assessment

PICOT Question

In registered nurses, does ultrasound-guided peripheral intravenous access training increase knowledge, confidence, and therefore the use of ultrasound for insertion of difficult peripheral intravenous insertion access?

Sponsors And Stakeholders

The medical/neurological intensive care unit (ICU) manager, the charge nurses in the medical/neurological ICU, and hospitalized patients are all stakeholders in this DNP project. The unit manager will serve as the project sponsor, and nurses within the ICU will be implementing the project and therefore are key stakeholders in the project. The hospital's education liaison will also serve as a key stakeholder as the education liaison

will be a partner in providing hands-on training as well as verbal and written educational materials.

SWOT Analysis

The organization has many strengths including registered nurse (RN) staff members who are willing to be trained on ultrasound-guided peripheral intravenous (IV) insertion. Resources are also available as the ICU has one Philips® ultrasound machine and one Bard® site rite ultrasound available for staff to use for peripheral IV insertions.

The organization's greatest weakness lies in the lack of staff in both numbers and experience. Most of the ICU nurses are new graduates or contract/temporary staff nurses. Due to nursing shortages, the charge nurse no longer serves as a resource nurse but has a patient assignment and provides patient care to those patients as opposed to being readily available to assist other nurses. Frequently, the house supervisor will call on the ICU nurses to go to other units in the organization to obtain IV access in patients who do not have current IV access or need additional access. The ICU staff is not always able to provide this service to the other unit's patients leaving many patients to miss doses of medications that are vital to recovery.

Having nurses in the ICU, as well as experienced nurses on the medical unit, who are trained on how to use ultrasound equipment to obtain peripheral IV access, will provide opportunities for new skill development and improve customer satisfaction.

The organization does not have a policy in place for ultrasound-guided peripheral IV access by registered nurses (RNs), nor does the organization have a training program in place. The organization has a new Chief Nursing Officer (CNO) who is

not yet familiar with all the organization's challenges and needs. The CNO's approval was obtained prior to the implementation of this change in practice. The project leader discussed the project implementation components with the CNO to gain approval.

Desired and Expected Outcomes

The desired outcome was to increase the number of RNs trained in ultrasound-guided peripheral IV catheter insertion, increase the knowledge and skill level of RNs, and decrease the number of failed peripheral IV insertion attempts, and therefore decrease the patients' pain related to multiple IV insertion attempts. This also serves as the expected outcome of the project.

Team Selection

The project team was composed of the facility's ICU manager, the ICU charge nurses, and the house RN supervisor. The unit manager served as the project sponsor. The ICU charge nurses are the individuals who travel to all areas of the organization to insert IV catheters in patients who are difficult to access. The house supervisors are the primary contact persons for nurses who need resources such as a peripheral IV in a patient who has no IV access and has proven difficult to cannulate.

Cost/Benefit Analysis

The cost/benefit analysis looked at two areas. One included the cost of raw materials. This included IV catheter start kits, the IV catheters, and the cost of ultrasound gel used when utilizing the Phillip® ultrasound or the Barb® site rite. The second cost analysis was more indirect with lower Press Ganey and Hospital Consumer Assessment of Healthcare Providers and Systems (HCAHPS) scores based on satisfaction

surveys sent to patients after discharge (Centers for Medicare and Medicaid Services [CMS], 2021). Patients who could not get IV pain medications due to no IV access had rated pain control during hospital stays very low on the Press Ganey surveys. The same is true for patients who felt antibiotics were not administered in a timely manner due to a lack of IV access. Low Press Ganey and HCAPS scores indirectly impact the hospital's financial compensation (CMS, 2021).

Scope

The project addressed training nurses to utilize the technique of ultrasound-guided peripheral IV access as a means of obtaining peripheral IV access to reduce the number of missed medication administrations in acutely ill hospitalized patients. At this time, the project did not address the cost-benefit analysis of raw materials nor did it address patient satisfaction.

Goals and Mission Statement

Goals

The primary goal of the project was to implement and assess the effectiveness of an ultrasound-guided peripheral IV training course for RNs in the ICU during the fall of 2024. The training course followed the guidelines of the American Institute of Ultrasound in Medicine. The second goal was to achieve a 25% increase in participant knowledge and confidence during the first 14 days of implementing the training. This was measured by administering a pre-test prior to the training course and a post-test at the conclusion of the educational session.

Mission Statement

This project intended to provide RNs with a training program in ultrasound-guided peripheral intravenous catheter insertion to increase peripheral intravenous insertion success rates and decrease patient discomfort.

Theoretical Underpinnings

Everett Rogers' diffusion of innovation theory (Rogers, 1983) explained how an innovation is presented to a group or team and how that innovation is accepted and implemented. Rogers' theory was used to guide the development and implementation of this DNP project. In this project, the innovation was the skill of ultrasound-guided peripheral intravenous insertion.

Rogers' 5-step process begins with knowledge sharing. Rogers described this as the point where the team members are exposed to a new idea or practice and gain knowledge about it (Rogers, 1983). This was accomplished with written materials, videos, and hands-on training. The second step in Rogers' theory is persuasion. This is perhaps the most important step in that team members will decide if the innovation is advantageous and worth the time and effort to learn more. In this step, emphasis was placed on the importance of the new innovation in saving time and improving patient comfort. The innovation needed to be viewed as advantageous for both the nurse and the patient for successful implementation and for consistent practice change to occur.

The third step in Rogers' diffusion of innovation theory is decision-making. In this step, the individual decides if the innovation is obtainable and advantageous (Rogers, 1983). If the innovation is viewed as favorable, it is more likely to be implemented than

if the team member perceives there will be obstacles to implementation, or the innovation is not viewed as advantageous.

Rogers describes five classifications of team members as they apply to adopting an innovation (Rogers, 1983). The first classification is the innovators. These were the nurses who were comfortable with technology and liked the challenge of learning new skills. The second and third classifications suggested by Rogers were the early adopters and the early majority adopters. The early adopters in the project were the charge nurses. These nurses were the team members who received training first and then helped train the other members of the team. The early majority of adopters were the critical care or intensive care unit (ICU) nurses. Some of these nurses may not be as comfortable with technology or may not be as open to innovation. The last two classifications are the late majority and the laggards who may or may not be willing to implement the innovation. These were found to be nurses who were comfortable with the status quo, proficient at peripheral intravenous catheter insertions, and did not feel the innovation saved time or was advantageous in any way. These were mainly the more seasoned nurses.

The fourth step in Rogers' innovation diffusion theory is implementation (Rogers, 1983). The nurses who decided the innovation was potentially advantageous adopted the change and began shadowing other nurses who were proficient with ultrasound-guided peripheral IV insertion and were encouraged to try the technique themselves. Once these nurses became comfortable with the practice, the final step of confirmation occurred. Confirmation occurs when the nurse determines the innovation does save

time and discomfort for the patient, and the nurses add the practice to their skill set. Rogers' theory stresses the last two steps, implementation and confirmation may not occur if members do not make the decision to implement the innovation (Rogers, 1983).

Work Planning

Timeline

A timeline (Appendix A) and a work breakdown structure (Appendix B) were utilized based on the five phases of project management. The initiation phase was conducted in the spring and summer of 2022. During the spring, a topic was chosen, and literature reviews were conducted. In the summer of 2022, a rough draft of the manuscript was submitted to the project chair and later revised. The planning and defining phases were conducted between the fall of 2022 and the fall of 2023 and were largely spent developing the assessment tools to be used as well as the training videos. Once all training and assessment tools were developed, the Quality Improvement (QI) application was submitted as well as the application for approval at the clinical site. The launching and execution phase took place in the fall of 2023. Participants were recruited, pre-intervention surveys were conducted, and training videos were made available. Over a 2-week period, training was available, and staff were encouraged to participate. During the evaluation phase, post-intervention surveys were obtained, and the information was analyzed. The final step, closure, included synthesizing a draft and final manuscript with a presentation.

Budget

There was essentially no cost incurred during the project. The videos were created with technology free to the project leader and accessed for free by the participants. The needed equipment was already available, but underutilized, at the facility. No additional time was needed for implementation as nurses were now utilizing the ultrasound equipment during a procedure the nurses would have been performing regardless of project implementation due to the patient's need, condition, or healthcare provider orders.

Planning for Evaluation

The DNP project is essentially a performance improvement project (PIP) and therefore, the use of a Plan-Do-Study-Act (PDSA) tool (CMS, nd) for evaluation was appropriate. The aim of this project was to increase the RNs' knowledge, confidence, and skills through training in ultrasound-guided peripheral IV catheter insertion.

The plan for this study involved changing the current practice of peripheral intravenous insertion (PIV) on patients with difficult access. The DNP project was predicted to increase knowledge through education and training, therefore increasing the RN's confidence and likelihood of implementing the intervention into current clinical practice.

The "do" phase involved a small number of RNs in direct care. RNs were given a pre-intervention survey through SurveyMonkey® to assess their current use and knowledge of PIV and assess their interest in learning ultrasound-guided techniques. RNs then were given access to training videos developed by the Project Leader. A post-

intervention survey was conducted to assess the RN's levels of knowledge and confidence in using ultrasound-guided PIV insertion techniques in current practice.

The "study" phase included analyzing responses obtained through SurveyMonkey®. Based on responses, the Project Leader was able to identify if the intervention and training videos were successful in increasing the RN's levels of knowledge and confidence and if the RNs plan to use the skill in future clinical practice. A Likert scale was used to assess the effectiveness of the interventions (Likert, 1932). A summary of responses was compiled and analyzed to determine if the intervention resulted in expected outcomes.

Acting on the findings included reviewing the summary and determining if the interventions should be adapted, adopted, or abandoned (CMS, nd).

Implementation

Threats and Barriers

Predictable threats and barriers included staffing shortages. Staffing shortages increased nurse-to-patient ratios and the amount of time nurses spent conducting patient care and decreased the likelihood that nurses would take the time to complete the project. This was mitigated by reminding participants of the limited amount of time required to participate in the project. The information was also included on the flyer that invited nurses to participate in the project.

Technology failure was a potential barrier. To mitigate this potential barrier, SurveyMonkey® was monitored twice daily to ensure data was being collected and participants were able to complete the pre- and post-surveys. The training video was

available on YouTube®. Daily monitoring of the site ensured the video was available for participants to view.

Monitoring of Implementation

Project implementation occurred immediately after QI approval was obtained from both the Gardner-Webb University Hunt School of Nursing QI committee and the facility IRB committee. The project leader posted the informational flyer inviting nurses to participate in the project in highly visible areas of the shift report room. Additionally, the project leader was available in person before, during, and after shift reports, from 0630 until 0730 and 1830 until 1930, during the first 7 days of implementation to answer questions, troubleshoot technology, and ensure flyers with project information remained in highly visible areas.

To ensure data was being collected, the data collection site, SurveyMonkey®, was monitored twice daily during the 14-day implementation period. The training video was posted to YouTube® and monitored by the project leader twice daily to ensure the video was available to participants.

Project Closure

At the end of the 14-day implementation period, the flyers were removed from the shift report room and replaced with a flyer notifying participants the project had ended. Additionally, participants were thanked for their participation on the posted flyer. The training video was changed from unlisted to private on YouTube® and the pre- and post-surveys were closed on SurveyMonkey®.

The Unit Manager and the Clinical Education Coordinator for Critical Care were notified the implementation period was completed and all items pertaining to the project had been removed from the shift report area.

Results

Participants

Forty-six full part-time or regular part-time nurses employed in the Medical/Neuro Intensive Care Unit were recruited through the recruitment flyer posted in the shift report area. Forty-one out of the 46 nurses (89%) employed on the unit at the time of implementation participated.

Pre- and Post-Likert Questions

For the statement "I am familiar with the benefits of ultrasound-guided peripheral intravenous insertion," 32 participants (78%) answered "disagree" or "strongly disagree" prior to watching the training video and 41 participants (100%) answered "agree" or "strongly agree" after watching the training video. For the statement, "I am familiar with how to set up the ultrasound machine", 40 participants (98%) answered "disagree" or "strongly disagree" prior to watching the training video and 30 participants (78%) answered "agree" or "strongly agree" after watching the training video. Additionally, for the statement, "I am confident about my knowledge of selecting the appropriate ultrasound probe and probe use", 40 participants (98%) of participants answered "disagree" or "strongly disagree" prior to watching the training video and 35 participants (85%) answered "agree" or "strongly agree" after viewing the training video. Next, the participants answered the statement "I am confident enough

with my knowledge of venous anatomy and how veins appear on ultrasound to find veins appropriate for venous access”, 40 participants (98%) answered “disagree” or “strongly disagree” prior to watching the training video with 35 participants (85%) answering “agree” or “strongly agree” after completing the training video. The final two Likert statements included on the surveys were designed to determine if participants were confident enough to attempt ultrasound-guided peripheral intravenous insertion technique as part of their clinical practice and 40 participants (98%) answered “disagree” or “strongly disagree” prior to the training. Following the training video, 21 participants (51%) answered “agree” or “strongly agree” indicating they felt confident enough to attempt the technique.

Summary

The goal of this performance improvement project was to implement and assess the effectiveness of an ultrasound-guided peripheral intravenous access training course. The second goal was to achieve at least a 25% increase in participant knowledge and confidence with the technique.

A training video with step-by-step instructions on how to set up and utilize the ultrasound machine, how to identify appropriate veins for cannulation, and how to access veins using real-time visualization with the ultrasound was created and made available to participants.

Prior to viewing the training video, only one participant (2%) reported feeling confident enough in their knowledge to attempt using the ultrasound to achieve peripheral intravenous access. This reflected the need for a training program. The data

demonstrated only 2% of participants felt confident enough in their knowledge to use the ultrasound-guided peripheral intravenous insertion technique prior to the training and 51% of participants reported feeling confident enough in their knowledge after the training. This 49% increase surpassed the goal of at least a 25% increase in confidence and knowledge. The data indicated the training video intervention provided participants with knowledge regarding the benefits of ultrasound-guided peripheral intravenous catheter insertion, evidence-based resources, and increased the likelihood project participants will adopt the technique in daily clinical practice. Therefore, the intervention was determined to be successful.

While the performance improvement project demonstrated the training video increased knowledge and the confidence level of participants, hands-on training in a simulation environment may further increase the number of participants willing to adopt the technique.

Sustainability of a training program in this environment at this time would be hampered by the large number of contract or short-term employees working in the Medical/Neuro Intensive Care Unit. However, a training program would be considered in the future should the unit obtain and retain a larger number of core staff.

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Appendix A
Project Timeline

Goal	Spring 2022	Summer 2022	Spring 2023	Fall 2023
Research and literature review on topic	█			
Write draft of manuscript		█		
Review and revise manuscript with project chair		█		
Create assessment tools			█	
Create videos			█	
Create QRS codes that link to videos			█	
IRB application and site approval				█
Upload videos once IRB and site approval obtained				█
Recruit participants and obtain pre-intervention evaluation				█
Obtain post-intervention evaluations				█
Analyze results and seek feedback from participants				█
Write draft of analysis and conclusions and submit to project chair				█
Complete project presentation				█

Appendix B

Work Breakdown Structure

