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Implementation of a Venous Thromboembolism Protocol and its Impact on Nurses' Attitudes and Knowledge

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Implementation of a Venous Thromboembolism Protocol and its Impact on Nurses' Attitudes and Knowledge:

Literature Review

BY

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Literature Review

This Doctor of Nursing Practice (DNP) Project is approved as a credible and independent investigation by a candidate for the DNP degree and is acceptable for meeting the project requirements for this degree. Acceptance of this DNP Project does not imply that the conclusions reached by the candidate are necessarily the conclusions of the major department.

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Abstract

Introduction: Venous thromboembolism (VTE) is the leading cause of preventable death in the United States following a surgical procedure. Nurses working with surgical patients should be comfortable with completing a VTE risk assessment, following prophylaxis recommendations, and recognizing the importance of proper prophylaxis.

Methods: A literature search was completed utilizing CINAHL, EBSCO, ScienceDirect, Journals@Ovid, PubMED, and Wiley Online Library. Search terms included: venous thromboembolism, risk, prevention, prophylaxis, nursing knowledge, competency assessment, educational measurement, questionnaire, survey, Caprini risk score, Caprini risk assessment, and surgery. There were nine articles that were relevant and utilized for this quality improvement project.

Gaps: There are limited published articles specific to the United States regarding nursing knowledge on VTE. There were no articles found that focused on rural settings and VTE prevention. Evidence pertaining to nurses completing the Caprini risk assessment model was not present within the literature.

Recommendations for Practice: The Caprini risk assessment model should be utilized with every surgical patient to decrease death and disability from VTE. Nurses and providers need education specific to the Caprini risk assessment model, as prevention requires a multidisciplinary approach.

Keywords: Caprini risk assessment model, VTE education, nursing knowledge and attitude

Implementation of a Venous Thromboembolism Protocol and its Impact on Nurses' Attitudes and Knowledge

Worldwide, venous thromboembolism (VTE) is the third most common cause of mortality and is comprised of pulmonary embolism (PE) and deep vein thrombosis (DVT) (Pannucci et al., 2017; Sousa da Silva et al., 2020). Not only is VTE deadly, but it is the cause of 250,000 hospitalizations annually in the United States (U.S.) (Pannucci et al., 2017). The occurrence of VTE plays a major role in prolonged hospitalization and increases hospital-associated expenses (Wang et al., 2021). Prevention of DVT is key, as initial diagnosis can be challenging and treatment is arduous and not always successful. The Joint Commission, American College of Chest Physicians (ACCP), and U.S. Surgeon General concur that VTE must be prevented to reduce morbidity and mortality (Pannucci et al., 2017).

To decrease the risk of VTE following a surgical procedure, there are a variety of prophylactic options. These include pharmacological, mechanical, and general care, such as early mobilization and exercise (Wang et al., 2021). Currently, VTE prophylaxis has a "one size fits all" approach. This type of approach is supported by the Joint Commission Surgical Care Improvement Project (SCIP)-VTE 2 guidelines, which recommend pharmacological prophylaxis for all general surgery patients unless there is a significant contraindication. These guidelines are imprecise and have the potential of unnecessarily putting a patient at an increased bleeding risk (Pannucci et al., 2017). One tool that takes into consideration patient- and procedure-specific risk is the Caprini Risk Assessment Model (RAM) (Fuentes et al., 2017).

The Caprini RAM recognizes common risk factors for VTE and weighs these factors, resulting in a point score correlating to VTE prophylactic recommendations. These factors include age, weight, medical history, type, and length of surgery. There are over 100 publications validating the Caprini RAM by comparing the score to actual 30-day VTE rates (Golemi et al., 2019). This RAM not only helps with VTE prophylaxis, but also considers a patient's individual bleeding risk and its use does not increase bleeding unnecessarily (Pannucci et al., 2017). The Caprini RAM can be completed by patients or healthcare workers, with an excellent level of agreement. It is universally endorsed by organizations and societies and is extensively validated (Fuentes et al., 2017).

Clinical Question

After an extensive review of the evidence related to VTE prevention prior to surgery and the importance of a protocol, a PICOT question was developed to guide this quality improvement project and is as follows: Among nurses at a rural outpatient surgery center (P), how does the implementation of a VTE prevention protocol (I), compared to no VTE prevention protocol (C) affect nurses' attitudes and knowledge regarding VTE prevention (O) over a 3-month period (T)?

Methods

A literature review was completed focusing on the above-mentioned PICOT question. Databases utilized include Cumulative Index to Nursing and Allied Health Literature (CINAHL), EBSCO, ScienceDirect, Journals@Ovid, PubMED and Wiley Online Library. Search terms used included the following: *venous thromboembolism, risk, prevention, prophylaxis, nursing knowledge, competency assessment, educational*

measurement, questionnaire, survey, Caprini risk score, Caprini risk assessment model, and surgery. Inclusion criteria included peer-reviewed journals written in English and published between 2014 and 2022. Exclusion criteria included publications prior to 2014 and not written in English. Ninety-seven articles were initially found. Abstracts were reviewed and nine articles were found to be relevant to this quality improvement project. These articles were appraised with permission utilizing the Johns Hopkins Nursing Evidence-Based Practice (JHNEBP) Model: Levels of Evidence toolkit (see Appendix C). The articles were compiled into an evidence table (see Appendix A). This resulted in the following levels and grades of articles: three level II articles, five level III articles, and one level V article with seven being grade A articles and two being grade B articles (see Appendix B).

Summary of Evidence

VTE Prevention

VTE is the third leading cause of death in the world (Sousa da Silva, et al., 2020). VTE prophylaxis is crucial, and in its absence, a patient's risk of developing a VTE after surgery is increased by 30% (Tadesse et al., 2020). Between 350,000-900,000 people in the U.S. develop a VTE annually, and 100,000 of them will die (Tadesse et al., 2020). Once someone develops a VTE, there is a 10-30% chance of recurrence within 5 years (Tadesse et al., 2020). Not only is VTE deadly, but it increases hospital length of stay and associated costs (Sousa da Silva et al., 2020). It is estimated that 50% of hospitalized patients are at risk for developing a VTE, but only half will receive the appropriate prophylaxis (Lockwood et al., 2018). Prevention is crucial and must be a priority of healthcare systems (Sousa da Silva et al., 2020). Prophylaxis includes both non-

pharmacological and pharmacological options. These include low molecular weight heparin, unfractionated heparin, direct oral anticoagulants, vitamin K antagonists, intermittent compression devices, compression stockings, and early ambulation (Tadesse et al., 2020). With a wide array of prophylactic options, knowing which one is best for each specific patient can be difficult. There are various tools available that can be utilized to assess a patient's risk for VTE prior to surgery. Popular tools include the Padua Score, the Improve Score, and the Caprini Risk Score (Golemi et al., 2019). The Padua Score and Improve Score are simpler tools but fail to recognize known factors that increase risk of VTE, such as family history of thrombosis and obstetrical complications (Golemi et al., 2019).

Caprini RAM. The Caprini RAM is a tool that can guide prophylactic recommendations based on a patient's individual VTE risk (Tadesse et al., 2020). The RAM was published originally in 1991, with the most recent modification in 2013 (Golemi et al., 2019). The Caprini RAM was created by Dr. Joseph A. Caprini and Dr. Juan Arcelus and has been validated by its use in over 5 million patients. This RAM has appeared in over 200 publications that have validated the scoring system by looking at patient outcomes of 30-day VTE rates (Golemi et al., 2019).

The Caprini RAM considers various factors including weight, gender, age, medical history, family history, and length and type of surgery (Golemi et al., 2019). Each factor is weighted based on literature, and given a point value (Golemi et al., 2019). When the points are totaled, the score is put into a risk category that provides prophylactic recommendations and length of prophylaxis (Golemi et al., 2019). The risk score ranges from 0 to >10. A score ranging from 0-2 means the risk for VTE is low, with

a 0.5% occurrence rate, and early ambulation is recommended. The risk is considered moderate, 0.7%, with a score of 3-4, and also recommends early ambulation. A score of 5-6 rates as high risk, with a 1.8% occurrence and recommendations include early ambulation and heparin, or intermittent compression. Very high risk is a score of 7-8 with a 4% occurrence rate; recommendations include early ambulation, heparin, and possible intermittent compression. Scores of 9 and above are the highest risk, with a 10.7% occurrence rate, and recommendations include early ambulation, heparin, and intermittent compression (Caprini, 2023).

The International Society on Thrombosis and Hemostasis recognizes the importance of VTE prevention. The society issued a "call to action" for all hospitalized patients to have a VTE risk assessment completed with use of the Caprini RAM recommended. This RAM provides a precision medicine approach and optimizes the risk/benefit relationship of a patient receiving VTE prophylaxis. The Caprini RAM identifies not only those that have an increased risk of VTE who would benefit from pharmacological options, but also patients at an increased risk of bleeding from pharmacological options (Pannucci et al., 2017).

Role of Nursing

Nurses are on the frontline of delivering quality care to patients and play an important role in translating guidelines into practice (Wang et al., 2021). Nurses can be the driving force for practice change and improve patient outcomes (Lockwood et al., 2018). Nurses do not prescribe pharmacological prophylaxis, but are crucial in performing risk assessment and educating patients and their families on risks, signs, symptoms, and anticoagulation therapy (Sousa da Silva et al., 2020). A nurse's awareness

can improve early detection and reduce the risk of patients developing a VTE. Reducing VTE involves collaboration among all healthcare workers involved in a patient's care with nurses playing a vital role in the ability to initiate and maintain prevention measures (Kaur et al., 2016).

Worldwide, 25%-40% of patients over 40 years old and having had an operation lasting greater than 1 hour will develop a DVT (Kaur et al., 2016). The occurrence of VTE is a significant health concern that needs to be addressed when caring for surgical patients. Nurses often are the first point of contact for a patient on the day of surgery. Nurses need to be knowledgeable on the prevention, appropriate prophylactic interventions, early recognition, diagnostics, and treatment of VTE. Various methods have been shown to improve nursing knowledge and include teaching programs and self-instructional modules. This increased knowledge may result in improved delivery of care to patients (Kaur et al., 2016).

Nursing knowledge can be difficult to measure. One study by Lee et al. (2014) developed a tool that measures nursing knowledge and perceived barriers toward VTE prevention. This study was conducted in California at two regional hospitals and involved a voluntary 10-minute survey completed by 221 bedside nurses. The survey showed that 44% of nurses rated their VTE knowledge as good and 28% as fair. Only 22% rated their knowledge as very good and 5% as excellent. The study also explored VTE assessments and found that only 26% of nurses completed a VTE risk assessment on all of their patients. Overall knowledge of VTE risk assessments was rated fair or poor in 30% of nurses and 31% reported that they rarely complete a VTE risk assessment on their patients. Nursing confidence was lowest in the ability to complete a thorough VTE risk

assessment when compared to other preventive strategies, such as education, lifestyle changes, and effective use of mechanical devices for VTE prevention. Increased VTE knowledge among nurses was associated with improved self-efficacy of preventive care, including risk assessments. Barriers to VTE preventive care included lack of knowledge, time constraints, and lack of a standardized tool or protocol. This study established the need for education to bedside nurses on VTE assessment and prevention (Lee et al., 2014).

Not only is knowledge important, but a positive attitude toward VTE prophylaxis is also essential. Nurses must have a positive attitude toward prevention and recognize that prevention is an essential and crucial part of nursing care. Nurses must recognize they play an important role in delivering quality care which affects a patient's clinical outcome. Nurses must feel empowered to take ownership of VTE prevention. Their ability to recognize VTE symptoms early is key to effective treatment. Education programs not only improve knowledge, but also improve attitudes toward prevention. Attitude towards a subject is often the result of experience or education and can be a major influence on behavior. Proper VTE prevention requires a multidisciplinary approach (Wang et al., 2021). This will require further training programs that can educate nurses and providers on prevention and VTE risk assessment.

Risk assessment involves coordination between multiple disciplines and needs to be supported by the healthcare system that will assist in delivering and tracking outcomes. This assessment can be paper-based or computer-based and should serve as reminder to providers and nurses to assess a patient's individual risk for VTE and provide decision support by supplying prophylactic recommendations. This approach has

previously been solely placed on the provider; however, nurses provide care at the bedside and are often the first to identify and respond to individual risks for VTE. Lee et al. (2014) showed there is a substantial need for education on VTE risk assessment and prophylaxis recommendations for nurses. Although nurses are unable to prescribe pharmacological prophylaxis, they are responsible for evaluating a patient's VTE risk and performing risk stratification procedures (Lee et al., 2014).

Lockwood et al. (2018) created a nurse-led program that involved education to nurses on VTE and how to apply evidence-based guidelines in caring for hip and knee arthroplasty patients during their hospital stay. This involved implementation and completion of a VTE risk assessment during the preoperative phase, and appropriate prophylactic interventions during the postoperative phase. In this study there was also a control group of nurses that did not receive VTE education. Preoperative nurse compliance with VTE prevention strategies after education at the intervention site was 93%, compared to 41% at the control site. Postoperative nurse compliance with VTE prevention strategies was 82% at the intervention site and 62% at the control site. Nurses can actively promote VTE prophylactic practices and perform ongoing assessments to help prevent or detect VTE sooner (Lockwood et al., 2018). This not only helps to prevent VTE, but also decreases mortality, length of stay, and costs due to adverse events (Sousa da Silva et al., 2020).

Gaps in the Literature

Much of the research regarding nursing knowledge on VTE is from different countries. Evidence is limited on studies done in the U.S. in the last 5 years, especially in rural health. Research focusing on rural nurses' attitudes and knowledge of VTE risk

assessments and prophylactic recommendations is also limited. Evidence specific to nurses completing the Caprini RAM was not present within the literature. In addition, Level I research specific to the Caprini RAM and nursing knowledge was not found in the literature.

Recommendations for Practice

The occurrence of VTE is a major health concern and has been identified by the Centers for Medicare and Medicaid Services as an avoidable complication and a "never event" (Lee et al., 2014). A "never event" is an identifiable, preventable safety issue and has serious consequences for patients (Centers for Medicare and Medicaid Services, 2006). To prevent death and disability from VTE, a risk assessment should be completed on every surgical patient. The Caprini RAM is a risk assessment tool that has been heavily validated with over 100 publications. The Caprini RAM can be completed by patients or healthcare providers with an almost perfect correlation between scores. This assessment must be filled out prior to surgery, either through a patient portal, at the preoperative clearance appointment, over the phone with the preoperative nurses, during the here-time call, or on the day of surgery in the preoperative phase of care. This form takes patients 5 minutes to complete, and another 5 minutes for the provider to complete and review. If the patient is having an inpatient procedure, this assessment can be completed daily to accurately assess their risk, depending on varying clinical problems that could arise or resolve during their stay, such as a central line (Golemi et al., 2019). Prior to implementation of this risk assessment, nurses and providers need education specific to the Caprini RAM. Training programs have been shown to improve risk assessment adherence and accuracy (Wang et al., 2021).

Conclusion

Venous thromboembolism is a worldwide issue with 60% of VTE cases occurring after a recent hospitalization. The World Health Organization declared VTE as the leading cause of death and disability linked to hospitalization in all countries (Golemi et al., 2019). The occurrence of VTE is preventable and must be addressed with initiation of risk assessment tools such as the Caprini RAM for all surgical patients. A validated risk assessment may result in increased awareness and knowledge and positive attitudes in nurses regarding the importance of preventing VTE in patients (Wang et al., 2021).

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survey. *Journal of Clinical Nursing*, *30*(5-6), 773–782.

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Appendix A

Evidence Table

Authors & Date	Study Design/ Method	Participants, Sample, Setting	Intervention/ Variables Studied	Measurement	Data Analysis	Findings/ Recommendations for Practice	Strengths/ Weaknesses	Levels of Evidence
Fuentes, H. E., Paz, L. H., Al-Ogaili, A., Andrade, X. A., Oramas, D. M., Salazar-Adum, J. P., Diaz-Quintero, L., Acob, C., Tafur, A., Caprini, J. (2017) *TH Open 01*(02) e106-112	**Cross Sectional Study: Mixed methods** 3 Phases: 1-interviewed patients and family of DVT support group and asked about CRS and created patient based form. 2-further optimized by using new form with patient and	Phase 1: patients/family of DVT support group-40 participants in 5 sessions. Phase 2: CRS trained physician and 20-patients. Phase 3: measured agreement between CRS scores of 42 patients/fa	Create and validate a new patient friendly CRS. Studied correlation between patient completed and physician completed CRS	Agreement of CRS between patient/family and physician completed. Qualitative and quantitative aspects.	SPSS version 23, kappa value, linear correlation, and Bland-Altman test. Kappa Value = 0.8	The new patient-completed CRS form had an excellent agreement level with the physician-completed form. Took patients an average of 5 minutes to complete. Took physicians as average of 6 minutes to finalize the score.	Participants had low education level making it generalizable to general population. Three-phase validation method. Single site study	Level III, A High Quality

	physician comparison of CRS-BMI an issue. 3-measured agreement level b/t physician and patient	mily and provider						
Golemi, I., Salazar Adum, J. P., Tafur, A., & Caprini, J. (2019) *Disease-a-Month 65*(8)	Expert Opinion, Nonresearch	n/a	n/a	n/a	n/a	Reviews in detail various VTE risks, the Caprini risk score, and the importance of prophylaxis based on individual risk factors	Extremely detailed, nonresearch	Level V, A
Kaur, R., Saagi, M. K., & Choudhary, R. (2016). *International Journal of Nursing*	Quasi-Experimental pre-test and post-test research design	N = 60 nurses, 30 in control group and 30 in experimental group from 1 hospital in Mohali, India	Intervention = structured teaching program on DVT prevention and management; Pre- and post-test data	Knowledge score pre- and post-intervention	Descriptive and inferential statistics	A structured teaching program does improve knowledge of nursing from 27% to 85%	Smaller sample size, one hospital	Level II, B

Education 8(1)								
Lee, J.-A., Grochow, D., Drake, D., Johnson, L., Reed, P., & Van Servellen, G. (2014). *Vascular Nursing 32*(1)	Quantitative, Exploratory descriptive study	N = 221 bedside nurses from 2 regional hospitals in California	Survey to identify nurses' perceived knowledge of VTE, assessment practices, self-efficacy in prevention care and perceived barriers to performing a VTE risk assessment	Nursing knowledge	Chi-square, Student t-tests and correlation; Stata 11.2; Cronbach alpha score was 0.84	Low frequency of VTE assessments, higher VTE knowledge correlated to higher likelihood of VTE assessment, barriers to performing VTE assessment = lack of standardized tool, time and knowledge	Generalization may be affected due to sample from two regional hospitals, participants could skip questions, low response rate	Level III, A
Lockwood, R., Kable, A., & Hunter, S. (2018) *Journal of Clinical Nursing 27*(5-6)	Quasi-experimental study	N=383 adult patients, two private hospitals in Australia	Nurse led evidence based VTE prevention program vs usual care in hip and knee arthroplasty patients	Adherence / Compliance scores on VTE prophylaxis guidelines	SAS v 9.4 and R version 2.3.4 Fisher exact tests and t tests for continuous variables	The intervention group had a compliance rate of 85% and the control group had a rate of 55%.	Large number of participants; lack of random assignment, 2 hospitals, potential for recall bias	Level II, A
Pannucci, C. J., Swistun,	Meta-Analysis,	13 studies	Rates of VTE and clinically relevant	Assessed study quality	Cochrane Collaboration Review	Chemoprophylaxis provides benefit and harm	Did not standardize chemoprophyl	Level II, A

L., MacDonald, J. K., Henke, P. K., & Brooke, B. S. (2017) *Annals of Surgery 265*(6)	observational		bleeding after a surgical procedure	with Newcastle-Ottowa Scale	Manager software version 5.3	when given indiscriminately. Data supports a strong need for precision medicine approach to VTE prophylaxis.	axis type, timing or duration. 2 studies did not report mechanical prophylaxis. Follow up was variable in studies.	High Quality
Sousa da Silva, J., Lee, J.-A., Grisante, D. L., Lopes, J. de L., & Lopes, C. T. (2020) *Acta Paulista de Enfermagem, 33*(4)	Cross-sectional, descriptive study	N=81 nurses	Nurses' self-perceived and objective knowledge, risk assessment, self-efficacy, and barriers to VTE risk assessment	Knowledge, self-efficacy, and perceived barriers. Quantitative and Qualitative data	Microsoft Office Excel and analyzed by descriptive statistics.	Most nurses consider their knowledge of VTE risk assessment good but less than half answered questions correctly. Lack of standardized protocol was the main barrier to VTE risk assessment.	Single institution, convenience sample, results based on nurses' self-reporting	Level III, A High Quality
Tadesse, T. A., Kedir, H. M., Fentie, A. M., & Abiye, A. A. (2020).	Retrospective cross-sectional study-chart review	N=155 patients on a surgical ward at Tikur Anbessa Specialized	Chart review-aimed to assess VTE risk and thromboprophylaxis practices among surgical patients	VTE risk using Caprini model and prophylaxis provided	SPSS version 25	Thromboprophylaxis was only provided for 17.78% of eligible patients, underutilization of	One hospital, chart review-documentation may be missing	Level III, B Good Quality

Risk Management and Healthcare Policy 13		Hospital (TASH) in Ethiopia				thromboprophylaxis due to perception of low incidence, failure to recognize high risk patients, and unfamiliarity with published recommendations		
Wang, Y., Wu, X., Ma, Y., Wang, X., Zhu, C., Cao, J., Jiao, J., Liu, G., Li, Z., Liu, Y., & Zhu, L. (2021) *Journal of Clinical Nursing 30*(5-6), 773-782	Observational, multicentric cross-sectional survey	N=485 Nurses from 256 wards in 16 hospitals in China	Nurses' knowledge, attitude and practice of VTE prophylaxis	Survey measuring nurses' attitude and knowledge; prophylactic practices extracted from medical records	SPSS statistical software version 25. Categorical variables expressed as percentages, continuous variables expressed as mean ± standard deviations	Low level of VTE prophylactic knowledge among orthopedic nurses, urgent need for additional training and continuing education, increase use of mechanical prophylaxis	Large study with nurses from 16 hospitals, potential for confounding and information bias due to conducting a secondary analysis of survey data	Level III, Grade A

Appendix B

Levels of Evidence

Level of Evidence		Grade	
II	**3**	**A**	**7**
III	**5**	**B**	**2**
V	**1**		
Total	**= 9**		**= 9**

Appendix C

JOHNS HOPKINS EBP MODEL AND TOOLS- PERMISSION

[redacted]

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Implementation of a Venous Thromboembolism Protocol and its Impact on Nurses' Attitudes and Knowledge:

Methodology

BY

Mikelle Eliason

A paper submitted in partial fulfillment of the requirements for the degree

Doctor of Nursing Practice

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Abstract

Background: Venous thromboembolism (VTE) is a leading cause of preventable death following a surgical procedure in the United States. To reduce this risk, it is crucial that nurses are able to recognize VTE risks, perform a VTE risk assessment, and follow appropriate prophylactic recommendations.

Methods: Nurses received VTE education and the Caprini risk assessment model (RAM) was initiated at a rural outpatient surgery center. A pre- and post-questionnaire approach was utilized to evaluate nurses' attitudes and knowledge on VTE risk assessment. Utilization of the Caprini RAM was tracked.

Results: There were 8 nurse participants. At a 5% level of significance, there was an overall improvement in mean knowledge scores and improvement in attitudes. P-values were very close to the significance level. Caprini RAM utilization was 74%.

Discussion: Results of the project suggest that education and implementation of a VTE risk assessment improves nursing knowledge and attitudes, but more evidence is needed to come to a definitive conclusion.

Implications for Practice: Educating nurses on VTE and risk assessment has the potential to improve nurses' knowledge and attitude. Increased awareness may promote proper VTE prophylaxis for surgical patients, having the potential to improve patient outcomes by decreasing VTE rates, and possibly saving lives.

Keywords: Caprini risk assessment model, VTE education, nursing knowledge and attitude

Implementation of a Venous Thromboembolism Protocol and its Impact on Nurses' Attitudes and Knowledge

Nurses have the ability to impact venous thromboembolism (VTE) prevention and prophylactic intervention implementation. Multidisciplinary cooperation is needed to improve VTE risk stratification and secure appropriate prophylaxis (Wang et al., 2021). To ensure a high level of care, nurses must be educated and confident in VTE risk assessment and practice recommendations (Kaur et al., 2016). Educating nurses on VTE and risk assessment not only improves nursing knowledge but also improve nurses' attitudes, which can play a major role in nurses' behavior (Wang et al., 2021).

Background/Purpose

In the United States (U.S.), VTE, including pulmonary embolism (PE) and deep vein thrombosis (DVT), is responsible for the death of more people each year than breast cancer and motor vehicle crashes combined (Pannucci et al., 2017). It is estimated that 350,000-900,000 people in the U.S. will develop VTE annually, with 100,000 dying (Tadesse et al., 2020). One-third of VTE deaths occur after a surgical procedure (Pannucci et al., 2017). Preventing VTE is important as diagnosis and treatment can be difficult and ineffective (Pannucci et la., 2017). The American College of Chest Physicians (ACCP), The Joint Commission, and The U.S. Surgeon General agree that prevention is crucial in decreasing morbidity and mortality due to VTE (Pannucci et al., 2017). With prevention being the critical element, there should be an individualized risk stratification tool utilizing patient specific factors to predict VTE risk and appropriate prophylactic interventions (Pannucci et al., 2017). Utilizing a risk assessment tool, like

the Caprini risk assessment model (RAM), provides a precision medicine approach to preventing VTE (Pannucci et al., 2017).

The Caprini RAM has been proven effective in over 100 studies comparing risk scores with 30-day VTE rates (Golemi et al., 2019). The Caprini RAM has been more extensively validated than any other risk assessment tool (Fuentes et al., 2017). This risk assessment considers a patient's individual risk factors and has been shown to spare patient's anticoagulation prophylaxis, which decreases bleeding complications while still ensuring efficacy (Fuentes et al., 2017). This assessment can be filled out by patients, providers, or nurses and takes around 5 minutes to complete (Golemi et al., 2019). The assessment can be revised during a patient's stay to account for a change in clinical course, such as central line insertion or other infection (Golemi et al., 2019). Once the Caprini RAM is completed, a score is given that correlates to a risk level and appropriate prophylactic recommendations (Tadesse et al., 2020).

Nurses play a major role in translating guidelines into practice (Wang et al., 2021). Studies have shown that American nurses have a high level of knowledge of VTE risk factors, but they do not have a high knowledge of prophylaxis recommendations or signs and symptoms of VTE (Sousa da Silva et al., 2020). Although nurses do not prescribe prophylaxis for VTE, they should be performing risk assessments and educating patients and their families (Sousa da Silva et al., 2020). The nurse is often the first point of contact for a patient, thus making it crucial for them to be able to identify VTE risk and know how to respond to this risk (Sousa da Silva et al., 2020).

PICOT Question

The PICOT question developed for this quality improvement project is as follows: Among nurses at a rural outpatient surgery center (P), how did the implementation of a VTE prevention protocol (I), compared to no VTE prevention protocol (C) affect nurses' attitudes and knowledge regarding VTE prevention (O) over a 3-month time period (T)?

Evidence Findings

Nurses are at the frontlines of delivering care and must be change agents to drive improvements (Lockwood et al., 2018). Nurse-led VTE interventions have shown significant influence in changing practice and improving adherence to VTE guidelines (Lockwood et al., 2018). A study by Lee et al. (2014) showed that nurses lack confidence in completing a comprehensive VTE risk assessment. Barriers to completing a risk assessment included lack of time, lack of knowledge, and lack of a standardized tool (Lee et al., 2014). Nurse education has been shown to increase compliance with VTE risk assessments and recommended prophylaxis (Lee et al., 2014). The study by Lee et al. (2014) also found that only 7% of nurses rated the quality of their VTE education as excellent, 26% as very good, and 22% as fair (Lee et al., 2014). Only 26% of nurses in this study completed a VTE risk assessment on all their patients (Lee et al., 2014). A study in Australia showed an increase in appropriate VTE prophylaxis from 27% to 85% after education sessions were held for nurses (Lockwood et al., 2018).

For patients VTE is an avoidable complication and should be a "never event" according to the Centers for Medicare and Medicaid Services (Centers for Medicare and Medicaid Services, 2006). A "never event" is an identifiable and preventable safety issue with severe consequences for patients (Centers for Medicare and Medicaid Services,

2006). When properly educated, nurses play a critical role in completing VTE risk assessments and educating patients and their families on VTE risks, signs and symptoms, and prophylactic recommendations (Sousa da Silva et al., 2020). This can then reduce a patient's VTE risk and improve early detection (Kaur et al., 2016).

Recommendations for Practice

In recognizing the lack of knowledge and awareness regarding VTE among nurses, education specific to VTE prevention and risk assessment is needed (Kaur et al., 2016). The study by Lee et al. (2014) found that nurses who had previous education specific to VTE reported better self-efficacy in completing a VTE risk assessment and implementing preventive care. There is a need for the focused education of nurses to improve VTE prevention practices and care (Wang et al., 2021).

To standardize nursing care related to VTE, an evidence-based risk assessment tool should be implemented (Sousa da Silva et al., 2020). A standardized risk assessment tool provides risk stratification and prophylactic recommendations that result in successful prevention of VTE (Tadesse et al., 2020). Implementing the Caprini RAM helps ensure proper VTE risk identification and prophylaxis (Pannucci et al., 2017). Education on the RAM can be included with the VTE education provided to nurses. This tool is user friendly and can be completed by nurses or patients prior to surgery (Golemi et al., 2019). Studies have shown a nearly perfect correlation between provider and patient completed forms (Golemi et al., 2019).

Gaps

There was little research on nursing knowledge and VTE risk assessments specific to the U.S., with most studies occurring in different countries. Studies that were

completed in the U.S. were not completed within the past 5 years. There was a lack of evidence specific to rural facilities and VTE prevention, with most studies taking place at urban medical facilities. No evidence was found regarding nurses' attitudes toward completing the Caprini RAM on patients. High quality level I research was not found related to implementation of the Caprini RAM and nursing knowledge.

Methods

Change Theory

The Johns Hopkins Evidence-Based Practice (JHEBP) Model was utilized in this project (Dang et al., 2022). The change theory of self-efficacy by Bandura was applied to motivate and call nurses to action (Bandura, 1989). A high sense of self-efficacy helps one visualize success and is a positive guide for performance (Bandura, 1989). The theoretical framework Nursing as Caring (Boykin & Shoenhofer, 2020) expects nurses to possess and utilize a well-developed knowledge base to provide their commitment of caring.

Setting

This project took place in a rural outpatient surgery center in the Upper Midwest. There are two endoscopy suites and two operating rooms at this facility. This project focused on patients having a surgical procedure and excluded endoscopy patients. At this facility, registered nurses (RNs) are trained in all areas, including the preoperative (preop) area, circulating cases (intraoperative), and the post-anesthesia care unit (PACU). Participation in this DNP Project from all RNs employed at this facility was requested but optional for RNs. The VTE educational session was required by the facility for all RNs to attend, but project survey participation was voluntary. There are five patient bays located

in the surgery area that serve as the preop and PACU areas. Four of the bays are divided by walls on three sides and a curtain on one, making privacy an issue at times. The bays are equipped with a computer to chart within the electronic health record (EHR), a vital sign machine, suction, oxygen, and a bed. Sequential compression devices (SCDs) and Baer huggers are also available for all bays. The goal was that patients would have already completed the Caprini RAM with the nurse via telephone prior to the day of surgery, but this could be completed in the preop phase of care if this tool was not already completed.

The nurses at this facility are responsible for calling every patient 2 business days prior to their procedure to tell the patient their arrival time and nothing per os (NPO) instructions. This call is known as the "here-time" call. The Caprini RAM was reviewed with the patient during this call. Patient answers were recorded on paper (see Appendix C). This assessment then went into the patient's paper chart that follows them on their day of surgery. This is known as the preop packet and it included the Caprini risk score and prophylactic recommendations, which were reviewed on the day of surgery by all nurses caring for that patient. Nurses had the opportunity to verbalize the Caprini prophylaxis interventions to the surgeons or advanced practice providers before surgery.

Sample

The sample for this DNP Project included RNs working at an outpatient surgery center. These RNs had a wide variety of nursing backgrounds, including flight, intensive care unit, medical-surgical, obstetrics, emergency department, and nursing home. Ten nurses were employed at this surgery center at the time of project implementation. There were eight full-time nurses and two part-time nurses. Three nurses have their bachelor of

science degree in nursing, while seven have an associate degree in nursing (See Appendix D). There were ten nurses eligible to participate in the project. One nurse was out on medical leave during implementation and the DNP Project Manager, who is employed at the facility, was excluded from participation.

Intervention Tools

The Caprini RAM and a nursing survey was implemented in this project. The VTE Prevention Knowledge and Attitudes Questionnaire developed by Wang et al. (2021) (See Appendix E) was utilized to measure nursing attitude and knowledge and was available for use without permission. This questionnaire was developed based on the 9th edition guidelines from the Antithrombotic Therapy for VTE Disease: Antithrombotic Therapy and Prevention of Thrombosis. This questionnaire has 14 questions, nine measuring knowledge and five measuring attitudes. Correct answers specific to knowledge gain a score of 1, whereas incorrect answers receive a score of 0. The scores on knowledge can range from 0-9. The attitude specific questions involve a Likert scale with 1=strongly agree, 2=somewhat agree, 3=somewhat disagree, and 4=strongly disagree. The validity of this questionnaire was evaluated by five nursing experts, two rounds of expert reviews, and has a Cronbach's alpha score of 0.810 (Wang et al., 2021).

The Caprini RAM was first published in 1991, with modifications in 2005 and 2013, and was created by Dr. Joseph A. Caprini and Dr. Juan Arcelus. The Caprini RAM is an individualized risk stratification tool that identifies a patient's risk for VTE and includes prophylactic recommendations (Pannucci et al., 2017). This RAM tool considers various factors such as weight, gender, age, length and type of surgery, and past medical history (Golemi et al., 2019) (See Appendix C). There are a series of questions for

providers, nurses, or patients to answer, which then provides a score and places the patient in a risk level category (Caprini, 2023). Approval to use the Caprini RAM was received (See Appendix F).

Scoring on the Caprini RAM ranges from 0-9 or greater and places the patient in a risk category. A lower score correlates to a lower risk category that only recommends early ambulation. A higher score correlates to a high-risk category and recommends early ambulation, unfractionated heparin (UFH) or low molecular weight heparin (LMWH), and intermittent pneumatic compression for a specified time. Scores in between low and high risk have varying recommendations of the interventions listed (See Appendix A). Total joint replacements fall under a different scoring system and will not be described as total joint replacement surgeries are not performed at this facility. The Caprini RAM has been validated in almost 5 million patients in over 200 peer reviewed publications (Caprini, 2023).

Project Procedure

This project was approved by the key stakeholder at the facility (see Appendix B) and the nursing research council at the site of project implementation. Prior to project implementation, providers were informed of the project. This helped prepare the providers for nurses recommending prophylactic recommendations based on the risk score. Participation among nurses and patients was completely voluntary. The RN participants attended a 20-minute education session on the Caprini risk assessment and VTE signs and symptoms, risks, and prevention. Education was provided by the DNP Project Manager with a PowerPoint presentation (see Appendix G). Nurses were given the VTE prevention knowledge and attitudes questionnaire prior to education starting

(see Appendix E). After a 3-month implementation period, nurses were given the questionnaire again. The questionnaire was on paper, and nurses were instructed to place the first three letters of their mother's maiden name at the top of the questionnaire, to allow for survey pairing and anonymity.

Implementation of the Caprini RAM involved all RNs. Patients were asked by the RNs to complete the questionnaire over the phone during their here-time call. If the patient had not completed this questionnaire prior to the day of surgery, the preop RN either asked the patient the risk assessment questions or had them fill it out themselves. Once completed, the Caprini risk score could be found in the patient's paper chart that follows them on the day of surgery, along with the appropriate VTE prophylactic recommendations. These recommendations were also posted at the nurses' station.

To encourage project participation, signs were hung at all nurses' stations to serve as a reminder to complete the Caprini RAM on all adult surgical patients. The DNP Project Manager reminded nurses about Caprini RAM completion at weekly meetings to encourage completion of the RAM and to promote open communication from nurses regarding questions or concerns related to RAM completion. An email was sent during project implementation that reminded nurses of key education points (see Appendix H). The DNP Project Manager was available at the facility 2 days each week to answer questions and collect data. All participants had access to the DNP Project Manager's cell phone number.

Data Collection. When completing the pre- and post-questionnaires, RN participants utilized the first three letters of their mother's maiden name to allow for anonymity and survey pairing during data analysis. Nurses were informed their consent

was given by completion of the paper questionnaire. Tool utilization was tracked and the number of patients that completed the assessment was compared to the total number of surgical patients during implementation.

Ethical Considerations

Approval for this DNP Project was given by the health system's nursing research council, the chief of surgery, and the key stakeholder. Approval was sought through the facility's institutional review board (IRB) (see Appendix A) and this approval was accepted by the university. Questionnaires completed by RNs were collected and stored in a locked, secure location at the facility with only the DNP Project Manager having access.

Results

Demographics

Data collected on nursing participants included age, gender, nursing degree type, years of experience, employment status, and if they had previously completed a VTE risk assessment (See Appendix D). A total of eight nurses participated in the project. Three nurses were aged 40-49 and five nurses were aged 30-39. All participants were female. Six nurses had their associate degree in nursing and two had their bachelor's degree in nursing. Years of nursing experience ranged from 5-17 years. Seven of the participants worked full-time and one participant was part-time. Prior to project implementation, six of the nurses had never completed a VTE risk assessment on a patient. Two nurses had completed VTE risk assessments but did not know the name of the assessment, as it was built into a previous employer's electronic charting system.

Statistical Testing Results

Statistical analysis was performed by the DNP Project Manager under the guidance of a university statistician. The knowledge questions were analyzed using a paired test known as the Wilcoxon signed-rank test. This is a non-parametric test, as normal distribution could not be assumed based on a sample size of eight. A significance level of 5% was used. The null hypothesis was that the difference in mean scores pre- and post-implementation was zero. This would imply there was no difference in scores before and after project implementation. Two alternative hypotheses were tested. The first was that the mean difference between pre- and post-scores is not equal to zero. The second alternative hypothesis was that the mean of the post-score is greater than the mean of the pre-score, which would indicate an improvement in scores.

Testing the alternative hypotheses resulted in failing to reject the null hypothesis for the first alternative (p-value 0.0625) and rejecting the null hypothesis with the second alternative (p-value 0.03125). These gave contradictory results due to the p-values being very close to the significance level. The results suggest rejecting the null hypothesis, which would mean there was an improvement in nursing knowledge, but there is not enough evidence/data to give a conclusive answer (Appendix I).

The attitude questions involved a Likert scale and required converting responses into numerical values which resulted in strongly agree=1, somewhat agree=2, somewhat disagree=3, and strongly disagree=4. The responses were then looked at in the aggregate by taking the mean of the responses of the five attitude questions. The Wilcoxon signed-rank test was used again as the data is paired into pre- and post-implementation questions. The null hypothesis and first alternative hypothesis remain the same as above.

The second alternative hypothesis is changed to test whether responses changed toward the direction of agree, from pre- to post-implementation.

Testing the alternative hypotheses resulted in failing to reject the null hypothesis for the first alternative (p-value 0.0625) and rejecting the null hypothesis with the second alternative (p-value 0.03125). These also gave contradictory results due to the p-values being very close to the significance level. The results suggest rejecting the null hypothesis, which would mean there was an improvement in nursing attitudes, but there is not enough evidence/data to give a conclusive answer (Appendix J).

It is interesting to note that the most change seen when looking at the attitude statements was from statement five. This statement was, “I think the occurrence of VTE is related to low-quality nursing care”. This statement saw the greatest change in shifting from disagreeing to strongly agreeing.

During the implementation phase, a total of 82 surgical patients met the requirements to participate in the project. The Caprini risk assessment was completed on 61 patients. Overall, the utilization rate was 74%.

Clinical Outcomes

The clinical outcomes in this project support the theory that implementing education and a VTE risk assessment does improve nursing knowledge and attitudes regarding VTE, but more evidence is needed to come to a definitive conclusion. This project helped nurses gain a better understanding of VTE and the role they can play in prevention, which has the possibility to improve nursing confidence. Nurses found the Caprini RAM easy to use and were supportive of permanent implementation within the electronic charting system.

Utilization of the Caprini RAM was 74%. The goal of at least 50% was met, but 100% would be ideal. This supports the need for the facility to implement the Caprini RAM for all adult surgery patients and make it a requirement in the electronic health record. This would help to ensure greater utilization.

Discussion

Barriers

Barriers for this project included RN participation. Adding the Caprini RAM into the here-time call or the preop phase added additional time needed by the nurses to prepare the patients for surgery. Another barrier was patient participation in answering more questions, but once they were educated on why these questions were being asked, participation was not an issue. Another barrier was change. Adding in the Caprini RAM was new, making it an easy step to forget. Also, most charting is completed via the EMR. With this assessment being completed on paper, this posed an additional barrier.

Implications for Practice

Impact on Organization

This DNP Project positively affected the organization and the nurses working there. The implementation of an educational session for nurses and completing the Caprini RAM on surgical patients has the potential to improve nursing knowledge and attitude toward VTE. This would be more definitive with a larger sample size. When the Caprini RAM was completed on patients, it ensured they were receiving appropriate VTE prophylaxis, that a patient's bleeding risk wasn't unnecessarily increased, and that patients received adequate VTE prophylaxis. The goal was that this project would show improvement in nurses' attitudes and knowledge, while improving patient outcomes,

resulting in a permanent adoption of Caprini RAM completion on all surgical patients. More data is needed to conclusively say that the project improved nurses' attitude and knowledge.

Finances

The costs of this project included supplies needed to complete pre- and post-questionnaires. This included $10 for paper and pens. There was a $34.19 cost for the locked document box. The cost associated with the statistical consulting was $450. These costs were covered by the DNP Project Manager.

Recommendations for Further Projects

The results of this project support future projects with a larger sample size of nurses carried out at a larger facility with higher patient volumes. Future projects could also compare VTE rates of patients prior to implementation of the Caprini RAM and VTE rates after implementation of the Caprini RAM with strict adherence of prophylactic recommendations. Implementing annual VTE education sessions as a refresher for current nurses and to increase knowledge and attitudes of new employees may also be beneficial.

Limitations

A limitation of this project is that it was completed in a small rural facility with a small patient case load. The surgical cases at this facility are limited to outpatient only and generally have fewer chronically ill patients. Nursing participation and sample size were also limited due to the size of the facility. Another limitation of this project is that there was no control group. However, a control group could pose an ethical issue as there

are known benefits to VTE prophylaxis. Due to this, it cannot be said that the project interventions caused pre- and post-questionnaire changes. Lastly, a limitation was that the nurses already knew the importance of VTE prevention, resulting in a lower mean pre-score, which correlates to strongly agreeing with statements prior to project implementation.

Conclusion

This project supports implementing education and a VTE risk assessment to improve nursing knowledge and attitudes regarding VTE, but more evidence is needed to come to a decisive conclusion**.** This increased knowledge and attitudes can ensure appropriate VTE prevention interventions for every surgical patient are individualized and fit the patient's needs. This will not only help ensure appropriate VTE prevention interventions but will also ensure a patient's risk of bleeding is not unnecessarily increased. This project has the potential to decrease the rate of VTE occurrence by implementing a practice that will ensure each patient has adequate VTE prophylactic interventions. Proper prophylaxis can potentially prevent a VTE occurrence in a patient, which has the potential to save lives (Fuentes et al., 2017).

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Appendix A

Facility IRB Approval

[redacted]

[redacted] **IRB OFFICIAL**
HUMAN SUBJECTS RESEARCH DETERMINATION

Federal regulations and [redacted] Institutional Review Board ([redacted] IRB) policy requires **ALL** research projects involving **humans as subjects** (including involvement of humans in one or more of the categories of research exempted or waived under the federal regulations), **OR the use of identifiable protected health information** be reviewed and approved by an IRB **PRIOR** to initiation of any research related activities, including recruitment and screening activities. The [redacted] IRB is the sole body designed to make official human subjects research (HSR) determinations at [redacted]

[redacted] **IRB will not review submissions after the project has been initiated or completed.**

This completed form is the official determination of the project information submitted to the [redacted] IRB. Please keep this information for your records.

Researcher / Credentials:	[redacted]
Email Address:	
Telephone Number:	
Project Title:	Implementation of a Venous Thromboembolism Protocol and Its Impacts on Nurses' Attitudes and Knowledge
Date of the Submission:	5/9/2023
Determination Date:	5/22/2023
Approved Data Elements:	Age Gender Type of nursing degree Years of nursing experience Employment status Completed a VTE assessment VTE prevention questionnaire Caprini RAMs Number of surgeries during implementation

[redacted] **IRB Determination:**

☐ INSUFFICIENT INFORMATION: Additional information is needed to complete the assessment of this project.

☑ WAIVED: the proposed activity, as described, **DOES NOT** meet criteria of Human Subjects Research. Submission of a [redacted] IRB research application is not required.

v.1.3.23

[redacted]

☐ REQUIRED: The proposed activity, as described, **DOES** meet criteria of Human Subjects Research. The [redacted] IRB office will contact you with the additional documents you are required to submit for further review. [redacted] **IRB approval or the IRB of Record approval must be obtained before the investigator begins research**.

Additional Documents Required:

In [redacted] efforts to ensure protection of our patient's data and before accessing, reviewing, using, collecting, or analyzing any [redacted] protected health information ([redacted] PHI), proper authorizations must be in place **BEFORE** these activities occur. If [redacted] PHI is going to be removed from our covered entity [redacted] approval is required to ensure the process for transfer of the data is secure and aligns with [redacted] policies. It is everyone's responsibility to protect patient's PHI. **DO NOT begin project/research activities until confirmation of receipt of these documents from the [redacted] IRB has been provided to you.**

- ☐ [redacted] Data Use Agreement or.
- ☐ [redacted] Data Use Agreement for Medical Students
- ☑ [redacted] Confidentiality Agreement

** Note: New agreements are required for each project/Human Subject Research submission.

This determination applies only to the activities described in this [redacted] IRB submission and does not apply should any changes be made. If changes are being considered or there are questions about whether [redacted] IRB re-review is needed, please submit a study modification to the [redacted] IRB for determination.

Thank you for your project submission. If you have any questions or concerns, please feel free to reach out to the [redacted]

If you Suspect a Breach of Information or Potential Identity Theft – report concerns to the [redacted]

[redacted] **IRB Determination form completed by:**

[redacted]

[redacted]	5.22.2023
[redacted]IRB Research Compliance Specialist or designee	Date

Appendix B

Facility Approval

DNP Project Site Agreement

Date:

This letter is in support of [redacted] DNP Project, Implementation of a Venous Thromboembolism Protocol and It's Impacts on Nurses' Attitude, Knowledge, and Adherence with the Caprini Risk Assessment Model (RAM), at the [redacted] Surgery Center. This project will provide education on venous thromboembolism, the Caprini risk assessment model, and appropriate prophylactic interventions. Nurses will voluntarily complete a pre- and post-survey to compare pre- and post-implementation knowledge and attitudes. Adherence with Caprini RAM prophylactic recommendations and actual prophylactic practices will be tracked. We agree to provide on-site guidance and resources to aid in project initiatives. [redacted] will serve as the key stakeholder and site sponsor.

We look forward to the results of the project.

[redacted]

Appendix C

Caprini Risk Assessment

[redacted]

Venous Thromboembolism Risk Factor Assessment

Patient's Name:_____ Age: ___ Sex: ___ Wgt:___lbs Joseph A. Caprini, MD, MS, FACS, RVT

Choose All That Apply

Each Risk Factor Represents 1 Point

- ☐ Age 41-60 years
- ☐ Minor surgery planned
- ☐ History of prior major surgery
- ☐ Varicose veins
- ☐ History of inflammatory bowel disease
- ☐ Swollen legs (current)
- ☐ Obesity (BMI >30)
- ☐ Acute myocardial infarction (< I month)
- ☐ Congestive heart failure (< 1 month)
- ☐ Sepsis (< 1 month)
- ☐ Serious lung disease incl. pneumonia (< 1 month)
- ☐ Abnormal pulmonary function (COPD)
- ☐ Medical patient currently at bed rest
- ☐ Leg plaster cast or brace
- ☐ Other risk factors_____

Each Risk Factor Represents 2 Points

- ☐ Age 60-74 years
- ☐ Major surgery (> 60 minutes)
- ☐ Arthroscopic surgery (> 60 minutes)
- ☐ Laparoscopic surgery (> 60 minutes)
- ☐ Previous malignancy
- ☐ Central venous access
- ☐ Morbid obesity (BMI >40)

Each Risk Factor Represents 3 Points

- ☐ Age over 75 years
- ☐ Major surgery lasting 2-3 hours
- ☐ BMI > 50 (venous stasis syndrome)
- ☐ History of SVT, DVT/PE
- ☐ **Family history of DVT/PE**
- ☐ Present cancer or chemotherapy
- ☐ Positive Factor V Leiden
- ☐ Positive Prothrombin 20210A
- ☐ Elevated serum homocysteine
- ☐ Positive Lupus anticoagulant
- ☐ Elevated anticardiolipin antibodies
- ☐ Heparin-induced thrombocytopenia (HIT)
- ☐ Other thrombophilia Type_____

Each Risk Factor Represents 5 Points

- ☐ Elective major lower extremity arthroplasty
- ☐ Hip, pelvis or leg fracture (< 1 month)
- ☐ Stroke (< 1 month)
- ☐ Multiple trauma (< 1 month)
- ☐ Acute spinal cord injury (paralysis)(< 1 month)
- ☐ Major surgery lasting over 3 hours

For Women Only (Each Represents 1 Point)

- ☐ Oral contraceptives or hormone replacement therapy
- ☐ Pregnancy or postpartum (<1 month)
- ☐ History of unexplained stillborn infant, recurrent spontaneous abortion (≥ 3), premature birth with toxemia or growth-restricted infant

Total Risk Factor Score ☐

Please see Following Page for Prophylaxis Safety Considerations

Revised November 4, 2006

1

Caprini Risk Score:

Suggested Prophylaxis Protocols

Caprini Score Risk Score VTE Risk Recommendation Prophylaxis				
Caprini Score	**Risk Score**	**VTE Risk (without prophylaxis)**	**Recommendation**	**Prophylaxis**
0-2	**Low**	**<0.5%**	**Early ambulation**	**During stay**
3-4	**Moderate**	**<0.7%**	**Early ambulation**	**During stay**
5-6	**High**	**1.8%**	**Early ambulation UFH or LMWH, or IPC**	**7-10 days**
7-8	**Very High**	**4.0%**	**Early ambulation UFH or LMWH, ± IPC**	**7-10 days**
9+	**Highest**	**10.7%**	**Early ambulation UFH or LMWH, + IPC**	**30 days**

Appendix D

Demographic Survey

What is your age?

20-29: _____

30-39: _____

40-49: _____

50-59: _____

60+: _____

What is your gender?

Male _____

Female _____

Prefer Not to Answer_____

What type of nursing degree do you have?

Bachelors _____

Associates _____

How many years of nursing experience do you have? _____

What is your employment status?

Full Time: _____

Part Time: _____

PRN: _____

Travel Nurse: _____

Have you ever completed a VTE risk assessment on a patient? Yes_____ No_____

If yes, which one? _____

Appendix E

Questionnaire for Assessing Nursing Knowledge and Attitude on VTE Prevention

VTE Prevention Knowledge and Attitudes Questionnaire	
Multiple Choice （single section）	
1. Which of the following is NOT among the leading causes of VTE?	
□Venous stasis	□Hypercoagulability
□Vessel wall injury	□Wound infection
2. Which of the following increases a person's risk of developing VTE?	
□Major surgery	□Malnutrition
□Hypertension	□Repeated venipuncture
3. Which of the following is NOT applicable for VTE prevention?	
□Quit smoking	□Ankle pump exercises
□Hydration	□Not massaging calf muscles
4. Mechanical thromboprophylaxis is more suitable for which group of patients?	
□Patients with congestive heart failure	□Patients with severe edema of lower extremities
□Patients with varicose veins of the lower extremities	□Patients who have recently undergone skin transplantation of the lower extremities
5. Which of the following descriptions of mechanical thromboprophylaxis is correct?	
□ Wrap the compression sleeve snugly around the patient’s limb. Achieve a snug and secure, but not too tight, fit around all sections of the patient’s limb.	
□If mechanical thromboprophylaxis is used in patients with a high risk of developing VTE, chemical thromboprophylaxis will not be necessary.	
□ To prevent pressure ulcers, larger-sized graduated compression stockings should be used.	

□Intermittent pneumatic compression garments inflate sequentially from a proximal to distal direction.	
6. Which of the following is an absolute contraindication for the utilization of chemical thromboprophylaxis?	
□The platelet count is less than 20 × 10^9/L	□Thrombophlebitis
□Congestive heart failure	□Previous intracranial hemorrhage
7. What should be assessed when using chemical thromboprophylaxis?	
□Bleeding tendency	□Changes in urine volume
□Abnormal liver functions	□Allergic reactions
8. Which of the following symptoms is NOT a clinical manifestation for acute deep vein thrombosis?	
□The skin color turns red and the temperature rises	□Limb ulcer
□Swelling of the legs	□Tenderness along the veins
9. Which of the following are clinical manifestations of pulmonary thromboembolism?	
□Dyspnea, chest pain, hemoptysis	□Chest pain, hemoptysis, coughing up pink foamy sputum
□Chest pain, dyspnea, coughing rust-colored sputum	□Dyspnea, hemoptysis, coughing up pink foamy sputum
Please tick in the following boxes based on how much you agree with each statement.	
1. The prevention of VTE is very important	
□Strongly agree	□Somewhat agree
□Somewhat disagree	□Strongly disagree
2. VTE prevention is one of the important aspects of nursing care	
□Strongly agree	□Somewhat agree

□Somewhat disagree	□Strongly disagree
3. I am willing to prevent VTE by observing the corresponding measures	
□Strongly agree	□Somewhat agree
□Somewhat disagree	□Strongly disagree
4. Nurses should initiatively perform a dynamic assessment to evaluate the risk of VTE	
□Strongly agree	□Somewhat agree
□Somewhat disagree	□Strongly disagree
5. I think the occurrence of VTE is related to low-quality nursing care	
□Strongly agree	□Somewhat agree
□Somewhat disagree	□Strongly disagree

Appendix F

Caprini RAM Use Approval

Caprini score

[redacted]

Sun 2/5/2023 10:36 AM

[redacted]

2 attachments (4 MB)

Venous thromboembolism prophylaxis using the Caprini score.pdf; Thrombosis prophylaxis in surgical patients using the Caprini Risk Score.pdf;

Greetings:
Here is a link to one of my videos. They can all be viewed on my website (www.capriniriskscore.org) under videos on the more resource page. You can also use the tool on my website to score patients and print the results.
Here are several publications also for your review. Of course you have my permission to use the tool in your studies. Please let me know if I can be of further help.

Regards,

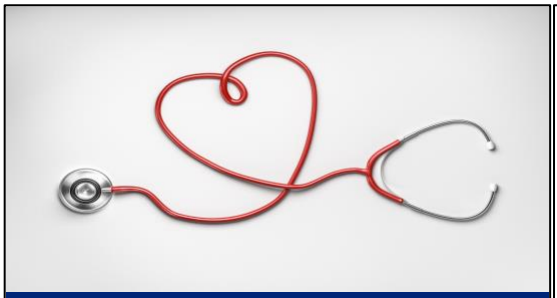
Dr. Caprini.
--https://www.youtube.com/watch?v=U9DcvxpeTTs

Joseph A. Caprini, MD, MS, FACS, RVT

[redacted]

Appendix G

Nursing Education PowerPoint

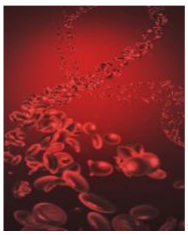


IMPLEMENTATION OF A VENOUS THROMBOEMBOLISM PROTOCOL AND ITS IMPACT ON NURSES' ATTITUDES AND KNOWLEDGE

MIKELLE ELIASON, DNP STUDENT

BACKGROUND

- Venous thromboembolism (VTE) is deadly
- 350,000-900,000 people in the US will develop VTE
- 1/3 of these occur after surgery
- Prevention of VTE is key
- Individualized risk stratification is needed



THE CAPRINI RISK ASSESSMENT MODEL

Precisions medicine

Extensively validated

Considers VTE risk and bleeding risk

Takes 5 minutes to fill out

Scores correlate to risk level

NURSING'S ROLE

Nurses crucial in translating evidence in practice

Nurses need more education on VTE

Nurses should be performing risk assessments

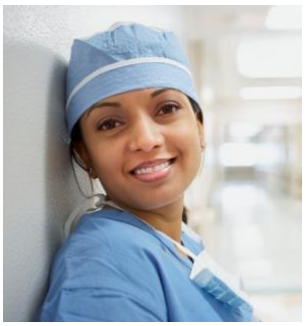
PICOT QUESTION

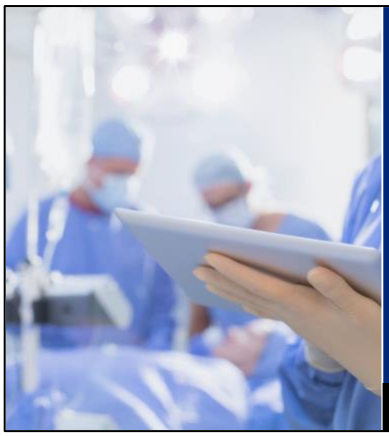
AMONG NURSES AT A RURAL OUTPATIENT SURGERY CENTER (P), HOW DOES THE IMPLEMENTATION OF A VTE PREVENTION PROTOCOL (I), COMPARED TO NO VTE PREVENTION PROTOCOL (C) AFFECT NURSES' ATTITUDE AND KNOWLEDGE REGARDING VTE PREVENTION (O) OVER A 3-MONTH TIME PERIOD (T)?

RECOMMENDATIONS FOR PRACTICE

Education on VTE prevention and risk assessment

Standardize VTE care





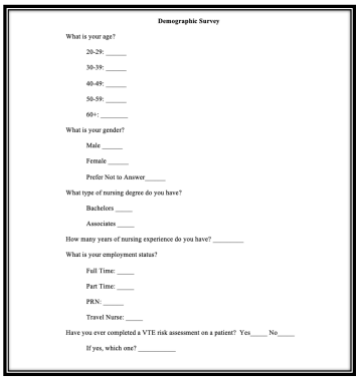
SETTING

Rural outpatient surgery center

Adult patients undergoing surgical procedure

SAMPLE

- RNs working at this outpatient surgery center
- Education will be required by facility manager
- Participation in the DNP Project is voluntary
- Preoperative cell department



Demographic Survey

What is your age?

20-29: _____

30-39: _____

40-49: _____

50-59: _____

60+: _____

What is your gender?

Male _____

Female _____

Prefer Not to Answer_____

What type of nursing degree do you have?

Bachelors _____

Associates _____

How many years of nursing experience do you have? _____

What is your employment status?

Full Time: _____

Part Time: _____

PRN: _____

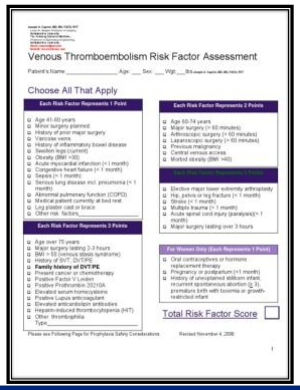
Travel Nurse: _____

Have you ever completed a VTE risk assessment on a patient? Yes_____ No_____

If yes, which one? _____

INTERVENTION TOOLS

- Caprini RAM
- VTE Prevention and Attitudes Questionnaire



Venous Thromboembolism Risk Factor Assessment

Patient's Name _____ Age: ___ Sex: ___ Wgt: ___ BMI (weight in kg/(height in m)²): ___

Choose All That Apply

Each Risk Factor Represents 1 Point

- Age 41-60 years
- Minor surgery planned
- History of prior major surgery
- Varicose veins
- History of inflammatory bowel disease
- Swollen legs (current)
- Obesity (BMI >25)
- Acute myocardial infarction (<1 month)
- Congestive heart failure (<1 month)
- Sepsis (<1 month)
- Serious lung disease incl. pneumonia (<1 month)
- Abnormal pulmonary function (COPD)
- Medical patient currently at bed rest
- Leg plaster cast or brace
- Other risk factors, _____

Each Risk Factor Represents 2 Points

- Age 61-74 years
- Major surgery (> 60 minutes)
- Arthroscopic surgery (> 60 minutes)
- Laparoscopic surgery (> 60 minutes)
- Previous malignancy
- Central venous access
- Morbid obesity (BMI >40)

Each Risk Factor Represents 3 Points

- Age over 75 years
- Major surgery lasting 3-5 hours
- BMI > 50 (morbid obesity-lipohypertrophy)
- Family history of DVT/PE
- Personal history of DVT/PE
- Present cancer or chemotherapy
- Positive Factor V Leiden
- Positive Prothrombin 20210A
- Elevated serum homocysteine
- Positive Lupus anticoagulant
- Elevated anticardiolipin antibodies
- Heparin-induced thrombocytopenia (HIT)
- Other thrombophilia Type_____

Each Risk Factor Represents 5 Points

- Elective major lower extremity arthroplasty
- Hip, pelvis or leg fracture (< 1 month)
- Stroke (< 1 month)
- Multiple trauma (< 1 month)
- Acute spinal cord injury (paralysis)(< 1 month)
- Major surgery lasting over 3 hours

For Women Only (Each Represents 1 Point)

- Oral contraceptives or hormone replacement therapy
- Pregnancy or postpartum (<1 month)
- History of unexplained stillborn infant, recurrent spontaneous abortion (≥ 3), premature birth with toxemia or growth-restricted infant

Total Risk Factor Score ☐

Please see Following Page for Prophylaxis Safety Considerations Revised November 4, 2006

(Caprini, 2023; Golemi et al., 2019)

CAPRINI RISK SCORE VTE RISK PROPHYLAXIS RECOMMENDATIONS

Caprini Score	Risk Score	VTE Risk (without prophylaxis)	Recommendation	Prophylaxis
0-2	Low	<0.5%	Early ambulation	During stay
3-4	Moderate	<0.7%	Early ambulation	During stay
5-6	High	1.8%	Early ambulation UFH or LMWH, or IPC	7-10 days
7-8	Very High	4.0%	Early ambulation UFH or LMWH, + IPC	7-10 days
9+	Highest	10.7%	Early ambulation UFH or LMWH, + IPC	30 days

(Caprini, 2023)

IMPLEMENTATION

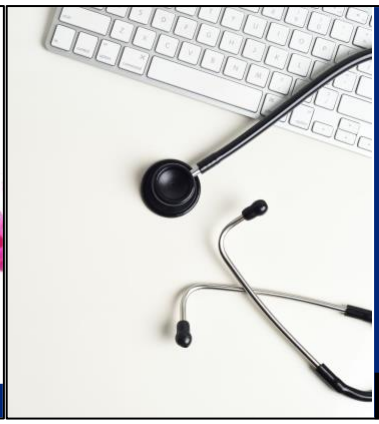
- Caprini risk assessment completed during Here-Time call
- Can be completed day of surgery
- Will only be in paper form, nothing charted within Epic
- Once patient discharged, place completed risk assessment in DNP Project Manager's file

BARRIERS

- This will add additional time to here-time calls or the preoperative phase
- The risk assessment takes less than 5 minutes to complete
- Educate patients when discussing the assessment

IMPACT

- Improve nursing knowledge and attitude
- Ensure appropriate VTE prophylaxis for patients
- Improve patient outcomes



PRACTICE

Patient scenario:
63 year old female having a rotator cuff repair. Her past medical history includes varicose veins and sleep apnea with CPAP use. She has a BMI of 31. Her family history includes diabetes and MI.

Appendix H

Nurse Education Email

Hello Everyone,

Thank you all so much for working hard to incorporate the Caprini Assessment into patient care. I know it takes extra time, but it can truly make a huge difference in a patient's recovery. My project will be completed on September 22nd. At this time another questionnaire will be completed by the nurses.

A reminder of some education the Caprini risk assessment has shown us:

Things that increase a patient's risk for a blood clot include surgery, family history/personal history DVT, age, clotting disorders, varicose veins, and oral contraception to name a few.

Always keep in mind that there may be contraindications for SCD use that include increased bleeding risk, heart failure, peripheral vascular disease, pre-existing DVTs, and lower extremity conditions exacerbated by intermittent compression such as dermatitis or a recent skin graft.

Contraindications for chemical thromboprophylaxis (medications used to prevent clots) include allergy to medication, active bleeding or high risk for bleeding, gastric ulcers, high INR and low platelet count (less than 50 x10^9/L).

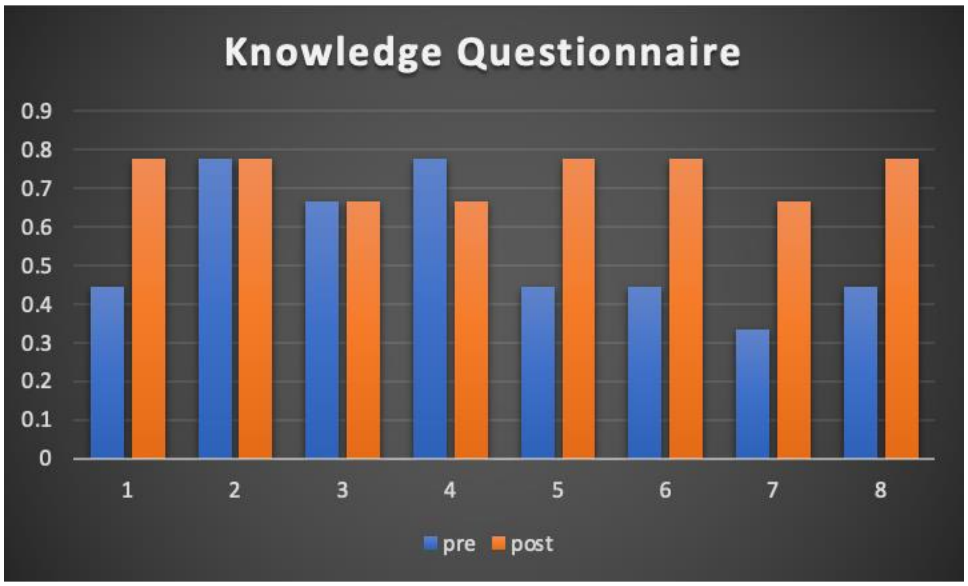
Make sure to teach your patients signs and symptoms of a blood clot: calf pain, erythema, warmth and swelling of the affected extremity. Signs of a PE may include chest pain, dyspnea (shortness of breath), and hemoptysis (coughing up blood).

Thanks again for all your support and hard work during this project implementation. It is truly appreciated!

[redacted]

Appendix I

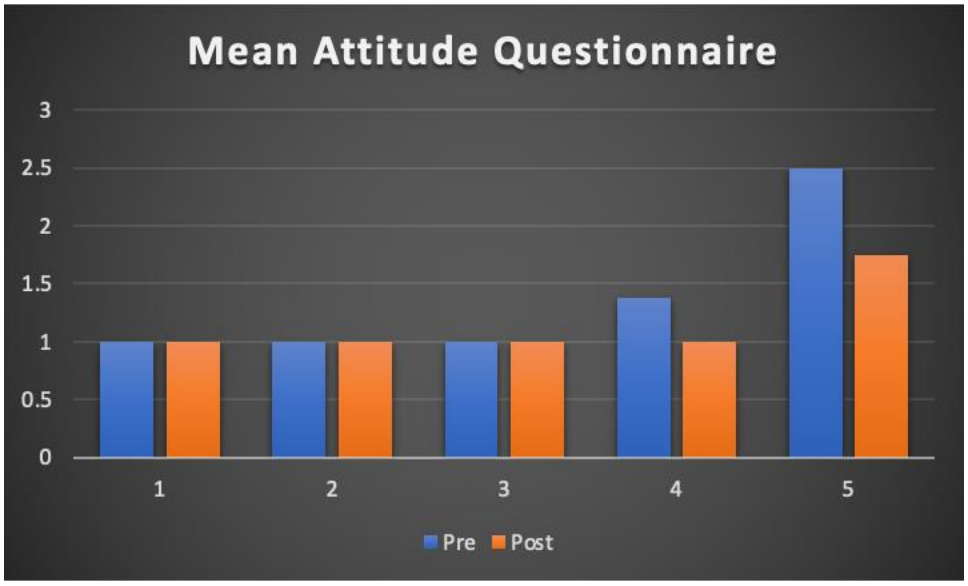
Knowledge Questionnaire Results



Null Hypotheses: the difference in mean scores pre and post was zero	**P-Value**	**Significance Level**	**Result**
Alternative 1: the mean difference between scores pre and post scores is not equal to zero	0.0625	0.05%	Fail to Reject the Null
Alternative 2: the mean of the post score is greater than the mean of the pre score	0.03125	0.05%	Reject the Null & conclude mean post scores were greater than mean pre scores

Appendix J

Attitudes Questionnaire Results



Null Hypothesis: the difference in mean scores between pre and post is zero	**P-Value**	**Significance Level**	**Results**
Alternative 1: the mean difference between scores pre and post scores is not equal to zero	0.0625	0.05%	Fail to Reject the Null
Alternative 2: the mean post score is less than the mean pre score	0.03125	0.05%	Reject the null and conclude mean post scores were less than mean pre scores