Spring 2023

Improving Intravenous Catheter Insertion Success in Difficult Access Patients

Heidi Berry
Gardner-Webb University, hberry1@gardner-webb.edu

Improving Intravenous Catheter Insertion Success in Difficult Access Patients

by

Heidi C. Berry

A project submitted to the faculty of
Gardner-Webb University Hunt School of Nursing
in partial fulfillment of the requirements for the degree of
Doctor of Nursing Practice

Boiling Springs, NC

2023

Submitted by:	Approved by:
_____	_____
Heidi Berry	Tina Lewis, DNP, FNP-C
_____	_____
Date	Date

Acknowledgements

I am overwhelmed in all humbleness and gratefulness to acknowledge my gratitude to all those who have assisted me to put these concepts above the level of simplicity and into something concrete.

The completion of this project could not have been accomplished without the support and guidance of my project chair, Dr. Tina Lewis. I offer my sincere appreciation for the continuous support of my DNP Project, for her patience, motivation, passion, and immense knowledge.

I cannot express enough thanks to my colleagues for their support of the advancement of my education and professional career.

Finally, to my caring, loving, and supportive partner, Carlos: my deepest gratitude. Your encouragement when times were difficult is much appreciated and duly noted. It was a great comfort and luxury to be surrounded by your positivity while I completed my work. My wholehearted thanks.

Abstract

Around one in every nine Emergency Department (ED) patients have Difficult Intravenous Access (DIVA) and 25% of ED patients will require more than one attempt (Fields et al., 2014a). Failed insertion attempts contribute to decreased patient satisfaction, care delays, and financial losses. The freestanding ED affiliated with a multi-state, not-for-profit healthcare system in an urban community had difficulty with first-attempt Peripheral IV (PIV) insertion success in identified patients. The target population was the clinical staff of the freestanding ED which included Registered Nurses and Paramedics. The objective outcome was to enhance personal knowledge of PIV catheter insertion in difficult-access patients and retain at least 80% of DIVA Clinical Predictor Tool education by the end of the project implementation. The project goal was that a reduction in PIV insertion attempts will result in improved patient outcomes and satisfaction. The quality improvement project was implemented with a survey method and statistical analysis was used to gather quantitative data. Two identical surveys were administered prior to and after the target population was presented with DIVA Clinical Predictor Tool education. The project data showed a 97.7% retention of DIVA Clinical Predictor Tool education after implementation. It was proven that when skilled clinicians were presented with education on the DIVA Clinical Predictor Tool and appropriate alternative insertion techniques, personal knowledge of PIV insertion in DIVA patients was improved.

Keywords: difficult access, intravenous catheter, DIVA, IV insertion, PIV, hard stick

Table of Contents

Problem Recognition 8

Problem Statement 9

Literature Review 9

Selection of the Articles 10

DIVA Identification 10

Consequences of Delay in Access 12

Combating DIVA 13

Needs Assessment 14

Target Population 14

Sponsors and Stakeholders 15

Organization Assessment 16

Resources 17

Desired and Expected Outcomes 18

Team Selection 18

Cost/Benefit Analysis 19

Scope of Problem 20

Goals, Objectives, and Mission Statement 21

Goals 21

Objectives 21

Mission Statement 22

Theoretical Underpinnings 22

Application 23

Work Planning 24

Project Management Tool 24

Timeline 24

Budget 25

Evaluation Plan 26

Project Implementation 27

Threat and Barriers 27

Successes 28

Monitoring of the Implementation 28

Project Closure 32

Data Analysis 32

Quantitative Data 32

Qualitative Data 35

Process Improvement Data 36

Conclusion 37

References 39

Appendices

A: DIVA Clinical Predictor Tool 43

B: Conceptual-Theoretical-Empirical Diagram 44

C: Gantt Chart 45

D: Education Narrative 46

E: Work Breakdown Structure 47

F: Anticipated Budget 48

G: Evaluation Plan 49

H: DIVA Clinical Predictor Tool Case Studies 50

I: Alternative Insertion Techniques 51

J: Implementation Surveys.....52

K: Introduction Email 53

List of Figures

Figure 1: Survey Results 33

Problem Recognition

Nursing in the emergency department (ED) is largely impacted by the high demands of overcrowding, increased care delays, growing financial losses for hospitals, and diminished patient satisfaction (Rippey et al., 2016). Failure to successfully insert a peripheral intravenous (PIV) catheter is contributory to the aforementioned issues. Establishing intravenous access is one of the most common procedures in the ED and is a critical step when performing interventions for acute patients (Davis et al., 2021). Individuals may be considered to have difficult intravenous access (DIVA) if more than two attempts are required (Fields et al., 2014b). Around one in every nine patients have DIVA and 25% of ED patients will require more than one attempt (Fields et al., 2014a). Caring for patients with DIVA increases the probability of clinician insertion failure. Department staff are sometimes unable to appropriately utilize and employ PIV insertion expertise at the time of need. Patients with DIVA are not being correctly identified and opportunities for first-attempt success are missing.

Staff nurses at a freestanding ED affiliated with a multi-state, not-for-profit healthcare system in an urban community are equipped with the educational expertise and qualifying PIV insertion experience to perform placement interventions when required. A failure to consistently utilize these skills can be correlated to the number of unsuccessful insertions. As a result, patients have been subjected to multiple PIV insertion attempts which is contributory to inconsistencies in best practice. An anonymous staff survey was conducted to examine the magnitude of this problem for the unit. Of the 22 teammates surveyed, 82% stated they see a patient with DIVA 1-3 times per shift. The survey revealed 73% of the participants admit to individually trying 1-3 attempts on a patient

with DIVA while 55% say a patient with DIVA will get stuck 4-6 times total by all attempting staff members. Additionally, 59% of the survey participants reported encountering 1-3 patients per work week who fail to receive a PIV due to DIVA.

Consequences of failed insertion attempts have been grouped into three categories based on what or who is affected. First, the unit itself will suffer as it sees an increase in wait times, length of stays, blood draw result times, and resultant patient census (Bahl et al., 2016). Second, the hospital company experiences an increase in errors and financial losses (Ehrhardt et al., 2018). Third, the patient undergoes psychological and physical repercussions of failed IV attempts. The patient is at increased risk for infection, delay in care, stress, pain/discomfort, emotional injury, and a decrease in overall satisfaction (Shaukat et al., 2019).

Problem Statement

The freestanding ED had difficulty with first attempt PIV insertion success in identified patients. Current practice reveals a patient with DIVA may undergo a total of 4-6 attempts. The rationale for implementing a quality improvement project on this unit was aimed at increasing insertion expertise on difficult access patients.

Literature Review

A literature review was conducted and articles were organized into three categories. Categories included articles supporting the identification of DIVA patients, the consequences of a delay in PIV access, and interventions to combat DIVA. Keywords and phrases used during the literature search included ‘difficult IV access,’ ‘DIVA,’ ‘intravenous,’ ‘PIV,’ ‘delaying intravenous access,’ ‘difficult sticks,’ ‘ultrasound-guided insertion,’ ‘IV catheter,’ and ‘peripheral venous’. The *Bulldog Onesearch* search engine

on the Gardner-Webb University, Dover library website was used to access an online database system. Scholarly and peer-reviewed articles were used with a limit of 10 years of publication date.

Selection of the Articles

This project aimed to impact individuals in the clinical setting performing PIV insertion. Articles used study participants of all ages. Terms such as difficult access, difficult stick, and DIVA were used interchangeably as they referred to the difficult intravenous access or insertion of a peripheral intravenous catheter.

A total of 16 empirical articles were reviewed in relation to and in support of this project. Of those, seven articles similarly addressed the topic of DIVA identification. Next, four articles were used to support the potential and confirmed consequences or risks of a delay in PIV access. Lastly, six articles provided interventions to resolve the difficulties of a DIVA patient. Each study has been analyzed according to its hypothesis, argument, method, results, and conclusion.

DIVA Identification

Introduction

Of those articles addressing the identification of DIVA patients, three used a DIVA screening in the clinical setting (Ehrhart et al., 2018; Loon et al., 2016; Shakaut et al., 2020). The remainder used clinician judgement and recorded patient characteristics (Fields et al., 2014b; Piredda et al., 2017; Piredda et al., 2019; Rippey et al., 2016). Needing a way to assist in recognizing difficult sticks, clinicians trial multiple techniques before attempting PIV insertion. Early recognition was influential when strategizing ways to increase first-attempt insertion success.

Content

Multiple methods were used including observational and prospective cohort studies. Sample sizes ranged from as little as 94 to 1,063 with multiple sample sizes closer to the latter number. Larger sample sizes were seen to produce more results and increase the outcome of each study (Loon et al., 2016; Rippey et al., 2016; Piredda et al., 2017). The articles similarly used data analysis to synthesize results and form conclusions.

A prospective cohort study performed by Shakaut et al. (2020) revealed the successful implementation of a DIVA screening tool to identify those patients presenting to the ED with difficult access. Participants of this study were able to prospectively identify which patients would undergo multiple attempts to better set expectations and seek out the most appropriately experienced clinician to attempt the first insertion. Additionally, by appropriately identifying a DIVA, the clinician was also able to determine if the use of supportive equipment was necessary.

Similarly, Ehrhart et al. (2018) and Loon et al. (2016) concluded the use of a DIVA screening tool aided clinicians in designating those patients with difficult access to better assign staff members who would initially attempt insertion. Each study tailored its DIVA screening tool to the population seen in their clinical setting and followed a scoring system. Significant value was awarded to the studies as they held high clinical significance and obtained their intended outcomes.

Authors Rippey et al. (2016), were able to prove clinicians with varying expertise can predict individual likelihood at first attempt insertion success on any given patient. This prospective cohort study hypothesized the clinician’s gestalt would support their

study objective. The gestalt was represented by two clinical decision algorithms which encompassed clinician experience, prediction of success, and factors contributing to DIVA. Results revealed a successful first-attempt insertion in 86% of the 734 study participants. The authors concluded that any clinician predicting their own insertion success to be above 90% would be considered accurate and gestalt was an appropriate tool in determining the probability of first-attempt insertion success or failure.

Consequences of Delay in Access

Introduction

All four studies were conducted in the ED and included study participants from the emergency setting (Fields et al., 2014a; Shokoohi et al., 2020; Witting, 2012; Witting et al., 2017). The studies aimed at uncovering care delays and negative outcomes in those patients designated as DIVA. With the recognition of delays, each group of authors was further led to conclude interventions addressing DIVA should be implemented. Thus, the literature review led to the subsequent category of articles.

Content

The article methods were observational and cohort studies. The sample sizes ranged from 116 to 108,256. Larger sample sizes more appropriately supported the validity and produced supplementary outcomes. Data analysis was used to organize and synthesize study results and findings.

An observational retrospective cohort analysis was conducted over 2 years on ED patients with DIVA requiring ultrasound-guided IV access placed by physicians or advanced practice providers. Awaiting placement from the specified clinicians increased the time to insertion success and ultimately proved an association between DIVA patients

and delays in care. The extent of the delays was defined through stalled diagnostics, therapeutics, and dispositions. Data analysis revealed DIVA patients would wait an additional 50 minutes for pain medication, 36 minutes for fluid administration, 29 minutes for laboratory results, 57 minutes for IV contrast, and 87 minutes for discharge (Shokoohi et al., 2020).

Another observational study by Fields et al. (2014), proved the association between multiple insertion attempts and perceived pain. It was hypothesized that patients requiring additional attempts would experience pain and emotional distress at higher levels. The study data revealed a 19mm higher pain score with two attempts and a 33mm higher score with three or more attempts. Resultingly, overall patient satisfaction was lower and the PIV insertion was reported to be the most painful experience during the ED visit.

Combating DIVA

Introduction

All six articles endorsed their objectives through the use of supportive equipment for PIV insertion (Bahl et al., 2016; Davis et al., 2021; Egan et al., 2013; McCarthy et al., 2016; Partovi-Deilami et al., 2016; Sou et al., 2017). The authors sought to improve outcomes by comparing the use of ultrasound machines to the standard palpation technique. It was hypothesized that the use of supportive equipment when attempting PIV insertion on those patients designated as DIVA would increase first-attempt success.

Content

Ultimately, a decrease in consequences associated with delays in access was directly linked to ultrasound-guided insertion (Bahl et al., 2016; Davis et al., 2021).

Lengthier placement times were recorded in those patients who received placement using the palpation technique. Study methods consisted of randomized controlled trials, observational studies, and cohort studies. Sample sizes ranged from 26 to 13,192. Significant value was placed on the studies with level 1 evidence (Bahl et al., 2016; McCarthy et al., 2016; Partovi-Deilami et al., 2016).

A randomized, prospective single-site study conducted by Bahl et al. (2016) supports the implementation of supportive equipment for PIV insertion success. Their clinicians had a higher success rate of 76% when using the ultrasound-guided insertion technique compared to 56% associated with the existing palpation method. It was also concluded the ultrasound-guided insertion technique cost less time than the traditional palpation method. Successful insertion was determined to be influenced by the use of supportive equipment with DIVA patients.

Needs Assessment

Target Population

To better understand the components of the clinical issue, an intervention question was created with a systematic approach using the PICOT format. The acronym represents the population, intervention, comparison intervention, outcome of interest, and time it takes for the intervention to accomplish the outcome. In the freestanding emergency department (ED) staff, how does the introduction of the difficult intravenous access (DIVA) Clinical Predictor Tool and correct intervention correlation compared with the current insertion practice affect peripheral intravenous (PIV) catheter insertion expertise within 15 minutes?

The target population (P) was identified as skilled clinicians attempting the insertion of a peripheral intravenous catheter. The intervention of interest (I) was the education of the DIVA Clinical Predictor Tool and the appropriate correlation of insertion technique compared to the comparison intervention (C) of the existing insertion method. The unit's current practice used a palpation-based approach. The desired outcome (O) was increased PIV insertion expertise. Lastly, the time allotted to achieve this outcome (T) was 15 minutes. In this study, the education of the DIVA Clinical Predictor Tool (Appendix A) to identify those patients with difficult access was expected to influence insertion success and decrease the total number of attempts. Anticipated outcomes were that a reduction in PIV insertion attempts will result in improved patient outcomes and satisfaction.

Sponsors and Stakeholders

Being a quality improvement project, the study aimed to gain the interest of key individuals both affected by and who can affect the desired outcomes. Sponsors and stakeholders are those that also recognize the problem, fund the project, and may be interested in the outcome. The following stakeholders were identified as those parties who would affect and be affected by the project.

This problem can equally be acknowledged by clinicians working in the freestanding ED. The unit clinicians participated in an anonymous survey and revealed fundamental data which supports the need for practice improvement. It was proposed the unit staff would likely participate in this study as stakeholders influencing and being influenced by the desired outcome. The clinical staff influenced the outcomes by implementing the intervention of interest. The staff was also affected by the first attempt

PIV insertion success as it decreased result times, length of stays, patient census, and total time spent on the task.

Additional stakeholders included those individuals largely benefitting from the desired outcome. ED patients should experience first attempt success which largely impacts the psychological and physical elements of their well-being. The patients were anticipated to see a decrease in emotional distress, pain/discomfort, risk of infection, and delays in care. These individuals were participatory in the study as they were directly influenced by the desired outcome.

Lastly, clinical management and the unit educator were considered to be sponsors and stakeholders in the study as they were affected by the desired outcome. Decreasing PIV insertion attempts affects supply costs, medical errors, and overall satisfaction scores. Medical errors cost over $4 billion per year and can be attributed to deficiencies in training, lack of consistency in procedures, and delays in care (Rodziewicz, 2022). Improving costs and satisfaction scores was expected to hold value to hospital supervisors and provide motivation for contribution as sponsors in the study.

Organizational Assessment

An organizational assessment was completed by using a SWOT analysis. The acronym evaluates internal strengths and weaknesses while identifying opportunities and threats of the external environment. The SWOT analysis is strategic for planning and management during project planning.

The internal analysis sought to examine the proficiencies of the hospital organization. The organization’s strengths were found to be the willingness of the unit staff and presenting patients to participate in the study. The clinical staff was highly

motivated to participate as they will be directly affected by the success of the desired outcome. The organization's weaknesses can be attributed to time constraints and staffing. The unit has experienced inconsistencies in the scheduling of daily clinicians due to staffing issues. Additionally, the staff could perceive the intervention of interest as one costing time and may omit its implementation.

External analysis is useful for assessing which environmental factors may influence the desired outcome. Opportunities found helpful to achieving the desired outcome include advances in technology and insertion techniques. The unit employs multiple different pieces of equipment which can be used to assist with PIV insertion. Potential threats were limited to patient census and loss of staff. The intervention of interest must be performed on patients requiring the insertion of a PIV. If the census is low, this will narrow the participatory subjects. Additionally, if participating staff is no longer employed by the project site, the quality improvement project would be at risk for unsuccessful results.

Resources

Multiple pieces of equipment were available in the unit for assisting with PIV insertion. In the event a DIVA is identified, the appropriate clinician is permitted to use equipment, such as an ultrasound machine for guided insertion and BD Nexiva diffusics-styled PIV catheters. The diffusics catheters are used to assist with easier insertion in patients with DIVA. The diffusics permit higher flow rates from power-injection procedures. This allows for smaller gauge catheters to be used in DIVA situations (BD, n.d.).

Additional resources available include existing PIV insertion policies. Existing organization policies say competent clinicians should not attempt more than three venipunctures. Lippincott procedures used by the organization contraindicate more than two attempts by one clinician (Lippincott Solutions, 2021). Organizational policies regarding ultrasound-guided PIV insertion prohibit more than two attempts by each certified nurse.

Desired and Expected Outcomes

Ultimately, the intended outcome of this study was to increase insertion expertise in difficult IV access patients. By reducing failed attempts, the unit, and organization will see a decrease in costs, wait times, and errors. Patient satisfaction and consistent care are expected to improve with the success of the desired and expected outcomes.

Team Selection

This study will have one practice partner located in and affiliated with the practice learning environment. The practice partner has a master's degree in nursing leadership, and during the project, the implementation timeline served as the freestanding unit's manager. The practice partner will provide insight and support for the success of the study. Being the unit's leader, the practice partner planned to motivate the clinical staff to participate in the study. Support will be evident as this role is directly affected by the desired outcome.

The project chair holds a doctoral degree as a family nurse practitioner and will provide guidance and direction for the project. The project chair will be influential in the creation and implementation through a review of this literature. Feedback will be offered and received to improve project intentions and outcomes.

The project leader was a DNP student and employee at the project implementation site. Potential conflicts of interest could have consisted of personal relationships with the participants and the effect it may have had on their participation. The DNP Project Leader's role consists of occasional charge nurse duties. With this role, the DNP Project Leader has no administrative responsibilities and is in no way connected to employee performance reviews, incentives, or wages. The project leader holds no management title or authority over the participants. The charge nurse role merely designates an individual each shift to oversee the flow of the department and handle patient scenarios. The DNP Project Leader did not implement the project while working as a charge nurse preventing any potential conflicts of interest.

Cost/Benefit Analysis

Costs included those monetarily associated with the proposed intervention. Included were the materials needed to print the DIVA Clinical Predictor Tool and the pre/post surveys (paper and ink). Ultimately, this was a low-cost project which consumed more time than monetary materials.

Benefits are expected results from a successful implementation of the proposed intervention. Those benefits were expected to include a reduction in PIV supply waste, payment for the administration of intravenous medications and fluids, and payment for laboratory blood diagnostic tests. The proposed benefits were expected to surely outweigh the costs of the project and provide significant justification for the implementation of the project.

The organization categorizes charges per patient based on signs, symptoms, and interventions. There are six total acuity levels and they range numerically from 1-5 with a

sixth critical care level. Each acuity level corresponds to an appropriate charge level. The charges are bundled to include supplies, nursing services, and the use of unit equipment. Patients requiring PIV insertion will fall into level 3 skipping levels 1 and 2. The organization's income from a level 3 in 2022 is $2,537.70 compared to $548.90 for a level 2 and $297.80 for a level 1. The organization has the potential to make an additional $1,988.80 per patient with the successful insertion and use of a PIV catheter. The organization also acquires income through the charge for intravenous medications and fluids which would previously be missed without PIV access. Failing to obtain PIV access in those same patients will result in multiple missed income opportunities for the organization. Obtaining PIV access in DIVA patients through the successful implementation of this project will provide a fiscal benefit for the organization.

Scope of Practice

This project used the DIVA Clinical Predictor Tool to identify those patients presenting to the ED with difficult access. This project educated participants on the proper implementation of the tool. This project correlated the clinician with appropriate training and expertise according to the results of the DIVA Clinical Predictor Tool. This project sought to reduce the number of insertion attempts by increasing first-attempt success.

This project did not implement ultrasound-guided PIV insertion education. This project did not implement PIV insertion education. Lastly, this project did not seek to alter the organization's current PIV insertion policy.

Potential barriers included the staff's hesitancy to participate in the project and use the DIVA Clinical Predictor Tool to identify those with difficult access. Contributing

to the staff's hesitancy may be time constraints, lack of interest, or lack of understanding. Participants may assume this project is intended to recreate current practices and procedures used for PIV insertions rather than recognizing the potential aid it may provide.

Goals, Objectives, and Mission Statement

Goals

The goal of this project was to increase the ED staff's expertise in peripheral intravenous catheter insertion in difficult-access patients. It was intended to decrease the number of failed attempts and alleviate negative consequences for the patient and organization. The goal was expected to be obtained through the correct identification of DIVA patients and the allocation of appropriate insertion techniques. Increased insertion success was thought to improve the overall experience for project participants.

Objectives

Process and outcome objectives were identified through the use of the SMART format. The acronym itself represents project parameters to ensure objectives are clear, defined, and organized. Specifically, the format stands for smart, measurable, achievable, relevant, and timely.

The process objective was established as the target population will review and analyze the DIVA Clinical Predictor Tool. The outcome objective was the target population will enhance their personal knowledge of PIV catheter insertion in difficult-access patients and retain at least 80% of DIVA Clinical Predictor Tool education by the end of the project implementation.

Mission Statement

The freestanding ED had problems with failed first attempt PIV insertion success. This project aimed to improve insertion success to create a better experience and outcome for the patients, staff, and organization by implementing the use of the DIVA Clinical Predictor Tool to better allocate proficient clinicians.

Theoretical Underpinnings

Considered a major contributor to understanding psychological change, Kurt Lewin created the Change Theory in the 1940s which acknowledges the process of change in human systems. This simplified theory uses a 3-stage model to discard and amend previous learning. The stages are referred to as unfreeze, change, and refreeze (Burnes, 2019). This model uses a block of ice as an analogy. Initially, melting the block of ice will make it open and responsive to the possibility of change. Next, by shaping the ice into the intended structure, change is created. Finally, refreezing the structure will ensure the change remains in place.

The three concepts of this theory include driving forces, restraining forces, and equilibrium. Equilibrium is the state at which no change occurs and two forces are equal. The driving forces assist in facilitating change by moving the individual toward the desired course. This aids in progressing the equilibrium towards change. The retraining forces hinder change as they oppose the driving forces (Bakari et al., 2017). A Conceptual-Theoretical-Empirical (CTE) diagram was used to display the relationship between the theoretical concepts and the project variables (Appendix B).

Application

The initial unfreezing stage requires the use of driving forces to influence an individual to acknowledge the need for change. In doing so, the individual must determine a need for change and reject the previous process as suboptimal (Burnes, 2019). The unit staff must be presented with the identified problem of the current PIV insertion practice, consequences of the current practice, potential benefits of improving the practice, and desired outcomes of improved practice. Consequences of current practice may include those directly or indirectly experienced by the staff. Those include increased length of stay, wait times, patient census, and insertion attempts. Ultimately, the driving forces will consist of improving workflow and decreasing time spent on PIV insertion tasks.

The change stage involves the individual supporting the new process. This stage may take time as the staff begins to explore and transform their thoughts, feeling, and behaviors (Burnes, 2019). By presenting and educating the staff on the DIVA Clinical Predictor Tool, the change stage will be initiated. The staff will be pushed to accept, adopt, and soon implement the DIVA Clinical Predictor Tool. Revisiting the driving forces from the unfreezing stage may be needed to communicate clearly and remind the staff of the original need for change.

Finally, the refreezing stage reflects successful change as individuals begin to embrace the new process. By establishing the change as the new standard of practice, the staff is less likely to return to the old standards of practice. Successful change can be acknowledged during this stage as the staff begins to independently implement the use of the DIVA Clinical Predictor Tool when PIV insertion is required.

Work Planning

Project Management Tool

The creation of a project management tool was to outline projected start dates and completion times for each project task. This tool was displayed in the form of a Gantt Chart (Appendix C). The tool consisted of six project tasks which began with the project design and ended with the final presentation of the project. The timeline of the tool covered a 9-month (33-week) period. Appropriate consideration was given to allow for earlier start dates and extra days of completion.

The tool began at week 0 with the project design which consisted of the completion of all steps, literature reviews, and project configurations. The design was allowed 16 days and will result in approval by the project chair. By week 8, university IRB application and approval will begin. This task will require around 22 days depending on approval. In week 11, facility IRB application and approval will take place lasting around 92 days maximum. Next, project implementation will occur in week 24. Implementation is comprised of staff education on the DIVA Clinical Predictor Tool, Education Narrative (Appendix D). A total of 4 weeks is allotted to this task to ensure all 16 staff members have been reached by the DNP project leader. Data analysis will begin during week 28 and require 26 days. Lastly, project submission and presentation are expected to occur in week 34 and take 14 days to complete. The presentation occurs on the seventh day after submission to the project chair.

Timeline

A timeline was utilized as a foundation for monitoring the project's planning and execution phases. To appropriately manage the initiation and completion of a task, a

work breakdown structure was created (Appendix E). Each project task and associated start dates were listed similarly to the project management tool. Additionally, the work breakdown structure indicates at which point each can be executed and what the execution is dependent upon. Consideration was given to allow for lingering tasks and necessary project completion points.

Each project task occurs sequentially to the one before and after with the exception of data analysis. This task may occur parallelly with implementation. University and facility IRB application and approval will require the completion of the project design task before being permitted to begin. Subsequently, implementation is dependent upon the completion of IRB approval. Data analysis is dependent upon implementation. Finally, the project submission and presentation task are dependent upon the data analysis task.

Budget

The budget was created to analyze the potential costs of the project (Appendix F). Costs for this project were limited to direct costs which include labor, materials, and time. Ultimately, it was hypothesized the project would be very low in cost and budget. Materials included one ream of copy paper and one ink cartridge. Costs were configured from the listed prices of the two items on Amazon.com. Lastly, time was factored into this budget as it represented the expense of working with the staff. Time spent educating and implementing the project was expected to cost 15 minutes for each staff member. Staff wages were hypothesized and an average sum was used at $40 per hour. With 16 staff members, 4 hours were allotted for time. The unit covered the costs of the project.

Evaluation Plan

The project used a quality improvement model to outline the evaluation plan for the objectives (Appendix G). Using the Plan-Do-Study-Act tool, the objective was broken down into project aim, action steps, measurable outcomes, and resulting process change. The plan is to assess and improve the staff's current knowledge level of PIV insertion on a DIVA patient. The do section of the tool consisted of the use of a pre-implementation survey, DIVA Clinical Predictor Tool education, and post-implementation survey for successful implementation. In the study section, the two surveys were analyzed to identify improvement in the staff knowledge level of PIV insertion in a DIVA patient. This confirmed extent of success of the project objective. Lastly, the act section reviewed survey results to support the adoption of a new policy. By adopting a new policy, a consistent future change could be seen.

The DIVA Clinical Predictor Tool, alternative insertion techniques, and case scenarios were presented as laminated handouts. The case study-styled questions were used to encourage the application of knowledge (Appendix H). The participants completed the questions with the assistance and guidance of the DNP project leader. Using the DIVA Clinical Predictor Tool, each question was answered according to the scoring system. A score of 4 or more prompted the use of alternative insertion techniques (Appendix I). Appropriate time was given for clarification or questions from the participants. This phase was considered the project implementation and *Do* phase of the quality improvement model.

A quantitative survey was used as the research instrument. The DIVA Clinical Predictor Tool was appropriate for the unit staff regarding PIV insertion knowledge. The

survey was printed on two sheets of paper and results was gathered anonymously. The pre/post-implementation survey consisted of four true or false questions and one select all that apply question (Appendix J). The five questions assessed the participant's ability to identify those criteria which contribute to DIVA. Given in the post-implementation phase, the survey again tested the participant's retainment and understanding of the DIVA Clinical Predictor Tool education. A comparison of the scores represented successful implementation. The expectation was to see high post-implementation survey scores indicating project success.

Project Implementation

Threats and Barriers

As the application process commenced, several barriers to project implementation arose. Completion of the University application was completed according to the proposed timeline and was considered a success. The projected project facility governing organization required several steps before submitting a facility Institutional Review Board (IRB) application. The following events were unanticipated obstacles that ultimately led to the failure to follow the proposed timeline.

The facility required an affiliated medical-education-based facility email address to enter the eIRB database. Acquisition of the email address required more time than originally anticipated which caused a delay. Facility-specific CITI modules were obtained which cost the project further delay. Additionally, a doctorally prepared project site employee was recruited as a mentor and principal investigator (PI). The PI was also expected to acquire an email address and enter the eIRB database from the affiliated medical-education-based facility. With the help of technical support, it was determined

the PI's previous email address and eIRB status had expired. A new request was submitted and further delay was initiated. By the end of the fall semester, progress could not be made toward a facility IRB application without the PI being admitted to the eIRB database.

Efforts towards a resolution were made with the goal of acquiring an affiliated medical-education-based facility email address for the PI and reinstating eIRB status. The submission of a facility IRB application was completed by the end of the fiscal year. Although there were unforeseen barriers to facility application and approval, project success was still likely due to the short implementation period.

Successes

Permission for the DNP Project Leader to serve as the interim PI for application purposes was granted to expedite the process. A facility eIRB application was created and submitted 2 weeks before the end of the fiscal year. A total of seven concerns from the IRB committee were addressed during a 2-week period. Facility approval was granted 1 week later and final university approval an additional week later. Project implementation started 2 weeks ahead of the predicted start date according to the timeline. The project received an exempt review from the facility and no longer needed a project mentor; therefore, previous barriers were overcome.

Monitoring of Implementation

Project implementation occurred efficiently with positive receptivity by the unit staff. After the introduction email was sent, staff were approached individually during a shift change in the nurse's station over a period of 4 weeks (Appendix K). The project was started once participants had handed off patient reports and indicated they had 15

minutes available for implementation. Due to an increase in unit staff, additional participants were available. The unit employs 35 clinicians. Three clinicians were excluded due to one being the DNP project leader, one being deployed in the military, and one ending employment. During project implementation, the unit acquired two new clinicians which resulted in a total of 34 qualifying clinicians. The project had 29 total participants. Implementation reached 13 additional staff members than originally predicted. Of the unit's qualifying clinicians, 85% participated in the project. A checklist of unit staff was kept to track which clinicians had received the education.

A total of 184 minutes were spent with the clinicians. The project used 56 minutes less than the predicted 240 minutes. An average of 6.3 minutes were spent with each participant with the longest session at 10 minutes and the shortest at 4 minutes. The total time of implementation was 76% of the predicted value and individual implementation was 42% of the predicted value. Using 1 hour less than planned, the DNP project cost the unit $40 less than originally budgeted. The project reached its participation goal 2 weeks into the implementation period at the halfway point. Of the total participants, 55% reached implementation during the first half of the project and 45% in the second half. The project closely followed its timeline and adhered to a 4-week implementation period.

The DNP Project Leader implemented a mandatory one-on-one education of the DIVA Clinical Predictor Tool to unit staff. The unit manager decided to authorize the education as mandatory, but completion of the survey remained voluntary. Individual sessions included a review of the informed consent, pre-implementation survey, DIVA screening tool, case studies, and post-implementation survey. Each participant was given a laminated copy of the DIVA Clinical Predictor Tool. The informed consent was

presented as an attachment before the surveys. Participants will be notified of the option to participate or not participate without prejudice. Participation in the project and consent were indicated by the completion of the surveys. After reviewing the consent, the DNP Project Leader gave appropriate privacy to the participants for survey completion by distancing 6 feet away. The two surveys were anonymously completed and submitted independently from the DNP project leader. Participants were given the option to respond or not respond to each question, turn in a blank survey, or discard the survey.

The DIVA Clinical Predictor Tool includes six variables:

1. altered fluid status (hypervolemia or hypovolemia);
2. presence of scars, tattoos, or tough skin (skin with a weathered, leathery, or orange-peel appearance);
3. frail and/or elderly skin;
4. whether veins were palpable;
5. whether veins were visible with a tourniquet; and
6. disease history, including chemotherapy, iv drug use (both prescribed and proscribed drug use), chronic renal failure, one arm available, diabetes, and sickle cell.

The tool has two columns, headed Yes and No, in which clinicians placed scores (0, 1, 2) for each variable. After marking the presence or absence of all variables, clinicians added up the values in both columns to arrive at a total score (Ehrhardt et al., 2018). A score of four or more indicated an individual was considered difficult to access and may benefit from alternative insertion techniques. Alternative insertion techniques appropriate to this

unit were an ultrasound-guided IV insertion, diffusics catheters, heat application, and a more experienced clinician.

The survey was administered to the participants to evaluate success project success and knowledge enhancement. The survey was given immediately prior to and after project implementation to ensure consistency and fairness of survey results. The survey consisted of four true/false questions and one select-all-that-apply question. Participants answered the questions based on pre-intervention knowledge of PIV insertion in difficult-access patients. The surveys contained no identifying data and were placed into an envelope in an unknown order without the DNP project leader's observation. The folder was located in the secure staff breakroom.

The participants were presented with five case study styled questions which were completed with the use of the DIVA Clinical Predictor Tool and assistance from the DNP Project Leader as an application-based style of learning. Education was presented to the participants at a comprehendible learning level. Overall, the participants voiced an understanding of the content and felt it related to current problems the unit faced. Participants were favorable to the ease of the content and did not require the original anticipated 15 minutes. Numerous participants had additional questions for the DNP Project Leader pertaining to the DIVA Clinical Predictor Tool and alternative insertion techniques. Six participants, including the new hires, were unaware of the diffusics catheters and required further education. This was considered an opportunity to improve overall knowledge of alternative insertion techniques and decrease future failed insertion attempts.

Project Closure

By the end of the implementation period, five staff members had not been reached for participation. Of the 15% not reached, three clinicians were never seen during implementation periods, and two left before implementation could happen. It was decided the implementation period could end as intended since the participation exceeded the projected value. Participation exceeded the predicted value by 180%. This was considered a success. To conclude the project, unit staff was informed of its completion by word of mouth. The envelope containing the surveys was removed from the staff breakroom for data analysis.

Not anticipated in project planning was how the DNP Project Leader would give privacy to participants during survey completion. Participants were informed of their right not to participate by submitting a blank survey, but participants were with the DNP Project Leader during survey completion. No consideration was given to how this could be done confidentially. A solution was created during the implementation period. It was decided to briefly create a distance of at least 6 feet between the DNP Project Leader and participants when completing the pre-implementation survey. For the post-implementation survey, the DNP Project Leader was dismissed. Adequate anonymity and confidentiality were given to project participants to minimize potential risks.

Data Analysis

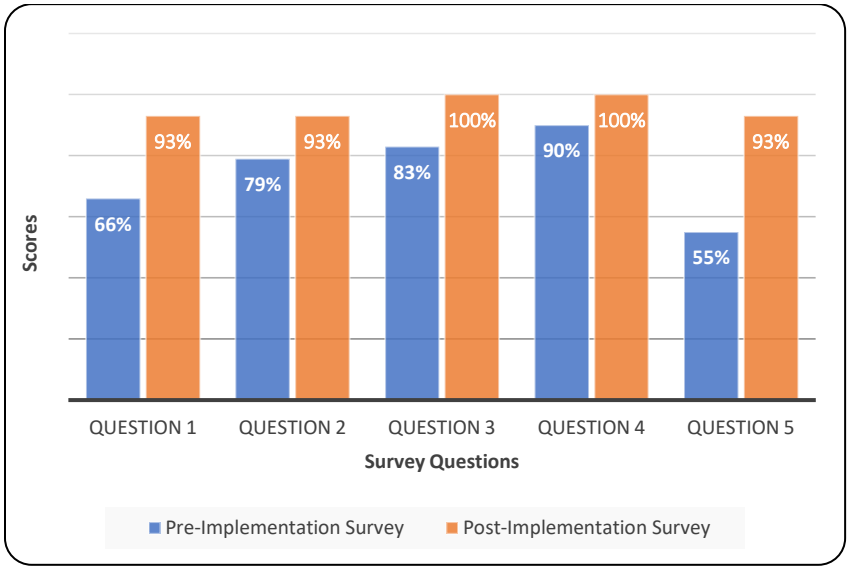
Quantitative Data

Quantitative data analysis was done with a descriptive statistical analysis method. The characteristics of the pre and post implementation surveys were evaluated and summarized to identify statistical trends. The analysis focused on each survey

individually and ended with a comparison of the two. Within each individual survey analysis, the questions were summarized according to their individual results (Figure 1). The surveys consisted of five identical questions and the results were calculated based on a passing/failing system as found on a test. The survey results represent the success of the implementation and ultimately the outcome of the project.

Figure 1

Survey Results



The first question of the pre-implementation survey which evaluated the participant's knowledge of age as a contributing factor of DIVA resulted in a 66% percent passing rate. Being the least correctly answered question, 10 out of the 29 participants could be assumed to have no prior knowledge. The second question asked the participant to apply their judgement regarding tourniquet application received higher scores with 23 participants scoring correctly leaving 21% with no prior knowledge. Following this trend is the third question addressing skin characteristics collected 24 accurate answers decreasing the proportion of participants with prior knowledge of the content to 17%. The

last true/false question received the highest results with 90% of participants selecting the correct answer. Of the total participants, 26 contained prior knowledge of fluid status as a DIVA contributor resulting in only 10% having no prior knowledge. Lastly, the select-all-that-apply question revealed 13 participants did not completely understand which diseases contributed to DIVA providing the DNP Project Leader with the opportunity to educate 45% with the DIVA Clinical Predictor Tool. Out of the six listed diseases, the average number of correct selections was five with two being the lowest outlier and six being the highest.

The post-implementation survey showed significant successful implementation and improvement of overall knowledge when identifying a DIVA patient. Questions three and four revealed all 29 participants chose the correct answer. It can be assumed those with no prior knowledge successfully retained the content of the education. The remainder of the three questions received a 93% passing rate with only two participants failing to select the correct answers. The average number of correct selections from the select-all-that-apply question was 5.9. Two participants correctly selected five out of six diseases. The outcomes of this survey show a direct correlation between the education of the DIVA Clinical Predictor Tool and the participant's knowledge level.

When comparing the results of the two surveys, the number of participants failing to select the correct answer on the post-implementation survey decreased thus increasing the number of accurate selections. At the individual level, the first question showed the highest advancement of knowledge with 27% of participants improving their scores. The pre-implementation survey had an absolute passing rate of 38% in comparison to 83% in the post-implementation survey. After the education was implemented, there was a 45%

increase in participant knowledge of identifying patients with DIVA. Finally, the correctly answered questions of the surveys were averaged and expressed as a passing score. The average score of the pre-implementation survey was 80%. On average, participants scored 97.7% on the post-implementation survey revealing an increase of 17.7% in correctly selected answers.

Qualitative Data

The DNP Project Leader collected qualitative data throughout project implementation through observations, narratives, and interview questions. Notes included individual responses both verbally and non-verbally. Observations were made as participants completed surveys and fulfilled the education requirement. All questions were recorded as narrative.

After the completion of project implementation, a generalized question was asked of the participants evaluating their thoughts on the project. Mostly it was asked if the participants thought incorporating the DIVA Clinical Predictor Tool would be beneficial to their practice. Responses were mostly positive and included ideas such as incorporating this content for new graduate nurses. Many participants found the DIVA Clinical Predictor Tool informative and improved their prior knowledge of contributing characteristics of a DIVA patient. Another participant felt the DIVA Clinical Predictor Tool would encourage accountability to follow the company policy of two insertion attempts. Contrarily, few participants had concerns regarding time and the inability to always use the screening tool. Other responses implied the clinicians felt the screening of patients was automatically completed by them internally.

Questions directed to the DNP Project Leader sought more information on the surveys and the alternative insertion techniques. The participants wanted to know if the DIVA Clinical Predictor Tool was going to be used in the electronic medical record (EMR) and how often they were supposed to screen patients. Other questions inquired if the surveys were graded and whether they contained trick questions. Finally, a majority of participants asked if they should write their names on the surveys after being told the surveys were meant to be anonymous.

When making observations, it was noted the participants were mostly Registered Nurses (RN) and mostly female. Many took their time looking over the informed consent and even detached it from the surveys to keep it. Some participants were noted rushing through the surveys and not fully reading the questions while others took their time to cover the content. Additionally, it was noted participants changed their selections on the surveys after re-reading the questions. Overall, the most notable observation was the high scores on the pre-implementation survey. The participants were mostly very well versed with DIVA patients and had significant experience with inserting PIV catheters in them.

Process Improvement Data

The project outcome objective sought to enhance personal knowledge of PIV catheter insertion in difficult-access patients and retain at least 80% of DIVA Clinical Predictor Tool education by the end of the project implementation. While it was proven an increase in knowledge from prior to the implementation to after, the outcome objective focused specifically on the percentage of education retained. This was measured by scoring the post-implementation surveys and averaging the scores. On average

participants scored a 97.7%. The project met its outcome objective; therefore, the project can be considered a success.

The project had a positive impact on the unit as the staff's knowledge surrounding PIV insertion on a DIVA patient was improved. If sustained, the unit could see improvements in turn-around times, supply waste, patient satisfaction, and general workflow. It can now be assumed the unit staff is re-aware of the facility policy on PIV insertions, the negative effects of multiple failed insertion attempts, and alternate insertion techniques. During project implementation, more utilization of ultrasound-guided insertion and those clinicians with more experience was seen earlier in the insertion process. Unit clinicians were decreasing the number of attempts and moving to alternative techniques.

The project could be sustained by adding the DIVA Clinical Predictor Tool to the Electronic Medical Record (EMR). While not every patient may be a DIVA, the use of the tool could be optional without forced completion. On another note, the DIVA Clinical Predictor Tool could automatically register information from the patient's history and give an estimated score. Clinicians would be notified of the estimated score only when IV medications, fluids, or blood draws are ordered. A lesser approach may be to create a selection when documenting a PIV for the total number of insertion attempts and if alternative techniques were used.

Conclusion

The freestanding Emergency Department affiliated with a multi-state, not-for-profit healthcare system had problems with correctly identifying patients with DIVA, and opportunities for first-attempt success were missed. The unit benefited from a project

aimed at increasing personal insertion expertise on difficult access patients. This project aimed to improve insertion success to create a better experience and outcome for the patients, staff, and organization by implementing the use of the DIVA Clinical Predictor Tool.

The project exceeded its objective to enhance personal knowledge in the target population of PIV catheter insertion in difficult-access patients. Of the target population, the project surpassed the original projected participation rate. The project saved more money during implementation than originally anticipated. Although the project was met with facility barriers, implementation began ahead of the projected timeline.

The project showed that when skilled clinicians were presented with education on the DIVA Clinical Predictor Tool and appropriate alternative insertion techniques, personal knowledge of PIV insertion in DIVA patients was improved. Thus, having successful implementation and exceeding its many predictions, this project holds high value for the organization and any future research. The repetition of this project has the potential to affect significant change in clinical practice.

References

Bahl, A., Pandurangadu, A. V., Tucker, J., & Bagan, M. (2016). A randomized controlled trial assessing the use of ultrasound for nurse-performed IV placement in difficult access ed patients. *The American Journal of Emergency Medicine, 34(10),* 1950–1954. https://doi.org/10.1016/j.ajem.2016.06.098

Bakari, H., Hunjra, A. I., & Niazi, G. S. (2017). How does authentic leadership influence planned organizational change? The role of employees' perceptions: Integration of theory of planned behavior and Lewin's three step model. *Journal of Change Management*, *17*(2), 155–187. https://doi.org/10.1080/14697017.2017.1299370

BD. (n.d.). *BD Nexiva diffusics closed IV catheter system*. https://www.bd.com/en-ca/offerings/capabilities/infusion-therapy/iv-catheters/bd-nexiva-diffusics-closed-iv-catheter-system

Burnes, B. (2019). The origins of Lewins' three-step model of change. *The Journal of Applied Behavioral Science*, *56*(1), 32–59. https://doi.org/10.1177/0021886319892685

Davis, E. M., Feinsmith, S., Amick, A. E., Sell, J., McDonald, V., Trinquero, P., Moore, A., Gappmaier, V., Colton, K., Cunningham, A., Ford, W., Feinglass, J., & Barsuk, J. H. (2021). Difficult intravenous access in the emergency department: Performance and impact of ultrasound-guided IV insertion performed by nurses. *The American Journal of Emergency Medicine*, *46*, 539–544. https://doi.org/10.1016/j.ajem.2020.11.013

Egan, G., Healy, D., O'Neill, H., Clarke-Moloney, M., Grace, P. A., & Walsh, S. R. (2012). Ultrasound guidance for difficult peripheral venous access: Systematic review and meta-analysis. *Emergency Medicine Journal*, *30*(7), 521–526. https://doi.org/10.1136/emermed-2012-201652

Ehrhardt, B. S., Givens, K. E., & Lee, R. C. (2018). Making it stick: Developing and testing the difficult intravenous access (DIVA) tool. *American Journal of Nursing, 118(7),* 56–62. https://doi.org/10.1097/01.naj.0000541440.91369.00

Fields, J. M., Piela, N. E., & Ku, B. S. (2014a). Association between multiple IV attempts and perceived pain levels in the emergency department. *The Journal of Vascular Access, 15(6),* 514–518. https://doi.org/10.5301/jva.5000282

Fields, J. M., Piela, N. E., Au, A. K., & Ku, B. S. (2014b). Risk factors associated with difficult venous access in adult ED patients. *The American Journal of Emergency Medicine, 32(10),* 1179–1182. https://doi.org/10.1016/j.ajem.2014.07.008

Lippincott Solutions. *IV catheter insertion*. (2021, August 20). https://procedures.lww.com/lnp/view.do?pld=28822048&hits=iv%2Cintravascular%2Cstarting%2Cintravenous%2Cintravascularly&a=true&ad=false&q=IV+start

Loon, F. H., Puijn, L. A., Houterman, S., & Bouwman, A. R. (2016). Development of the A-diva scale. *Medicine*, *95*(16). https://doi.org/10.1097/md.0000000000003428

McCarthy, M. L., Shokoohi, H., Boniface, K. S., Eggelton, R., Lowey, A., Lim, K., Shesser, R., Li, X., & Zeger, S. L. (2016). Ultrasonography versus landmark for peripheral intravenous cannulation: A randomized controlled trial. *Annals of Emergency Medicine*, *68*(1), 10–18. https://doi.org/10.1016/j.annemergmed.2015.09.009

Partovi-Deilami, K., Nielsen, J. K., Moller, A. M., Nesheim, S. S., & Jorgensen, V. L. (2016). Effect of ultrasound-guided placement of difficult-to-place peripheral venous catheters: A prospective study of a training program for nurse anesthetists. *AANA journal*, 84(2), 86–92.

Piredda, M., Biagioli, V., Barrella, B., Carpisassi, I., Ghinelli, R., Giannarelli, D., & De Marinis, M. G. (2017). Factors affecting difficult peripheral intravenous cannulation in adults: A prospective observational study. *Journal of Clinical Nursing*, *26*(7-8), 1074–1084. https://doi.org/10.1111/jocn.13444

Piredda, M., Fiorini, J., Facchinetti, G., Biagioli, V., Marchetti, A., Conti, F., Iacorossi, L., Giannarelli, D., Matarese, M., & De Marinis, M. G. (2019). Risk factors for a difficult intravenous access: A multicenter study comparing nurses' beliefs to evidence. *Journal of Clinical Nursing*, *28*(19-20), 3492–3504. https://doi.org/10.1111/jocn.14941

Rippey, J. C. R., Carr, P. J., Cooke, M., Higgins, N., & Rickard, C. M. (2016). Predicting and preventing peripheral intravenous cannula insertion failure in the emergency department: Clinician 'gestalt' wins again. *Emergency Medicine Australasia*, *28(6)*, 658–665. https://doi.org/10.1111/1742-6723.12695

Rodziewicz, T. L. (2022, January 4). *Medical error reduction and prevention*. StatPearls. https://www.ncbi.nlm.nih.gov/books/NBK499956/

Shaukat, H., Neway, B., Breslin, K., Watson, A. R., Poe, K., Boniface, K., & Cohen, J. S. (2020). Utility of the DIVA score for experienced emergency department technicians. *Journal of the Association for Vascular Access*, *24*(4), 38–44. https://doi.org/10.2309/j.java.2019.004.007

Shokoohi, H., Loesche, M. A., Duggan, N. M., Liteplo, A. S., Huang, C., Al Saud, A. A., McEvoy, D., Liu, S. W., & Dutta, S. (2020). Difficult intravenous access as an independent predictor of delayed care and prolonged length of stay in the emergency department. *Journal of the American College of Emergency Physicians Open*, *1*(6), 1660–1668. https://doi.org/10.1002/emp2.12222

Sou, V., McManus, C., Mifflin, N., Frost, S. A., Ale, J., & Alexandrou, E. (2017). A clinical pathway for the management of difficult venous access. *BMC Nursing*, *16*(1). https://doi.org/10.1186/s12912-017-0261-z

Witting, M. D. (2012). IV access difficulty: Incidence and delays in an urban emergency department. *The Journal of Emergency Medicine*, *42*(4), 483–487. https://doi.org/10.1016/j.jemermed.2011.07.030

Witting, M. D., Moayedi, S., Brown, L. A., & Ismail, A. (2017). Predictors and delays associated with the need for advanced techniques for intravenous access. *The Journal of Emergency Medicine*, *53*(2), 172–177. https://doi.org/10.1016/j.jemermed.2017.04.002

Appendix A

DIVA Clinical Predictor Tool

Clinical Predictor Tool to Help Identify Patients with Difficult IV Access (DIVA)

A successful IV attempt is defined as an attempt in which a saline flush can be injected without compromising the vein, and IV access is ready to be used for fluid and/or medication.

Date: _____ Patient Age: ____ Patient Gender: _____

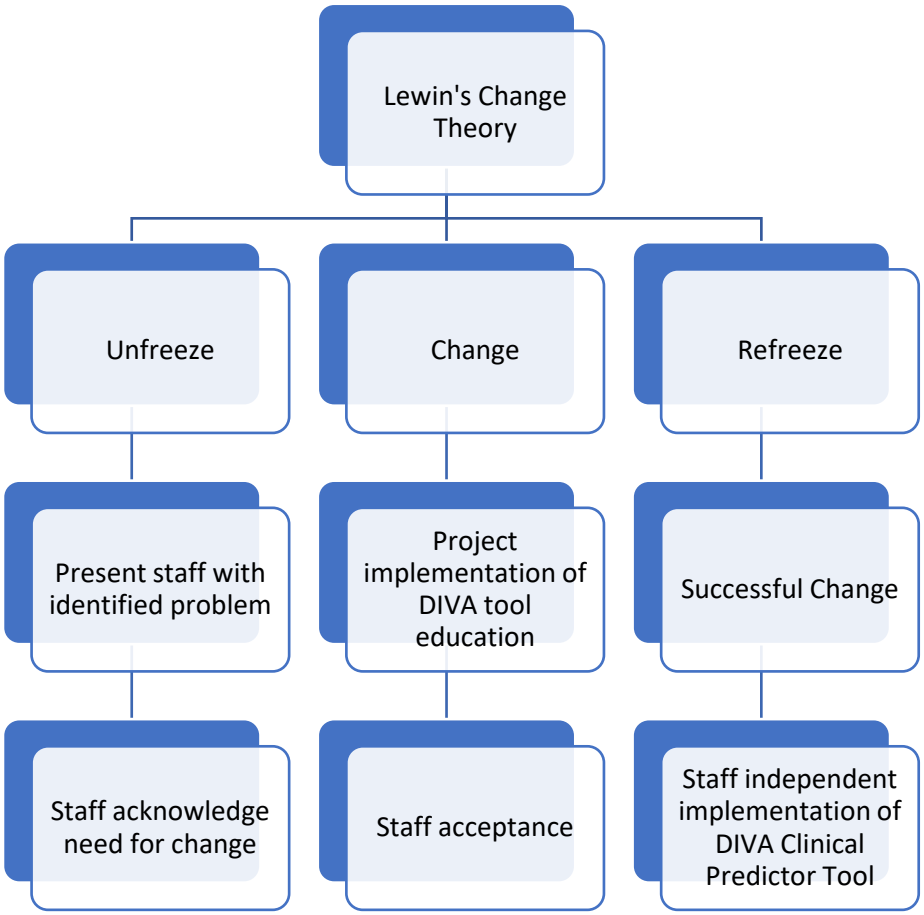
Characteristic	No	Yes
1. Altered Fluid Status: Hypo/Hyper (Please circle Hypo or Hyper)	0	1
2. Scars/Tattoos/Tough Skin	0	1
3. Frail/Elderly	0	1
4. Vein Palpable with Tourniquet	2	0
5. Vein Visible with Tourniquet	2	0
6. Disease History		
a. Chemotherapy	0	1
b. IV drug use	0	2
c. Only one arm available	0	1
d. Chronic renal failure	0	2
e. Diabetes	0	1
f. Sickle cell disease	0	1

Total the score. Add both the No and Yes columns. A score of 4 or higher indicates the patient may be considered a difficult IV access and may benefit from special interventions (e.g. ultrasound, heat, etc.).

Ehrhardt, B. S., Givens, K. E., & Lee, R. C. (2018). Making it stick: Developing and testing the difficult intravenous access (DIVA) tool. AJN, *American Journal of Nursing, 118(7)*, 56–62. https://doi.org/10.1097/01.naj.0000541440.91369.00

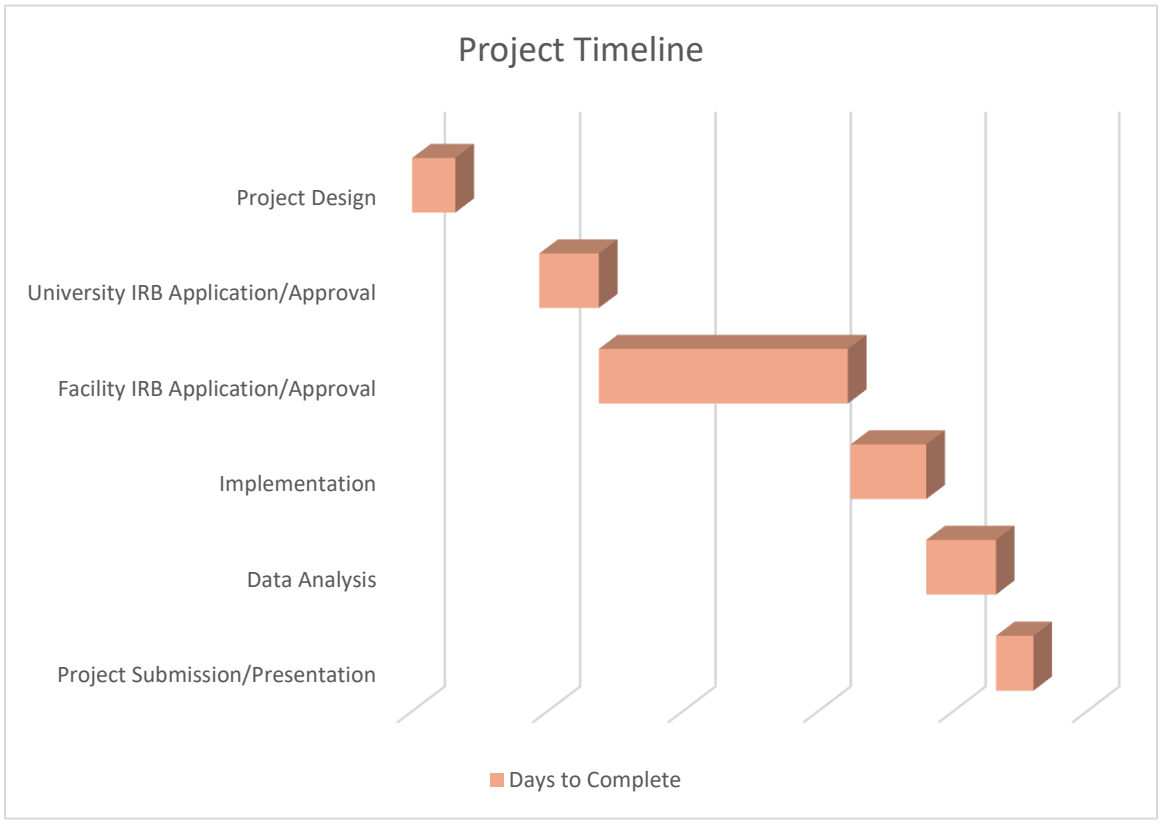
Appendix B

Conceptual-Theoretical-Empirical Diagram



Appendix C

Gantt Chart



Appendix D

Education Narrative

Establishing intravenous access is one of the most common procedures we do in the ED and is required to give care to patients. Individuals may be considered to have difficult intravenous access (DIVA) or be a 'difficult stick' if more than two attempts are made. Often, first attempt insertion is unsuccessful and these patients endure multiple insertion attempts resulting in increased wait times, delays in care, discomfort, emotional stress, and poor patient outcomes. It is a common occurrence that we fail to obtain access in DIVAs and as a result miss opportunities for blood diagnostics and medication administration. I researched how we could better identify a DIVA to improve insertion success and I would like to take a moment to show you what I found.

Please take a moment to complete this short survey before I continue. Answer the questions to your best knowledge and ability. This survey is not for a grade, but merely a way to evaluate your knowledge about the topic.

This is the DIVA Clinical Predictor Tool. The tool can be used to screen patients before attempting IV catheter insertion. The tool includes six variables and six sub variables. The tool will give an immediate indication of the probable difficulty of performing an IV insertion.

Use the patient's history and physical findings to circle yes or no for each listed variable. When finished, total the scores by adding both the no and the yes columns. A total score of 4 or higher may indicate the patient may be considered a difficult IV access and may benefit from alternative interventions. Alternative interventions include ultrasound guided IV insertion, diffusics catheters, heat application, and an experienced clinician.

We can now use the DIVA Clinical Predictor Tool to answer 5 case study questions with different patient scenarios. Read the questions and identify the variables each patient has which contributes to difficult IV access. Total the number of variables for each to give them a score. This is not for a grade, but merely a way to provide a quick practice session with the tool. Let's review them together to see how you did.

Lastly, please take a moment to complete this short survey. Answer the questions to your best knowledge and ability. The survey is not for a grade, but merely a way to evaluate your knowledge about the topic after learning about the DIVA Clinical Predictor Tool.

Appendix E

Work Breakdown Structure

Task	Estimated Start	Estimated Length to Completion	Sequential or Parallel	Dependent Upon
Project Design	Week 1	16 days	Sequential	None
University IRB Application/Approval	Week 8	22 days	Sequential	Project Design
Facility IRB Application/Approval	Week 11	92 days	Sequential	Project Design
Implementation	Week 24	28 days	Sequential	IRB Approval
Data Analysis	Week 28	26 days	Parallel	Implementation
Project Submission/Presentation	Week 34	14 days	Sequential	Data Analysis

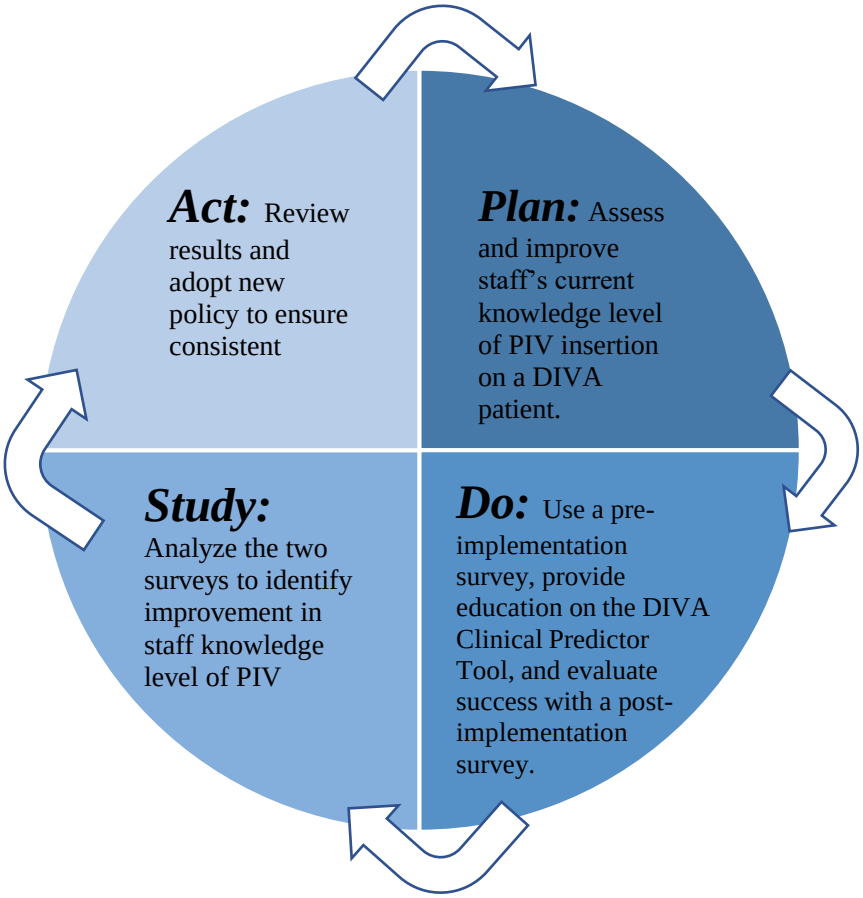
Appendix F

Anticipated Budget

Cost Category	Resource	Detail	Total Cost in Dollars
Direct Costs	Labor	DNP Project Leader	$0
	Materials	Paper, Ink	$50.00
	Time (4 hours @ $40)	Cost of time spent with unit staff	$160.00
		Total project costs:	**$210.00**

Appendix G

Evaluation Plan



Appendix H

Diva Clinical Predictor Tool Case Studies

The DIVA Clinical Predictor Tool Case Studies

1. A 32 y.o. male presents with vomiting for the last 48 hours. Upon assessment, you notice tattoos and the absence of a visible vein when the tourniquet is applied. What is his DIVA score?

2. A 24 y.o. female presents for sickle cell pain and states she is in crisis. She denies vomiting or history of IV drug use. Your assessment reveals no scars or tattoos. Her skin is soft and she has a normal BMI. What is her DIVA score?

3. A 42 y.o. male needs a CT scan with contrast dye. He admits he has a history of IV drug use and you notice many scars on his upper extremities. What is his DIVA score?

4. A 69 y.o female needs PIV access and a blood draw. She has a history of a left sided mastectomy and is currently on chemotherapy for ovarian cancer. After applying the tourniquet, you cannot visualize the vein but you can palpate it. What is her DIVA score?

5. A 58 y.o. male with diabetes and chronic renal failure needs a PIV. He has a fistula in his left arm and very tough skin. After applying the tourniquet, you cannot visualize or palpate the vein. What is his DIVA score?

A scoring of ____ or more indicates the patient may have difficult IV access and may benefit from alternative insertion techniques.

Appendix I

Alternative Insertion Techniques

Alternative Insertion Techniques

- Ultrasound guided IV
- BD Nexiva Diffusics catheters
- Heat application
- Experienced clinician

Appendix J

Implementation Surveys

Pre/Post Implementation Survey

True or False A patient 65 years and older is considered elderly and may contribute to difficult IV access.

True or False Applying a tourniquet should reveal a vein which is visible and palpable.

True or False Scars, tattoos, and tough skin contribute to difficult IV access.

True or False Hypovolemia and hypervolemia are considered altered fluid status and may contribute to difficult IV access.

Check which conditions listed below you think contribute to difficult IV access

- ☐ Chemotherapy
- ☐ Chronic renal failure
- ☐ Sickle cell
- ☐ Diabetes
- ☐ IV drug use
- ☐ Only one arm available

Appendix K

Introduction E-mail

Greetings! I am very excited to share with you a quality improvement project I have been working on. For my DNP project, I am addressing the issues we have with peripheral intravenous catheter insertion on patients with difficult access (difficult sticks). I believe if we improve our insertion practices, we can improve the patient experience and unit outcomes.

This project is expected to take ≤ 15 minutes of your time. The time will consist of a quick one-on-one education session. Any remainder of time can be spent completing 2 short surveys. I plan to catch you at the change of shift after you have given hand-off patient report.

Please note: While the education session is mandatory, completion of the 2 surveys is voluntary. No identifying data will be linked to the surveys. There is no penalty for withdrawing.

Thank you for potentially allowing me this opportunity to share my DNP project with you!