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Implementation Guidelines for Total Hip and Total Knee Arthroplasty to Reduce the Incidence of Deep Vein Thrombosis and Subsequent Pulmonary Embolism

Mitchell McCorkle
mccorkle2@otterbein.edu

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Mitchell McCorkle, BSN, RN, CCRN

Department of Nursing, Otterbein University

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DNP Final Scholarly Project Team:

Dr. Brian Garrett, CRNA, DNP, Team Leader

Dr. Amy Bishop, DNP, AGCNS-BC Team Member

Dr. Danielle Winch, CRNA, DNP

Approved by: Brian Garrett, CRNA

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Correspondence concerning this article should be addressed to Otterbein Project Team Leader, 1 South Grove Street, Westerville, OH 43081. bgarrett@otterbein.edu

Abstract

With patients living longer, the orthopedic sector has given rise to joint prostheses as a treatment for those experiencing osteoarthritis (OA). With the increase of these procedures, there is also an increased risk of deep vein thrombosis (DVT) and subsequent pulmonary embolus (PE) following these surgical procedures. The orthopedic medical community and anesthesia providers aim to decrease DVT and PE risk through multiple modalities. The anesthesia focuses on reducing DVT, and PE involves a multimodal approach to each anesthetic. Modalities used for the multimodal approach involve peripheral nerve blocks (PNB), neuraxial spinal anesthesia, early mobilization, postoperative nausea and vomiting (PONV) reduction, and tranexamic acid to prevent bleeding during these procedures. This study's research has concluded that tranexamic acid does not increase the risk of DVT following total hip (THA) or total knee arthroplasty (TKA) in appropriate populations. Muscle-sparing PNB or spinal anesthetics allow for earlier ambulation in THA and TKA patients. A multimodal approach to PONV allows patients to mobilize faster and allows a short post-anesthetic care unit (PACU) stay. Combined and coupled with educating the patient on the importance of early mobilization participation, it decreases the risk of DVT and PE following THA and TKA.

Keywords: deep vein thrombosis, pulmonary embolus, neuraxial anesthesia, PONV, early mobilization, peripheral nerve block, total hip arthroplasty, total knee arthroplasty.

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Introduction

OA is one of the most common conditions affecting the synovial joints of the knees and hips in adults 50 and older. OA begins with an injury to the collagen matrix, leading to cartilaginous outgrowths that eventually ossify and produce osteophytes (Hurley, 2023). Hypertrophy and inflammation of the synovial joints in the hips and knees facilitate more destructive processes within the synovial cavity (Hurley, 2023). Once enough damage affects the joint, the lack of cartilage leaves patients with painful ambulation and activities of daily living, such as basic ambulation. These structures further damage the joint in a positive feedback loop-like process, worsening the patient's quality of life.

Healthcare providers seek to increase the quality of life in these individuals with safe and effective medical practices. Each year, total hip and knee arthroplasties or joint replacement procedures increase as life expectancies increase. From 2012 through 2022, 2.8 million hip and knee procedures have been performed within the United States alone (American Academy of Orthopaedic Surgeons, 2022). When conservative medical management of OA does not improve the quality of life of orthopedic patients, the subsequent line of treatment is surgical intervention total hip (THA) and total knee arthroplasty (TKA). Due to the increasing age of patients, medical comorbidities, and reduced mobility, these patients are at a higher risk of adverse outcomes in the perioperative period for THA and TKA. Pulmonary emboli (PE) often results as a complication of a deep vein thrombosis (DVT) that becomes venous thromboembolism.

Any surgical intervention puts a patient at risk for complications such as DVT and PE. Older populations are at higher risk, and the risk doubles for each decade over 50 (Minges et al., 2018). As the human population ages, the risks accompanying surgery begin to increase. Those

patients undergoing THA and TKA are at an increased risk of DVT and subsequent PE development in the postoperative period. Data collection throughout the history of these procedures reveals a DVT complication rate of up to 39%-74% following THA or TKA (Mula et al., 2020). Diagnosing DVT or PE is multifactorial and utilizes physical manifestations in combination with imaging studies to complete a diagnosis. Physical manifestations of DVT include swelling, tenderness, redness, distended veins, or firmness in a vein (American Academy of Orthopaedic Surgeons, 2021). While these symptoms appear readily appreciable, this is not always the case. According to the Centers for Disease Control and Prevention (2022), nearly half of people experiencing DVT do not show symptoms.

The clinical presentation of PE is often non-specific and may lead to a missed diagnosis in patients exhibiting symptoms (Ouellette, 2020). A missed diagnosis can be detrimental to patient outcomes, leading to significant patient morbidity and mortality. Classic signs and symptoms of PE are pleuritic chest pain, shortness of breath, hypoxia, and some non-specific signs are syncope, wheezing, productive cough, fever, decreased level of consciousness, and new-onset atrial fibrillation (Ouellette, 2020). An overlooked or missed diagnosis of DVT and PE may have devastating circumstances.

With proper anesthetic techniques, patient participation, and a vigilant healthcare team, the risk of DVT/PE after THA or TKA procedures can be minimized. Prevention of DVT and PE following THA and TKA mutually benefits the patient and the healthcare system by reducing readmission while improving patient outcomes. This study aims to identify anesthetic practice guidelines for anesthetic patient optimization surrounding THA and TKA in preventing DVT.

Background

Pathophysiology of DVT/PE

Many factors contribute to the formation of a blood clot, and those factors can be either enhanced or inhibited through medical intervention and mitigation of risk factors. The clotting cascade begins in one of the extrinsic and intrinsic pathways (Smith et al., 2015). The extrinsic pathway begins with latent enzyme precursors, precisely tissue factor (TF), an integral membrane protein, and factor VIIa. These two factors work synergistically to activate downstream substrates (Smith et al., 2015). This interaction must occur before the many other interactions occur downstream. The TF: VIIa complex alters factors, including factor IX and factor X, into the active form, factor IXa and Xa (Smith et al., 2015). Without these two activated factors, the clotting cascade in the extrinsic cascade is ineffective. Two cofactors, factors VIIIa and V, combine with factors IXa and X, respectively, to produce a large thrombin burst during the clotting cascade (Smith et al., 2015). Thrombin converts fibrinogen into fibrin, forms a clot composed of fibrin, and activates platelets for hemostasis (Smith et al., 2015).

When initiating a clot, the intrinsic pathway utilizes different clotting factors but converges at the common coagulation pathway with the extrinsic pathway. The intrinsic pathway begins with the activation of factor XII, plasma prekallikrein (PK), and high-molecular-weight kininogen (HK) (Smith et al., 2015). The most crucial factor is factor XII, although these three factors are included in the intrinsic pathway. Factor XII becomes activated when blood collides with an artificial surface and becomes factor XIIa (Smith et al., 2015). Consequently, a positive feedback loop forms by newly activated factor XIIa activating PK to kallikrein, and kallikrein continues to activate factor XII (Smith et al., 2015). The final common pathway begins with the Tissue Factor and VIIa complex activating factor X. Further, factor Xa combines with factor Va

and converts prothrombin to thrombin, producing a fibrin clot and activating platelets (Smith et al., 2015). Hemostasis can be maintained with all these combined working in unison. However, clot formation is not always the desired effect and may result in adverse outcomes in patients undergoing THA and TKA.

Recent evidence has highlighted that PE is often not an isolated complication but a propagated issue from a DVT (Ouellette, 2020). It is of the utmost importance to prevent DVT and the formation of PE in THA and TKA patients. Some of these risks can be mitigated with thromboprophylaxis following surgery.

Risk Factors for DVT/PE

Development of DVT and PE in the perioperative period following THA and TKA procedures can be life-threatening for those patients. Before discharge, whether in same-day surgery centers or as an inpatient after undergoing THA or TKA, researchers found that the prevalence of DVT was 8.9% (Jones et al., 2020). While it is not the complete responsibility of the anesthesia provider to prevent DVT, anesthetic modalities can help prevent DVT from developing. Prevention of DVT or PE development begins by mitigating risk factors that pertain to each patient. More common risk factors for DVT or PE are major surgery, slow blood flow, increases in estrogen, family history of DVT or PE, age, obesity, inherited clotting disorders, and previous DVT or PE (Centers for Disease Control, 2022). Common comorbidities in patients over 50 undergoing surgery are coronary heart disease, chronic kidney disease, and diabetes mellitus (Xiong & Cheng, 2023). These comorbidities increase the risk of DVT development by 8.88 times, 2.86 times, and 2.71 times, respectively (Xiong & Cheng, 2023). Limited mobility is a sizeable precipitating factor in conjunction with other risk factors and is not limited to the postoperative period for these patients. Xiong and Cheng (2023) reported preoperative DVT in

40 cases (6.85%) out of 584 patients. While the preoperative risk factors in these patients are not entirely known from a lifestyle standpoint, other risk factors can be analyzed and determine a patient's overall risk.

Other factors are not usually specific to DVT that increase DVT incidence are increased erythrocyte sedimentation rate, interleukin 6, procalcitonin, decreased red blood cells, increased platelet count, and plateletcrit (Xiong & Cheng, 2023). Some of these factors are inflammatory markers and are not routinely monitored before a THA or TKA, while platelets and red blood cell counts are usually tested before surgery. The patient and the healthcare team are responsible for mitigating many modifiable risk factors before the surgical procedure.

Diagnosis of DVT and PE

Advances in medicine allow healthcare providers to diagnose high-risk patients with DVT that may be asymptomatic postoperatively. Not all patients are tested for DVT unless something is provoking the pathology, such as pain, swelling, tenderness, erythema, or warm skin (National Health Service, 2023). In both symptomatic and symptomatic patients, alternative diagnostic modalities can aid in diagnosing DVT and PE. Duplex ultrasonography is the golden standard for DVT diagnosis (Centers for Disease Control, 2022). This ultrasound methodology utilizes sound waves to detect venous blood movement, stasis, or blot clots in deep veins (Centers for Disease Control, 2022). As the current golden standard diagnostic test, Duplex ultrasonography delivers the most definitive diagnosis of DVT in affected patients. However, point-of-care ultrasound (POCUS) is becoming increasingly important in medicine. A recent study conducted by Barrose-Antle (2021) highlights the capability of POCUS when diagnosing a suspected DVT. While the gold standard of Duplex ultrasonography could be used with other clinical observations, when possible, a lack of radiology technicians on night and weekend shifts

leaves healthcare providers and patients with minimal resources for an acute diagnosis (Barrose-Antle, 2021). While this methodology of DVT diagnosis is gaining some popularity, other diagnostic tests reliably detect DVT. D-dimer blood testing, venography, and magnetic resonance imaging (MRI) tests with proven efficacy detect the presence of DVT in patients (Mayo Clinic, 2022). However, MRI is not commonly used for DVT diagnosis in the legs and is utilized more in diagnosing DVT in the abdomen (Mayo Clinic, 2022). Blood clots release a D-Dimer protein in most patients with severe DVT, although this test is not specific for DVT (Mayo Clinic, 2022). Contrast venography is the past gold standard of DVT, which includes dye and X-rays to develop an image of the blood vessels in the legs and feet (Mayo Clinic, 2022). Early recognition and treatment are pertinent to patient safety and well-being. PE is often present in 60-80% of patients with a DVT, even though these patients may be asymptomatic on presentation (Ouellette, 2020). If a PE is suspected based on provider assessment, Computed Tomography Angiography serves as the gold standard for the diagnosis of PE in patients experiencing a suspected PE (Ouellette, 2020)

Significance to the Profession

DVT and PE Prevention

Anesthetic practices play a significant role in DVT and PE prevention within an integral part of the healthcare team to prevent these adverse outcomes in patients. Different anesthetic modalities contribute to the overall patient risk of DVT and PE development. Recent research has shown that regional and neuraxial anesthesia is beneficial in alleviating the common side effects of general anesthesia, including PONV and delirium (Rodriguez-Patarroyo, 2021). Relieving patients from these side effects and controlling postoperative pain allow patients to begin mobilizing shortly after surgery. Regional anesthesia techniques are responsible for

postoperative pain control, and these have advanced to minimize the number of major muscle groups affected by TKA (Rodriguez-Patarroyo, 2021). By sparing the major muscle groups of the leg, patients can ambulate promptly after surgery, reducing venous pooling or stasis. Regional anesthesia further decreases the opiate requirements following surgery and prevents the adverse side effects of opiate generous anesthesia. Healthcare providers can work together to minimize the risk factors of DVT or PE development in each THA or TKA patient and provide increasingly better outcomes.

Impact on Healthcare Systems and Anesthetic Practices

Hypercoagulability, often presenting as DVT and PE following THA and TKA, is not only devastating to patient health but also affects the course of care in the perioperative period. While not a dedicated universal practice guideline, these interventions provide healthcare providers and patients with a directory of postoperative care. Formerly, postoperative care was performed on an inpatient basis. Now, healthcare systems lean toward ambulatory TKA, moving the responsibility to the patient and those at home with the patients. The healthcare system aims toward achieving the following goals for ambulatory TKA: maximizing patient safety, discharging the patient to an appropriate environment, and minimizing complications (Rodriguez-Merchan, 2020).

One tool, the Outpatient Arthroplasty Risk Assessment (OARA), categorizes and stratifies patients based on comorbidities (Scully et al., 2020). Stratification is essential when deciding which patients are eligible for ambulatory surgery due to patient risk and the ability to perform activities of daily living at home with assistance. Ambulation after surgery is an essential factor that allows patients to qualify for ambulatory surgery and help decrease the risk of DVT (Scully et al., 2020). Multiple factors coincide with keeping patients eligible for early

ambulation to decrease the risk of DVT and PE following THA or TKA. Anesthesia technique is prominent in keeping patients comfortable during surgery while minimizing side effects and hindering patients from early mobilization.

In THA and TKA surgeries, anesthesia providers can anesthetize patients with multiple modalities. Regional or neuraxial anesthesia in combination with general anesthesia has become common for these surgical procedures for TKA. However, in an attempt to allow patients to ambulate after surgery, an adductor canal block should be used while avoiding femoral and sciatic blocks (Scully et al., 2020). The adductor canal block spares the quadriceps muscles and allows patients to ambulate shortly after surgery. If the femoral and sciatic nerve blocks are used, the femoral block blunts the motor function of the quadriceps, and the sciatic block will cause foot drop, both of which increase the risk of patient falls postoperatively (Scully et al., 2020). Adequate pain control from these interventions allows patients to participate in therapeutic interventions and minimize certain DVT or PE development risk factors.

Coagulation is an important parameter to study when taking a patient for THA and TKA due to their risk of possible significant blood loss (Liu et al., 2011). New methodologies of blood loss prevention and coagulation optimization have been developed to avoid significant blood losses resulting in a needed transfusion. Tranexamic acid has reduced blood loss in THA and TKA without increasing the risk of DVT and PE (Fillingham et al., 2019).

Due to other medical reasons or comorbidities, some of these patients have other medical conditions requiring anticoagulation daily. These patients are of particular concern because there must be a balance between the risk of bleeding and the risk of thrombus formation. Some providers may suggest the preoperative cessation of anticoagulants to reduce the risk of bleeding. If there is a concern of thrombosis, bridge therapy with low molecular weight heparin or

unfractionated heparin can provide supplemental anticoagulation until after the procedure (Golden & Hopkins, 2023).

General anesthesia and heavy use of narcotics were the mainstays of THA and TKA anesthesia before developing shorter-acting medications, allowing a more rapid emergence (Li et al., 2019). A few of these shorter-acting medications are propofol, fentanyl, and rocuronium, compared to older anesthetics, including thiopental, morphine, and pancuronium. These medications are less disruptive to the human body, and the doses of medications are easily titratable. Fewer undesirable side effects occur when these shorter-acting mediations are paired with regional or spinal anesthesia. The lack of postoperative pain, nausea, and vomiting allows patients to ambulate earlier, decreasing venous stasis in the lower extremities (Li et al., 2019).

Problem Statement

Orthopedic surgeons perform more than 600,000 knee arthroplasties and 300,000 hip arthroplasties yearly in the United States (Shmerling, 2021). As with any surgical or medical procedure, there are risks involved. Two significant complications that affect both patient morbidity and mortality following TKA and THA are DVT and PE (Heo et al., 2020).

Prevention of DVT or PE is not limited to the surgeon or the immediate care team within the operating room. Instead, a perioperative team can decrease risk with early mobilization, opioid-sparing multimodal pain control, patient education, and anesthetic techniques shown to decrease the risk of complications (Wainwright et al., 2019). Given this information, optimizing each patient before surgery and utilizing evidence-based practice to improve patient outcomes is imperative. There are many ways to provide a successful anesthetic plan while preventing DVT and PE and comfort throughout the perioperative period. Years before the regular use of regional or neuraxial anesthesia, general anesthesia was the standard anesthetic protocol.

PICOT Question

In patients older than 50 years of age undergoing THA or TKA (P), would the development and implementation of evidence-based practice guidelines for the anesthetic management of postoperative hypercoagulability (I) versus traditional practice (C) change the incidence of DVT and PE(O) following the 14 days after surgery (T)?

Project Objectives

DVT and PE are life-threatening adverse events that present in a significant portion of patients undergoing THA or TKA due to the total volume of these procedures (Santana et al., 2020). Prevention of DVT and PE begins in the perioperative period and persists through discharge and recovery at home. Before discharge, healthcare providers provide the bulk of preventative modalities to patients who underwent THA and TKA. An important aspect of postoperative recovery involves educating healthcare providers and patients about different methods to prevent DVT and PE. This evidence-based project will determine current best practice guidelines for perioperative practices to decrease the incidence and reduce the risk of DVT and PE in patients aged 50 years or older undergoing THA and TKA.

- Perform a systematic literature review to ascertain best practice guidelines surrounding DVT and PE prevention following THA and TKA.
- Develop evidence-based anesthetic practice guidelines for healthcare systems and patients, including interventions and education surrounding DVT and PE prevention.
- Utilize the JHEBP PET Model to guide project implementation.
- Develop a comprehensive plan to adjust the perioperative anesthetic guidelines for DVT and PE prevention following THA and TKA.

These objectives outline developing clinical practice guidelines to prevent DVT and PE following THA and TKA.

Literature Synthesis and Analysis

Literature Review

Databases

Literature relevant to the PICO question was located at Otterbein University's OneSearch Research Databases tab. The Research Databases tab grants access to all the databases Otterbein has established academic relationships. The primary database used was the Cumulative Index to Nursing and Allied Health Literature (CINAHL), with subsequent searches on Google Scholar and PUBMED. The literature review was conducted to identify and analyze the literature containing pertinent evidence-based practice for reducing DVT and PE occurrences following THA and TKA. The data in this literature review comes from a great pool of information focusing on anesthesia interventions. Search terms used to find that data and summary analysis are included below, with an extensive effort to provide evidence-based clinical practice guidelines to improve patient outcomes.

Literature Search Terms

The original search using key terms and Boolean operators "orthopedic surgery or hip or knee and DVT or deep vein thrombosis or venous thrombosis or thromboembolism" yielded 3,244 results. The search was filtered to 2018 – current, English language, and scholarly articles, giving 970 results. Articles that contained information not solely related to THA and TKA with subsequent DVT or PE were not considered for this project. Further exploration into different topic areas included multiple examples of Early Recovery After Surgery (ERAS) models, including tranexamic acid (TXA), regional/neuraxial anesthesia, multimodal analgesia, and

antiemetics. Each topic area consisted of another search criteria, with most containing ERAS protocols within the search.

Boolean operators to examine the effectiveness of TXA were "tranexamic acid or TXA and DVT or deep vein thrombosis or venous thrombosis or thromboembolism." The original search gave 10,503 results, limited to academic journals, English language, full text available, and 2018 – current narrowing results to 7,203. The addition of Boolean operators total hip replacement or total hip arthroplasty or hip replacement surgery and total knee arthroplasty or total knee replacement or TKA narrowed results to 178 articles. These results were filtered to include only IV tranexamic acid and DVT development following THA or TKA.

Another search was performed using the Boolean operators: "total hip replacement or total hip arthroplasty or hip replacement surgery and total knee replacement or total knee arthroplasty or TKR or TKA or knee replacement or knee joint replacement and anesthesia." Initial results yielded 109 articles, further narrowed to 97 articles by selecting English language, full text, 2018 – present, and academic journals. From there, articles about interventions involved in the clinical practice guidelines were selected for examination. In total, 12 articles were selected for in-depth analysis, including ERAS protocols for further examination and analysis.

Tranexamic Acid

Tranexamic acid (TXA) has recently become popular as a blood loss prevention measure in THA and TKA (Saad et al., 2021). TXA is an antifibrinolytic and works by binding to lysine binding sites on plasmin to prevent plasmin's conversion into plasminogen, further degrading the fibrin matrix (Prudovsky, 2022). When used to prevent blood loss, one must consider increasing the risk of DVT or PE when TXA is used. However, TXA does not increase coagulation in patients; it prevents the breakdown of the already-established fibrin matrix (Fischer et al., 2020).

Recent research has shown that TXA does not increase the risk of DVT or venous thromboembolism (VTE) when used for blood loss prevention in THA and TKA (Fillinghamet al., 2019; Prudovsky, 2022; Reale et al., 2021; Wainwright et al., 2019; Wei & Liu, 2015). Anesthesia providers and surgeons alike must evaluate dosage and timing of administration. There is no unanimity on administration timing for TXA (Balachandar & Abuzakuk, 2019). Current literature has not agreed on TXA dosage as there is wide variability in TXA effective dosage research for THA and TKA. However, the literature outlines the importance of further research on optimal dosing (Reale et al., 2021).

Regional/Neuraxial Anesthesia

Many anesthetic techniques exist for successful THA and TKA surgical procedures. Recent research aims to compile the safest anesthetic methods while reducing delays in early ambulation postoperatively, decreasing the risk of DVT. The current topic of debate is using modern general anesthesia, neuraxial anesthesia, and regional anesthetic techniques. The current literature reflects no clinically significant benefit in using neuraxial anesthesia over modern general anesthesia (Kendall et al., 2021; Wainwright et al., 2019). However, conflicting studies support that neuraxial anesthesia decreases complications such as DVT postoperatively (Pazuik et al., 2020; Warren et al., 2019).

Regional anesthesia carries a significant portion of early mobilization. There are regional techniques that cause lower extremity weakness and others that spare motor control, increasing the incidence of postoperative early ambulation. While effective in providing excellent pain relief, the femoral nerve block causes quadriceps muscle weakness and does not make the patient a candidate for early mobilization (Wainwright et al., 2019; Warren et al., 2019). The expansion of regional anesthetic techniques has provided the widespread use of the adductor canal block.

The adductor canal block targets the saphenous nerve and is a sensory nerve block (Warren et al., 2019). The quad-sparing technique of the adductor canal block allows for earlier ambulation and decreased risk of venous stasis and DVT (Wang et al., 2017; Warren et al., 2019). There is currently no consistent recommended regional nerve block shown to decrease pain while maintaining muscle function in THA between the Quadratus Lumborum, Lumbar Plexus, and Fascia Iliaca blocks (Fillingham, 2022; Kamel et al., 2022).

Multimodal Analgesia

Multimodal analgesia attempts to tackle perioperative pain through various interventions as opposed to a single pathway analgesia in the THA or TKA patient. Successful multimodal analgesia has been achieved by implementing NSAIDs, acetaminophen, celecoxib, gabapentin, and low-dose oral opioids. Current research supports the use of pain-relieving adjuncts; there is no consensus between researchers and healthcare systems, but NSAIDs, gabapentin, low-dose oral opioids, and selective COX-2 inhibitors are given perioperatively to decrease postoperative opioid consumption, and the side effects of opioids are supported by (Frassanito, 2019: Oseka, 2018; Wainwright, 2019; Warren et al., 2019). Other research has implemented other adjuncts, such as ketamine and the above-stated adjuncts (Cornett, 2019). Adding these adjuncts allows earlier mobilization by preventing side effects associated with opioids and preventative pain measures proven to benefit the patient.

Antiemetics

PONV is a significant barrier to early ambulation and delayed patient discharge following surgery. Anesthesia plays an integral role in PONV prophylaxis, as many of the drugs given by anesthesia providers aim to prevent the development of PONV. PONV prevention follows similar guidelines as multimodal pain control. Using medications that prevent PONV often

affects different pathways in the body and is often effective in most patients. Often, PONV results from inadequate preventative measures. Common risk factors include nonsmokers, history of PONV, female sex assigned at birth, and postoperative opioids (Cornett et al., 2019; Moraitis, 2020). The best modality to prevent PONV is to prevent exposure to general anesthesia and postoperative opioids (Soffin & YaDeau, 2016). Common PONV anesthetic practice involves the administration of dexamethasone and a serotonin antagonist or ondansetron intraoperatively (Moraitis et al., 2020; Soffin & YaDeau, 2016). While the aim is to prevent PONV, not all situations are preventable, and there are rescue medications for anesthesia providers to resort to when prevention does not work (Jin et al., 2020). These commonly include ondansetron, promethazine, and droperidol and can be used as a rescue medication (Jin et al., 2020).

Summary of Analysis

DVT and PE pose a significant risk to patient well-being in the perioperative period surrounding THA and TKA. Multiple factors contribute to the risk of DVT and PE within the perioperative period. This literature search aims to compile EBP to decrease the incidence of DVT and subsequent PE following lower extremity orthopedic surgery, including THA and TKA.

The approach to preventing DVTs is multifactorial and must be assessed on an individual patient basis. Understanding the risks associated with each patient allows healthcare providers to implement prevention strategies and alter the plan of care to fit the patient best. Implementing evidence-based clinical practice guidelines can reduce surgical stress, improve healthcare quality, reduce economic burdens, and further postoperative recovery (Li et al., 2019). There are multiple methodologies for providing a safe and effective anesthetic for patients undergoing

THA or TKA. This project seeks to determine effective anesthetic strategies and decrease DVT and subsequent PE development following THA and TKA surgery. Further exploration will further solidify this evidence for DVT/PE prevention. Current research is a practical basis for performing these anesthetic interventions and considerations, but standardization throughout healthcare systems will lead to optimal patient outcomes.

Project Design

The Johns Hopkins Evidence-Based Practice (JHEBP) PET model is a scholarly project framework for the Doctor of Nursing Practice (DNP). This portion of the JHEBP model fits this project perfectly and allows constant redevelopment and criticism of current project practices. The JHEBP model begins with inquiry, progresses to practice and learning, develops a best practice, and further improves that practice (Dang et al., 2022). This DNP project aims to develop clinical practice guidelines for preventing hypercoagulable states in patients over 50 undergoing THA or TKA. The inquiry stage of this project is composed of understanding the pathology of hypercoagulable states and particular practices that may increase or decrease the risk of DVT or PE development. Throughout the practice and learning phase, specific subcategories form the foundation of the JHEBP model. A visual representation of this process is available in Appendix B. Permission to use this model without adaptation was obtained from Johns Hopkins, as evidenced by Appendix C.

Using the PET Management guide of the JHEBP is the practice question, which involves the development of the PICO question. For this scholarly project, the PICO is: In patients older than 50 years of age undergoing THA or TKA, would the development and implementation of evidence-based practice guidelines for reduction of postoperative hypercoagulability versus traditional practice reduce the incidence of DVT and PE following surgery? The second stage of

evidence is searching current literature for best practices to reduce the incidence of DVT and PE following THA or TKA. Evidence supporting the guidelines was critically appraised for study strength and quality to ensure the best outcomes listed in (Appendix D). The final translation stage compiles the appraised evidence and develops recommendations for guidelines to reach the desired results.

Once the recommendations are compiled, implementation begins within the clinical setting. After implementation, participants must continue to monitor the success of the practice guidelines and look for improvements to increase the project's success. Reflection on practice improvements begins the process again, going through the inquiry phase, practice question, evidence, and translation stages (Dang et al., 2022).

Methods

The inquiry begins with understanding the severe complications of DVT and PE following THA or TKA. Appraisal of individual articles vetted the research from reliable sources and ensured it pertained to the PICO of the project as outlined in the literature tables. According to the research, anesthetic clinical guidelines were developed for DVT and PE prevention following THA and TKA surgical procedures.

A practice question is developed from the inquiry stage and then guides the research process for DVT following THA and TKA. The research question serves as a basis from which the literature search occurs. From the research question, new details may arise and further provoke the literature search, thus slightly causing the research question to adapt. Once the evidence is appraised and selected for the project, that evidence is then translated from research, where clinical guidelines are developed. From those clinical guidelines, the clinical practice portion at the implementation facility develops a best practice model. After criticizing the best

practices, lapses in practice or faults throughout any part of the project can be resolved during the practice problems and reflection phases of the JHEBP Model.

Implementation

The implementation portion of this project will require a multidisciplinary approach throughout the perioperative environment. This process begins with developing a plan for staff education, rolling out a protocol, and finding ways to track the interventions' effectiveness. Implementing a new project requires those involved to buy in and follow the guidelines set forth by the new protocol. Education should begin with the anesthesia department as those providers will provide most of the interventions within this project.

Before education, the Internal Review Board (IRB) must approve the project. Once granted approval, implementation of the project may begin. The anesthesia department begins as ground zero for the start of implementation. Education for anesthesia will begin with a series of emails forewarning the staff about the upcoming change. This methodology decreases the program's cost and ensures access to the educational material. Reminders will be mentioned to staff in weekly staff meetings to encourage individuals to check email and outline the project.

Assume anesthesia staff are uncomfortable performing regional anesthesia. In that case, accommodations will allow staffing to have a regional Certified Registered Nurse Anesthetist (CRNA) or Medical Doctor of Anesthesiology (MDA) established from 0700 to 1200. This anesthesia provider will assist or complete the regional nerve blocks each day. The anesthesia provider overseeing the patient through the case will provide the backup who should participate in placing regional blockades when possible. For those requesting education to become proficient as regional anesthesia providers, these participants must follow the hospital protocol to perform these interventions. A reduction in training costs is possible through on-the-job teaching

from certified anesthesia providers to other providers. This form of education allows hands-on practice while having the safety of certified staff to coach or take over in the case of a problematic regional anesthetic. The Proposal PowerPoint Presentation will serve as supplemental education or a reference for the current practicing providers.

Within the emails sent to staff, a start date for the new implementation will be included to allow adequate time to prepare for the change. An educational PowerPoint will be included for anesthesia provider education in the last set of emails. A poster will be placed in the anesthesia breakrooms and perioperative areas that anesthesia staff frequent. If anesthesia staff require more education on this subject matter and new practice guidelines to implement, a two-hour paid workshop will provide all the necessary information for anesthesia staff to review. Employees will be subject to a small quiz during this paid workshop to ensure a baseline knowledge of the project and its implementation. For inquiries and questions, anesthesia staff can contact the project leaders for clarification. Project leaders can also be available for weekly staff meetings to address any questions or concerns from the anesthesia department.

Preoperative staff will also be affected by the implementation of the new project. Education for perioperative staff will outline the guidelines and changes to the preoperative stay of the patients. The preoperative nurses may slightly alter their practice due to the time allotments for placing regional nerve blocks and the intraoperative staff for neuraxial anesthesia. In order to answer questions related to workflow or time management that may occur, allowing perioperative staff to understand the new procedures will give them adequate time for adaptation and the information necessary to implement changes on their end successfully. Emails will be sent to educate these nurses, detailing how the new practices will affect their preoperative and intraoperative environment.

Pharmacy is another department that must be aware of the new clinical practices in the perioperative environment. The clinical guidelines will affect the amount of perioperative medication stocked within the medication dispensing system within the perioperative workstations. These medications include local anesthetics, antiemetics, lipid emulsion, and adequate supplies of midazolam and fentanyl. These medications play an essential role in regional anesthesia and have some implications in neuraxial anesthesia. The pharmacy department's participation is imperative because there will be differences from current practices within the hospital system. These may include changes in finances, including medication expenses, stocking appropriate medications, and preparing or sending these medications to the appropriate floors, whether the patient is in the perioperative outpatient or inpatient setting.

Another population that should be educated on these new guidelines is the patients. As a newly approved project within the hospital, new education must be passed on to patients to ensure a proper, complication-free recovery. As these new guidelines are implemented, the patients deserve the right to know the changes in care and the research behind the practice changes. Giving the patients the research also gives them the autonomy to look at the research that has led this institution.

As a new implementation of guidelines, a lapse in education is expected, and project organizers intend to provide super users of anesthesia and perioperative staff who are available most of the shifts throughout the work week. These users are available through hospital communication systems and can fill knowledge gaps within the practice setting. These positions are voluntary and chosen with the participation of the staff. Implementation is planned to go smoothly.

Timeline

The timeline for this project would begin with a 30-day introduction period and extend for one year. The first education emails would begin 30 days before implementation and continue at 15 days, seven days, three days, and one day before enrollment. With this implementation method, staff have ample opportunity to understand the new changes and the reasoning behind them. The timeline is flexible for teaching, training, and increasing supplies within the training window.

Within the 30-day introduction period, anesthesia staff will attend a 30-minute presentation during the weekly CRNA meeting at the hospital. This will allow anesthesia staff to learn about the new program rollout, practices, and changes coming to the facility. Having this meeting weekly will allow a multitude of staff to see the project and allow any questions about the practice change to be addressed. These presentations will be presented by the project leader, who has compiled and developed these guidelines. This may require extra time for the project designer but does allow for a more effective rollout. Considering staff input before and during rollout will lead to a more effective implementation process. During the presentation, staff can bring concerns about the project forward. These concerns will be addressed, or the plan can be modified to fit the anesthesia profession better. These include the time needed for regional anesthesia, preoperative medications, and refining the preoperative experience for patients and nursing staff. However, if the plan is modified in any way, these changes will have to be presented to the IRB within the hospital system for approval once again. Gaining additional IRB approval may take some time, but the overall project will improve with the input and knowledge of current anesthesia providers within the department.

For employees who become regional anesthesia experts, a workshop can be set up within the facility to practice the skills necessary to carry out the prescribed duties detailed within project guidelines. These workshops will be two hours or less to save the cost of this project, and anesthesia providers must have a basic knowledge and understanding of the content from the provided informational material before attending the workshop. The two-hour workshop will show the implementation of the clinical practices within this project. This will count toward continuous medical education (CME) benefits within the employee allowance. Data collection will influence the number of anesthesia staff participating in these workshops. Critical analysis will occur on the data collected and ensure efficiency and efficacy. After one year, the effectiveness of this program will be reevaluated to see if it is sustainable. This period will allow time for staff to adjust and allow the different departments affected to adapt to the changes.

Proposed Budget Plan

The cost of this project will be relatively small compared to other initiatives that may take place when implementing a practice change. Ultrasound machines used for regional anesthesia are present within this healthcare facility and, therefore, are not an associated cost within this project. The facility stocks supplies necessary for completing regional anesthesia blocks but may need to increase the quantities. Recent calculations based on scheduled procedures at the target implantation site plan for 780 TKA and 520 procedures per year. The pharmacy may need to increase the medications available to anesthesia staff, including antiemetics, local anesthetics, lipid emulsion, and tranexamic acid. Current practices within this facility use these medications, but the quantity of these medications may need to be increased depending on the number of procedures that occur. The following breakdown of cost is further organized in Appendix E.

The typical cost for ropivacaine used for regional nerve blocks at a concentration of 5 milligrams/milliliter for 30 milliliters is $20.24 (WebMDRx, n.d.). The cost used for spinal bupivacaine ranges between $12.24 and $17.18 for concentrations of 0.5% and 0.75%, respectively (Drugs.com, n.d.). A box of 25 four-inch echogenic needles for peripheral nerve blocks costs $675 per box (Grayline Medical, n.d.). A box of 25 spinal needles costs about $200.50 (Fischer Scientific, n.d.). These prices reflect online prices and may not be used in the project as the pilot facility may already have supply agreements or contracts. In that case, these contracts would be navigated, and requests could be made if more supplies are needed.

The costs may require higher anesthesia costs for teaching regional anesthesia to anesthesia staff. If the hospital system were to look at the bigger picture, the cost of regional anesthesia would decrease the cost in an ambulatory setting (Graff et al., 2023). If the nurse anesthesia staff requires extra education, the hospital board will require further approval because this is no small financial matter. This project requires minimal staff to implement, and although there are extra requirements for staff to implement skills, not all staff need to participate in these skills. As of now, the average pay rate of a nurse anesthetist is $101 (Salar.com, n.d.). Depending on how many nurse anesthetists want to take the two-hour-long seminar, one would take their hourly rate and pay that for those hours so employees are compensated for their time. For the project leader, compensation will be at their hourly base rate and will reduce clinical hours so overtime is not incurred, increasing project costs. The project leader is expected to spend no more than 20 hours per work week once this project is up and running. These decreased costs benefit patients, insurance companies, and hospitals alike. As companies attempt to maintain profits, hospitals and insurance companies look for cost-saving measures whenever possible.

Outcomes

The outcomes of this project look to decrease and ultimately prevent the incidence of DVT and PE following TKA and THA. Monitoring and data collection throughout the implementation period will allow project team leaders to follow the information and ensure the project provides the intended outcomes. Goals throughout this project include TXA administration, early ambulation, reduced PONV, opiate use reduction, increased peripheral nerve blocks, and increased utilization of neuraxial anesthesia in the pursuit of decreasing DVT/PE.

Project leaders will monitor patient outcomes 14 days following the surgical procedure. The project leaders will look for readmission rates, DVT/PE diagnosis, or prolonged hospital stays related to surgery complications. Complications that do not fall under the DVT or PE category or a complication thereof will not be considered when determining the effectiveness of this project. Data will be extracted through chart audits and notifications from the surgical team in follow-up appointments. A special request will be made to the information technology department to flag patients within the electronic medical record (EMR) system to notify providers that this person was subject to this project. This information route will allow the providers to contact the appropriate personnel if complications arise.

The data on these patients will be organized within an Excel worksheet displaying the procedure received along with the provided interventions. The master list will contain all patients participating in this project for the first year, and ongoing analysis will prove the benefit of the project interventions. The master list will be contained within the hospital system and encrypted to abide by privacy laws restricting the use of patient information. Any data extracted from these

lists will be de-identified before presentation and will only contain statistics proving the efficacy or incidence of complications.

Quality Improvement Analysis

The analysis will continue throughout the initial intervention period for one calendar year. Throughout the year, all data will be collected quarterly and scrutinized to evaluate the efficacy of this project. Previous rates of DVT and PE will be needed to compare the effectiveness of the project implementation and outcomes. There is a slight concern as the patient population will change, and patients in the new project group have a slight chance of being in both the intervention and pre-intervention groups. From a statistical standpoint, this may skew some data unfavorably. Although not all patients are the same, this data will give project leaders sufficient evidence to prevent DVT and PE following future THA and TKA procedures.

As a current practice at this facility, follow-up phone calls to patients one day post-operatively assess the quality of their pain relief and motor function following the THA or TKA. This will satisfy the patient with the new interventions and the efficacy of the peripheral nerve blocks before surgery. The post-operative call will also assess the incidence of the risks associated with peripheral nerve blocks, the leading cause being nerve damage and other associated risks with these procedures (Wiederhold et al., 2023). Input from the patient provides valuable information based on the type of blocks utilized and could also provide the performance of blocks per provider. These calls can also evaluate the incidence of early ambulation, PONV, and other undesirable outcomes associated with THA and TKA. While interpreting the data, if certain providers are not performing well, an in-service and more instruction can increase the efficacy of that specific provider.

Project leaders will analyze the interventions provided, the incidence of DVT or PE, and any undesirable outcomes. From this information, project leaders and hospital leadership can critically appraise the effectiveness of the interventions and modify practices to avoid further complications while providing better outcomes. The outcomes will be analyzed after modifications as a continuous measure to ensure the utmost patient safety and efficacy of the interventions and services provided to patients.

Limitations and Barriers

There are multiple limitations and barriers when approaching this project. Variability between patients is a standard limitation that can interfere with the practices employed within this final scholarly project. For example, regional and neuraxial anesthesia is often contraindicated when coagulopathy is present. There is a higher risk of bleeding that outweigh the benefits of the nerve block. Not all limitations and barriers will be the clinical aspect of patient care. Possible limitations from implementation rollout may be a lack of provider adherence, supply stocking issues, supply storage, patient consent for the project, and other unforeseen issues that may arise. A smooth transition to implementation is expected, but project leaders are available for implementation issues.

Limitations and barriers will be dealt with on a rolling basis, allowing swift action and problem-solving. Resolution of these incidents will be multifactorial and carried out case-by-case. A suitable body of evidence supports these interventions from an anesthetic perspective and patient outcomes. However, patients would benefit from an interdisciplinary team that covers perioperative interventions from each specialty. Further research into ERAS protocols and clinical practice guidelines encompassing the entire perioperative process will improve patient experience and improved outcomes for healthcare providers.

Conclusion

Providers and patients undergoing THA and TKA must consider many risks associated with these surgical procedures. One significant risk factor associated with these is DVT and PE (National Blood Clot Alliance, 2023). A primary key to avoiding these significant risks applies to the field of anesthesia. Accounting for these risks begins in the preoperative period and follows through the surgical procedure until the postoperative period. Anesthesia providers play a significant role in allowing patients to benefit from the THA and TKA procedures. The utilization of multimodal analgesia, motor-sparing regional anesthesia, PONV prophylaxis, and neuraxial anesthesia provides the benefits of decreased incidence of DVT and PE by promoting early mobilization in patients after surgery. This project utilizes the PET portion of the JHEBP Model to implement the practices, continually observe and modify clinical practices, and allow anesthesia providers to improve their practice. Enacting the guidelines from the project designers gives anesthesia providers the best evidence-based guidelines to apply to practice. These recommendations will reform the anesthetic provided to patients undergoing THA and TKA. By utilizing the EBP guidelines for THA and TKA, patients will have a decreased risk of DVT/PE which allows for better patient outcome and improved medical practices.

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Wei, Z., & Liu, M. (2015). The effectiveness and safety of tranexamic acid in total hip or knee arthroplasty: A meta-analysis of 2720 cases. *Transfusion Medicine*, *25*(3), 151–162. Retrieved July 25, 2023, from https://doi.org/10.1111/tme.12212

Wiederhold, B., O'Rourke, M., Garmon, E., Peterson, E., & Stevens, J. (2023, April 29). Nerve block anesthesia. Treatment & Management | Point of Care. https://www.statpearls.com/point-of-care/34526

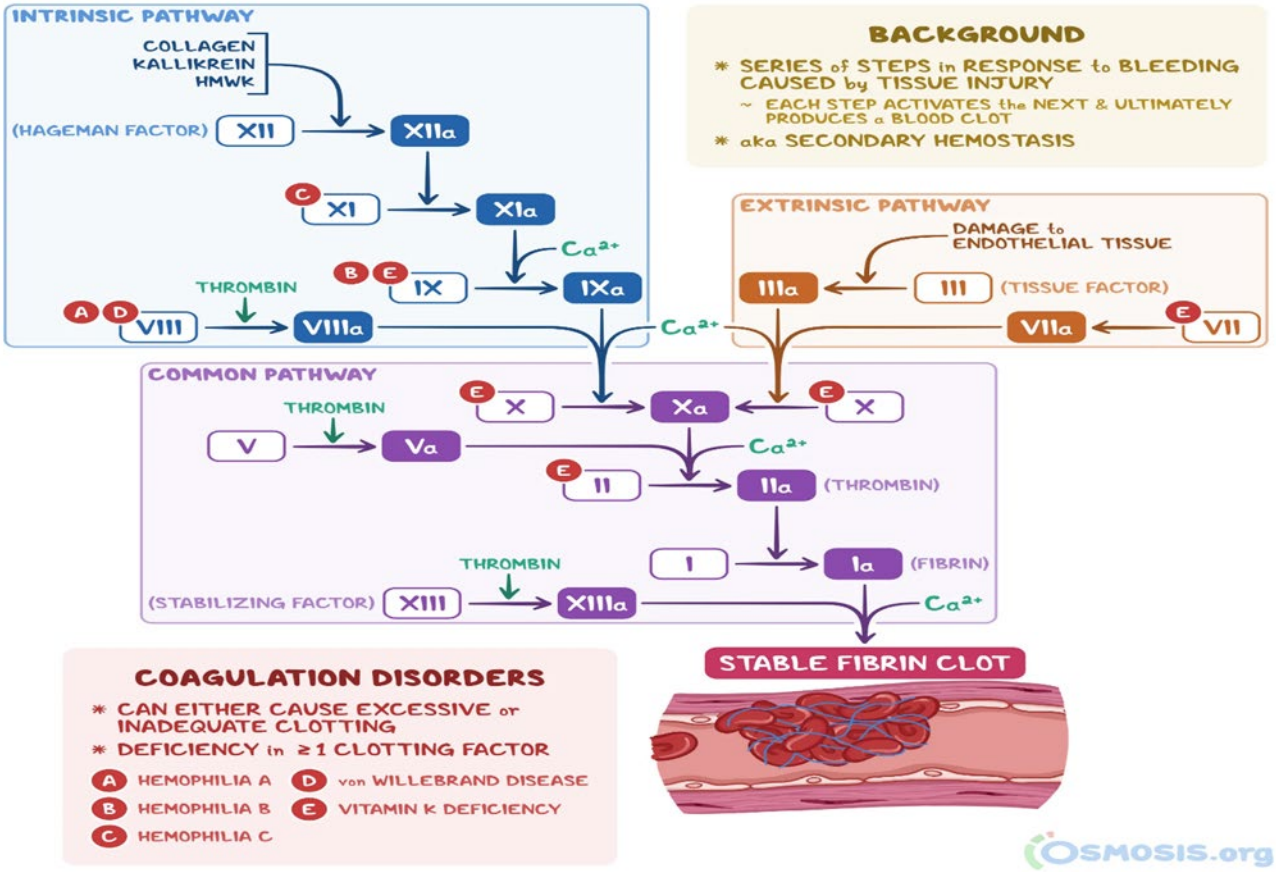
Xiong, X., & Cheng, B. (2023). Preoperative risk factors for deep vein thrombosis in knee osteoarthritis patients undergoing total knee arthroplasty. *Journal of Orthopaedic*

Science, *28*(1), 180–187. Retrieved May 29, 2023, from https://doi.org/10.1016/j.jos.2021.09.016

Zhang, Z., Song, K., Yao, Y., Jiang, T., Pan, P., & Jiang, Q. (2019). Incidence and risk factors for post-thrombotic syndrome in patients with deep vein thrombosis following total knee and hip arthroplasty. *The Journal of Arthroplasty*, *34*(3), 560–563. Retrieved July 23, 2023, from https://doi.org/10.1016/j.arth.2018.10.013

Appendix A

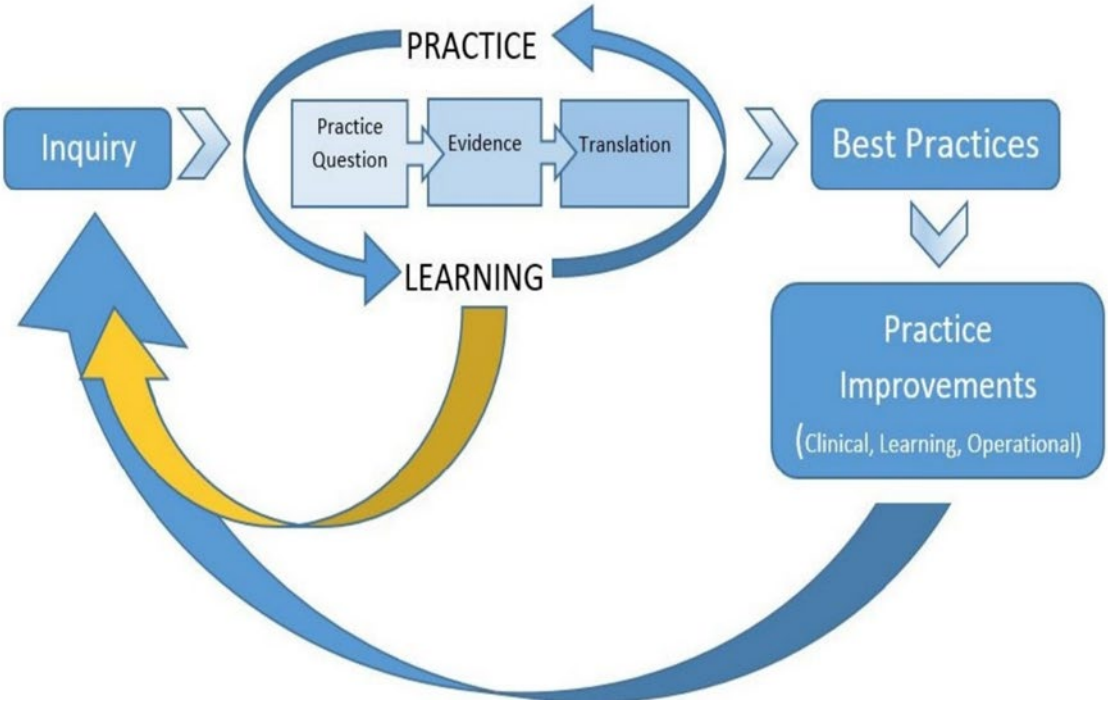
Coagulation Cascade



(Tarantino, n.d.)

Appendix B

Johns Hopkins Evidence-Based Practice Model



Appendix C

Permission of Use

JOHNS HOPKINS EBP MODEL AND TOOLS- PERMISSION

Johns Hopkins Nursing
Center for Evidence-Based Practice

Thank you for your submission.
We are happy to give you permission to use the Johns Hopkins Evidence-Based Practice model and tools to adhere to our legal terms noted below.
No further permission for use is necessary.

You may not modify the model or the tools without written approval from Johns Hopkins.
All references to source forms should include "© 2022 Johns Hopkins Health System/Johns Hopkins School of Nursing."
The tools may not be used for commercial purposes without special permission.
If interested in commercial use or discussing changes to the tool, please email ijhn@jhmi.edu.

Available Downloads:

2022 JHEBP Tools- English version

Appendix D

Annotated Bibliography Tables

Appendix A: Evidence Review Worksheet Assignment C

APA Citation:

Reale, D., Andriolo, L., Gursoy, S., Bozkurt, M., Filardo, G., & Zaffagnini, S. (2021). Complications of Tranexamic Acid in Orthopedic Lower Limb Surgery: A Meta-Analysis of Randomized Controlled Trials. *BioMed Research International*, *2021*, 1–14. https://doi.org/10.1155/2021/6961540

Conceptual Framework or Model	***Design or Method***	***Sample & Setting***	***Major Variables Studied & their Definitions, if any***	***Outcome Measurement(s)***	***Data Analysis***	***Findings***	***Level of Evidence***	***Quality of Evidence: Critical Worth to Practice***
Theoretical basis for the study: Examining the safety and complications associated with Tranexamic Acid, especially DVT, in lower extremity orthopedic surgery	Meta-analysis was performed on the PubMed, Web of Science, and Cochrane Library databases in January 2020 using the following string (Tranexamic acid) AND ((knee) OR (hip) OR (ankle) OR (lower limb)) to identify RCTs about TXA use in patients undergoing every kind of lower limb surgical orthopedic procedures, with IV, IA, or oral administration, and compared with a control arm to quantify the VTE complication rates.	**Number of Characteristics:** 1,797 articles total articles found, with 140 articles meeting eligibility criteria **Exclusion Criteria:** Articles written in other languages, preclinical studies, studies of a different design than RCT, and reviews **Attrition:** None **Setting:** Systematic review of previously published research	**Independent variables: IV1=** Systemic or local administration of TXA **IV2=** Total hip arthroplasty or Total knee arthroplasty **Dependent variables:** Development of DVT/PE postoperatively following TXA administration	**Scale(s) used:** Patients developing a DVT after THA or TKA **Reliability information (*alphas*, if any):** 15,659 patients included in this study	**Statistical tests, if any:** Peto's Method and z statistics of Peto's Method, Pooled odds ratio	**Statistical findings, if any:** No increases in the risk of DVT with TXA administration. 2.4% risk of DVT development with TXA and 2.8% DVT development without TXA administration. **Qualitative findings, if any:** none	II	**Strengths:** large data pool **Limitations:** Focuses on DVT as a complication when there are multiple complications **Risk or harm if implemented:** no imminent risk or harm implemented. This study searches to find the risk of DVT development. **Feasibility of use in the project practice area**: Feasible

Will complete this in Assignment E

Annotated Bibliography statement(maybe several sentences summarizing the article based upon the information above using professional APA writing style): Researchers performed a meta-analysis of 140 articles and compiled data on the safety of TXA use in lower extremity orthopedic surgery. This study included TXA in multiple administration forms, including intravenous, intraarticular, and oral forms for TKA, THA, ACL repair, intertrochanteric fracture, and meniscectomies. Researchers found no increase in DVT or PE between the TXA and the control groups.

Thematic Analysis

Key Themes or FSP related significance:
1. Lower Extremity orthopedic surgery – THA/TKA
2. TXA administration
3. TXA safety in a large data pool
4. Focus on DVT as the complication of choice
5. Explore different administration routes and examine the safety of each administration method.

Appendix A: Evidence Review Worksheet Assignment C

APA Citation:
Fillingham, Y. A., Ramkumar, D. B., Jevsevar, D. S., Yates, A. J., Bini, S. A., Clarke, H. D., Schemitsch, E., Johnson, R. L., Memtsoudis, S. G., Sayeed, S. A., Sah, A. P., & Della Valle, C. J. (2019). Tranexamic acid in total joint arthroplasty: The endorsed clinical practice guides of the american association of hip and knee surgeons, american society of regional anesthesia and pain medicine, american academy of orthopaedic surgeons, hip society, and knee society. Regional Anesthesia & Pain Medicine, 44(1), 7–11. Retrieved May 31, 2023, from https://doi.org/10.1136/rapm-2018-000024

Conceptual Framework or Model	***Design or Method***	***Sample & Setting***	***Major Variables Studied & their Definitions, if any***	***Outcome Measurement (s)***	***Data Analysis***	***Findings***	***Level of Evidence***	***Quality of Evidence: Critical Worth to Practice***
Theoretical basis for the study: The combined clinical practice guidelines are meant to address common and important questions related to the efficacy and safety of TXA in primary TJA. Using the AAOS Clinical Practice Guidelines and Systematic Review Methodology, the committee members completed a series of direct meta-analyses and network meta-analyses to support the clinical practice guidelines.	Peer-reviewed clinical practice guidelines agreed upon by multiple accredited organizations. Responses to questions supported by evidence and research studies.	**Number of Characteristics:** 8 questions answered for the clinical guidelines. **Exclusion Criteria:** not listed **Attrition:** not listed **Setting:** Clinical review of relevant research to develop clinical practice guidelines.	**Independent variables:** multiple variables dependent on the question to be answered and research from which guidelines were developed. **Dependent variables:** The use of TXA in patient populations.	**Scale(s) used:** not listed **Reliability information (*alphas*, if any):** not listed	**Statistical tests, if any:** **Qualitative analysis, if any:** none listed.	**Statistical findings, if any:** not listed as this is a conglomeration of recommendations **Qualitative findings, if any:** not listed as this is a conglomeration of recommendations	Contains multiple meta-analyses based on the clinical guidelines.	**Strengths:** studies included for references. **Limitations:** slight lack of information when drawing all conclusions. **Risk or harm if implemented:** not implemented. **Feasibility of use in the project practice area:** feasible.

Will complete this in Assignment E

Annotated Bibliography statement(maybe several sentences summarizing the article based upon the information above using a professional APA writing style):

These clinical practice guidelines contain multiple guidelines outlining the use of TXA within specific patient populations and for THA and TKA. Within these clinical practice guidelines, rationale, and data support the guidelines for future clinical practice. A multitude of clinical situations are provided in this study and support most cases encountered with THA and TKA.
Thematic Analysis **Key Themes or FSP related significance:** **1.** TXA implications/Risk of VTE **2.** TXA administration methods **3.** TXA and comorbidities

Appendix A: Evidence Review Worksheet Assignment C

APA Citation:

Wainwright, T. W., Gill, M., McDonald, D. A., Middleton, R. G., Reed, M., Sahota, O., Yates, P., & Ljungqvist, O. (2019). Consensus statement for perioperative care in total hip replacement and total knee replacement surgery: Enhanced recovery after surgery (eras®) society recommendations. Acta Orthopaedica, 91(1), 3–19. Retrieved March 22, 2023, from https://doi.org/10.1080/17453674.2019.1683790

Conceptual Framework or Model	*Design or Method*	*Sample & Setting*	*Major Variables Studied & their Definitions, if any*	*Outcome Measurement(s)*	*Data Analysis*	*Findings*	*Level of Evidence*	*Quality of Evidence: Critical Worth to Practice*
Theoretical basis for the study: Multidisciplinary consensus review summarizing literature and proposing recommendations for perioperative care of patients undergoing total hip and total knee replacements with an ERAS program.	Studies were selected for this consensus statement with attention to meta-analysis, randomized controlled trials, and extensive prospective cohort studies.	**Number of Characteristics: Exclusion Criteria: Attrition: none described Setting:** 17 topic areas are involved within the consensus statement involving THA and TKA. Databases used: Medline, CINAHL	**Independent variables: IV1=** not listed **IV2 =** not listed **Dependent variables:** not listed	**Scale(s) used:** Possible levels of evidence included "high" (i.e., systematic reviews, meta-analyses, or robust randomized controlled trials), "moderate" (i.e., smaller randomized controlled trials or prospective cohort data), or "low" (i.e., retrospective data). In line with ERAS guidelines for other surgical procedures (Gustafsson et al. 2013), the Grading of Recommendations, Assessment, Development, and Evaluation (GRADE) system was used to evaluate the quality of	**Statistical tests, if any:** not listed. **Qualitative analysis, if any:** not listed.	**Statistical findings, if any,** not listed **Qualitative findings, if any:** not listed	**III**	**Strengths:** RCT and meta-analysis included **Limitations:** includes retrospective studies and prospective studies. **Risk or harm if implemented:** not implemented **Feasibility of use in the project practice area:** feasible with limitations varying on facility.

				evidence and recommendations **Reliability information (*alphas*, if any):** none listed.				

Will complete this in Assignment E

Annotated Bibliography statement(maybe several sentences summarizing the article based upon the information above using professional APA writing style): Multiple articles ranging from retrospective studies to meta-analyses summarized and combined to form a best practice for THA and TKA. Eleven of these recommendations involve anesthesia-related practices and impact anesthetic recommendations and practices. These practices include PONV prevention, regional anesthesia, TXA administration, early mobilization, and a standardized anesthetic protocol. These recommendations are supported by a strength of evidence rating to accompany the recommendation.

Thematic Analysis
Key Themes or FSP-related significance:
1. Tranexamic Acid
2. Regional anesthesia
3. PONV
4. Early mobilization

Appendix A: Evidence Review Worksheet Assignment C

APA Citation:
Wei, Z., & Liu, M. (2015). The effectiveness and safety of tranexamic acid in total hip or knee arthroplasty: A meta-analysis of 2720 cases. Transfusion Medicine, 25(3), 151–162. Retrieved July 25, 2023, from https://doi.org/10.1111/tme.12212

Conceptual Framework or Model	*Design or Method*	*Sample & Setting*	*Major Variables Studied & their Definitions, if any*	*Outcome Measurement(s)*	*Data Analysis*	*Findings*	*Level of Evidence*	*Quality of Evidence: Critical Worth to Practice*
Theoretical basis for the study: To evaluate the safety and efficacy of tranexamic acid (TXA) in total knee arthroplasty (TKA) and total hip arthroplasty (THA).	A meta-analysis combined all data from available randomized controlled trials, regardless of the methods of TXA administration, which included administering intravenously, intra-articularly, topically, or orally.	**Number of Characteristics:** 39 included trials totaling 2720 patients. 1422 received TXA, and 1298 served as a control group. **Exclusion Criteria:** Studies were excluded from the analysis if (i) the patients received revision replacement of the joint; (ii) all data were shown as the medians and/or ranges, and we could not obtain the original information by anyway; (iii) patients had received any other strategy to decrease	**Independent variables: IV1=** administration of TXA **IV2= Dependent variables:** allogenic blood transfusions that are required.	**Scale(s) used:** Confidence interval of 95% **Reliability information (*alphas*, if any):** none listed.	**Statistical tests, if any:** Confidence intervals, relative risk, variability, heterogenicity as opposed to chance. The fixed effect model was used for pooling and analyzing when there was no significant heterogenicity. **Qualitative analysis, if any:** not listed.	**Statistical findings, if any,** not listed **Qualitative findings, if any:** not listed.	**I**	**Strengths:** The sample sizes are large enough to give good credit to the findings within this review—two independent reviewers to eliminate bias. **Limitations:** Firstly, limitations of this meta-analysis include the small sample size of each primary study and the significant heterogeneity in total blood loss and transfusion requirements. Secondly, only English-

		blood loss peri-operation or post-operation; (iv) studies were published in language other than English. **Attrition:** not listed **Setting: not listed**						language works of literature were included in this meta-analysis. There may be publication bias. Thirdly, some included trials excluding high-risk factors such as patients with a history of cardiovascular disease; the safety of TXA in high-risk patients should be explained cautiously. **Risk or harm if implemented:** relative risk with 95% confidence intervals. **Feasibility of use in the project practice area:** Feasible

Will complete this in Assignment E

Annotated Bibliography statement(maybe several sentences summarizing the article based upon the information above using professional APA writing style): To evaluate the safety and efficacy of tranexamic acid (TXA) in total knee arthroplasty (TKA) and total hip arthroplasty (THA). The specific endpoints assessed in this meta-analysis include the total blood loss, the incidence rate of deep vein thrombosis (DVT) and pulmonary embolisms (PE), and the number of patients requiring at least 1 U of red blood cell following surgery. This analysis contained inclusion and exclusion criteria, solid statistical analysis, and substantial evidence in support of TXA administration in total hip or total knee arthroplasty.

Thematic Analysis
Key Themes or FSP-related significance:
1. Tranexamic acid
2. Deep Vein Thrombosis
3. Pulmonary embolus
4. Total hip and total knee arthroplasty

Appendix A: Evidence Review Worksheet Assignment C

APA Citation:
Balachandar, G., & Abuzakuk, T. (2019). Is there an optimal timing of administration of single-dose intravenous tranexamic acid in bilateral total knee arthroplasty? a comparison between preoperative and intraoperative dose. Journal of Orthopaedic Surgery, 27(3), 230949901988091. Retrieved July 24, 2023, from https://doi.org/10.1177/2309499019880915

Conceptual Framework or Model	*Design or Method*	*Sample & Setting*	*Major Variables Studied & their Definitions, if any*	*Outcome Measurement(s)*	*Data Analysis*	*Findings*	*Level of Evidence*	*Quality of Evidence: Critical Worth to Practice*
Theoretical basis for the study: This study aimed to determine whether the timing of administration of single-dose intravenous TA (either given preoperatively or intraoperatively) significantly affects blood loss reduction.	This study compared two cohorts of patients with end-stage arthritis of the knees who underwent bilateral TKA and were given single-dose intravenous TA (1 g or 15 mg/kg) at different times during surgery.	**Number of Characteristics :** 80 patients split randomly into preoperative TXA and intraoperative TXA administration. **Exclusion Criteria:** Patients with allergy to TXA, severe renal failure (those whose creatinine clearance was >250 mmol/l), and a history of venous thromboembolism were not given TXA and were excluded from the study. **Attrition:** 26 patients excluded **Setting:** the surgeries were all performed by the same surgeon with a tourniquet inflated to 350mmHg at mid-thigh under spinal anesthesia, either with or without anesthesia.	**Independent variables: IV1=** Timing of TXA administration **Dependent variables:** Blood transfusion needed intraoperatively	**Scale(s) used:** The difference in PO and the postoperative hemoglobin on day 1 (hemoglobin difference—A), the difference in PO and the lowest hemoglobin (hemoglobin—B) prior to receiving transfusion or at discharge, and the number of allogeneic blood units transfused in each group. **Reliability information (*alphas*, if any):** not listed	**Statistical tests, if any:** student's t-test, Mann-Whitney U-test, Fisher's test, p-value **Qualitative analysis, if any:** not listed	**Statistical findings, if any:** Single-dose intravenous TA given before surgery is as effective as a dose given during arthroplasty of the first knee in reducing blood loss in bilateral TKA. **Qualitative findings, if any:** none listed.	**II**	**Strengths:** good randomization between the two groups, data organization, consistency, and the conclusions drawn following other research. **Limitations:** smaller participant pool **Risk or harm if implemented:** not implemented **Feasibility of use in the project practice area:** feasible

Will complete this in Assignment E

Annotated Bibliography statement(maybe several sentences summarizing the article based on the information above using a professional APA writing style): This study aims to compare TXA administration's timing. The study was conducted to review the results of administering TA (same dose, same route) at different periods during bilateral TKA and determine whether there is any difference in efficacy. A given as single intravenous preoperative dose (15 mg/kg) is as effective as an intraoperative dose in reducing blood loss in bilateral knee arthroplasty.

Thematic Analysis
Key Themes or FSP-related significance:
1. Total knee arthroplasty
2. Tranexamic acid
3. Deep vein thrombosis

Appendix A: Evidence Review Worksheet Assignment C
APA Citation:

Kendall, M. C., Cohen, A. D., Principe-Marrero, S., Sidhom, P., Apruzzese, P., & De Oliveira, G. (2021). Spinal versus general anesthesia for patients undergoing outpatient total knee arthroplasty: A national propensity matched analysis of early postoperative outcomes. BMC Anesthesiology, 21(1). Retrieved July 25, 2023, from https://doi.org/10.1186/s12871-021-01442-2

Conceptual Framework or Model	***Design or Method***	***Sample & Setting***	***Major Variables Studied & their Definitions, if any***	***Outcome Measurement(s)***	***Data Analysis***	***Findings***	***Level of Evidence***	***Quality of Evidence: Critical Worth to Practice***
Theoretical basis for the study: A comparison of different anesthetic techniques to evaluate short-term outcomes has yet to be performed for patients undergoing outpatient knee replacements. This investigation compared short-term spinal (SA) outcomes versus general anesthesia (GA) in patients undergoing outpatient total knee replacements.	Clinical information of the subjects was obtained between 2005 and 2018 from the American College of Surgeons (ACS) National Surgical Quality Improvement Program (NSQIP) database. Files were queried to extract all patients scheduled. Patients who underwent primary, elective, and unilateral TKA were identified using the Current Procedural Terminology (CPT) code 27,447.	**Number of Characteristics:** 353,970 patients undergoing unilateral TKA were included in the NSQIP database for 2005–2018. A total of 6,504 patients underwent outpatient TKA, and 5,574 were eligible after exclusion criteria **Exclusion Criteria:** Cases involving trauma, fracture, neoplasms, infectious diseases, or patients under 18 were excluded. **Setting:** not listed	**Independent variables: IV1=** Type of anesthesia (general vs. spinal) **Dependent variables:** postoperative outcomes of outpatient TKA, either serious adverse events (SAE) or minor adverse events (MAE)	**Scale(s) used:** not listed. **Reliability information (*alphas*, if any):** not listed.	**Statistical tests, if any:** paired t-test, McNemar's Test, Bowkers Symmetry test, adjusted p-value, students t-test, chi-square test **Qualitative analysis, if any:** none listed.	**Statistical findings, if any:** The type of anesthetic technique, general or spinal anesthesia, does not alter short-term SAEs, readmissions, and failure to rescue in patients undergoing outpatient TKR surgery. Recognizing the benefits of SA tailored to anesthetic management may maximize the clinical benefits in this patient population. **Qualitative findings, if any:** none listed	**III**	**Strengths:** deidentified patient data, grouping of adverse events based on severity, statistical analysis conducted using software **Limitations:** incomplete randomization, observational data, **Risk or harm if implemented:** not listed **Feasibility of use in the project practice area:** feasible

Will complete this in Assignment E

Annotated Bibliography statement(maybe several sentences summarizing the article based upon the information above using professional APA writing style): A recent shift toward outpatient TKA has led to questions about the type of anesthetic delivered to these patients. Spinal anesthetics have benefits, and the theoretical basis leads anesthetic providers to lean toward these anesthetics for TKA. However, not all patients will qualify for these anesthetics. This study aims to study the effectiveness of spinal versus general anesthesia and the adverse outcomes that accompany these anesthetics. The researchers found that the type of anesthesia does not alter the short-term adverse events, readmissions, and failure to rescue in patients undergoing outpatient TKA. However, those who received general anesthesia reported a more significant amount of minor and adverse events.

Thematic Analysis
Key Themes or FSP related significance:
1. Outpatient total knee arthroplasty
2. Spinal anesthesia
3. General anesthesia

Appendix A: Evidence Review Worksheet Assignment C

APA Citation:

Paziuk, T. M., Luzzi, A. J., Fleischman, A. N., Goswami, K., Schwenk, E. S., Levicoff, E. A., & Parvizi, J. (2020). General vs spinal anesthesia for total joint arthroplasty: A single-institution observational review. The Journal of Arthroplasty, 35(4), 955–959. Retrieved July 10, 2023, from https://doi.org/10.1016/j.arth.2019.11.019

Conceptual Framework or Model	***Design or Method***	***Sample & Setting***	***Major Variables Studied & their Definitions, if any***	***Outcome Measurement(s)***	***Data Analysis***	***Findings***	***Level of Evidence***	***Quality of Evidence: Critical Worth to Practice***
Theoretical basis for the study: The purpose of this study is to compare the effects of anesthesia technique on TJA outcomes prospectively	A 2-year, prospective, observational study was conducted at a single institution	**Number of Characteristics:** A total of 2242 patients underwent total hip arthroplasty (n ¼ 656; 29.26%) or total knee arthroplasty (n ¼ 1586; 70.74%) between 2015 and 2017 **Exclusion Criteria:** If a patient was scheduled to receive SA, but they ultimately ended up receiving GA. They were removed from the cohort **Attrition:** not listed **Setting:** single institution.	**Independent variables: IV1=** Spinal vs General anesthesia **IV2= Dependent variables**: Overall complication rate	**Scale(s) used:** Charlson Comorbidity Index **Reliability information (*alphas*, if any):** not listed.	**Statistical tests, if any:** chi-square test, t-test, Mann-Whitney U-test **Qualitative analysis, if any:** not listed	**Statistical findings, if any:** The primary outcome of the overall 90-day complication rate was significantly lower in the SA cohort compared to the GA cohort when assessed via multivariate analysis (7.02% vs 10.14%; odds ratio [OR], 0.66; 95% confidence interval [CI], 0.49-0.90; P < .01 **Qualitative findings, if any:** none listed	**III**	**Strengths:** Statistical evaluation was used, a decent-sized population pool was used, the possible limitations were highlighted, and the data was significant enough to conclude. **Limitations:** observational study design, cohort differences, possible selection bias, single institution. **Risk or harm if implemented: Feasibility of use in the project practice area:**

Will complete this in Assignment E

Annotated Bibliography statement(maybe several sentences summarizing the article based upon the information above using a professional APA writing style): This article studies the effectiveness and safety of spinal anesthetics when compared to general anesthesia. The researchers used overall complication rates when comparing the two methods of anesthesia for total joint arthroplasty. Researchers found that patients who underwent spinal anesthesia had a significantly lower complication rate when compared to the general anesthetic group. Multivariate analysis was used in this study to account for the many variables between patients and pre-existing medical diagnoses.

Thematic Analysis

Key Themes or FSP related significance:

1. Total hip arthroplasty
2. Total knee arthroplasty
3. General anesthetic
4. Spinal anesthesia

APA Citation:
Wang, D., Yang, Y., Li, Q., Tang, S.-L., Zeng, W.-N., Xu, J., Xie, T.-H., Pei, F.-X., Yang, L., Li, L.-L., & Zhou, Z.-K. (2017). Adductor canal block versus femoral nerve block for total knee arthroplasty: A meta-analysis of randomized controlled trials. Scientific Reports, 7(1). Retrieved July 25, 2023, from https://doi.org/10.1038/srep40721

Conceptual Framework or Model	***Design or Method***	***Sample & Setting***	***Major Variables Studied & their Definitions, if any***	***Outcome Measurement(s)***	***Data Analysis***	***Findings***	***Level of Evidence***	***Quality of Evidence: Critical Worth to Practice***
Theoretical basis for the study: To evaluate whether ACB exhibited better outcomes concerning quadriceps strength, pain control, ambulation ability, and complications.	Meta-analysis	**Number of Characteristics:** 647 patients **Inclusion Criteria:** To qualify for inclusion, the studies had to be randomized controlled trials comparing ACB with FNB in primary post-TKA patients. Any non-RCTs, quasi-RCTs, retrospective studies, cadaver studies, comments, letters, editorials, protocols, guidelines, surgical registries, and review papers were excluded. Disagreements were resolved by consensus. **Attrition:** less than 20% across all studies.	**Independent variables: IV1=** Femoral nerve block **IV2=** Adductor canal block **Dependent variables:** Muscle strength, pain at rest or activity, mobilization ability, range of motion, tourniquet time, and hospital stay.	**Scale(s) used: Reliability information (*alphas*, if any):**	**Statistical tests, if any:** P-value, Odds ratios, chi-squared test, z-test	**Statistical findings, if any:** The study found that ACB is an effective alternative to provide less motor strength impairment and faster recovery but provides comparable pain relief with decreased risk of falls compared with the FNB. **Qualitative findings, if any:** not listed	**I**	**Strengths:** large patient pool, excellent inclusion criteria, great statistical analysis. **Limitations:** higher attrition rate, multiple, limiting studies only comparing FNB and ACB. **Risk or harm if implemented:** not implemented **Feasibility of use in the project practice area:** feasible

Will complete this in Assignment E

Annotated Bibliography statement(maybe several sentences summarizing the article based upon the information above using professional APA writing style): Advancements in regional anesthesia allow for sensory blockade with muscle-sparing modalities to allow earlier ambulation and discharge with patients undergoing TKA. This study compared the safety and effectiveness of ACB versus FNB in patients. Researchers in this study compared significant safety concerns with the FNB and the pain relief effectiveness of the FNB. Researchers also tracked opioid consumption between the two blocks and concluded that ACB is effective in reducing pain following TKA while sparing motor function.

Thematic Analysis
Key Themes or FSP related significance:
1. Peripheral Nerve Block
2. Femoral nerve block
3. Adductor Canal block

APA Citation:
Fillingham, Y. A., Hannon, C. P., Kopp, S. L., Sershon, R. A., Stronach, B. M., Meneghini, R., Abdel, M. P., Griesemer, M. E., Austin, M. S., Casambre, F. D., Woznica, A., Nelson, N., Hamilton, W. G., & Della Valle, C. J. (2022). The efficacy and safety of regional nerve blocks in total hip arthroplasty: Systematic review and direct meta-analysis. The Journal of Arthroplasty, 37(10), 1922–1927.e2. Retrieved July 25, 2023, from https://doi.org/10.1016/j.arth.2022.04.035

Conceptual Framework or Model	***Design or Method***	***Sample & Setting***	***Major Variables Studied & their Definitions, if any***	***Outcome Measurement(s)***	***Data Analysis***	***Findings***	***Level of Evidence***	***Quality of Evidence: Critical Worth to Practice***
Theoretical basis for the study: The purpose of this study was to evaluate the efficacy and safety of regional nerve blocks after THA in support of the combined clinical practice guidelines of the American Association of Hip and Knee Surgeons, American Academy of Orthopaedic Surgeons, Hip Society, Knee Society, and American Society of Regional Anesthesia and Pain Management	Systematic review and direct comparison meta-analysis	**Number of Characteristics:** n = 11 high-quality studies **Inclusion Criteria:** English language, human subjects, all study subjects have undergone primary THA, comparative study design including the use of fascia iliac, lumbar plexus, or quadratus lumborum block, and reported quantitative outcome data. **Attrition:** not listed. **Setting:** not listed.	**Independent variables: IV1=** regional nerve blocks **IV2=** local anesthetic infiltration **Dependent variables:** pain control in the postoperative period	**Scale(s) used: Reliability information (*alphas*, if any):**	**Statistical tests, if any:** confidence intervals	**Statistical findings, if any,** not listed **Qualitative findings, if any:** not listed	I	**Strengths:** comparison of all THA peripheral nerve blocks. **Limitations:** Variation between studies is not a completely homogenous data set, there is a lack of local anesthetic dosing, and complications were not reported. **Risk or harm if implemented:** not implemented. **Feasibility of use in the project practice area:** feasible

Will complete this in Assignment E

Annotated Bibliography statement(maybe several sentences summarizing the article based upon the information above using a professional APA writing style):
This study examined the effectiveness of certain regional nerve blocks versus local infiltration at the surgical site. This meta-analysis compiled multiple studies to investigate the viability of these regional blocks for THA procedures. The researchers found that local infiltration should be considered before regional blocks because of safety concerns and costs associated with regional anesthesia. If a regional block is utilized, researchers specified that the fascia iliaca block is preferred over the other two.

Thematic Analysis
Key Themes or FSP related significance:
1. Peripheral nerve block
2. Total hip arthroplasty
3. Local anesthetic

APA Citation:
Frassanito, L., Vergari, A., Nestorini, R., Cerulli, G., Placella, G., Pace, V., & Rossi, M. (2019). Enhanced recovery after surgery (eras) in hip and knee replacement surgery: Description of a multidisciplinary program to improve management of the patients undergoing major orthopedic surgery. MUSCULOSKELETAL SURGERY, 104(1), 87–92. Retrieved May 17, 2023, from https://doi.org/10.1007/s12306-019-00603-4

Conceptual Framework or Model	***Design or Method***	***Sample & Setting***	***Major Variables Studied & their Definitions, if any***	***Outcome Measurement(s)***	***Data Analysis***	***Findings***	***Level of Evidence***	***Quality of Evidence: Critical Worth to Practice***
Theoretical basis for the study: This study aimed to evaluate an ERAS pathway for THA and TKA replacement procedures, looking at the length of stay, complication, and patient satisfaction.	Observational Study	**Number of Characteristics:** 207 patients (78 THA and 129 TKA) **Inclusion Criteria:** Patient scheduled for THA and TKA **Attrition:** not listed **Setting:** singular facility	**Independent variables: IV1=** Implementation of an ERAS protocol for THA and TKA. **Dependent variables:** length of stay, complications, patient satisfaction.	**Scale(s) used:** QoLS (quality of life scale), KOOS (knee injury and osteoarthritis outcome score), satisfaction questionnaire, numerical pain rating scale. **Reliability information (*alphas*, if any):** not listed.	**Statistical tests, if any:** Statistical analysis was performed utilizing GraphPad Prism software.	**Statistical findings, if any:** All patients were discharged, and satisfaction scores were higher than 7 in 94.4% of patients. The overall complication rate was 3.4% throughout the study. **Qualitative findings, if any:**	IV	**Strengths: Limitations:** descriptive pilot study, need RCT to confirm results, length of follow-up limited to 6 months, **Risk or harm if implemented:** not listed. **Feasibility of use in the project practice area:** feasible

Will complete this in Assignment E

Annotated Bibliography statement(maybe several sentences summarizing the article based upon the information above using a professional APA writing style): This observation study focused on studying the effectiveness of ERAS protocols when performing THA and TKA. The ERAS protocol involved a multimodal approach to pain control and PONV prevention to decrease the length of stay and minimize the complication rate. At the end of this study, the researchers concluded that an ERAS protocol should be suggested as the benefits allow earlier patient discharge and a quicker return to patient independence. The authors note this study's limitations and recommend further RCT to solidify the evidence shown in this study further.

Thematic Analysis
Key Themes or FSP related significance:
1. Total hip arthroplasty
2. Total knee arthroplasty
3. ERAS protocol

APA Citation:
Oseka, L., & Pecka, S. (2018). Anesthetic management in early recovery after surgery protocols for total knee and total hip arthroplasty. American Association of Nurse Anesthesiology, 86(1), 32–39. Retrieved July 25, 2023, from https://cdn.coverstand.com/23204/472063/3e32da19b95e0adc9d83b36d3101f33a9d257eae.pdf

Conceptual Framework or Model	***Design or Method***	***Sample & Setting***	***Major Variables Studied & their Definitions, if any***	***Outcome Measurement(s)***	***Data Analysis***	***Findings***	***Level of Evidence***	***Quality of Evidence: Critical Worth to Practice***
Theoretical basis for the study: This review was used to compile evidence and provide practice recommendations for anesthetic management that supported improved pain management and early mobilization with patients undergoing THA and TKA procedures.	Integrative Review	**Number of Characteristics:** multiple studies. **Exclusion Criteria:** not included **Attrition:** not included **Setting:** not included	**Independent variables: IV1=** multimodal pain control **Dependent variables:** pain control, opioid consumption, early mobilization	**Scale(s) used:** not listed. **Reliability information (*alphas*, if any):** not listed	**Statistical tests, if any,** not listed	**Statistical findings, if any,** not listed **Qualitative findings, if any:** not listed	IV	**Strengths: a** conglomeration of good evidence while including multiple anesthetic practices. **Limitations:** low strength in some research of anesthetic modalities. **Risk or harm if implemented :** not implemented **Feasibility of use in the project practice area:** feasible

Will complete this in Assignment E

Annotated Bibliography statement(maybe several sentences summarizing the article based on the information above using a professional APA writing style): This review was conducted by two CRNAs to compile the best evidence-based practices related to anesthesia and THA and TKA. Researchers combed through many articles to compile the best evidence for multimodal analgesia, peripheral nerve blocks, neuraxial anesthesia, early ambulation, and reducing complications. This review concluded that preoperative and perioperative interventions greatly influenced patient pain, opioid consumption, hospital length of stay, and early mobility. The authors also note that further research is needed to develop specific medication protocols and finalize an ERAS protocol.

Thematic Analysis
Key Themes or FSP related significance:
1. Regional anesthesia
2. Multimodal pain control
3. Early mobilization
4. Anesthetic modalities

APA Citation:
Moraitis, A., Hultin, M., & Walldén, J. (2020). Risk of postoperative nausea and vomiting in hip and knee arthroplasty: A prospective cohort study after spinal anaesthesia including intrathecal morphine. BMC Anesthesiology, 20(1). https://doi.org/10.1186/s12871-020-01154-z

Conceptual Framework or Model	***Design or Method***	***Sample & Setting***	***Major Variables Studied & their Definitions, if any***	***Outcome Measurement(s)***	***Data Analysis***	***Findings***	***Level of Evidence***	***Quality of Evidence: Critical Worth to Practice***
Theoretical basis for the study: This observational study aimed to investigate the risk of PONV after spinal blockade combined with intrathecal morphine and to explore associations with patient and perioperative factors, including PONV-prophylaxis.	Prospective observational cohort study	**Number of Characteristics :** 109 patients **Inclusion Criteria:** those over 18 years of age undergoing THA or TKA under spinal anesthesia with intrathecal morphine. **Attrition:** **Setting:** County hospital in Sweden	**Independent variables: IV1=** One antiemetic medication **IV2=** Multiple antiemetic medicaitons **Dependent variables:** Presence of PONV following intrathecal morphine	**Scale(s) used:** Numeric rating scale, PONV impact scale **Reliability information (*alphas*, if any):** not listed.	**Statistical tests, if any:** Pearson's chi-squared test and calculate odds ratio	**Statistical findings, if any:** More liberal use of PONV prophylaxis may be warranted. **Qualitative findings, if any:** not listed.	II	**Strengths:** provided information showing insufficient PONV prophylaxis and demonstrated increased efficacy with multimodal PONV prophylaxis. **Limitations: It was a** small one-hospital study, not an RCT, with only three measures of PONV prophylaxis, but still encountered higher levels of PONV. **Risk or harm if implemented :** not implemented **Feasibility of use in the project practice area:** feasible

Will complete this in Assignment E

Annotated Bibliography statement (maybe several sentences summarizing the article based upon the information above using professional APA writing style): Researchers aim to assess the risk of PONV after intrathecal morphine administration and the current efficacy of PONV prophylaxis. This study included 109 patients with their incidence of PONV and the PONV prophylaxis they received. Researchers found that 70% of the patients who received sub-optimal PONV prophylaxis had PONV following surgery. Those who received optimal prophylaxis had a significantly lower rate of PONV at 38%. This study concluded that there is still a relatively high risk for PONV with intrathecal morphine, but providers should lean toward more liberal PONV prophylaxis to decrease the incidence.

Thematic Analysis
Key Themes or FSP related significance:
1. PONV
2. Neuraxial anesthesia
3. PONV prophylaxis

APA Citation:
Jin, Z., Gan, T. J., & Bergese, S. D. (2020). Prevention and treatment of postoperative nausea and vomiting (ponv): A review of current recommendations and emerging therapies. Therapeutics and Clinical Risk Management, Volume 16, 1305–1317. Retrieved July 25, 2023, from https://doi.org/10.2147/tcrm.s256234

Conceptual Framework or Model	*Design or Method*	*Sample & Setting*	*Major Variables Studied & their Definitions, if any*	*Outcome Measurement(s)*	*Data Analysis*	*Findings*	*Level of Evidence*	*Quality of Evidence: Critical Worth to Practice*
Theoretical basis for the study: This review aims to summarize the most up-to-date recommendations surrounding PONV management and compile new evidence on treatment options.	Review and compilation of current evidence-based practices surrounding PONV	**Number of Characteristics:** numerous studies and current guidelines **Exclusion Criteria:** not listed **Attrition:** not listed **Setting:** not listed	**Independent variables:** Not present as this study is a review of multiple guidelines and current evidence-based practices **Dependent variables:** decreasing PONV and PONV treatment	**Scale(s) used:** not listed **Reliability information (*alphas*, if any):** not listed	**Statistical tests, if any:** Not listed	**Statistical findings, if any:** not listed. **Qualitative findings, if any:** not listed	III	**Strengths:** compilation of multiple evidence-based guidelines **Limitations: It is** not a singular study but focuses on a broader picture. **Risk or harm if implemented:** not implemented. **Feasibility of use in the project practice area:** feasible.

Will complete this in Assignment E

Annotated Bibliography statement(maybe several sentences summarizing the article based upon the information above using a professional APA writing style):
This study reviewed literature and practices to evaluate the effectiveness of PONV treatment and prophylaxis. Researchers searched the database to find current PONV prophylactic and treatment practices guidelines. These practices include medications, anesthetic planning, and hydration surrounding the perioperative period. Researchers also included chemoprophylaxis as this is another emerging drug class shown to be effective in decreasing PONV. Researchers included holistic methodologies such as acupuncture, acupressure therapy, and pharmacologic interventions. In combination, all of these modalities mentioned by the authors have been shown to decrease the risk of PONV or provide relief in most patient populations. These recommendations should be further explored and implemented within medicine.

Thematic Analysis
Key Themes or FSP related significance:
1. PONV prophylaxis
2. PONV treatment
3. Evidence-based

Appendix E

Budget

Supply/Device	Unit Cost	Total Cost
CRNA Hourly Rate (Staffing Cost)	$98.93 x 50 x 2 hours	$9,893
Ropivacaine 0.5% (Capitol)	$20.24 x 780	$15,787.20
Bupivacaine 0.5% - 0.75% (Capitol)	$12.24 – $17.18 x 520	$6,364.80 - $8,933.60
Echogenic Needles (25) (Capitol)	$675 x 32	$21,600
Spinal Needles (25)	$200.50 x 21	$4,210.50

Appendix F

Clinical Guidelines

RECOMMENDATIONS FOR ANESTHETIC MANAGEMENT TO DECREASE DVT AND PE FOR THA AND TKA SURGICAL PROCEDURES

CURRENT PRACTICE

- ☐ The traditional and most common anesthetic practice for THA and TKA involves the use of general anesthesia, spinal anesthetics, and opioids in the perioperative area surrounding these procedures. New anesthetic practices involve motor-sparing peripheral nerve block, multimodal analgesia, spinal anesthetics, and PONV prevention to decrease the incidence of DVT and PE following THA and TKA.

RECOMMENDATION #1

Allow the implementation of regional and neuraxial anesthesia for all applicable patients undergoing THA and TKA

- ☐ The use of the motor-sparing adductor canal and iPACK block allows for significant analgesia while maintaining motor integrity of the quadriceps, leading to earlier ambulation.
- ☐ Spinal anesthetics effectively provide analgesia for THA and TKA during the procedure. However, the patient must wait to regain motor function before attempting early ambulation. Neuraxial anesthesia is significantly shorter than a peripheral nerve block that affects motor function.

RECOMMENDATION #2

All anesthetic providers should employ a multimodal analgesic approach to pain control for patients undergoing THA and TKA procedures.

- ☐ Perioperative pain can be modulated through a multimodal approach of preoperative selective NSAIDs (Celebrex), gabapentin, low-dose oral opioids, and the addition of ketamine to an analgesic protocol.
- ☐ These medications have shown success in analgesia for THA and TKA and should be considered in patients for those who are not contraindicated.

RECOMMENDATION #3

PONV prevention should be one of the corner points of anesthetic practices for every THA and TKA procedure to facilitate early mobilization.

- ☐ Many of the prophylactic medications for PONV work through different pathways and, therefore default to the multimodal approach of prevention or management.

- ☐ These antiemetic strategies included minimizing PONV risk, administration of dexamethasone, and ondansetron. For those who still experience PONV, rescue medications commonly include promethazine, droperidol, and propofol.