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An Evaluation of a Nerve Block Protocol in Patients with Hip Fractures

Jenna Buchman
Grand Valley State University

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An Evaluation of a Nerve Block Protocol in Patients with Hip Fractures

Jenna Buchman

Kirkhof College of Nursing

Grand Valley State University

Advisor: Dr. Karen Burritt

Advisory Team: Dr. Della Hughes Carter, & Lisa Zuckerman, CNS

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Abstract

BACKGROUND/PURPOSE: Pain management for hip fracture patients in the time before surgery is crucial. Literature highlights the success of local, single injection nerve blocks to aid in preoperative pain management. A local hospital implemented a preoperative, single injection nerve block protocol in March 2018. This quality improvement project investigated: (1) organization protocol compliance, and (2) if the preoperative single injection nerve block protocol reduces hip fracture pain, use of systemic opioid analgesics, decreases incidence of adverse opioid effects, and reduces cost of care. **SUBJECTS:** Patients ages 18 and older admitted with the primary diagnosis of an operable isolated hip fracture (n=100). **METHODS:** Data measures were extracted from the electronic health records and the trauma registry and were entered into REDCap encrypted software. **ANALYSIS:** Data was analyzed using SAS statistical software to verify whether the intervention was successful in meeting cost, quality, and compliance measures. **RESULTS:** Results were not statistically significant in reducing oral and intravenous narcotic use before ($p=0.80$; $p=0.39$) and after ($p=0.23$; $p=0.10$) surgical correction, nor was there statistically significant change in adverse effects ($p=0.10$) and length of stay ($p=0.90$). However, there was a statistically significant reduction in preoperative pain levels following nerve block administration ($p<0.0001$). Protocol compliance was 66% over seven months. **CONCLUSION:** The results of this project were consistent with the literature; nerve block injection may reduce preoperative pain for patients with an operable hip fracture. Further investigation is needed to determine if narcotic use and length of stay could be impacted if time variability in nerve block administration were reduced and if protocol compliance were increased.

Keywords: hip fractures, preoperative period, nerve block, and pain management

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An Evaluation of a Nerve Block Protocol in Hip Fracture Patients

Introduction

Hip fractures are a debilitating injury associated with acute pain, functional impairment, increased morbidity and mortality, and substantial financial burden (Centers for Disease Control and Prevention [CDC], 2016a; Riddell, Ospina, & Holroyd-Leduc, 2016; Sanzone, 2016). For those ages 65 and older, this type of injury is one of the most common reasons for admission to an orthopedic unit, resulting in over 300,000 hospitalizations annually (CDC, 2016a; Freeman & Clarke, 2016; HCUPnet, 2012). One of the most important aspects of surgery is pain management, as most hip fracture patients experience moderate to severe pain (Sanzone, 2016). Effective pain control is associated with early postoperative ambulation and functional recovery, decreased length of stay, decreased thrombotic events, and improved patient satisfaction (Wang, Sun, Wang, Hao, 2017).

Yet, optimal pain control is typically underutilized in hip fracture care (Haslam, Lansdown, Lee, van der Vyver, 2013). There is limited research and expert agreement on the most effective approach to controlling preoperative hip fracture pain. The current standards of practice reflect an opioid model of analgesia. However, systemic opioid use in the preoperative phase is associated with significant side effects, such as nausea, vomiting, constipation, confusion or delirium, drowsiness, and respiratory depression (Freeman & Clarke, 2016; Sanzone, 2016; Wang et al., 2017).

Additionally, mismanaged preoperative pain is associated with increased cost of care, prolonged rehabilitation, patient dissatisfaction, and overall increased risk of morbidity and mortality (Riddell et al., 2016; Sanzone, 2016). Therefore, early effective preoperative pain management represents a key opportunity for patient care improvement.

An abundance of literature supports the use of nerve blocks as an effective adjunct for localized, preoperative pain control (Morrison, et al., 2016; Sanzone, 2016; Riddell et al., 2016; Ritcey, Pageau, Woo, & Perry, 2016). A nerve block is an injection of a local anesthetic around a nerve. In the case of a hip fracture, the injection would be localized to one of the branches of the lumbar plexus. The nerve block relieves pain regionally by interrupting pain signal transmission to the central nervous system (Wang et al., 2017). Common orthopaedic nerve blocks include a psoas compartment block, a femoral block, fascia iliaca compartment block, or combined nerve blocks. The techniques of administering a local nerve block include the landmark method, a nerve stimulator, or an ultrasound (Guay, Parker, Griffiths, & Kopp, 2017). These nerve blocks then target pain locally, which reduces systemic side effects of traditional narcotic use. Side effects may include injection site hematoma, nerve damage, block failure, and local anesthetic toxicity.

The orthopedic physicians at XXX decided to implement a standardized protocol where all individuals admitted with a primary diagnosis of an isolated hip fracture would receive a preoperative localized, single injection nerve block. This standardized protocol was developed by the orthopaedic clinical nurse specialist (CNS) in December of 2017. It was enacted officially in March 2018 to improve hip fracture pain management from the point of emergency department admission to the operating room. The purpose of this quality improvement is therefore to determine whether or not the nerve block protocol will reduce preoperative pain, narcotic medication use, narcotic-related adverse effects, and inpatient care cost in operable hip fractures.

Assessment of the Organizational

Framework for Assessment

The Burke-Litwin Model of Organizational Performance and Change (1992) is a causal model describing the twelve interconnected factors of organizational change (see Appendix A). The

Burke-Litwin Model (1992) is divided into microscopic, or transactional factors, and macroscopic, or transformational factors. Microscopic, or transactional, variables include work unit climate, management practices, structure, task and individual skills, motivation, systems, individual needs and values, and individual and organizational performance (Burke & Litwin, 1992). Macroscopic, or transformational, variables include external environment, leadership, mission and strategy, and organizational culture (Burke & Litwin, 1992). This model has content validity and internal reliability, which means that it consistently measures what it purports to measure across all of its constructs (Burke & Litwin, 1992; Stone, 2015).

Ethics and Protection of Human Subjects

Prior to data collection and analysis, an application was submitted to the XXX Institutional Review Board. No project activities will commence prior to review and approval by the Board. The purpose and scope of this project was limited to evidence-based quality improvement. The data used for analysis was de-identified and coded when pulled from the patient chart and transferred to a data collection tool. No research consent was needed for this quality improvement project, as it entails retrospective data collection. All members of the team have completed human subjects protection training via the Collaborative Institute Training Initiative and their interactions with patient records were guided accordingly.

Stakeholders

Key stakeholders include those individuals or groups entrenched and invested in the organization (Moran et al., 2017). Consulting with people that have skill sets, experience, and perspectives provide valuable insight to the organization practices. Within the context of this project, the key stakeholders include the healthcare providers and residents (orthopedics, emergency medicine, internal medicine, and anesthesia), nurse practitioners, physician assistants, the rapid response team, patients, registered nurses (RNs), unit leadership (ED, PACU, OR, and

OU managers), and each unit's clinical nurse specialists (CNSs) and leaders (CNLs). The orthopaedic physicians and residents order pain medications before and after surgery and perform the surgeries. RNs administer the pain medications, assess and monitor the patient response, and document pain scores before, during, and after surgery. This helps ensure accurate and timely documentation of pain treatment. Patients receive the pain medication as well as undergo surgery for their hip fractures. Unit leadership and the CNSs monitor unit processes, satisfaction, and compliance with organization policy, quality, and standards. Therefore, all are considered key stakeholders in this organizational assessment.

SWOT

A SWOT analysis is a tool used to evaluate the current state of an organization. The acronym SWOT stands for 'strengths', 'weaknesses', 'opportunities', and 'threats' (Gurel & Tat, 2017). Threats refer to situations or entities that may endanger or impede the organization's functions. Opportunities refer to situations, resources, or entities that an organization may use advantageously and/or to counteract threats (Gurel & Tat, 2017). Internal strengths include advantageous and unique characteristics that differentiate the organization from its competitors. A weakness, though, refers to an organization's lack of situations, resources, functions, or abilities, which contribute to inefficient or ineffective functioning (Gurel & Tat, 2017).

This analysis assessed an organization's external threats and opportunities as well as its internal strengths and weaknesses. A SWOT analysis was conducted to assess the current state of hip fracture pain control across the ED, PACU, OR and OU (see Appendix B). The awareness gleaned from this analysis can help the organization reach preoperative hip fracture pain management goals (Gurel & Tat, 2017).

Strengths of the organization include leadership training in Lean Six Sigma, a culture of process improvement, organization-wide teamwork, Magnet designation, The Joint Commission (TJC) orthopaedic certifications, Hospital Quality Awards, Clinical Quality Awards for joint replacements, the presence of an orthopaedic nurse navigator, and joint repair preparation classes (American Nurses Association, American Nurses Credentialing Center, & American Nurses Foundation, 2018; GoLeanSixSigma, 2016; Healthgrades, 2018; TJC, 2018). Major weaknesses of the organization are a lack of standardized pain management for hip fractures and use of variable orthopaedic order sets for patients. Other weaknesses include an inability for providers to regularly meet face to face, anesthesiology staffing, new provider unfamiliarity, transitions of care at discharge, and utilizing the same diagnostic related group (DRG) codes for hip fractures and elective hip arthroplasty.

Opportunities for the organization include decreasing the unnecessary use of opioids, implementing new evidence in the form of preoperative nerve blocks, and the new orthopaedic group merger (Morrison, et al., 2016; Sanzone, 2016; Riddell et al., 2016; Ritcey, Pageau, Woo, & Perry, 2016). Additionally, another opportunity includes gleaning insight from sister organizations with similar protocols. Threats to the organization are competition from other local hospitals with already established nerve block protocols, local branding from other hospitals, insurance company preference, and Centers for Medicaid and Medicare reimbursement measures (CMS, 2018).

Clinical Practice Question

The organizational assessment and SWOT analysis suggest that the already implemented nerve block protocol can positively impact hip fracture care. The clinical practice questions are: (1) Does this preoperative, single-injection nerve block, which serves as a pain management adjunct, reduce preoperative reports of pain, overall administration frequency of opioid analgesic/morphine equivalents, incidence of opioid-associated adverse effects, and costs of inpatient care in hip

fracture patients over an 8 month period compared to standard preoperative opioid analgesic therapy/morphine equivalents? (2) What is the protocol compliance rate?

Review of the Literature

Method

The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guideline served as the framework for this review (Moher, Liberati, Tetzlaff, Altman, & PRISMA Group, 2009). A comprehensive search was conducted in the PubMed, Cochrane Library, CINAHL, and Web of Science databases and was limited to reviews in the English language from 2008 to 2018. Keywords were hip fractures, preoperative period, nerve block, and pain management. The search expertise of an experienced librarian was also utilized.

Inclusion and Exclusion Criteria

Population. Included were sample populations that were at least 16 years of age and older with an acute a hip fracture. Studies were excluded if the sample included people younger than 16 years old, if subjects underwent an elective total hip arthroplasty or revision, subjects with mid-shaft or unspecified femoral fractures, and subjects that were deemed non-operable.

Intervention. The intervention is the administration of a single injection nerve block (femoral [FNB], psoas compartment, fascia iliaca compartment [FICB], 3-in-1) prior to surgery for a hip fracture as an adjunct to standard preoperative opioid analgesics. Both nerve stimulator, landmark, and ultrasound guided (USG) forms of administration were included in order to capture more robust evidence. Types of blocks (ropivacaine, bupivacaine, etc.) were included in the search and not separately evaluated. Studies were excluded if the nerve block administration occurred right before, during or after surgery, if a continuous nerve block catheter was placed, if the subject also received an epidural or spinal anesthetic in conjunction with the nerve block, or if nerve block administration occurred for a different injury.

Comparison. The primary comparisons were those patients treated with just standard administration of preoperative opioid analgesic/morphine equivalents for pain control. Studies were excluded if the comparison was a non-steroidal anti-inflammatory medication, acetaminophen, or epidural/spinal anesthesia.

Outcome. Primary outcomes consisted of acute pain management, frequency of opioid pain medication use, and overall opioid medication use. Secondary outcomes included delirium, opioid or nerve block adverse side effects, mortality, functional status, and length of stay. Studies that failed to address at least one of these outcome measures were excluded.

Search Outcomes

The initial search using the aforementioned keywords yielded 62 articles across 4 databases (see Appendix C). Papers were removed if they were duplicates, did not meet the inclusion criteria, and did not meet content criteria. The final 10 papers evaluated adults who presented to the hospital for a hip fracture (see Appendix D).

Intervention and Comparison Characteristics

Each review compared administration of a single injection nerve block (femoral [FNB], psoas compartment, fascia iliaca compartment [FICB], 3-in-1) prior to surgery for a hip fracture alone or as an adjunct to standard preoperative opioid analgesics. The most common medication of comparison was with morphine (oral, intramuscular, or intravenous), followed by fentanyl and alfentanil. Each study included either a nerve stimulator, landmark, or USG form of administration, although the USG technique recently emerged as the gold standard (Scurrah et al., 2018). Across studies, administration of preoperative nerve blocks included trained ER physicians, orthopaedic surgeons, anesthesiologists, paramedics, and junior physicians.

Measures

The ten studies/reviews focused primarily on the efficacy preoperative regional nerve blocks. The Visual Analog Scale (VAS), Verbal Rating Scale (VRS) and the Numeric Rating Scale (NRS) were the primary tools used to measure and report differences in pain. Changes in pain scores on the VAS, VRS, or NRS was considered significant if $P \leq 0.05$ at a 95% confidence interval (CI). Another outcome measure included safety (10 studies/reviews), which was defined as the frequency of adverse events stemming from either the intervention or comparison group. The reviews also reported on the resultant reduction in opioid analgesic use (9 studies/reviews), which was reported in milligrams. Finally, the 1 review reported on the time to the next opioid analgesic dose following regional nerve block administration, which was recorded in minutes.

Results

Efficacy of Regional Nerve Blocks. The three systematic reviews demonstrated reductions in preoperative hip fracture pain for the FNB, FICB and 3-in-1 nerve block (About-Setta et al., 2011; Riddell et al., 2016; Ritcey et al., 2016). Two reviews concluded that the evidence supports regional nerve blocks as an effective method in reducing pain compared to standard opioid care. Only one single injection study did not favor regional block efficacy, but pre-block pain scores were significantly higher in this group (Guay et al., 2017). The two combined systematic reviews and meta-analyses found significant reductions in preoperative hip fracture pain associated movement and positioning. However, acute pain was variable or not therapeutically different at rest (Fadhilillah & Chan, 2017; Steenberg & Miller, 2018).

The integrative review evaluated the current care continuum in the ED for hip fracture patients. The single randomized controlled trial deemed high quality evaluated preoperative FICB to the control group: systemic morphine combined with a placebo injection mimicking an FICB.

The study (n=48) found static, or resting, pain ($P<0.01$) and dynamic, or moving, pain ($P=0.02$) relief superior in the FICB group compared to the morphine and placebo FICB group (Wennberg et al., 2018). The narrative review evaluating eight randomized controlled trials found that regional nerve blocks reduce hip fracture pain on movement within 30 min of block placement (Scurrah et al., 2018). Additionally, FICB, FNB, psoas compartment, and combined nerve block provided superior analgesia to placebo or 'standard care' in hip fractures (Scurrah et al., 2018).

In the AAOS (2014) review, five out of the six (n=593 patients) high strength studies evaluated preoperative pain management. The sixth study investigated preoperative and postoperative pain. VAS scores indicated significant reduction in reported preoperative pain in five out of the six studies and nonsignificant reduction of pain in the other study (Mean preoperative VAS score of placebo vs. FICB: 68.2 vs. 61.4, $P=0.59$) (AAOS, 2014).

The single randomized controlled trial (n=266) evaluated the effect of FNB and opioids (n=129) to conventional opioid treatment (n=137) on preoperative pain (VAS) and preoperative opioid consumption (Unneby et al., 2017). Self-rated and proxy VAS pain scores decreased from baseline to 12 hours in intervention group versus the control ($P<0.001$ and $P=0.003$, respectively) (Unneby et al., 2017).

Safety. The clinical practice guideline, the four systematic reviews, the randomized controlled trial, and the integrative review found no major immediate complications, such as adverse toxicity or persistent paresthesia, for FNB, FICB, or 3-in-1 blocks (AAOS, 2014; About-Setta et al., 2011; Guay et al., 2017; Riddell et al., 2016; Ritcey et al., 2016; Unneby, 2017; Wennberg et al., 2018).

The two combined systematic reviews and meta-analyses also evaluated safety of single injection nerve blocks in preoperative hip fracture pain. In the review and analysis by Fadhlillah &

Chan (2017), the FICB group had reduced analgesia breakthrough (n=57 vs. n=73), reduced drowsiness/sedation (n=1 vs. n=22), reduced desaturation (n=0 vs. n=4), and reduced nausea and vomiting (n=3 vs. n=7) compared to standard preoperative analgesia. Both groups reported localized bruising (n=3), though (Fadhlillah & Chan, 2017). In the review and analysis by Steenberg & Miller (2018), there was a 1.7% incidence rate of hematoma at the injection site.

The narrative review by Scurrah et al. (2018) found one study where the inpatient mortality with the regional nerve block was 5.5% versus 15% (P=0.0024) in the standard care control group. There was no statistically significant difference in cardiac complications, deep vein thrombosis, pulmonary embolism, nausea and vomiting, respiratory infection, stroke, surgical wound infection, or urinary tract infections with regional nerve blocks compared to standard preoperative hip fracture pain management (Scurrah et al., 2018).

In terms of safety by administration, the narrative review also found that junior staff, paramedics, and new residents can be trained to effectively administer nerve blocks without increase in complications (Scurrah et al., 2018). The AAOS (2014) clinical practice guidelines for hip fractures also reports that the type of administering provider (emergency physicians, anesthesiologists, orthopaedic surgeons) did not compromise patient safety.

Reduction in opioid use. Three of the systematic reviews, the narrative review, and one of the combined systematic review and meta-analysis found less opioid consumption in the preoperative nerve block intervention group compared to the opioid control group (Abou-Setta et al., 2011; Guay et al., 2017; Ritcey et al., 2016; Scurrah et al., 2018; Steenberg & Miller, 2018). However, Ritcey et al. (2016) were unable to conclude whether reduced IV opiate use also resulted in reduced adverse effects due to under-reporting in most of the studies.

Unneby et al. (2017) found that the FNB and opioid intervention group received significantly less opioids than the control group (Intravenous: 2.3 ± 4 mg vs. 5.7 ± 5.2 mg, $P < 0.001$; Oral: 2.1 ± 4.1 mg vs. 3.6 ± 6.4 mg, $P = 0.017$). Additionally, patients with dementia in the intervention group received less intravenous opioids compared to the control group (2.1 ± 3.3 mg vs. 5.8 ± 5 mg, $P < 0.001$) (Unneby et al., 2017).

Delay in additional opioid use. Steenberg & Miller (2018) analyzed two studies comparing the need for additional opioids in the FICB group versus the opioid control group in preoperative hip fracture patients. In one study, the FICB group waited an average of 245 minutes (95% CI: 2055, 285) before requesting another opioid dose compared to the opioid control group, which waited an average of 145 minutes ((95% CI: 14.9, 275) ($P = 0.12$)). The other study reported similar findings for the FICB group, which waited an average of 516 minutes (95% CI: 437, 594) compared to 270 minutes in the opioid control group ((95% CI: 189, 351) ($P < 0.01$)). In total, the FICB group waited longer for first request of additional analgesia compared to the opioid control group (SMD= 0.93 (95% CI: 0.02, 1.84) ($P = 0.05$)) (Steenberg & Miller, 2018).

Discussion of Evidence to be Used for Project

A key theme in this review is that preoperative pain control for hip fractures can be improved. Single injection nerve blocks as a solitary intervention or as an adjunct to opioids compared to standard preoperative opioid care offer a promising solution to this problem. Although four of the reviews each report that only one study has a low risk of reporting bias, all ten studies included in this review conclude overall that single injection, regional nerve blocks are at least as effective, if not superior, to standard opioid analgesia in reducing hip fracture pain.

About-Setta et al. (2011) concludes that there is a moderate level of evidence supporting use of nerve blocks in hip fractures, but that more rigorous studies will help provide definitive

guidelines. However, the AAOS (2014) clinical practice guidelines give a strong recommendation for the use of preoperative regional analgesia. Additionally, all ten studies report that the use of regional nerve blocks in hip fractures is relatively safe. However, the authors of each review cite the underreporting of adverse events as an issue that should be more transparent in study results.

The other eight reviews provided evidence that supported the ability of single injection regional nerve blocks in reducing additional preoperative opioid consumption. These results are promising, given the substantial side effects associated with opioid consumption. One review reported on the delay in time associated with additional opioid doses following administration of the FICB compared to the opioid control groups (Steenberg & Miller, 2018). These two studies were part of the meta-analyses, which conveys a high level of evidentiary support. Despite low heterogeneity of the p-value, the authors caution readers to consider study heterogeneity.

Limitations

The review presents several limitations. In terms of the reviews, the small sample sizes, heterogeneity of study methodology, and moderate to high reporting bias should all be considered when weighing the evidence. Additionally, the overall evidence level supporting regional nerve blocks in preoperative hip fracture pain is moderate. Limitations of the DNP student may include search methods that could have eliminated pertinent articles.

Conclusion

Use of opioid analgesics remains a common practice in pre-operative hip fracture management. However, the review demonstrates the efficacy and safety of single injection regional nerve blocks in hip fracture patients. The overall evidence supporting nerve block use is moderate due to small sample sizes and study design variation, but it offers an alternative to current preoperative pain management practices and patient outcomes (see Appendix E).

Phenomenon Conceptual Model

The phenomenon of preoperative pain management in hip fractures is best conveyed through the revised Theory of Symptom Management Model (Dodd, Janson, & Facione, 2001). Symptoms can be distressing to a patient and can pose management challenges for healthcare providers. This theoretical model defines a symptom as a subjective experience that conveys personal biopsychosocial changes. A sign, though is defined as an objective, or measurable component of a disease (Dodd et al., 2001). Both signs and symptoms help inform the course of patient care.

However, this model primarily focuses on effectively managing active patient symptoms, which are based on patient perception and report. Consideration is also given to nonverbal patients and patients who are at risk for developing symptoms. In the revised model, there are three domains: the Person, Health and Illness, and the Environment (Dodd et al., 2001). The Person domain pertains to intrinsic variables that impact the way in which a person perceives and responds to the symptom experience. These include demographic, psychological, sociologic, and physiologic variables (Dodd et al., 2001). The Health and Illness domain includes individual risk factors, injuries, diseases, or disabilities. These variables also impact the symptom experience and a person's desire to seek care. Conversely, the absence of signs or symptoms does not necessarily equate to health (Dodd et al., 2001). Finally, the Environmental domain represents an individual's environment encompasses physical, social, and cultural variables. The context in which symptoms occur impact the symptom experience as well as the type of treatment and projected outcomes (Dodd et al., 2001).

These three domains influence the three dimensions of the model: Symptom experience, Management strategies, and Outcomes. A symptom experience is an individual's perception, assigned meaning, and response to a symptom (Dodd et al., 2001). The goal of symptom

management is to delay or avoid a negative health outcome. Components of symptom management include the time, method, amount, location, and purpose of an intervention designed to mitigate or eliminate patient symptoms (Dodd et al., 2001). Finally, the Outcomes represent the product of symptom experience and management. This dimension includes functional and emotional status, self-care, quality of life, morbidity, mortality, and cost of interventions (Dodd et al., 2001).

Overall, this model offers a comprehensive conceptualization of symptom expression. It helps clinicians understand symptoms in order to select appropriate management strategies and assess the impact of such strategies (Dodd et al., 2001). Therefore, this model serves as the best lens through which to view the phenomenon of preoperative hip fracture pain (see Appendix F).

Project Plan

Purpose of Project and Objectives

The orthopedic physicians at XXX decided to implement a standardized protocol where all individuals admitted with a primary diagnosis of an isolated, operable hip fracture would receive a localized, single injection nerve block. The protocol was enacted in March 2018 to safely and effectively manage pain for this patient population from the point of emergency department admission to the operating room. The purpose of this quality improvement is therefore to determine whether or not the preoperative nerve block protocol addresses the following objectives: reduced preoperative pain, reduced narcotic drug use, reduced narcotic-related adverse effects, and reduced potential cost of inpatient care in this population.

Design for the Evidence-based Initiative

The nerve block protocol was designed by the orthopaedic CNS through the communication of all of the key stakeholders involved in hip fracture care (see Appendix G). This protocol and list of responsibilities is located in the education booklets in the ED and OU for staff to reference. The CNS has already educated all care teams and units involved to familiarize

employees with the protocol and associated expectations. Anesthesiology also maintains the organization's standard for educating the patient on the nerve block and clearing a patient for the nerve block. Feedback was collected on an ongoing basis to identify, address, and mitigate factors that may contribute to negative patient outcomes. For data analysis, the pre-block protocol data is obtained through a retrospective record review based on the aforementioned outcome indicators.

Setting

The organization of interest is a local West Michigan hospital that sees a full spectrum of patient conditions and provides a variety of services. The units involved in this proposed practice change, though, include the emergency department (ED), the post-anesthesia care unit (PACU), the surgical floor (OR), and the orthopaedic medical-surgical unit (OU). These units are integral to the continuum of care for hip fracture patients from time of admission to discharge. Patients admitted in the ED for hip fractures will typically go straight to preoperative holding on the surgical floor if there is an opening in the OR schedule. If not, then the patients are sent to the OU until there is an opening in the OR. After the procedure in the OR, the patients are held in PACU to monitor for anesthesia side effects, vital signs, and pain. Once the patient is deemed stable, the patient is transferred to the OU for postoperative care until discharge. In 2017, there were 168 hip fractures, of which 146 received surgical correction.

Participants

All patients admitted to the organization for hip fractures and are eligible for surgery from March 1, 2018 to December 31, 2018 were offered the nerve block as part of the established protocol. The pre-nerve block group included all patients admitted to the organization for hip fractures and underwent surgical correction from June 1, 2017 to February 28, 2018. Patients were excluded if their hip fracture is non-operable, for nerve block refusal, or if there is a medical allergy to the nerve block medication.

Model Guiding Implementation

Utilization of Rosswurm & Larrabee's Model for Evidence-Based Practice Change (1999) provides the best approach to effectively evaluate this preoperative nerve block protocol for hip fractures. This model provides a systematic process for implementing evidence-based change through the assistance of key stakeholders and in the context of the cultural climate. It was initially developed to correct the continued struggle of research utilization by practitioners (Rosswurm & Larrabee, 1999). This model has six steps for implementation and sustainability (see Appendix H).

First step: Assess need for change in practice. This step involves the collection of data in order to identify a clinical practice problem. This organizational data is then compared to external, or national databases, from which care standards are established. Information is also gleaned from key stakeholders to substantiate the practice problem's effect on patient care (Rosswurm & Larrabee, 1999).

Second step: Link problem with interventions and outcomes. The problem must then be translated into a standardized nursing or clinical classification. This facilitates ease of data collection, analysis, and dissemination. This step then includes connecting the practice problem to interventions and subsequent outcome expectations (Rosswurm & Larrabee, 1999).

Third step: Synthesize best evidence. At this step, the proposed interventions and outcomes are further clarified to facilitate a more specific literature review. Practitioners appraise the quality of the literature and level of evidence. The purpose of this step is therefore to investigate whether the current literature supports the need for the practice within that particular healthcare context (Rosswurm & Larrabee, 1999).

Fourth step: Design a change. Following the synthesis of evidence, practitioners may then construct a protocol that details the sequence of steps for the practice change. Process and outcome indicators will be outlined for recording and data analysis. These indicators outline staff actions, resources, costs, and projected patient care outcomes (Rosswurm & Larrabee, 1999).

Fifth step: Implement and evaluate change. Implementation of the practice change must be accompanied by continuous monitoring, reinforcement, and openness to staff feedback. Data is collected for the length of the intervention trial and analyzed to verify whether the practice change was successful in meeting the desired outcome indicators. Staff and peer feedback, cost, and benefits and risks are also taken into consideration when evaluating the effectiveness of the change (Rosswurm & Larrabee, 1999).

Sixth step: Integrate and maintain change. Following implementation of a pilot protocol, staff and organizational buy-in help produce a revised protocol for approval. Integration and sustainability of the practice change occurs when stakeholders are continuously informed and included. This enhances the acceptance and perceived feasibility of the practice change within the context of the organization (Rosswurm & Larrabee, 1999).

Implementation Steps and Strategies

Following the organizational assessment, SWOT analysis, and literature review, the goal of the next steps is to assess whether or not this protocol is effective in meeting the specified measures. In accordance with Rosswurm and Larrabee's model (1999) and Powell et al. (2015) implementation strategies, steps to evaluate this nerve block protocol include the following:

1. Build a coalition prior to implementation by November 5th, 2018.

According to Powell et al. (2015), building a coalition refers to recruiting and building relationships with key stakeholders in order to partner in the implementation initiative.

Steps to build a coalition involves:

- Prior cultivated relationship in April 2018 with the designated orthopaedic CNS that spearheaded this initiative. She serves as a liaison to the orthopaedic, emergency medicine, internal medicine, and anesthesia providers, the nurse practitioners, physician assistants, the rapid response team, unit managers (ED, PACU, OR, and OU managers), and the ED, PACU, and OR clinical nurse CNSs and CNLs. This was because the organization's Institutional Review Board (IRB) was not yet granted to the DNP student.
 - The DNP student established communication and attended meetings with the orthopaedic CNL, orthopaedic nurse navigator, the orthopaedic unit nurse manager, the Clinical Service Director, and the trauma CNS throughout several meetings in May, June, and July of 2018.
 - The DNP student met with Grand Valley State University Statistician graduate student in May 2018 to review excel spreadsheet for data collection.
 - The DNP student established phone and email communication with the Clinical Information Specialist, the information data specialist who helped facilitate data extraction from the patient EHR for data analysis.
2. Submit application to Grand Valley and organization's IRB for project approval and EHR access by November 9th, 2018.
- Submission of the IRB application by this data to both organizations granted access to the EHR system for retrospective and real-time data collection.
 - Approval also ensured ethical oversight by the two organizations.
 - The organization already implemented the protocol in March 2018. The DNP student's role therefore involved data collection, analysis, and assistance with possible recommendations protocol revision.

3. Develop an evaluation blueprint by November 9th, 2018.

According to Powell et al. (2015), developing an evaluation blueprint includes “1) an aim/purpose; 2) scope of the change; 3) timeframe and milestones; and 4) appropriate performance/progress measures” (p. 8). Steps needed to formulate a blueprint for evaluating the nerve block protocol include:

- The aim/purpose or clinical question was stated earlier. The protocol was already implemented in March 2018.
- The scope of the change includes the units affected by the proposed nerve block protocol. These include the ED, PACU, OR, and OU.
- The timeframe and specific data measures will be explained in later sections.

4. Evaluation of workflow modifications pending approval of IRB access by November 26th, 2018. Steps include:

- The orthopaedic CNS already compiled the appropriate order sets for hip fracture admission, which includes the nerve block, due to the DNP student’s initial inability to access charts and the EHR. This, combined with the hip fracture care flowchart, facilitated ease of ordering and mitigate staff and provider confusion.
- Monthly audits (Point 5) will determine whether the protocol is being followed by the staff involved in this protocol.

5. Perform weekly audits of the outcome measures starting December 1, 2018, pending Grand Valley State University and the organization’s IRB approvals.

Powell et al. (2015) define audits as a process of collecting and summarizing clinical data acquired over a designated time period. Providing clinicians and administrators with

this data will facilitate real-time evaluation and monitoring of the protocol success in case protocol revisions must be made. Steps include:

- Meet with Clinical Information Specialist who will help direct the DNP student on how to extract the data appropriate for the project. Meetings and/or phone call correspondence occurred on the same day each month that the DNP Student was present at the organization to perform the chart audits.
- Monthly audits occurred from the time of IRB approval until January 2018 in order to collect a large enough sample size for comparison of the pre-protocol/no nerve block patient sample. The IRB approval was requested until January 2019 to ensure complete data retrieval.
- Audits for the retrospective data of the pre-protocol/no nerve block patient sample occurred within the same timeframe.
- The monthly data will be analyzed and turned around to both the orthopaedic CNS, the orthopaedic CNL, the orthopaedic nurse navigator, the orthopaedic unit nurse manager, the Clinical Service Director, and the trauma CNS for review.

6. Dissemination of final project report by March 25th, 2018.

Following data collection and analysis, the final strategy involves sharing local knowledge with key stakeholders to inform them about how care quality has changed as a result of protocol implementation (Powell et al., 2015). Sister organizations and other local organizations may build on the success or general knowledge of this nerve block protocol to promote care quality in their hip fracture patients.

- Disseminating results to ED, PACU, OR, OU and other pertinent providers and administrators via email or in person by March 25th, 2019.

Measures

Measurement tools and indicators include electronic health record data on: (1) Demographics of hip fracture patients (age, sex, race); (2) Hip fracture post-surgical readmission rates to the ED within 30 and 90 days; (3) Hip fracture mortality rates in the hospital; (4) Pre-operative and post-operative Numeric Pain Scale or Visual Analog pain scores; (5) Pre-block and post-block Numeric Pain Scale scores; (6) Time from admission to the ED to administration of a nerve block; (7) Time from admission to the ED to the OR (preoperative waiting time); (8) Time from block administration to the OR; (9) Number of preoperative opioid analgesics used in morphine milliequivalents (MME); (10) Number of postoperative opioid analgesics used in MME; (11) Length of patient stay; (12) Cost of inpatient treatment and stay; (13) Incidence of pneumonia; (14) Incidence of delirium; (15) Incidence of unexpected intensive-care unit transfer; (16) Whether the nerve block was given/refused; and (16) Patient discharge destination.

Data Collection Procedures

In order to ensure the safety and privacy of participants and research data, patient names and MRNs did not leave the premises of the organization's computers. The DNP student was the lead data collector. This collection was overseen by the orthopaedic CNS at the organization (see Appendix J). The DNP student utilized REDCap software at the site to encrypt the data and ensure patient privacy. Pertinent data was obtained with the assistance of the Clinical Information Specialist and Trauma CNS. The only patient demographic data collected for entering into the REDCap encrypted software included: patient age, sex, and race.

The other outcome indicators are numeric variables that did not risk identifying the patient. For instance, each of the data outcomes were numerically coded and did not involve protected health information (i.e. Sex: 0=Male, 1=Female; Race: 0=Caucasian, 1=African American,

2=Hispanic, 3=Other; Hip fracture readmission: 0= no readmission in 30 days, 1=readmission in 30 days). Patient chart information did not leave the organization's campus. Only the data relating to the study outcomes were pulled, coded, and entered into REDCap prior to departure from the organization. This ensured security of protected health information and eliminated the potential for such information to be deliberately or unintentionally discovered. Data collection occurred weekly at the organization and ended in February 2019.

Data Management

Collected data relevant to the patient outcome measures were stored in REDCap. The original patient charts were kept within the organization's EHR system and did not depart from the campus databases. This data will be available to the organization for review and audit per the designated 7 years after conclusion of this project. The REDCap data was exported to and analyzed by a Grand Valley State University statistics graduate student.

Analysis

The procedure for analysis of the current state of hip fracture pain management included recording of the aforementioned measurement indicators. In order to evaluate the preoperative waiting time, a dataset of patient transfers was manually reviewed. The time in hours was then quantified into a variable that could be processed into REDCap. Based on the quantified preoperative times, each patient's preoperative pain score was then manually extracted from the data set. Once the delineation between preoperative and postoperative periods was outlined, the length of stay, postoperative patient numeric pain score, and postoperative opioid analgesic use were also calculated. The term "morphine milligram equivalents" (MME) accounts for differences in opioid drug type and strength by equating its dose in milligrams of morphine (CDC, 2017). MMEs were calculated using American Pain Society (2016) CDC (2016b) conversions (see

Appendix I). Oral medications were converted to MME with the oral morphine conversion factor. Intravenous (IV) medications were converted to MME with the IV morphine conversion factor.

The graduate statistics student transferred the de-identified data from the exported REDCap file to the SAS statistical software for data analysis at Grand Valley State University. Outcome evaluation underwent inferential statistic testing through independent samples t-test. Assuming that the data fits a normal distribution, this method tested for significance between the two independent patient groups (no nerve block vs. nerve block) and for organizational compliance with the protocol. The outcome measures are displayed later as charts and graphs for presentation.

Resources & Budget

The financial justification for this project should be noted (see Appendix K). So far, the calculated cost of in-kind mentoring of the organization's CNS was forty hours, which totals \$1,920 (Salary.com, 2018a). In terms of the nerve block kits, there is one kit stocked on the intensive care unit and three kits stocked in the ED. The items in each kit all could be used when a nerve block is administered. The contents of each kit total \$30.95. Extra emergency supplies outside of the kit, but kept on the aforementioned units, include one bag of lipids (\$9.12) and one continuous nerve stimulator kit (\$51.59). Four kits (\$123.80) and the additional extra emergency supplies (\$242.84) would total \$366.64.

The organization decided to use the ultrasound-guided (USG) technique for administration. The USG technique has shortest time to onset of action, requires the least amount of local anesthetic, and has fewer complications compared to the other administration methods (Bates, Rhodes, & Amini, 2015).

Two common procedural (CPT) codes are needed for nerve block administration. The CPT code 76942, which is for Ultrasonic guidance for needle placement, has a facility price in Michigan of \$32.50 (CMS, 2018a). The second CPT code 64447, which is for a single femoral

nerve block injection, has a facility price in Michigan of \$67.99 (CMS, 2018b). An anesthesiologist earns approximately \$176.00 per hour (Salary.com, 2018b). It would therefore cost \$44.00 for the fifteen minutes needed to administer the block. Narcotic cost savings would be negligible, according to the organization's Clinical Pharmacy Services Program Director and Manager (see Appendix L).

The three DRGs used interchangeably for hip fractures have an estimated operating room supply cost of \$2500 per hip fracture case (XXX, 2018). The cost of the procedure itself will not change, which varies from \$18,294.49 to \$38,640.43 for the Grand Rapids and Muskegon area (Blue Cross Blue Shield, 2015). The projected cost for length of stay in a non-profit organization in Michigan is \$2,298.00 (Kaiser Family Foundation, 2018). The organization provided the cost of \$405.00 per day for an OU unit, and so these approximations were used for estimation.

Usual length of stay for hip fractures 50 years and older is approximately 5.6 days (Basques, Bohl, Golinvaux, Leslie, Baumgaertner, & Grauer, 2015; Nikkel, Kates, Schreck, Maceroli, Mahmood, & Elfar, 2015). However, the organization's trauma CNS reports that the average length of stay for their hip fracture patients was 3.89 days in 2017. This includes all hip fractures, regardless of whether they had surgery.

Shortening the time from ED admission to surgery can reduce length of hospital stay (LOS) by one full day (Basques et al., 2015). This protocol may result in LOS cost savings due to its expedited pre-surgical pathway and the nerve block to mitigate pain and narcotic adverse reactions. Reduction in LOS is calculated by adding the cost of one day of care with the reimbursement for the nerve block procedure. For reduction in LOS of one day, hip fracture care costs are reduced from \$1,575.45 to \$1,170.45. Using the 146 operable hip fractures in 2017, this translates into a projected annual cost savings of \$73,801.54.

Timeline

Utilization of Rosswurm and Larrabee's Utilization of Rosswurm & Larrabee's Model for Evidence-Based Practice Change (1999) provides the best approach to effectively implement a preoperative nerve block protocol for hip fractures.

1. **Assess need for change in practice.** Meetings with key stakeholders began on April 25, 2018. The DNP student met with the aforementioned key stakeholders of the organization between April and September 2018 to conduct an organizational assessment and a SWOT analysis assess the factors that would positively or negatively impact the nerve block protocol started in April 2018.
2. **Link problem with interventions and outcomes.** The problem of preoperative hip fracture pain management was identified. The DNP student reviewed the literature for the preoperative nerve block efficacy in hip fracture patients.
3. **Synthesize best evidence.** The review found that the local, single injection nerve blocks as a means of reducing preoperative pain and opioid analgesic use was at least moderately effective. Therefore, the previously enacted protocol was justified by research.
4. **Design an evaluation of the practice change.** The DNP student created a plan for evaluation and analysis of the data collected during this quality improvement project. This included a data dictionary and collection tool in REDCap that reflects the outcome measures of interest. This program de-identified sensitive patient information. Data analysis occurred with the assistance of a Grand Valley State graduate statistics student.
5. **Evaluate the practice change.** Weekly audits started on January 7, 2018, following Grand Valley State University and the organization's IRB approvals. Data was

collected for the length of the intervention trial and analyzed to verify whether the practice change was successful in meeting the desired outcome indicators. Data collection ended in February 2018. Staff and peer feedback, cost, and benefits and risks were also taken into consideration at each weekly audit and during unit meetings in order to evaluate the effectiveness of the change.

6. **Integrate data that supports this change.** Following the end of this quality improvement project, staff and organizational buy-in will help with future protocol revision and data analysis. The EHR order sets and standards of care for all hip fracture surgical candidates admitted to the organization will also help sustain this practice change.

Project Result Overview

Approach Modifications

During the process of data medical record review, additional patient characteristics were identified that were not delineated in the original project proposal. In the spirit of continuous quality improvement, the project was modified to accommodate: a change in patient date ranges for each collection group, inclusion and exclusion criteria for additional patient characteristics, and additional data measures.

Per preference from the organization, the DNP student used the REDCap-encrypted program instead of an Excel spreadsheet for data collection. The REDCap data dictionary was then modified from the original data dictionary to reflect the aforementioned changes. The student met with and developed this plan in collaboration with the site mentor and project advisor. These modifications fell within the parameters of the original IRB approvals from the organization and Grand Valley, as they just expanded upon the original outcomes outlined in the project proposal (see Appendix M). The project was modified as follows:

Timeframe changes. Once the DNP student was granted access to the electronic charts, it was discovered that there were a number of preoperative nerve blocks administered to patients within the month of March. Additionally, due to the timeframe to submit the data for analysis, the timeframe of evaluation was reduced from 9 months to 7 months for the pre-nerve block and nerve block groups. Therefore, the timeframe for the pre-nerve block patients was shifted from the original June 1, 2017 – February 28, 2018 to August 1, 2017 – February 28, 2018. The timeframe for the nerve block group was then shifted from the original April 1, 2018 – December 31, 2018 to March 1, 2018 – September 30, 2018. This resulted in 50 patients in each group.

Patient characteristics. Following initiation of medical record review, the extent of patient variability also required further definition. While reviewing the electronic patient charts, there

were several concerning patient diagnoses and medications that the DNP student and her advisors felt were not representative of the organization's usual hip fracture population. In order to preserve the integrity and assumption of normality between the two groups, several exclusion criteria were added during the electronic chart review process.

The original exclusion criteria included: non-operable patients, nerve block refusal, or a medical allergy to the nerve block medication. Additional exclusion criteria added during evaluation included: active cancer with chemotherapy and/or radiation treatment, diagnosis of generalized chronic pain, diagnosis of low back pain with routine use of prescribed narcotics, multi-trauma cases, current polysubstance abuse, and patients placed on comfort care while at the organization. Patients were still included if they had a diagnosis of low back pain and no narcotic use or used narcotics as needed per their medication list. Patients with cancer were also included if there was no evidence of active chemotherapy and/or routine narcotic use in the electronic chart.

Data outcomes. While manually reviewing each chart, data outcome entries were expanded to include: a diagnosis of dementia; incidences of post-surgical 60-day readmission rates; pre and post-operative pain scores and reassessment scores for non-narcotic medications; pre and post-operative pain scores and reassessment scores at 24, 48, 72, and 96 hours of LOS; and pre-block and post-block pain reassessment scores. Additionally, separate labels for oral (PO) and intravenous (IV) narcotic medication were created for each narcotic intake data measure in order to more accurately report MME usage by patients. Pain scores and pain reassessment scores were included for non-narcotic medications, such as acetaminophen and cyclobenzaprine, in order to capture the full context of pain control. If there was no narcotic pain medication administered within a set time frame, a value of 0 was entered into REDCap. Patient pain reassessments that were marked as "sleeping" were not included in the reassessment score total and were assigned a value. Organization compliance with the nerve block protocol was also added as an outcome.

Project Results

Demographics. Following the application of the aforementioned timeframe changes and patient exclusion factors, 50 patients in each group met inclusion criteria for a total sample of 100 patients ($n=100$). All 50 patients in the nerve block group received a nerve block in the preoperative period. Patient demographics were checked for normality (see Appendix N). Males ($n=16$; 32%) and females ($n=34$; 68%) were fairly evenly distributed across the pre-block patient. In the nerve block group, similar findings were seen with males ($n=13$; 26%) and females ($n=37$; 74%). Additionally, the racial distribution of Caucasians ($n=48$; 96%), African Americans ($n=1$; 2%), and Hispanic ($n=1$; 2%) patients in the pre-block group was equal in distribution to the Caucasians ($n=48$; 96%), African Americans ($n=1$; 2%), and Hispanic ($n=1$; 2%) patients in the nerve block group. Patients admitted in either group with a pre-existing diagnosis of dementia were also evenly split between the pre-block group ($n=18$; 36%) and the nerve block group ($n=19$; 38%). In terms of age, the pre-block group ranged from 57 to 99 years ($M=80.54$; $SD=9.30$). In the nerve block group, age ranged from 60 to 100 years ($M=82.80$ years; $SD=10.45$).

Care service time periods. Timeframes for care service transitions were calculated using REDCap (see Appendix O). The mean time in hours from patient admission to the OR in both groups was 21.92 hours, but ranged from 3.60 hours to 68.37 hours ($SD=10.05$). The average time in hours from patient admission to nerve block administration was 4.80 hours in the nerve block group, but ranged from 0.78 hours to 24.95 hours ($SD=4.69$). Finally, the average time from nerve block administration to the OR in the nerve block group was 17.29 hours, but ranged from 0.27 hours to 70.98 hours ($SD=11.81$).

Narcotic use. Narcotic use in oral and IV MME was calculated for total narcotics used preoperatively, postoperatively, and at 24, 48, 72, and 96 hours of inpatient stay (see Appendix P, Tables 1-6, Figures 1-4). Both PO and IV narcotic use in either group underwent non-parametric t-

testing because normality assumptions were not met. The preoperative oral MME consumed in the pre-block group ranged from 0.00 to 30.00 ($M=5.80$, $SD=7.02$). In the nerve block group, the oral MME intake ranged from 0.00 to 47.50 ($M=7.40$, $SD=10.77$) ($p=0.80$). The preoperative IV MME consumed in the pre-block group ranged from 0.00 to 36.70 ($M=9.65$, $SD=8.41$). In the nerve block group, the intake of IV MME ranged from 0.00 to 30.00 ($M=8.44$, $SD=8.14$) ($p=0.39$).

The postoperative oral MME consumed in the pre-block group ranged from 0.00 to 142.50 ($M=30.68$, $SD=32.97$). In the nerve block group, the intake of MME or oral narcotics ranged from 0.00 to 95.00 ($M=21.10$, $SD=22.13$) ($p=0.23$). The postoperative IV MME consumed in the pre-block group ranged from 0.00 to 28.00 ($M=1.91$, $SD=4.57$). In the nerve block group, the intake of IV MME ranged from 0.00 to 16.00 ($M=0.91$, $SD=2.84$) ($p=0.10$).

At 24 hours of inpatient stay, the average amount of oral MME consumed in the pre-block group ($N=50$) and the nerve block group ($N=50$) was 7.45 and 6.80, respectively ($p=0.27$). At 48 hours of inpatient stay, the average amount of oral MME consumed in the pre-block group ($N=49$) and the nerve block group ($N=48$) was 13.77 and 9.27, respectively ($p=0.42$). At 72 hours of inpatient stay, the average amount of oral MME consumed in the pre-block group ($N=36$) and the nerve block group ($N=34$) was 12.85 and 7.94, respectively ($p=0.33$). At 96 hours of inpatient stay, the average amount of oral MME consumed in the pre-block group ($N=14$) and the nerve block group ($N=17$) was 10.27 and 7.20, respectively ($p=0.98$).

At 24 hours of inpatient stay, the average amount of IV MME consumed in the pre-block group ($N=50$) and nerve block group ($N=50$) were 10.51 and 8.48, respectively ($p=0.19$). At 48 hours of inpatient stay, the average amount of IV MME consumed in the pre-block group ($N=49$) and nerve block group ($N=48$) were 1.35 and 0.63, respectively ($p=0.11$). At 72 hours of inpatient stay, the average amount of IV MME consumed in the pre-block group ($N=36$) and nerve block group ($N=34$) were 0.09 and 0.29, respectively ($p=0.28$). Finally, at 96 hours of inpatient stay, the

average amount of IV MME consumed in the pre-block group ($N=14$) and nerve block group ($N=17$) were 0.00 and 0.20, respectively ($p=0.41$).

Data on the difference between narcotic use before and after nerve block administration could not be analyzed due variance in time periods from admission to block and block to the OR. Since the times varied so much among the nerve block group patients, there was unlikely to have reoccurring doses.

Pain levels. Pain levels, or ratings, were averaged and entered into REDCap. Data analysis compared pain levels over designated time periods via non-parametric t-tests. For the pre-nerve block group, the average preoperative pain was 6.22/10 ($SD=2.54$) with an average reassessment level of 4.25/10 ($SD=2.31$). For the nerve block group, the average preoperative pain was 5.95/10 ($SD=2.00$) with an average reassessment level of 4.52/10 ($SD=2.44$). During the postoperative period until discharge, the pre-nerve block group averaged a 4.37/10 ($SD=1.83$) with an average reassessment level of 2.88/10 ($SD=1.92$). In the nerve block group, the average pain level during the same time period was 3.78/10 ($SD=1.71$) with an average reassessment level of 2.45/10 ($SD=1.77$). Therefore, both of the pre and postoperative comparisons were not significant (see Appendix Q, Figure 1).

Pain levels and pain reassessment levels were also averaged, entered into REDCap, and analyzed at 24, 48, 72, and 96 hours after surgery in both groups. During the first 24 hours after surgery, the average pain level in the pre-block group was 4.75/10 ($SD=1.89$) with an average reassessment level of 3.36/10 ($SD=2.08$). For the nerve block group, the average pain level was 4.11/10 ($SD=1.75$) and average reassessment level was 2.69/10 ($SD=2.03$) during the same time period. This does not represent a statistically significant change.

The average pain level 48 hours after surgery in the pre-block group was 4.27/10 ($SD=2.08$), with an average reassessment level of 2.84/10 ($SD=2.13$). During the same timeframe, the nerve block group average pain level was 3.57/10 ($SD=2.03$) and average reassessment level was 2.21/10 ($SD=1.97$). At 72 hours after surgery, the average pain level of the pre-block group was 3.71/10 ($SD=2.08$) and the average pain reassessment level was 2.37/10 ($SD=2.18$). For the nerve block group, the average pain was 3.67/10 ($SD=2.11$) and average pain reassessment was 2.64/10 ($SD=2.22$). Finally, 96 hours after surgery saw the pre-block group with an average pain level of 3.99/10 ($SD=1.85$) and reassessment of 2.88/10 ($SD=1.92$). For the nerve block group, the average pain level was 3.51/10 ($SD=2.60$), with an average reassessment pain level of 2.35/10 ($SD=2.24$). These do not represent statistically significant changes (see Appendix Q, Figure 2).

The efficacy of the nerve block on preoperative pain levels was calculated using a paired t-test comparing the difference in the average pain level before nerve block administration and the average pain level after nerve block administration (see Appendix Q, Figure 3). There was a statistically significant average reduction of 2.20/10 ($SD=1.96$) for patients ($p<0.0001$).

Length of stay. Overall, the intervention did not have a clinically significant effect on length of stay (see Appendix R). The duration of patient stay for the pre-block group ranged from 1.91 days to 27.75 days, with an average of 4.61 days ($SD=4.13$). The duration of stay in the nerve block group ranged from 1.64 to 27.44 days, with an average of 4.34 days ($SD=3.63$) ($p=0.90$). This represents a reduction in length of stay by 6.51 hours, or 27% of the 24-hour day.

Cost savings. The nerve block group saw a reduction in length of stay by 6.51 hours. The projected cost of patient stay, including the cost of the procedure and an anesthesia consult, totals \$2,279.69 at 4.61 days. However, the adjusted care cost for patient stay, including reimbursement reductions and new costs from a 6.51 hour stay reduction, totals \$1,883.55. This results in a \$57,836.44 annual cost savings for the organization as a result of the nerve block protocol.

Secondary outcomes. Secondary outcomes included incidence of pneumonia, incidence of delirium, unplanned transfer to the intensive care unit, readmissions, location of discharge, and mortality. Incidences of pneumonia did not differ between the two groups, with 1 patient in each group having a diagnosis of pneumonia upon discharge. There was also only 1 unplanned transfer to the intensive care unit in the nerve block group, but this transfer was unrelated to the nerve block. In terms of delirium, the nerve block did produce a reduction in episodes of delirium, but it was not statistically significant ($p=0.10$). The nerve block also did not reduce the incidence of delirium in patients with diagnosis of dementia present on admission (see Appendix S, Table 1).

There were 4 readmissions each in the pre-block and nerve block groups. In the pre-block group, one 30-day and one 90-day readmission were related to the hip fractures, while the other two were pertained to another medical problem. In the nerve block group, there was one 90-day readmission related to the patient falling on the surgically corrected hip again. The other readmissions were related to other comorbidities. The majority of the patients were discharged to subacute rehabilitation, followed by discharge to home with home health and to the home with outpatient physical therapy (see Appendix S, Table 2). There was one death in the nerve block group, but this was unrelated to the block. It was sudden so the patient was not placed on hospice.

Organization compliance. There were 112 total patients admitted to the organization with a hip fracture during the 7 month period of the initial nerve block protocol administration. Although only 50 patients met inclusion criteria for the nerve block group, 72 out of the 112 patients received a nerve block within the preoperative period. Organization compliance with the protocol was therefore 64% for the first 7 months of protocol implementation. After reviewing the trauma registry data that was available from October 1, 2018 to December 31, 2018, there were 41 hip fracture patients, of which 30 received preoperative nerve blocks. Compliance therefore increased to 73% in the 3 months following the timeframe for the DNP student evaluation.

Discussion

Overall, the data indicates that there are no statistically significant reductions in oral and IV narcotic use for total narcotics used preoperatively, postoperatively, and at 24, 48, 72, and 96 hours of inpatient stay. There was also no statistically significant reduction in patient length of stay or patient adverse effects, such as incidence of pneumonia, delirium, and unplanned transfer to the intensive care unit. Patient pain levels and reassessment levels between both groups were often comparable as well. The only statistically significant finding was the preoperative reduction in pain levels following nerve block administration. Due to variance in time of preoperative block administration, narcotic difference could not be calculated and the correlation between reduction in pain level and narcotic use could not be determined.

Although there were no statistically significant values, there were some clinically significant reductions in pre and postoperative intravenous narcotic use, postoperative oral narcotic use, and episodes of delirium. However, the data still does not indicate that there is a direct association between administration of the nerve block and the anticipated outcomes. Possible reasons for differences between the anticipated and observed results includes sample size, compliance rate, and variance in time of preoperative nerve block administration. Stricter control over these factors may lead to outcomes consistent with current literature. However, the literature does not define the most effective time to administer a preoperative nerve block. This could be an organization-specific intervention that requires future research. Overall, these changes could produce more effective, safer pain control and increased cost savings for the organization.

Strengths of this project include the detailed electronic chart review completed by the DNP student to compile fifty data measures for collection on each patient. However, due to the quality improvement and retrospective nature of this project, the DNP student was unable to influence the processes that impacted this data.

Limitations

The factors that limit internal validity of this project are the small sample size of the patient population, the lack of time standardization for nerve block administration, and the current organization compliance with the protocol. Due to the retrospective and non-research nature of this project, such factors could not be controlled by the DNP student during evaluation. Additionally, no multiplicity adjustments were used for data outcomes. Future efforts to minimize limitations should center around sampling a larger homogenous population, as several results were trending towards significance with this project's current sample size. Future efforts should also focus on greater organization compliance to the nerve block protocol to minimize variance between care transition times and nerve block administration.

Conclusion

Hip fractures are a debilitating injury that typically requires surgery. One of the most important aspects of hip fracture management is pain control, especially in the preoperative period. Current standards of practice primarily reflect an opioid model of analgesia, but these medications are associated with dangerous adverse effects. Recent literature highlights the success of local, single injection nerve blocks to aid in preoperative pain management. In accordance with the literature, the orthopaedic physicians at the organization implemented a preoperative, single injection nerve block protocol for hip fracture patients in March of 2018. However, this protocol had not yet been evaluated for organization compliance and patient outcomes.

This quality improvement project investigated whether this protocol reduces hip fracture pain, use of systemic opioid analgesics, decreases incidence of adverse opioid effects, and reduces cost of care. Results were not statistically significant in reducing oral and intravenous narcotic use before ($p=0.80$; $p=0.39$) and after ($p=0.23$; $p=0.10$) surgical correction, nor was there statistically significant change in adverse effects ($p=0.10$) and length of stay ($p=0.90$) despite a 6.51 hour stay

reduction between groups. However, these results could be deemed clinically significant due to the implications of these reductions on patient care outcomes. A larger sample size could also produce more significant results. Protocol compliance was 66% over seven months. However, there was a statistically significant reduction in average preoperative pain levels following administration of the nerve block ($p < 0.0001$).

The results of this project were consistent with the literature; nerve block injection may reduce preoperative pain for patients with an operable hip fracture. Further investigation is needed to determine if narcotic use and length of stay could be impacted if time variability in nerve block administration were reduced and if protocol compliance were increased.

Implications for Practice and Further Study in the Field

This DNP project encourages multiple practice implications. The literature supports the efficacy of single injection nerve blocks for hip fracture patients in the preoperative period. Although the results of the data outcome evaluation were not statistically significant, they are clinically significant. This presents an ongoing opportunity for the organization to improve upon protocol compliance and block administration standardization. A larger sample size could also be more beneficial in obtaining significant results. Currently there is no assigned individual tracking such outcomes, nor is there a designated process to ensure time standardization of preoperative block administration. Appointing an employee to continue monitoring patient data measures and organization compliance will provide expedited feedback turnaround.

Revising the current protocol to include a time standardized administration of the nerve block may also help reduce the administration variability. Only a few articles in the literature review accounted for time from admission to block placement. The randomized control trial by Unneby et al. (2017) administered femoral nerve blocks within 82.9 minutes (+/- 95.7 minutes) of admission.

Another study by Haslam et al. (2013) evaluated timing of USG femoral nerve blocks in hip fracture patients when administered by ED physicians and residents. Although there were no direct time measures in their results, their block timing included administration immediately after X-ray confirmation of fracture, or immediately after medical assessment and triage. This highlights the need for improved timing of block administration upon admission to the ED, with possible future focus on training ED physicians, residents, NPs, and PAs to administer a USG nerve block. These changes could streamline processes and expedite pain control. The protocol may then produce the patient outcomes that originally led to the protocol introduction.

Sustainability Plan

Continued stakeholder commitment, funding, and resource provision will help ensure that this nerve block protocol is sustainable. Although there are several internal weaknesses and external threats that may complicate protocol compliance, the organization's internal strengths and opportunities may overcome these barriers. Data tracking sustainability beyond this quality improvement project may be successful if a key person is appointed to continue tracking cost and quality outcome measures. Additionally, unit feedback and cooperation may allow for more accurate and timelier EHR input if workload demands are balanced with patient care.

Dissemination of Results

Dissemination of project results will first occur at the university in front of the DNP student project faculty and site advisor on March 25, 2019. The dissemination of results to the organization is pending, but will occur before April 27, 2019. The final draft of the scholarly quality improvement project will be uploaded to ScholarWorks© following final approval from the DNP student's faculty advisor. Additionally, the DNP student could disseminate findings in the form of a literature publication in order to further current knowledge about preoperative, single injection nerve blocks in hip fracture patients.

Reflection on DNP Essentials

The American Association of Colleges of Nursing's (AACN, 2006) eight essential DNP competencies helped guide the DNP student through this quality improvement project and towards graduation. These competencies serve as a foundation for DNP practice, and were developed and met during the evaluation of the organization's nerve block protocol.

Scientific Underpinnings for Practice

Scientific underpinnings for practice reflect the rigor of the doctoral education and the basis for nursing actions (AACN, 2006). The scientific basis of this quality improvement was rooted in the comprehensive literature review that validated the organization's implementation and current use of the nerve block protocol. The patient data outcomes were also derived from the scientific literature. Additionally, evidence-based nursing theory and implementation models, such as the Model for Evidence-Based Practice Change (Rosswurm & Larrabee, 1999) guided the DNP student's evaluation of the protocol in order to offer recommendations for improvement.

Organizational and Systems Leadership

In order to affect change in organizational and policy arenas, the DNP student must be proficient in leading quality improvement and change sustainability (AACN, 2006). The DNP student demonstrated organizational and systems leadership by first conducting an organizational assessment of current practice needs (Burke & Litwin, 1992). This assessment validated the need for improved preoperative pain control in hip fractures. The DNP student therefore formulated a quality improvement project that evaluated current organization practices. The DNP student also demonstrated leadership through continuous, independent communication and inquiry with key stakeholders at the organization. Sensitivity to the organization's culture and populations, including patients and providers, were also maintained during the project (AACN, 2006).

Clinical Scholarship and Analytical Methods

Scholarly nursing practice is a hallmark of DNP education (AACN, 2006). The DNP is equipped to translate evidence into practice at the patient-provider interface in order to produce improved health care outcomes (AACN, 2006). During this quality improvement project, the DNP student used a systematic, analytic approach to appraise current literature on the use of nerve blocks in hip fracture patients. The DNP student then designed a quality improvement project to evaluate the organization's current practice. Utilization of technology and the assistance of a statistical consultant allowed the DNP student to successfully examine the effect of the organization's current nerve block protocol and offer suggestions for improvement.

Information Systems Technology

Use of information technology allows the DNP to assess, manage, and apply new knowledge related to quality improvement initiatives (AACN, 2006). The DNP student utilized the Cerner electronic health record system for manual chart review. The encrypted REDCap software was used to ensure privacy of patient data collection. Finally, the use of the SAS software for data analysis allowed the DNP student to interpret the efficacy of the nerve block protocol. Legal and ethical issues were avoided through the approval of the organization's and university's IRBs.

Advocacy for Health Care Policy

Addressing current care issues through policy development promotes increased access and quality of care, especially for those who consistently experience health care disparities (AACN, 2006). This DNP project focused on hip fracture patients, who are typically considered a vulnerable population due to their age and comorbidities. The DNP student collaborated with key stakeholders to critically analyze and offer recommendations for the current preoperative nerve block protocol for this population. This project did not include policy change at the state, federal, or international level.

Interprofessional Collaboration

Interprofessional collaboration requires effective communication, partnering, and leadership in order to contribute to healthcare advancement (AACN, 2006). The DNP student worked collaboratively with physicians, a pharmacist, organization leadership, unit nurses and ancillary staff CNSs, CNLs, a statistician, and faculty advisors to develop and implement this quality improvement project. This collaboration allowed the DNP student to complete and disseminate the evaluation results of the current preoperative nerve block protocol in hip fractures.

Clinical Prevention Population Health

Health promotion and disease prevention is a foundational principle of DNP clinical practice (AACN, 2006). This project focused on reduction of preoperative pain, reduction of narcotic use, reduction in adverse effects, and reduction in length of patient stay, which results in faster restoration of mobility. The student collected and evaluated data measures specific to hip fracture patients in order to provide recommendations for improved pain management in this population. The psychosocial and cultural components of care related to clinical prevention were included through application of the Theory of Symptom Management Model (Dodd et al., 2001).

Advanced Nursing Practice

Advanced nursing practice includes advanced assessment and holistic treatment throughout a variety of care settings. These clinical experiences also help the DNP graduate comprehend the consequences of care decisions (AACN, 2006). For this quality improvement project, the DNP student created and sustained therapeutic partnerships with key organizational stakeholders in order to facilitate evaluation of the organization's nerve block protocol. Additionally, the DNP student demonstrated advanced clinical judgment, systems thinking, and accountability through the development, evaluation, and dissemination of the current operational state and impact of the protocol.

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Appendix A

The Burke-Litwin Model of Organizational Performance and Change

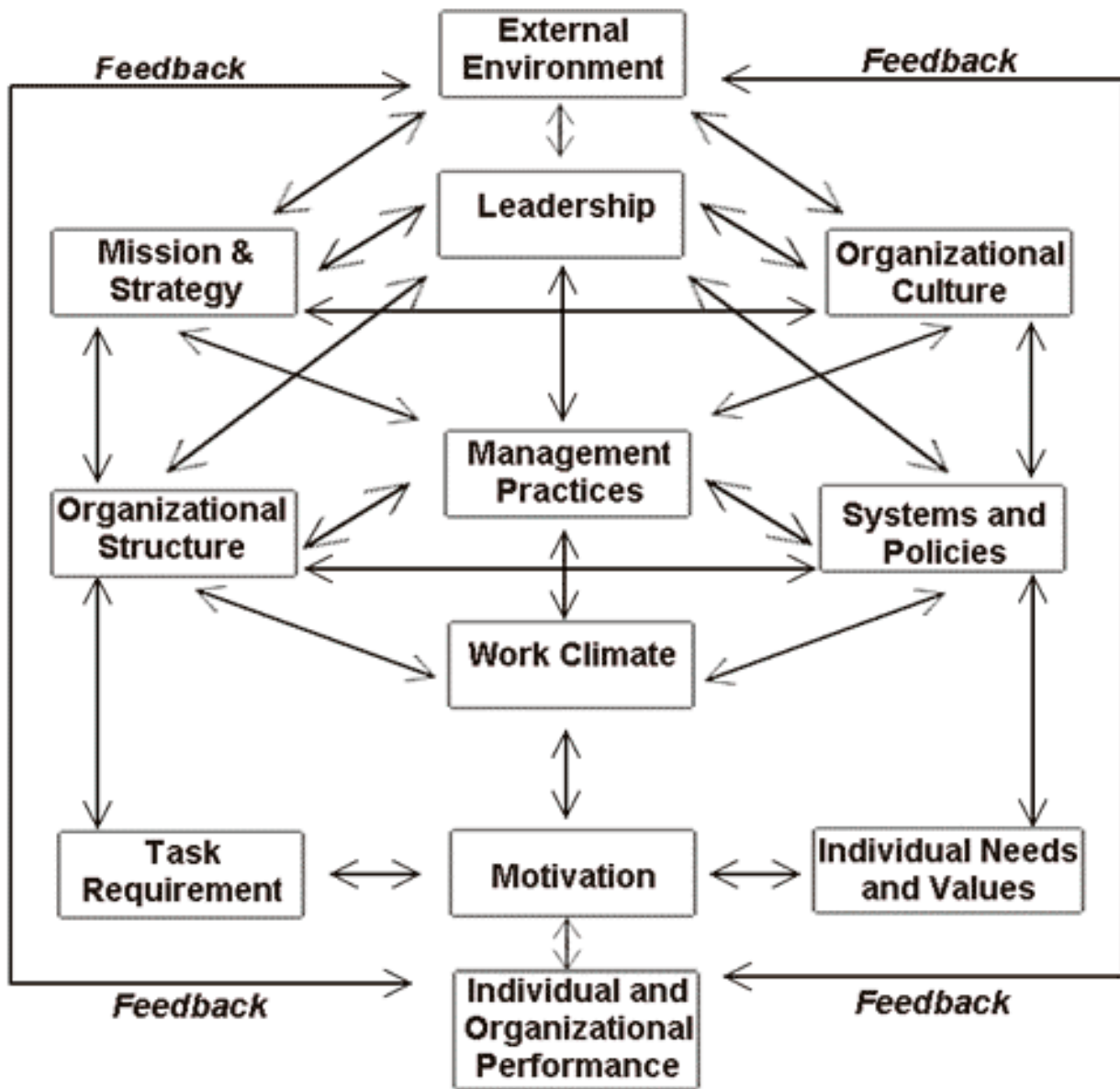


Figure 1. A model of organizational performance and change. Reprinted from "A Causal Model of Organizational Performance and Change," by W. W. Burke and G. H. Litwin, 1992, *Journal of Management*, 18, 528. Copyright 1992 by Southern Management Association.

Appendix B

SWOT Analysis of the ED, PACU, OR, and OU

<p style="text-align: center;">Strengths</p> <ul style="list-style-type: none"> • Lean Six Sigma trained leadership • Culture of process improvement • Organization-wide teamwork • Magnet designation • TJC orthopaedic certifications • Hospital Quality Awards • Clinical Quality Awards for joint replacement • Nurse navigator • Joint classes 	<p style="text-align: center;">Weaknesses</p> <ul style="list-style-type: none"> • Lack of standardized protocol for communication and pain management for hip fractures • Providers meeting face to face • Staffing issues with anesthesiology, PACU, OU, RR • New provider unfamiliarity • Transitions of care • DRG codes
<p style="text-align: center;">Opportunities</p> <ul style="list-style-type: none"> • Decrease use of opioids in midst of current opioid crisis • New evidence supporting nerve blocks • Established protocols for hip fractures from sister hospitals of parent company • Orthopaedic group merger 	<p style="text-align: center;">Threats</p> <ul style="list-style-type: none"> • Other local hospitals already implemented nerve block protocol for hip fractures • More competitive local branding • Insurance company preference • Centers for Medicaid and Medicare reimbursement measures

Appendix C

Search Terms Used for Literature Review in Databases

Database	PubMed	CINAHL	Cochrane	Web of Science
Keywords	MeSH: Hip fractures, preoperative period, nerve block, pain management	Nerve block, hip fracture, preoperative pain management	Preoperative, nerve block, hip fracture, pain management	Nerve block, hip fracture, preoperative, pain management
Keyword Combinations	Hip fractures AND Preoperative period AND nerve block Hip fractures AND Preoperative period AND Nerve block AND Pain management	Hip fracture AND nerve block	Preoperative AND nerve block AND hip fracture Nerve block AND hip fracture AND Pain management	Preoperative AND nerve block AND hip fracture AND pain management “hip fractures” “nerve block”
Search Results	4 articles	14 articles	1 article	43 articles

Appendix D

PRISMA Flow Diagram of Systematic Search

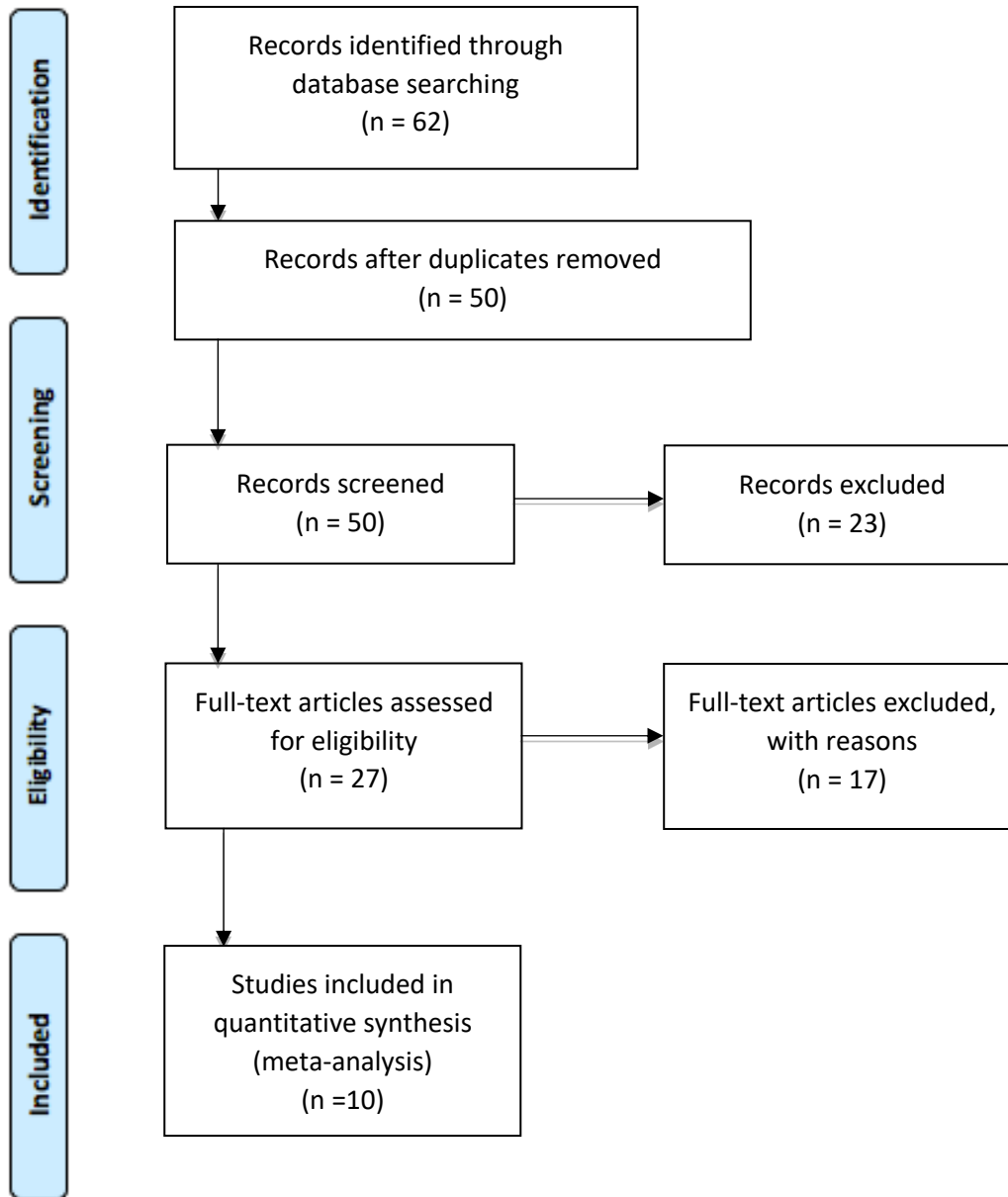


Figure 1. Flow diagram of search selection process. Adapted from “Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement,” by D. Moher, A. Liberati, J. Tetzlaff, D. Altman, and PRISMA Group. Copyright 2009 by PLoS Medicine.

Appendix E

Table of evidence on the efficacy of nerve blocks

Author (Year) Purpose	Design (N)	Inclusion Criteria	Intervention vs Comparison	Results	Conclusion
AAOS (2014) Compile a practice guideline based on current evidence to inform care of hip fractures in patients over age 65	Systematic review of prospective randomized clinical trial studies (N=6 studies) on regional analgesia for preoperative pain control	Full article report of clinical study starting from 1966; peer-reviewed; 10 or more patient per group; English; $\geq 50\%$ patient follow-up in studies with follow-up time points; Mean age of 65 with hip fracture	Comparison of preoperative administration of local anesthetic in fascia iliaca or femoral compartment on pain control vs. control group as measured by VAS.	<p>Efficacy:</p> <ul style="list-style-type: none"> • Five out of the six (n=593 patients) high strength studies were limited to preoperative pain, sixth study included preoperative and postoperative • VAS scores indicated significant reduction in reported preoperative pain in 5/6 studies and nonsignificant reduction of pain in one study (Mean preop VAS score of placebo vs. FICB: 68.2 vs. 61.4, P=0.59) <p>Safety of Intervention:</p> <ul style="list-style-type: none"> • Type of administering provider (emergency physicians, anesthesiologists, orthopaedic surgeons) did not compromise patient safety • FICB <ul style="list-style-type: none"> ○ Hematoma, no adverse toxicity, no persistent paresthesia, decreased delirium • 3-in-1 nerve block <ul style="list-style-type: none"> ○ No difference from control in pulse, oxygenation, or respiratory rate during study • FNB 	Studies to date show reduced hip fracture preoperative pain. AAOS (2014) strength of recommendation is strong (4 stars) for use of preoperative regional analgesia in the form of nerve blocks. Further research needed on following outcomes needed: total opioid use pre-op, delirium incidence, and length of stay.

<p>Abou-Setta (2011) Review benefits and harms of pharmacologic and non-pharmacologic hip fracture pain management</p>	<p>Systematic review (N=83 RCTs, 5 non-RCTs, 14 cohort studies); Nerve block (N=29 RCTs)</p>	<p>RCTs, non-RCTs, cohort studies, and case-control studies; No language restrictions; January 1990-December 2010; Adults \geq 50 y.o. with hip fracture; any pain management intervention; No specifics on pain method or point of time in care (preoperative, intraoperative, postoperative)</p>	<p>Nerve block (3-in-1, combined lumbosacral plexus, FICB, femoral, lumbar plexus +sciatic nerve, epidural and combined blocks) compared with placebo, standard care, or another nerve block.</p>	<ul style="list-style-type: none"> • No local, systemic complications <p>Efficacy:</p> <ul style="list-style-type: none"> • 5 of 29 RCTs evaluated preoperative pain for nerve block vs. opioid analgesic control. • FICB <ul style="list-style-type: none"> ○ One study (n=48) found static ($P<0.01$) and dynamic ($P=0.02$) pain relief superior in FICB group compared to morphine + placebo FICB. Less mean total IM morphine consumption (0 mg vs. 6 mg, $P<0.01$) with FICB • 3-in-1 preoperative nerve block <ul style="list-style-type: none"> ○ One study (n=40) VAS score 2.0* at 20 minutes after block. VAS score 2.1* at 2 minutes after control. (*$p<0.001$ vs. VAS score before FIC block or IV alfentanil). VAS score at positioning for spinal anesthesia lower compared to VAS of control ($P=0.001$) ○ One study (n=94) Time to best response/mean difference faster in block group (95% CI: -2.93 hours [-5.48 to -0.38 h]) and required less morphine per hour than control (95% CI: - 	<p>Systematic review not specific for nerve blocks, but one pain management method included in review. Pooled results for acute pain in nerve block studies were not reported due to significant heterogeneity. Moderate evidence to suggest efficacy of nerve blocks in reducing pain in hip fractures, as all nerve block types provided superior analgesia to no block or standard care. USG nerve block provided most significant effects of regional block. However, not enough well designed studies to be completely definitive.</p>
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				<p>0.68 mg/h [-1.23 to -0.12 mg/h])</p> <ul style="list-style-type: none"> • FNB <ul style="list-style-type: none"> ○ One study (n=50) Pain with FNB less than control at 15 min (P<0.05) and 2 hours (P<0.01) ○ One study (n=14) Pain with FNB less than control at 1 hour (p<0.04), but not statistically significant at 4 and 24 hours <p>Safety of Intervention:</p> <ul style="list-style-type: none"> • FICB <ul style="list-style-type: none"> ○ No adverse toxicity, no hematoma, no persistent paresthesia ○ Greater sedation in the morphine group (n=6) versus the FICB group (n=1) at 180 minutes after block administration (P=0.05) • 3-in-1 nerve block <ul style="list-style-type: none"> ○ No difference from control in pulse, oxygenation, or respiratory rate during study • FNB <ul style="list-style-type: none"> ○ No local or systemic complications 	
Fadhlillah (2017) Determine the analgesic	Systematic review and meta-analysis	RCT in English; Patients ≥18y.o. with	Single injection pre-operative FICB vs. standard	<p><i>Efficacy:</i></p> <ul style="list-style-type: none"> • Acute pain significantly reduced with positioning and movement in 	FICB is superior in acute hip fracture pre-operative pain compared to

efficacy and safety profile of fascia iliaca compartment block (FICB) on preoperative pain in hip fracture patients	(N=8 studies, 645 patients)	isolated traumatic hip fracture; Received single injection FICB preoperatively; No search date restriction applied	preoperative systematic analgesia	<p>FICB (SMD) = -1.82 (95% CI: -2.26 to -1.38, p<0.00001)</p> <ul style="list-style-type: none"> Acute pain was variable at rest with FICB (p=0.20) <p><i>Safety of Intervention:</i></p> <ul style="list-style-type: none"> Reduced analgesia breakthrough (n=57 vs. n=73) Reduced drowsiness/sedation (n=1 vs. n=22) Reduced desaturation (n=0 vs. n=4) Reduced nausea and vomiting (n=3 vs. n=7) Both groups reported localized bruising (n=3) 	standard analgesia, especially during positioning and mobilization. FICB also is superior in safety and reduces reliance on systemic analgesics. However, only one study found low risk of bias.
Guay (2017) Nerve block efficacy as preoperative or postoperative analgesia, or supplemental to general anesthesia in hip fractures	Systematic review (N= 7 trials, 322 participants)	RCTs comparing use of nerve blocks preoperatively, operatively, or postoperatively to no regional blockade added to general or neuraxial anesthesia as part of care provided for adults ≥ 16 y.o. with hip fracture/proximal femoral	Participants randomized to peripheral nerve block (FNB, FICB, psoas compartment) using landmark, nerve stimulator or USG technique added to or not to general or neuraxial anesthesia for surgery vs. opioids	<p><i>Efficacy:</i></p> <ul style="list-style-type: none"> Five studies evaluating single injection nerve blocks (n=123) compared to opioid analgesia (n=122) showed decrease in opioid consumption favoring nerve blocks. SMD -0.73 (95% CI: -1.01, -0.44) Out of three studies evaluating pain at rest 30 minutes after single block injection placement, two studies demonstrated reduction in pain favoring block. SMD -1.39 (95% CI: -2.11, -0.66) and SMD-1.36 (95% CI: -2.04, -0.68), respectively. Only one single injection study did not favor regional block efficacy, 	Regional blockade reduces pain on movement within 30 minutes after block placement and reduces opioid consumption.

		fracture; From 1966 to 2016		<p>but pre-block pain scores were significantly higher in this group.</p> <p><i>Safety of Intervention:</i></p> <ul style="list-style-type: none"> • No trials reported major complications • More data needed to determine impact on mortality 	
Riddell (2016) Update evidence from review by Abou-Setta (2011) on the use of FNBs in the ED for managing hip fracture pain in the elderly.	Systematic review (N=7 studies)	RCTs published between December 2010 to May 2014 to serve as an update to Abou-Setta (2011); About-Setta (2011) reference list also used; Use of femoral nerve block in ED settings (pre-op) to treat hip fractures; ≥65 y.o.; pain and analgesic consumption	Femoral nerve block vs. placebo control (opioid or 'standard care' analgesic)	<p><i>Efficacy:</i></p> <ul style="list-style-type: none"> • Four studies evaluated single femoral nerve block injections: <ul style="list-style-type: none"> ○ FNB <ul style="list-style-type: none"> ▪ 1 study (n=50) Pain with FNB less than control at 15 min (P<0.05) and 2 hours (P<0.01) ▪ 1 study (n=14) Pain with FNB less than control at 1 hour (p<0.04), but not statistically significant at 4 and 24 hours ○ 3-in-1 block <ul style="list-style-type: none"> ▪ 1 study (n=94) Time to best response/mean difference faster in block group (95% CI: -2.93 hours [-5.48 to -0.38 h]) and required less morphine per hour than control (95% CI: -0.68 mg/h [-1.23 to - 	FNBs appear to be effective in managing acute pre-operative hip fracture pain in the elderly. Meta-analysis could not be conducted due to study heterogeneity. Heterogeneity encountered in procedure type of femoral block placement and methods used to assess pain (VAS vs. NRS). Only 1 study did not have a high risk of bias.

				<p>0.12 mg/h]</p> <ul style="list-style-type: none"> ▪ 1 study (n=36) showed significant reduction in NRS scores 4 hours post-block (P<0.001) and greater overall pain relief measured by summed pain intensity difference of 11.0 (IQR=4.0 to 21.8) in block + morphine group vs. 4.0 (IQR=-2.0 to 5.8) in sham injection/placebo + morphine group (P=0.001). <p><i>Safety of Intervention:</i></p> <ul style="list-style-type: none"> • 3-in-1 block <ul style="list-style-type: none"> ○ No difference in adverse events between groups in 1 study (n=36) • FNB <ul style="list-style-type: none"> ○ No local or systemic complications 	
Ritcey (2016) Investigate if pre-operative nerve blocks result in reductions in pain, parenteral opiate use, and complications	Systematic review of RCTs (N=9 studies); Meta-analysis could not be conducted	RCTs from 1946 to 2014; ≥ 16 y.o. with acute hip or femoral neck fracture; Single injection FNB,	Single injection nerve blocks (Single injection FNB, 3-in-1 FNB, or FICB) with standard pain management	<p><i>Efficacy:</i></p> <ul style="list-style-type: none"> • Two studies utilized FNB (n=40), Four studies utilized 3-in-1 FNB (n=97), and three studies used FICB (n=147) • One study used ultrasound guidance (USG), Five used landmark technique, and three studies used nerve stimulator 	Regional nerve blocks are at least as effective and potentially superior in reducing pain compared to standard pain management.

<p>compared to standard pain management in hip fractures</p>	<p>due to study heterogeneity</p>	<p>3-in-1 FNB, or FICB; Pre-operative injection; Pain score reduction recorded</p>		<ul style="list-style-type: none"> • One study was double-blinded and USG (n=36) found: <ul style="list-style-type: none"> ○ Reduced 11-point numerical rating scale (NRS) scores at 4 hours (p<0.001). ○ Median summed pain intensity difference (SPID) was 11.0 (IQR = 4.0 to 21.8) in FNB group vs. 4.0 (IQR = -2.0 to 5.8) in placebo group over 4 hours ○ Patients in placebo group received more IV morphine than FNB group (5.0 mg, IQR= 2.0 to 8.4 mg vs. 0.0 mg, IQR= 0.0 to 1.5 mg) <p><i>Safety of Intervention:</i></p> <ul style="list-style-type: none"> • None of the studies reported any immediate complications • One double-blinded USG study found no difference in adverse events between groups • Unable to conclude whether reduced IV opiate use also resulted in reduced adverse effects due to under-reporting in most of the studies 	<p>Sample sizes were small in all RCTs, ranging from 33-154 participants. Lack of double-blinding in six out of nine studies resulted in moderate to high risk of bias. Only one study had overall low risk of bias.</p>
<p>Scurrah (2018) Examine current pain management for hip fractures in the</p>	<p>Narrative review of RCTs (N=8)</p>	<p>Level 1 and Level 2 Clinical trials, clinical audits, review articles, and meta-</p>	<p>Regional nerve blocks for acute hip fracture pain vs. standard care, opioid placebo</p>	<p><i>Efficacy:</i></p> <ul style="list-style-type: none"> • Regional nerve blocks reduce hip fracture pain on movement within 30 min of block placement (Guay, 2017) 	<p>Nerve blocks reduce acute pain, opiate consumption and delirium. Nerve blocks for hip fractures</p>

<p>elderly, especially role of regional nerve blocks</p>		<p>analyses in English; >18 y.o.; From 2007-May 2017</p>		<ul style="list-style-type: none"> • FICB, FNB, psoas compartment, and combined nerve block provided superior analgesia to placebo or ‘standard care’ in hip fractures (About-Setta, 2017) • Preoperative single injection regional nerve blocks reduce consumption of opioids in hip fractures and opioid side effects <ul style="list-style-type: none"> ○ One study (n=48) found less mean total IM morphine consumption (0 mg vs. 6 mg, P<0.01) with FICB versus morphine + FICB placebo ○ One study (n=161) found 33-40% reduction in parenteral morphine equivalent consumption and reduction in opioid side effects (3% vs. 12.4%, P=0.03) ○ FICB in one study (n=69) reduced mean opioid use from 6.2 mg to 2.0 mg (P=0.01) and opioid overdose incidence (7.2% to 0%, P=0.001) <p><i>Safety:</i></p> <ul style="list-style-type: none"> • One study in inpatient mortality with nerve block: 5.5% vs. 15% (P=0.0024) 	<p>should be integrated into routine pain management protocols. Additional research is needed on cost savings of nerve blocks on length of stay, mortality, morbidity, and quality of life.</p>
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				<ul style="list-style-type: none"> • No statistically significant difference in cardiac complications, deep vein thrombosis, pulmonary embolism, nausea and vomiting, respiratory infection, stroke, surgical wound infection, or urinary tract infection (Abou-Setta, 2011) • In FICB study (n=48), greater sedation in the morphine group (n=6) versus the FICB group (n=1) at 180 minutes after block administration (P=0.05) • USG technique improves safety and efficacy of nerve blocks <ul style="list-style-type: none"> ○ One study found greater sensory loss in medial thigh with USG vs. “two-pop/loss of resistance” technique” (95% vs. 60%) and complete sensory loss in anterior, medial, and lateral thigh (82% vs. 47%) • Junior staff, paramedics, and new residents can be trained to effectively administer nerve blocks without increase in complications 	
Steenberg (2018) Investigate FICB benefit and adverse events in pre-	Systematic review and meta-analyses of RCTs (N=8) and quasi-	RCTs and quasi-RCTs from database inception to 2016;	Comparison FICB with non-intervention, placebo, paracetamol, NSAIDs, opioid,	<i>Efficacy:</i> <ul style="list-style-type: none"> • Two studies demonstrated analgesic effect in FICB group in first 30 minutes (P=0.001 fentanyl control, P=0.047 morphine sulfate control). Only one study had 3 hour 	FICB has superior analgesic effect compared with opioids during movement, but not at rest. FICB had

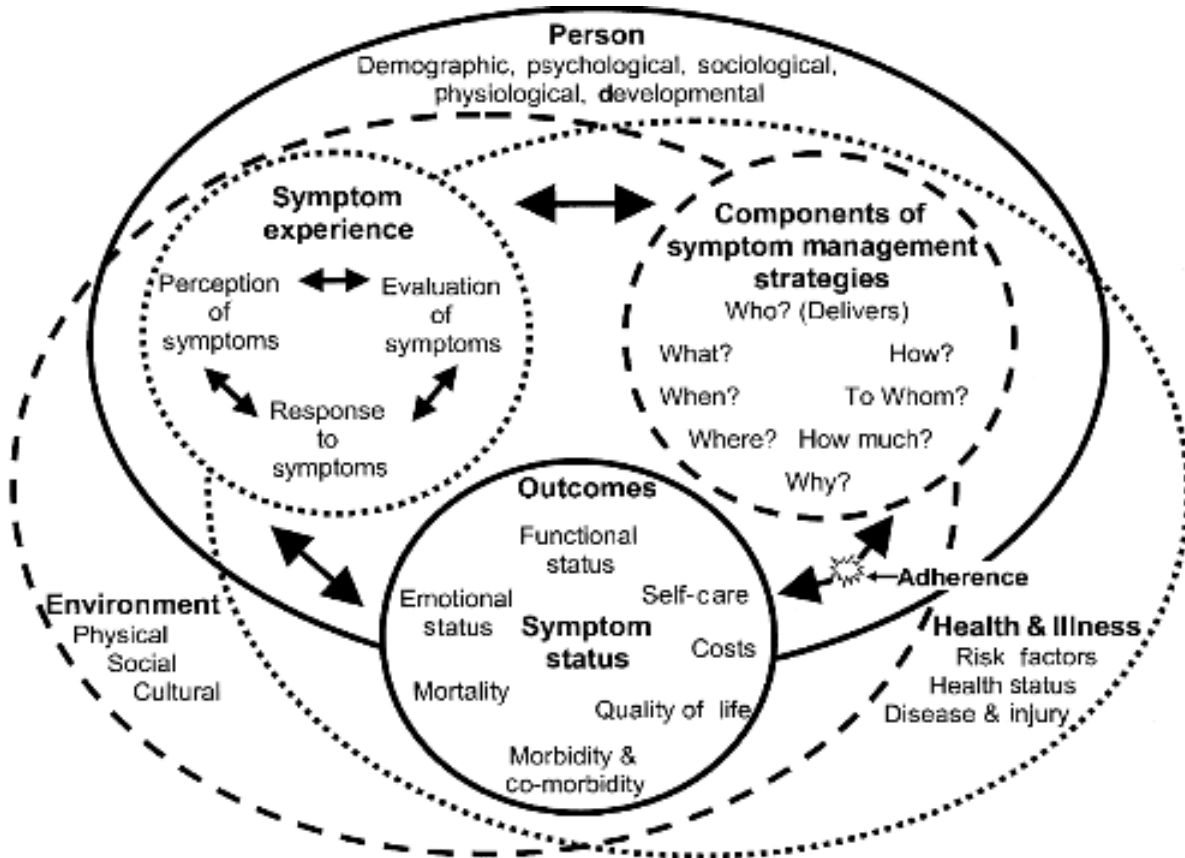
operative hip fracture patients	RCTs (N=3) (N=11 total)	≥ 18 y.o. with hip fracture; Pre-operative administration; Studies published in peer-reviewed journals	or other nerve blockades using visual analog scale (VAS) and NRS; Continuous catheter and single injection included but clearly delineated; Four (N=4) studies included opioids as control	<p>measurement, which was in favor of FICB (P=0.01)</p> <ul style="list-style-type: none"> • During movement, three studies were in favor of FICB in first 30 minutes (P=0.02), SMD 1.58 (95% CI: -2.90, -0.25). No difference at rest (P=0.15), SMD -0.59 (95% CI: -1.40,0.21) • Three studies reported mean dose of additional morphine for: <ul style="list-style-type: none"> ○ 4.11 mg (95% CI: 2.61,5.61) vs. 7.42 mg (95% CI: 5.24,9.60) (P=0.03) ○ 0 mg (95% CI: 0,0) vs. 6 mg (95% CI: 5.38,6.62) (P<0.01) ○ 0 mg (95% CI: -1.24,1.24) vs. 5 mg (95% CI: 2.20,7.80), (P=0.03) • Meta-analysis of two studies on request for additional opioids: <ul style="list-style-type: none"> ○ 245 min (95% CI: 2055,285) vs. 145 min (95% CI: 14.9, 275) (P=0.12) ○ 516 min (95% CI: 437,594) vs. 270 min (95% CI: 189,351) (P<0.01) ○ Total between studies: longer time for first request of additional analgesia in FICB group SMD 0.93 (95% CI: 0.02,1.84) (P=0.05) • Meta-analysis of four studies: 	lower pre-operative additional opioid use and longer duration between block and first analgesic dose. N=3 RCTs were rated with low risk of bias and N=5 RCTs had a high risk of bias. N=3 quasi-RCTs also had a high risk of bias. Concern with heterogeneity of studies and under-reporting of adverse effects.
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				<ul style="list-style-type: none"> ○ FICB had lower preoperative opioid analgesia SMD -1.89 (95% CI: -3.63, -0.14) (P=0.03) • Compared to opioids at rest, the meta-analysis did not demonstrate a difference. <p><i>Safety of Intervention:</i></p> <ul style="list-style-type: none"> • Incidence rate of hematomas at injection site: 1.7% for articles included in the review • Eight cohort and retrospective studies (n=2179) in full text of the review cite 4 instances of anesthetic toxicity (risk of 0.18%) and 2 hematomas at the injection site (risk of 0.9%). 	
Unneby (2017) Determine whether preoperative femoral nerve block administration reduced acute pain and opioid use in elderly patients, including those with dementia	RCT (n=266 patients)	Patients \geq 70 years admitted to orthopaedic hospital ward for hip fracture prior to surgery; With or without dementia; Consent to treatment	FNB + opioids (n=129) or conventional opioid treatment (n=137) effect on preoperative pain (VAS) and preoperative opioid consumption	<p><i>Efficacy:</i></p> <ul style="list-style-type: none"> • Self-rated and proxy VAS pain scores decreased from baseline to 12 hours in intervention group vs. control (P<0.001 and P=0.003, respectively) • Intervention group received significantly less opioids than control group (IV, 2.3 ± 4 mg vs. 5.7 ± 5.2 mg, P<0.001; Oral, 2.1 ± 4.1 mg vs. 3.6 ± 6.4 mg, P=0.017) • Patients with dementia in intervention group received less IV opioids compared to control group (2.1 ± 3.3 mg vs. 5.8 ± 5 mg, P<0.001) 	Before randomization, n=191 patients received opioids (IV or oral) in the ambulance or in the ED, which may account for lower VAS pain scores. However, FNB further reduced scores at 12 hours. Recommend nerve block administration performed in ED to

				<p><i>Safety:</i></p> <ul style="list-style-type: none"> • No adverse events reported for FNB 	improve results of this study.
<p>Wennberg (2018) Evaluate current evidence surrounding emergency care for patients admitted with hip fracture, with focus of pain</p>	<p>Integrative review (N=38 articles: 34 quantitative, 4 qualitative)</p>	<p>Double-blind RCTs to qualitative studies; Publish from 1998 to 2017; Described chain of emergency care for hip fractures after falling; Age range not specified in methodology</p>	<p>Regional nerve block vs. parenteral opioids, Multifactorial program impact on delirium, Experiences of physical pain, current practices of managing pain in hip fractures, Efficacy of fast-track management system, TENS efficacy, Describe lived experiences of older adult in ED</p>	<p><i>Efficacy:</i></p> <ul style="list-style-type: none"> • Of 34 quantitative studies, only three rated as High quality, however one study evaluated single vs. continuous nerve block and one study evaluated nerve blocks vs. NSAIDs. This left one RCT that evaluated preoperative FICB compared to systemic morphine: <ul style="list-style-type: none"> ○ The study (n=48) found static (P<0.01) and dynamic (P=0.02) pain relief superior in FICB group compared to morphine + placebo FICB using 5 point Verbal ranking scale. Less mean total IM morphine consumption (0 mg vs. 6 mg, P<0.01) with FICB <p><i>Safety:</i></p> <ul style="list-style-type: none"> • FICB <ul style="list-style-type: none"> ○ No adverse toxicity, no persistent paresthesia ○ Greater sedation in the morphine group (n=6) vs. the FICB group (n=1) at 180 minutes after block administration (P=0.05) 	<p>After evaluating the quantitative and qualitative evidence, the results indicate that nerve blocks can be effective in preoperative pain management for hip fractures. However, the paper presents with a majority of low-level evidence according to the GRADE criteria.</p>

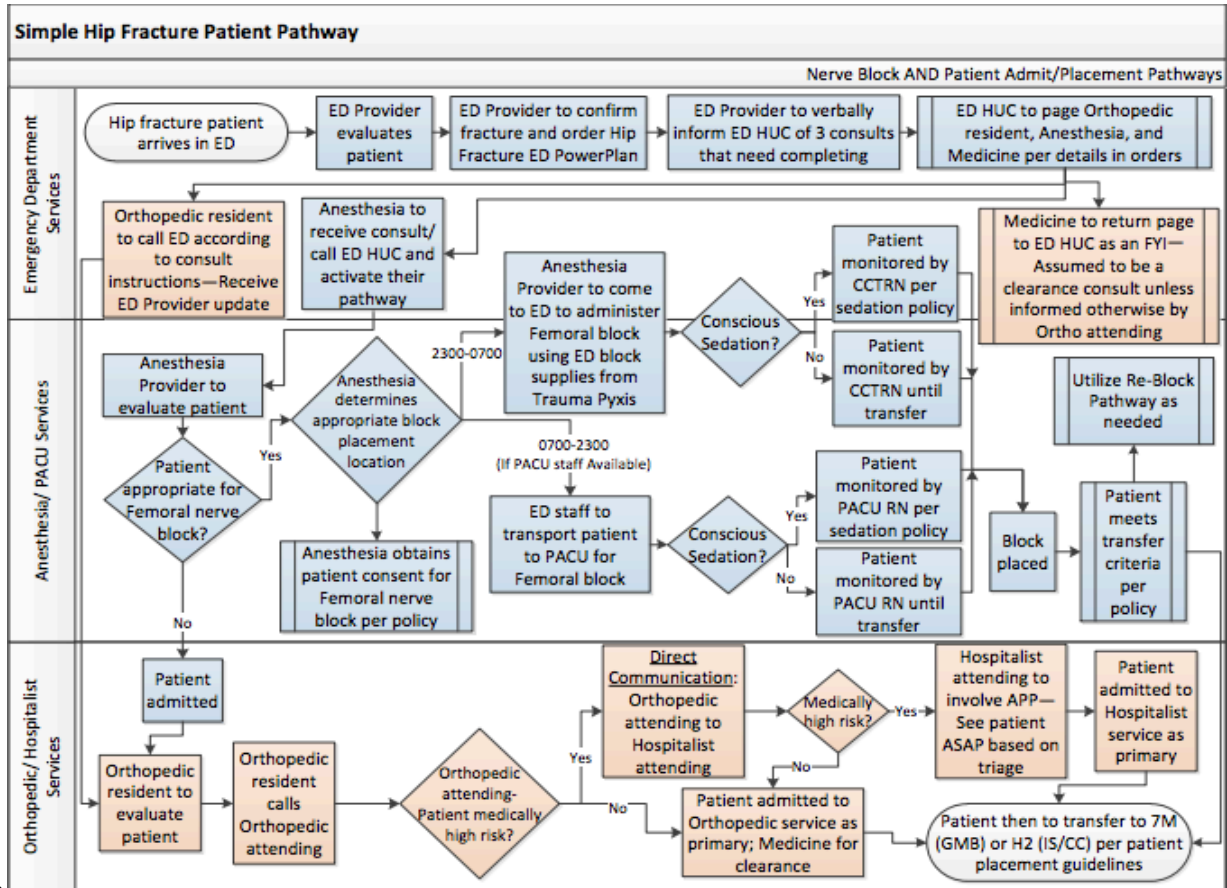
Appendix F

Theory of Symptom Management Model



Adapted from “Advancing the science of symptom management,” by M. Dodd, S. Janson, N. Facione, J. Faucett, E.S. Froelicher, J. Humphreys ... D. Taylor. Copyright 2001 by Journal of Advanced Nursing.

Appendix G



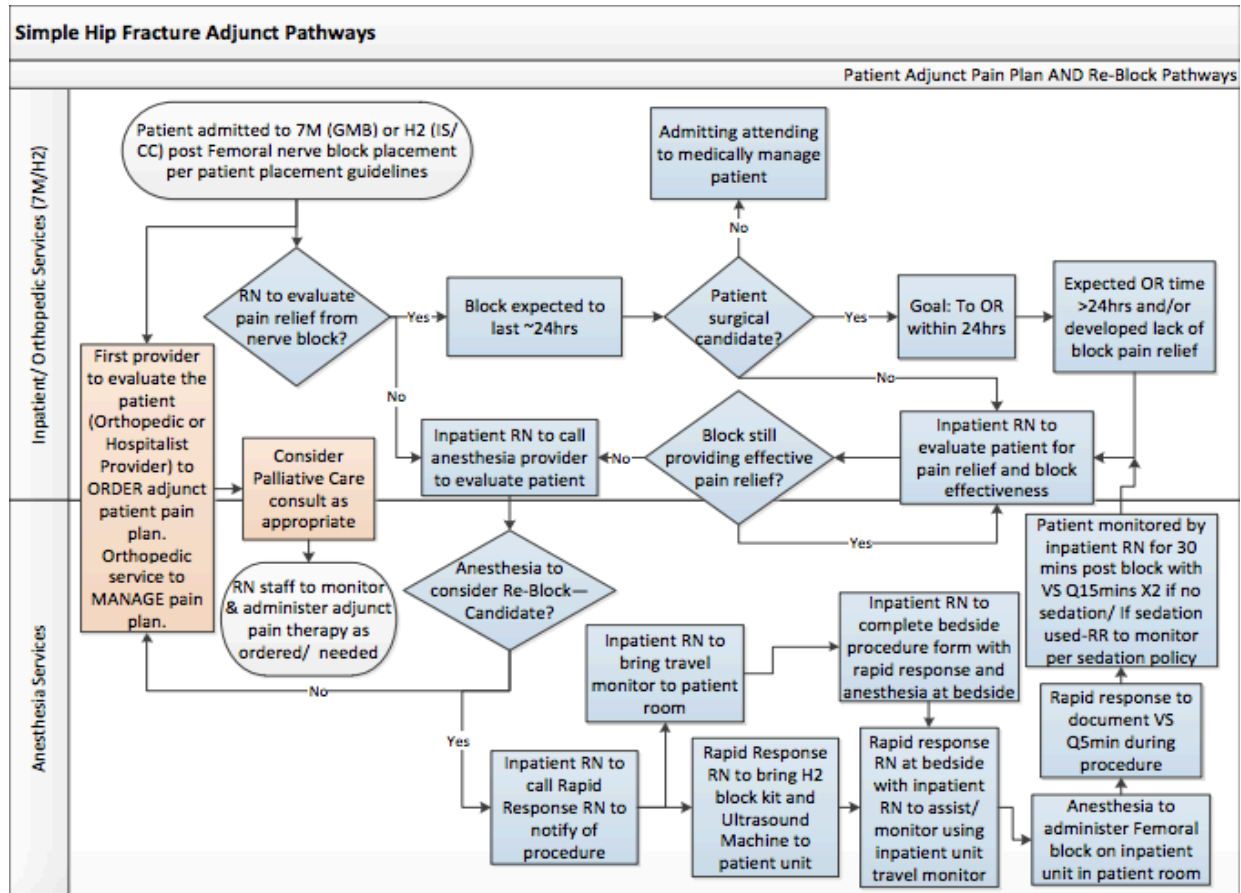


Figure 1. Adapted from “Hip fracture pathway,” by L. Zuckerman. Copyright 2017 by XXX.

Fascia Iliaca Blocks and LOCAL ANESTHETIC SYSTEMIC TOXICITY (LAST)

Prepared by: Kathy L. Johnson, BSN, RN, CPAN, CAPA

Adapted by:

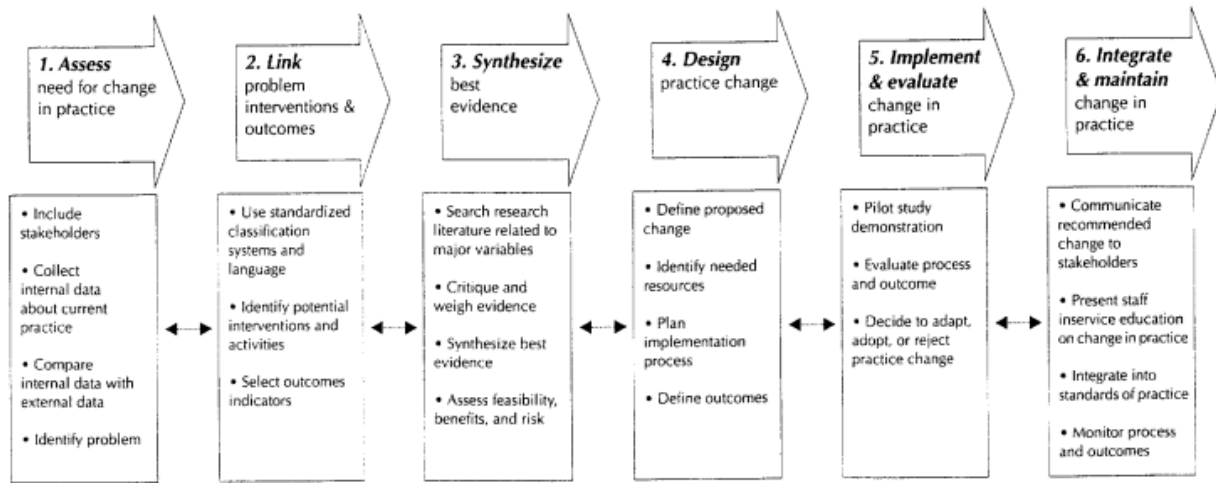
Alison Zeerip, MSN, RN, CPNP

Sherri Veurink-Balicki, MSN, RN, CEN

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Figure 2. Adapted from “Staff educational powerpoint: Fascia iliaca blocks and local anesthetics systemic toxicity (LAST),” by K.L. Johnson, A. Zeerip, and S. Veurink-Balicki. Copyright 2018 by XXX.

Appendix H



Adapted from “A model for change to evidence-based practice,” by M.A. Rosswurm and J.H.

Larrabee. Copyright 1999 by Journal of Nursing Scholarship.

Appendix I

Morphine Equivalent Conversions

Medication	Route of Administration	Morphine Equivalent	Conversion Factor
HYDROmorphine (Dilaudid)	Intravenous	0.15 mg	6.7
Fentanyl	Intravenous	10 mcg	0.1
Oxycodone	Oral	2 mg	1.5
Acetaminophen-HYDROcodone (Norco)	Oral	1 mg	1
Tramadol (Ultram)	Oral	10 mg	0.1

Appendix J

Letter of Agreement for Organization Advisor

**Grand Valley State University
Kirkhof College of Nursing
Doctor of Nursing Program**

Immersion Mentor Agreement

Student Name: Jenna Buchman

Project Site: (Include Unit if applicable):
MHSM/Mercy Health Saint Mary's Grand Rapids Campus

I will serve as a mentor for the above student and facilitate completion of the project in the organization.

Mentor (print name) Lisa Zuckerman

Mentor Signature Lisa Zuckerman **Date:** 05/15/2018

Phone: 616-685-4802

Email: lisa.zuckerman@mercyhealth.com

Submit in DNP Immersion Bb Site, "Submit Assignments Here" DNP Immersion Mentor Agreement icon.

Academic Community Liaison
Kirkhof College of Nursing
Grand Valley State University
616-331-5763 (office)
616-331-2510 (fax)

Appendix K

Budget and Projected Cost

Doctor of Nursing Practice Project Financial Operating Plan	
Hip Fracture Care Cost Analysis	
EXPENSES	
Project Expenses (Including Donated Resources)	
Project Manager Time (in-kind donation)	1,920.00
Team Member Time:	
Statistician (in-kind donation)	100.00
Consultation:	
Anesthesia	44.00
Additional Costs:	
Cost of Length of Stay (3.89 days at \$405/day)	1,575.45
Nerve Block Supplies and Stock	366.64
Cost of print/copy/fax of Powerpoint Education	2.00
Projected Expenses Total (Including donated resources)	4,008.09
Donated Resources	
Project Manager Time	-1,920.00
Statistician	-100.00
DONATED RESOURCES TOTAL	-2,020.00
TOTAL EXPENSES INCURRED FOR HOSPITAL	1,988.09
FINAL COSTS	
Cost Analysis	
Projected Expenses	1,988.09
Reimbursement for USG for needle placement per patient (2018 Facility price CPT)	-32.50
Reimbursement for Injection per patient (Anesthetic agent, Femoral nerve, single (2018 Facility CPT))	-67.99
Reduction in LOS by 1 day (2.89 days)	-405.00
NEW TOTAL COST OF HIP FRACTURE CARE	1,482.60
PROJECTED ANNUAL COST SAVINGS TO ORGANIZATION (2017 Hip Fracture Data)	73,801.54


Appendix L

Cost of preoperative and postoperative narcotic medications included in order sets

Medication	Dose, Route, Frequency	Pain Level Indication Numeric Scale	Cost
Tramadol (Ultram)	50 mg, Oral, q 4 hours	Moderate (4-6/10)	\$0.60/tab
Acetaminophen-HYDROcodone (Norco)	5 mg/325 mg, Oral, q 4 hours	Moderate (4-6/10)	\$0.17/tab
Acetaminophen-OxyCODONE (Oxycodone)	5 mg, Oral, q 4 hours	Moderate (4-6/10) – Severe (7-10/10)	\$0.18/tab
Morphine	1 mg, Intravenous, q 2 hours	Severe (7-10/10)	\$1.63/syringe (syringe manufactured as 4 mg/1mL syringe, but charge would be the same for any dose up to 4 mg)
HYDROmorphine (Dilaudid)	0.5 mg, Intravenous, q 4 hours	Severe (7-10/10)	\$1.80/syringe (syringe manufactured as 1 mg/mL syringe, but charge would be the same for any dose up to 1 mg)

Appendix M

Institutional Review Board Approval



MERCY HEALTH MercyHealth.com

NOTICE OF CLINICAL QUALITY IMPROVEMENT MEASUREMENT DESIGNATION

To: Jenna Buchman, BSN, RN
11055 Stanford Ave
Allendale, MI 49401

Re: IRB# 18-1120-11
Evaluation of a Nerve Block Protocol in Patients with Hip Fractures


Date: 11/20/2018

This is to inform you that the Mercy Health Regional Institutional Review Board (IRB) has reviewed your proposed research project entitled "*Evaluation of a Nerve Block Protocol in Patients with Hip Fractures*". The IRB has determined that your proposed project is not considered human subjects research. The purpose and objective of the proposed project meets the definition of a clinical quality improvement measurement. All publications referring to the proposed project should include the following statement:
"This project was undertaken as a Clinical Quality Improvement Initiative at Mercy Health and, as such, was not formally supervised by the Mercy Health Regional Institutional Review Board per their policies."

The IRB requests careful consideration of all future activities using the data that has been proposed to be collected and used "in order to assess whether the nerve block protocol has improved patients' overall pain management, mitigated narcotic-associated adverse effects, and reduced the costs of care in hip fracture patients when compared to patients who did not receive the nerve block protocol prior to its implementation in April 2018."

The IRB requests resubmission of the proposed project if there is a change in the current clinical quality improvement measurement design that includes testing hypothesis, asking a research question, following a research design or involves overriding standard clinical decision making and care.

Please feel free to contact me if you have any questions regarding this matter.


Tiffany VanTilburg, CIC
Office of the IRB

Copy: File

Institutional Review Board - 200 Jefferson Ave. SE – Grand Rapids, MI 49503 - P: 616.685.6198

Figure 1. Institutional Review Board approval letter from the organization site.



DATE: December 05, 2018

TO: Karen Burritt
FROM: HRRC
STUDY TITLE: Evaluation of a Nerve Block Protocol in Patients with Hip Fractures
REFERENCE #: 19-166-H
SUBMISSION TYPE: HRRC Research Determination Submission

ACTION: Not Research
EFFECTIVE DATE: December 05, 2018
REVIEW TYPE: Administrative Review

Thank you for your submission of materials for your planned scholarly activity. It has been determined that this project does not meet the definition of research* according to current federal regulations. The project, therefore, does not require further review and approval by the Human Research Review Committee (HRRC).

A summary of the reviewed project and determination is as follows:

The purpose of this quality improvement project is to assess whether a nerve block protocol has improved patients' overall pain management, mitigated narcotic-associated adverse effects, and reduced the costs of care in hip fracture patients when compared to the patients who did not receive the nerve block protocol prior to April 2018. This project will be completed at a local hospital to ensure this initiative has improved patient care and outcomes as expected. While this is a systematic investigation, it is not designed to create new generalizable knowledge. Therefore, this project does not meet the federal definition of research and IRB oversight is not needed.

An archived record of this determination form can be found in IRBManager from the Dashboard by clicking the "_ xForms" link under the "My Documents & Forms" menu.

If you have any questions, please contact the Office of Research Compliance and Integrity at (616) 331-3197 or rci@gvsu.edu. Please include your study title and study number in all correspondence with our office.

Sincerely,
Office of Research Compliance and Integrity

*Research is a systematic investigation, including research development, testing and evaluation, designed to develop or contribute to generalizable knowledge (45 CFR 46.102 (d)).

Human subject means a living individual about whom an investigator (whether professional or student) conducting research obtains: data through intervention or interaction with the individual, or identifiable private information (45 CFR 46.102 (f)).

Office of Research Compliance and Integrity | 1 Campus Drive | 049 James H Zumberge Hall | Allendale, MI 49401
Ph 616.331.3197 | rci@gvsu.edu | www.gvsu.edu/rci

Figure 2. Institutional Review Board approval letter from Grand Valley State University.

Appendix N

Patient Demographics		
	Pre-Block Group	Nerve Block Group
Sample Size	N=50	N=50
Gender Distribution		
Male	N=16	N=13
Female	N=34	N=37
Race Distribution		
Caucasian	N=48	N=48
African American	N=1	N=1
Hispanic	N=1	N=1
Dementia Diagnoses	N=18	N=19
Average Patient Age	80.54 years	82.80 years

Appendix O

Table 1. Care transition timeframes output using SAS MEANS output procedure.

Care Service Timeframes in Hours					
Calculated Field	N	Mean Time	SD	Minimum	Maximum
Admission to OR Time	100	21.92	10.05	3.60	68.37
Pre-Block	50	21.98	9.08	3.72	56.32
Nerve Block	50	21.87	11.03	3.60	68.37
Admission to Block Time	50	4.80	4.69	0.78	24.95
Block to OR Time	50	17.29	11.81	0.27	70.98

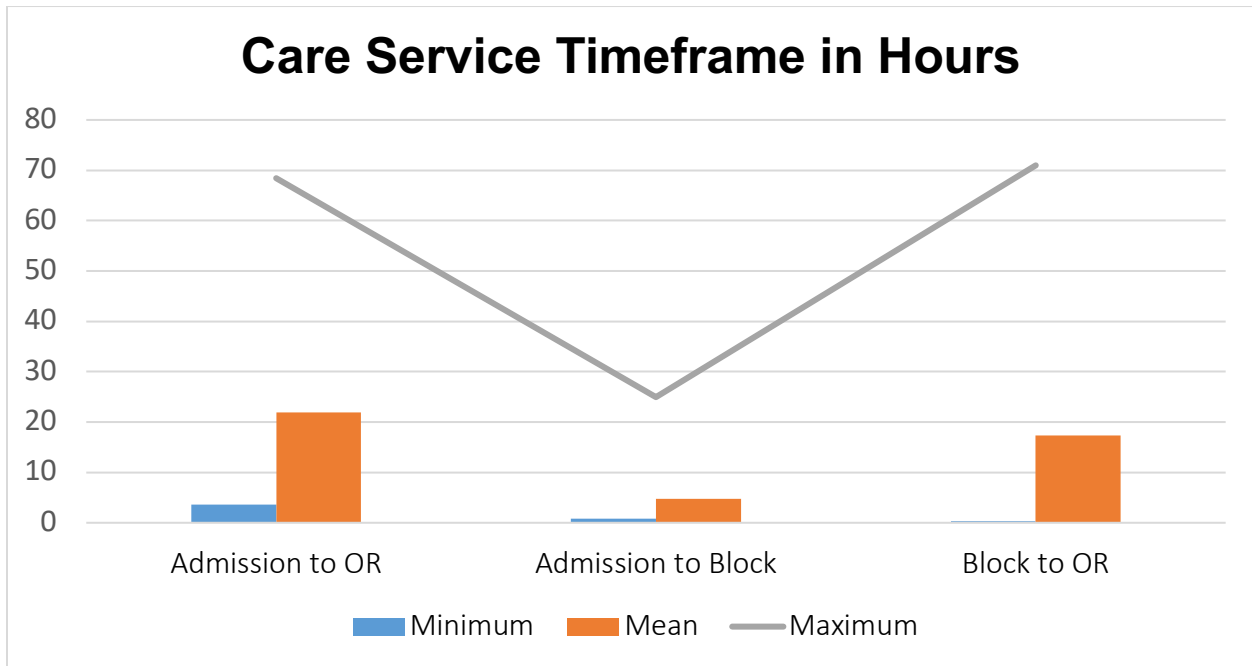


Figure 1. Care transition timeframes illustrated as a graphical output.

Appendix P

Table 1. Preoperative oral MME patient intake

Preoperative Oral MME					
	N	Mean MME	SD	Minimum	Maximum
Pre-Block Group	50	5.80	7.02	0.00	30.00
Nerve Block Group	50	7.40	10.77	0.00	47.50
		$p=0.80$			

Note. Data analysis with Wilcoxon Two-Sample Test ($Z=2489.50$).

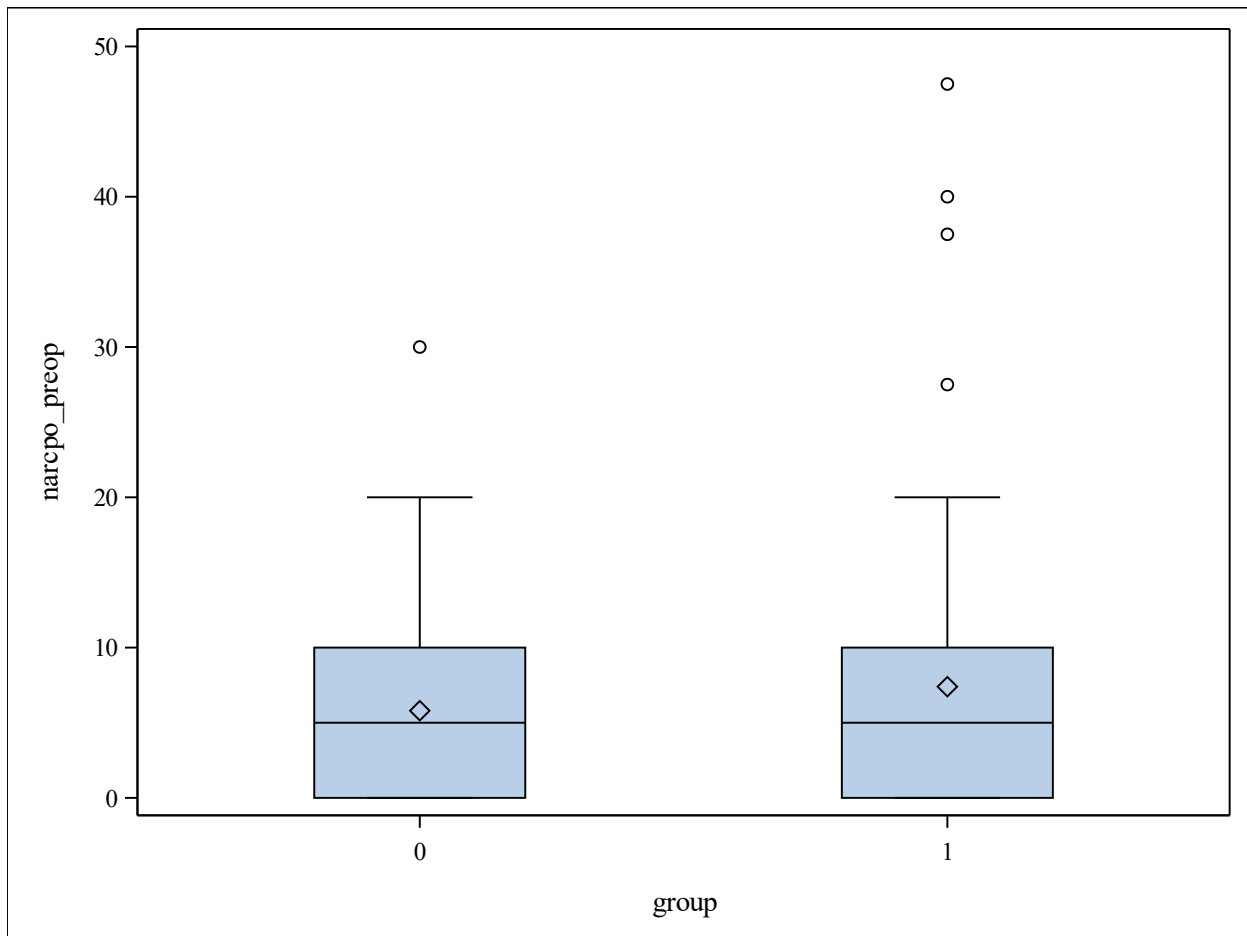


Figure 1. Preoperative oral MME intake. Box plots depicting entire data set for the Pre-block and Nerve Block groups. Group 0 refers to the Pre-block group, and group 1 refers to the Nerve Block group.

Table 2. Preoperative intravenous MME patient intake

Preoperative Intravenous MME					
	N	Mean MME	SD	Minimum	Maximum
Pre-Block Group	50	9.65	8.41	0.00	36.70
Nerve Block Group	50	8.44	8.14	0.00	30.00
		$p=0.39$			

Note. Data analysis with Wilcoxon Two-Sample Test ($Z=2649.50$).

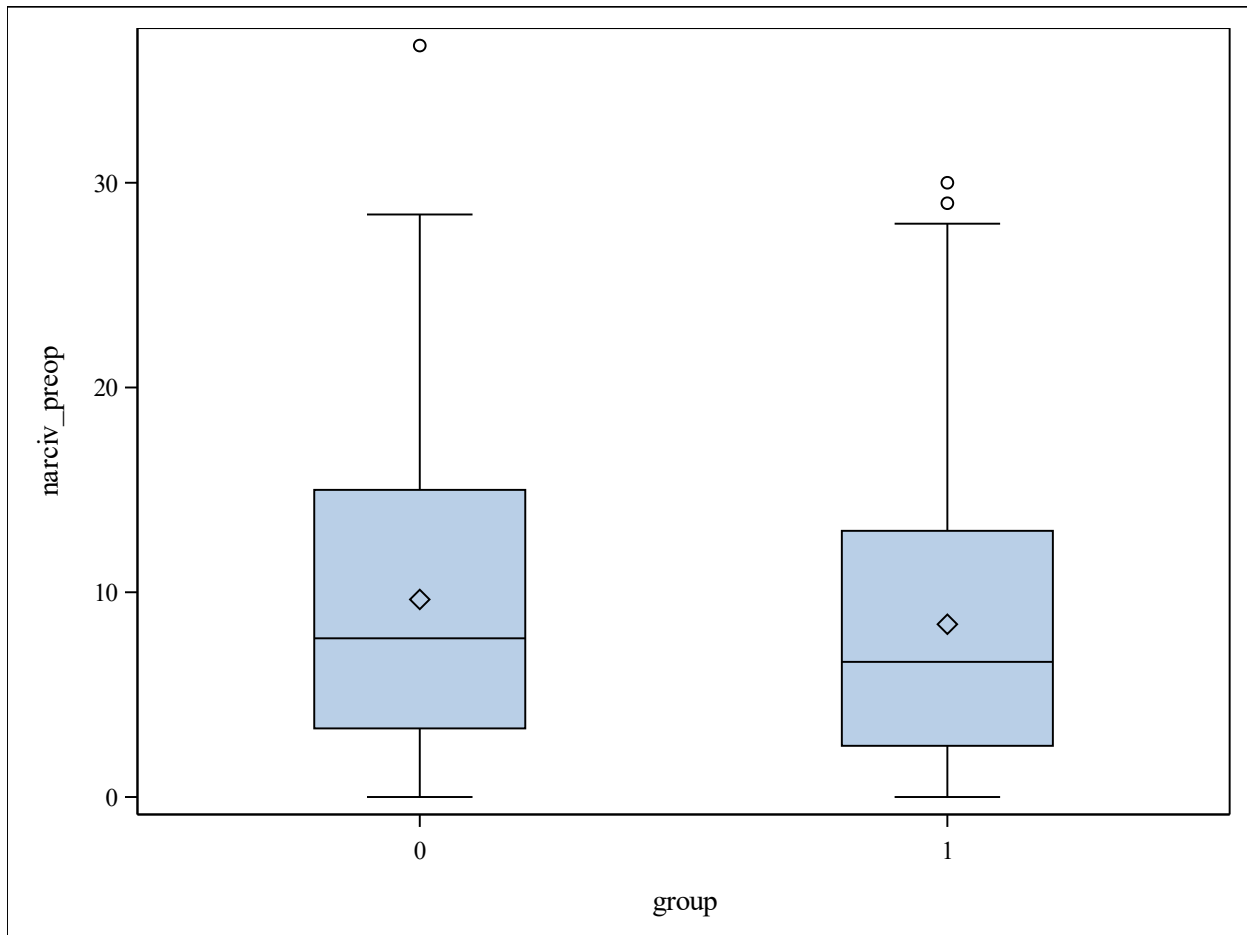


Figure 2. Preoperative IV MME intake. Box plots depicting entire data set for the Pre-block and Nerve Block groups. Group 0 refers to the Pre-block group, and group 1 refers to the Nerve Block group.

Table 3. Postoperative oral MME patient intake

Postoperative Oral MME					
	N	Mean MME	SD	Minimum	Maximum
Pre-Block Group	50	30.68	32.97	0.00	142.50
Nerve Block Group	50	21.10	22.13	0.00	95.00
		$p=0.23$			

Note. Data analysis with Wilcoxon Two-Sample Test ($Z=2697.50$).

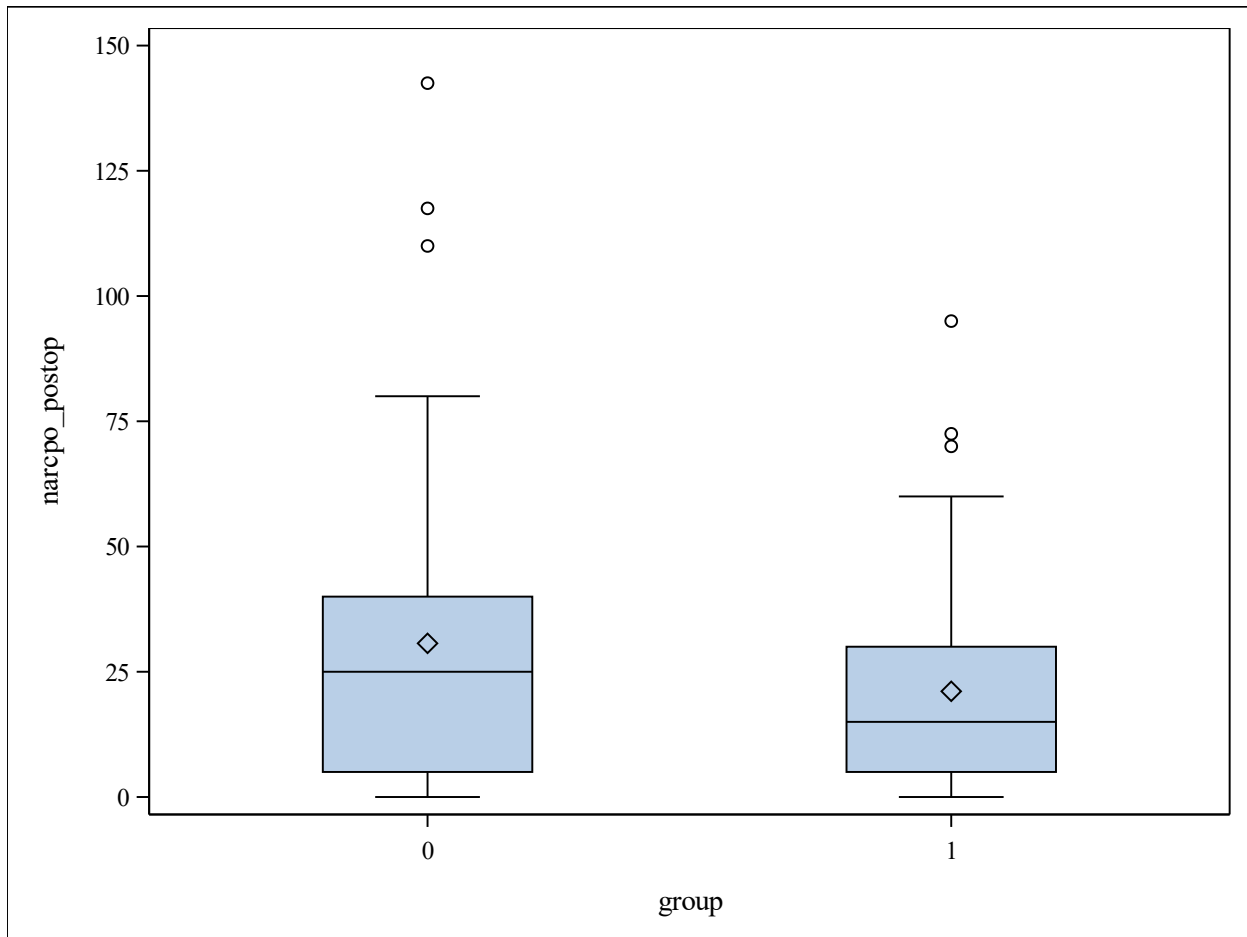


Figure 3. Postoperative oral MME intake. Box plots depicting entire data set for the Pre-block and Nerve Block groups. Group 0 refers to the Pre-block group, and group 1 refers to the Nerve Block group.

Table 4. Postoperative intravenous MME patient intake

Postoperative Intravenous MME					
	N	Mean MME	SD	Minimum	Maximum
Pre-Block Group	50	1.91	4.57	0.00	28.00
Nerve Block Group	50	0.91	2.84	0.00	16.00
		$p=0.10$			

Note. Data analysis with Wilcoxon Two-Sample Test ($Z=2703.50$).

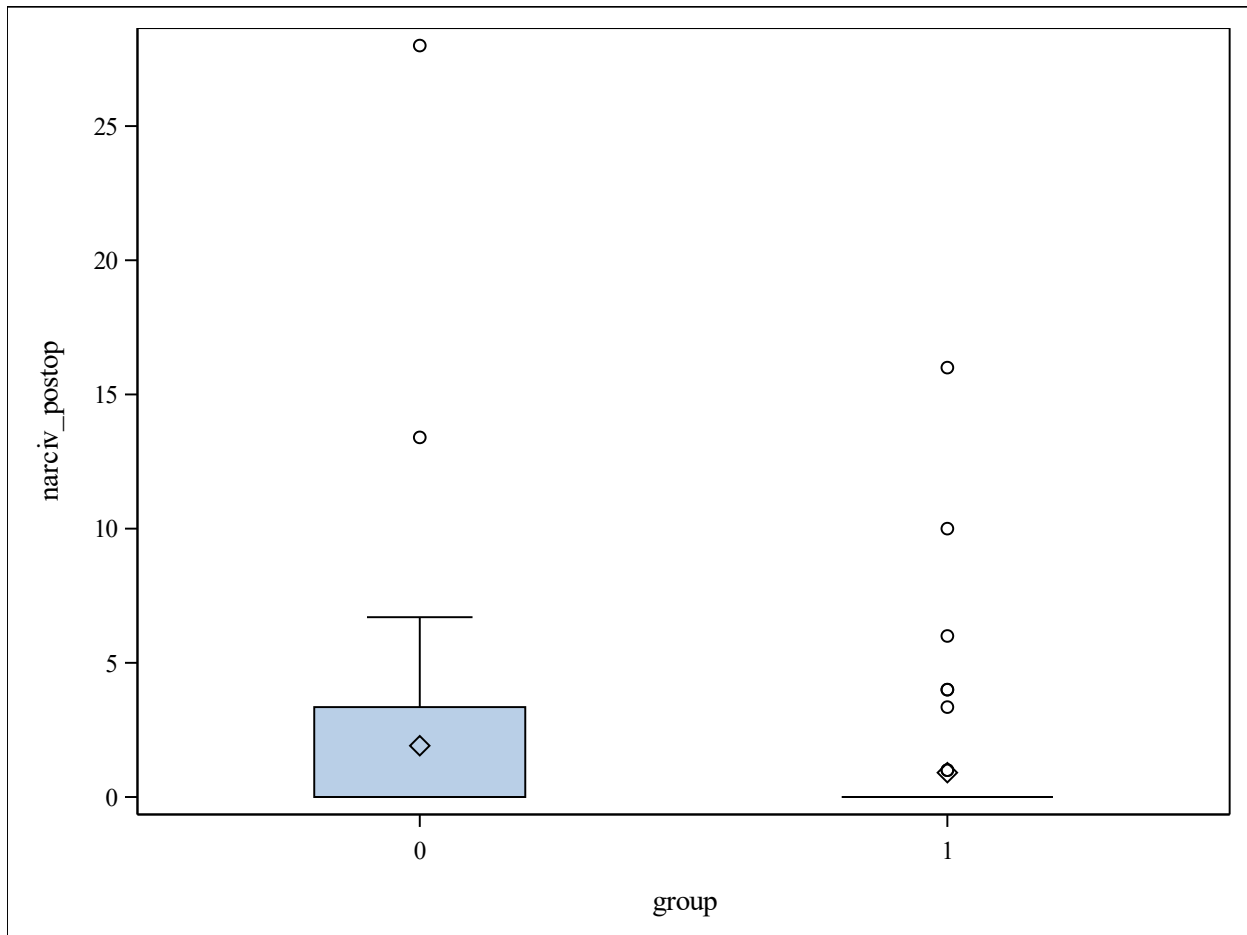


Figure 4. Postoperative IV MME intake. Box plots depicting entire data set for the Pre-block and Nerve Block groups. Group 0 refers to the Pre-block group, and group 1 refers to the Nerve Block group.

Table 5. Oral MME intake at 24, 48, 72, and 96 hours of inpatient stay

Total Oral MME Intake		
	N	Mean MME
24 Hours		
Pre-Block Group	50	7.45
Nerve Block Group	50	6.80
<i>p</i> -value	0.27	
48 Hours		
Pre-Block Group	49	13.77
Nerve Block Group	48	9.27
<i>p</i> -value	0.42	
72 Hours		
Pre-Block Group	36	12.85
Nerve Block Group	34	7.94
<i>p</i> -value	0.33	
96 Hours		
Pre-Block Group	14	10.27
Nerve Block Group	17	7.20
<i>p</i> -value	0.98	

Note. Outcomes for the Pre-block and Nerve Block groups analyzed through Wilcoxon Two-Sample Test.

Table 6. Intravenous MME intake at 24, 48, 72, and 96 hours of inpatient stay

Total Intravenous MME Intake		
	N	Mean MME
24 Hours		
Pre-Block Group	50	10.50
Nerve Block Group	50	8.48
<i>p</i> -value	0.19	
48 Hours		
Pre-Block Group	49	1.35
Nerve Block Group	48	0.63
<i>p</i> -value	0.11	
72 Hours		
Pre-Block Group	36	0.09
Nerve Block Group	34	0.29
<i>p</i> -value	0.28	
96 Hours		
Pre-Block Group	14	0.00
Nerve Block Group	17	0.20
<i>p</i> -value	0.41	

Note. Outcomes for the Pre-block and Nerve Block groups analyzed through Wilcoxon Two-Sample Test.

Appendix Q

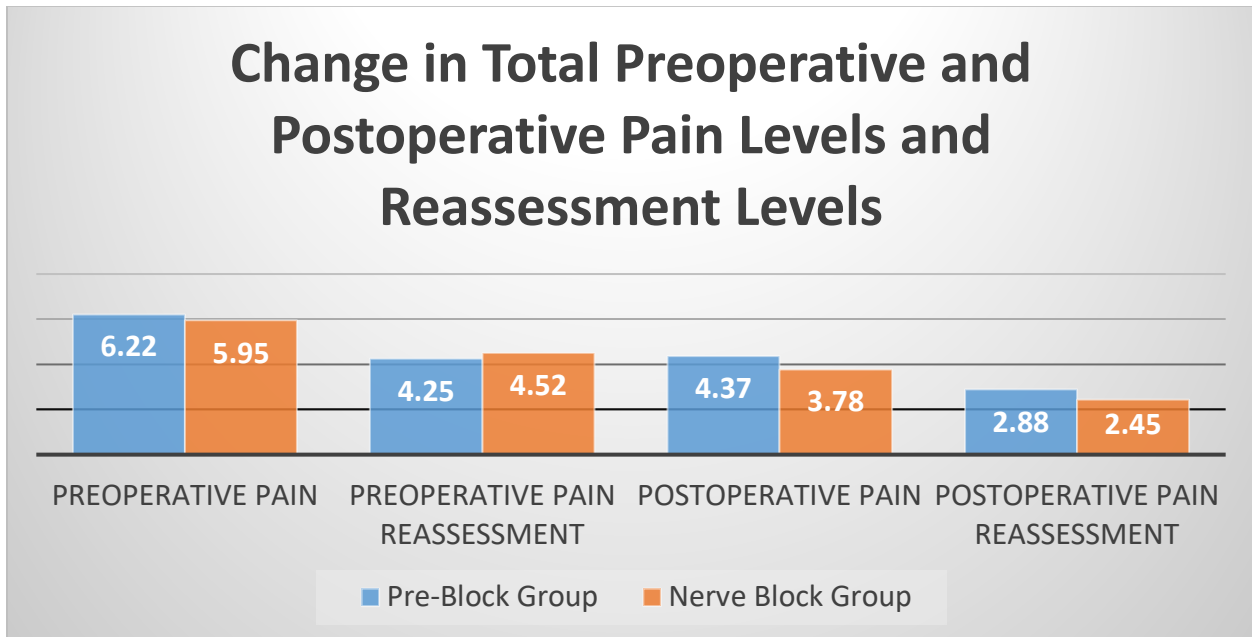


Figure 1. The change in total preoperative and postoperative pain levels and reassessment levels.

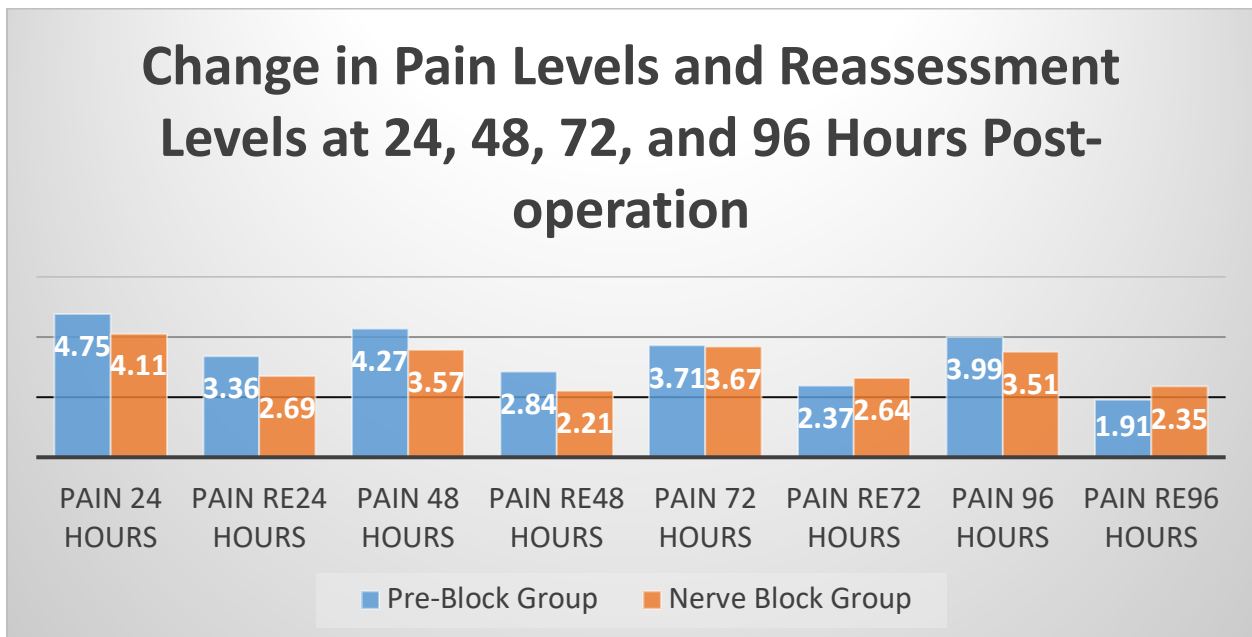


Figure 2. The change in pain levels and pain reassessment levels at 24, 48, 72, and 96 hours postoperatively and until discharge.

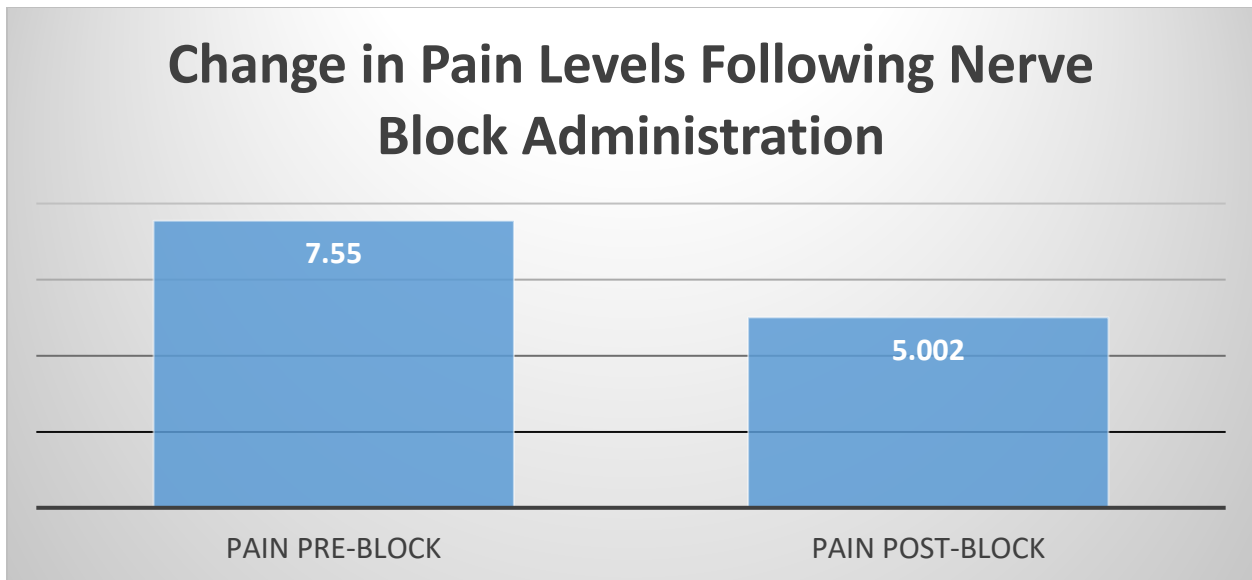


Figure 3. The change in reported pain levels following preoperative nerve block administration.

Appendix R

Analysis of Variance for Length of Patient Stay			
Classified by Variable Group			
Group	N	Mean LOS (Hours)	
Pre-Block	50	110.74333	
Nerve Block	50	104.237667	
Wilcoxon Two-Sample Statistic			2544.0000
<i>p</i>-value			0.90

Appendix S*Table 1.* Secondary Patient outcome indicators.

Secondary Patient Outcomes				
	N Total	Delirium	Pneumonia	ICU Transfer
Pre-Block Group	50	11	1	0
Nerve Block Group	50	5	1	1

Table 2. Discharge location for patients across both groups.

		Table of group by dc_loc				
		dc_loc				
		home	home health	sar	other	Total
group						
pre	Frequency	3	4	43	0	50
	Percent	3.00	4.00	43.00	0.00	50.00
	Row Pct	6.00	8.00	86.00	0.00	
	Col Pct	60.00	50.00	50.59	0.00	
post	Frequency	2	4	42	2	50
	Percent	2.00	4.00	42.00	2.00	50.00
	Row Pct	4.00	8.00	84.00	4.00	
	Col Pct	40.00	50.00	49.41	100.00	
Total	Frequency	5	8	85	2	100
	Percent	5.00	8.00	85.00	2.00	100.00

Note. “Pre” group represents the pre-block group; “Post” represents the nerve block group; “sar” represents subacute rehabilitation; “Other” is any discharge location.

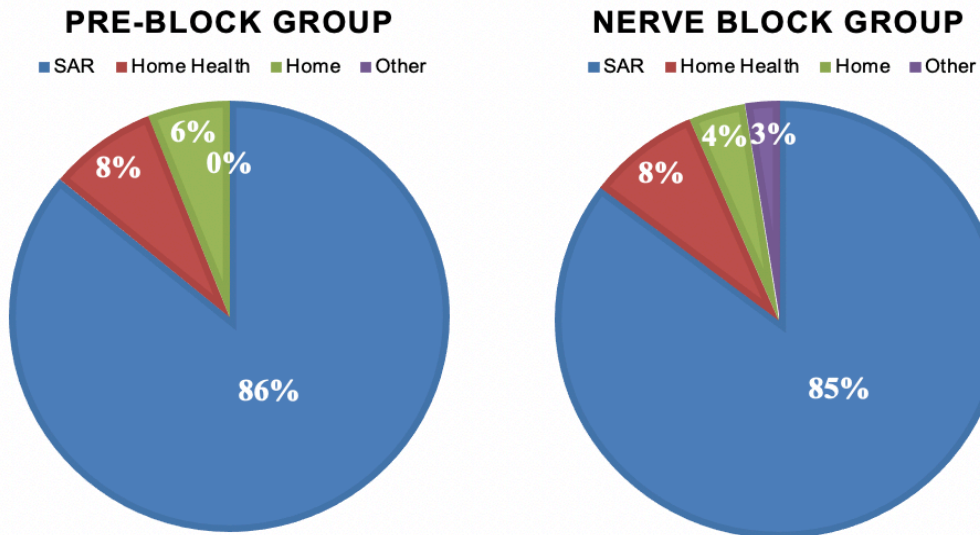


Figure 1. Discharge location as exhibited in a chart representation.