**Review Article**

Capstone Project: Educational Enhancements to Reduce Venous Thromboembolism Events in Orthopedic Surgical Patients

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**How to cite this article:** Lehan K and Lehan JR (2021) Capstone Project: Educational Enhancements to Reduce Venous Thromboembolism Events in Orthopedic Surgical Patients. Int J Nurs & Healt Car Scie 01(13): 2021-53.

**Submission Date:** 26 June, 2021; **Accepted Date:** 20 August, 2021; **Published Online:** 26 August, 2021

**Abstract**

Venous Thromboembolism (VTE) is a disease that includes Deep Vein Thrombosis (DVT) and Pulmonary Embolus (PE). DVT’s and PE’s are serious, potentially life-threatening events that afflict orthopedic surgical patients at a higher rate compared to medical and general surgery patients. Many VTE events occur after the patient has been discharged from the hospital. It is a critical responsibility of the nurse to educate patients on preventative measures and recognizing the signs and symptoms that require immediate medical attention as this information could be life-saving. The literature recognizes that nurses are often ill- prepared and lack confidence in their abilities to properly instruct patients regarding VTE. Providing appropriate VTE education that builds upon the nurses’ foundation of existing knowledge increases their confidence and ability to educate patients. The literature concludes that asynchronous online education programs can be used as effective tools to increase nursing knowledge. A prospective test/retest design was utilized to measure the difference in nurses’ knowledge as a result of implementing an online education program on VTE. A total of 87 nurses completed the learning module which was presented in a PowerPoint format. The posttest scores increased within a range of 17 to 24 points with a mean of 19.2 points. This study supports the existing evidence in the literature concluding online educational programs as efficacious learning tools to increase nursing knowledge on this critical and timely condition.

**Introduction and Purpose**

Venous Thromboembolism (VTE) is a disease that includes Deep Vein Thrombosis (DVT), a blood clot lodged in the deep veins, and Pulmonary Embolus (PE), a blood clot that has broken free and traveled to the lungs. DVTs and PEs are serious and life-threatening medical conditions that can result in death. However, they are preventable and, in the event preventative measures fail, treatable when discovered early [1,2]. The Agency for Healthcare Research and Quality (AHRQ) has identified VTE prevention as a key opportunity to improving patient safety [3]. VTE is responsible for more than half a million hospitalizations annually in the United States and is a contributing cause in over 300,000 deaths [4,5]. VTE events burden the U.S. healthcare system, costing an astounding seven to ten billion dollars each year [6]. Certain patients are at higher risk for VTE events, such as those patients who are immobilized after surgery. VTE is a common and serious complication following major orthopedic surgery [7]. According to Virchow’s Triad, patients undergoing orthopedic surgery are at risk in all three critical categories involved in the development of a thrombus - hypercoagulability, vascular damage, and circulatory stasis [8]. Without appropriate preventative measures, VTE events can affect an estimated 40% to 60% of patients undergoing major orthopedic procedures compared to 10% to 40% in medical and general surgery patients. It is estimated that death can occur within one month for approximately six percent of DVT patients and 12% of PE patients [9]. Surgical patients are at increased risk for developing VTE due to numerous clinical factors including tourniquet times, nature of the procedure, physiologic changes that occur as a result of the surgical trauma, and disease-specific comorbidities such as diabetes and cancer [10].

VTE prophylaxis has been identified as a top strategy in improving patient outcomes. The Centers for Medicare and Medicaid Services (CMS) has proclaimed VTE as a “never event”, meaning VTE is preventable [11]. However, prevention strategies identified by the American Academy of Orthopedic Surgeons (AAOS) and the American College of Chest Physicians provide conflicting evidence. From a pharmacological perspective, the concern and continued dispute over efficacious practices verses the increased risk of bleeding has led to continued controversy and disagreement [12,13]. With this reason, as well as time constraints imposed by the semester, in mind, this project’s main focus is on non-pharmacological best practices in the prevention of VTE and those measures that nursing provides which can directly impact and improve patient outcomes. A larger project will continue throughout 2021 to examine standardizing VTE pharmacological prophylaxis for orthopedic spine patients as this has been completed for total hip and knee patients as required by the Joint Commission for Advanced Total Hip and Knee Arthroplasty certification.



VTE is a monitored quality metric at this author’s organization, an orthopedic specialty health care facility. As a result of routine reviews of the monthly quality dashboards, an increase in VTE events was identified. The rise in occurrences was sustained over a four-month period from June 2020 to September 2020. This upward trend resulted in the organization ending fiscal year 2020 at an overall rate of 1.89, above the hospital’s target goal of 1.40 for VTE events. As a result of these findings, a continuous improvement project was initiated to identify areas of opportunity that would result in decreased VTE occurrences and improved patient outcomes. Pingleton, et al. [11] recognized aligning quality improvement initiatives with education as essential. Following a thorough review of the VTE data, the organization decided to focus on enhancing education provided to both nursing staff and patients at risk for VTE events. This author was tasked with developing an online education module (Attachment 1) to build upon the nurses’ existing foundational knowledge of VTE. Both a pretest and posttest (Attachment 2) were created to measure the effect of this intervention on nursing knowledge. Nursing Leadership and the Professional Advancement staff approved the module as one of the required learning courses essential to maintaining total hip and knee advanced certification by the Joint Commission. Therefore, the module will be assigned to all case managers and rehabilitation staff in addition to the entire continuum of nursing staff from prescreening through inpatient. Additionally, this author created a one-page patient education sheet (Attachment 3) to improve patient awareness of the potential complication of VTE following orthopedic surgery, associated risks, and the preventative measures that are recommended. Following approval from the Spine, Arthroplasty, and Nursing Executive Committees, the patient education sheet will be provided to all patients at their pre-admission screening appointments prior to surgery. This information will also be available on the organization’s patient education website as well as the patient education television channel.

In a concept analysis of proactivity in VTE prevention, Adams [14] recognized that the attitude of health care team members on VTE is often reactive verses proactive indicating not enough is done to prevent these events from occurring. Since VTE is an international patient safety issue, prevention-based education is imperative. In a 2020 study conducted by Khan and colleagues [15], a significantly higher rate of VTE rates was identified when compared to what has traditionally been documented in the literature. The authors attributed this increase to the current health crisis. They believed that due to the restrictions imposed by COVID-19, such as self-isolation periods prior to elective surgeries further limiting mobility, patients undergoing elective orthopedic surgery had an even more significant incidence of VTE events. This may be one possible contributing factor to the increase observed at this author’s organization and an interesting perspective on the far-reaching effects of the pandemic. This further highlights the need and timeliness for enhancement to VTE education.

**Outcome Objectives for the Capstone Project**

This educational enhancement project has a two-fold objective - 1. to increase nursing knowledge by building upon the nurse’s existing foundational knowledge of VTE and 2. to increase patient awareness and knowledge related to risks associated with VTE events, signs and symptoms to immediately report to your healthcare provider and appropriate preventative strategies. The ultimate goal is to decrease VTE events within this author’s organization resulting in a return to the target goal of 1.40 or below as a result of these interventions. An essential responsibility of the nurse is to provide patient education. This duty has gained even more importance due to increasingly shorter lengths of stay. Imparting education to the patient empowers them to play an active role in their care and outcome [16].

Increased nursing knowledge was measured with the use of a pretest and posttest administered in conjunction with the developed education module. Collins, et al. [17] identified nursing as the largest group involved in direct clinical care within health care systems. Nurses play a central role in both VTE prevention and providing patient education. The goal of the PowerPoint VTE online education module is to build upon the nurses’ existing knowledge of VTE leading to an improvement in patient care and outcomes as well as an increased confidence to educate patients on the topic. Many VTE events occur after the patient is discharged to home [18], making it especially critical for at-risk patients to be knowledgeable and aware of their risk factors as well as the signs and symptoms that should be immediately reported to their provider. Patients must also understand the rationale for complying with prophylactic measures and the importance of seeking immediate medical attention should any concerning symptoms appear. A new one-page education sheet will be provided and reviewed with all patients at the preadmission screening appointment once approved by senior leadership. After the completion of this project, continued evaluation of the intervention will continue. On the postoperative discharge phone call, patients will be asked a series of brief questions regarding the VTE education that was provided both at the preadmission screening appointment as well as during their course of stay. This information will be used to determine if the educational enhancement impacted patient knowledge. This data will also be used to identify any further opportunities to enhance education along the continuum of patient care.

**Literature Review and Theoretical Framework**

This author conducted a literature review of peer reviewed articles using Medline, PubMed, and CINAHL databases at Emmanuel College’s Cardinal Cushing Library. Reference dates used were from January 2009 to present. Additional literature review was completed using the Nursing Reference Center at this author’s hospital with identical reference dates. Search terms included venous thromboembolism, orthopedic surgery complications, nursing knowledge and education, patient education, online learning, and VTE risks and prevention. Hundreds of articles were identified and reviewed for pertinent content. The articles selected are included on the reference page.

 The fundamental tenets of Knowles’ Adult Learning Theory are centered on adults being autonomous, self-directed learners and possessing both a willingness and motivation to learn [19]. Nurses within the hospital, a Magnet designated organization, realize the significance of continuous, lifelong learning. Nurses are responsible for imparting a great deal of the required education and teaching to patients. Therefore, the nurse must be the content expert in order to provide appropriate, correct and thorough information. Nurses are obligated to effectively communicate vital information that is crucial to an uneventful and successful postoperative recovery. Appropriately educated and trained nurses are accomplished in assessing for VTE risks, ensuring suitable prophylactic measures are in place, and providing essential patient education [17]. Knowles recognized that adult learners possess a foundational knowledge accumulated from life experiences, work activities, and previous education [20]. Education provided through professional development builds upon the nurses’ existing educational framework. Nurses should possess a mastery of knowledge and be confident when providing patient education on the risks associated with VTE events and the best preventative measures to avoid this complication. The literature reports that nurses do not always feel confident in their ability to provide patient education on VTE risks, signs and symptoms, and preventative treatments. This can be a barrier to effectively educating the patient [7,21] discovered that staff often demonstrated low levels of VTE knowledge even in orthopedic institutions where the patients are at the highest risk. They identified the importance of ongoing education for staff to reduce VTE as a result of hospitalization. By understanding and building upon the fundamental aspects of VTE prevention, nurses can be more confident in educating patients on risks and preventative courses of action. Knowles believed that adult learners should be guided in the development of their knowledge [20]. Self-directed learning is the preferred method for adults as this method allows them to have some level of control over their learning environment. Computer-based learning provides this control. Blum and colleagues [22] developed a PowerPoint presentation to educate nurses on issues surrounding VTE. The authors identified this to be an effective learning tool evidenced by the improvement between pretest and posttest scores. Bill Pelz [23], an award-winning professor for excellence in online teaching, identified allowing the student to do the work as one of the main principles of online pedagogy [20]. By increasing nurses’ knowledge of VTE risks and prevention, nurses can be more confident in discussing and educating patients on these preventable events.

According to Knowles’ Adult Learning Theory, the learner’s motivation to learn increases when it results in a feeling of accomplishment [19]. In her concept analysis, Adams [14] found that developing nurses’ knowledge and skills greatly contributed to improving VTE prophylaxis. Furthermore, nurses reported a feeling of empowerment and increased job satisfaction as a result of learning about their impact on improved patient outcomes. Knowles recognized the importance of connecting the impact of the learning to a relevant goal or worthwhile experience for the adult learner. Learners place more value on learning that directly helps them attain a professional goal [20].

In a prospective study by Wolpin and colleagues [24], participants were given a pretest, followed by online VTE education content, followed by a posttest. The authors hypothesized that healthcare providers would demonstrate increased mastery of issues surrounding VTE prophylaxis as a result of completing online educational training. Participants received two separate e-mail notifications of the training. The authors noted multiple benefits of online education including learners having the ability to access the content at a time and place that is convenient to their lifestyle and schedule. The study concluded that participants found the training helpful and approved of the time requirement. An increase of almost 15% in mastery of the VTE content was demonstrated between the pretest and posttest. Wolpin, et al. [24] recommended healthcare facilities offer online training as part of comprehensive VTE prevention efforts.

Munoz-Figueroa and Ojo [25] noted that although deaths caused by VTE events remain the number one preventable cause of hospital deaths, evidence continues to support the lack of awareness among nurses and other healthcare providers about the impact of VTE incidence. During a practice improvement initiative, Duff, et al. [3] found that only 49% of patients were receiving appropriate VTE prophylaxis. Staff education and training initiatives were the key method of intervention used by these authors to improve VTE prevention. As a result of their strategies, a post-intervention audit found that 82% of surgical patients were receiving appropriate VTE prophylaxis - an increase of 21%.

A second objective of this capstone was to increase patient knowledge and understanding of VTE risks factors, signs and symptoms, and prophylactic measures to incorporate and continue following discharge. Due to shorter lengths of stay in the hospital, the execution of delivering patient education in a timely manner has grown even more critical. Because the majority of the hopsital’s surgeries are elective, education begins in the preoperative phase. This allows for a more effective and efficient method of delivering essential patient education. The fundamental tenets of Knowles’ Adult Learning Theory are Andragogy, or an adult-focused learning approach, and self-directed learning, where the learner takes ownership and responsibility of their learning experience [26,27]. This author created a one-page VTE education sheet that will be provided to all patients prior to surgery. Patients can take proprietorship of the learning process once the VTE education sheet is provided and reviewed at their pre-admission screening appointment. Adults must be active participants in the learning process and be goal oriented. This information is timely and relevant to the patient’s recovery and according to Adult Learning Theory, this will further inspire the patient to want to learn from the materials provided [20]. To further reinforce this information, the education tool will be uploaded to the hospital’s patient education portal and viewable on the patient education television channel.

The literature is oversaturated with reports of knowledge deficits related to patient awareness of VTE. Boulton and colleagues [28] conducted a street survey interview of nearly 400 participants and concluded that public awareness of VTE was limited, particularly in relation to VTE as a potential postoperative complication. The National Blood Clot Alliance (NBCA) discovered a significant gap in patient knowledge of VTE as a result of surveying 500 patients following recent hospitalizations [29] completed a global survey of over seven thousand participants in nine countries and found awareness of VTE events to be lowest in comparison to other conditions such as breast cancer, stroke, and heart attack [29]. Patients play an integral role in preventing VTE events when properly educated and engaged in their care. The study conducted by Popoola and colleagues [29] found that 63% of patients preferred to receive VTE education from reading a piece of paper while 55% preferred to receive the education by speaking with a nurse. The majority of patients (94%) were amenable to reading a one-page educational paper on the topic.

Apenteng and colleagues [18] recognized patient involvement as a critical component in preventing hospital-associated thrombosis, or HAT. Despite this fact, they found that only half of the interviewed patients had a clear understanding of PE and DVT when conducting their qualitative study. The study was noted to be consistent with previous research identifying patients as having inadequate knowledge of VTE events. The authors identified the importance of improving patient education in order for patients to have a clear understanding and the ability to recognize signs and symptoms of VTE. In a cross-sectional study, Valizdad Hasnlooie, et al. [30] concluded proper educational sessions for high-risk patients on the topic of VTE prophylaxis led to correct use of preventative measures reducing the incidence of DVT and its complications.

Torres and colleagues [10] identified a higher rate of VTE events among their patient population as a result of reviewing their organization’s quality data. VTE events were noted to be more than double the national benchmark. A multidisciplinary committee was formed and tasked with developing patient-centered education to improve VTE occurrences. They identified patient non-compliance with prophylactic measures as a major contributing issue. The interventions included enhancing staff education and developing a VTE patient education pamphlet that was included as part of the preoperative instructional materials. Torres and colleagues [10] concluded that staff education in combination with supplemental patient education proved to be effective in increasing patient compliance and decreasing VTE events within their institution.

As a result of completing a patient audit, Haymes [31] discovered patients did not possess specific knowledge surrounding VTE risk factors and appropriate prophylactic measures. He instituted targeted written and verbal educational information during the patient’s preoperative assessment as a strategy to improve patient knowledge. The findings from a post-intervention audit demonstrated that the additional patient education provided during the preoperative assessment appointment was effective in increasing patient awareness of various aspects of VTE. Haymes [31] found that the preoperative assessment appointment was an optimal time to begin providing patients with VTE education.

Recognizing the importance of lifelong learning is a tenet within Magnet recognized organizations. As a Magnet designated hospital, the organization prides itself on providing the very best nursing care and fostering continuous improvement within the professional nursing practice. Nurses are encouraged to engage in continuous improvement projects that can directly impact nursing care resulting in improved patient outcomes. Transformational leadership is a hallmark of nursing management within Magnet organizations [32]. The theory of transformational leadership involves a leader working with a team to identify and guide a needed change in tandem. Leaders are enthusiastic about change. They encourage and motivate staff to take an active role in identifying the need for an improvement and allows them to become leaders as well. Critical thinking and research are expected [33]. This project is an example of a continuous improvement project identified by nursing leadership who then empowered this author to work collaboratively with other healthcare professionals to directly impact and improve patient outcomes. Nurses will be educated on the most up-to-date evidence-based practices. They will integrate their newly acquired knowledge into meaningful learning which will translate into patient teaching opportunities that engage the patient to minimize their risk for a VTE event. Transformational leadership is a teamwork type approach to inspire innovation, institute change, and accomplish goals that improve organizational outcomes.

**Methodology**

The hospital is a 118-bed orthopedic specialty hospital in Boston, Massachusetts. The facility is part of a larger system and specializes in the care and treatment of patients with musculoskeletal disorders. The majority of the surgeries performed are considered elective procedures. Patients range from those with no comorbidities to the medically complex.

As a result of identifying an increase in the hospital’s VTE rate during a quality monitor, a continuous improvement program was initiated. A thorough literature review was completed to determine appropriate interventions aimed at improving the VTE rate with a goal of returning to the hospital’s target rate of 1.40 or lower. A VTE subgroup composed of nurses from varying backgrounds and different clinical areas was formed. Opportunities to enhance VTE education for both nursing staff and at-risk patients were identified.

This author created a VTE online education module. The focus of the program was on VTE risks, signs and symptoms, preventative measures, and the importance of providing patient education using Teach Back methodology. The program was assigned to all inpatient nurses across five units including the ICU, 4-East, 4-West, 5-East and 5-West. The material presented in the module was approved by the Executive Director of Professional Development and the Executive Director of Quality and Patient Safety, Clinical Education, Professional Development, and Inpatient Nursing. The module is also being used as one of three mandatory total joint specific educational units for maintaining Advanced Total Hip and Knee Certification by the Joint Commission. As a result, the learning program will also be assigned to all nurses with direct patient care (preadmission screening, post-anesthesia care unit, surgical day), case managers and rehabilitation staff at a later date. A prospective test/retest design was utilized to measure the difference in nurses’ knowledge as a result of the intervention, in this case, the online education module. The education was presented in the form of a PowerPoint presentation which was loaded into HealthStream, hospital’s electronic education management system. The pretest and posttest content were designed in a multiple-choice format and the scramble option was implemented on the questions to increase reliability of the test. All nurses received an autogenerated e-mail notification informing them of the mandatory assigned learning module. The program was completed within a four-week period in March, 2021. The nurses also received an autogenerated alert reminding them to complete the required assignment as the deadline for completing the module approached.

This writer also created a one-page patient education sheet to enhance patient awareness of VTE signs and symptoms and strategic prophylactic measures. The information provided included a definition and explanation of blood clots, signs and symptoms to report immediately, important prophylactic measures, and common medications prescribed to prevent events from occurring. This one-page information sheet will be provided to all patients at their preadmission screening appointment prior to surgery. The preadmission screening provider will review the information with the patient and use teach back methodology to ensure patient understanding. The provider will answer any questions the patient may have on the topic. The educational sheet will be added to the preadmission education packet once approved by senior leadership. Following the initiation of its distribution, patients will be asked a series of brief, pointed questions on the postoperative phone call. This data will assist in evaluating the effectiveness of the education sheet.

VTE events are tracked monthly and documented on the quality monitor dashboards. Continued attention and focus will be spent reviewing the effects of these interventions on event occurrence. Additional continuous improvement interventions will be innovated if an improvement is not apparent from the discussed interventions and strategies.

**Evaluation of the Project Outcomes**

The VTE online education program was launched in HealthStream on March 1, 2021 and concluded on March 31, 2021. The module was assigned to 143 inpatient nurses. A total of 91 nurses initiated the program with 87 completing the entire module within the specified timeframe. The pretest answers were blinded, preventing the participants from learning the correct answers prior to the posttest. The pretest scores ranged from 46% to 53% with a mean of 48.6%. The posttest scores ranged from 65% to 70% with a mean of 67.8%. The posttest scores increased within a range of 17 to 24 points with a mean of 19.2 points (Attachment 4). There were no challenges on any of the test questions.

The pretest scores from this project align with the research conducted by McFarland, et al. [7] and Munoz-Figueroa and Ojo [25] indicating the existence of a knowledge deficit in nurses’ awareness of VTE, even those that work with patient populations at the highest risk. Following completion of the education module, there was a nearly 20-point increase witnessed in the posttest scores. This supports the research findings by Blum, et al. [22] and Wolpin, et al. [24] concluding that a PowerPoint presentation and online education program, respectively, are effective learning tools to increase nursing knowledge on the subject of VTE. These authors recommended the adoption of such programs into existing professional development programs to further enhance learning opportunities. The program designed by this author also supports Knowles belief in guiding the development of knowledge for adult learners. This learning strategy built upon the nurses’ existing foundational knowledge of VTE and the computer-based program allowed them control over their learning environment. Nurses were provided with education that could be potentially lifesaving and improve overall patient outcomes. According to Knowles Adult Learning Theory, awareness of this benefit will increase the nurses’ desire to learn [19].

This author also created a one-page VTE education sheet to enhance patient education on this important topic. Although data collection and evaluation have yet to be completed on this intervention, this initiative aligns with the findings by [29] that 63 % of patients preferred to receive VTE education in the form of a paper hand-out. There is a wealth of literature reporting the existence of a knowledge deficit by patients on the subject of VTE, [18,28,29,31] supporting the need to identify learning opportunities. On the post-operative phone call, patients will be asked if they received education on VTE and if the information was understandable. Data will be collected in May 2021. This data will be analyzed to help determine the effectiveness of the education sheet. According to Knowles Adult Learning Theory, patients will be motivated to learn since the topic is pertinent to a successful recovery [20].

**Summary and Conclusion**

Patient education is critical information and is mainly carried out by nurses [16]. Patient education empowers the patient to improve their outcome and avoid complications and hospital readmission. VTE education should be delivered throughout the entire continuum of care and include all stakeholders including the care team and the patient and care partner [29]. A hallmark of patient-centered care is to empower patients to make informed decisions regarding their care. The American Academy of Orthopedic Surgeons (AAOS) recommend patient education as a preventative strategy for VTE events. Snyder, et al. [12,13] found that the most significant indicator of VTE incidence is patient compliance highlighting the importance of educating the patient on prophylactic measures and signs and symptoms of this potentially life-threatening occurrence.

Knowles recognized the need to demonstrate that learning is both applicable and of value to the learner [20]. VTE education is critical to patients and nurses alike. The learning that results from professional development opportunities, such as the discussed education module, builds upon the nurses’ existing foundation of knowledge and experience further enhancing their ability to properly educate patients. Nurses realize the importance of their role in educating patients and the impact it has on patient outcomes. An estimated 45% - 80% of all VTE events occur after the patient has been discharged from the acute care setting making sound and successful patient education critically important [25]. Patients must be educated on the signs and symptoms that warrant immediate attention as well as prophylactic measures to implement to decrease the occurrences of these events.

As an ongoing continuous improvement program, this author will continue to work collaboratively with the healthcare team to collect and analyze data and identify additional strategies to decrease the hospital’s VTE rate. From a Quality and Patient Safety perspective, the ultimate goal is to provide the safest, high quality care to all patients and continually strive to improve overall patient outcomes.

**Acknowledgement**

I would like to acknowledge the brilliant graduate faculty at Emmanuel College, Boston, MA, for their endless support, guidance, insight, patience and encouragement.

**References**

1. [Lee SI, Allen R, Garfin S (2019) Venous thromboembolism in spine surgery: Review of the current literature and future directions. Seminars in Spine Surgery 31: 1-5.](https://www.sciencedirect.com/science/article/pii/S1040738319300838?via%3Dihub)
2. [Restrepo P, Jameson DL, Carroll DL (2015) Improving deep vein thrombosis prophylaxis with mechanical modalities in surgical intensive care unit. Journal of Nursing Care Quality 30: 31-37.](https://journals.lww.com/jncqjournal/Abstract/2015/01000/Improving_Deep_Vein_Thrombosis_Prophylaxis_With.7.aspx)
3. [Duff J, Walker K, Omari A (2010) Translating venous thromboembolism (VTE) prevention evidence into practice: A multidisciplinary evidence implementation project. Worldviews on Evidence-Based Nursing 8: 30-39.](https://sigmapubs.onlinelibrary.wiley.com/doi/10.1111/j.1741-6787.2010.00209.x)
4. [Agency for Healthcare Research and Quality (2013) Pharmacological and mechanical prophylaxis of venous thromboembolism among special populations.](https://effectivehealthcare.ahrq.gov/products?fB0D=field_product_typeAresearch_report&fB1D=field_product_typeAsystematic_review&fB2D=field_product_typeAtechnical_brief&sort_by=field_product_pub_date)
5. [Tocco, S., Martin, B., & Stacy, K.M. Preventing venous thromboembolism in adults. (2016). Critical Care Nurse 36: 20-23.](https://aacnjournals.org/ccnonline/article-abstract/36/5/e20/3532/Preventing-Venous-Thromboembolism-in-Adults?redirectedFrom=fulltext)
6. [Grosse SD, Nelson RE, Nyarko KA, et al. (2016) The economic burden of incident venous thromboembolism in the United States: A review of estimated attributable healthcare costs. Thrombosis Research 137: 3-10.](https://pubmed.ncbi.nlm.nih.gov/26654719/)
7. [McFarland L, Murray E, Harrison S, et al. (2014) Current practice of venous thromboembolism prevention in acute trusts: A qualitative study. BMJ Open 4: 1-8.](https://bmjopen.bmj.com/content/4/6/e005074)
8. [American Heart Association. (2013). Circulation. AHA Journals.](https://www.ahajournals.org/doi/10.1161/CIRCULATIONAHA.113.004586)
9. [Flevas DA, Megaloikonomos PD, Dimopoulos L, et al. (2018) Thromboembolism prophylaxis in orthopaedics: An update. EFORT Open Reviews 3: 136-148.](https://online.boneandjoint.org.uk/doi/full/10.1302/2058-5241.3.170018)
10. [Torres MB, Kendall HA, Kerwin A, et al. (2020). Venous thromboembolism prevention compliance: A multidisciplinary educational approach utilizing NSQIP best practice guidelines. The American Journal of Surgery, 220: 1333-1337.](https://linkinghub.elsevier.com/retrieve/pii/S0002961020304141)
11. [Pingleton SK, Carlton E, Wilkinson S, et al (2013) Reduction of venous thromboembolism (vte) in hospitalized patients. Academic Medicine 88: 1454-1459.](https://pubmed.ncbi.nlm.nih.gov/23969376/)
12. [Snyder MA, Sympson AN, Scheuerman CM, et al. (2017) Efficacy in deep vein thrombosis prevention with extended mechanical compression device therapy and prophylactic aspirin following total knee arthroplasty: A randomized control trial. The Journal of Arthroplasty 32: 1478-1482.](https://linkinghub.elsevier.com/retrieve/pii/S0883540316309123)
13. [Sheth NP, Lieberman JR, Della CJ (2010) DVT prophylaxis in total joint reconstruction. Orthopedic Clinician North America 41: 273-280.](https://www.sciencedirect.com/science/article/abs/pii/S0030589810000052?via%3Dihub)
14. [Adams A (2015) Proactivity in VTE prevention: A concept analysis. British Journal of Nursing 24: 20-25.](https://www.magonlinelibrary.com/doi/abs/10.12968/bjon.2015.24.1.20)
15. [Khan SA, Logan P, Asokan A, et al. (2020) The incidence of venous thromboembolism in total joint replacement during covid-19 pandemic. Bone & Joint Open 1: 751-756.](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7750738/)
16. [Atay S, Akkaya G, Duygulu S (2020) Nurses’ perception of using empowering discourse for patient education: A qualitative study. International Journal of Caring Sciences 3: 1089-1095.](http://www.internationaljournalofcaringsciences.org/docs/33_1_atay_original_13_2.pdf)
17. [Collins R, MacLellan L, Gibbs H, et al. (2010) Venous thromboembolism prophylaxis: the role of the nurse in changing practice and saving lives. Australian Journal of Advanced Nursing 27: 83-89.](https://www.ajan.com.au/archive/Vol27/27-3_Collins.pdf)
18. [Apenteng PN, Fitzmaurice D, Litchfield I, et al. (2016) Patients' perceptions and experiences of the prevention of hospital-acquired thrombosis: A qualitative study. BMJ Open 6: 1-7.](https://doi.org/10.1136/bmjopen-2016-013839)
19. [Candela L (2020) Theoretical foundations of teaching and learning. In: Billings DM, Halstead JA (Editors). Teaching in nursing: A guide for faculty 6: 247-269.](https://www.elsevier.com/books/teaching-in-nursing/billings/978-0-323-29054-8)
20. [O’Neil CA, Fisher CA, Rietschel MJ (2014) Developing Online Learning Environments in Nursing Education (Third Edition) Springer.](https://silo.tips/download/developing-online-learning-environments-in-nursing-education)
21. [Greenall R (2016) Using patient education to reduce risk of VTE. Nursing Times 12: 5-8.](https://www.nursingtimes.net/clinical-archive/patient-safety/using-patient-education-to-reduce-risk-of-vte-11-07-2016/)
22. [Muñoz-Figueroa G, Ojo O (2015) Venous thromboembolism: Use of graduated compression stockings. British Journal of Nursing 24: 680-685.](https://www.magonlinelibrary.com/doi/abs/10.12968/bjon.2015.24.13.680)
23. [Blum CA, McCaffrey RG, Bishop M, et al (2012) Educating nurses about veno-thrombolytic events (vte). Journal for Nurses in Staff Development 28: 173-176.](https://journals.lww.com/jnsdonline/Abstract/2012/07000/Educating_Nurses_About_Veno_thrombolytic_Events.5.aspx)
24. [Wolpin S, Lee JA, Glenny RW, et al. (2010) Evaluation of online training on the prevention of venous thromboembolism. Vascular and Endovascular Surgery 45: 146-156.](https://cyberleninka.org/article/n/1066563)
25. [Muntz J (2009) Thromboprophylaxis is orthopedic surgery: How long is too long? The American Journal of Orthopedics 38: 394-401.](https://vasocare.com/wp-content/uploads/2019/03/3-Thromboprophylaxis-in-Orthopedic-Surgery-How-long-is-long-enough.pdf)
26. [Sanchez LM, Cooknell LE (2017) The power of 3. Nursing 47: 17-19.](https://journals.lww.com/nursing/Fulltext/2017/02000/The_Power_of_3__Using_adult_learning_principles_to.6.aspx)
27. [Papadakos C, Papadakos J, Catton P, et al. (2014). From theory to pamphlet: The 3ws and an h process for the development of meaningful patient education resources. Journal of Cancer Education 29: 304-310.](https://pubmed.ncbi.nlm.nih.gov/24420003/)
28. [Boulton A, Fenton M, Loka T, et al. (2015) Public knowledge of deep vein thrombosis: A street survey in the suburbs of Birmingham, UK. Quality in Primary Care 23: 31-39.](https://doi.org/10.21833/ijaas.2020.03.014)
29. [Popoola VO, Lau BD, Shihab HM, et al. (2016) Patient preferences for receiving education on venous thromboembolism prevention - a survey of stakeholder organizations. PLOS ONE 11: 1-10.](https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0152084)
30. [Valizad Hasnlooie M, Sharifi H, Zeinali A, et al. (2020) Assessment of the effect of education on correct prophylaxis of deep vein thrombosis among patients admitted to intensive care unit. Medical Journal of Tabriz University of Medical Sciences and Health Services 42: 340-347.](https://mj.tbzmed.ac.ir/Article/22821)
31. [Haymes A (2015) Venous thromboembolism: Patient awareness and education in the pre-operative assessment clinic. Journal of Thrombosis and Thrombolysis 41: 459-463.](https://link.springer.com/article/10.1007/s11239-015-1224-4)
32. [Gokenback V, Thomas PL (2020) Maximizing human capital. In L. Roussel, P. L. Thomas, & J. L. Harris (Eds.), Management and leadership for nurse administrators 8: 189-226.](https://www.jblearning.com/catalog/productdetails/9781284148121)
33. [McNaron ME (2009) Using transformational learning principles to change behavior in the OR. Association of Operative Registered Nurses (AORN) Journal 89: 851-860.](https://aornjournal.onlinelibrary.wiley.com/doi/abs/10.1016/j.aorn.2009.01.027)