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Retrospective Cohort Study of Patients with Chronic Low Back Pain in an Outpatient Pain Specialist Clinic

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RETROSPECTIVE COHORT STUDY OF PATIENTS WITH CHRONIC LOW BACK PAIN IN AN OUTPATIENT PAIN SPECIALIST CLINIC

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Approved November 10, 2020

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ABSTRACT

RETROSPECTIVE COHORT STUDY OF PATIENTS WITH CHRONIC LOW BACK PAIN IN AN OUTPATIENT PAIN SPECIALIST CLINIC

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Thesis supervised by Dr. Khalid Kamal

Background: Chronic low back pain (LBP) is a back pain that lasts for three or more than three months in the lumbar region of the spinal cord. A nerve injury or damage in the spinal cord region (neuropathic pain) requires multimodal treatment approach for pain reduction. With various treatment options utilized in the pain management of these patients, identifying demographical and clinical characteristics of patients with chronic LBP utilizing interventional procedures and pharmacologic treatments is imperative. **Objective: (**i) To describe the demographics (age, gender, race, ethnicity, smoking status, alcohol consumption status, drug use status) and clinical characteristics (procedures, medications) of patients with chronic LBP, (ii) to assess the prevalence of comorbid conditions including hypertension, anxiety and depression in the chronic LBP cohort and assess their demographic an clinical characteristics, (iii) to assess the demographic and

clinical characteristics of patients with chronic LBP who are currently prescribed the following medications: blood thinners (anticoagulants/antiplatelet), herbal medications, benzodiazepines and opioids, (iv) to assess the mean pain level pre- and post-procedure for patients with chronic LBP that have undergone a single interventional therapeutic LBP procedure throughout the study period.

Methods: A retrospective cohort data analysis was conducted using electronic medical record (EMR) data of newly enrolled patients with chronic LBP in 2018. Data extraction was carried out for LBP patients, but all the analyses were conducted for adult patients with chronic non-cancer LBP. The chronic LBP cohort was identified by filtering out patients who suffered with LBP for less than 3 months (acute) within the study period. Further, patients with any type of cancer as a comorbid condition and those with age below 18 years were excluded from the chronic LBP cohort. Descriptive analyses were conducted to assess demographical and clinical characteristics of chronic LBP patients and cohorts identified within these patients based on the type of comorbidity or medications they were on. Pain relief obtained from interventional therapeutic procedures was also calculated using the mean pain scores before and after the procedure. All statistical analyses were conducted using SAS (SAS Institute Inc., Cary, NC, USA).

Results: A total of 464 adult patients with chronic LBP were identified in the EMR from January 2018 to February 2020. The mean age of the patient cohort was 61.96 years, majority were females (52.8%), Whites (93.97%) and non-Hispanic Latino (96.77%). Most patients never smoked (57.24%) or currently consumed alcohol (53.39%). The mean duration of chronic LBP was 64.15 months and mean office follow-up visits were 3 visits. The most prevalent therapeutic procedure was lumbar epidural steroid injection

(ESI) (36.85%) and diagnostic procedure was lumbar medial branch block (15.73%). For patients that underwent lumbar ESI, a maximum of five repetitions and an average of 1.68 repetitions were required to obtain sustained pain relief over a 2-year follow-up period. Also, on an average pain reduction of about 55% was obtained from this procedure. The prevalence of pain medications by line of therapy was found as 24.78% for first-line medications, 26.07% for second-line medications and 9.91% for third-line medications. Patients with chronic LBP also had hypertension (n=188, 40.52%) and anxiety and depression (n=120, 25.86%). Similar patient characteristics were further analyzed based on the type of medications patients were on: (i) blood thinners (n=154, 33.18%), herbal medications (n=45, 9.69%), benzodiazepines (n=67, 14.43%) and opioids (n=121, 26.07%).

Conclusion: Patients with chronic LBP suffer with the condition for a prolonged duration and require multimodal treatment approach including interventional procedures and pharmacologic treatments. Although these treatment options do not provide sustained pain relief, they do provide temporary symptomatic pain relief.

DEDICATION

I dedicate this thesis to my mother, Veena, my father, Vijay and my brother, Gaurang. Thank you for having faith in me and for always supporting all my dreams, that have now come true. The amount of sacrifices you've made, the encouragement and happiness you've provided, has enabled me to do better and to be hopeful, always.

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CHAPTER 1: BACKGROUND

INTRODUCTION

Chronic non-cancer pain

Chronic non-cancer pain (CNCP) is defined as moderate to severe pain typically lasting three months or more and not associated with any malignancy.[1] A number of conditions such as low back pain, neck pain, osteoarthritis, rheumatoid arthritis, bilateral leg pain, and fibromyalgia are classified as CNCP.[1] There is evidence to suggest that CNCP is linked to restrictions in functional mobility and daily activities, poor quality of life (QoL), and comorbid conditions such as anxiety and depression.[1,16]

Types of CNCP

CNCP is mainly categorized into nociceptive pain and neuropathic pain. Both nociceptive and neuropathic pain can coexist and can be chronic in nature. Nociceptive pain is induced by nociceptors, which are primary afferent nerve endings present in skin, muscle, joints or visceral forms.[2] The nociceptors are activated in response to either noxious stimuli such as mechanical injury, cold, and heat insults or polymodal stimuli such as chemical, mechanical, and thermal insults.[2] The peripheral inflammation of nociceptors activates non-myelinated C-fibers and myelinated A-δ fibers which releases substance P and calcitonin gene-related peptide (CGRP), thus amplifying the local inflammation.[2] This inflammation is generally considered transient in nature.

Neuropathic pain involves both peripheral and central nervous systems (CNS). After an injury to the nervous system, the spinal cord receives the pain impulse from the primary afferent C-fibers and A-δ nerves through its dorsal horn.[2] These nerves

terminating at lamina I-II further transmit the input to thalamus via the neurokinin-1-receptors present in lamina I. The pain signals are processed in the CNS and if the signals are persistent it contributes to its chronicity.[2] Neuropathic pain is more severe and tends to have higher than average pain scores along with poor QoL.

Pathogenesis of CNCP

After tissue injury, a host of inflammatory mediators including adenosine-5-triphosphate (ATP), bradykinin, interleukin–1 ß (IL-1ß), prostaglandin E_2, tumor necrosis factor-α (TNF- α), sodium (Na^+), proton (H^+), potassium (K^+), histamine, nerve growth factor and serotonin are released from the mast cells, macrophages and epithelial cells of the damage tissue.[3] Activation of cyclo-oxygenase-2 (COX-2) enzyme produces prostaglandins that results in the nociceptors activation. Nociceptors transmit the signals via the voltage- or ligand-gated channels and protein kinases A and C pathways. C-fibers activated by the peripheral inflammation releases substance P and calcitonin gene-related peptide (CGRP). The process occurs in the periphery defined as peripheral sensitization or primary hyperalgesia.[2] Ongoing and intense sensitization of C-fiber in primary afferent neurons and spinal cord causes N-methyl-D-aspartate (NMDA) activation and removal of Mg^{2+} block on the NMDA receptor, thereby facilitating the co-release of substance P and CGRP within the CNS. These substances activate the glial cells, which then upregulate COX-2 and nitric oxide synthetase (NOS) resulting in release of prostaglandin E_2 and inflammatory mediators including interleukin-1, interleukin-6 and TNF- α causing central sensitization or secondary hyperalgesia.[2] The increase of COX-2 in the spinal cord causes the metabolism of 2-arachidonoylglycerol (2-AG) to prostaglandin E_2, which increases

the inflammation and pain intensity.[2] Consequently, the persistent nociception transits to chronic pain due to neural and glial remodeling (neuroplasticity) wherein the neuronal synapses are remodeled and the neurons develop more connections with second-order neurons within CNS. This process of neuroplasticity increases the pain sensitivity of neurons in response to stimuli eventually leading to chronic pain.[2] It is still not clear whether persistent inflammation or the inflammatory mediators are responsible for maintaining chronic neuropathic pain.

Low back pain

Depending on the duration of the pain, low back pain (LBP) can be classified into acute, subacute, and chronic pain. Acute pain persists for less than six weeks, subacute persists for six weeks to three months, and chronic pain for more than three months.[4] Based on specific pathophysiological mechanism, LBP is further categorized into specific or non-specific LBP. Specific LBP includes symptoms caused by infection, osteoporosis, rheumatoid arthritis, fracture or tumor.[4] Specific low back pain could be caused by a herniated disc, degenerative disc disease and arthritis (i.e. facet joint arthritis). It could also involve muscle pain. Non-specific LBP, on the other hand, incudes symptoms that lack any identifiable cause.

Lower back is a complex structure that includes tendons and muscles, highly sensitive nerves and nerve roots, small and complex joints and spinal discs. A problem or an irritation with any of these structures can cause LBP.[5] Various conditions can cause LBP such as lumbar spinal stenosis, lumbar radiculopathy, degenerative disc disease and herniated disc.[5] LBP radiates in the lumbar region of the spinal cord and can also cause

leg pain (sciatica). If episodes of acute or subacute LBP are not detected in the early stage, they can lead to chronic LBP.[4] Chronic LBP has been shown to result in severe exacerbations of pain leading to disability.[4] Early diagnosis and treatment of acute or subacute LBP significantly reduces the pain intensity and persistence of the pain. Pain medications and interventional procedures reduce the severity of chronic LBP but not its persistence.[4]

EPIDEMIOLOGY

Among all the United States (US) adults with disability, LBP is the second most common cause.[6] Global prevalence estimates of LBP range from 1.4% to 20%.[7] The prevalence of LBP in high-income countries such as the US is about 30% compared to 18% in low-income countries.[7] The global incidence estimates of LBP range from as low as 0.024% to a high of 7%.[7] The global 1-year incidence of any episode of LBP ranges from 1.5% to 36%. The incidence of LBP is found to increase with age[7], and the odds of reporting LBP is 1.5 times in white individuals compared to individuals who are Black and/or Hispanics.[8]

RISK FACTORS

Several risk factors are associated with occurrence and chronicity of LBP and can be categorized into personal, psychosocial and occupational factors.[4] Personal risk factors include age, physical fitness, metabolism, weakness of back and abdominal muscles and smoking and those for chronicity include obesity, low educational level and high levels of pain and disability.[4] Psychosocial risk factors for occurrence include stress,

anxiety, negative mood, poor cognitive functioning and pain behavior and those for chronicity include distress, depressive mood, somatization.[4] Occupational risk factors for occurrence include working with heavy weights, job dissatisfaction, lengthy period of standing and poor work relationships and for chronicity include unavailability of light duty on return to work; job requirement of lifting for three quarters of the day.[4]

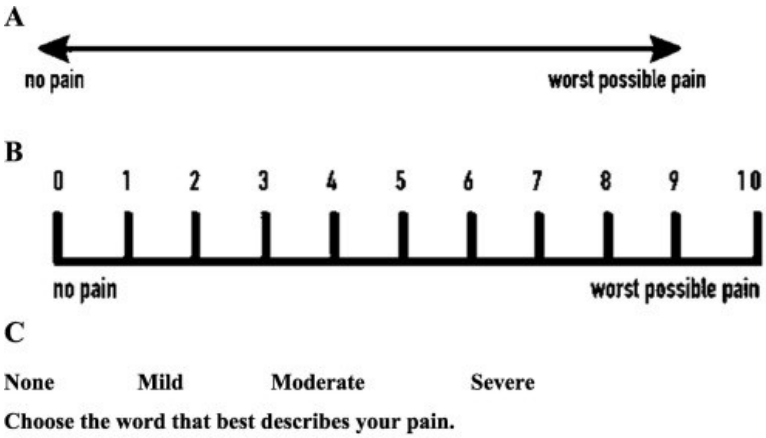
PAIN ASSESSMENT

A comprehensive pain assessment is recommended prior to implementing a treatment plan for LBP. Instruments such as Visual Analog Scale (VAS), Numerical Rating Scale (NRS), Verbal Rating Scale/Descriptor Scale, Faces Pain Rating Scale, and Short form McGill Pain Questionnaire have reportedly been utilized to assess the level of LBP in patients.[9,10] **(Refer Figure 2)**

1) Visual Analog Scale: It consists of a straight line anchored by two endpoints 'no pain' and 'worst possible pain.' The patients are required to mark their current pain intensity level on the scale.[9] Major drawbacks with this tool are the requirement for a physical equipment (e.g. pen and paper) and the need for patients to possess motor skills, visual acuity, and abstract thinking.[10]

2) Numerical Rating Scale: It is a numerical scale ranging from 0 to 10, where 0 = no pain, 1-3 = mild pain, 4-6 = moderate pain and 7-10 = severe pain. The instrument can be administered via telephone or in-person.[9] NRS is a preferred tool to measure pain intensity when the population of interest can use it reliably.[10]

Figure 1: Pain Assessment Scales



A: Visual Analog Scale (VAS), B: Numerical Rating Scale (NRS), C: Verbal Rating Scale (VRS)

Source: Karcioglu et al, 2018[9]

3) Verbal Rating Scale/Descriptor Scale: In this scale, patients are required to mark their level of pain intensity based on descriptors, which range from none, mild, moderate, or severe pain. The precision of the scale compared to VAS and NRS is limited due to its inability to provide more choices.[9]

4) Short-Form McGill Pain Questionnaire: This pain questionnaire consists of a VDS with 15 adjectives to describe sensory and affective qualities of pain and a VAS to evaluate the patient's current pain intensity. The questionnaire possesses the ability to distinguish between different types of pain and is sensitive to the change in the pain level.[11,12]

TREATMENT

Multimodal interventions are utilized for pain management of patients with chronic pain. Single modality interventions are rarely used alone and are often combined into the multimodal treatment strategy.[13] Using more than one type of therapy provides better pain control and reduces pain intensity for about 4 months to a year. Different multimodal interventions include: (1) ablative techniques, (2) acupuncture, (3) blocks (*i.e.*, joint and nerve or nerve root), (4) botulinum toxin injections, (5) electrical nerve stimulation, (6) epidural steroids with or without local anesthetics, (7) intrathecal drug therapies, (8) minimally invasive spinal procedures, (9) pharmacologic management, (10) physical or restorative therapy, (11) psychologic treatment, and (12) trigger point injections.[13] Out of the various multimodal interventions, this chapter focuses on pharmacologic management and interventional procedures only.

Pain medications

For the pharmacological treatment of neuropathic pain, Neuropathic Pain Special Interest Group (NeuPSIG) evidence-based guidelines recommend following step-wise treatment approach.[14] After diagnosis, it is recommended that the pain specialist, if applicable should initiate treatment for the disease-causing neuropathic pain.

For symptomatic treatment of neuropathic pain, first-line treatment options including tricyclic antidepressants (nortriptyline, desipramine), dual reuptake inhibitors of serotonin and norepinephrine (duloxetine, venlafaxine), calcium channel α2-δ ligands (ie, gabapentin and pregabalin) should be utilized, and topical lidocaine for localized peripheral neuropathic pain alone or in combination with other first-line therapies should be utilized.[14] While on the treatment, reassess the pain level and health-related quality of life of the patients. If significant pain relief (eg, average pain reduced to ≤3/10) is obtained using first-line therapy, continue with that treatment option. If partial pain relief (eg, average pain remains ≥4/10) after an appropriate trial, add one of the other 4 first-line medications. If inadequate pain relief (eg, <30% reduction) is obtained at target dosage after an appropriate trial, switch to an alternative first-line medication. If trials of first-line medications alone and in combination fail, the guidelines recommend consideration of second-line medications.[14]

Opioid analgesics and tramadol are recommended as second-line treatments and can be considered for first-line use under certain clinical circumstances.[14] Patients who cannot tolerate or who do not respond adequately to first- and second-line medications, are recommended with third-line medications including antidepressant medications (e.g. bupropion, citalopram, and paroxetine), antiepileptic medications (e.g. carbamazepine,

lamotrigine, oxcarbazepine, topiramate, and valproic acid), topical low concentration capsaicin, dextromethorphan, memantine, and mexiletine.[14]

Interventional Procedures

Practice Guidelines developed by the American Society of Anesthesiologists (ASA) provides recommendations on chronic pain management using interventional procedures.[13] After a thorough patient history assessment, physical examination and psychosocial evaluation, interventional diagnostic procedures can be conducted as a part of patient's evaluation based on patient's clinical presentation.[13] The interventional diagnostic procedures should be followed by appropriate therapeutic procedures. Some of the procedures can be used for both purposes. **Table 1** provides classification of interventional diagnostic and therapeutic procedures for chronic pain.[13]

Chronic pain patients on anticoagulants/antiplatelets and on various concomitant medications with antiplatelet effects including non-steroidal anti-inflammatory drugs (NSAIDs), aspirin and serotonin reuptake inhibitors have demonstrated increased bleeding complications when continued during interventional pain procedures. Therefore, the American Society of Regional Anesthesia and Pain Medicine (ASRA) guidelines have classified interventional spine and pain procedures based on potential risk of bleeding in patients on anticoagulants/antiplatelets.[15] **(Refer Table 2)**

Table 1: Classification of interventional diagnostic and therapeutic procedures for CNCP

Diagnostic procedures	Therapeutic procedures
▪ Selective nerve root blocks ▪ Medial branch blocks ▪ Facet joint injections ▪ Sacroiliac joint injections ▪ Lateral branch blocks ▪ Sympathetic blocks ▪ Peripheral blocks ▪ Provocative discography	▪ Epidural steroid injection (Interlaminar, Transforaminal) ▪ Joint blocks (Intraarticular facet joint injections, Sacroiliac joint injections) ▪ Nerve and nerve root blocks (Lumbar sympathetic blocks, Sympathetic nerve blocks, Medial branch blocks) ▪ Ablative techniques (Chemical denervation, Cryoablation, radiofrequency ablation) ▪ Intrathecal drug injections (opioid, non-opioid) ▪ Electrical nerve stimulation (Subcutaneous peripheral nerve stimulation, Spinal cord stimulation, Permanent spinal cord stimulation implantation ▪ Transcutaneous electrical nerve stimulation (TENS) ▪ Minimally invasive spinal procedures (Kyphoplasty, Vertebroplasty, Percutaneous disc decompression) ▪ Trigger point injections

Source: Practice guidelines for chronic pain management, ASA[13]

Table 2: Pain Procedures Classification According to the Potential Risk of Serious Bleeding

High-risk procedures	Intermediate-risk procedures	Low-risk procedures
▪ Spinal cord stimulation trial and implant ▪ Dorsal root ganglion stimulation ▪ Intrathecal catheter and pump implant ▪ Percutaneous decompression laminotomy ▪ Epiduroscopy and epidural decompression	▪ Interlaminar ESIs (C, T, L, S) ▪ Transforaminal ESIs (C, T, L, S) ▪ Cervical facet MBNB and RFA ▪ Intradiscal procedures (C, T, L) ▪ Sympathetic blocks (stellate, T, splanchnic, celiac, lumbar, hypogastric) ▪ Trigeminal and sphenopalatine ganglia blocks	▪ Peripheral nerve blocks ▪ Peripheral joints and musculoskeletal injections ▪ Trigger point injections including piriformis injection ▪ Sacroiliac joint injection and sacral lateral branch blocks ▪ Thoracic and lumbar facet MBNB and RFA ▪ Peripheral nerve stimulation trial and implant ▪ Pocket revision and implantable pulse generator/intrathecal pump replacement

Abbreviations: C, cervical; L, lumbar; S, sacral; T, thoracic; ESI, epidural steroid injection; MBNB, medial branch nerve block; RFA, radiofrequency ablation

Source: ASRA guidelines, Regional Anesthesia and Pain Medicine, 2018[15]

COMORBID CONDITIONS

The predominant comorbidities in LBP population include anxiety and depression since most studies[16] have reported the association between LBP and anxiety and depression. Previous studies[17, 18] have reported that hypertension did not have any association with chronic LBP. There is a need to identify the prevalence of chronic LBP patients with these comorbid conditions to better inform the clinical practice to treat the underlying cause of chronic LBP for such patients.

Anxiety: The American Psychological Association (APA) defines anxiety as "an emotion characterized by feelings of tension, worried thoughts and physical changes like increased blood pressure." Patients with anxiety disorders and chronic pain have lower tolerance for pain compared to those without anxiety disorders. Being more fearful to the side-effects of medications lead to exacerbations of pain in this cohort.[19]

Depression: The APA defines depression as "a negative affective state, ranging from unhappiness and discontent to an extreme feeling of sadness, pessimism, and despondency, that interferes with daily life." Chronic pain and depression are intertwined due to the involvement of same nerves and neurotransmitters. Chronic pain can have impact in different aspects of life such as sleep, social network, relationships or work inducing stressful feelings. People with depression and chronic pain might be less tolerant towards the pain and experience it considerably.[20]

Hypertension: Patients with chronic pain may have reduced heart rate variability and baroreflex sensitivity and is related to impaired cardiovascular regulation. The elevated blood pressure is associated with increased sensitivity to pain, thus aggravating the pain and worsening the pain experience in patients with chronic pain and comorbid hypertension.[21,22] Therefore, heart rate and blood pressure are not reliable indicators of pain intensity.

PROBLEM STATEMENT

LBP is a common chronic condition, especially in the older population, and is typically treated with different pain medications and interventional procedures. Most studies have assessed the utilization of pain treatments, however there is a lack of description of patients at risk for chronic LBP and utilization data on pharmacologic treatments and procedures with respect to disease duration and pain severity. Also, studies[16] have reported the association of comorbid conditions such as anxiety and depression with chronic pain, but none have focused specifically on patients with LBP.

Since pain management requires multimodal interventions, the procedures need to be monitored for certain drug interactions. The American Society of Regional Anesthesia and Pain Medicine (ASRA) guidelines for patients on antiplatelet and anticoagulants undergoing interventional spine and pain procedures, recommend the discontinuation of blood thinners prior to conducting intermediate-risk or high-risk procedures to avoid spinal hematoma.[15] The ASRA guidelines also recommend the discontinuation of herbal medicines prior to any interventional procedure, as the co-administration of herbal medicines with blood thinners causes significant bleeding or interaction.[15]

There's a need to evaluate characteristics of patients on opioids and benzodiazepines in order to identify the different types of procedures these patients undergo in their multimodal treatment strategy. Finally, a few studies have assessed the change in pain scores from baseline to after the use of a single interventional therapeutic procedure. However, none of them have been conducted in patients with LBP.

CONCEPTUAL FRAMEWORK

This study will utilize the electronic medical record data from an outpatient pain clinic based in southwestern Pennsylvania. The pain management clinic provides a comprehensive treatment plan and uses diagnostics techniques to detect the origin of pain with the ultimate goal of providing significant pain relief to the patients. This study will include new patients with a diagnosis of chronic LBP enrolled in the practice from January 2018 through February 2020.

STUDY OBJECTIVES AND RESEARCH QUESTIONS

Overall goal is to explore pain management in patients with LBP in an outpatient pain clinic.

Specific research questions include:

1. To describe the demographics (age, gender, race, ethnicity, smoking status, alcohol consumption status, drug use status) and clinical characteristics (procedures, medications) of patients with chronic LBP
2. To assess the prevalence of comorbid conditions including hypertension, anxiety and depression in the chronic LBP cohort and to compare the demographic and

clinical characteristics of patients (i) with and without hypertension and (ii) with and without anxiety and/or depression

3. To assess the demographic and clinical characteristics of patients with chronic LBP who are currently prescribed the following medications: blood thinners (anticoagulants/antiplatelet), herbal medications, benzodiazepines and opioids

4. To assess the mean pain level pre- and post-procedure for patients with chronic LBP that have undergone a single interventional therapeutic LBP procedure throughout the study period

STUDY SIGNIFICANCE

The evaluation of clinical characteristics including pain scores in patients with chronic LBP will provide useful data on commonly prescribed pain medications and interventional procedures and assist physicians in making informed decisions regarding appropriate pain management. The study will help to identify and inform the practice regarding the type of patient population at highest risk for chronic LBP, various treatment options within pharmacologic and interventional procedure and the extent of pain relief provided by these treatments.

STUDY LIMITATIONS

The study generalizability is limited as data is collected from one outpatient clinic in southwestern Pennsylvania. Moreover, the study assesses the population that has been treated by a single practictioner limiting the treatment options that could have been considered after consensus from multiple practitioners. As the study includes newly

enrolled patients in 2018 at the clinic, it does not differentiate between patients that were first diagnosed in this practice or that were previously diagnosed in other practice. This might lead to loss of important information and introduced a systematic bias.

CHAPTER 2: SYSTEMATIC LITERATURE REVIEW

Chronic Non-Cancer Pain

Increase in prescription opioid use among patients with CNCP has been a public health concern over the last decade. Existing protocol-driven studies have limitations in assessing the effectiveness of therapies and thus, there is a need to identify real-world studies from diverse population regarding the use and effectiveness of opioids and non-opioids in CNCP. A systematic literature review was conducted to report the findings of existing real-world evidence studies of opioid and non-opioid use in patients with CNCP.

METHODS

Utilizing the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines, a systematic literature review was conducted to identify real-world evidence studies. A search strategy was developed for the following key words: chronic non-cancer pain, opioid, non-opioid, prescription drug misuse and study designs. The search was conducted in three databases—PubMed, PsycINFO and EMBASE (Refer **Appendix I**) with a search limit set at the year 2018. Identified articles were imported in Covidence systematic review software (Veritas Health Innovation, Melbourne, Australia). Duplicates were eliminated and the remaining articles were subjected to title abstract screening followed using inclusion and exclusion criteria. Finally, full text reviews were conducted, and a qualitative synthesis was conducted to extract information of interest from the articles.

Inclusion and Exclusion Criteria

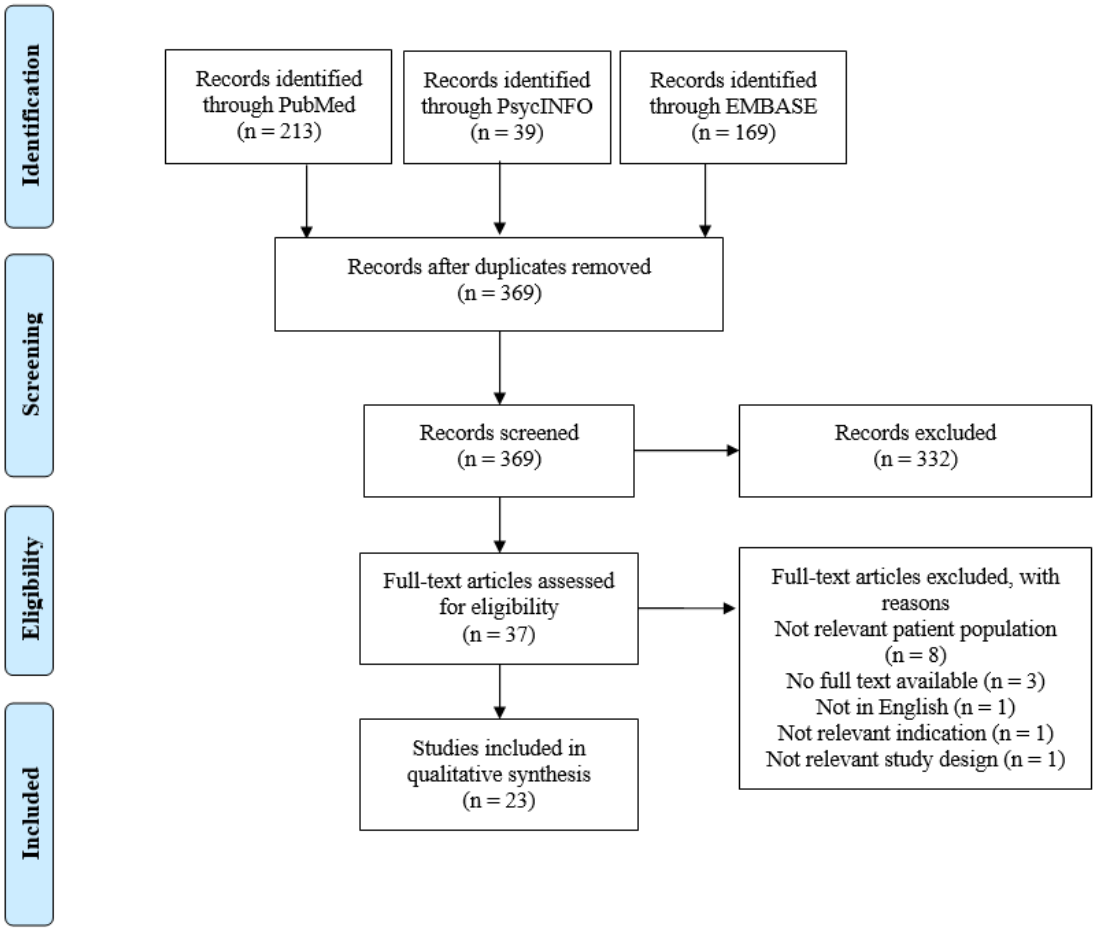
The studies included adult patients with CNCP undergoing pain management and prescribed opioid and/or non-opioid drugs. Following real-world evidence study designs were included retrospective studies, cohort studies, longitudinal studies, case-control studies and cross-sectional studies. Studies involving illicit drugs, pregnant women, patients below 18 years of age, economic evaluations or healthcare resource utilization were excluded from the review. Additionally, qualitative studies, experimental design studies, systematic reviews, case studies, editorials, commentaries, review articles, non-English articles, erratum, conference abstracts and dissertations were excluded.

RESULTS

Upon executing the search strategy on the PubMed, PsycINFO and EMBASE, a total of 421 articles were identified. After removing 52 duplicate articles, 369 articles underwent title abstract screening and further, articles were excluded based on inclusion/exclusion criteria. A full text review of 37 articles was then conducted following which 23 articles were included in the final review. **(Refer Figure 3)**

All but two studies (n=21, 91.3%) were conducted in the US.[23,24,25,26,27,28,29,30,31,32,33,34,35,36,37,38,39,40,41,42,43].The other two were conducted in France[44] and Switzerland[45]. Majority of the studies utilized administrative claims data (n=15, 65.21%) followed by electronic medical record (n=3, 13.04 %), institutional database (n=3, 13.04 %) and survey (n=2, 8.7%). Out of 23 studies, 10 studies (43.47%) assessed LBP along with other CNCP conditions.

Figure 2: Schematic representation of systematic literature review using the Preferred Reporting Items for Systematic Review and Meta-Analyses (PRISMA) Guidelines



Amongst these 10 studies, only one study focused on chronic LBP alone. Following types of studies were identified from the review: 1) Opioid use studies in patients with CNCP and/or comorbidity/surgical procedure, 2) Opioid use studies based on prescribing pattern, 3) Opioid overdose/misuse related studies.

1) Opioid use studies in patients with CNCP and/or comorbidity/surgical procedure:

Eight studies[25, 31, 33,35,36,37,38,42] (34.8%) evaluated the use of opioids in patients with CNCP who had a history of substance use or mental health disorder, or other conditions like epilepsy and HIV/AIDS. These studies observed a high prevalence of long-term use of opioids and higher-dose opioids. Studies assessing specifically migraine or headache-related pain (n=5, 21.73%) reported more opioids being prescribed than triptans and that the prevalence of chronic headache was high among those with analgesic overuse. Brummett *et al.* (2017) reported no significant difference in incidence of new persistent opioid use between patients that underwent minor surgery compared to those that underwent major surgery. The results suggested that prolonged opioid use probably was not entirely due to surgical pain, and could be associated with preoperative pain disorders, anxiety and depression.[25]

2) Opioid use studies based on prescribing pattern:

Axeen *et al.* (2018) indicated that opioid users in the Medicare population between 2006 to 2010 were actually abusing opioids and interestingly, the largest quantity increases were being prescribed by nurse practitioners and physician assistants.[24] In a study comparing residents of San Francisco, California to those nonlocal residents, Bauer *et al.* (2016) observed higher opioid doses and lower rates of urine drug testing among patients with a nonlocal home address. Patients treated by resident physicians were less likely to

receive higher-dose chronic opioid compared with patients treated by faculty or nurse practitioner.[28]

3) Opioid overdose/misuse related studies:

Several studies demonstrated a direct relationship between prescribed opioid dose and the risk of opioid overdose death.[26,29,31,39] Hoffman *et al.* (2017) reported that in patients with polyneuropathy who received prolonged opioid treatment, there was no improvement in the functional status markers. Instead adverse outcomes were seen in these patients including depression, opioid dependence and opioid overdose.[27] West *et al.* (2016) reported higher rates of prescription opioids misuse and serious medical outcomes in older adults compared to younger adults.[32] Several studies have reported a host of risk factors including anxiety, depression, alcohol and substance use disorders, mood disorders, concomitant use of benzodiazepine and sedative-hypnotics associated with persistent opioid use and opioid overdose.[25,26,36,40] A summary of the systematic literature review is included in **Table 3**.

Table 3: Description of CNCP studies

Author, Year, Country	Study Aim	Data Source, Study Design, Sample Size, Study Period	Setting of the study	CNCP condition	Key findings	Limitations
Schwedt et al,[23] 2018 USA	To estimate rates of acute medication overuse (AMO) and determine associations of AMO with individual and headache characteristics.	Survey Longitudinal cross-sectional study 3,649 patients October 2016 to January 2017	Members of Research Now, Plano, TX (internet research panel)	Migraine	Compared with those not overusing medications, respondents with AMO were significantly more likely to be taking triptans, opioids, barbiturates, and ergot alkaloids and significantly less likely to be taking NSAIDs. Respondents with AMO had significantly more monthly headache days (MHDs); higher migraine symptom severity, higher pain intensity scores; and higher rates of cutaneous allodynia.	The risk of AMO by individual medication class was not assessed, information that might have helped to guide drug choices and targeted educational efforts in clinical practice.

Axeen et al,[24] 2018 USA	To determine characteristics and trends in opioid use, questionable use, and prescribing in Medicare *(extracted data for chronic non-cancer pain only)*.	Administrative claims data Retrospective cohort study 21,120,682 patients 2006 to 2012	Medicare claims data	Headache, chronic pain, myalgia, arthritis, low back pain	Opioid users were increasingly likely to abuse opioids or display patterns of questionable use from 2006 to 2010, with a slowdown in later years. Prescribing quantity and intensity varied by specialty. The largest quantity increases were among nurse practitioners and physician assistants.	Because prescriptions are not tied directly to a medical encounter in the claims data, measures of diagnoses reflect the comorbidities of patients receiving opioids rather than the direct diagnosis for which the opioid was prescribed.
De Rijk et al,[44] 2018 France	To investigate the headache characteristics and clinical features of elderly migraine patients at a tertiary headache center.	French National Observatory of Migraine and Headache database Retrospective cohort study 239 patients 2006 to 2015	16 tertiary-care headache clinics and one specialized headache emergency department	Migraine	Out of 30.1% patients that reported medication overuse, 31.65% overused triptan and 70.9% overused combination analgesics. Higher frequencies of migraine were observed for patients whose age at onset of migraine was younger than 18 years, and low frequency migraine was observed in the later onset group.	Age onset of the patients may not be accurate since migraine cannot be recognized when younger.

Brummett et al,[25] 2017 USA	To determine the incidence of new persistent opioid use after minor and major surgical procedures.	Administrative claims data Retrospective cohort study 36,177 patients January 2012 to June 2015	National managed care company affiliated with OptumInsight	Minor and Major surgical procedure	No significant difference was observed in incidence of new persistent opioid use between minor surgery and major surgery group thereby suggesting that prolonged opioid use is not entirely due to surgical pain. Risk factors independently associated with new persistent postoperative opioid use included preoperative tobacco use, alcohol and substance abuse disorders, mood disorders, anxiety and preoperative pain disorders.	Actual opioid consumption was not captured in the study. Categorization of major vs. minor surgical conditions may be subject to critique. Claims data does not allow for assessment of degree of impairment of painful conditions and mood disorders that might be driving persistent opioid use.

Garg et al,[26] 2017 USA	To determine whether patterns of opioid use are associated with risk of opioid-related mortality among opioid users.	Administrative claims data Retrospective cohort study 150,821 patients April 2006 to December 2010	Washington Medicaid	NA	Compared with patients at 1–19 mg/d, risk of opioid overdose death significantly increased at 50–89 mg/d, 90–119 mg/d, 120–199 mg/d, and >=200 mg/d. Patients using long-acting plus short-acting Schedule II opioids had 4.7 times the risk of opioid overdose death than non- Schedule II opioids alone. Risk of opioid overdose death was particularly high for opioids combined with skeletal muscle relaxants, benzodiazepines, sedative-hypnotics.	Unable to distinguish between incident and chronic opioid users. Data were only available for individuals with fee-for-service (67%–75% of Medicaid enrollees during study years).

Hoffman et al,[27] 2017 USA	To quantify the prevalence of long-term opioid use among patients with polyneuropathy and to assess the association of long-term opioid use with functional status, adverse outcomes, and mortality.	Rochester Epidemiology Project (REP) database Retrospective case-control cohort study Cases: 2892 patients with Polyneuropathy and Controls: 14435 patients January 2006 to December 2010	Prescription database from all ambulatory practice professionals in Olmsted County, Minnesota	Polyneuropathy	Among the 2892 patients with polyneuropathy and the 14,435 controls, patients with polyneuropathy received long-term opioids more often than did controls (545 [18.8%] vs 780 [5.4%]). No functional status markers were improved by long-term use of opioids in patients with polyneuropathy. Adverse outcomes were more common among patients with polyneuropathy receiving long-term opioids, including depression, opioid dependence and opioid overdose.	Prescription duration was calculated in most cases presuming patients took each as-needed dosage. Daily morphine equivalents were not estimated, which prevented determination of a dose effect.
Bauer et al,[28] 2016 USA	To describe the population of patients prescribed opioids (CNCP) at 2 academic primary care clinics and evaluate patient and provider characteristics associated with higher-risk	Electronic medical record Retrospective cohort study 842 patients March 2012 to March 2013	Two academic primary care clinics	NA	Higher opioid doses and lower rates of urine drug testing were observed among patients with a nonlocal home address when compared to San Francisco address. Patients treated by resident physicians were less likely to receive higher-dose chronic opioid compared with patients treated by faculty or nurse practitioner.	Risk factors for initiation of opioids or opioid dose escalation could not be assessed since cohort was already treated with opioid and the opioid dose was determined based on most recent prescriptions. Patients could have obtained additional prescriptions or urine

	opioid prescriptions.				Lower rates of urine drug testing were observed among patients with faculty or nurse practitioner. Black patients were almost twice as likely to complete a urine drug test as compared to non-Hispanic white patients.	drug testing outside these 2 clinics.
Bohnert et al,[29] 2016 USA	To examine the association of prescribed opioid dosage as a continuous measure in relation to risk of unintentional opioid overdose to identify the range of dosages associated with risk of overdose at a detailed level.	Administrative claims data Nested case-control study Cases: 399 and Controls: 221 patients 2004 to 2009	Veterans Health Administration system Veterans Health Administration's National Patient Care Database VHA's Pharmacy Benefits	Headache, peripheral neuropathy, central pain syndrome, chronic pain syndrome, migraine, atypical face pain, osteomyelitis	Average prescribed opioid dosage was higher for cases, with a mean of 98.1 MEM than controls, whose prescribed opioid dosage had a mean of 47.7 MEM. In a receiver operating characteristic (ROC) analysis, dosage was a moderately good “predictor” of opioid overdose death, indicating that, on average, overdose cases had a prescribed opioid dosage higher than 71% of controls.	Exclusion of deaths that were undetected unintentional opioid overdoses (eg, misclassified as suicide, or opioids involved but not detected or recorded by medical examiner)

Ray et al,[30] 2016 USA	To compare all-cause mortality for CNCP patients prescribed either long-acting opioids or alternative medications for moderate to severe chronic pain.	Administrative claims data Retrospective cohort study 22,912 patients 1999 to 2012	Tennessee Medicaid linked to death certificates and a standard hospital discharge database	Back pain, other musculoskeletal pain, abdominal pain, headache, other neurologic pain	Prescription of long-acting opioids for CNCP, compared with anticonvulsants or cyclic antidepressants, was associated with a significantly increased risk for all-cause mortality, including deaths from causes other than overdose.	Reliance on the death certificate to classify the cause of death, raised the possibility that the cardiovascular death finding was due to misclassification.
Liang et al,[31] 2016 USA	To examine risk factors for drug overdose by sex reflecting differing patterns of opioid and other drug use.	Administrative claims data Retrospective cohort study 206,869 patients January 2009 to July 2012	National privately insured enrollees from Aetna Health Maintenance Program (HMO)	Back pain, large joint arthritis/other musculoskeletal disorders, neuropathic pain, chronic pain unspecified, chronic headache	For both sexes, substance use was the strongest predictor of drug overdose with an adjusted odds ratio (AOR) of 5.95 for women vs. 4.69 for men. AOR for benzodiazepine use was higher in men than women (2.75 vs 2.35 respectively).	The study could not distinguish prevalent opioid users from new users. Only predictors measured within six months after the first filled opioid prescription were considered because it is important to distinguish risks early after starting therapy.

West et al,[32] 2016 USA	To examine recent trends in misuse of prescription opioids and associated medical outcomes among older-aged adults (60+ years) and compared the patterns with trends among younger-aged adults (20–59 years).	Electronic medical record and narrative report (calls) Retrospective cohort study 57,681 patients 2006 to 2014	Researched Abuse, Diversion and Addiction-Related Surveillance (RADARS®) System Poison Centers Program database (40 to 49 centers)	NA	Population rates of misuse of prescription opioids were higher for older adults than for younger adults, and this disparity increased over time. Rates of serious medical outcomes among the older ages followed an increasing linear trend; in contrast, rates among younger adults rose and fell during the period, with recent rates trending downward.	Use of passive data collection systems that introduced a potential selection bias by reliance on information that is voluntarily reported to poison centers.
Wilner et al,[33] 2016 USA	To compare the prevalence of analgesic opioid use in an insured patient population with epilepsy to a matched control population without epilepsy.	Administrative claims data Case-control cohort study Cases: 10,271 patients with Polyneuropathy and Controls: 20,542 patients 2012	Nine health plans contracting with Accordant Health Services (AHS)	Joint pain or stiffness, abdominal pain, headache, pain in limb, chest pain, sprain of different parts, sinusitis, migraine, lumbago, backache, cervicalgia, fracture, fibromyalgia, sciatica, chronic pain, jaw pain	The prevalence of pain diagnosis was 51% in the group with epilepsy and 39% in the matched control group. Analgesic opioids were used by 26% of individuals in the group with epilepsy vs. 18% of matched controls. The prevalence of psychiatric diagnoses was 27% in the group with epilepsy and 12% in the matched controls.	Patients with nonepileptic seizures may have been mistakenly included if they were taking antiepileptic medication. Conversely, people with controlled epilepsy on no antiepileptic medication may have been missed by the identification algorithm.

Liang et al,[34] 2015 USA	To address the hypothesis that daily opioid dose and total dose may offer complementary information for clinicians to distinguish patients at increased risk of drug overdose.	Administrative claims data Retrospective cohort study 206,869 patients January 2009 to July 2012	National privately insured enrollees from Aetna Health Maintenance Program (HMO)	Back pain, musculoskeletal disorders, neuropathic pain, chronic pain unspecified, chronic headache	Relative to no opioid therapy, persons at highest risk for overdose received a daily MED of ≥100 mg regardless of total dose or a daily MED of 50 to 99 mg with a high total MED (>1,830 mg). The hazard ratio was significantly lower (1.43) for 50 to 99 mg daily MED with a lower total MED (≤1,830 mg), whereas hazard ratios for lower daily MEDs did not differ by total dose.	The study could not evaluate the reason for increased overdose risk in patients with high total dose of opioid prescriptions.
Turner et al,[35] 2015 USA	To examine interactions of filled prescriptions for opioids, benzodiazepines, antidepressants, and zolpidem with mental health disorders in regard to drug overdose.	Administrative claims data Retrospective cohort study 206,869 patients January 2009 to July 2012	National privately insured enrollees from Aetna Health Maintenance Program (HMO)	Back pain, large joint arthritis, musculoskeletal disorders, neuropathic pain, chronic pain unspecified, chronic headache	The adjusted odds ratios (AOR) for overdose was highest (AOR=7.06) for persons with depression and a high opioid dose (≥100 mg) versus no depression or opioid use. Opioids and longer-duration benzodiazepines were associated with drug overdose among all subjects, but opioid risk was greatest for persons with depression.	Drug overdoses in this cohort may have been due to illicit drug use or suicide attempts.

Dobscha et al,[36] 2013 USA	To describe patterns of prescription opioid initiation, identify correlates of opioid initiation, and examine correlates of receipt of chronic opioid therapy (COT) among veterans with persistent non-cancer pain.	Administrative claims data Retrospective cohort study 5,961 patients 2008	Regional VA healthcare facilities and two national VA databases Veterans Integrated Service Network [VISN]-20 Data Warehouse	Fibromyalgia, inflammatory bowel disease, low back pain, migraine headache, neck or joint pain, neuropathy, arthritis	Veterans prescribed COT were younger, had greater pain intensity, and high rates of psychiatric and substance use disorders (SUDs) compared to veterans in the other two groups. Adjusting for age, sex, and baseline pain intensity, major depression and nicotine dependence were associated with receiving any opioid prescription and with COT respectively.	Reasons for prescription of adjunctive medications (e.g., antidepressants) could not be determined.
Schmid et al,[45] 2013 Switzerland	To evaluate the diagnostic criteria of MOH in a mixed population of chronic pain patients to gain information about the prevalence and possible associations with MOH.	Data of all patients referred to interdisciplinary pain clinic Retrospective cohort study 178 patients September 2005 to December 2007	Interdisciplinary pain clinic at the University Hospital of Zurich	Headache, neurological, psychiatric, rheumatologic, other pain disorder	Chronic headache was more prevalent among patients with analgesic overuse (39.8%) than without analgesic overuse (18%). History of headache (OR 2.5), history of migration (OR 2.9) and comorbid depression (OR 3.5) were associated with overuse of acute medication.	Bias of data collection due to quality of recorded information and inadequacy of patient's reports could be seen.

Silverberg et al,[37] 2012 USA	To examine changes in use of prescription opioids for the management of chronic non-cancer pain in HIV-infected patients and to identify patient characteristics associated with long-term use.	Administrative claims data Retrospective cohort study 6,939 patients 1997 to 2005	Health plans: Kaiser Permanente Northern California (KPNC) and Group Health Cooperative (GHC) in Washington State	NA	In 2005, 8% of HIV+ individuals had prevalent long-term opioid use, more than double the prevalence among HIV-uninfected individuals. The strongest associations with prevalent use among HIV-infected individuals were female gender, Charlson comorbidity score of 2 or more, injection drug use history, substance use disorders. CD4, HIV RNA, and AIDS diagnoses were associated with prevalent opioid use early in the antiretroviral therapy era (1997), but not in 2005.	Lack of information regarding indications for opioid prescribing, including types of pain experienced.

Kobus et al,[38] 2012 USA	To study the prevalence of high-dose opioid use, as well as associated demographic, clinical, and health service utilization correlates among low back pain patients. *(health service utilization information was not extracted)*	Administrative claims data Retrospective cohort study 15,471 patients 2003 to 2005	Ambulatory data of Kaiser Permanente Northwest (KPNW) region, a large, not-for-profit, integrated health care system. KPNW serves the Portland, Oregon and Vancouver, Washington metropolitan area.	Low back pain	Higher-dose opioid use occurred in 2.9% of patients who received any opioids and in 8.6% of patients who received opioids long-term. Compared to lower-dose or no opioid use comparison group, patients in the higher-dose group had higher rates of mental health and substance use disorders, concurrent sedative-hypnotic use.	While the focus of the study was on patients with a known back pain diagnosis, the reason for being prescribed higher dose opioid therapy was unknown, particularly given high levels of co-morbidity.
Dunn et al,[39] 2010 USA	To estimate rates of opioid overdose and their association with an average prescribed daily opioid dose among patients receiving medically prescribed, long-term opioid therapy.	Electronic medical record Retrospective cohort study 9,940 patients 1997 to 2005	Group Health Cooperative - Health Maintenance Organization (HMO)	Back or neck pain, osteoarthritis, headache, extremity pain, abdominal pain or hernia, menstrual pain; temporomandibular disorder pain; fractures, contusions, injuries	Compared with patients receiving 1 to 20 mg/d of opioids, patients receiving 50 to 99 mg/d had a 3.7-fold increase in overdose risk and a 0.7% annual overdose rate. Patients receiving 100 mg/d or more had an 8.9-fold increase in overdose risk and a 1.8% annual overdose rate.	Small number of overdoses in the study cohort was observed.

Edlund et al,[40] 2010 USA	To analyze trends between 2000 and 2005 in opioid prescribing among individuals with non-cancer pain conditions (NCPC), with and without MH and SUDs.	Administrative claims data Retrospective cohort study Health Core: 485,794 patients; 2000 and 897,537 patients; 2005 Arkansas Medicaid: 36,283 patients; 2000 and 43,520 patients; 2005 2000 and 2005	A national, commercially-insured population (Health Core) and Arkansas Medicaid enrollees.	Back pain, neck pain, arthritis/joint pain, headache/migraine, and HIV/AIDS	In 2000, among individuals with CNCP, chronic opioid use was more common among those with a MH or SUD than those without in commercially insured (8% versus 3%) and Arkansas Medicaid (20% versus 13%). Between 2000 and 2005, in commercially insured, rates of chronic opioid use increased by 34.9% among individuals with an MH or SUD, and 27.8% among individuals without these disorders whereas in Arkansas Medicaid, chronic opioid use increased by 55.4% among individuals with an MH or SUD, and 39.8% among those without.	Researchers were not able to separate methadone used for pain from methadone used for methadone maintenance. Results represent population trends and not the trends of individual enrollees.
Scher et al,[41] 2010 USA	To describe patterns of medication use among Chronic Daily Headache (CDH) and Episodic Headache (EH) sufferers in a general population sample.	Survey, Nested case-control study; CDH cases: 206 patients and EH controls: 507 patients, NA	Computer-assisted telephone survey in Atlanta, GA; Baltimore, MD or Philadelphia, PA, metropolitan areas	Chronic daily headache	CDH subjects were more likely than EH controls to use over-the-counter/caffeine combination products, triptans, opioid compounds. After adjusting for demographic factors, primary headache type and number of medications taken, CDH sufferers are more likely to use opioid-combination analgesics, and less likely to use aspirin or ibuprofen, than EH sufferers.	CDH status was unknown at baseline; thus, some of the CDH sufferers at follow-up may have already had CDH at the first assessment.

Weisner et al,[42] 2009 USA	To examine trends and characteristics of long-term opioid use in persons with non-cancer pain and a substance abuse history.	Administrative claims data Retrospective cohort study 1997 to 2005	Health plans: Kaiser Permanente Northern California (KPNC) and Group Health Cooperative (GHC) in Washington State	NA	At KPNC (1999–2005), prevalence of long-term use increased from 11.6% to 17.0% for those with substance use disorder histories and from 2.6% to 3.9% for those without substance use disorder histories. Respective GH rates (1997–2005), increased from 7.6% to 18.6% and from 2.7% to 4.2%. Among persons with an opioid disorder, KPNC rates increased from 44.1% to 51.1%, and GH rates increased from 15.7% to 52.4%. Long-term opioid users with a prior substance abuse diagnosis received higher dosage levels, were more likely to use Schedule II and long-acting opioids, and were more often frequent users of sedative-hypnotic medications in addition to their opioid use.	Opioid use disorders may be over-diagnosed for those who had already been prescribed opioids, given the confusion between substance use disorders (addiction) and physiological dependence, which often occurs with regular opioid use.

Tepper et. al,[43] 2006 USA	To describe the prescription drug claims for acute headache treatments of persons in the United States with a migraine or nonmigraine headache diagnosis who were enrolled in a large health care plan with pharmacy benefits.	Administrative claims data Retrospective cohort study 2003	Integrated Healthcare Information Services National Managed Care Benchmark Database - data from more than 30 US healthcare plans	Migraine 346.xx, 307.81, 784.0	Of the 6.2 million continuous enrollees in 2003, approximately 10% had at least 1 medical claim for migraine or nonmigraine headache. Of these persons, 64% did not have a claim for any prescription drug commonly used for the acute treatment of headache. Among persons with any headache diagnosis who had a claim for a prescription headache medication, 69% received opioids. Opioids were prescribed for migraine sufferers more frequently than triptans (59% vs 41 %).	Could not differentiate between medications prescribed for daily use and those to be taken as needed, without detailed pharmacy data such as number of pills prescribed or dispensed.

Limitations

The systematic literature review has few limitations. Full text was not available for few articles, thus excluding studies that had captured relevant information. Major limitations were observed with respect to the type of data source utilized. Few studies evaluated opioid and non-opioid utilization irrespective of the CNCP condition, excluding information related to the pain condition. The search strategy did not include specific opioid and non-opioid drugs, instead drug classes for opioid and non-opioid drugs were broadly included, thus leaving out some relevant articles.

Conclusions

The systematic review provided a detailed summary into the opioid and non-opioid utilization and different factors associated with increased risk of drug overdose in various CNCP conditions. Very few studies focused on patients with chronic LBP, which is the commonly reported chronic pain illness in the population. There is a need to identify the prevalence of opioid and non-opioid use and utilization of interventional procedures in patients with chronic LBP with different pain levels.

Chronic Low Back Pain

Upon conducting a systematic review for patients with CNCP, an overall view of pain management in the CNCP was captured. To further understand existing studies carried out in chronic LBP with a focus on the interventional procedures performed in this cohort, a literature review was conducted. A search strategy was built utilizing key words related to back pain, interventional procedures and study designs **(Refer Appendix**

II). A total of 164 studies were identified after executing the search strategy on PubMed. Articles irrelevant to study objectives were excluded. Finally, qualitative synthesis of 10 articles was conducted to extract information related to Chronic LBP **(Refer Table 4).**

Studies assessed various Chronic LBP conditions including Bertolotti syndrome, lumbosacral radiculopathy, lumbar radiculopathy, radicular pain, sacroiliac joint pain, lumbosacral radicular pain, lumbar spinal stenosis, lumbago, lumbosacral sprain, herniated disk, radiculopathy and degenerative disease. Goluboysky *et al.* reported that patients with Bertolotti syndrome had significantly more prior epidural steroid injections (ESI) and worse QoL as compared to those with lumbosacral radiculopathy.[46] Tagowski *et al.* indicated that 4 weeks after ESI injection the probability of >=50% pain reduction was lower in the dexamethasone group than that in the triamcinolone group.[47] Wei *et al.* reported that increased pre-injection opioid use has no impact on long-term QoL after ESI for degenerative spine diseases.[48] Reddy *et al.* estimated a significant reduction in mean pain score and improvement in QoL of patients with sacroiliac joint post radiofrequency neurotomy.[49] Plastaras *et al.* reported immediate and delayed adverse events associated with transforaminal ESI and indicated that the adverse events were associated with various risk factors including gender, age, pre-procedure VAS, steroid type, and fluoroscopy time.[50] El-Yahchouchi *et al.* concluded that immediate pain score response was weakly associated with 2-month outcomes of transforaminal ESI.[51] Kang *et al.* observed decreased bone mineral density in patients treated with ESI using triamcinolone (>200 mg) for a period of one year in postmenopausal women treated for LBP.[52] Smith *et al.* reported a decrease in pain scores from pre-injection to post-injection

in both interlaminar ESI and transforaminal ESI groups, but no significant difference in pain scores between the two groups.[53]

Table 4: Description of Chronic LBP studies

Author, Year, Country	Study Aim	Data Source, Study Design, Sample Size, Study Period	Setting of the study	Chronic LBP condition	Key findings	Limitations
Golubovsky et al,[46] 2019 USA	To examine the quality of life and prior treatments in patients with Bertolotti syndrome at first presentation to the authors' center in comparison with those with radiculopathy.	Center for Spine Health database Retrospective cohort study Bertolotti syndrome: 22 patients, Radiculopathy: 46 patients 2005 to 2018	Center for Spine Health	Bertolotti syndrome, Lumbosacral radiculopathy	Patients with Bertolotti syndrome had significantly more prior epidural steroid injections (ESI) and have worse physical and mental health scores than age- and sex-matched patients with lumbosacral radiculopathy. Both groups of patients had mild depression and clinically meaningful reduction in their quality of life.	The lack of availability of postoperative patient-reported outcome limited the ability to evaluate preoperative to postoperative changes.

Tagowski et al,[47] 2019 Switzerland	To compare pain relief after CT-guided lumbar epidural steroid injections (ESI) using particulate (triamcinolone) and non-particulate (dexamethasone) steroids, and to explore factors affecting the effectiveness of both steroid types.	Institute of Medical Radiology of the Solothurn Hospitals database Retrospective cohort study 806 patients March 2005 to December 2014	Institute of Medical Radiology of the Solothurn Hospitals	Lumbar radiculopathy	Four weeks post-injection, the overall chance of >= 50% pain reduction was lower in the dexamethasone group than that in the triamcinolone group. In the dexamethasone cohort, the intensity of baseline pain and the presence of a herniated intervertebral disc in the infiltrated segment were both significant and independent predictors of >= 50% pain relief. No significant correlation was observed between effectiveness of triamcinolone and other concomitant variables including baseline pain level.	Lack of information regarding the duration of symptoms or additional oral analgesic medication which could have potential effects on outcome. Loss of telephone follow-up of several patients could have affected the outcome.
Wei et al,[48] 2017 USA	To evaluate the association between pre-injection opioid use and patient-reported outcomes (PROs) following spine epidural steroid injection.	Prospective web-based longitudinal spine registry database Retrospective cohort study 276 patients March 2011 to July 2016	Academic Institution	Radicular pain	Increased pre-injection opioid use does not impact long-term outcomes after epidural steroid injections (ESI) for degenerative spine diseases. A pre-injection morphine-equivalent amount around 50 mg/day may represent a threshold above which the 3-month effectiveness of ESI for back- and neck-related disability decreases.	Researchers were unable to directly quantify the preoperative duration of opioid consumption. The differences in the types of ESI and number of injections patients received may affect the PROs.

Reddy et al,[49] 2016 UK	To assess the effectiveness of Simplicity Radiofrequency (RF) neurotomy in terms of pain relief, quality of health improvement in patients suffering from sacroiliac joint (SIJ) pain and complications associated with the procedure.	Tertiary hospital database Retrospective cohort study 16 patients April 2012 to June 2013	Tertiary hospital	Sacroiliac joint pain	A statistically significant reduction in both mean pain score and median pain score at 12 months was observed. An improvement in general health and psychological components of Short Form 12 scores was reported.	Change in medication intake was not recorded, which might affect the outcomes. Lost to follow-up of 10 patients out of 26 patients who underwent RF.
Plastaras et al,[50] 2015 USA	To systematically identify the types and incidence of adverse events (AE) associated with transforaminal epidural steroid injection (TFESI). Additionally, to evaluate demographic and clinical factors that may predict a higher risk of an AE.	Electronic medical record Retrospective cohort study 1,295 patients March 2004 and April 2007	Multi-physician academic Physical Medicine and Rehabilitation clinic	Lumbosacral radicular pain	Common immediate AEs were vasovagal reaction and interrupted procedure from intravascular flow. Common delayed AEs included: pain exacerbation, injection site, soreness, headache, facial flushing/sweating, and insomnia. Significant associations were identified between AEs and gender, age, preprocedure VAS, steroid type, and fluoroscopy time.	Follow-up period of 24 to 72 hours may have been too short to capture all delayed AEs.

El-Yahchouchi et al,[51] 2014 USA	To assess whether the immediate anesthetic response of pain relief (sensory blockade) or weakness (motor blockade) after lumbar transforaminal epidural steroid injection (TFESI) is associated with longer term effectiveness in pain relief and functional recovery.	Quality assurance database Retrospective cohort study 2,634 patients January 2006 to February 2011	Single academic radiology practice	Radicular pain	Immediate numerical rating scale (NRS) response was weakly associated with 2-month outcomes. NRS and Roland-Morris disability questionnaire (R-M) responses at 2 weeks were more strongly associated with the 2-month response.	Stratification by the nature of compressive lesion was not performed.
Kang et al,[52] 2012 South Korea	To explore the relationship between bone mineral density (BMD) and Epidural steroid injection (ESI) in postmenopausal women treated for lower back pain.	Medical record Retrospective cohort study 90 patients July 2005 to June 2011	Kangwon National University Hospital	LBP	Decreased BMD was observed in patients treated with ESI. No significant difference was observed between or within the group treated with ESI and group treated without ESI in terms of mean percentage change from baseline BMD.	Study did not include long-term assessments of the effect of ESI on BMD.

Smith et al,[53] 2010 USA	To compare short-term improvement in pain and long-term surgical rates and the need for repeat injections between interlaminar ESI and transforaminal ESI for symptomatic lumbar spinal stenosis.	Academic spine center database Retrospective case control study 19 patients 2007	Academic spine center	Lumbar spinal stenosis	Decrease in visual analog scale (VAS) scores from pre-injection to post-injection was observed within each group. No statistically significant difference between the two groups in pre-injection to follow-up VAS scores was reported. Neither transforaminal ESI nor interlaminar ESI resulted in superior short-term pain improvement or fewer long-term surgical interventions or repeat injections when compared with each other.	Small sample size might have affected the results.
Friedly et al,[54] 2008 USA	To evaluate whether the use of epidural steroid injections (ESIs) is associated with decreased subsequent opioid use in patients in the Department of Veteran's Affairs (VA) and to determine whether treatment with multiple injections are associated with decreased opioid use and lumbar surgery after ESIs.	National VA administrative database Retrospective case control study 13,741 patients October 2001 to September 2003	Department of VA	LBP, lumbago, lumbosacral sprain, herniated disk, radiculopathy, spinal stenosis, degenerative disease	Opioid use did not decrease in the 6 months after ESIs. Patients who received more than 3 injections were more likely than patients receiving fewer injections to start taking opioids after ESIs (19% vs 13%) and to undergo lumbar surgery after ESIs (8.7% vs 6.3%).	Patients were tracked for only 6 months before and after receiving ESIs, hence information regarding lumbar surgery conducted either before or after the study period were not captured. Opioid dose was not determined, excluding the information about reduction of opioid dose after ESI.

Kapural et al,[55] 2007 USA	To examine the relationship between the magnetic resonance imaging (MRI) findings, pain scores, and opiates use in patients with lumbar spinal stenosis (LSS) undergoing lumbar epidural steroid (LES) injections.	Electronic medical record Retrospective case control study 719 patients 1999	Pain management department	Lumbar spinal stenosis	No association exists between the pretreatment age, sex, or number of vertebral levels affected on MRI with pretreatment VAS pain scores or opioid use. The improvement in VAS pain scores after LES injections correlated with number of lumbar levels affected and the severity of stenosis.	The study lacks control over co-interventions including oral medications and other interventional pain procedures.

Friedly *et al.* reported that opioid use did not decrease in the 6 months follow-up period after ESI in the Veteran population. Moreover, patients receiving more than 3 ESIs were more likely to start taking opioids and undergo lumbar surgery after ESI.[54] Kapural *et al.* indicated a correlation between an improvement in pain scores after lumbar ESI and number of lumbar levels affected and severity of stenosis.[55]

Conclusion

Studies have reported mixed results pertaining to the outcomes observed after LBP procedures. A few studies reported an improvement in pain reduction while others have reported several adverse events after LBP procedures. There is a need to evaluate the post-procedural outcomes. The opioid utilization did not decrease after the interventional procedure, indicative of lower pain relief obtained from procedures. Also, a need to assess the opioid utilization pattern among patients that have undergone procedures has been identified through this review, which would enable an understanding of severity of pain managed by the procedures using their pain scores.

CHAPTER 3: METHODS

The overall aim of the study was to explore pain management such as pain medications and interventional procedures in patients with chronic LBP. The data was obtained from an outpatient pain specialist clinic based in southwestern Pennsylvania. The study was approved by the pain clinic and Institutional Review Board (IRB) of Duquesne University. Additionally, patient data was protected by complying with the Health Insurance Portability and Accountability Act (HIPAA) standards of Duquesne University and the pain clinic.

ELECTRONIC MEDICAL RECORD DATA OF OUTPATIENT PAIN CLINIC

The clinic treats an array of pain conditions including LBP, neck pain, arthritis pain, nerve pain, cancer pain and complex regional pain syndrome and offer various pain treatment procedures in the multimodal treatment approach. The electronic medical record (EMR) data of the clinic includes patient information pertaining to demographics, medications, procedures, laboratory tests, x-rays, discontinuation instructions and progress notes. The progress notes are recorded during each patient visit and include current condition, history of present illness, past medical history, family history, social history, review of symptoms, vitals, exams, care plan and medications (new or discontinued). Information regarding social history, family history, history of present illness, past medical history, prior medications are collected via a self-reported pain assessment form by the clinic, and then recorded into the EMR system by the clinic staff. For the study sample, patients who were new to the practice with chronic LBP in the year

2018 were identified and data was extracted from January 1st, 2018 to February 29th, 2020. All patients were followed from their first office visit till the cut-off date. The maximum follow-up duration for any patient in the study was 26 months. But not all patients will have follow-up duration of 26 months. The follow-up duration for patients will vary depending on their first visit date into the practice. **Table 5** includes variables and their values as listed in the EMR and operationalized values of each variables to conduct analyses for the study.

Table 5: Operationalized value of variables of interest for the study

Variable	Value of the variable in EMR	Operationalized value of the variable for the study
Patient Identification Number (ID)	Unique IDs assigned to each patient	Randomly assigned dummy IDs
Date of birth	Mm/dd/yyyy format	Mm/dd/yyyy format Age calculated as of Feb, 2020
Race	• White • Black • Asian • Mixed • All other races • Declined to specify/unknown	• White • Black • Asian • Declined to specify/unknown • Other Races: Includes mixed and all other races
Ethnicity	• Hispanic/Latino • Non-Hispanic/Latino • Decline to specify	• Hispanic/Latino • Non-Hispanic/Latino • Decline to specify
Gender	• Male • Female	• Male • Female
Current condition	Pain-related disease conditions (name listed) for which the patient was visiting the office were recorded for first and follow-up visits	Pain-related disease conditions (name listed) for which the patient was visiting the office was recorded only from the first visit
Medical problems	Comorbid conditions (name listed) were recorded for first and follow-up visits	Comorbid conditions (name listed) were recorded only from first visit
Social history: • Smoking • Alcohol consumption • Drug use	Smoking history was recorded in each office visit • Smoking status: Light tobacco smoker, Heavy tobacco smoker, Current smoker, Occasionally, Former smoker, Never	Smoking history was recorded only from first office visit • Smoking status: o Current smoker: Includes light tobacco smoker, heavy tobacco smoker,

	• Alcohol Consumption: Number of drinks/day or week or month, Consumed in the past, Occasionally, Rare, Never, No • Drug Use status: Regularly uses marijuana, Sporadically uses marijuana, Medical marijuana use, Regularly uses herbal supplements, Former drug user, Never, No *Drug use is inclusive of use of illicit drugs such as heroin, cocaine, marijuana or others. It also includes medical marijuana use*	occasionally, current smoker o Former smoker o Never • Alcohol consumption status: o Currently consume alcohol: Includes number of drinks/day or week or month, occasionally, rare o No: Includes consumed in the past, never and no • Drug use status: o Current user: Includes regularly uses marijuana, sporadically uses marijuana, medical marijuana use o Former user o No: Includes regularly uses herbal supplements, no and never
Review of systems (ROS): • Height • Weight	• Height (inches): was recorded for each visit	• Height (inches): was recorded only from first

• Blood pressure • Pain level	• Weight (lbs): was recorded for each visit • Blood pressure (mmHg): was recorded for each visit • Pain level: was recorded for each visit using numeric rating scale (NRS) of 0 to 10	visit and rounded up to whole number • Weight (lbs): was recorded for each visit • Blood pressure (mmHg): was recorded for each visit • Pain level: was recorded for each visit using numeric rating scale (NRS) of 0 to 10
Drug Abuse Screening Test (DAST) Score DAST score has a scale of 1 to 10. Score of 0 = no problem related to drug abuse and 10 = severe level of problem related to drug abuse	DAST score was recorded for each visit for eligible patients.	DAST score was recorded for each visit for eligible patients
International Classification of Diseases (ICD) code	ICD codes for chronic pain conditions were recorded for each office visit	ICD codes for chronic pain conditions were recorded for each office visit
Disease duration	Disease duration was recorded from initial pain assessment form filled by the patient during first visit	If disease duration was reported in days, weeks or year then it was converted to months. If patient reported duration as several weeks or months or years, then it was assumed that

		the pain was for more than 3 months (chronic)
Medications: • Prior medications • Current medications • Newly prescribed medications • Discontinued medications	• Prior medications: Medication name, strength, dose; was recorded for each visit • Current medications: Medication name, strength, dose, quantity; was up to date when the data was collected • Newly prescribed medications: Medication name, strength, dose, quantity, date of prescribing; was up to date when the data was collected • Discontinued medications: Medication name, strength, dose, quantity, date of discontinuation; was up to date when the data was collected	• Prior medications: Medication name, strength; was recorded only from first visit • Current medication (as of Feb 2020): Medication name, strength • Newly prescribed medications: Medication name, strength, date of prescribing (cutoff date Feb 2020) • Discontinued medications: Medication name, strength, date of discontinuation (cutoff date Feb 2020) *Duration of patients on current and prior medications was not captured*
Procedures: • Procedure name • Current Procedural Terminology (CPT) • Telephone follow-up Date with Pain level	• Procedure name and CPT code: Name of the procedure with its unique CPT code and date the procedure was performed was recorded • Telephone follow-up Date with Pain level	• Procedure name and CPT code: Name of the procedure with its CPT code and date the procedure was performed was recorded (cutoff date Feb 2020) • Telephone follow-up Date with Pain level

DATA EXTRACTION

A list of patients with LBP who were newly enrolled in the practice in 2018, was provided to the researchers by the clinic. The variables of interest were manually extracted from the EMR into an Excel file and the patients' identification numbers were then de-identified. Data extraction was carried out for LBP patients, but all the analyses were conducted for patients with chronic LBP. Patients with chronic LBP were identified by using the following inclusion/exclusion criteria:

Inclusion criteria:

1) Patients suffering with LBP for three or more than three months (chronic) when they come into the practice for the first time
2) Patients with or without concurrent other chronic pain conditions
3) Patients could be newly diagnosed with chronic LBP at this clinic or could be previously diagnosed
4) Patients seeking treatment for pain and other disease conditions from other physicians

Exclusion criteria:

1) Patients who suffered with LBP for less than 3 months (acute) within the study period
2) Patients with any type of cancer as a comorbid condition and
3) those with age below 18 years

The Excel files were converted into Statistical Analysis System (SAS) file and all data analyses were conducted using SAS (SAS Institute Inc., Cary, NC, USA). **Appendix III** provides the SAS codes for data import and analyses.

DATA ANALYSIS

Objective 1: To describe the demographics (age, gender, race, ethnicity, smoking status, alcohol status, drug use status) and clinical characteristics (disease duration, procedures, medications) of patients with chronic LBP.

Descriptive analyses (mean, median, standard deviation, frequency distribution) were carried out to provide distribution of patient demographics and clinical characteristics of the entire cohort. Patient demographics including age, gender, race, ethnicity, smoking status, alcohol status and drug use status were described. Clinical characteristics including disease duration, types of procedures, average number of office visits were described. The types of procedures were categorized as those performed for LBP and non-LBP related conditions. The procedures were further categorized as diagnostic and therapeutic procedures. Average number of repetitions of each LBP therapeutic procedure was determined. The prevalence of the line of therapy of current medications for treating neuropathic chronic LBP patients, was also identified.

Objective 2: To assess the prevalence of comorbid conditions including hypertension, anxiety and depression in the chronic LBP cohort and to compare the demographic and clinical characteristics of patients (i) with and without hypertension and (ii) with and without anxiety and/or depression

The study identified hypertension and anxiety and/or depression from the comorbid conditions variable list, extracted for each patient from their first office visit. Similarly, patients without hypertension and patients without anxiety and/or depression were identified from comorbidities reported in their first office visit. Descriptive analyses

(mean, median, standard deviation, frequency distribution) were conducted to provide distribution of patient demographics and clinical characteristics of patients with and without each of these comorbid conditions by creating separate cohorts for these comorbid conditions.

Objective 3: To assess the demographic and clinical characteristics of patients with chronic LBP who are currently prescribed the following medications: blood thinners (anticoagulants/antiplatelet), herbal medicines, benzodiazepines and opioids

Four separate cohorts were developed of patients with chronic LBP currently taking: 1) blood thinners (anticoagulants/antiplatelet), 2) herbal medicines, 3) benzodiazepines and 4) opioids. These groups were not mutually exclusive, and patients could be in multiple cohorts based on the medications they were taking. **Appendix IV** provides the list of medications under each of these categories identified in this cohort. The list was created by extracting current medications for all patients and classifying them based on their therapeutic class in Microsoft Excel. NSAIDs, except for aspirin, were not included in the anticoagulants/antiplatelets category. Herbal medicines with only anticoagulant effect (potential for bleeding) were included.[15] Descriptive analyses (mean, median, standard deviation, frequency distribution) were conducted within each of these cohorts. Descriptive analyses of patient demographics including age, gender, race, ethnicity, smoking status, alcohol status and drug use status were conducted. Similarly, descriptive analyses of clinical characteristics including disease duration, office visits and types of therapeutic LBP procedures were carried out. The therapeutic LBP procedures identified in blood thinner and herbal medicines cohort were categorized

based on the potential risk of serious bleeding. The four groups were not mutually exclusive, and patients could be in multiple cohorts based on the medications they were taking.

Objective 4: To assess the mean pain level pre- and post- procedure for patients with chronic LBP that have undergone a single therapeutic LBP procedure throughout the study period.

Patients with chronic LBP who have undergone single interventional procedure throughout the study period were identified. Patients that have undergone diagnostic procedures and non-LBP procedures were excluded from the analysis. The mean difference between pain level of patients was calculated using the pain level at the first visit and pain level reported after the procedure was performed. This calculation was performed for each procedure type. Patients with missing value for pain level were excluded from the analysis. Within the cohort of patients that have undergone single procedure, a paired t-test was conducted by grouping patients based on procedure type.

Next chapter entails results of the research questions discussed in this chapter and provides summary of results obtained from the analysis of the EMR data of patients with chronic LBP.

CHAPTER 4: RESULTS

A total of 586 newly enrolled patients with chronic LBP in the year 2018 were identified from the EMR database of the clinic. After excluding patients with acute pain (pain for less than three months, n=60), patients with cancer as a comorbid condition (n=62) and patients below the age of 18 years (n=0), the final cohort included 464 adult patients with chronic non-cancer LBP.

Objective 1

To describe the demographics (age, gender, race, ethnicity, smoking status, alcohol status, drug use status) and clinical characteristics (disease duration, procedures, medications) of patients with chronic LBP

Descriptive analyses were conducted on the final cohort of 464 patients with chronic non-cancer LBP. **Table 6** describes the demographic characteristics including age, gender, race, ethnicity, smoking status, alcohol status, drug use status and clinical characteristics such as disease duration, procedure types and office visits. The mean age of the patient cohort was 60.87 years, majority were females (52.8%), Whites (93.97%) and non-Hispanic Latino (96.77%). Most patients never smoked (57.24%) or currently consumed alcohol (53.39%). The mean duration of chronic LBP was 64.15 months and mean office follow-up visits were about 3 visits during the study period. **Table 7** describes the LBP and non-LBP procedures performed in patients with chronic LBP. A total of 289 (62.28%) of patients were identified that had undergone at least one procedure throughout the follow-up period. The most prevalent procedures among LBP

Table 6: Demographic and clinical characteristics of patients with chronic LBP

Variables	Overall (N=464)
Age in years Mean ± SD Median (IQR)	 60.87 ± 15.74 62 (22)
Gender (n,%)	
Female	245, 52.80%
Male	219, 47.20%
Race (n,%)	
White	436, 93.97%
Black	23, 4.96%
Asian	2, 0.43%
Other races	3, 0.65%
Ethnicity (n,%)	
Non-Hispanic Latino	449, 96.77%
Declined to specify/Unknown	13, 2.80%
Hispanic/Latino	2, 0.43%
Smoking Status (n,%)	
Never	261, 57.24%
Former smoker	104, 22.81%
Current smoker	91, 19.96%
Alcohol consumption status (n,%)	
Currently consume alcohol	244, 53.39%
No	213, 46.61%
Drug use status (n,%)	
No	431, 94.52%
Current user	18, 3.95%
Former user	7, 1.54%
Disease duration in months Mean ± SD Median (IQR)	 64.15 ± 93.79 22 (65)
Office visits Mean ± SD Median (IQR)	 3.34 ± 3.12 2 (3)

Table 7: Types of LBP and non-LBP interventional procedures performed in patients with chronic LBP

LBP procedures	Frequency (n) N=464	Percent (%)
Diagnostic procedures		
Lumbar medial branch block	73	15.73%
Therapeutic procedures		
Lumbar epidural steroid injection	171	36.85%
Caudal epidural steroid injection	34	7.33%
Transforaminal epidural steroid injection	32	6.90%
Lumbar/Sacral medial branch radiofrequency	16	3.45%
Trigger point injection	11	2.37%
Spinal cord stimulation trial	6	1.29%
Permanent spinal cord stimulation implantation	3	0.65%
Nerve root block	2	0.43%
Sacroiliac joint radiofrequency	1	0.22%
Both diagnostic and therapeutic		
Intra-articular sacroiliac joint injection	15	3.23%

Non-LBP procedures	Frequency (n) N=464	Percent (%)
Diagnostic procedures		
Genicular nerve block	1	0.22%
Therapeutic procedures		
Cervical epidural steroid injection	8	1.72%
Superior lateral genicular nerve block	3	0.65%
Piriformis injection	3	0.65%
Trochanteric bursa injection	3	0.65%
Intra-articular hip injection	2	0.43%
Knee injection	2	0.43%
Ilioinguinal/iliohypogastric nerve block	1	0.22%
Cervical epidural steroid injection/Multiple trigger point injection	1	0.22%
Sacrococcygeal injection	1	0.22%
Shoulder injection	1	0.22%
Genicular neurotomy	1	0.22%
Saphenous nerve block	1	0.22%
Suprascapular nerve block	1	0.22%
Both diagnostic and therapeutic		
Lateral femoral cutaneous nerve block	2	0.43%
Thoracic medial branch block	1	0.22%
Cervical medial branch block	1	0.22%
Thoracic/Lumbar medial branch block	1	0.22%

procedures were lumbar epidural steroid injection (36.85%), followed by lumbar medial branch block (15.73%) and caudal epidural steroid injection (7.33%). The most prevalent procedure among non-LBP procedures was cervical epidural steroid injection (1.72%). Out of all the 11 LBP procedures conducted, the most prevalent diagnostic procedure was lumbar medial branch block and therapeutic procedure was interlaminar (lumbar, caudal) epidural steroid injection. Only one procedure was identified as being both diagnostic and therapeutic in nature, intra-articular sacroiliac joint injection. **Table 8** describes the repetition for interventional therapeutic LBP procedures performed in the chronic LBP cohort with maximum of five and four repetitions and an average of 1.68 and 1.41 repetitions for lumbar epidural steroid injection and transforaminal epidural steroid injection during the study period. No procedures were performed in about 37.71% (n=175) of patients in this cohort. Different line of therapy were identified from current medications for patients with chronic LBP **(Refer Table 9).**

Table 8: Number of repetitions for interventional therapeutic LBP procedures performed in the chronic LBP patient cohort

Type of procedure	Repetitions across entire cohort
Lumbar epidural steroid injection	Mean ± SD: 1.68 ± 0.85 Median (IQR): 2 (1) Maximum: 5
Caudal epidural steroid injection	Mean ± SD: 1.41 ± 0.65 Median (IQR): 1 (1) Maximum: 3
Transforaminal epidural steroid injection	Mean ± SD: 1.41 ± 0.75 Median (IQR): 1 (1) Maximum: 4
Lumbar/Sacral medial branch radiofrequency	Mean ± SD: 1.38 ± 0.71 Median (IQR): 1 (0.5) Maximum: 3
Intra-articular sacroiliac joint injection	Mean ± SD: 1.33 ± 0.61 Median (IQR): 1 (1) Maximum: 3
Trigger point injection	Mean ± SD: 1.27 ± 0.64 Median (IQR): 1 (0) Maximum: 3
Spinal cord stimulation trial	Mean ± SD: 1.17 ± 0.40 Median (IQR): 1 (0) Maximum: 2
Permanent spinal cord stimulation implantation	Mean ± SD: 1 ± 0 Median (IQR): 1 (0) Maximum: 1
Sacroiliac joint radiofrequency	Mean ± SD: 1 ± 0 Median (IQR): 1 (0) Maximum: 1
Nerve root block	Mean ± SD: 1 ± 0 Median (IQR): 1 (0) Maximum: 1

Table 9: Different line of therapy identified from current medications for patients with chronic LBP

Patients on pain medications	Frequency, percent (n,%)
First-line medications	115, 24.78%
Second-line medications	121, 26.07%
Third-line medications	46, 9.91%

Objective 2

To assess the prevalence of comorbid conditions including hypertension, anxiety and depression in the chronic LBP cohort and to compare the demographic and clinical characteristics of patients (i) with and without hypertension and (ii) with and without anxiety and/or depression

Patients with chronic LBP who had hypertension (n=188, 40.52%) were compared to those without hypertension (n=276, 59.48%). Similarly, patients with chronic LBP who had anxiety and/or depression (n=120, 25.86%) were compared to those without anxiety and/or depression (n=344, 74.14%). Descriptive analyses were conducted on the four cohorts. **Table 10** describes the demographic characteristics including age, gender, race, ethnicity, smoking status, alcohol status, drug use status and clinical characteristics such as disease duration, procedure types and office visits. A relatively older population was observed in the hypertension cohort (67 years) as compared to the non-hypertension cohort (56 years). Males were predominant in the hypertension cohort whereas females were predominant in the non-hypertension cohort. A relatively younger population was observed in the anxiety and/or depression cohort (55 years) as compared to the non-anxiety and/or depression cohort (62 years). Females were predominant in the anxiety and/or depression cohort whereas males were predominant in non-anxiety and/or depression cohorts. In hypertension cohort most patients did not consume alcohol compared to non-hypertension cohort. Similar proportion of alcohol consumption was seen in anxiety and/or depression when compared with non- anxiety and/or depression cohort. Mean duration of chronic LBP was more in hypertension cohort (65 months) than in non-hypertension cohort (62 months). The mean duration of

Table 10: Demographic and clinical characteristics of patients with chronic LBP and hypertension and Anxiety/Depression compared to patients with chronic LBP without hypertension and Anxiety/Depression

Variables	Hypertension (N=188)	No Hypertension (N=276)	Anxiety &/or Depression (N=120)	No Anxiety &/or Depression (N=344)
Age in years				
Mean ± SD	67.07 ± 12.48	56.64 ± 16.34	55.5 ± 15.22	62.74 ± 15.51
Median (IQR)	67 (18)	57.5 (24)	56 (19.5)	65 (22.5)
Sex (n,%)				
Female	88, 46.81%	157, 56.88%	77, 64.17%	168, 48.84%
Male	100, 53.19%	119, 43.12%	43, 35.83%	176, 51.16%
Race (n,%)				
White	171, 90.96%	265, 96%	109, 90.83%	327, 95.06%
Black	15, 7.98%	8, 2.9%	8, 6.67%	5, 4.36%
Asian	-	1, 0.36%	-	2, 0.58%
Other races	1, 0.53%	1, 0.36%	1, 0.83%	-
Declined to specify/ Unknown	1, 0.53%	1, 0.36%	2, 1.67%	-
Ethnicity (n,%)				
Non-Hispanic Latino	186, 98.94%	263, 95.29%	114, 95%	335, 97.38%
Declined to specify/ Unknown	2, 1.06%	11, 3.99%	5, 4.17%	8, 2.33%
Hispanic Latino	-	2, 0.72%	1, 0.83%	1, 0.29%
Smoking Status (n,%)				
Never	103, 55.38%	158, 58.52%	62, 52.10%	199, 59.05%
Former smoker	44, 23.66%	60, 22.22%	27, 22.69%	77, 22.85%
Current smoker	39, 20.97%	52, 19.26%	30, 25.21%	61, 18.10%
Alcohol status (n,%)				
Currently consume alcohol	88, 47.57%	156, 57.35%	58, 49.15%	186, 54.87%
No	97, 52.43%	116, 42.65%	60, 50.85%	153, 45.13%
Drug Use status (n,%)				
No	177, 95.68%	254, 93.73%	108, 90.76%	323, 95.85%
Current user	5, 2.7%	13, 4.8%	9, 7.56%	9, 2.67%
Former user	3, 1.62%	4, 1.48%	2, 1.68%	5, 1.48%
Disease duration in months				
Mean ± SD	65.98 ± 97.77	62.67 ± 90.75	76.2 ± 89.76	59.69 ± 95.08
Median (IQR)	24 (64)	18 (66)	36 (108)	16 (54)
Office visits				
Mean ± SD	3.57 ± 3.63	3.18 ± 2.72	3.45 ± 3.73	3.3 ± 2.89
Median (IQR)	3 (3)	2 (3)	2 (3)	2 (3)

chronic LBP was more for patients suffering with anxiety and/or depression (76 months) than those without (59 months). Majority of the population was White and non-Hispanic Latino across all four cohorts. Most patients never smoked and did not use drugs in all four cohorts. Mean office visits were highest for hypertension cohort (4 visits) and similar for the other three cohorts (3 visits) during the study period.

The most prevalent therapeutic procedure was interlaminar (lumbar, caudal) epidural steroid injection across all the four cohorts, followed by transforaminal epidural steroid injection in hypertension cohort and intra-articular sacroiliac joint injection in anxiety and/or depression cohorts **(Refer Table 11).**

Table 11: Types of interventional therapeutic LBP procedures performed in patients with chronic LBP and hypertension and Anxiety/Depression compared to patients with chronic LBP without hypertension and Anxiety/Depression

Type of procedure	Hypertension (n,%) (N=188)	No Hypertension (n,%) (N=276)	Anxiety and/or Depression (n,%) (N=120)	No Anxiety and/or Depression (n,%) (N=344)
Lumbar epidural steroid injection	70, 37.23%	101, 36.59%	32, 26.67%	139, 40.41%
Caudal epidural steroid injection	14, 7.45%	20, 7.25%	11, 9.17%	23, 6.69%
Transforaminal epidural steroid injection	8, 4.26%	24, 8.7%	6, 5%	26, 7.56%
Lumbar/Sacral medial branch radiofrequency	6, 3.19%	10, 3.62%	4, 3.33%	12, 3.49%
Intra-articular sacroiliac joint injection	4, 2.13%	11, 3.99%	7, 5.83%	8, 2.33%
Trigger point injection	4, 2.13%	7, 2.54%	5, 4.17%	6, 1.74%
Spinal cord stimulation trial	2, 1.06%	4, 1.45%	2, 1.67%	4, 1.16%
Permanent spinal cord stimulation implantation	1, 0.53%	2, 0.72%	2, 1.67%	1, 0.29%
Sacroiliac joint radiofrequency	1, 0.53%	-	1, 0.83%	-
Nerve root block	1, 0.53%	1, 0.36%	1, 0.83%	1, 0.29%

Objective 3:

To assess the demographic and clinical characteristics of patients with chronic LBP who are currently prescribed the following medications: blood thinners (anticoagulants/antiplatelet), herbal medicines, benzodiazepines and opioids

Patients with chronic LBP (n=464) were further categorized based on the type of medications they were taking during the study period **(Refer Table 12)**. A total of 154 (33.18%) patients were prescribed blood thinners (anticoagulants and antiplatelets). The mean age across the patient cohort was 70.84 years with majority being Male (61.69%), White (95.45%) and non-Hispanic Latino (99.35%). Most patients never smoked (54.30%) and 52.98% did not consume alcohol. The mean duration of chronic LBP across this patient cohort was 59.87 months with a mean of three office visits during the study period. The most prevalent procedure performed across the cohort was interlaminar (lumbar, caudal) epidural steroid injection (37.66%) which belongs to the category of intermediate-risk for bleeding when performed with concurrent use of blood thinners. Of all the 9 procedures conducted in the blood thinner cohort all 3 categories of procedures based on potential risk for bleeding were identified. Other LBP therapeutic procedures conducted within blood thinner cohort are classified based on their potential risk of serious bleeding **(Refer Table 13).**

A total of 11 (2.37%) patients were prescribed herbal medicines that had anticoagulant effects. The mean age of the patient cohort was 69.90 years with majority being Female (54.55%), White (90.91%) and non-Hispanic Latino (100%). Most patients never smoked (63.64%) and 63.64% currently consumed alcohol. The mean duration of chronic LBP was 34.22 months with a mean of three office visits during the study period.

Table 12: Demographic of patients with chronic LBP and currently on blood thinners, herbal medicines, benzodiazepines, opioids

Variables	Blood Thinners (N=154)	Herbal medications (N=11)	Benzodiazepines (N=67)	Opioids (N=121)
Age in years				
Mean ± SD	70.84 ± 12.26	69.90 ± 9.56	59.43 ± 13.22	64.44 ± 14.98
Median (IQR)	71 (17)	72 (10)	59 (19)	65 (22)
Sex (n,%)				
Female	59, 38.31%	6, 54.55%	47, 70.15%	74, 61.16%
Male	95, 61.69%	5, 45.45%	20, 29.85%	47, 38.84%
Race (n,%)				
White	147, 95.45%	10, 90.91%	65, 97.01%	116, 95.87%
Black	7, 4.55%	1, 9.09%	1, 1.49%	3, 2.48%
Other races	-	-	1, 1.49%	1, 0.83%
Declined to specify/ Unknown	-	-	-	1, 0.83%
Ethnicity				
Non-Hispanic Latino	153, 99.35%	11, 100%	64, 95.52%	119, 98.35%
Declined to specify/ Unknown	1, 0.65%	-	3, 4.48%	2, 1.65%
Smoking Status				
Never	82, 54.30%	7, 63.64%	32, 48.48%	69, 57.50%
Former smoker	44, 29.14%	4, 36.36%	21, 31.82%	25, 20.83%
Current smoker	25, 16.56%	-	13, 19.70%	26, 21.67%
Alcohol status				
Currently consume alcohol	71, 47.02%	7, 63.64%	32, 48.48%	49, 40.50%
No	80, 52.98%	4, 36.36%	34, 51.52%	72, 59.50%
Drug Use status				
No	145, 95.39%	11, 100%	61, 92.42%	116, 96.67%
Current user	5, 3.29%	-	4, 6.06%	2, 1.67%
Former user	2, 1.32%	-	1, 1.52%	2, 1.67%
Disease duration in months				
Mean ± SD	59.87 ± 96.99	34.22 ± 42.77	108.74 ± 117.72	75.70 ± 94.68
Median (IQR)	18 (53)	12 (16)	54	24
Office visits				
Mean ± SD	3 ± 2.99	3.4 ± 2.29	3.55 ± 3.87	3.24 ± 3.69
Median (IQR)	3 (2)	3 (2)	2 (3)	2 (3)

Table 13: Types of interventional therapeutic LBP procedures within each cohort of patients with LBP on blood thinners, herbal medicines, benzodiazepines, opioids

Type of procedure	Blood Thinners (n,%) (N=154)	Herbal medications (n,%) (N=11)	Benzodiazepines (n,%) (N=67)	Opioids (n,%) (N=121)
Low-risk procedures				
Lumbar/Sacral medial branch radiofrequency	6, 3.90%	-	2, 2.99%	3, 2.48%
Intra-articular sacroiliac joint injection	4, 2.60%	-	2, 2.99%	-
Trigger point injection	2, 1.30%	-	3, 4.48%	1, 0.83%
Sacroiliac joint radiofrequency	1, 0.65%	-	-	-
Intermediate risk procedures				
Lumbar epidural steroid injection	58, 37.66%	7, 63.64%	20, 29.85%	34, 28.10%
Caudal epidural steroid injection	12, 7.79%	1, 9.09%	5, 7.46%	8, 6.61%
Transforaminal epidural steroid injection	5, 3.25%	-	3, 4.48%	7, 5.79%
High-risk procedures				
Spinal cord stimulation trial	1, 0.65%	-	2, 2.99%	1, 0.83%
Permanent spinal cord stimulation implantation	1, 0.65%	-	2, 2.99%	-

Note: Procedures were categorized based on their potential risk of bleeding only for blood thinners cohort and herbal medicines cohort

The most prevalent procedure performed in this cohort was lumbar epidural steroid injection (63.64%). In herbal medications cohort, predominantly intermediate-risk procedures were conducted whereas none were identified in the low-risk and high-risk procedure category.

A total of 67 (14.43%) patients were prescribed benzodiazepines. The mean age of the cohort was 59.43 years with majority being Female (70.15%), White (97.01%) and Non-Hispanic Latino (95.52%). Most patients never smoked (48.48%) and 51.52% did not consume alcohol. The mean duration disease was 108.74 months with a mean of four office visits during the study period. The most prevalent procedure performed in this cohort was lumbar epidural steroid injection (29.85%).

A total of 121 (26.07%) patients were prescribed opioids. The mean age was 64.44 years with majority being Female (61.16%), White (95.87%) and Non-Hispanic Latino (98.35%). Most patients never smoked (57.50%) and 59.5% did not consume alcohol. The mean duration of chronic LBP was 75.70 months with a mean of three office visits during the study period. The most prevalent procedure performed was lumbar epidural steroid injection (28.10%).

Objective 4:

To assess the mean pain level pre- and post- procedure for patients with chronic LBP that have undergone a single therapeutic LBP procedure throughout the study period

The difference in mean pain scores was calculated in patients that have undergone single interventional therapeutic procedure utilizing pain levels recorded at first office visit and after the procedure was performed. As different types of procedures were

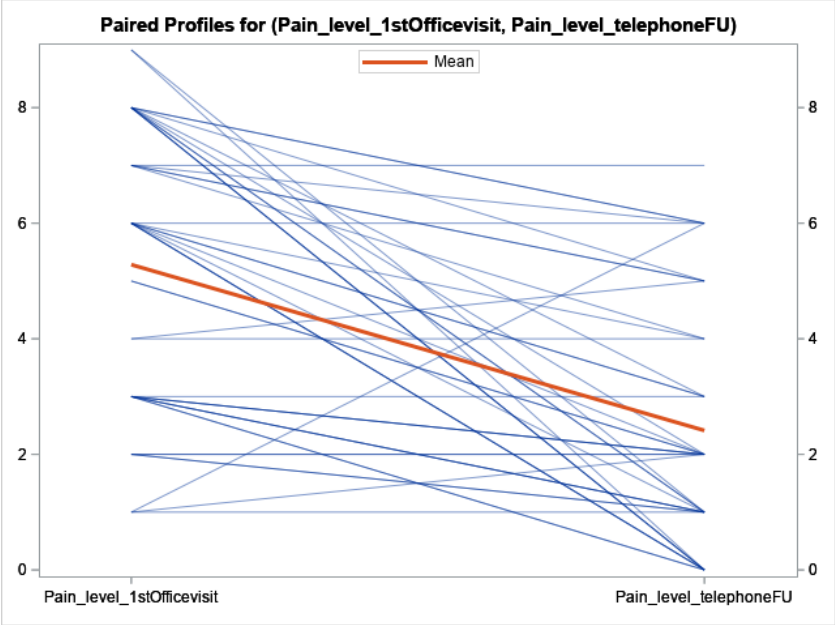
performed on patients, mean difference in pain scores were calculated separately for each of these procedures. Paired t-test was conducted for the most performed procedure which was lumbar epidural steroid injection. A total of 109 patients (23.49%) of the cohort with chronic LBP had undergone only a single procedure. After excluding patients that had undergone non-LBP and diagnostic procedures (both LBP and non-LBP) from this cohort, a total of 84 patients were remaining that had undergone therapeutic LBP procedure. Six different therapeutic LBP procedures were identified in these 84 patients during the 26 months follow-up period. Further, eight patients that had missing value for pain level were excluded and finally 76 patients were analyzed **(Refer Table 14).** Based on the level of mean difference in pain levels before and after the procedure, lumbar epidural steroid injection demonstrated statistically significant pain reduction ($p < 0.05$) with a mean difference of 2.86. **Refer figure 4** for graphical depiction of the mean differences results of the procedure type lumbar epidural steroid injection.

Table 14: Mean difference between pain levels at first office visit and after therapeutic LBP procedure

Procedure Name	Number of patients (n) N= 76	At first office visit (Mean)	After procedure (Mean)	Mean difference between pain levels at first office visit and after procedure
Lumbar epidural steroid injection	46	5.28	2.41	2.87*
Caudal epidural steroid injection	13	5.62	2.62	3
Transforaminal epidural steroid injection	10	6	3.4	2.6
Trigger point injection	4	7.25	5	2.25
Intra-articular sacroiliac joint injection	2	5	3	2
Nerve root block	1	8	1	7

* Paired t-test, $p<0.05$

Figure 3: Mean difference between pain levels at first office visit and after procedure type - lumbar epidural steroid injection



CHAPTER 5: DISCUSSION

This chapter discusses the study findings, draws conclusions, presents study implications, lists limitations of the study and provides recommendations for future research.

LBP is the second most common cause of disability in the US and it is important to understand the demographic and clinical characteristics of patients who suffer with this condition. The majority of the patients with chronic LBP in the study were females and over 60 years of age. A national study that surveyed patients with chronic LBP reported similar patient demographics in terms of gender and age.[8] Also, chronic LBP was predominantly seen in White and non-Hispanic Latino population in the study. Similarly, a study by Freburger *et al.* reported the prevalence of chronic LBP higher in White non-Hispanic individuals in relation to Hispanic individuals.[56] However, there are some differences seen in our population compared to those reported in the literature. A majority of the patients with chronic LBP in our study never smoked which is contrary to the results of a systematic review that reported that chronic LBP was more prevalent in smokers than in non-smokers.[57] Another finding of our study that majority of patients did not use illicit drugs was contradictory to the findings from the National Health and Nutrition Examination Survey (NHANES) which reported illicit drug use in chronic LBP population in the US.[58] In the NHANES survey, the drug use information was collected via private computer-based questionnaire, which is less susceptible to self-reporting bias as compared to the pain clinic, that collects the information directly from patients through a form during their first office visit. The other reason for this contradiction could be the

small sample size of our study in comparison to NHANES survey which includes a large population representative of the US population.

One of the ways to alleviate pain in patients with chronic LBP is through the use of interventional procedures. The clinic routinely performs a number of these procedures depending on the demographic and clinical characteristics of the patients. The procedure that was performed in majority of the patients was epidural steroid injections (lumbar, caudal, transforaminal). Epidural steroid injection is reported to be an effective treatment option, and has shown to provide moderate to short-term effect in the management of chronic LBP.[59] In addition to LBP procedures, other non-LBP procedures were also seen to be prevalent in this cohort, that might be because of presence of concomitant chronic pain conditions including neck pain, shoulder pain, knee pain, leg pain, hand pain, foot pain, cervical pain, coccygeal pain, hip pain, buttocks pain, thigh pain, thoracic pain, mid back pain, ankle pain, groin pain, abdominal pain, arm pain and whole body pain in the study cohort.

The study investigated the prevalence of comorbid conditions commonly seen in patients with chronic LBP. Almost half of the study population had hypertension, and this was consistent with the findings of by Jacob *et al*, which reported that hypertension is one of the predictors for chronic LBP.[60] The elevated blood pressure is associated with increased sensitivity to pain, thus aggravating the pain and worsening the pain experience in patients with chronic LBP and comorbid hypertension,[21,22] thus indicating that the pain level could be overestimated. Hypertension was observed in older persons in our study which was similar to findings from Riguad *et al* that reported higher prevalence of hypertension was observed in older population (60 years and older).[66] Our study also

found that more females suffered with anxiety and/or depression compared to males, this was finding was similar to Albert *et al* that estimated higher prevalence of depression in females than males.[67]

Patients with chronic pain usually take a number of pain medications including tricyclic depressants, dual reuptake inhibitors of serotonin and norepinephrine, calcium channel α2-δ ligands, opioid analgesics, tramadol and NSAIDs. However, aspirin, NSAIDs and serotonin reuptake inhibitors (SRIs) demonstrate antiplatelet activity and thus, need to be monitored during interventional procedures due to increased risk of bleeding.[15] A number of patients with chronic LBP take anticoagulant/antiplatelet therapy and one of the reasons for that could be due to comorbidities such as atrial fibrillation (AF), deep vein thrombosis (DVT), pulmonary embolism and coronary artery disease (CAD) that require acute or chronic anticoagulation or chronic antiplatelet treatment.[15,61,62] The prevalence of patients on blood thinners and with AF, DVT, CAD and pulmonary embolism within our cohort was about 18% (result calculated but now shown in the results section, SAS code attached). Further, if patients are on both blood thinners and pain medications with antiplatelet effects, the risk is even higher. Thus, it is important to make sure these medications are used with caution. The study reported the most prevalent procedure performed in patients on blood thinners was interlaminar (lumbar, caudal) epidural steroid injection, which is a procedure with potential for intermediate risk of bleeding.[15] Patients on herbal medications such as garlic extract, ginkgo biloba, green tea, ginseng among many others, cause significant bleeding due to their antiplatelet effect or interact with other anticoagulants.[15] Although, prevalence of patients on herbal medications was only about 9% in this study, lumbar epidural steroid

injection (intermediate-risk procedure) was most performed in about 46% of patients within this cohort. Thus, physician might require discontinuation of anticoagulants/antiplatelet and herbal medications a few days prior to conducting the procedure to avoid bleeding. We also explored the prevalence of patients on benzodiazepines (14%) which is used to treat anxiety. Majority of the population in the benzodiazepine cohort was female (70.15%) and a similar prevalence of female population was observed in the anxiety cohort (67%) of this study as well. Although we did not study the use of benzodiazepines in the anxiety population, the greater use of benzodiazepines in females could be due to them suffering from anxiety disorders. About 48% of patients on benzodiazepines consumed alcohol, these patients could be heavy drinkers or occasional or rare drinkers. Because all such patients were categorized as current alcohol drinkers, the extent of their alcohol consumption was not distinguished among patients on benzodiazepines and is a limitation of the study. Opioids are second-line treatment option for chronic neuropathic pain and about 26% of patients are on opioids. In addition to pharmacological treatments, patients in this cohort have undergone interlaminar and transforaminal epidural steroid injection, lumbar/sacral medial branch radiofrequency, trigger point injections and spinal cord stimulation trial, this indicates that a multimodal treatment approach was required for management of chronic LBP as mentioned in the guideline.[13]

Upon calculation of mean change in pain scores before and after the single therapeutic LBP procedure, most procedures reported pain reduction to some extent. The study revealed that an immediate and significant pain relief was provided by the interlaminar epidural steroid injections, trigger point injections for patients with chronic

LBP. However, the effect is not long-lasting. For example, the most commonly performed procedure across the entire cohort was lumbar epidural steroid injection (36.85%) and provides significant pain relief. But lumbar epidural steroid injection is also the most repeated procedure with maximum five repetitions (median = 2) in the study period of about two years. This indicates that the procedure does not provide a sustained and prolonged pain relief. Supporting evidence for the effect of epidural corticosteroid injections was found in Chou *et al* where the injection was associated with immediate alleviations in pain and function, but advantages were small and not sustained.[63]

STUDY IMPLICATIONS

The present study was one of the first to assess the demographical and clinical characteristics of patients with chronic LBP specifically focusing on their pain level, interventional procedures and pharmacologic management, using EMR data.

Implications to the patients and caregivers

The study provides real-world data on procedures and pain level, which can assist patients and their caregivers during shared decision making about the procedures they intend to undergo and for understanding the extent of pain relief they can potentially obtain from these procedures. The data also highlights the repetition of certain procedures in a clinical setting required for desired pain relief. This can help the patients and their caregivers to set up a concrete treatment plan and establish realistic expectations from the procedures and treatment plan with their specialist.[64,65]

Implications to the pain specialists

The study findings indicate that epidural steroid injections were performed the most in treating chronic LBP. The injections provided significant pain relief when compared to other procedures and repeated injections provided sustained effect. Moreover, the study will help to identify and inform the practice regarding the type of patient population at highest risk for chronic LBP via their demographics, comorbid conditions and medication related information. Thus, enabling the specialists to identify relevant important factors that can relieve or exacerbate the pain and if dose adjustments or monitoring would be required.

LIMITATIONS OF THE STUDY

The study has some limitations, and these should be considered before drawing inferences from the reported results.

The limitations associated with any retrospective and cross-sectional database are applicable to this study. These include systematic or recorder bias, data coding-recoding errors, incomplete data and lack of temporality.

First, the study duration is limited to about two years January 2018 to February 2020, hence any changes in patient's treatment plan after this period were not captured in our database. Second, patient's history of prior procedures performed or prior visits to other pain specialists before visiting the study pain clinic were not included in the database. Third, visits to other physicians and inpatient procedures conducted during the study period were not captured in our database. Fourth, since it was impossible to determine pain duration for patients who reported as several weeks/months instead of a definite

length, they were assumed to have chronic pain for more than three months. There's a possibility that some of these patients could have had pain for less than three months. Fifth, the study has a small sample size, is confined to a particular region and has only one physician treating all patients in the clinic; therefore, the generalizability of this study is limited to patients visiting similar practices, with similar demographics and geographic region. Sixth, the patients were classified into cohorts based on the specific class of medications the patients were currently taking during the study period. However, there's a possibility that these patients could be concomitantly taking one or more medications (for instance, both blood thinners and opioids) and our study did not capture such patients. Therefore, these patients could be overlapping in other medication specific cohorts as well. Because the comorbid conditions were identified from first visit's progress notes, patients that were diagnosed with hypertension, anxiety and depression conditions in the follow-up visits were not captured. Seventh, patients could be on other multimodal treatments such as pharmacologic treatment, physical therapy, psychologic treatment, acupuncture or chiropractic care that could impact pain relief, such variables were not captured in the database. Also, it is possible that these variables could have impacted the pain reduction as observed before and after the lumbar epidural steroid injection was performed. The classification of medications by line of therapy was not conducted by type of pain such neuropathic pain, nociceptive pain or mixed pain. We did a cohort analyses and the follow-ups were different for different patients and the data could possibly be skewed by patients who could have had longer follow-ups than those who did not have. Moreover, we also attempted to capture the change in mean pain scores for patients that had undergone multiple procedures, but the variability in follow-

up period after the first procedure was a major limitation while conducting analysis. For instance, second procedure could be performed after the 3rd follow-up visit and third procedure could be performed after the 6th follow-up visit. Thus, making it difficult to track pain scores and quantify the change in pain score for all patients across all their follow-up visits either when grouped by number of procedures or by type of procedure.

RECOMMENDATIONS FOR FUTURE RESEARCH

This study described the demographical and clinical characteristics of patients with chronic LBP in an outpatient clinic in Pittsburgh region utilizing a cross-sectional study design (study period of 2 years). However, further studies should aim at conducting a longitudinal study with broader patient sample (i.e. not limited to single center as this study is) to trace the change in pain level and sustainability of interventional procedures over a longer duration. Moreover, future research should compare interventional procedures and pain relief obtained from them and their safety in other outpatient clinics with similar population. This will help in providing scientific evidence in association with treatment strategies opted at this study clinic. Additionally, a study tracking the patient journey from various other pain clinics, evaluating their change in pharmacologic treatment, procedures and pain relief obtained would be useful in a robust comparison of treatment plans and their benefits across pain clinics. Various patient characteristics identified from the study can be used to explore risk factors for chronic LBP and to determine their association with chronic LBP.

Appendix I

Search strategy for CNCP systematic review

Search strategy for PubMed

("Analgesics, Opioid"[Mesh] OR "Analgesics, Opioid"[tiab] OR "Opioid Analgesics"[tiab] OR "Opioids"[tiab] OR "Partial Opioid Agonists"[tiab] OR "Opioid Partial Agonists"[tiab] OR "Full Opioid Agonists"[tiab] OR "Opioid Full Agonists"[tiab] OR "Opioid Mixed Agonist-Antagonists"[tiab] OR "Opioid Mixed Agonist Antagonists"[tiab] OR "Narcotics"[MeSH] OR "Narcotics"[tiab] OR "Narcotic"[tiab] OR "Narcotic Analgesics"[tiab] OR "Narcotic Effect"[tiab] OR "Narcotic Effects"[tiab] OR "Analgesics, Short Acting"[MeSH] OR "Short-Acting Analgesics"[tiab] OR "Calcitonin Gene-Related Peptide Receptor Antagonists"[Mesh] OR "Calcitonin Gene-Related Peptide Receptor Antagonists"[tiab] OR "Calcitonin Gene Related Peptide Receptor Antagonists"[tiab] OR "CGRP Receptor Antagonists"[tiab] OR "GEPANTS"[tiab] OR "Opiate Alkaloids"[Mesh] OR "Opiate Alkaloids"[tiab] OR "Opiates"[tiab] OR "Alkaloid Opiates"[tiab] OR "Analgesics, Non-Narcotic"[Mesh] OR "Non-Narcotic Analgesics"[tiab] OR "Nonopioid Analgesics"[tiab] OR "Non-Opioid Analgesics"[tiab] OR "Non Opioid Analgesics"[tiab] OR "Nonnarcotic Analgesics"[tiab] OR "Muscle Relaxants, Central"[Mesh] OR "Central Muscle Relaxants"[tiab] OR "Centrally Acting Muscle Relaxants"[tiab] OR "Antipsychotic Agents"[Mesh] OR "Antipsychotic Agents"[tiab] OR "Antipsychotics"[tiab] OR "Major Tranquilizers"[tiab] OR "Major Tranquilizing Agents"[tiab] OR "Neuroleptic Drugs"[tiab] OR "Neuroleptics"[tiab] OR "Antipsychotic Drugs"[tiab] OR "Neuroleptic Agents"[tiab] OR "Antipsychotic Effect" OR "Antipsychotic Effects" OR "Antidepressive Agents"[Mesh] OR "Antidepressive

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Search Strategy for PsycINFO

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"Muscle Relaxing Drugs" OR DE "Baclofen" OR DE "Diazepam" OR DE "Theophylline" OR DE "Succinylcholine" OR DE "Anticonvulsive Drugs" OR DE "Carbamazepine" OR DE "Gabapentin" OR DE "Pregabalin" OR DE "Clonazepam OR DE "Diphenylhydantoin" OR DE "Phenobarbital" OR DE "Valproic Acid" OR DE "Antidepressant Drugs" OR DE "Bupropion" OR DE "Citalopram" OR DE "Fluoxetine" OR DE "Fluvoxamine" OR DE "Lithium Carbonate" OR DE "Methylphenidate" OR DE "Mianserin" OR DE "Moclobemide" OR DE "Nefazodone" OR DE "Nomifensine" OR DE "Paroxetine" OR DE "Phenelzine" OR DE "Serotonin Norepinephrine Reuptake Inhibitors" OR DE "Sertraline" OR DE "Sulpiride" OR DE "Trazodone" OR DE "Tricyclic Antidepressant Drugs" OR DE "Venlafaxine" OR DE "Zimeldine" OR DE "Neuroleptic Drugs" OR DE "Olanzapine" OR DE "Aripiprazole" OR DE "Clozapine" OR DE "Quetiapine" OR DE "Reserpine" OR DE "Risperidone" OR DE "Sulpiride" OR DE "Pain Management") AND (DE "Back Pain" OR DE "Chronic Pain" OR DE "Headache" OR DE "Migraine Headache" OR DE "Muscle Contraction Headache" OR DE "Myofascial Pain" OR DE "Neuralgia" OR DE "Trigeminal Neuralgia" OR DE "Neuropathic Pain" OR DE "Somatoform Pain Disorder" OR DE "Complex Regional Pain Syndrome (Type I)" OR DE "Fibromyalgia" OR "Non-cancer pain") AND (("Prescription Drug*" AND (misuse* OR overuse* OR abuse*)) OR "Medication Overuse") AND (DE "Longitudinal Studies" OR DE "Retrospective Studies" OR DE "Cohort Analysis" OR DE "Hypothesis Testing" OR "Longitudinal Stud*" OR "Retrospective Stud*" OR "Cohort Analys*" OR "Cohort stud*" OR "Hypothesis Testing" OR "Cross-section* stud*" OR "Cross-section* analys*" OR "Prevalence stud*")

Search strategy for EMBASE

('opiate' OR 'opiate'/exp OR 'narcotic analgesic agent' OR 'narcotic analgesic agent'/exp OR 'analgesic agent' OR 'analgesic agent'/exp OR 'antirheumatic agent' OR 'antirheumatic agent'/exp OR 'nonsteroid antiinflammatory agent' OR 'nonsteroid antiinflammatory agent'/exp OR 'muscle relaxant agent' OR 'muscle relaxant agent'/exp OR 'neuroleptic agent' OR 'neuroleptic agent'/exp OR 'antidepressant agent' OR 'antidepressant agent'/exp OR 'anticonvulsive agent' OR 'anticonvulsive agent'/exp OR 'pain management' OR 'pain management'/exp OR 'pain control' OR 'pain control'/exp) AND ('prescription drug misuse' OR 'prescription drug misuse'/exp OR 'prescription drug abuse' OR 'medication overuse') AND ('chronic noncancer pain' OR 'nonmalignant pain' OR 'abdominal pain' OR 'abdominal pain'/exp OR 'allodynia' OR 'allodynia'/exp OR 'bone pain' OR 'bone pain'/exp OR 'burning sensation' OR 'burning sensation'/exp OR 'chronic pain' OR 'chronic pain'/exp OR 'migraine' OR 'migraine'/exp OR 'chronic daily headache' OR 'chronic daily headache'/exp OR 'face pain' OR 'face pain'/exp OR 'hyperalgesia' OR 'hyperalgesia'/exp OR 'chronic inflammatory pain' OR 'chronic inflammatory pain'/exp OR 'intractable pain' OR 'intractable pain'/exp OR 'musculoskeletal pain' OR 'musculoskeletal pain'/exp OR 'myalgia' OR 'myalgia'/exp OR 'neuralgia' OR 'neuralgia'/exp OR 'nociceptive pain' OR 'nociceptive pain'/exp OR 'noncardiac chest pain' OR 'noncardiac chest pain'/exp OR 'postoperative pain' OR 'postoperative pain'/exp OR 'spinal pain' OR 'spinal pain'/exp OR 'psychogenic pain' OR 'psychogenic pain'/exp) AND ('retrospective study' OR 'retrospective study'/exp OR 'cross-sectional study' OR

'cross-sectional study'/exp OR 'longitudinal study' OR 'longitudinal study'/exp OR 'case control study' OR 'case control study'/exp OR ‘cohort analysis’ OR ‘cohort analysis’/exp)

Appendix II

Search strategy for LBP literature review

Search Strategy for PubMed

("Low Back Pain"[tiab] OR "Back Pain"[Mesh] OR "Back Pain"[tiab] OR "Back Pains"[tiab] OR "Backache"[tiab] OR "Backaches"[tiab] OR "Back Ache"[tiab] OR "Back Aches"[tiab] OR "Back Pain without Radiation"[tiab] OR "Vertebrogenic Pain Syndrome"[tiab] OR "Vertebrogenic Pain Syndromes"[tiab] OR "Back Pain with Radiation"[tiab]) AND ("Epidural steroid injections"[tiab] OR "Lumbar medial branch block"[tiab] OR "Pain procedures"[tiab] OR "Interventional procedures"[tiab]) AND ("Retrospective Studies"[Mesh] OR "Retrospective Studies"[tiab] OR "Retrospective Study"[tiab] OR "Retrospective Analysis"[tiab] OR "Electronic Health Records"[Mesh] OR "Electronic Health Records"[tiab] OR "Electronic Health Record"[tiab] OR "EHR"[tiab] OR "Electronic Medical Record"[tiab] OR "Electronic Medical Records"[tiab] OR "EMR"[tiab] OR "Computerized Medical Record"[tiab] OR "Computerized Medical Records"[tiab] OR "Cohort Studies"[tiab] OR "Cohort Study"[tiab] OR "Cohort Analysis"[tiab] OR "Cohort"[tiab] OR "Longitudinal Studies"[Mesh] OR "Longitudinal Studies"[tiab] OR "Longitudinal Study"[tiab] OR "Longitudinal Analysis"[tiab] OR "Longitudinal"[tiab] OR "Case-Control Studies"[Mesh] OR "Case-Control Studies"[tiab] OR "Cross-Sectional Studies"[Mesh] OR "Cross-Sectional Studies"[tiab] OR "Cross-Sectional Study"[tiab] OR "Cross-Sectional Analyses"[tiab] OR "Cross-Sectional Analysis"[tiab] OR "Cross Sectional Analyses"[tiab] OR "Cross Sectional Analysis"[tiab] OR "Cross-sectional"[tiab] OR "Prevalence"[mesh:noexp] OR "Prevalence"[tiab] OR (Case[tiab] AND Control[tiab])

OR (Cases[tiab] AND Controls[tiab]) OR (Cases[tiab] AND Controlled[tiab]) OR (Case[tiab] AND Comparison*[tiab]) OR (Cases[tiab] AND Comparison*[tiab]) OR "Cohort studies"[mesh:noexp] OR "Control group"[tiab] OR "Control groups"[tiab])

APPENDIX III:

SAS Code

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/*Data import*/
proc import datafile= "C:\Users\gauri\Desktop\Data_XYZ_10_10_2020.xlsx"
dbms=xlsx out=Totalcohort replace;
getnames=yes ;
sheet=Original_data;
run;

/*Removed blank 2 observations*/
Data Totalcohort_1;/*586 patients*/
set Totalcohort;
if Patient_ID ne .;
run;

/*Creating final cohort of pts with > 3 months non-cancer pain*/
data Finalcohort Cancer_comorb_pts;
set Totalcohort_1;
if Patient_ID ne .;
if Disease_Duration__months_ >=3 or Disease_Duration__months_ = . ;
/*526*/
Age=year('29feb2020'd- DOB)- 1960;
If Age>=18;/*526*/
Comorb_1=Upcase(Comorb_1); Comorb_2=Upcase(Comorb_2);
Comorb_3=Upcase(Comorb_3); Comorb_4=Upcase(Comorb_4);
Comorb_5=Upcase(Comorb_5);Comorb_6=Upcase(Comorb_6);Comorb_7=Upcase(Com
orb_7);Comorb_8=Upcase(Comorb_8);Comorb_9=Upcase(Comorb_9);Comorb_10=Up
case(Comorb_10);Comorb_11=Upcase(Comorb_11);Comorb_12=Upcase(Comorb_12)
;Comorb_13=Upcase(Comorb_13);Comorb_14=Upcase(Comorb_14);
Comorb_15=Upcase(Comorb_15);Comorb_16=Upcase(Comorb_16);Comorb_17=Upcas
e(Comorb_17);
Comorb_18=Upcase(Comorb_18);Comorb_19=Upcase(Comorb_19);Comorb_20=Upcas
e(Comorb_20);Comorb_21=Upcase(Comorb_21);Comorb_22=Upcase(Comorb_22);Co
morb_23=Upcase(Comorb_23);Comorb_24=Upcase(Comorb_24);Comorb_25=Upcase(
Comorb_25);Comorb_26=Upcase(Comorb_26);Comorb_27=Upcase(Comorb_27);Como
rb_28=Upcase(Comorb_28);Comorb_29=Upcase(Comorb_29);
Disease_Duration__months_1= input(Disease_Duration__months_, 5.);

%let Cancer_Type="BREAST CANCER" "COLON CANCER" "KIDNEY CANCER"
"PROSTATE CANCER" "THROAT CANCER" "OVARIAN CANCER" "LUNG CANCER"
"BLADDER CANCER" "CERVICAL CANCER" "SKIN CANCER" "BASAL CELL CANCER"
"LIVER CANCER" "CANCER" "ORAL CANCER" "THYROID CANCER" "UTERINE CANCER"
"MELANOMA";
if Comorb_1 in (&Cancer_Type) or Comorb_2 in (&Cancer_Type) or Comorb_3
in (&Cancer_Type) or Comorb_4 in (&Cancer_Type) or Comorb_5 in
(&Cancer_Type) or Comorb_6 in (&Cancer_Type) or Comorb_7 in
(&Cancer_Type) or Comorb_8 in (&Cancer_Type) or Comorb_9 in
(&Cancer_Type) or Comorb_10 in (&Cancer_Type) or
Comorb_11 in (&Cancer_Type) or Comorb_12 in (&Cancer_Type) or Comorb_13
in (&Cancer_Type) or Comorb_14 in (&Cancer_Type) or Comorb_15 in
(&Cancer_Type) or Comorb_16 in (&Cancer_Type) or Comorb_17 in
(&Cancer_Type) or Comorb_18 in (&Cancer_Type) or Comorb_19 in
(&Cancer_Type) or Comorb_20 in (&Cancer_Type) or
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Comorb_21 in (&Cancer_Type) or Comorb_22 in (&Cancer_Type) or Comorb_23
in (&Cancer_Type) or Comorb_24 in (&Cancer_Type) or Comorb_25 in
(&Cancer_Type) or Comorb_26 in (&Cancer_Type) or Comorb_27 in
(&Cancer_Type) or Comorb_28 in (&Cancer_Type) or Comorb_29 in
(&Cancer_Type) then output Cancer_comorb_pts; /*62 pts*/
else output Finalcohort;/*464 pts- pain for more than 3 months and non-
cancer adult pts */

run;


/*Descriptive stats of demographics and clinical*/
proc freq data=Finalcohort order=freq;
tables race ethnicity sex smoking alcohol drug_use ;
run;

proc univariate data=Finalcohort ;
var Disease_Duration__months_1 Age;
run;

/*Total number of office visits for each patient*/
proc sort data=Finalcohort out=sorted_Finalcohort;
by Patient_ID;
run;

data Num_officevisits;
set sorted_Finalcohort;
by Patient_ID;
if first.Patient_ID;
Num_Officevisits=0;
if First_OfficeVisit ne . then do;
Num_Officevisits=1;
if Second_OfficeVisit ne . then Num_Officevisits+1;
if Third_OfficeVisit ne . then Num_Officevisits+1;
if Fourth_OfficeVisit ne . then Num_Officevisits+1;
if Fifth_OfficeVisit ne . then Num_Officevisits+1;
if sixth_OfficeVisit ne . then Num_Officevisits+1;
if seventh_OfficeVisit ne . then Num_Officevisits+1;
if eighth_OfficeVisit ne . then Num_Officevisits+1;
if ninth_OfficeVisit ne . then Num_Officevisits+1;
if tenth_OfficeVisit ne . then Num_Officevisits+1;
if eleventh_OfficeVisit ne . then Num_Officevisits+1;
if twelve_OfficeVisit ne . then Num_Officevisits+1;
if thirteen_OfficeVisit ne . then Num_Officevisits+1;
if fourteen_OfficeVisit ne . then Num_Officevisits+1;
if fifteen_OfficeVisit ne . then Num_Officevisits+1;
if sixteen_OfficeVisit ne . then Num_Officevisits+1;
if seventeen_OfficeVisit ne . then Num_Officevisits+1;
if eighteen_OfficeVisit ne . then Num_Officevisits+1;
if nineteen_OfficeVisit ne . then Num_Officevisits+1;
if twenty_OfficeVisit ne . then Num_Officevisits+1;
if twentyone_OfficeVisit ne . then Num_Officevisits+1;
if twentytwo_OfficeVisit ne . then Num_Officevisits+1;
if twentythree_OfficeVisit ne . then Num_Officevisits+1;
if twentyfour_OfficeVisit ne . then Num_Officevisits+1;
if twentyfive_OfficeVisit ne . then Num_Officevisits+1;
end;
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else do;
Num_Officevisits=0;
end;
run;

/*Mean median max office visits across entire cohort*/

proc univariate data=Num_officevisits;
var Num_Officevisits;
run;


/*Prevalence of comorbid conditions including hypertension, anxiety and
depression */
data comorbs_htn_anx_dep;
set Finalcohort ;
if Comorb_1 = "HTN" or Comorb_2= "HTN" or Comorb_3= "HTN" or Comorb_4=
"HTN" or Comorb_5= "HTN" or Comorb_6= "HTN" or Comorb_7= "HTN" or
Comorb_8= "HTN" or Comorb_9= "HTN" or Comorb_10= "HTN" or Comorb_11=
"HTN" or Comorb_12= "HTN" or Comorb_13= "HTN" or
Comorb_14= "HTN" or Comorb_15= "HTN" or Comorb_16= "HTN" or Comorb_17=
"HTN" or Comorb_18= "HTN" or Comorb_19= "HTN" or Comorb_20 = "HTN" then
HTN= 1; else HTN=0;

if Comorb_1 in ("ANXIETY" "DEPRESSION") or Comorb_2 in ("ANXIETY"
"DEPRESSION") or Comorb_3 in ("ANXIETY" "DEPRESSION") or Comorb_4 in
("ANXIETY" "DEPRESSION") or Comorb_5 in ("ANXIETY" "DEPRESSION") or
Comorb_6 in ("ANXIETY" "DEPRESSION") or Comorb_7 in ("ANXIETY"
"DEPRESSION") or Comorb_8 in ("ANXIETY" "DEPRESSION") or Comorb_9 in
("ANXIETY" "DEPRESSION") or Comorb_10 in ("ANXIETY" "DEPRESSION") or
Comorb_11 in ("ANXIETY" "DEPRESSION") or Comorb_12 in ("ANXIETY"
"DEPRESSION") or Comorb_13 in ("ANXIETY" "DEPRESSION") or
Comorb_14 in ("ANXIETY" "DEPRESSION") or Comorb_15 in ("ANXIETY"
"DEPRESSION") or Comorb_16 in ("ANXIETY" "DEPRESSION") or Comorb_17 in
("ANXIETY" "DEPRESSION") or Comorb_18 in ("ANXIETY" "DEPRESSION") or
Comorb_19 in ("ANXIETY" "DEPRESSION") or Comorb_20 in ("ANXIETY"
"DEPRESSION") or Comorb_21 in ("ANXIETY" "DEPRESSION") or Comorb_22 in
("ANXIETY" "DEPRESSION") or Comorb_23 in ("ANXIETY" "DEPRESSION") or
Comorb_24 in ("ANXIETY" "DEPRESSION") or Comorb_25 in ("ANXIETY"
"DEPRESSION") or Comorb_26 in ("ANXIETY" "DEPRESSION") or Comorb_27 in
("ANXIETY" "DEPRESSION") or Comorb_28 in ("ANXIETY" "DEPRESSION") or
Comorb_29 in ("ANXIETY" "DEPRESSION") then Anx_Dep= 1; else Anx_Dep=0;

run;

proc freq data=comorbs_htn_anx_dep order=freq;
tables HTN Anx_Dep;
run;

/*Descriptive stats of demographics and clinical - htn*/
data htn;
set comorbs_htn_anx_dep;
if htn=1;
run;

proc freq data=htn order=freq;
tables race ethnicity sex smoking alcohol drug_use ;
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```
run;

proc univariate data=htn ;
var Disease_Duration__months_1 Age;
run;

/*Descriptive stats of demographics and clinical - without htn*/
data No_htn;
set comorbs_htn_anx_dep;
if htn=0;
run;

proc freq data=No_htn order=freq;
tables race ethnicity sex smoking alcohol drug_use ;
run;

proc univariate data=No_htn ;
var Disease_Duration__months_1 Age;
run;

/*Descriptive stats of demographics and clinical - with anxiety and/or
depression*/
data Anx_Dep;
set comorbs_htn_anx_dep;
if Anx_Dep=1;
run;

proc freq data=Anx_Dep order=freq;
tables race ethnicity sex smoking alcohol drug_use ;
run;

proc univariate data=Anx_Dep ;
var Disease_Duration__months_1 Age;
run;

/*Descriptive stats of demographics and clinical - without anxiety
and/or depression*/

data No_Anx_Dep;
set comorbs_htn_anx_dep;
if Anx_Dep=0;
run;

proc freq data=No_Anx_Dep order=freq;
tables race ethnicity sex smoking alcohol drug_use ;
run;

proc univariate data=No_Anx_Dep ;
var Disease_Duration__months_1 Age;
run;

/*Total number of office visits for each patient-htn*/
proc sort data=htn out=sorted_htn;
by Patient_ID;
run;

data Num_officevisits_htn;
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```
set sorted_htn;
by Patient_ID;
if first.Patient_ID;
Num_Officevisits=0;
if First_OfficeVisit ne . then do;
Num_Officevisits=1;
if Second_OfficeVisit ne . then Num_Officevisits+1;
if Third_OfficeVisit ne . then Num_Officevisits+1;
if Fourth_OfficeVisit ne . then Num_Officevisits+1;
if Fifth_OfficeVisit ne . then Num_Officevisits+1;
if sixth_OfficeVisit ne . then Num_Officevisits+1;
if seventh_OfficeVisit ne . then Num_Officevisits+1;
if eighth_OfficeVisit ne . then Num_Officevisits+1;
if ninth_OfficeVisit ne . then Num_Officevisits+1;
if tenth_OfficeVisit ne . then Num_Officevisits+1;
if eleventh_OfficeVisit ne . then Num_Officevisits+1;
if twelve_OfficeVisit ne . then Num_Officevisits+1;
if thirteen_OfficeVisit ne . then Num_Officevisits+1;
if fourteen_OfficeVisit ne . then Num_Officevisits+1;
if fifteen_OfficeVisit ne . then Num_Officevisits+1;
if sixteen_OfficeVisit ne . then Num_Officevisits+1;
if seventeen_OfficeVisit ne . then Num_Officevisits+1;
if eighteen_OfficeVisit ne . then Num_Officevisits+1;
if nineteen_OfficeVisit ne . then Num_Officevisits+1;
if twenty_OfficeVisit ne . then Num_Officevisits+1;
if twentyone_OfficeVisit ne . then Num_Officevisits+1;
if twentytwo_OfficeVisit ne . then Num_Officevisits+1;
if twentythree_OfficeVisit ne . then Num_Officevisits+1;
if twentyfour_OfficeVisit ne . then Num_Officevisits+1;
if twentyfive_OfficeVisit ne . then Num_Officevisits+1;
end;
else do;
Num_Officevisits=0;
end;
run;

/*Mean median max office visits across entire cohort*/

proc univariate data=Num_officevisits_htn ;
var Num_Officevisits;
run;

/*Total number of office visits for each patient- without htn*/
proc sort data=No_htn out=sorted_No_htn;
by Patient_ID;
run;

data Num_officevisits_No_htn;
set sorted_No_htn;
by Patient_ID;
if first.Patient_ID;
Num_Officevisits=0;
if First_OfficeVisit ne . then do;
Num_Officevisits=1;
if Second_OfficeVisit ne . then Num_Officevisits+1;
if Third_OfficeVisit ne . then Num_Officevisits+1;
if Fourth_OfficeVisit ne . then Num_Officevisits+1;
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if Fifth_OfficeVisit ne . then Num_Officevisits+1;
if sixth_OfficeVisit ne . then Num_Officevisits+1;
if seventh_OfficeVisit ne . then Num_Officevisits+1;
if eighth_OfficeVisit ne . then Num_Officevisits+1;
if ninth_OfficeVisit ne . then Num_Officevisits+1;
if tenth_OfficeVisit ne . then Num_Officevisits+1;
if eleventh_OfficeVisit ne . then Num_Officevisits+1;
if twelve_OfficeVisit ne . then Num_Officevisits+1;
if thirteen_OfficeVisit ne . then Num_Officevisits+1;
if fourteen_OfficeVisit ne . then Num_Officevisits+1;
if fifteen_OfficeVisit ne . then Num_Officevisits+1;
if sixteen_OfficeVisit ne . then Num_Officevisits+1;
if seventeen_OfficeVisit ne . then Num_Officevisits+1;
if eighteen_OfficeVisit ne . then Num_Officevisits+1;
if nineteen_OfficeVisit ne . then Num_Officevisits+1;
if twenty_OfficeVisit ne . then Num_Officevisits+1;
if twentyone_OfficeVisit ne . then Num_Officevisits+1;
if twentytwo_OfficeVisit ne . then Num_Officevisits+1;
if twentythree_OfficeVisit ne . then Num_Officevisits+1;
if twentyfour_OfficeVisit ne . then Num_Officevisits+1;
if twentyfive_OfficeVisit ne . then Num_Officevisits+1;
end;
else do;
Num_Officevisits=0;
end;
run;

/*Mean median max office visits across entire cohort*/

proc univariate data=Num_officevisits_No_htn ;
var Num_Officevisits;
run;


/*Total number of office visits for each patient-anxiety and/or
depressson*/
proc sort data=Anx_Dep out=sorted_Anx_Dep;
by Patient_ID;
run;

data Num_officevisits_Anx_Dep;
set sorted_Anx_Dep;
by Patient_ID;
if first.Patient_ID;
Num_Officevisits=0;
if First_OfficeVisit ne . then do;
Num_Officevisits=1;
if Second_OfficeVisit ne . then Num_Officevisits+1;
if Third_OfficeVisit ne . then Num_Officevisits+1;
if Fourth_OfficeVisit ne . then Num_Officevisits+1;
if Fifth_OfficeVisit ne . then Num_Officevisits+1;
if sixth_OfficeVisit ne . then Num_Officevisits+1;
if seventh_OfficeVisit ne . then Num_Officevisits+1;
if eighth_OfficeVisit ne . then Num_Officevisits+1;
if ninth_OfficeVisit ne . then Num_Officevisits+1;
if tenth_OfficeVisit ne . then Num_Officevisits+1;
if eleventh_OfficeVisit ne . then Num_Officevisits+1;
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if twelve_OfficeVisit ne . then Num_Officevisits+1;
if thirteen_OfficeVisit ne . then Num_Officevisits+1;
if fourteen_OfficeVisit ne . then Num_Officevisits+1;
if fifteen_OfficeVisit ne . then Num_Officevisits+1;
if sixteen_OfficeVisit ne . then Num_Officevisits+1;
if seventeen_OfficeVisit ne . then Num_Officevisits+1;
if eighteen_OfficeVisit ne . then Num_Officevisits+1;
if nineteen_OfficeVisit ne . then Num_Officevisits+1;
if twenty_OfficeVisit ne . then Num_Officevisits+1;
if twentyone_OfficeVisit ne . then Num_Officevisits+1;
if twentytwo_OfficeVisit ne . then Num_Officevisits+1;
if twentythree_OfficeVisit ne . then Num_Officevisits+1;
if twentyfour_OfficeVisit ne . then Num_Officevisits+1;
if twentyfive_OfficeVisit ne . then Num_Officevisits+1;
end;
else do;
Num_Officevisits=0;
end;
run;

/*Mean median max office visits across entire cohort*/

proc univariate data=Num_officevisits_Anx_Dep;
var Num_Officevisits;
run;

/*Total number of office visits for each patient-without anxiety and/or
depressson*/
proc sort data=No_Anx_Dep out=sorted_No_Anx_Dep;
by Patient_ID;
run;

data Num_officevisits_No_Anx_Dep;
set sorted_No_Anx_Dep;
by Patient_ID;
if first.Patient_ID;
Num_Officevisits=0;
if First_OfficeVisit ne . then do;
Num_Officevisits=1;
if Second_OfficeVisit ne . then Num_Officevisits+1;
if Third_OfficeVisit ne . then Num_Officevisits+1;
if Fourth_OfficeVisit ne . then Num_Officevisits+1;
if Fifth_OfficeVisit ne . then Num_Officevisits+1;
if sixth_OfficeVisit ne . then Num_Officevisits+1;
if seventh_OfficeVisit ne . then Num_Officevisits+1;
if eighth_OfficeVisit ne . then Num_Officevisits+1;
if ninth_OfficeVisit ne . then Num_Officevisits+1;
if tenth_OfficeVisit ne . then Num_Officevisits+1;
if eleventh_OfficeVisit ne . then Num_Officevisits+1;
if twelve_OfficeVisit ne . then Num_Officevisits+1;
if thirteen_OfficeVisit ne . then Num_Officevisits+1;
if fourteen_OfficeVisit ne . then Num_Officevisits+1;
if fifteen_OfficeVisit ne . then Num_Officevisits+1;
if sixteen_OfficeVisit ne . then Num_Officevisits+1;
if seventeen_OfficeVisit ne . then Num_Officevisits+1;
if eighteen_OfficeVisit ne . then Num_Officevisits+1;
if nineteen_OfficeVisit ne . then Num_Officevisits+1;
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if twenty_OfficeVisit ne . then Num_Officevisits+1;
if twentyone_OfficeVisit ne . then Num_Officevisits+1;
if twentytwo_OfficeVisit ne . then Num_Officevisits+1;
if twentythree_OfficeVisit ne . then Num_Officevisits+1;
if twentyfour_OfficeVisit ne . then Num_Officevisits+1;
if twentyfive_OfficeVisit ne . then Num_Officevisits+1;
end;
else do;
Num_Officevisits=0;
end;
run;

/*Mean median max office visits across entire cohort*/

proc univariate data=Num_officevisits_No_Anx_Dep;
var Num_Officevisits;
run;


/*Therapeutic LBP Procedures prevalence in htn cohort*/
data proc_htn;
set htn;
CPT_Name_1=upcase(CPT_Name_1); CPT_Name_2=upcase(CPT_Name_2);
CPT_Name_3=upcase(CPT_Name_3);
CPT_Name_4=upcase(CPT_Name_4);CPT_Name_5=upcase(CPT_Name_5);CPT_Name_6=
upcase(CPT_Name_6);

If CPT_Name_1= "LESI" or CPT_Name_2= "LESI" or CPT_Name_3= "LESI" or
CPT_Name_4= "LESI" or CPT_Name_5= "LESI" or CPT_Name_6= "LESI" then
LESI=1; else LESI=0;
If CPT_Name_1= "CAUDAL ESI" or CPT_Name_2= "CAUDAL ESI" or CPT_Name_3=
"CAUDAL ESI" or CPT_Name_4= "CAUDAL ESI" or CPT_Name_5= "CAUDAL ESI" or
CPT_Name_6= "CAUDAL ESI" then Caudal_ESI=1; else Caudal_ESI=0;
If CPT_Name_1= "TFESI" or CPT_Name_2= "TFESI" or CPT_Name_3= "TFESI" or
CPT_Name_4= "TFESI" or CPT_Name_5= "TFESI" or CPT_Name_6= "TFESI" then
TFESI=1; else TFESI=0;
If CPT_Name_1= "LUMBAR/SACRAL MB RF" or CPT_Name_2= "LUMBAR/SACRAL MB
RF" or CPT_Name_3= "LUMBAR/SACRAL MB RF" or CPT_Name_4= "LUMBAR/SACRAL
MB RF" or CPT_Name_5= "LUMBAR/SACRAL MB RF" or CPT_Name_6=
"LUMBAR/SACRAL MB RF" then Lumb_Sac_MBRF=1; else Lumb_Sac_MBRF=0;
If CPT_Name_1= "INTRA ARTICULAR SIJ INJECTION" or CPT_Name_2= "INTRA
ARTICULAR SIJ INJECTION" or CPT_Name_3= "INTRA ARTICULAR SIJ INJECTION"
or CPT_Name_4= "INTRA ARTICULAR SIJ INJECTION" or CPT_Name_5= "INTRA
ARTICULAR SIJ INJECTION" or CPT_Name_6= "INTRA ARTICULAR SIJ INJECTION"
then Intrarticular_sij_Inj=1; else Intrarticular_sij_Inj=0;
If CPT_Name_1= "TPI" or CPT_Name_2= "TPI" or CPT_Name_3= "TPI" or
CPT_Name_4= "TPI" or CPT_Name_5= "TPI" or CPT_Name_6= "TPI" then TPI=1;
else TPI=0;
If CPT_Name_1= "SPINAL CORD STIMULATION TRIAL" or CPT_Name_2= "SPINAL
CORD STIMULATION TRIAL" or CPT_Name_3= "SPINAL CORD STIMULATION TRIAL"
or CPT_Name_4= "SPINAL CORD STIMULATION TRIAL" or CPT_Name_5= "SPINAL
CORD STIMULATION TRIAL" or CPT_Name_6= "SPINAL CORD STIMULATION TRIAL"
then Stim_trial=1; else Stim_trial=0;
If CPT_Name_1= "PERMANENT SPINAL CORD STIMULATION IMPLANTATION" or
CPT_Name_2= "PERMANENT SPINAL CORD STIMULATION IMPLANTATION" or
CPT_Name_3= "PERMANENT SPINAL CORD STIMULATION IMPLANTATION" or
CPT_Name_4= "PERMANENT SPINAL CORD STIMULATION IMPLANTATION" or
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CPT_Name_5= "PERMANENT SPINAL CORD STIMULATION IMPLANTATION" or
CPT_Name_6= "PERMANENT SPINAL CORD STIMULATION IMPLANTATION" then
Stim_implant=1; else Stim_implant=0;
If CPT_Name_1= "SIJ RF" or CPT_Name_2= "SIJ RF" or CPT_Name_3= "SIJ RF"
or CPT_Name_4= "SIJ RF" or CPT_Name_5= "SIJ RF" or CPT_Name_6= "SIJ RF"
then SIJ_RF=1; else SIJ_RF=0;
If CPT_Name_1= "NERVE ROOT BLOCK" or CPT_Name_2= "NERVE ROOT BLOCK" or
CPT_Name_3= "NERVE ROOT BLOCK" or CPT_Name_4= "NERVE ROOT BLOCK" or
CPT_Name_5= "NERVE ROOT BLOCK" or CPT_Name_6= "NERVE ROOT BLOCK" then
Nrvrootblk=1; else Nrvrootblk=0;

run;

proc freq data=proc_htn;
tables Caudal_ESI Intrarticular_sij_Inj LESI Lumb_Sac_MBRF Stim_trial
Stim_implant TPI TFESI SIJ_RF  Nrvrootblk;
run;

/*Therapeutic LBP Procedures prevalence in non-htn cohort*/
data proc_no_htn;
set No_htn;
CPT_Name_1=upcase(CPT_Name_1); CPT_Name_2=upcase(CPT_Name_2);
CPT_Name_3=upcase(CPT_Name_3);
CPT_Name_4=upcase(CPT_Name_4);CPT_Name_5=upcase(CPT_Name_5);CPT_Name_6=
upcase(CPT_Name_6);

If CPT_Name_1= "LESI" or CPT_Name_2= "LESI" or CPT_Name_3= "LESI" or
CPT_Name_4= "LESI" or CPT_Name_5= "LESI" or CPT_Name_6= "LESI" then
LESI=1; else LESI=0;
If CPT_Name_1= "CAUDAL ESI" or CPT_Name_2= "CAUDAL ESI" or CPT_Name_3=
"CAUDAL ESI" or CPT_Name_4= "CAUDAL ESI" or CPT_Name_5= "CAUDAL ESI" or
CPT_Name_6= "CAUDAL ESI" then Caudal_ESI=1; else Caudal_ESI=0;
If CPT_Name_1= "TFESI" or CPT_Name_2= "TFESI" or CPT_Name_3= "TFESI" or
CPT_Name_4= "TFESI" or CPT_Name_5= "TFESI" or CPT_Name_6= "TFESI" then
TFESI=1; else TFESI=0;
If CPT_Name_1= "LUMBAR/SACRAL MB RF" or CPT_Name_2= "LUMBAR/SACRAL MB
RF" or CPT_Name_3= "LUMBAR/SACRAL MB RF" or CPT_Name_4= "LUMBAR/SACRAL
MB RF" or CPT_Name_5= "LUMBAR/SACRAL MB RF" or CPT_Name_6=
"LUMBAR/SACRAL MB RF" then Lumb_Sac_MBRF=1; else Lumb_Sac_MBRF=0;
If CPT_Name_1= "INTRA ARTICULAR SIJ INJECTION" or CPT_Name_2= "INTRA
ARTICULAR SIJ INJECTION" or CPT_Name_3= "INTRA ARTICULAR SIJ INJECTION"
or CPT_Name_4= "INTRA ARTICULAR SIJ INJECTION" or CPT_Name_5= "INTRA
ARTICULAR SIJ INJECTION" or CPT_Name_6= "INTRA ARTICULAR SIJ INJECTION"
then Intrarticular_sij_Inj=1; else Intrarticular_sij_Inj=0;
If CPT_Name_1= "TPI" or CPT_Name_2= "TPI" or CPT_Name_3= "TPI" or
CPT_Name_4= "TPI" or CPT_Name_5= "TPI" or CPT_Name_6= "TPI" then TPI=1;
else TPI=0;
If CPT_Name_1= "SPINAL CORD STIMULATION TRIAL" or CPT_Name_2= "SPINAL
CORD STIMULATION TRIAL" or CPT_Name_3= "SPINAL CORD STIMULATION TRIAL"
or CPT_Name_4= "SPINAL CORD STIMULATION TRIAL" or CPT_Name_5= "SPINAL
CORD STIMULATION TRIAL" or CPT_Name_6= "SPINAL CORD STIMULATION TRIAL"
then Stim_trial=1; else Stim_trial=0;
If CPT_Name_1= "PERMANENT SPINAL CORD STIMULATION IMPLANTATION" or
CPT_Name_2= "PERMANENT SPINAL CORD STIMULATION IMPLANTATION" or
CPT_Name_3= "PERMANENT SPINAL CORD STIMULATION IMPLANTATION" or
CPT_Name_4= "PERMANENT SPINAL CORD STIMULATION IMPLANTATION" or
CPT_Name_5= "PERMANENT SPINAL CORD STIMULATION IMPLANTATION" or
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CPT_Name_6= "PERMANENT SPINAL CORD STIMULATION IMPLANTATION" then
Stim_implant=1; else Stim_implant=0;
If CPT_Name_1= "SIJ RF" or CPT_Name_2= "SIJ RF" or CPT_Name_3= "SIJ RF"
or CPT_Name_4= "SIJ RF" or CPT_Name_5= "SIJ RF" or CPT_Name_6= "SIJ RF"
then SIJ_RF=1; else SIJ_RF=0;
If CPT_Name_1= "NERVE ROOT BLOCK" or CPT_Name_2= "NERVE ROOT BLOCK" or
CPT_Name_3= "NERVE ROOT BLOCK" or CPT_Name_4= "NERVE ROOT BLOCK" or
CPT_Name_5= "NERVE ROOT BLOCK" or CPT_Name_6= "NERVE ROOT BLOCK" then
Nrvrootblk=1; else Nrvrootblk=0;

run;

proc freq data=proc_no_htn;
tables Caudal_ESI Intrarticular_sij_Inj LESI Lumb_Sac_MBRF Stim_trial
Stim_implant TPI TFESI SIJ_RF  Nrvrootblk;
run;


/*Therapeutic LBP Procedures prevalence in anxiety and/or depression
cohort*/
data proc_Anx_Dep;
set Anx_Dep;
CPT_Name_1=upcase(CPT_Name_1); CPT_Name_2=upcase(CPT_Name_2);
CPT_Name_3=upcase(CPT_Name_3);
CPT_Name_4=upcase(CPT_Name_4);CPT_Name_5=upcase(CPT_Name_5);CPT_Name_6=
upcase(CPT_Name_6);

If CPT_Name_1= "LESI" or CPT_Name_2= "LESI" or CPT_Name_3= "LESI" or
CPT_Name_4= "LESI" or CPT_Name_5= "LESI" or CPT_Name_6= "LESI" then
LESI=1; else LESI=0;
If CPT_Name_1= "CAUDAL ESI" or CPT_Name_2= "CAUDAL ESI" or CPT_Name_3=
"CAUDAL ESI" or CPT_Name_4= "CAUDAL ESI" or CPT_Name_5= "CAUDAL ESI" or
CPT_Name_6= "CAUDAL ESI" then Caudal_ESI=1; else Caudal_ESI=0;
If CPT_Name_1= "TFESI" or CPT_Name_2= "TFESI" or CPT_Name_3= "TFESI" or
CPT_Name_4= "TFESI" or CPT_Name_5= "TFESI" or CPT_Name_6= "TFESI" then
TFESI=1; else TFESI=0;
If CPT_Name_1= "LUMBAR/SACRAL MB RF" or CPT_Name_2= "LUMBAR/SACRAL MB
RF" or CPT_Name_3= "LUMBAR/SACRAL MB RF" or CPT_Name_4= "LUMBAR/SACRAL
MB RF" or CPT_Name_5= "LUMBAR/SACRAL MB RF" or CPT_Name_6=
"LUMBAR/SACRAL MB RF" then Lumb_Sac_MBRF=1; else Lumb_Sac_MBRF=0;
If CPT_Name_1= "INTRA ARTICULAR SIJ INJECTION" or CPT_Name_2= "INTRA
ARTICULAR SIJ INJECTION" or CPT_Name_3= "INTRA ARTICULAR SIJ INJECTION"
or CPT_Name_4= "INTRA ARTICULAR SIJ INJECTION" or CPT_Name_5= "INTRA
ARTICULAR SIJ INJECTION" or CPT_Name_6= "INTRA ARTICULAR SIJ INJECTION"
then Intrarticular_sij_Inj=1; else Intrarticular_sij_Inj=0;
If CPT_Name_1= "TPI" or CPT_Name_2= "TPI" or CPT_Name_3= "TPI" or
CPT_Name_4= "TPI" or CPT_Name_5= "TPI" or CPT_Name_6= "TPI" then TPI=1;
else TPI=0;
If CPT_Name_1= "SPINAL CORD STIMULATION TRIAL" or CPT_Name_2= "SPINAL
CORD STIMULATION TRIAL" or CPT_Name_3= "SPINAL CORD STIMULATION TRIAL"
or CPT_Name_4= "SPINAL CORD STIMULATION TRIAL" or CPT_Name_5= "SPINAL
CORD STIMULATION TRIAL" or CPT_Name_6= "SPINAL CORD STIMULATION TRIAL"
then Stim_trial=1; else Stim_trial=0;
If CPT_Name_1= "PERMANENT SPINAL CORD STIMULATION IMPLANTATION" or
CPT_Name_2= "PERMANENT SPINAL CORD STIMULATION IMPLANTATION" or
CPT_Name_3= "PERMANENT SPINAL CORD STIMULATION IMPLANTATION" or
CPT_Name_4= "PERMANENT SPINAL CORD STIMULATION IMPLANTATION" or
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CPT_Name_5= "PERMANENT SPINAL CORD STIMULATION IMPLANTATION" or
CPT_Name_6= "PERMANENT SPINAL CORD STIMULATION IMPLANTATION" then
Stim_implant=1; else Stim_implant=0;
If CPT_Name_1= "SIJ RF" or CPT_Name_2= "SIJ RF" or CPT_Name_3= "SIJ RF"
or CPT_Name_4= "SIJ RF" or CPT_Name_5= "SIJ RF" or CPT_Name_6= "SIJ RF"
then SIJ_RF=1; else SIJ_RF=0;
If CPT_Name_1= "NERVE ROOT BLOCK" or CPT_Name_2= "NERVE ROOT BLOCK" or
CPT_Name_3= "NERVE ROOT BLOCK" or CPT_Name_4= "NERVE ROOT BLOCK" or
CPT_Name_5= "NERVE ROOT BLOCK" or CPT_Name_6= "NERVE ROOT BLOCK" then
Nrvrootblk=1; else Nrvrootblk=0;

run;

proc freq data=proc_Anx_Dep;
tables Caudal_ESI Intrarticular_sij_Inj LESI Lumb_Sac_MBRF Stim_trial
Stim_implant TPI TFESI SIJ_RF  Nrvrootblk;
run;



/*Therapeutic LBP Procedures prevalence in without anxiety and/or
depression cohort*/
data proc_No_Anx_Dep;
set No_Anx_Dep;
CPT_Name_1=upcase(CPT_Name_1); CPT_Name_2=upcase(CPT_Name_2);
CPT_Name_3=upcase(CPT_Name_3);
CPT_Name_4=upcase(CPT_Name_4);CPT_Name_5=upcase(CPT_Name_5);CPT_Name_6=
upcase(CPT_Name_6);

If CPT_Name_1= "LESI" or CPT_Name_2= "LESI" or CPT_Name_3= "LESI" or
CPT_Name_4= "LESI" or CPT_Name_5= "LESI" or CPT_Name_6= "LESI" then
LESI=1; else LESI=0;
If CPT_Name_1= "CAUDAL ESI" or CPT_Name_2= "CAUDAL ESI" or CPT_Name_3=
"CAUDAL ESI" or CPT_Name_4= "CAUDAL ESI" or CPT_Name_5= "CAUDAL ESI" or
CPT_Name_6= "CAUDAL ESI" then Caudal_ESI=1; else Caudal_ESI=0;
If CPT_Name_1= "TFESI" or CPT_Name_2= "TFESI" or CPT_Name_3= "TFESI" or
CPT_Name_4= "TFESI" or CPT_Name_5= "TFESI" or CPT_Name_6= "TFESI" then
TFESI=1; else TFESI=0;
If CPT_Name_1= "LUMBAR/SACRAL MB RF" or CPT_Name_2= "LUMBAR/SACRAL MB
RF" or CPT_Name_3= "LUMBAR/SACRAL MB RF" or CPT_Name_4= "LUMBAR/SACRAL
MB RF" or CPT_Name_5= "LUMBAR/SACRAL MB RF" or CPT_Name_6=
"LUMBAR/SACRAL MB RF" then Lumb_Sac_MBRF=1; else Lumb_Sac_MBRF=0;
If CPT_Name_1= "INTRA ARTICULAR SIJ INJECTION" or CPT_Name_2= "INTRA
ARTICULAR SIJ INJECTION" or CPT_Name_3= "INTRA ARTICULAR SIJ INJECTION"
or CPT_Name_4= "INTRA ARTICULAR SIJ INJECTION" or CPT_Name_5= "INTRA
ARTICULAR SIJ INJECTION" or CPT_Name_6= "INTRA ARTICULAR SIJ INJECTION"
then Intrarticular_sij_Inj=1; else Intrarticular_sij_Inj=0;
If CPT_Name_1= "TPI" or CPT_Name_2= "TPI" or CPT_Name_3= "TPI" or
CPT_Name_4= "TPI" or CPT_Name_5= "TPI" or CPT_Name_6= "TPI" then TPI=1;
else TPI=0;
If CPT_Name_1= "SPINAL CORD STIMULATION TRIAL" or CPT_Name_2= "SPINAL
CORD STIMULATION TRIAL" or CPT_Name_3= "SPINAL CORD STIMULATION TRIAL"
or CPT_Name_4= "SPINAL CORD STIMULATION TRIAL" or CPT_Name_5= "SPINAL
CORD STIMULATION TRIAL" or CPT_Name_6= "SPINAL CORD STIMULATION TRIAL"
then Stim_trial=1; else Stim_trial=0;
If CPT_Name_1= "PERMANENT SPINAL CORD STIMULATION IMPLANTATION" or
CPT_Name_2= "PERMANENT SPINAL CORD STIMULATION IMPLANTATION" or
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CPT_Name_3= "PERMANENT SPINAL CORD STIMULATION IMPLANTATION" or
CPT_Name_4= "PERMANENT SPINAL CORD STIMULATION IMPLANTATION" or
CPT_Name_5= "PERMANENT SPINAL CORD STIMULATION IMPLANTATION" or
CPT_Name_6= "PERMANENT SPINAL CORD STIMULATION IMPLANTATION" then
Stim_implant=1; else Stim_implant=0;
If CPT_Name_1= "SIJ RF" or CPT_Name_2= "SIJ RF" or CPT_Name_3= "SIJ RF"
or CPT_Name_4= "SIJ RF" or CPT_Name_5= "SIJ RF" or CPT_Name_6= "SIJ RF"
then SIJ_RF=1; else SIJ_RF=0;
If CPT_Name_1= "NERVE ROOT BLOCK" or CPT_Name_2= "NERVE ROOT BLOCK" or
CPT_Name_3= "NERVE ROOT BLOCK" or CPT_Name_4= "NERVE ROOT BLOCK" or
CPT_Name_5= "NERVE ROOT BLOCK" or CPT_Name_6= "NERVE ROOT BLOCK" then
Nrvrootblk=1; else Nrvrootblk=0;

run;

proc freq data=proc_No_Anx_Dep;
tables Caudal_ESI Intrarticular_sij_Inj LESI Lumb_Sac_MBRF Stim_trial
Stim_implant TPI TFESI SIJ_RF  Nrvrootblk;
run;



/*Procedures performed across all patients*/
data Procedures;/*464 pts*/
set Finalcohort;
CPT_Name_1=upcase(CPT_Name_1); CPT_Name_2=upcase(CPT_Name_2);
CPT_Name_3=upcase(CPT_Name_3);
CPT_Name_4=upcase(CPT_Name_4);CPT_Name_5=upcase(CPT_Name_5);CPT_Name_6=
upcase(CPT_Name_6);

If CPT_Name_1= "CAUDAL ESI" or CPT_Name_2= "CAUDAL ESI" or CPT_Name_3=
"CAUDAL ESI" or CPT_Name_4= "CAUDAL ESI" or CPT_Name_5= "CAUDAL ESI" or
CPT_Name_6= "CAUDAL ESI" then Caudal_ESI=1; else Caudal_ESI=0;
If CPT_Name_1= "CERVICAL ESI" or CPT_Name_2= "CERVICAL ESI" or
CPT_Name_3= "CERVICAL ESI" or CPT_Name_4= "CERVICAL ESI" or CPT_Name_5=
"CERVICAL ESI" or CPT_Name_6= "CERVICAL ESI" then CERVICAL_ESI=1; else
CERVICAL_ESI=0;
If CPT_Name_1= "CERVICAL ESI/MULTIPLE TPI" or CPT_Name_2= "CERVICAL
ESI/MULTIPLE TPI" or CPT_Name_3= "CERVICAL ESI/MULTIPLE TPI" or
CPT_Name_4= "CERVICAL ESI/MULTIPLE TPI" or CPT_Name_5= "CERVICAL
ESI/MULTIPLE TPI" or CPT_Name_6= "CERVICAL ESI/MULTIPLE TPI" then
CERVICAL_ESI_MultTPI=1; else CERVICAL_ESI_MultTPI=0;
If CPT_Name_1= "GENICULAR NERVE BLOCK" or CPT_Name_2= "GENICULAR NERVE
BLOCK" or CPT_Name_3= "GENICULAR NERVE BLOCK" or CPT_Name_4= "GENICULAR
NERVE BLOCK" or CPT_Name_5= "GENICULAR NERVE BLOCK" or CPT_Name_6=
"GENICULAR NERVE BLOCK" then GENICULAR_NERVE_BLOCK=1; else
GENICULAR_NERVE_BLOCK=0;
If CPT_Name_1= "INTRA ARTICULAR HIP INJECTION" or CPT_Name_2= "INTRA
ARTICULAR HIP INJECTION" or CPT_Name_3= "INTRA ARTICULAR HIP INJECTION"
or CPT_Name_4= "INTRA ARTICULAR HIP INJECTION" or CPT_Name_5= "INTRA
ARTICULAR HIP INJECTION" or CPT_Name_6= "INTRA ARTICULAR HIP INJECTION"
then Intrarticular_Hip_Inj=1; else Intrarticular_Hip_Inj=0;
If CPT_Name_1= "INTRA ARTICULAR SIJ INJECTION" or CPT_Name_2= "INTRA
ARTICULAR SIJ INJECTION" or CPT_Name_3= "INTRA ARTICULAR SIJ INJECTION"
or CPT_Name_4= "INTRA ARTICULAR SIJ INJECTION" or CPT_Name_5= "INTRA
ARTICULAR SIJ INJECTION" or CPT_Name_6= "INTRA ARTICULAR SIJ INJECTION"
then Intrarticular_sij_Inj=1; else Intrarticular_sij_Inj=0;
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If CPT_Name_1= "KNEE INJECTION" or CPT_Name_2= "KNEE INJECTION" or
CPT_Name_3= "KNEE INJECTION" or CPT_Name_4= "KNEE INJECTION" or
CPT_Name_5= "KNEE INJECTION" or CPT_Name_6= "KNEE INJECTION" then
knee_inj=1; else knee_inj=0;
If CPT_Name_1= "LATERAL FEMORAL CUTANEOUS NERVE BLOCK" or CPT_Name_2=
"LATERAL FEMORAL CUTANEOUS NERVE BLOCK" or CPT_Name_3= "LATERAL FEMORAL
CUTANEOUS NERVE BLOCK" or CPT_Name_4= "LATERAL FEMORAL CUTANEOUS NERVE
BLOCK" or CPT_Name_5= "LATERAL FEMORAL CUTANEOUS NERVE BLOCK" or
CPT_Name_6= "LATERAL FEMORAL CUTANEOUS NERVE BLOCK" then
lat_femoral_CNB=1; else lat_femoral_CNB=0;
If CPT_Name_1= "LESI" or CPT_Name_2= "LESI" or CPT_Name_3= "LESI" or
CPT_Name_4= "LESI" or CPT_Name_5= "LESI" or CPT_Name_6= "LESI" then
LESI=1; else LESI=0;
If CPT_Name_1= "LUMBAR/SACRAL MB RF" or CPT_Name_2= "LUMBAR/SACRAL MB
RF" or CPT_Name_3= "LUMBAR/SACRAL MB RF" or CPT_Name_4= "LUMBAR/SACRAL
MB RF" or CPT_Name_5= "LUMBAR/SACRAL MB RF" or CPT_Name_6=
"LUMBAR/SACRAL MB RF" then Lumb_Sac_MBRF=1; else Lumb_Sac_MBRF=0;
If CPT_Name_1= "SPINAL CORD STIMULATION TRIAL" or CPT_Name_2= "SPINAL
CORD STIMULATION TRIAL" or CPT_Name_3= "SPINAL CORD STIMULATION TRIAL"
or CPT_Name_4= "SPINAL CORD STIMULATION TRIAL" or CPT_Name_5= "SPINAL
CORD STIMULATION TRIAL" or CPT_Name_6= "SPINAL CORD STIMULATION TRIAL"
then Stim_trial=1; else Stim_trial=0;
If CPT_Name_1= "PERMANENT SPINAL CORD STIMULATION IMPLANTATION" or
CPT_Name_2= "PERMANENT SPINAL CORD STIMULATION IMPLANTATION" or
CPT_Name_3= "PERMANENT SPINAL CORD STIMULATION IMPLANTATION" or
CPT_Name_4= "PERMANENT SPINAL CORD STIMULATION IMPLANTATION" or
CPT_Name_5= "PERMANENT SPINAL CORD STIMULATION IMPLANTATION" or
CPT_Name_6= "PERMANENT SPINAL CORD STIMULATION IMPLANTATION" then
Stim_implant=1; else Stim_implant=0;
If CPT_Name_1= "PIRIFORMIS MUSCLE INJECTION" or CPT_Name_2= "PIRIFORMIS
MUSCLE INJECTION" or CPT_Name_3= "PIRIFORMIS MUSCLE INJECTION" or
CPT_Name_4= "PIRIFORMIS MUSCLE INJECTION" or CPT_Name_5= "PIRIFORMIS
MUSCLE INJECTION" or CPT_Name_6= "PIRIFORMIS MUSCLE INJECTION" then
piriformis_inj=1; else piriformis_inj=0;
If CPT_Name_1= "RIGHT ILIOINGUINAL/ILIOHYPOGASTRIC NERVE BLOCK" or
CPT_Name_2= "RIGHT ILIOINGUINAL/ILIOHYPOGASTRIC NERVE BLOCK" or
CPT_Name_3= "RIGHT ILIOINGUINAL/ILIOHYPOGASTRIC NERVE BLOCK" or
CPT_Name_4= "RIGHT ILIOINGUINAL/ILIOHYPOGASTRIC NERVE BLOCK" or
CPT_Name_5= "RIGHT ILIOINGUINAL/ILIOHYPOGASTRIC NERVE BLOCK" or
CPT_Name_6= "RIGHT ILIOINGUINAL/ILIOHYPOGASTRIC NERVE BLOCK" then
Ilio_nerv_blk=1; else Ilio_nerv_blk=0;
If CPT_Name_1= "SACROCOCCYGEAL JOINT INJECTION" or CPT_Name_2=
"SACROCOCCYGEAL JOINT INJECTION" or CPT_Name_3= "SACROCOCCYGEAL JOINT
INJECTION" or CPT_Name_4= "SACROCOCCYGEAL JOINT INJECTION" or
CPT_Name_5= "SACROCOCCYGEAL JOINT INJECTION" or CPT_Name_6=
"SACROCOCCYGEAL JOINT INJECTION" then Sacrococc_Inj=1; else
Sacrococc_Inj=0;
If CPT_Name_1= "TPI" or CPT_Name_2= "TPI" or CPT_Name_3= "TPI" or
CPT_Name_4= "TPI" or CPT_Name_5= "TPI" or CPT_Name_6= "TPI" then TPI=1;
else TPI=0;
If CPT_Name_1= "TROCHANTERIC BURSA INJECTION" or CPT_Name_2=
"TROCHANTERIC BURSA INJECTION" or CPT_Name_3= "TROCHANTERIC BURSA
INJECTION" or CPT_Name_4= "TROCHANTERIC BURSA INJECTION" or CPT_Name_5=
"TROCHANTERIC BURSA INJECTION" or CPT_Name_6= "TROCHANTERIC BURSA
INJECTION" then Troch_Bursa_inj=1; else Troch_Bursa_inj=0;
If CPT_Name_1= "RIGHT SHOULDER INJECTION" or CPT_Name_2= "RIGHT
SHOULDER INJECTION" or CPT_Name_3= "RIGHT SHOULDER INJECTION" or
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CPT_Name_4= "RIGHT SHOULDER INJECTION" or CPT_Name_5= "RIGHT SHOULDER
INJECTION" or CPT_Name_6= "RIGHT SHOULDER INJECTION" then
Shoulder_inj=1; else Shoulder_inj=0;
If CPT_Name_1= "TFESI" or CPT_Name_2= "TFESI" or CPT_Name_3= "TFESI" or
CPT_Name_4= "TFESI" or CPT_Name_5= "TFESI" or CPT_Name_6= "TFESI" then
TFESI=1; else TFESI=0;
If CPT_Name_1= "SUPEROLATERAL GENICULAR NEUROTOMY" or CPT_Name_2=
"SUPEROLATERAL GENICULAR NEUROTOMY" or CPT_Name_3= "SUPEROLATERAL
GENICULAR NEUROTOMY" or CPT_Name_4= "SUPEROLATERAL GENICULAR NEUROTOMY"
or CPT_Name_5= "SUPEROLATERAL GENICULAR NEUROTOMY" or CPT_Name_6=
"SUPEROLATERAL GENICULAR NEUROTOMY" then Genicular_neurotomy=1; else
Genicular_neurotomy=0;
If CPT_Name_1= "RIGHT SAPHENOUS NERVE BLOCK" or CPT_Name_2= "RIGHT
SAPHENOUS NERVE BLOCK" or CPT_Name_3= "RIGHT SAPHENOUS NERVE BLOCK" or
CPT_Name_4= "RIGHT SAPHENOUS NERVE BLOCK" or CPT_Name_5= "RIGHT
SAPHENOUS NERVE BLOCK" or CPT_Name_6= "RIGHT SAPHENOUS NERVE BLOCK"
then Saphenous_Nerv_blk=1; else Saphenous_Nerv_blk=0;
If CPT_Name_1= "RIGHT SUPRASCAPULAR NERVE BLOCK" or CPT_Name_2= "RIGHT
SUPRASCAPULAR NERVE BLOCK" or CPT_Name_3= "RIGHT SUPRASCAPULAR NERVE
BLOCK" or CPT_Name_4= "RIGHT SUPRASCAPULAR NERVE BLOCK" or CPT_Name_5=
"RIGHT SUPRASCAPULAR NERVE BLOCK" or CPT_Name_6= "RIGHT SUPRASCAPULAR
NERVE BLOCK" then Suprascapular_nerv_blk=1; else
Suprascapular_nerv_blk=0;
If CPT_Name_1= "SIJ RF" or CPT_Name_2= "SIJ RF" or CPT_Name_3= "SIJ RF"
or CPT_Name_4= "SIJ RF" or CPT_Name_5= "SIJ RF" or CPT_Name_6= "SIJ RF"
then SIJ_RF=1; else SIJ_RF=0;
If CPT_Name_1= "THORACIC MBB" or CPT_Name_2= "THORACIC MBB" or
CPT_Name_3= "THORACIC MBB" or CPT_Name_4= "THORACIC MBB" or CPT_Name_5=
"THORACIC MBB" or CPT_Name_6= "THORACIC MBB" then THORACIC_MBB=1; else
THORACIC_MBB=0;
If CPT_Name_1= "LMBB" or CPT_Name_2= "LMBB" or CPT_Name_3= "LMBB" or
CPT_Name_4= "LMBB" or CPT_Name_5= "LMBB" or CPT_Name_6= "LMBB" then
LMBB=1; else LMBB=0;
If CPT_Name_1= "NERVE ROOT BLOCK" or CPT_Name_2= "NERVE ROOT BLOCK" or
CPT_Name_3= "NERVE ROOT BLOCK" or CPT_Name_4= "NERVE ROOT BLOCK" or
CPT_Name_5= "NERVE ROOT BLOCK" or CPT_Name_6= "NERVE ROOT BLOCK" then
Nrvrootblk=1; else Nrvrootblk=0;
If CPT_Name_1= "RIGHT CERVICAL MBB" or CPT_Name_2= "RIGHT CERVICAL MBB"
or CPT_Name_3= "RIGHT CERVICAL MBB" or CPT_Name_4= "RIGHT CERVICAL MBB"
or CPT_Name_5= "RIGHT CERVICAL MBB" or CPT_Name_6= "RIGHT CERVICAL MBB"
then cervical_mbb=1; else cervical_mbb=0;
If CPT_Name_1= "THORACIC AND LUMBAR MBB" or CPT_Name_2= "THORACIC AND
LUMBAR MBB" or CPT_Name_3= "THORACIC AND LUMBAR MBB" or CPT_Name_4=
"THORACIC AND LUMBAR MBB" or CPT_Name_5= "THORACIC AND LUMBAR MBB" or
CPT_Name_6= "THORACIC AND LUMBAR MBB" then thoralumbmbb=1; else
thoralumbmbb=0;
If CPT_Name_1= "SUPERIOR LATERAL GENICULAR NERVE BLOCK" or CPT_Name_2=
"SUPERIOR LATERAL GENICULAR NERVE BLOCK" or CPT_Name_3= "SUPERIOR
LATERAL GENICULAR NERVE BLOCK" or CPT_Name_4= "SUPERIOR LATERAL
GENICULAR NERVE BLOCK" or CPT_Name_5= "SUPERIOR LATERAL GENICULAR NERVE
BLOCK" or CPT_Name_6= "SUPERIOR LATERAL GENICULAR NERVE BLOCK" then
suplatgenblk=1; else suplatgenblk=0;


run;

/*Frequency of each of the above procedures*/
```

```
proc freq data=Procedures;
tables Caudal_ESI CERVICAL_ESI CERVICAL_ESI_MultTPI
GENICULAR_NERVE_BLOCK Intrarticular_Hip_Inj Intrarticular_sij_Inj
knee_inj lat_femoral_CNB LESI Lumb_Sac_MBRF Stim_trial Stim_implant
piriformis_inj Ilio_nerv_blk Sacrococc_Inj TPI Troch_Bursa_inj TFESI
Shoulder_inj Genicular_neurotomy Saphenous_Nerv_blk
Suprascapular_nerv_blk SIJ_RF THORACIC_MBB LMBB Nrvrootblk cervical_mbb
thoralumbmbb suplatgenblk Ilio_nerv_blk;
run;


/*Most prevalent procedures repeated for a chronic LBP patient during
follow ups by
recording the max value of repetitions for each procedure and lowest
repetition (by min value)*/
Data Remainder_Procedures Procedures_Rep_LESI Procedures_Rep_CaudalESI
Procedures_Rep_TPI Procedures_Rep_SIJinj Proc_Rep_Stim_trial
Proc_Rep_Stim_implant Procedures_Rep_TFESI Proc_rep_lum_sac_mbrf
Proc_rep_SIJRF Proc_rep_nrvrootblk;
set Procedures;
If CPT_Name_1 ne " ";/*289 pts have had at least one procedure*/
If LESI= 1 then output Procedures_Rep_LESI;
if Caudal_ESI=1 then output Procedures_Rep_CaudalESI;
if TPI=1 then output Procedures_Rep_TPI;
if Intrarticular_sij_Inj=1 then output Procedures_Rep_SIJinj;
if Stim_Trial=1 then output Proc_Rep_Stim_trial;
if Stim_implant=1 then output Proc_Rep_Stim_implant;
if TFESI=1 then output Procedures_Rep_TFESI;
if Lumb_Sac_MBRF=1 then output Proc_rep_lum_sac_mbrf;
if SIJ_RF=1 then output Proc_rep_SIJRF;
if Nrvrootblk=1 then output Proc_rep_nrvrootblk;
else output Remainder_Procedures;
run;

data Procedures_Rep_LESI_1;
set Procedures_Rep_LESI;
If CPT_Name_1= "LESI" then CPT_name1_dummy=1; else CPT_name1_dummy=0;
If CPT_Name_2= "LESI" then CPT_name2_dummy=1; else CPT_name2_dummy=0;
If CPT_Name_3= "LESI" then CPT_name3_dummy=1; else CPT_name3_dummy=0;
If CPT_Name_4= "LESI" then CPT_name4_dummy=1; else CPT_name4_dummy=0;
If CPT_Name_5= "LESI" then CPT_name5_dummy=1; else CPT_name5_dummy=0;
If CPT_Name_6= "LESI" then CPT_name6_dummy=1; else CPT_name6_dummy=0;

CPT_LESI_Rep_Count =
CPT_name1_dummy+CPT_name2_dummy+CPT_name3_dummy+CPT_name4_dummy+CPT_nam
e5_dummy+CPT_name6_dummy;
run;

proc univariate data=Procedures_Rep_LESI_1;
var CPT_LESI_Rep_Count;
run;

data Procedures_Rep_CaudalESI_1;
set Procedures_Rep_CaudalESI;
If CPT_Name_1= "CAUDAL ESI" then CPT_name1_dummy=1; else
CPT_name1_dummy=0;
```

```
If CPT_Name_2= "CAUDAL ESI" then CPT_name2_dummy=1; else
CPT_name2_dummy=0;
If CPT_Name_3= "CAUDAL ESI" then CPT_name3_dummy=1; else
CPT_name3_dummy=0;
If CPT_Name_4= "CAUDAL ESI" then CPT_name4_dummy=1; else
CPT_name4_dummy=0;
If CPT_Name_5= "CAUDAL ESI" then CPT_name5_dummy=1; else
CPT_name5_dummy=0;
If CPT_Name_6= "CAUDAL ESI" then CPT_name6_dummy=1; else
CPT_name6_dummy=0;

CPT_CaudalESI_Rep_Count =
CPT_name1_dummy+CPT_name2_dummy+CPT_name3_dummy+CPT_name4_dummy+CPT_nam
e5_dummy+CPT_name6_dummy;
run;

proc univariate data= Procedures_Rep_CaudalESI_1;
var CPT_CaudalESI_Rep_Count;
run;


data Procedures_Rep_TPI_1;
Set Procedures_Rep_TPI;
If CPT_Name_1= "TPI" then CPT_name1_dummy=1; else CPT_name1_dummy=0;
If CPT_Name_2= "TPI" then CPT_name2_dummy=1; else CPT_name2_dummy=0;
If CPT_Name_3= "TPI" then CPT_name3_dummy=1; else CPT_name3_dummy=0;
If CPT_Name_4= "TPI" then CPT_name4_dummy=1; else CPT_name4_dummy=0;
If CPT_Name_5= "TPI" then CPT_name5_dummy=1; else CPT_name5_dummy=0;
If CPT_Name_6= "TPI" then CPT_name6_dummy=1; else CPT_name6_dummy=0;

CPT_TPI_Rep_Count =
CPT_name1_dummy+CPT_name2_dummy+CPT_name3_dummy+CPT_name4_dummy+CPT_nam
e5_dummy+CPT_name6_dummy;
run;


proc univariate data= Procedures_Rep_TPI_1 ;
var CPT_TPI_Rep_Count;
run;



data Procedures_Rep_SIJinj_1;
set Procedures_Rep_SIJinj;
If CPT_Name_1= "INTRA ARTICULAR SIJ INJECTION" then CPT_name1_dummy=1;
else CPT_name1_dummy=0;
If CPT_Name_2= "INTRA ARTICULAR SIJ INJECTION" then CPT_name2_dummy=1;
else CPT_name2_dummy=0;
If CPT_Name_3= "INTRA ARTICULAR SIJ INJECTION" then CPT_name3_dummy=1;
else CPT_name3_dummy=0;
If CPT_Name_4= "INTRA ARTICULAR SIJ INJECTION" then CPT_name4_dummy=1;
else CPT_name4_dummy=0;
If CPT_Name_5= "INTRA ARTICULAR SIJ INJECTION" then CPT_name5_dummy=1;
else CPT_name5_dummy=0;
If CPT_Name_6= "INTRA ARTICULAR SIJ INJECTION" then CPT_name6_dummy=1;
else CPT_name6_dummy=0;
```

```
CPT_SIJinj_Rep_Count =
CPT_name1_dummy+CPT_name2_dummy+CPT_name3_dummy+CPT_name4_dummy+CPT_nam
e5_dummy+CPT_name6_dummy;
run;

proc univariate data= Procedures_Rep_SIJinj_1 ;
var CPT_SIJinj_Rep_Count;
run;

data Proc_rep_nrvrootblk_1;
set Proc_rep_nrvrootblk;
If CPT_Name_1= "NERVE ROOT BLOCK" then CPT_name1_dummy=1; else
CPT_name1_dummy=0;
If CPT_Name_2= "NERVE ROOT BLOCK" then CPT_name2_dummy=1; else
CPT_name2_dummy=0;
If CPT_Name_3= "NERVE ROOT BLOCK" then CPT_name3_dummy=1; else
CPT_name3_dummy=0;
If CPT_Name_4= "NERVE ROOT BLOCK" then CPT_name4_dummy=1; else
CPT_name4_dummy=0;
If CPT_Name_5= "NERVE ROOT BLOCK" then CPT_name5_dummy=1; else
CPT_name5_dummy=0;
If CPT_Name_6= "NERVE ROOT BLOCK" then CPT_name6_dummy=1; else
CPT_name6_dummy=0;

CPT_Nrvrootblk_Rep_Count =
CPT_name1_dummy+CPT_name2_dummy+CPT_name3_dummy+CPT_name4_dummy+CPT_nam
e5_dummy+CPT_name6_dummy;
run;

proc univariate data= Proc_rep_nrvrootblk_1 ;
var CPT_Nrvrootblk_Rep_Count;
run;


data Proc_Rep_Stim_trial_1;
set Proc_Rep_Stim_trial;
If CPT_Name_1= "SPINAL CORD STIMULATION TRIAL" then CPT_name1_dummy=1;
else CPT_name1_dummy=0;
If CPT_Name_2= "SPINAL CORD STIMULATION TRIAL" then CPT_name2_dummy=1;
else CPT_name2_dummy=0;
If CPT_Name_3= "SPINAL CORD STIMULATION TRIAL" then CPT_name3_dummy=1;
else CPT_name3_dummy=0;
If CPT_Name_4= "SPINAL CORD STIMULATION TRIAL" then CPT_name4_dummy=1;
else CPT_name4_dummy=0;
If CPT_Name_5= "SPINAL CORD STIMULATION TRIAL" then CPT_name5_dummy=1;
else CPT_name5_dummy=0;
If CPT_Name_6= "SPINAL CORD STIMULATION TRIAL" then CPT_name6_dummy=1;
else CPT_name6_dummy=0;

CPT_StimTrial_Rep_Count =
CPT_name1_dummy+CPT_name2_dummy+CPT_name3_dummy+CPT_name4_dummy+CPT_nam
e5_dummy+CPT_name6_dummy;
run;

proc univariate data= Proc_Rep_Stim_trial_1 ;
var CPT_StimTrial_Rep_Count;
run;
```

```
data Proc_Rep_Stim_implant_1;
set Proc_Rep_Stim_implant;
If CPT_Name_1= "PERMANENT SPINAL CORD STIMULATION IMPLANTATION" then
CPT_name1_dummy=1; else CPT_name1_dummy=0;
If CPT_Name_2= "PERMANENT SPINAL CORD STIMULATION IMPLANTATION" then
CPT_name2_dummy=1; else CPT_name2_dummy=0;
If CPT_Name_3= "PERMANENT SPINAL CORD STIMULATION IMPLANTATION" then
CPT_name3_dummy=1; else CPT_name3_dummy=0;
If CPT_Name_4= "PERMANENT SPINAL CORD STIMULATION IMPLANTATION" then
CPT_name4_dummy=1; else CPT_name4_dummy=0;
If CPT_Name_5= "PERMANENT SPINAL CORD STIMULATION IMPLANTATION" then
CPT_name5_dummy=1; else CPT_name5_dummy=0;
If CPT_Name_6= "PERMANENT SPINAL CORD STIMULATION IMPLANTATION" then
CPT_name6_dummy=1; else CPT_name6_dummy=0;

CPT_StimImplant_Rep_Count =
CPT_name1_dummy+CPT_name2_dummy+CPT_name3_dummy+CPT_name4_dummy+CPT_nam
e5_dummy+CPT_name6_dummy;
run;

proc univariate data= Proc_Rep_Stim_implant_1 ;
var CPT_StimImplant_Rep_Count;
run;

data Procedures_Rep_TFESI_1;
Set Procedures_Rep_TFESI;
If CPT_Name_1= "TFESI" then CPT_name1_dummy=1; else CPT_name1_dummy=0;
If CPT_Name_2= "TFESI" then CPT_name2_dummy=1; else CPT_name2_dummy=0;
If CPT_Name_3= "TFESI" then CPT_name3_dummy=1; else CPT_name3_dummy=0;
If CPT_Name_4= "TFESI" then CPT_name4_dummy=1; else CPT_name4_dummy=0;
If CPT_Name_5= "TFESI" then CPT_name5_dummy=1; else CPT_name5_dummy=0;
If CPT_Name_6= "TFESI" then CPT_name6_dummy=1; else CPT_name6_dummy=0;

CPT_TFESI_Rep_Count =
CPT_name1_dummy+CPT_name2_dummy+CPT_name3_dummy+CPT_name4_dummy+CPT_nam
e5_dummy+CPT_name6_dummy;
run;


proc univariate data= Procedures_Rep_TFESI_1 ;
var CPT_TFESI_Rep_Count;
run;


data Proc_rep_lum_sac_mbrf_1;
Set Proc_rep_lum_sac_mbrf;
If CPT_Name_1= "LUMBAR/SACRAL MB RF" then CPT_name1_dummy=1; else
CPT_name1_dummy=0;
If CPT_Name_2= "LUMBAR/SACRAL MB RF" then CPT_name2_dummy=1; else
CPT_name2_dummy=0;
If CPT_Name_3= "LUMBAR/SACRAL MB RF" then CPT_name3_dummy=1; else
CPT_name3_dummy=0;
If CPT_Name_4= "LUMBAR/SACRAL MB RF" then CPT_name4_dummy=1; else
CPT_name4_dummy=0;
```

```
If CPT_Name_5= "LUMBAR/SACRAL MB RF" then CPT_name5_dummy=1; else
CPT_name5_dummy=0;
If CPT_Name_6= "LUMBAR/SACRAL MB RF" then CPT_name6_dummy=1; else
CPT_name6_dummy=0;

CPT_Lumsac_mbrf_Rep_Count =
CPT_name1_dummy+CPT_name2_dummy+CPT_name3_dummy+CPT_name4_dummy+CPT_nam
e5_dummy+CPT_name6_dummy;
run;


proc univariate data= Proc_rep_lum_sac_mbrf_1 ;
var CPT_Lumsac_mbrf_Rep_Count;
run;

data Proc_rep_SIJRF_1;
Set Proc_rep_SIJRF;
If CPT_Name_1= "SIJ RF" then CPT_name1_dummy=1; else CPT_name1_dummy=0;
If CPT_Name_2= "SIJ RF" then CPT_name2_dummy=1; else CPT_name2_dummy=0;
If CPT_Name_3= "SIJ RF" then CPT_name3_dummy=1; else CPT_name3_dummy=0;
If CPT_Name_4= "SIJ RF" then CPT_name4_dummy=1; else CPT_name4_dummy=0;
If CPT_Name_5= "SIJ RF" then CPT_name5_dummy=1; else CPT_name5_dummy=0;
If CPT_Name_6= "SIJ RF" then CPT_name6_dummy=1; else CPT_name6_dummy=0;

CPT_SIJRF_Rep_Count =
CPT_name1_dummy+CPT_name2_dummy+CPT_name3_dummy+CPT_name4_dummy+CPT_nam
e5_dummy+CPT_name6_dummy;
run;


proc univariate data= Proc_rep_SIJRF_1 ;
var CPT_SIJRF_Rep_Count;
run;



/*Mean pain score difference using pre-procedure and post-procedure
pain scores*/
data single_procedures;
set Finalcohort;
CPT_Name_1=upcase(CPT_Name_1); CPT_Name_2=upcase(CPT_Name_2);
CPT_Name_3=upcase(CPT_Name_3);
CPT_Name_4=upcase(CPT_Name_4);CPT_Name_5=upcase(CPT_Name_5);CPT_Name_6=
upcase(CPT_Name_6);

if (CPT_Name_1 ne " ") and (CPT_Name_2 eq " "); /*109 pts*/
if CPT_Name_1 in ("TFESI" "LESI" "TPI" "CAUDAL ESI" "INTRA ARTICULAR
SIJ INJECTION" "NERVE ROOT BLOCK"); /*84 pts*/
run;


proc freq data=single_procedures nlevels;
tables CPT_Name_1;
run;

proc means data=single_procedures n;
var patient_ID;
```

```
run;

data single_procedures_1 ;
set single_procedures;
Pain_level_1stOfficevisit = input (Pain_level_O1, 1.);
Pain_level_telephoneFU = input (Pain_level_TFU_1, 1.);
if Pain_level_O1=. or Pain_level_TFU_1=. then delete;
run;

data SP_TFESI SP_LESI SP_TPI SP_CaudalESI SP_SIJinj SP_NRB;
set single_procedures_1;
If CPT_Name_1 = "TFESI" then output SP_TFESI;
If CPT_Name_1 = "LESI" then output SP_LESI;
If CPT_Name_1 = "TPI" then output SP_TPI;
If CPT_Name_1 = "CAUDAL ESI" then output SP_CaudalESI;
If CPT_Name_1 = "INTRA ARTICULAR SIJ INJECTION" then output SP_SIJinj;
If CPT_Name_1= "NERVE ROOT BLOCK" then output SP_NRB;
run;


proc sort data =single_procedures_1;
by CPT_Name_1;
run;

PROC TTEST DATA=single_procedures_1 ALPHA=.05; /*76 pts*/
    PAIRED Pain_level_1stOfficevisit*Pain_level_telephoneFU;
      by CPT_Name_1;
RUN;



/*Mean pain scores for TFESI*/
title1 "Mean/Median pain scores pre-proc and post-proc for TFESI";
proc means data=SP_TFESI mean median maxdec=2;
var Pain_level_1stOfficevisit;
run;

proc means data=SP_TFESI mean median maxdec=2;
var Pain_level_telephoneFU;
run;
title1;

/*Mean pain scores for LESI*/
title2 "Mean/Median pain scores pre-proc and post-proc for LESI";
proc means data=SP_LESI mean ;
var Pain_level_1stOfficevisit;
run;

proc means data=SP_LESI  mean;
var Pain_level_telephoneFU;
run;
title2;

/*Mean pain scores for TPI*/
title3 "Mean/Median pain scores pre-proc and post-proc for TPI";
proc means data=SP_TPI mean median maxdec=2;
var Pain_level_1stOfficevisit;
```

```
run;

proc means data=SP_TPI mean median maxdec=2;
var Pain_level_telephoneFU;
run;
title3;

/*Mean pain scores for Caudal ESI*/
title4 "Mean/Median pain scores pre-proc and post-proc for Caudal ESI";
proc means data=SP_CaudalESI mean median maxdec=2;
var Pain_level_1stOfficevisit;
run;

proc means data=SP_CaudalESI mean median maxdec=2;
var Pain_level_telephoneFU;
run;
title4;

/*Mean pain scores for SIJ injection*/
title5 "Mean/Median pain scores pre-proc and post-proc for SIJ
injection";
proc means data=SP_SIJinj mean median maxdec=2;
var Pain_level_1stOfficevisit;
run;

proc means data=SP_SIJinj mean median maxdec=2;
var Pain_level_telephoneFU;
run;
title5;

/*Mean pain scores for Nerve root block injection*/
proc means data=SP_NRB mean median maxdec=2;
var Pain_level_1stOfficevisit;
run;

proc means data=SP_NRB mean median maxdec=2;
var Pain_level_telephoneFU;
run;


/*Mean pain score difference code ends here*/




/*Descriptive characteristics -blood thinners meds under current meds*/
data blood_thinner;/*154 PATIENTS*/
set Finalcohort;
Current_meds_1=upcase(Current_meds_1);
Current_meds_2=upcase(Current_meds_2);
Current_meds_3=upcase(Current_meds_3);
Current_meds_4=upcase(Current_meds_4);
Current_meds_5=upcase(Current_meds_5);
Current_meds_6=upcase(Current_meds_6);Current_meds_7=upcase(Current_med
s_7);Current_meds_8=upcase(Current_meds_8);Current_meds_9=upcase(Curren
```

```
t_meds_9);Current_meds_10=upcase(Current_meds_10);Current_meds_11=upcas
e(Current_meds_11);
Current_meds_12=upcase(Current_meds_12);Current_meds_13=upcase(Current_
meds_13);Current_meds_14=upcase(Current_meds_14);Current_meds_15=upcase
(Current_meds_15);Current_meds_16=upcase(Current_meds_16);Current_meds_
17=upcase(Current_meds_17);Current_meds_18=upcase(Current_meds_18);Curr
ent_meds_19=upcase(Current_meds_19);Current_meds_20=upcase(Current_meds
_20);Current_meds_21=upcase(Current_meds_21);Current_meds_22=upcase(Cur
rent_meds_22);
Current_meds_23=upcase(Current_meds_23);
Current_meds_24=upcase(Current_meds_24);
Current_meds_25=upcase(Current_meds_25);
Current_meds_26=upcase(Current_meds_26);
Current_meds_27=upcase(Current_meds_27);
Current_meds_28=upcase(Current_meds_28);
Current_meds_29=upcase(Current_meds_29);
Current_meds_30=upcase(Current_meds_30);
Current_meds_31=upcase(Current_meds_31);
Current_meds_32=upcase(Current_meds_32);

%let Blood_thinner="ELIQUIS" "JANTOVEN" "PLAVIX" "ECOTRIN" "BAYER LOW
DOSE" "CLOPIDOGREL" "ASPIRIN" "BRILINTA" "ELMIRON" "WARFARIN" "XARELTO"
"PRASUGREL";
if Current_meds_1 in (&blood_thinner) or Current_meds_2 in
(&blood_thinner)or Current_meds_3 in (&blood_thinner) or Current_meds_4
in (&blood_thinner) or Current_meds_5 in (&blood_thinner) or
Current_meds_6 in (&blood_thinner)or Current_meds_7 in (&blood_thinner)
or Current_meds_8 in (&blood_thinner) or Current_meds_9 in
(&blood_thinner) or Current_meds_10 in (&blood_thinner)or
Current_meds_11 in (&blood_thinner) or Current_meds_12 in
(&blood_thinner) or Current_meds_13 in (&blood_thinner) or
Current_meds_14 in (&blood_thinner) or Current_meds_15 in
(&blood_thinner)
or Current_meds_16 in (&blood_thinner) or Current_meds_17 in
(&blood_thinner) or Current_meds_18 in (&blood_thinner) or
Current_meds_19 in (&blood_thinner) or Current_meds_20 in
(&blood_thinner) or Current_meds_21 in (&blood_thinner) or
Current_meds_22 in (&blood_thinner) or Current_meds_23 in
(&blood_thinner)or Current_meds_24 in (&blood_thinner)or
Current_meds_25 in (&blood_thinner) or Current_meds_26 in
(&blood_thinner) or Current_meds_27 in (&blood_thinner) or
Current_meds_28 in (&blood_thinner) or Current_meds_29 in
(&blood_thinner)
or Current_meds_30 in (&blood_thinner) or Current_meds_31 in
(&blood_thinner) or Current_meds_32 in (&blood_thinner) then
blood_thinner=1; else blood_thinner=0;

if blood_thinner=1;
run;

/*Demographics for blood thinners*/
proc freq data=blood_thinner order=freq;
tables race ethnicity sex smoking alcohol drug_use ;
run;


proc univariate data=blood_thinner;
```

```
var Disease_Duration__months_1 Age;
run;

/*Types of procedures performed - blood thinner cohort*/
data Bloodthinner_proc;
set blood_thinner;
CPT_Name_1=upcase(CPT_Name_1); CPT_Name_2=upcase(CPT_Name_2);
CPT_Name_3=upcase(CPT_Name_3);
CPT_Name_4=upcase(CPT_Name_4);CPT_Name_5=upcase(CPT_Name_5);CPT_Name_6=
upcase(CPT_Name_6);

If CPT_Name_1= "CAUDAL ESI" or CPT_Name_2= "CAUDAL ESI" or CPT_Name_3=
"CAUDAL ESI" or CPT_Name_4= "CAUDAL ESI" or CPT_Name_5= "CAUDAL ESI" or
CPT_Name_6= "CAUDAL ESI" then Caudal_ESI=1; else Caudal_ESI=0;
If CPT_Name_1= "CERVICAL ESI" or CPT_Name_2= "CERVICAL ESI" or
CPT_Name_3= "CERVICAL ESI" or CPT_Name_4= "CERVICAL ESI" or CPT_Name_5=
"CERVICAL ESI" or CPT_Name_6= "CERVICAL ESI" then CERVICAL_ESI=1; else
CERVICAL_ESI=0;
If CPT_Name_1= "CERVICAL ESI/MULTIPLE TPI" or CPT_Name_2= "CERVICAL
ESI/MULTIPLE TPI" or CPT_Name_3= "CERVICAL ESI/MULTIPLE TPI" or
CPT_Name_4= "CERVICAL ESI/MULTIPLE TPI" or CPT_Name_5= "CERVICAL
ESI/MULTIPLE TPI" or CPT_Name_6= "CERVICAL ESI/MULTIPLE TPI" then
CERVICAL_ESI_MultTPI=1; else CERVICAL_ESI_MultTPI=0;
If CPT_Name_1= "GENICULAR NERVE BLOCK" or CPT_Name_2= "GENICULAR NERVE
BLOCK" or CPT_Name_3= "GENICULAR NERVE BLOCK" or CPT_Name_4= "GENICULAR
NERVE BLOCK" or CPT_Name_5= "GENICULAR NERVE BLOCK" or CPT_Name_6=
"GENICULAR NERVE BLOCK" then GENICULAR_NERVE_BLOCK=1; else
GENICULAR_NERVE_BLOCK=0;
If CPT_Name_1= "INTRA ARTICULAR HIP INJECTION" or CPT_Name_2= "INTRA
ARTICULAR HIP INJECTION" or CPT_Name_3= "INTRA ARTICULAR HIP INJECTION"
or CPT_Name_4= "INTRA ARTICULAR HIP INJECTION" or CPT_Name_5= "INTRA
ARTICULAR HIP INJECTION" or CPT_Name_6= "INTRA ARTICULAR HIP INJECTION"
then Intrarticular_Hip_Inj=1; else Intrarticular_Hip_Inj=0;
If CPT_Name_1= "INTRA ARTICULAR SIJ INJECTION" or CPT_Name_2= "INTRA
ARTICULAR SIJ INJECTION" or CPT_Name_3= "INTRA ARTICULAR SIJ INJECTION"
or CPT_Name_4= "INTRA ARTICULAR SIJ INJECTION" or CPT_Name_5= "INTRA
ARTICULAR SIJ INJECTION" or CPT_Name_6= "INTRA ARTICULAR SIJ INJECTION"
then Intrarticular_sij_Inj=1; else Intrarticular_sij_Inj=0;
If CPT_Name_1= "KNEE INJECTION" or CPT_Name_2= "KNEE INJECTION" or
CPT_Name_3= "KNEE INJECTION" or CPT_Name_4= "KNEE INJECTION" or
CPT_Name_5= "KNEE INJECTION" or CPT_Name_6= "KNEE INJECTION" then
knee_inj=1; else knee_inj=0;
If CPT_Name_1= "LATERAL FEMORAL CUTANEOUS NERVE BLOCK" or CPT_Name_2=
"LATERAL FEMORAL CUTANEOUS NERVE BLOCK" or CPT_Name_3= "LATERAL FEMORAL
CUTANEOUS NERVE BLOCK" or CPT_Name_4= "LATERAL FEMORAL CUTANEOUS NERVE
BLOCK" or CPT_Name_5= "LATERAL FEMORAL CUTANEOUS NERVE BLOCK" or
CPT_Name_6= "LATERAL FEMORAL CUTANEOUS NERVE BLOCK" then
lat_femoral_CNB=1; else lat_femoral_CNB=0;
If CPT_Name_1= "LESI" or CPT_Name_2= "LESI" or CPT_Name_3= "LESI" or
CPT_Name_4= "LESI" or CPT_Name_5= "LESI" or CPT_Name_6= "LESI" then
LESI=1; else LESI=0;
If CPT_Name_1= "LUMBAR/SACRAL MB RF" or CPT_Name_2= "LUMBAR/SACRAL MB
RF" or CPT_Name_3= "LUMBAR/SACRAL MB RF" or CPT_Name_4= "LUMBAR/SACRAL
MB RF" or CPT_Name_5= "LUMBAR/SACRAL MB RF" or CPT_Name_6=
"LUMBAR/SACRAL MB RF" then Lumb_Sac_MBRF=1; else Lumb_Sac_MBRF=0;
If CPT_Name_1= "SPINAL CORD STIMULATION TRIAL" or CPT_Name_2= "SPINAL
CORD STIMULATION TRIAL" or CPT_Name_3= "SPINAL CORD STIMULATION TRIAL"
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or CPT_Name_4= "SPINAL CORD STIMULATION TRIAL" or CPT_Name_5= "SPINAL
CORD STIMULATION TRIAL" or CPT_Name_6= "SPINAL CORD STIMULATION TRIAL"
then Stim_trial=1; else Stim_trial=0;
If CPT_Name_1= "PERMANENT SPINAL CORD STIMULATION IMPLANTATION" or
CPT_Name_2= "PERMANENT SPINAL CORD STIMULATION IMPLANTATION" or
CPT_Name_3= "PERMANENT SPINAL CORD STIMULATION IMPLANTATION" or
CPT_Name_4= "PERMANENT SPINAL CORD STIMULATION IMPLANTATION" or
CPT_Name_5= "PERMANENT SPINAL CORD STIMULATION IMPLANTATION" or
CPT_Name_6= "PERMANENT SPINAL CORD STIMULATION IMPLANTATION" then
Stim_implant=1; else Stim_implant=0;
If CPT_Name_1= "PIRIFORMIS MUSCLE INJECTION" or CPT_Name_2= "PIRIFORMIS
MUSCLE INJECTION" or CPT_Name_3= "PIRIFORMIS MUSCLE INJECTION" or
CPT_Name_4= "PIRIFORMIS MUSCLE INJECTION" or CPT_Name_5= "PIRIFORMIS
MUSCLE INJECTION" or CPT_Name_6= "PIRIFORMIS MUSCLE INJECTION" then
piriformis_inj=1; else piriformis_inj=0;
If CPT_Name_1= "RIGHT ILIOLINGUINAL/ILIOHYPOGASTRIC NERVE BLOCK" or
CPT_Name_2= "RIGHT ILIOLINGUINAL/ILIOHYPOGASTRIC NERVE BLOCK" or
CPT_Name_3= "RIGHT ILIOLINGUINAL/ILIOHYPOGASTRIC NERVE BLOCK" or
CPT_Name_4= "RIGHT ILIOLINGUINAL/ILIOHYPOGASTRIC NERVE BLOCK" or
CPT_Name_5= "RIGHT ILIOLINGUINAL/ILIOHYPOGASTRIC NERVE BLOCK" or
CPT_Name_6= "RIGHT ILIOLINGUINAL/ILIOHYPOGASTRIC NERVE BLOCK" then
Ilio_nerv_blk=1; else Ilio_nerv_blk=0;
If CPT_Name_1= "SACROCOCCYGEAL JOINT INJECTION" or CPT_Name_2=
"SACROCOCCYGEAL JOINT INJECTION" or CPT_Name_3= "SACROCOCCYGEAL JOINT
INJECTION" or CPT_Name_4= "SACROCOCCYGEAL JOINT INJECTION" or
CPT_Name_5= "SACROCOCCYGEAL JOINT INJECTION" or CPT_Name_6=
"SACROCOCCYGEAL JOINT INJECTION" then Sacrococc_Inj=1; else
Sacrococc_Inj=0;
If CPT_Name_1= "TPI" or CPT_Name_2= "TPI" or CPT_Name_3= "TPI" or
CPT_Name_4= "TPI" or CPT_Name_5= "TPI" or CPT_Name_6= "TPI" then TPI=1;
else TPI=0;
If CPT_Name_1= "TROCHANTERIC BURSA INJECTION" or CPT_Name_2=
"TROCHANTERIC BURSA INJECTION" or CPT_Name_3= "TROCHANTERIC BURSA
INJECTION" or CPT_Name_4= "TROCHANTERIC BURSA INJECTION" or CPT_Name_5=
"TROCHANTERIC BURSA INJECTION" or CPT_Name_6= "TROCHANTERIC BURSA
INJECTION" then Troch_Bursa_inj=1; else Troch_Bursa_inj=0;
If CPT_Name_1= "RIGHT SHOULDER INJECTION" or CPT_Name_2= "RIGHT
SHOULDER INJECTION" or CPT_Name_3= "RIGHT SHOULDER INJECTION" or
CPT_Name_4= "RIGHT SHOULDER INJECTION" or CPT_Name_5= "RIGHT SHOULDER
INJECTION" or CPT_Name_6= "RIGHT SHOULDER INJECTION" then
Shoulder_inj=1; else Shoulder_inj=0;
If CPT_Name_1= "TFESI" or CPT_Name_2= "TFESI" or CPT_Name_3= "TFESI" or
CPT_Name_4= "TFESI" or CPT_Name_5= "TFESI" or CPT_Name_6= "TFESI" then
TFESI=1; else TFESI=0;
If CPT_Name_1= "SUPEROLATERAL GENICULAR NEUROTOMY" or CPT_Name_2=
"SUPEROLATERAL GENICULAR NEUROTOMY" or CPT_Name_3= "SUPEROLATERAL
GENICULAR NEUROTOMY" or CPT_Name_4= "SUPEROLATERAL GENICULAR NEUROTOMY"
or CPT_Name_5= "SUPEROLATERAL GENICULAR NEUROTOMY" or CPT_Name_6=
"SUPEROLATERAL GENICULAR NEUROTOMY" then Genicular_neurotomy=1; else
Genicular_neurotomy=0;
If CPT_Name_1= "RIGHT SAPHENOUS NERVE BLOCK" or CPT_Name_2= "RIGHT
SAPHENOUS NERVE BLOCK" or CPT_Name_3= "RIGHT SAPHENOUS NERVE BLOCK" or
CPT_Name_4= "RIGHT SAPHENOUS NERVE BLOCK" or CPT_Name_5= "RIGHT
SAPHENOUS NERVE BLOCK" or CPT_Name_6= "RIGHT SAPHENOUS NERVE BLOCK"
then Saphenous_Nerv_blk=1; else Saphenous_Nerv_blk=0;
If CPT_Name_1= "RIGHT SUPRASCAPULAR NERVE BLOCK" or CPT_Name_2= "RIGHT
SUPRASCAPULAR NERVE BLOCK" or CPT_Name_3= "RIGHT SUPRASCAPULAR NERVE
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BLOCK" or CPT_Name_4= "RIGHT SUPRASCAPULAR NERVE BLOCK" or CPT_Name_5=
"RIGHT SUPRASCAPULAR NERVE BLOCK" or CPT_Name_6= "RIGHT SUPRASCAPULAR
NERVE BLOCK" then Suprascapular_nerv_blk=1; else
Suprascapular_nerv_blk=0;
If CPT_Name_1= "SIJ RF" or CPT_Name_2= "SIJ RF" or CPT_Name_3= "SIJ RF"
or CPT_Name_4= "SIJ RF" or CPT_Name_5= "SIJ RF" or CPT_Name_6= "SIJ RF"
then SIJ_RF=1; else SIJ_RF=0;


run;

/*Freq of procedures*/
proc freq data=Bloodthinner_proc;
tables Caudal_ESI CERVICAL_ESI CERVICAL_ESI_MultTPI
GENICULAR_NERVE_BLOCK Intrarticular_Hip_Inj Intrarticular_sij_Inj
knee_inj lat_femoral_CNB LESI Lumb_Sac_MBRF Stim_trial Stim_implant
piriformis_inj Ilio_nerv_blk Sacrococc_Inj TPI Troch_Bursa_inj TFESI
Shoulder_inj Genicular_neurotomy Saphenous_Nerv_blk
Suprascapular_nerv_blk SIJ_RF;
run;


/*Office visits - blood thinners*/
proc sort data=blood_thinner out=sorted_blood_thinner;
by Patient_ID;
run;

data Num_office_bloodthin;
set sorted_blood_thinner;
by Patient_ID;
if first.Patient_ID;
Num_Officevisits=0;
if First_OfficeVisit ne . then do;
Num_Officevisits=1;
if Second_OfficeVisit ne . then Num_Officevisits+1;
if Third_OfficeVisit ne . then Num_Officevisits+1;
if Fourth_OfficeVisit ne . then Num_Officevisits+1;
if Fifth_OfficeVisit ne . then Num_Officevisits+1;
if sixth_OfficeVisit ne . then Num_Officevisits+1;
if seventh_OfficeVisit ne . then Num_Officevisits+1;
if eighth_OfficeVisit ne . then Num_Officevisits+1;
if ninth_OfficeVisit ne . then Num_Officevisits+1;
if tenth_OfficeVisit ne . then Num_Officevisits+1;
if eleventh_OfficeVisit ne . then Num_Officevisits+1;
if twelve_OfficeVisit ne . then Num_Officevisits+1;
if thirteen_OfficeVisit ne . then Num_Officevisits+1;
if fourteen_OfficeVisit ne . then Num_Officevisits+1;
if fifteen_OfficeVisit ne . then Num_Officevisits+1;
if sixteen_OfficeVisit ne . then Num_Officevisits+1;
if seventeen_OfficeVisit ne . then Num_Officevisits+1;
if eighteen_OfficeVisit ne . then Num_Officevisits+1;
if nineteen_OfficeVisit ne . then Num_Officevisits+1;
if twenty_OfficeVisit ne . then Num_Officevisits+1;
if twentyone_OfficeVisit ne . then Num_Officevisits+1;
if twentytwo_OfficeVisit ne . then Num_Officevisits+1;
if twentythree_OfficeVisit ne . then Num_Officevisits+1;
if twentyfour_OfficeVisit ne . then Num_Officevisits+1;
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if twentyfive_OfficeVisit ne . then Num_Officevisits+1;
end;
else do;
Num_Officevisits=0;
end;
run;


/*Mean median office visit - blood thinner*/
proc univariate data=Num_office_bloodthin;
var Num_Officevisits;
run;


/*Descriptive characteristics - herbal meds under current meds*/

data herbal_meds;/*45 PATIENTS*/
set Finalcohort;
Current_meds_1=upcase(Current_meds_1);
Current_meds_2=upcase(Current_meds_2);
Current_meds_3=upcase(Current_meds_3);
Current_meds_4=upcase(Current_meds_4);
Current_meds_5=upcase(Current_meds_5);
Current_meds_6=upcase(Current_meds_6);Current_meds_7=upcase(Current_med
s_7);Current_meds_8=upcase(Current_meds_8);Current_meds_9=upcase(Curren
t_meds_9);Current_meds_10=upcase(Current_meds_10);Current_meds_11=upcas
e(Current_meds_11);
Current_meds_12=upcase(Current_meds_12);Current_meds_13=upcase(Current_
meds_13);Current_meds_14=upcase(Current_meds_14);Current_meds_15=upcase
(Current_meds_15);Current_meds_16=upcase(Current_meds_16);Current_meds_
17=upcase(Current_meds_17);Current_meds_18=upcase(Current_meds_18);Curr
ent_meds_19=upcase(Current_meds_19);Current_meds_20=upcase(Current_meds
_20);Current_meds_21=upcase(Current_meds_21);Current_meds_22=upcase(Cur
rent_meds_22);
Current_meds_23=upcase(Current_meds_23);
Current_meds_24=upcase(Current_meds_24);
Current_meds_25=upcase(Current_meds_25);
Current_meds_26=upcase(Current_meds_26);
Current_meds_27=upcase(Current_meds_27);
Current_meds_28=upcase(Current_meds_28);
Current_meds_29=upcase(Current_meds_29);
Current_meds_30=upcase(Current_meds_30);
Current_meds_31=upcase(Current_meds_31);
Current_meds_32=upcase(Current_meds_32);

%let herbal_meds= "GINGER ROOT" "GINKGO BILOBA" "GARLIC-PARSLEY" "GREEN
TEA EXTRACT" "GARLIC OIL" "KOREAN GINSENG" "GREEN TEA" ;
if Current_meds_1 in (&herbal_meds) or Current_meds_2 in
(&herbal_meds)or Current_meds_3 in (&herbal_meds) or Current_meds_4 in
(&herbal_meds) or Current_meds_5 in (&herbal_meds) or Current_meds_6 in
(&herbal_meds)or Current_meds_7 in (&herbal_meds) or Current_meds_8 in
(&herbal_meds) or Current_meds_9 in (&herbal_meds) or Current_meds_10
in (&herbal_meds)or Current_meds_11 in (&herbal_meds) or
Current_meds_12 in (&herbal_meds) or Current_meds_13 in (&herbal_meds)
or Current_meds_14 in (&herbal_meds) or Current_meds_15 in
(&herbal_meds)
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or Current_meds_16 in (&herbal_meds) or Current_meds_17 in
(&herbal_meds) or Current_meds_18 in (&herbal_meds) or Current_meds_19
in (&herbal_meds) or Current_meds_20 in (&herbal_meds) or
Current_meds_21 in (&herbal_meds) or Current_meds_22 in (&herbal_meds)
or Current_meds_23 in (&herbal_meds)or Current_meds_24 in
(&herbal_meds)or Current_meds_25 in (&herbal_meds) or Current_meds_26
in (&herbal_meds) or Current_meds_27 in (&herbal_meds) or
Current_meds_28 in (&herbal_meds) or Current_meds_29 in (&herbal_meds)
or Current_meds_30 in (&herbal_meds) or Current_meds_31 in
(&herbal_meds) or Current_meds_32 in (&herbal_meds) then herbal_meds=1;
else herbal_meds=0;

if herbal_meds=1;
run;

/*Freq for herbal meds*/
proc freq data=herbal_meds order=freq;
tables race ethnicity sex smoking alcohol drug_use ;
run;


proc univariate data=herbal_meds;
var Disease_Duration__months_1 Age;
run;

/*Types of procedures performed - herbal meds cohort*/
data herbal_meds_proc;
set herbal_meds;
CPT_Name_1=upcase(CPT_Name_1); CPT_Name_2=upcase(CPT_Name_2);
CPT_Name_3=upcase(CPT_Name_3);
CPT_Name_4=upcase(CPT_Name_4);CPT_Name_5=upcase(CPT_Name_5);CPT_Name_6=
upcase(CPT_Name_6);

If CPT_Name_1= "CAUDAL ESI" or CPT_Name_2= "CAUDAL ESI" or CPT_Name_3=
"CAUDAL ESI" or CPT_Name_4= "CAUDAL ESI" or CPT_Name_5= "CAUDAL ESI" or
CPT_Name_6= "CAUDAL ESI" then Caudal_ESI=1; else Caudal_ESI=0;
If CPT_Name_1= "CERVICAL ESI" or CPT_Name_2= "CERVICAL ESI" or
CPT_Name_3= "CERVICAL ESI" or CPT_Name_4= "CERVICAL ESI" or CPT_Name_5=
"CERVICAL ESI" or CPT_Name_6= "CERVICAL ESI" then CERVICAL_ESI=1; else
CERVICAL_ESI=0;
If CPT_Name_1= "CERVICAL ESI/MULTIPLE TPI" or CPT_Name_2= "CERVICAL
ESI/MULTIPLE TPI" or CPT_Name_3= "CERVICAL ESI/MULTIPLE TPI" or
CPT_Name_4= "CERVICAL ESI/MULTIPLE TPI" or CPT_Name_5= "CERVICAL
ESI/MULTIPLE TPI" or CPT_Name_6= "CERVICAL ESI/MULTIPLE TPI" then
CERVICAL_ESI_MultTPI=1; else CERVICAL_ESI_MultTPI=0;
If CPT_Name_1= "GENICULAR NERVE BLOCK" or CPT_Name_2= "GENICULAR NERVE
BLOCK" or CPT_Name_3= "GENICULAR NERVE BLOCK" or CPT_Name_4= "GENICULAR
NERVE BLOCK" or CPT_Name_5= "GENICULAR NERVE BLOCK" or CPT_Name_6=
"GENICULAR NERVE BLOCK" then GENICULAR_NERVE_BLOCK=1; else
GENICULAR_NERVE_BLOCK=0;
If CPT_Name_1= "INTRA ARTICULAR HIP INJECTION" or CPT_Name_2= "INTRA
ARTICULAR HIP INJECTION" or CPT_Name_3= "INTRA ARTICULAR HIP INJECTION"
or CPT_Name_4= "INTRA ARTICULAR HIP INJECTION" or CPT_Name_5= "INTRA
ARTICULAR HIP INJECTION" or CPT_Name_6= "INTRA ARTICULAR HIP INJECTION"
then Intrarticular_Hip_Inj=1; else Intrarticular_Hip_Inj=0;
If CPT_Name_1= "INTRA ARTICULAR SIJ INJECTION" or CPT_Name_2= "INTRA
ARTICULAR SIJ INJECTION" or CPT_Name_3= "INTRA ARTICULAR SIJ INJECTION"
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or CPT_Name_4= "INTRA ARTICULAR SIJ INJECTION" or CPT_Name_5= "INTRA
ARTICULAR SIJ INJECTION" or CPT_Name_6= "INTRA ARTICULAR SIJ INJECTION"
then Intrarticular_sij_Inj=1; else Intrarticular_sij_Inj=0;
If CPT_Name_1= "KNEE INJECTION" or CPT_Name_2= "KNEE INJECTION" or
CPT_Name_3= "KNEE INJECTION" or CPT_Name_4= "KNEE INJECTION" or
CPT_Name_5= "KNEE INJECTION" or CPT_Name_6= "KNEE INJECTION" then
knee_inj=1; else knee_inj=0;
If CPT_Name_1= "LATERAL FEMORAL CUTANEOUS NERVE BLOCK" or CPT_Name_2=
"LATERAL FEMORAL CUTANEOUS NERVE BLOCK" or CPT_Name_3= "LATERAL FEMORAL
CUTANEOUS NERVE BLOCK" or CPT_Name_4= "LATERAL FEMORAL CUTANEOUS NERVE
BLOCK" or CPT_Name_5= "LATERAL FEMORAL CUTANEOUS NERVE BLOCK" or
CPT_Name_6= "LATERAL FEMORAL CUTANEOUS NERVE BLOCK" then
lat_femoral_CNB=1; else lat_femoral_CNB=0;
If CPT_Name_1= "LESI" or CPT_Name_2= "LESI" or CPT_Name_3= "LESI" or
CPT_Name_4= "LESI" or CPT_Name_5= "LESI" or CPT_Name_6= "LESI" then
LESI=1; else LESI=0;
If CPT_Name_1= "LUMBAR/SACRAL MB RF" or CPT_Name_2= "LUMBAR/SACRAL MB
RF" or CPT_Name_3= "LUMBAR/SACRAL MB RF" or CPT_Name_4= "LUMBAR/SACRAL
MB RF" or CPT_Name_5= "LUMBAR/SACRAL MB RF" or CPT_Name_6=
"LUMBAR/SACRAL MB RF" then Lumb_Sac_MBRF=1; else Lumb_Sac_MBRF=0;
If CPT_Name_1= "SPINAL CORD STIMULATION TRIAL" or CPT_Name_2= "SPINAL
CORD STIMULATION TRIAL" or CPT_Name_3= "SPINAL CORD STIMULATION TRIAL"
or CPT_Name_4= "SPINAL CORD STIMULATION TRIAL" or CPT_Name_5= "SPINAL
CORD STIMULATION TRIAL" or CPT_Name_6= "SPINAL CORD STIMULATION TRIAL"
then Stim_trial=1; else Stim_trial=0;
If CPT_Name_1= "PERMANENT SPINAL CORD STIMULATION IMPLANTATION" or
CPT_Name_2= "PERMANENT SPINAL CORD STIMULATION IMPLANTATION" or
CPT_Name_3= "PERMANENT SPINAL CORD STIMULATION IMPLANTATION" or
CPT_Name_4= "PERMANENT SPINAL CORD STIMULATION IMPLANTATION" or
CPT_Name_5= "PERMANENT SPINAL CORD STIMULATION IMPLANTATION" or
CPT_Name_6= "PERMANENT SPINAL CORD STIMULATION IMPLANTATION" then
Stim_implant=1; else Stim_implant=0;
If CPT_Name_1= "PIRIFORMIS MUSCLE INJECTION" or CPT_Name_2= "PIRIFORMIS
MUSCLE INJECTION" or CPT_Name_3= "PIRIFORMIS MUSCLE INJECTION" or
CPT_Name_4= "PIRIFORMIS MUSCLE INJECTION" or CPT_Name_5= "PIRIFORMIS
MUSCLE INJECTION" or CPT_Name_6= "PIRIFORMIS MUSCLE INJECTION" then
piriformis_inj=1; else piriformis_inj=0;
If CPT_Name_1= "RIGHT ILIOLINGUINAL/ILIOHYPOGASTRIC NERVE BLOCK" or
CPT_Name_2= "RIGHT ILIOLINGUINAL/ILIOHYPOGASTRIC NERVE BLOCK" or
CPT_Name_3= "RIGHT ILIOLINGUINAL/ILIOHYPOGASTRIC NERVE BLOCK" or
CPT_Name_4= "RIGHT ILIOLINGUINAL/ILIOHYPOGASTRIC NERVE BLOCK" or
CPT_Name_5= "RIGHT ILIOLINGUINAL/ILIOHYPOGASTRIC NERVE BLOCK" or
CPT_Name_6= "RIGHT ILIOLINGUINAL/ILIOHYPOGASTRIC NERVE BLOCK" then
Ilio_nerv_blk=1; else Ilio_nerv_blk=0;
If CPT_Name_1= "SACROCOCCYGEAL JOINT INJECTION" or CPT_Name_2=
"SACROCOCCYGEAL JOINT INJECTION" or CPT_Name_3= "SACROCOCCYGEAL JOINT
INJECTION" or CPT_Name_4= "SACROCOCCYGEAL JOINT INJECTION" or
CPT_Name_5= "SACROCOCCYGEAL JOINT INJECTION" or CPT_Name_6=
"SACROCOCCYGEAL JOINT INJECTION" then Sacrococc_Inj=1; else
Sacrococc_Inj=0;
If CPT_Name_1= "TPI" or CPT_Name_2= "TPI" or CPT_Name_3= "TPI" or
CPT_Name_4= "TPI" or CPT_Name_5= "TPI" or CPT_Name_6= "TPI" then TPI=1;
else TPI=0;
If CPT_Name_1= "TROCHANTERIC BURSA INJECTION" or CPT_Name_2=
"TROCHANTERIC BURSA INJECTION" or CPT_Name_3= "TROCHANTERIC BURSA
INJECTION" or CPT_Name_4= "TROCHANTERIC BURSA INJECTION" or CPT_Name_5=
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"TROCHANTERIC BURSA INJECTION" or CPT_Name_6= "TROCHANTERIC BURSA
INJECTION" then Troch_Bursa_inj=1; else Troch_Bursa_inj=0;
If CPT_Name_1= "RIGHT SHOULDER INJECTION" or CPT_Name_2= "RIGHT
SHOULDER INJECTION" or CPT_Name_3= "RIGHT SHOULDER INJECTION" or
CPT_Name_4= "RIGHT SHOULDER INJECTION" or CPT_Name_5= "RIGHT SHOULDER
INJECTION" or CPT_Name_6= "RIGHT SHOULDER INJECTION" then
Shoulder_inj=1; else Shoulder_inj=0;
If CPT_Name_1= "TFESI" or CPT_Name_2= "TFESI" or CPT_Name_3= "TFESI" or
CPT_Name_4= "TFESI" or CPT_Name_5= "TFESI" or CPT_Name_6= "TFESI" then
TFESI=1; else TFESI=0;
If CPT_Name_1= "SUPEROLATERAL GENICULAR NEUROTOMY" or CPT_Name_2=
"SUPEROLATERAL GENICULAR NEUROTOMY" or CPT_Name_3= "SUPEROLATERAL
GENICULAR NEUROTOMY" or CPT_Name_4= "SUPEROLATERAL GENICULAR NEUROTOMY"
or CPT_Name_5= "SUPEROLATERAL GENICULAR NEUROTOMY" or CPT_Name_6=
"SUPEROLATERAL GENICULAR NEUROTOMY" then Genicular_neurotomy=1; else
Genicular_neurotomy=0;
If CPT_Name_1= "RIGHT SAPHENOUS NERVE BLOCK" or CPT_Name_2= "RIGHT
SAPHENOUS NERVE BLOCK" or CPT_Name_3= "RIGHT SAPHENOUS NERVE BLOCK" or
CPT_Name_4= "RIGHT SAPHENOUS NERVE BLOCK" or CPT_Name_5= "RIGHT
SAPHENOUS NERVE BLOCK" or CPT_Name_6= "RIGHT SAPHENOUS NERVE BLOCK"
then Saphenous_Nerv_blk=1; else Saphenous_Nerv_blk=0;
If CPT_Name_1= "RIGHT SUPRASCAPULAR NERVE BLOCK" or CPT_Name_2= "RIGHT
SUPRASCAPULAR NERVE BLOCK" or CPT_Name_3= "RIGHT SUPRASCAPULAR NERVE
BLOCK" or CPT_Name_4= "RIGHT SUPRASCAPULAR NERVE BLOCK" or CPT_Name_5=
"RIGHT SUPRASCAPULAR NERVE BLOCK" or CPT_Name_6= "RIGHT SUPRASCAPULAR
NERVE BLOCK" then Suprascapular_nerv_blk=1; else
Suprascapular_nerv_blk=0;
If CPT_Name_1= "SIJ RF" or CPT_Name_2= "SIJ RF" or CPT_Name_3= "SIJ RF"
or CPT_Name_4= "SIJ RF" or CPT_Name_5= "SIJ RF" or CPT_Name_6= "SIJ RF"
then SIJ_RF=1; else SIJ_RF=0;


run;

/*Freq - procedures*/
proc freq data=herbal_meds_proc;
tables Caudal_ESI CERVICAL_ESI CERVICAL_ESI_MultTPI
GENICULAR_NERVE_BLOCK Intrarticular_Hip_Inj Intrarticular_sij_Inj
knee_inj lat_femoral_CNB LESI Lumb_Sac_MBRF Stim_trial Stim_implant
piriformis_inj Ilio_nerv_blk Sacrococc_Inj TPI Troch_Bursa_inj TFESI
Shoulder_inj Genicular_neurotomy Saphenous_Nerv_blk
Suprascapular_nerv_blk SIJ_RF;
run;


/*Office visits -herbal meds*/
proc sort data=herbal_meds out=sorted_herbal_meds;
by Patient_ID;
run;

data Num_office_herbalmed;
set sorted_herbal_meds;
by Patient_ID;
if first.Patient_ID;
Num_Officevisits=0;
if First_OfficeVisit ne . then do;
Num_Officevisits=1;
```

```
if Second_OfficeVisit ne . then Num_Officevisits+1;
if Third_OfficeVisit ne . then Num_Officevisits+1;
if Fourth_OfficeVisit ne . then Num_Officevisits+1;
if Fifth_OfficeVisit ne . then Num_Officevisits+1;
if sixth_OfficeVisit ne . then Num_Officevisits+1;
if seventh_OfficeVisit ne . then Num_Officevisits+1;
if eighth_OfficeVisit ne . then Num_Officevisits+1;
if ninth_OfficeVisit ne . then Num_Officevisits+1;
if tenth_OfficeVisit ne . then Num_Officevisits+1;
if eleventh_OfficeVisit ne . then Num_Officevisits+1;
if twelve_OfficeVisit ne . then Num_Officevisits+1;
if thirteen_OfficeVisit ne . then Num_Officevisits+1;
if fourteen_OfficeVisit ne . then Num_Officevisits+1;
if fifteen_OfficeVisit ne . then Num_Officevisits+1;
if sixteen_OfficeVisit ne . then Num_Officevisits+1;
if seventeen_OfficeVisit ne . then Num_Officevisits+1;
if eighteen_OfficeVisit ne . then Num_Officevisits+1;
if nineteen_OfficeVisit ne . then Num_Officevisits+1;
if twenty_OfficeVisit ne . then Num_Officevisits+1;
if twentyone_OfficeVisit ne . then Num_Officevisits+1;
if twentytwo_OfficeVisit ne . then Num_Officevisits+1;
if twentythree_OfficeVisit ne . then Num_Officevisits+1;
if twentyfour_OfficeVisit ne . then Num_Officevisits+1;
if twentyfive_OfficeVisit ne . then Num_Officevisits+1;
end;
else do;
Num_Officevisits=0;
end;
run;

/*Mean median office visit -herbal*/
proc univariate data=Num_office_herbalmed ;
var Num_Officevisits;
run;



/*Descriptive characteristics - benzodiazepines under current meds*/

data benzo;/*67 PATIENTS*/
set Finalcohort;
Current_meds_1=upcase(Current_meds_1);
Current_meds_2=upcase(Current_meds_2);
Current_meds_3=upcase(Current_meds_3);
Current_meds_4=upcase(Current_meds_4);
Current_meds_5=upcase(Current_meds_5);
Current_meds_6=upcase(Current_meds_6);Current_meds_7=upcase(Current_med
s_7);Current_meds_8=upcase(Current_meds_8);Current_meds_9=upcase(Curren
t_meds_9);Current_meds_10=upcase(Current_meds_10);Current_meds_11=upcas
e(Current_meds_11);
Current_meds_12=upcase(Current_meds_12);Current_meds_13=upcase(Current_
meds_13);Current_meds_14=upcase(Current_meds_14);Current_meds_15=upcase
(Current_meds_15);Current_meds_16=upcase(Current_meds_16);Current_meds_
17=upcase(Current_meds_17);Current_meds_18=upcase(Current_meds_18);Curr
ent_meds_19=upcase(Current_meds_19);Current_meds_20=upcase(Current_meds
_20);Current_meds_21=upcase(Current_meds_21);Current_meds_22=upcase(Cur
rent_meds_22);
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```
Current_meds_23=upcase(Current_meds_23);
Current_meds_24=upcase(Current_meds_24);
Current_meds_25=upcase(Current_meds_25);
Current_meds_26=upcase(Current_meds_26);
Current_meds_27=upcase(Current_meds_27);
Current_meds_28=upcase(Current_meds_28);
Current_meds_29=upcase(Current_meds_29);
Current_meds_30=upcase(Current_meds_30);
Current_meds_31=upcase(Current_meds_31);
Current_meds_32=upcase(Current_meds_32);

%let benzo="ALPRAZOLAM" "LORAZEPAM" "CLONAZEPAM" "VALIUM" "ATIVAN"
"DIAZEPAM" "TEMAZEPAM" "XANAX" "KLONOPIN";
if Current_meds_1 in (&benzo) or Current_meds_2 in (&benzo) or
Current_meds_3 in (&benzo) or Current_meds_4 in (&benzo) or
Current_meds_5 in (&benzo) or Current_meds_6 in (&benzo)or
Current_meds_7 in (&benzo) or Current_meds_8 in (&benzo) or
Current_meds_9 in (&benzo) or Current_meds_10 in (&benzo)or
Current_meds_11 in (&benzo) or Current_meds_12 in (&benzo) or
Current_meds_13 in (&benzo) or Current_meds_14 in (&benzo) or
Current_meds_15 in (&benzo)
or Current_meds_16 in (&benzo) or Current_meds_17 in (&benzo) or
Current_meds_18 in (&benzo) or Current_meds_19 in (&benzo) or
Current_meds_20 in (&benzo) or Current_meds_21 in (&benzo) or
Current_meds_22 in (&benzo) or Current_meds_23 in (&benzo) or
Current_meds_24 in (&benzo)or Current_meds_25 in (&benzo) or
Current_meds_26 in (&benzo) or Current_meds_27 in (&benzo) or
Current_meds_28 in (&benzo) or Current_meds_29 in (&benzo)
or Current_meds_30 in (&benzo) or Current_meds_31 in (&benzo) or
Current_meds_32 in (&benzo) then benzo=1; else benzo=0;

if benzo=1;
run;

/*Demographics and clinical for benzo meds*/
proc freq data=benzo order=freq;
tables race ethnicity sex smoking alcohol drug_use ;
run;


proc univariate data=benzo ;
var Disease_Duration__months_1 Age;
run;

/*Types of procedures performed - benzo cohort*/
data benzo_proc;
set benzo;
CPT_Name_1=upcase(CPT_Name_1); CPT_Name_2=upcase(CPT_Name_2);
CPT_Name_3=upcase(CPT_Name_3);
CPT_Name_4=upcase(CPT_Name_4);CPT_Name_5=upcase(CPT_Name_5);CPT_Name_6=
upcase(CPT_Name_6);

If CPT_Name_1= "CAUDAL ESI" or CPT_Name_2= "CAUDAL ESI" or CPT_Name_3=
"CAUDAL ESI" or CPT_Name_4= "CAUDAL ESI" or CPT_Name_5= "CAUDAL ESI" or
CPT_Name_6= "CAUDAL ESI" then Caudal_ESI=1; else Caudal_ESI=0;
If CPT_Name_1= "CERVICAL ESI" or CPT_Name_2= "CERVICAL ESI" or
CPT_Name_3= "CERVICAL ESI" or CPT_Name_4= "CERVICAL ESI" or CPT_Name_5=
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"CERVICAL ESI" or CPT_Name_6= "CERVICAL ESI" then CERVICAL_ESI=1; else
CERVICAL_ESI=0;
If CPT_Name_1= "CERVICAL ESI/MULTIPLE TPI" or CPT_Name_2= "CERVICAL
ESI/MULTIPLE TPI" or CPT_Name_3= "CERVICAL ESI/MULTIPLE TPI" or
CPT_Name_4= "CERVICAL ESI/MULTIPLE TPI" or CPT_Name_5= "CERVICAL
ESI/MULTIPLE TPI" or CPT_Name_6= "CERVICAL ESI/MULTIPLE TPI" then
CERVICAL_ESI_MultTPI=1; else CERVICAL_ESI_MultTPI=0;
If CPT_Name_1= "GENICULAR NERVE BLOCK" or CPT_Name_2= "GENICULAR NERVE
BLOCK" or CPT_Name_3= "GENICULAR NERVE BLOCK" or CPT_Name_4= "GENICULAR
NERVE BLOCK" or CPT_Name_5= "GENICULAR NERVE BLOCK" or CPT_Name_6=
"GENICULAR NERVE BLOCK" then GENICULAR_NERVE_BLOCK=1; else
GENICULAR_NERVE_BLOCK=0;
If CPT_Name_1= "INTRA ARTICULAR HIP INJECTION" or CPT_Name_2= "INTRA
ARTICULAR HIP INJECTION" or CPT_Name_3= "INTRA ARTICULAR HIP INJECTION"
or CPT_Name_4= "INTRA ARTICULAR HIP INJECTION" or CPT_Name_5= "INTRA
ARTICULAR HIP INJECTION" or CPT_Name_6= "INTRA ARTICULAR HIP INJECTION"
then Intrarticular_Hip_Inj=1; else Intrarticular_Hip_Inj=0;
If CPT_Name_1= "INTRA ARTICULAR SIJ INJECTION" or CPT_Name_2= "INTRA
ARTICULAR SIJ INJECTION" or CPT_Name_3= "INTRA ARTICULAR SIJ INJECTION"
or CPT_Name_4= "INTRA ARTICULAR SIJ INJECTION" or CPT_Name_5= "INTRA
ARTICULAR SIJ INJECTION" or CPT_Name_6= "INTRA ARTICULAR SIJ INJECTION"
then Intrarticular_sij_Inj=1; else Intrarticular_sij_Inj=0;
If CPT_Name_1= "KNEE INJECTION" or CPT_Name_2= "KNEE INJECTION" or
CPT_Name_3= "KNEE INJECTION" or CPT_Name_4= "KNEE INJECTION" or
CPT_Name_5= "KNEE INJECTION" or CPT_Name_6= "KNEE INJECTION" then
knee_inj=1; else knee_inj=0;
If CPT_Name_1= "LATERAL FEMORAL CUTANEOUS NERVE BLOCK" or CPT_Name_2=
"LATERAL FEMORAL CUTANEOUS NERVE BLOCK" or CPT_Name_3= "LATERAL FEMORAL
CUTANEOUS NERVE BLOCK" or CPT_Name_4= "LATERAL FEMORAL CUTANEOUS NERVE
BLOCK" or CPT_Name_5= "LATERAL FEMORAL CUTANEOUS NERVE BLOCK" or
CPT_Name_6= "LATERAL FEMORAL CUTANEOUS NERVE BLOCK" then
lat_femoral_CNB=1; else lat_femoral_CNB=0;
If CPT_Name_1= "LESI" or CPT_Name_2= "LESI" or CPT_Name_3= "LESI" or
CPT_Name_4= "LESI" or CPT_Name_5= "LESI" or CPT_Name_6= "LESI" then
LESI=1; else LESI=0;
If CPT_Name_1= "LUMBAR/SACRAL MB RF" or CPT_Name_2= "LUMBAR/SACRAL MB
RF" or CPT_Name_3= "LUMBAR/SACRAL MB RF" or CPT_Name_4= "LUMBAR/SACRAL
MB RF" or CPT_Name_5= "LUMBAR/SACRAL MB RF" or CPT_Name_6=
"LUMBAR/SACRAL MB RF" then Lumb_Sac_MBRF=1; else Lumb_Sac_MBRF=0;
If CPT_Name_1= "SPINAL CORD STIMULATION TRIAL" or CPT_Name_2= "SPINAL
CORD STIMULATION TRIAL" or CPT_Name_3= "SPINAL CORD STIMULATION TRIAL"
or CPT_Name_4= "SPINAL CORD STIMULATION TRIAL" or CPT_Name_5= "SPINAL
CORD STIMULATION TRIAL" or CPT_Name_6= "SPINAL CORD STIMULATION TRIAL"
then Stim_trial=1; else Stim_trial=0;
If CPT_Name_1= "PERMANENT SPINAL CORD STIMULATION IMPLANTATION" or
CPT_Name_2= "PERMANENT SPINAL CORD STIMULATION IMPLANTATION" or
CPT_Name_3= "PERMANENT SPINAL CORD STIMULATION IMPLANTATION" or
CPT_Name_4= "PERMANENT SPINAL CORD STIMULATION IMPLANTATION" or
CPT_Name_5= "PERMANENT SPINAL CORD STIMULATION IMPLANTATION" or
CPT_Name_6= "PERMANENT SPINAL CORD STIMULATION IMPLANTATION" then
Stim_implant=1; else Stim_implant=0;
If CPT_Name_1= "PIRIFORMIS MUSCLE INJECTION" or CPT_Name_2= "PIRIFORMIS
MUSCLE INJECTION" or CPT_Name_3= "PIRIFORMIS MUSCLE INJECTION" or
CPT_Name_4= "PIRIFORMIS MUSCLE INJECTION" or CPT_Name_5= "PIRIFORMIS
MUSCLE INJECTION" or CPT_Name_6= "PIRIFORMIS MUSCLE INJECTION" then
piriformis_inj=1; else piriformis_inj=0;
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If CPT_Name_1= "RIGHT ILIOLINGUINAL/ILIOHYPOGASTRIC NERVE BLOCK" or
CPT_Name_2= "RIGHT ILIOLINGUINAL/ILIOHYPOGASTRIC NERVE BLOCK" or
CPT_Name_3= "RIGHT ILIOLINGUINAL/ILIOHYPOGASTRIC NERVE BLOCK" or
CPT_Name_4= "RIGHT ILIOLINGUINAL/ILIOHYPOGASTRIC NERVE BLOCK" or
CPT_Name_5= "RIGHT ILIOLINGUINAL/ILIOHYPOGASTRIC NERVE BLOCK" or
CPT_Name_6= "RIGHT ILIOLINGUINAL/ILIOHYPOGASTRIC NERVE BLOCK" then
Ilio_nerv_blk=1; else Ilio_nerv_blk=0;
If CPT_Name_1= "SACROCOCCYGEAL JOINT INJECTION" or CPT_Name_2=
"SACROCOCCYGEAL JOINT INJECTION" or CPT_Name_3= "SACROCOCCYGEAL JOINT
INJECTION" or CPT_Name_4= "SACROCOCCYGEAL JOINT INJECTION" or
CPT_Name_5= "SACROCOCCYGEAL JOINT INJECTION" or CPT_Name_6=
"SACROCOCCYGEAL JOINT INJECTION" then Sacrococc_Inj=1; else
Sacrococc_Inj=0;
If CPT_Name_1= "TPI" or CPT_Name_2= "TPI" or CPT_Name_3= "TPI" or
CPT_Name_4= "TPI" or CPT_Name_5= "TPI" or CPT_Name_6= "TPI" then TPI=1;
else TPI=0;
If CPT_Name_1= "TROCHANTERIC BURSA INJECTION" or CPT_Name_2=
"TROCHANTERIC BURSA INJECTION" or CPT_Name_3= "TROCHANTERIC BURSA
INJECTION" or CPT_Name_4= "TROCHANTERIC BURSA INJECTION" or CPT_Name_5=
"TROCHANTERIC BURSA INJECTION" or CPT_Name_6= "TROCHANTERIC BURSA
INJECTION" then Troch_Bursa_inj=1; else Troch_Bursa_inj=0;
If CPT_Name_1= "RIGHT SHOULDER INJECTION" or CPT_Name_2= "RIGHT
SHOULDER INJECTION" or CPT_Name_3= "RIGHT SHOULDER INJECTION" or
CPT_Name_4= "RIGHT SHOULDER INJECTION" or CPT_Name_5= "RIGHT SHOULDER
INJECTION" or CPT_Name_6= "RIGHT SHOULDER INJECTION" then
Shoulder_inj=1; else Shoulder_inj=0;
If CPT_Name_1= "TFESI" or CPT_Name_2= "TFESI" or CPT_Name_3= "TFESI" or
CPT_Name_4= "TFESI" or CPT_Name_5= "TFESI" or CPT_Name_6= "TFESI" then
TFESI=1; else TFESI=0;
If CPT_Name_1= "SUPEROLATERAL GENICULAR NEUROTOMY" or CPT_Name_2=
"SUPEROLATERAL GENICULAR NEUROTOMY" or CPT_Name_3= "SUPEROLATERAL
GENICULAR NEUROTOMY" or CPT_Name_4= "SUPEROLATERAL GENICULAR NEUROTOMY"
or CPT_Name_5= "SUPEROLATERAL GENICULAR NEUROTOMY" or CPT_Name_6=
"SUPEROLATERAL GENICULAR NEUROTOMY" then Genicular_neurotomy=1; else
Genicular_neurotomy=0;
If CPT_Name_1= "RIGHT SAPHENOUS NERVE BLOCK" or CPT_Name_2= "RIGHT
SAPHENOUS NERVE BLOCK" or CPT_Name_3= "RIGHT SAPHENOUS NERVE BLOCK" or
CPT_Name_4= "RIGHT SAPHENOUS NERVE BLOCK" or CPT_Name_5= "RIGHT
SAPHENOUS NERVE BLOCK" or CPT_Name_6= "RIGHT SAPHENOUS NERVE BLOCK"
then Saphenous_Nerv_blk=1; else Saphenous_Nerv_blk=0;
If CPT_Name_1= "RIGHT SUPRASCAPULAR NERVE BLOCK" or CPT_Name_2= "RIGHT
SUPRASCAPULAR NERVE BLOCK" or CPT_Name_3= "RIGHT SUPRASCAPULAR NERVE
BLOCK" or CPT_Name_4= "RIGHT SUPRASCAPULAR NERVE BLOCK" or CPT_Name_5=
"RIGHT SUPRASCAPULAR NERVE BLOCK" or CPT_Name_6= "RIGHT SUPRASCAPULAR
NERVE BLOCK" then Suprascapular_nerv_blk=1; else
Suprascapular_nerv_blk=0;
If CPT_Name_1= "SIJ RF" or CPT_Name_2= "SIJ RF" or CPT_Name_3= "SIJ RF"
or CPT_Name_4= "SIJ RF" or CPT_Name_5= "SIJ RF" or CPT_Name_6= "SIJ RF"
then SIJ_RF=1; else SIJ_RF=0;


run;

/*Freq- proc*/
proc freq data=benzo_proc;
tables Caudal_ESI CERVICAL_ESI CERVICAL_ESI_MultTPI
GENICULAR_NERVE_BLOCK Intrarticular_Hip_Inj Intrarticular_sij_Inj
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```
knee_inj lat_femoral_CNB LESI Lumb_Sac_MBRF Stim_trial Stim_implant
piriformis_inj Ilio_nerv_blk Sacrococc_Inj TPI Troch_Bursa_inj TFESI
Shoulder_inj Genicular_neurotomy Saphenous_Nerv_blk
Suprascapular_nerv_blk SIJ_RF;
run;


/*Office visits -benzo meds*/
proc sort data=benzo out=sorted_benzo;
by Patient_ID;
run;

data Num_office_benzo;
set sorted_benzo;
by Patient_ID;
if first.Patient_ID;
Num_Officevisits=0;
if First_OfficeVisit ne . then do;
Num_Officevisits=1;
if Second_OfficeVisit ne . then Num_Officevisits+1;
if Third_OfficeVisit ne . then Num_Officevisits+1;
if Fourth_OfficeVisit ne . then Num_Officevisits+1;
if Fifth_OfficeVisit ne . then Num_Officevisits+1;
if sixth_OfficeVisit ne . then Num_Officevisits+1;
if seventh_OfficeVisit ne . then Num_Officevisits+1;
if eighth_OfficeVisit ne . then Num_Officevisits+1;
if ninth_OfficeVisit ne . then Num_Officevisits+1;
if tenth_OfficeVisit ne . then Num_Officevisits+1;
if eleventh_OfficeVisit ne . then Num_Officevisits+1;
if twelve_OfficeVisit ne . then Num_Officevisits+1;
if thirteen_OfficeVisit ne . then Num_Officevisits+1;
if fourteen_OfficeVisit ne . then Num_Officevisits+1;
if fifteen_OfficeVisit ne . then Num_Officevisits+1;
if sixteen_OfficeVisit ne . then Num_Officevisits+1;
if seventeen_OfficeVisit ne . then Num_Officevisits+1;
if eighteen_OfficeVisit ne . then Num_Officevisits+1;
if nineteen_OfficeVisit ne . then Num_Officevisits+1;
if twenty_OfficeVisit ne . then Num_Officevisits+1;
if twentyone_OfficeVisit ne . then Num_Officevisits+1;
if twentytwo_OfficeVisit ne . then Num_Officevisits+1;
if twentythree_OfficeVisit ne . then Num_Officevisits+1;
if twentyfour_OfficeVisit ne . then Num_Officevisits+1;
if twentyfive_OfficeVisit ne . then Num_Officevisits+1;
end;
else do;
Num_Officevisits=0;
end;
run;

/*Mean median office visit -benzo*/
proc univariate data=Num_office_benzo ;
var Num_Officevisits;
run;


/*Descriptive characteristics - opioids under current meds*/
```

```
data opioid;/*121 PATIENTS*/
set Finalcohort;
Current_meds_1=upcase(Current_meds_1);
Current_meds_2=upcase(Current_meds_2);
Current_meds_3=upcase(Current_meds_3);
Current_meds_4=upcase(Current_meds_4);
Current_meds_5=upcase(Current_meds_5);
Current_meds_6=upcase(Current_meds_6);Current_meds_7=upcase(Current_med
s_7);Current_meds_8=upcase(Current_meds_8);Current_meds_9=upcase(Curren
t_meds_9);Current_meds_10=upcase(Current_meds_10);Current_meds_11=upcas
e(Current_meds_11);
Current_meds_12=upcase(Current_meds_12);Current_meds_13=upcase(Current_
meds_13);Current_meds_14=upcase(Current_meds_14);Current_meds_15=upcase
(Current_meds_15);Current_meds_16=upcase(Current_meds_16);Current_meds_
17=upcase(Current_meds_17);Current_meds_18=upcase(Current_meds_18);Curr
ent_meds_19=upcase(Current_meds_19);Current_meds_20=upcase(Current_meds
_20);Current_meds_21=upcase(Current_meds_21);Current_meds_22=upcase(Cur
rent_meds_22);
Current_meds_23=upcase(Current_meds_23);
Current_meds_24=upcase(Current_meds_24);
Current_meds_25=upcase(Current_meds_25);
Current_meds_26=upcase(Current_meds_26);
Current_meds_27=upcase(Current_meds_27);
Current_meds_28=upcase(Current_meds_28);
Current_meds_29=upcase(Current_meds_29);
Current_meds_30=upcase(Current_meds_30);
Current_meds_31=upcase(Current_meds_31);
Current_meds_32=upcase(Current_meds_32);

%let opioid="HYDROCODONE-ACETAMINOPHEN" "OXYCODONE" "OXYCODONE-
ACETAMINOPHEN" "TRAMADOL" "NORCO" "HYDROCODONE-IBUPROFEN" "HCD-APAP"
"OXYMORPHONE" "PERCOCET" "FENTANYL" "VICODIN" "MORPHINE" "XTAMPZA"
"ACETAMINOPHEN-CODEINE" "METHADONE" "ENDOCET";
if Current_meds_1 in (&opioid) or Current_meds_2 in (&opioid)or
Current_meds_3 in (&opioid) or Current_meds_4 in (&opioid) or
Current_meds_5 in (&opioid) or Current_meds_6 in (&opioid)or
Current_meds_7 in (&opioid) or Current_meds_8 in (&opioid) or
Current_meds_9 in (&opioid) or Current_meds_10 in (&opioid)or
Current_meds_11 in (&opioid) or Current_meds_12 in (&opioid) or
Current_meds_13 in (&opioid) or Current_meds_14 in (&opioid) or
Current_meds_15 in (&opioid)
or Current_meds_16 in (&opioid) or Current_meds_17 in (&opioid) or
Current_meds_18 in (&opioid) or Current_meds_19 in (&opioid) or
Current_meds_20 in (&opioid) or Current_meds_21 in (&opioid) or
Current_meds_22 in (&opioid) or Current_meds_23 in (&opioid)or
Current_meds_24 in (&opioid)or Current_meds_25 in (&opioid) or
Current_meds_26 in (&opioid) or Current_meds_27 in (&opioid) or
Current_meds_28 in (&opioid) or Current_meds_29 in (&opioid)
or Current_meds_30 in (&opioid) or Current_meds_31 in (&opioid) or
Current_meds_32 in (&opioid) then opioid=1; else opioid=0;

if opioid=1;
run;


/*Demographics and clinical for opioid meds*/
proc freq data=opioid order=freq;
```

```
tables race ethnicity sex smoking alcohol drug_use ;
run;


proc univariate data=opioid ;
var Disease_Duration__months_1 Age;
run;


/*Types of procedures performed - opioid cohort*/
data opioid_proc;
set opioid;
CPT_Name_1=upcase(CPT_Name_1); CPT_Name_2=upcase(CPT_Name_2);
CPT_Name_3=upcase(CPT_Name_3);
CPT_Name_4=upcase(CPT_Name_4);CPT_Name_5=upcase(CPT_Name_5);CPT_Name_6=
upcase(CPT_Name_6);

If CPT_Name_1= "CAUDAL ESI" or CPT_Name_2= "CAUDAL ESI" or CPT_Name_3=
"CAUDAL ESI" or CPT_Name_4= "CAUDAL ESI" or CPT_Name_5= "CAUDAL ESI" or
CPT_Name_6= "CAUDAL ESI" then Caudal_ESI=1; else Caudal_ESI=0;
If CPT_Name_1= "CERVICAL ESI" or CPT_Name_2= "CERVICAL ESI" or
CPT_Name_3= "CERVICAL ESI" or CPT_Name_4= "CERVICAL ESI" or CPT_Name_5=
"CERVICAL ESI" or CPT_Name_6= "CERVICAL ESI" then CERVICAL_ESI=1; else
CERVICAL_ESI=0;
If CPT_Name_1= "CERVICAL ESI/MULTIPLE TPI" or CPT_Name_2= "CERVICAL
ESI/MULTIPLE TPI" or CPT_Name_3= "CERVICAL ESI/MULTIPLE TPI" or
CPT_Name_4= "CERVICAL ESI/MULTIPLE TPI" or CPT_Name_5= "CERVICAL
ESI/MULTIPLE TPI" or CPT_Name_6= "CERVICAL ESI/MULTIPLE TPI" then
CERVICAL_ESI_MultTPI=1; else CERVICAL_ESI_MultTPI=0;
If CPT_Name_1= "GENICULAR NERVE BLOCK" or CPT_Name_2= "GENICULAR NERVE
BLOCK" or CPT_Name_3= "GENICULAR NERVE BLOCK" or CPT_Name_4= "GENICULAR
NERVE BLOCK" or CPT_Name_5= "GENICULAR NERVE BLOCK" or CPT_Name_6=
"GENICULAR NERVE BLOCK" then GENICULAR_NERVE_BLOCK=1; else
GENICULAR_NERVE_BLOCK=0;
If CPT_Name_1= "INTRA ARTICULAR HIP INJECTION" or CPT_Name_2= "INTRA
ARTICULAR HIP INJECTION" or CPT_Name_3= "INTRA ARTICULAR HIP INJECTION"
or CPT_Name_4= "INTRA ARTICULAR HIP INJECTION" or CPT_Name_5= "INTRA
ARTICULAR HIP INJECTION" or CPT_Name_6= "INTRA ARTICULAR HIP INJECTION"
then Intrarticular_Hip_Inj=1; else Intrarticular_Hip_Inj=0;
If CPT_Name_1= "INTRA ARTICULAR SIJ INJECTION" or CPT_Name_2= "INTRA
ARTICULAR SIJ INJECTION" or CPT_Name_3= "INTRA ARTICULAR SIJ INJECTION"
or CPT_Name_4= "INTRA ARTICULAR SIJ INJECTION" or CPT_Name_5= "INTRA
ARTICULAR SIJ INJECTION" or CPT_Name_6= "INTRA ARTICULAR SIJ INJECTION"
then Intrarticular_sij_Inj=1; else Intrarticular_sij_Inj=0;
If CPT_Name_1= "KNEE INJECTION" or CPT_Name_2= "KNEE INJECTION" or
CPT_Name_3= "KNEE INJECTION" or CPT_Name_4= "KNEE INJECTION" or
CPT_Name_5= "KNEE INJECTION" or CPT_Name_6= "KNEE INJECTION" then
knee_inj=1; else knee_inj=0;
If CPT_Name_1= "LATERAL FEMORAL CUTANEOUS NERVE BLOCK" or CPT_Name_2=
"LATERAL FEMORAL CUTANEOUS NERVE BLOCK" or CPT_Name_3= "LATERAL FEMORAL
CUTANEOUS NERVE BLOCK" or CPT_Name_4= "LATERAL FEMORAL CUTANEOUS NERVE
BLOCK" or CPT_Name_5= "LATERAL FEMORAL CUTANEOUS NERVE BLOCK" or
CPT_Name_6= "LATERAL FEMORAL CUTANEOUS NERVE BLOCK" then
lat_femoral_CNB=1; else lat_femoral_CNB=0;
If CPT_Name_1= "LESI" or CPT_Name_2= "LESI" or CPT_Name_3= "LESI" or
CPT_Name_4= "LESI" or CPT_Name_5= "LESI" or CPT_Name_6= "LESI" then
LESI=1; else LESI=0;
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If CPT_Name_1= "LUMBAR/SACRAL MB RF" or CPT_Name_2= "LUMBAR/SACRAL MB
RF" or CPT_Name_3= "LUMBAR/SACRAL MB RF" or CPT_Name_4= "LUMBAR/SACRAL
MB RF" or CPT_Name_5= "LUMBAR/SACRAL MB RF" or CPT_Name_6=
"LUMBAR/SACRAL MB RF" then Lumb_Sac_MBRF=1; else Lumb_Sac_MBRF=0;
If CPT_Name_1= "SPINAL CORD STIMULATION TRIAL" or CPT_Name_2= "SPINAL
CORD STIMULATION TRIAL" or CPT_Name_3= "SPINAL CORD STIMULATION TRIAL"
or CPT_Name_4= "SPINAL CORD STIMULATION TRIAL" or CPT_Name_5= "SPINAL
CORD STIMULATION TRIAL" or CPT_Name_6= "SPINAL CORD STIMULATION TRIAL"
then Stim_trial=1; else Stim_trial=0;
If CPT_Name_1= "PERMANENT SPINAL CORD STIMULATION IMPLANTATION" or
CPT_Name_2= "PERMANENT SPINAL CORD STIMULATION IMPLANTATION" or
CPT_Name_3= "PERMANENT SPINAL CORD STIMULATION IMPLANTATION" or
CPT_Name_4= "PERMANENT SPINAL CORD STIMULATION IMPLANTATION" or
CPT_Name_5= "PERMANENT SPINAL CORD STIMULATION IMPLANTATION" or
CPT_Name_6= "PERMANENT SPINAL CORD STIMULATION IMPLANTATION" then
Stim_implant=1; else Stim_implant=0;
If CPT_Name_1= "PIRIFORMIS MUSCLE INJECTION" or CPT_Name_2= "PIRIFORMIS
MUSCLE INJECTION" or CPT_Name_3= "PIRIFORMIS MUSCLE INJECTION" or
CPT_Name_4= "PIRIFORMIS MUSCLE INJECTION" or CPT_Name_5= "PIRIFORMIS
MUSCLE INJECTION" or CPT_Name_6= "PIRIFORMIS MUSCLE INJECTION" then
piriformis_inj=1; else piriformis_inj=0;
If CPT_Name_1= "RIGHT ILIOLINGUINAL/ILIOHYPOGASTRIC NERVE BLOCK" or
CPT_Name_2= "RIGHT ILIOLINGUINAL/ILIOHYPOGASTRIC NERVE BLOCK" or
CPT_Name_3= "RIGHT ILIOLINGUINAL/ILIOHYPOGASTRIC NERVE BLOCK" or
CPT_Name_4= "RIGHT ILIOLINGUINAL/ILIOHYPOGASTRIC NERVE BLOCK" or
CPT_Name_5= "RIGHT ILIOLINGUINAL/ILIOHYPOGASTRIC NERVE BLOCK" or
CPT_Name_6= "RIGHT ILIOLINGUINAL/ILIOHYPOGASTRIC NERVE BLOCK" then
Ilio_nerv_blk=1; else Ilio_nerv_blk=0;
If CPT_Name_1= "SACROCOCCYGEAL JOINT INJECTION" or CPT_Name_2=
"SACROCOCCYGEAL JOINT INJECTION" or CPT_Name_3= "SACROCOCCYGEAL JOINT
INJECTION" or CPT_Name_4= "SACROCOCCYGEAL JOINT INJECTION" or
CPT_Name_5= "SACROCOCCYGEAL JOINT INJECTION" or CPT_Name_6=
"SACROCOCCYGEAL JOINT INJECTION" then Sacrococc_Inj=1; else
Sacrococc_Inj=0;
If CPT_Name_1= "TPI" or CPT_Name_2= "TPI" or CPT_Name_3= "TPI" or
CPT_Name_4= "TPI" or CPT_Name_5= "TPI" or CPT_Name_6= "TPI" then TPI=1;
else TPI=0;
If CPT_Name_1= "TROCHANTERIC BURSA INJECTION" or CPT_Name_2=
"TROCHANTERIC BURSA INJECTION" or CPT_Name_3= "TROCHANTERIC BURSA
INJECTION" or CPT_Name_4= "TROCHANTERIC BURSA INJECTION" or CPT_Name_5=
"TROCHANTERIC BURSA INJECTION" or CPT_Name_6= "TROCHANTERIC BURSA
INJECTION" then Troch_Bursa_inj=1; else Troch_Bursa_inj=0;
If CPT_Name_1= "RIGHT SHOULDER INJECTION" or CPT_Name_2= "RIGHT
SHOULDER INJECTION" or CPT_Name_3= "RIGHT SHOULDER INJECTION" or
CPT_Name_4= "RIGHT SHOULDER INJECTION" or CPT_Name_5= "RIGHT SHOULDER
INJECTION" or CPT_Name_6= "RIGHT SHOULDER INJECTION" then
Shoulder_inj=1; else Shoulder_inj=0;
If CPT_Name_1= "TFESI" or CPT_Name_2= "TFESI" or CPT_Name_3= "TFESI" or
CPT_Name_4= "TFESI" or CPT_Name_5= "TFESI" or CPT_Name_6= "TFESI" then
TFESI=1; else TFESI=0;
If CPT_Name_1= "SUPEROLATERAL GENICULAR NEUROTOMY" or CPT_Name_2=
"SUPEROLATERAL GENICULAR NEUROTOMY" or CPT_Name_3= "SUPEROLATERAL
GENICULAR NEUROTOMY" or CPT_Name_4= "SUPEROLATERAL GENICULAR NEUROTOMY"
or CPT_Name_5= "SUPEROLATERAL GENICULAR NEUROTOMY" or CPT_Name_6=
"SUPEROLATERAL GENICULAR NEUROTOMY" then Genicular_neurotomy=1; else
Genicular_neurotomy=0;
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If CPT_Name_1= "RIGHT SAPHENOUS NERVE BLOCK" or CPT_Name_2= "RIGHT
SAPHENOUS NERVE BLOCK" or CPT_Name_3= "RIGHT SAPHENOUS NERVE BLOCK" or
CPT_Name_4= "RIGHT SAPHENOUS NERVE BLOCK" or CPT_Name_5= "RIGHT
SAPHENOUS NERVE BLOCK" or CPT_Name_6= "RIGHT SAPHENOUS NERVE BLOCK"
then Saphenous_Nerv_blk=1; else Saphenous_Nerv_blk=0;
If CPT_Name_1= "RIGHT SUPRASCAPULAR NERVE BLOCK" or CPT_Name_2= "RIGHT
SUPRASCAPULAR NERVE BLOCK" or CPT_Name_3= "RIGHT SUPRASCAPULAR NERVE
BLOCK" or CPT_Name_4= "RIGHT SUPRASCAPULAR NERVE BLOCK" or CPT_Name_5=
"RIGHT SUPRASCAPULAR NERVE BLOCK" or CPT_Name_6= "RIGHT SUPRASCAPULAR
NERVE BLOCK" then Suprascapular_nerv_blk=1; else
Suprascapular_nerv_blk=0;
If CPT_Name_1= "SIJ RF" or CPT_Name_2= "SIJ RF" or CPT_Name_3= "SIJ RF"
or CPT_Name_4= "SIJ RF" or CPT_Name_5= "SIJ RF" or CPT_Name_6= "SIJ RF"
then SIJ_RF=1; else SIJ_RF=0;


run;

/*Freq- proc*/
proc freq data=opioid_proc;
tables Caudal_ESI CERVICAL_ESI CERVICAL_ESI_MultTPI
GENICULAR_NERVE_BLOCK Intrarticular_Hip_Inj Intrarticular_sij_Inj
knee_inj lat_femoral_CNB LESI Lumb_Sac_MBRF Stim_trial Stim_implant
piriformis_inj Ilio_nerv_blk Sacrococc_Inj TPI Troch_Bursa_inj TFESI
Shoulder_inj Genicular_neurotomy Saphenous_Nerv_blk
Suprascapular_nerv_blk SIJ_RF;
run;


/*Office visits -opioid meds*/
proc sort data=opioid out=sorted_opioid;
by Patient_ID;
run;

data Num_office_opioid;
set sorted_opioid;
by Patient_ID;
if first.Patient_ID;
Num_Officevisits=0;
if First_OfficeVisit ne . then do;
Num_Officevisits=1;
if Second_OfficeVisit ne . then Num_Officevisits+1;
if Third_OfficeVisit ne . then Num_Officevisits+1;
if Fourth_OfficeVisit ne . then Num_Officevisits+1;
if Fifth_OfficeVisit ne . then Num_Officevisits+1;
if sixth_OfficeVisit ne . then Num_Officevisits+1;
if seventh_OfficeVisit ne . then Num_Officevisits+1;
if eighth_OfficeVisit ne . then Num_Officevisits+1;
if ninth_OfficeVisit ne . then Num_Officevisits+1;
if tenth_OfficeVisit ne . then Num_Officevisits+1;
if eleventh_OfficeVisit ne . then Num_Officevisits+1;
if twelve_OfficeVisit ne . then Num_Officevisits+1;
if thirteen_OfficeVisit ne . then Num_Officevisits+1;
if fourteen_OfficeVisit ne . then Num_Officevisits+1;
if fifteen_OfficeVisit ne . then Num_Officevisits+1;
if sixteen_OfficeVisit ne . then Num_Officevisits+1;
if seventeen_OfficeVisit ne . then Num_Officevisits+1;
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if eighteen_OfficeVisit ne . then Num_Officevisits+1;
if nineteen_OfficeVisit ne . then Num_Officevisits+1;
if twenty_OfficeVisit ne . then Num_Officevisits+1;
if twentyone_OfficeVisit ne . then Num_Officevisits+1;
if twentytwo_OfficeVisit ne . then Num_Officevisits+1;
if twentythree_OfficeVisit ne . then Num_Officevisits+1;
if twentyfour_OfficeVisit ne . then Num_Officevisits+1;
if twentyfive_OfficeVisit ne . then Num_Officevisits+1;
end;
else do;
Num_Officevisits=0;
end;
run;

/*Mean median office visit - opioid*/
proc univariate data=Num_office_opioid ;
var Num_Officevisits;
run;


/*Prevalence of ANTINEUROPATHIC MEDS*/

data FIRSTLINE;
set FinalCohort;

Current_meds_1=upcase(Current_meds_1);
Current_meds_2=upcase(Current_meds_2);
Current_meds_3=upcase(Current_meds_3);
Current_meds_4=upcase(Current_meds_4);
Current_meds_5=upcase(Current_meds_5);
Current_meds_6=upcase(Current_meds_6);Current_meds_7=upcase(Current_med
s_7);Current_meds_8=upcase(Current_meds_8);Current_meds_9=upcase(Curren
t_meds_9);Current_meds_10=upcase(Current_meds_10);Current_meds_11=upcas
e(Current_meds_11);
Current_meds_12=upcase(Current_meds_12);Current_meds_13=upcase(Current_
meds_13);Current_meds_14=upcase(Current_meds_14);Current_meds_15=upcase
(Current_meds_15);Current_meds_16=upcase(Current_meds_16);Current_meds_
17=upcase(Current_meds_17);Current_meds_18=upcase(Current_meds_18);Curr
ent_meds_19=upcase(Current_meds_19);Current_meds_20=upcase(Current_meds
_20);Current_meds_21=upcase(Current_meds_21);Current_meds_22=upcase(Cur
rent_meds_22);
Current_meds_23=upcase(Current_meds_23);
Current_meds_24=upcase(Current_meds_24);
Current_meds_25=upcase(Current_meds_25);
Current_meds_26=upcase(Current_meds_26);
Current_meds_27=upcase(Current_meds_27);
Current_meds_28=upcase(Current_meds_28);
Current_meds_29=upcase(Current_meds_29);
Current_meds_30=upcase(Current_meds_30);
Current_meds_31=upcase(Current_meds_31);
Current_meds_32=upcase(Current_meds_32);

%let FL="NORTRIPTYLINE" "PAMELOR" "DULOXETINE" "VENLAFAXINE"
"GABAPENTIN" "PREGABALIN" "LIDOCAINE" "ASPERCREME LIDOCAINE";
if Current_meds_1 in (&FL) or Current_meds_2 in (&FL)or Current_meds_3
in (&FL) or Current_meds_4 in (&FL) or Current_meds_5 in (&FL) or
Current_meds_6 in (&FL)or Current_meds_7 in (&FL) or Current_meds_8 in
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(&FL) or Current_meds_9 in (&FL) or Current_meds_10 in (&FL)or
Current_meds_11 in (&FL) or Current_meds_12 in (&FL) or Current_meds_13
in (&FL) or Current_meds_14 in (&FL) or Current_meds_15 in (&FL)
or Current_meds_16 in (&FL) or Current_meds_17 in (&FL) or
Current_meds_18 in (&FL) or Current_meds_19 in (&FL) or Current_meds_20
in (&FL) or Current_meds_21 in (&FL) or Current_meds_22 in (&FL) or
Current_meds_23 in (&FL)or Current_meds_24 in (&FL)or Current_meds_25
in (&FL) or Current_meds_26 in (&FL) or Current_meds_27 in (&FL) or
Current_meds_28 in (&FL) or Current_meds_29 in (&FL)
or Current_meds_30 in (&FL) or Current_meds_31 in (&FL) or
Current_meds_32 in (&FL) then FL=1; else FL=0;

if FL=1;
run;

/*Second line meds are opioids - prevalence calculated in the code for
opioid medication specific cohort*/

data THIRDLINE;
set FinalCohort;

Current_meds_1=upcase(Current_meds_1);
Current_meds_2=upcase(Current_meds_2);
Current_meds_3=upcase(Current_meds_3);
Current_meds_4=upcase(Current_meds_4);
Current_meds_5=upcase(Current_meds_5);
Current_meds_6=upcase(Current_meds_6);Current_meds_7=upcase(Current_med
s_7);Current_meds_8=upcase(Current_meds_8);Current_meds_9=upcase(Curren
t_meds_9);Current_meds_10=upcase(Current_meds_10);Current_meds_11=upcas
e(Current_meds_11);
Current_meds_12=upcase(Current_meds_12);Current_meds_13=upcase(Current_
meds_13);Current_meds_14=upcase(Current_meds_14);Current_meds_15=upcase
(Current_meds_15);Current_meds_16=upcase(Current_meds_16);Current_meds_
17=upcase(Current_meds_17);Current_meds_18=upcase(Current_meds_18);Curr
ent_meds_19=upcase(Current_meds_19);Current_meds_20=upcase(Current_meds
_20);Current_meds_21=upcase(Current_meds_21);Current_meds_22=upcase(Cur
rent_meds_22);
Current_meds_23=upcase(Current_meds_23);
Current_meds_24=upcase(Current_meds_24);
Current_meds_25=upcase(Current_meds_25);
Current_meds_26=upcase(Current_meds_26);
Current_meds_27=upcase(Current_meds_27);
Current_meds_28=upcase(Current_meds_28);
Current_meds_29=upcase(Current_meds_29);
Current_meds_30=upcase(Current_meds_30);
Current_meds_31=upcase(Current_meds_31);
Current_meds_32=upcase(Current_meds_32);

%let TL="BUPROPION" "WELLBUTRIN" "CITALOPRAM" "CELEXA" "PAROXETINE"
"LAMOTRIGINE" "LAMICTAL" "TOPIRAMATE" "TOPAMAX" "ROBITUSSIN";
if Current_meds_1 in (&TL) or Current_meds_2 in (&TL)or Current_meds_3
in (&TL) or Current_meds_4 in (&TL) or Current_meds_5 in (&TL) or
Current_meds_6 in (&TL)or Current_meds_7 in (&TL) or Current_meds_8 in
(&TL) or Current_meds_9 in (&TL) or Current_meds_10 in (&TL)or
Current_meds_11 in (&TL) or Current_meds_12 in (&TL) or Current_meds_13
in (&TL) or Current_meds_14 in (&TL) or Current_meds_15 in (&TL)
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or Current_meds_16 in (&TL) or Current_meds_17 in (&TL) or
Current_meds_18 in (&TL) or Current_meds_19 in (&TL) or Current_meds_20
in (&TL) or Current_meds_21 in (&TL) or Current_meds_22 in (&TL) or
Current_meds_23 in (&TL)or Current_meds_24 in (&TL)or Current_meds_25
in (&TL) or Current_meds_26 in (&TL) or Current_meds_27 in (&TL) or
Current_meds_28 in (&TL) or Current_meds_29 in (&TL)
or Current_meds_30 in (&TL) or Current_meds_31 in (&TL) or
Current_meds_32 in (&TL) then TL=1; else TL=0;

if TL=1; ;
run;

/*code ends here*/

/*Prevalence of patients with AF, DVT, PE, CAD*/
data atrialfib_bt;
set blood_thinner;
Comorb_1=Upcase(Comorb_1); Comorb_2=Upcase(Comorb_2);
Comorb_3=Upcase(Comorb_3); Comorb_4=Upcase(Comorb_4);
Comorb_5=Upcase(Comorb_5);Comorb_6=Upcase(Comorb_6);Comorb_7=Upcase(Com
orb_7);Comorb_8=Upcase(Comorb_8);Comorb_9=Upcase(Comorb_9);Comorb_10=Up
case(Comorb_10);Comorb_11=Upcase(Comorb_11);Comorb_12=Upcase(Comorb_12)
;Comorb_13=Upcase(Comorb_13);Comorb_14=Upcase(Comorb_14);
Comorb_15=Upcase(Comorb_15);Comorb_16=Upcase(Comorb_16);Comorb_17=Upcas
e(Comorb_17);
Comorb_18=Upcase(Comorb_18);Comorb_19=Upcase(Comorb_19);Comorb_20=Upcas
e(Comorb_20);Comorb_21=Upcase(Comorb_21);Comorb_22=Upcase(Comorb_22);Co
morb_23=Upcase(Comorb_23);Comorb_24=Upcase(Comorb_24);Comorb_25=Upcase(
Comorb_25);Comorb_26=Upcase(Comorb_26);Comorb_27=Upcase(Comorb_27);Como
rb_28=Upcase(Comorb_28);Comorb_29=Upcase(Comorb_29);


%let BTComorb="ATRIAL FIBRILLATION" "DEEP VEIN THROMBOSIS" "PULMONARY
EMBOLISM" "CAD";
if Comorb_1 in (&BTComorb) or Comorb_2 in (&BTComorb) or Comorb_3 in
(&BTComorb) or Comorb_4 in (&BTComorb) or Comorb_5 in (&BTComorb) or
Comorb_6 in (&BTComorb) or Comorb_7 in (&BTComorb) or Comorb_8 in
(&BTComorb) or Comorb_9 in (&BTComorb) or Comorb_10 in (&BTComorb) or
Comorb_11 in (&BTComorb) or Comorb_12 in (&BTComorb) or Comorb_13 in
(&BTComorb) or Comorb_14 in (&BTComorb) or Comorb_15 in (&BTComorb) or
Comorb_16 in (&BTComorb) or Comorb_17 in (&BTComorb) or Comorb_18 in
(&BTComorb) or Comorb_19 in (&BTComorb) or Comorb_20 in (&BTComorb) or
Comorb_21 in (&BTComorb) or Comorb_22 in (&BTComorb) or Comorb_23 in
(&BTComorb) or Comorb_24 in (&BTComorb) or Comorb_25 in (&BTComorb) or
Comorb_26 in (&BTComorb) or Comorb_27 in (&BTComorb) or Comorb_28 in
(&BTComorb) or Comorb_29 in (&BTComorb) then output atrialfib_bt; /*40
pts*//*486 pts- pain for more than 3 months and non-cancer adult pts */

run;
```

APPENDIX IV

List of current medications identified under each category

1) Blood thinners (Anti-coagulants and Anti-platelets)

- Aspirin
- Eliquis
- Jantoven
- Plavix
- Ecotrin
- Bayer Low Dose
- Clopidogrel
- Brilinta
- Elmiron
- Warfarin
- Xarelto
- Prasugrel

2) Herbal medicines with anticoagulant effects as identified in *Narouze et al (2017)*

- Ginger Root
- Ginkgo Biloba
- Garlic Parsley
- Green Tea Extract
- Garlic oil
- Korean Ginseng
- Green tea

3) **Benzodiazepines**

- Alprazolam
- Lorazepam
- Clonazepam
- Valium
- Ativan
- Diazepam
- Temazepam
- Xanax
- Klonopin

4) **Opioids**

- Hydrocodone Acetaminophen
- Oxycodone
- Oxycodone Acetaminophen
- Tramadol
- Norco
- Hydrocodone Ibuprofen
- Hydrocodone/APAP
- Oxymorphone
- Percocet
- Fentanyl
- Vicodin
- Morphine
- Xtampza

- Acetaminophen Codeine
- Methadone
- Endocet

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