Quality Improvement Project: Pain Management in Hospitalized Geriatric Patients with Cognitive Impairment

DNP Final Report

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Abstract

Background: Pain in cognitively impaired hospitalized geriatric patients remains prevalent and is often under-treated. Strong evidence-based publications examining pain management strategies in this population remains limited. Ensuring cognitively impaired geriatric patients receive appropriate pain management requires the use of evidence-based guidelines and literature. *Purpose*: The purpose of this DNP project was to compare current practice to evidence-based guidelines and literature about the assessment, treatment, and management of pain in hospitalized geriatric patients with cognitive impairment. The project aimed to identify if cognitively impaired, traumatically injured adults receive similar pain management regimens to cognitively intact geriatric patients admitted to the trauma service at Oregon Health and Science University (OHSU). *Conclusion*: Provider-initiated pharmaceutical treatment strategies were in accordance with current pain management guidelines. With respect to pain and cognitive assessments, the findings of this project demonstrated variability in the application of nursing-implemented pain and cognitive assessments, and providers did not document pain assessments in either group. No statistical significance was found between drug ordering or drug administration (as-needed or scheduled) in cognitively intact versus impaired participants. *Clinical Implications:* The findings of this project suggest a need for future study to evaluate nurses' and providers' decision-making regarding pain and cognitive assessments in hospitalized geriatric patients. Additional large sample multi-site randomized control trials specific to this population are needed to further evaluate for associations in pain management between cognitively intact versus cognitively impaired hospitalized geriatric patients.

Pain Management in Geriatric Patients with Cognitive Impairment

Pain in hospitalized geriatric patients with cognitive impairment poses complex management problems. Geriatric patients with cognitive impairments often have memory, speech, and language deficits that can hinder their ability to accurately report their level of discomfort to healthcare providers. Past research has shown that up to 70 percent of older hospitalized adults have a pain problem (Feast, White, Kupeli, Vickerstaff, & Sampson, 2018; Molton & Terrill, 2014), and those with cognitive impairment are at higher risk of having their pain go under-treated and are less likely to receive analgesics (Feldt, Ryden, & Miles, 1998; Morrison & Siu, 2000; Titler et al., 2003). Data continues to suggest that under-treated pain in older hospitalized adults is associated with significant physical and social consequences including exacerbation of cognitive impairment, functional loss, increased medical complications related to immobility, sleep disturbances, and increased care utilization and cost (Briggs et al., 2016; Feast et al., 2018; Leslie & Inouye, 2011). Ensuring cognitively impaired geriatric patients receive appropriate pain management requires the use of evidence-based interventions. Identifying those at risk of under-treated pain can prevent unnecessary suffering and/or undue medical complications (Briggs et al., 2016). Purpose: This DNP project compares current practice to evidence-based guidelines and literature about the assessment, treatment, and management of pain in hospitalized geriatric patients with cognitive impairment. The project aims to identify gaps in current practice and provide clinical recommendations for future practice, as indicated.

Background

The geriatric population is progressively increasing nationwide. According to the U.S Census Bureau, those aged 65 and older represent the largest segment of the U.S population (U.S

Department of Health and Human Services, 2013). Pain is a common health problem among this demographic as it is a reported characteristic in 48 to 70 percent of those aged 65 and older, (Feast et al., 2018; Molton et al., 2014) with an even higher prevalence in hospitalized cognitively impaired older adults (Corsi et al., 2018). Women are more likely to be afflicted with pain than men. Women report a longer duration of pain with increased severity (Molton et al., 2014; Corsi et al., 2018). Pain prevalence also increases from childhood to adulthood and into geriatric years, and for those aged 65 and older, pain prevalence is two times higher compared to adults aged 65 or less (Corsi et al., 2018).

Although pain is a common characteristic in this population, it is not considered a normal part of the aging process. There is also no evidence to support that geriatric patients with a cognitive impairment experience less pain. Clinical management guidelines and evidence-based literature continue to emphasize the importance of frequent pain assessments coupled with prompt pain management when caring for these patients. Yet the presence of pain in cognitively impaired geriatric patients frequently goes misdiagnosed, under-reported, and/or under-treated, thereby resulting in improper medical management (Feldt et al., 1998; Morrison et al., 2000; Titler et al., 2003).

Hospitalized older adults with cognitive impairments are less likely to receive or ask for pain medications despite similar pain diagnoses to those without cognitive impairments (Feldt et al., 1998; Morrison et al., 2000; Titler et al., 2003). Such discrepancies can be attributed to the way those with cognitive impairments often lose the linguistic functions necessary to report pain. As a result, these patients may be suffering in silence or manifesting behaviors such as agitation or aggression that caregivers and medical providers often misinterpret as a component of their cognitive impairment. When, in fact, the behavior is the result of pain. Improper management of

pain in this population can jeopardize the physical and mental wellbeing of patients and lead to poor clinical outcomes.

Inadequately treated pain in cognitively impaired geriatric patients carries negative health consequences in the acute care setting. Under-treated pain can hinder the ability of patients to participate in needed therapy for recovery and diminish life quality. Common sympathetic manifestations of pain in this group include exacerbation of base cognitive function, sleep disturbances, gait impairment, a lower degree of mobility, falls, depression, malnutrition, and reduced social participation (Briggs et al., 2016; Feast et al., 2018; Yates et al., 1998). Physiological indicators of under-treated pain include tachypnea, tachycardia, widening pulse pressure, and increased sympathetic response (Apkarian, Hashmi, & Baliki, 2011). All of which can cause costly and often unwarranted medical complications associated with poor clinical outcomes and extended hospitalization. It is the role of the medical provider to promptly identify high risk cognitively impaired geriatric patients upon hospitalization to initiate early and appropriate pain management strategies, thereby avoiding undue medical complications.

Cognitive Impairment

Twenty-one to 40 percent of hospitalized patients aged 65 and older present with a form of cognitive impairment (Reynish et al., 2017). Cognitive impairments are described as deficits that affect the way individuals process, perceive, store, and retrieve information. Multiple etiologies can lead to acute or chronic cognitive impairments. The most common neurodegenerative disorders that are known to affect cognitive performance include Alzheimer's disease, Lewy body disease, Parkinson's disease, and generalized cerebellar degeneration (Patterson, 1989). Cerebral stroke is the most frequently described vascular disorder that affects cognition and traumatic brain injuries can affect mentation in the acute or chronic setting. Other

conditions that lead to neurodegenerative dysfunction include toxicities, electrolyte abnormalities, infectious processes, or anoxic events (Reynish et al., 2017). All of the above stated physiological conditions can cause a host of cognitive deficits, including delirium and dementia.

The most common cognitive impairments in hospitalized geriatric patients are delirium and dementia. Approximately 40 percent of individuals admitted to the hospital have a diagnosis of dementia (Sampson, Blanchard, Jones, Tookman, & King, 2009), and those admitted with a diagnosis of dementia are six times more likely to admit with delirium (Whittamore, Goldberg, Gladman, Bradshaw, & Harwood, 2014). Although multiple conditions can result in cognitive impairment as mentioned above, the focus of this project was aimed towards those with dementia and/or delirium given their high prevalence in the acute care setting.

Of all the dementia classifications, Alzheimer's disease is the most common, as it affects approximately 22 million people worldwide and roughly 5 million in the United States (Mayeux & Stern, 2012). Dementia prevalence can be difficult to capture due to the various subtypes that can coexist. The majority of research regarding the prevalence of dementia focuses on the veteran population. From veteran-focused research, it is estimated that 10 percent of individuals aged 65 and older are afflicted with some form of dementia (Davis et al., 2013). A large multi-center publication examining 2.4 million veterans over 5 years found a dementia prevalence of 9.5 percent in those aged 65 to 84 and as high as 18 percent in those aged 85 and older (Krishnan et al., 2005). Given that those aged 65 and older make up the fastest-growing segment of the population, one can assume that the number of those with dementia will continue to grow rapidly, thereby posing a significant challenge to healthcare systems nationwide.

Delirium also carries a high incidence rate among Americans, as it affects more than 7 million individuals annually (American Delirium Society, 2018) and affects 10-42 percent of hospitalized patients aged 65 and older (Burton, Siddiqi, Teale, Barugh & Sutton, 2019). Unlike dementia, delirium is a reversible neurocognitive syndrome where cognitive changes occur abruptly, and symptoms can fluctuate throughout the day. The hallmark symptom that separates delirium from dementia is inattention. Delirium carries its own negative impacts for patients admitted to the hospital, as it contributes to overall mortality, morbidity, healthcare cost, (Burton et al., 2019) and often results in a diminished quality of life for both patients and caregivers (Leslie et al., 2011).

Given the high prevalence of delirium, dementia, and pain in hospitalized elderly patients, it is reasonable to assume that a large percentage of patients with delirium and/or dementia must also experience pain. The following is a review of relevant literature examining best practices for pain management in cognitively impaired elderly patients, including assessment tools, practice guidelines, and pharmacological treatment strategies. Non-pharmacological pain management strategies were not included in this review of literature.

Literature Review

Cognitive Assessment

The Diagnostic and Statistical Manual of Mental Disorders Fifth Edition (DSM-V) provide clinical recommendations for assessing cognitive impairment. Guidelines recommend that initial assessments should begin with evaluating the patient's level of consciousness followed by a comprehensive physical exam (Carey, 2015). Medical providers often miss the initial signs of cognitive impairment in hospitalized geriatric patients with a reported missed diagnosis rate as high as 70 percent (Briggs et al., 2016). Cognitive impairment may be apparent

but mistakenly attributed to the individual's age or psychiatric condition. One study found 40 percent of patients hospitalized for treatment of a hip fracture were initially referred to psychiatric services for treatment of depression and were later found to have impaired cognition due to delirium (Marcantonio et al., 2002). These findings illustrate the need for providers to complete a comprehensive exam of those presenting with cognitive impairment prior to declaring a behavioral disturbance that is psychiatric or chronic in nature.

Careful attention to the hallmark delirium symptoms of acute onset, fluctuating course, and inattention should aid in the distinction of delirium from dementia. In contrast to delirium, dementia is typically gradual, does not fluctuate much, and progresses over months to years where attention is generally intact. When in doubt, a diagnosis of delirium should be assumed, as it is often reversible once the medical cause is identified and treated. This also holds true for those hospitalized with a known dementia diagnosis, given they can also become delirious with acute illness.

Cognitive Impairment Assessment Tools

Useful clinical instruments to assess for cognitive impairment include the Confusion Assessment Method (CAM) tool. Evidence continues to support the use of CAM for delirium detection in the acute care setting. Recent publications examining bedside instruments used for delirium detection found best evidence to support the use of the CAM in the hospital setting compared to other assessment tools (Lichtner et al., 2014). The CAM tool takes less than five minutes to conduct and has a sensitivity of 94 to 100 percent and a specificity of 90 to 95 percent (Wei, Fearing, Sternberg, & Inouye, 2008). For these reasons, the CAM has become the standard of practice for delirium screening in the hospital setting. It is a fast tool that can be easily incorporated into clinicians' bedside assessments. Hospitalized patients found to be CAM

positive should be deemed delirious until all other differentials contributing to their cognitive impairment may be and ruled out.

Pain Assessment Tools

Although evidence supports that younger, cognitively intact adults receive more pain medications than older adults with similar injuries, little is known about pain management in hospitalized cognitively impaired geriatric patients. Effectively assessing and managing pain in older hospitalized adults is difficult because the ability to assess pain is often dependent on the patient's ability to subjectively report his or her experience. Research continues to show that the most reliable way to assess for pain is through the patient's ability to provide a verbal description and/or rating of pain (Karcioglu et al., 2018; Lichtner et al., 2014). Commonly used verbal pain assessment scales in the acute care setting include the Verbal Descriptor Scale and Numeric Rating Scale (Karcioglu, Topaloglu, Dikme, & Dikme, 2018). While these tools are reliable in cognitively intact persons with pain, those with cognitive impairments may struggle to properly describe their pain via verbal communication. For this reason, the accuracy of a verbal pain assessment scale decreases with the severity of cognitive impairment.

Behavioral and observation-based pain assessment tools are considered best practice in those unable to provide a reliable verbal assessment pain measure due to verbal limitations related to their cognitive impairment (Karcioglu et al., 2018). Behavioral and observational-based scales should not be used in those who are able to provide a verbal assessment measure. However, when verbal expression is severely compromised, observed behaviors become the primary form of communication. Common pain indicators in those with cognitive impairment who are unable to verbalize their pain include changes in facial expression such as grimacing, frowning, or general distortion. Patients may also vocalize i.e., moaning, sighing, or calling out,

and may change their body position or motor activity as an indication of pain (Herr, Coyne, Ely, Gélinas, & Manworren, 2019). Currently, several behavioral and observation-based pain assessment tools demonstrate with good reliability and validity the ability to capture pain in those with cognitive impairment (Lichtner et al., 2014). All of these assessment tools require a subjective evaluation by typically a nurse to determine the presence or absence of pain.

While these tools are considered best practice, it is important to note their limitations. Pain is a subjective experience that can only be measured through self-reporting or observation. In those with cognitive impairments, behavioral and observation-based pain assessment tools may misinterpret observed behaviors with overlapping conditions like hunger, thirst, need to toilet, or anxiety. For this reason, the behavioral and observation-based pain assessment tools are not specific to only pain. However, these tools are essential first steps in assessing pain in those with cognitive impairment. For those who screen positive, a comprehensive clinical evaluation to determine the cause is essential.

Pain Management Treatment Strategies

Consensus exists regarding the elements of best practice in geriatric pain management. Much of the literature and recommendations, however, are based on expert opinion given that the majority of trials focus on young adult populations with specific conditions. Few studies have been conducted on hospitalized patients aged 65 and older and even less research involves those with cognitive decline (Corsi et al., 2018; Feast et al., 2018; McLachlan et al., 2011). Publications focused on pain management in geriatric patients with cognitive impairments are generally limited to subjects with dementia in nursing home settings. Given the limited body of

evidence specific to this population, providers must individualize and closely monitor pain management regimens to ensure optimal outcomes.

Guidelines of the American Pain Society and the American Geriatric Society agree that pain management regimens should have the following components: 1) a documented pain management strategy that includes frequent pain assessments, monitoring, and reassessments; 2) institutional protocols for interdisciplinary and collaborative approaches to pain management; 3) pain alleviation strategies must include both non-pharmacological and pharmacological interventions; 4) pain control plans must be catered to individual need (Ferrell et al., 2009; Horgas, Yoon, & Grall, 2012). Current research and expert opinion in the geriatric community continues to support that pain management in those with cognitive impairment requires a comprehensive approach including behavioral evaluations, input from family or caregivers familiar to the patient's treatment preferences and past pain indicators, and evaluation of diagnoses that may be contributing to pain (Achterberg et al., 2013; Burton et al., 2019; Feast et al., 2018). Once pain is identified, rapid implementation of treatment is advised to avoid an exacerbation of functional impairments that can lead to prolonged hospitalization and increased suffering (Feast et al., 2018).

Pharmacological treatment is an intrinsic element of pain management for most patients and is particularly important for those with cognitive impairments due to their inability to participate in many non-pharmacological interventions such as cognitive-behavioral pain therapy, patient pain education, or distraction techniques. Pharmacological treatment is relatively simple to implement and generally consists of non-opioid analgesics, opioids, and other adjuvant medications. The use of non-opioid analgesics remains the first-line approach for those in pain with dementia (Ferrell et al., 2009; Herr et al., 2019; Horgas et al., 2012). Opioids, and other

adjuvant medications are second-line due to risk of adverse side effects (Ferrell et al., 2009). Drug dosage should start low with a gradual increase as indicated to allow patients to adapt and build a tolerance to therapy. Once medication dosage has reached a point of symptom relief, providers should begin to titrate drug dosage down until reaching the end of analgesic therapy.

Non-opioid analgesics comprise a group of compounds including NSAIDS, paracetamol, and salicylic acids and its derivatives (McLachlan et al., 2014). Non-opioid analgesics share therapeutic actions and have similar side effects. They are the most commonly prescribed analgesics and are the most useful in treating somatic pain with soft tissue injury and inflammatory processes (Kaye et al., 2014). Recent literature reviews are in-line with current guidelines that call for paracetamol as first line in the management of pain for cognitively impaired geriatric patients (Corbett, Husebo, Achterberg, Aarsland, Erdal, & Flo, 2014; Ferrell et al., 2009; Horgas et al., 2012). The use of non-steroidal anti-inflammatory medications (NSAID)s in this population should be used with caution due to adverse side effects.

NSAIDs carry a risk related to their roof effect. This phenomenon occurs when increasing dosage does not correlate with increased analgesic effect. Instead, dose increase correlates with increased adverse side effects (Corbett et al., 2014). Dangerous side effects related to the use of NSAIDs include life-threatening gastrointestinal and cardiac disorders (Chen & Ashcroft, 2007; Wongrakpanich, Melhado, & Rangaswami, 2018). Geriatric patients are at even higher risk, given their propensity toward peptic ulcer disorders, renal disease, coagulation disorders, and steroid use. If prescribed, providers should consider adding a garso-protection agent i.e., proton pump inhibitors to aid in risk reduction. Of note, although lower risk, paracetamol can be hepatotoxic with excess or long-term use (Yoon, Babar, Choudhary, Kutner, & Pyrsopoulos, 2016).

Psychoactive drugs such as neuroleptics and benzodiazepines should be avoided in geriatric patients with cognitive impairment, as these drugs can exacerbate their clinical condition. Other medications prone to adverse side effects in this population include the use of medications to treat neuropathic pain, such as gabapentinoids. Alternatively, medications like norepinephrine and serotonin reuptake inhibitors (SSRI) may be a sufficient alternative to more dangerous medications like NSAIDs, opioids, and gabapentinoids as they have less dangerous side effects and can raise pain thresholds in geriatric patients.

Opioids include morphine and any other compound able to produce morphine-like effects (McLachlan et al., 2014). Several synthetic variations and neuropeptide compounds are part of the opioid family. Evidence supporting the use of opioids for acute or chronic pain among cognitively impaired geriatric patients remains poor with limited clinical trials. Major side effects associated with opioids include gastrointestinal issues, tolerance, sedation, dependence, respiratory depression, and drug to drug interactions where the risk of adverse side effects increases with age. Organ function also naturally declines with age; reduced hepatic and renal blood flow impacts opioid metabolism and clearance, which can result in drug toxicity. If providers do not adjust medication dosages accordingly, increased adverse events and unwarranted medical complications related to drug toxicity may result.

Scheduled Versus As-needed Pharmaceuticals

Published evidence examining the use of scheduled pharmaceuticals in cognitively impaired hospitalized patients remains limited. The use of scheduled, as opposed to as-needed, dosing for the treatment of acute or chronic pain is a valid consideration for those who have lost the ability to communicate their level of discomfort. Evidence suggests that scheduling opioids for geriatric patients with cognitive impairment may decrease pain. One RCT conducted on 25

subjects found scheduling low dose long-acting opioids to nursing home residents aged 85 and older with known dementia decreased agitation (Manfredi et al., 2003). Behavioral symptoms such as agitation and aggression can often be the only indication of pain in those with severe cognitive impairment.

Under-treated pain provides one explanation for agitation in those with dementia. Many people with dementia also suffer from chronic, painful comorbidities that can manifest in multiple ways, including agitation. The usual treatment for agitation in those with dementia begins with identifying and eliminating the underlying cause. If agitation continues, then pharmaceutical interventions are frequently employed. Opioids may be beneficial in treating pain where agitation is the presenting symptom, but may also assist in relieving agitation when the associated distress is unrelated to physical pain. Providers should consider agitation as a possible nonspecific indicator of pain in these patients but also realize many diagnostic differentials need to be examined to determine the cause of agitation prior to administering opioids.

The use of scheduled as opposed to as-needed non-opioid analgesics in cognitively impaired hospitalized patients is also not well studied. Studies examining pain in cognitively impaired geriatric patients primarily focus on nursing home residents. One single-center double-blinded crossover study investigated the use of scheduled versus as-needed acetaminophen in individuals with severe dementia living in nursing homes. They found no change in discomfort scores between scheduled and as-needed medication administration. Less than 20 percent of individuals in the control arm of the study received as-needed acetaminophen (Paice, Noskin,Vanagunas, & Shott, 2005). The findings of this publication likely demonstrate the inadequate dosage of acetaminophen (2,600 mg per 24 hour) for the treatment of pain rather than the effectiveness of scheduled versus as-needed medication dosing. Of note, one must consider

that scheduling pain medications may result in patients receiving a higher percentage of the ordered daily dose compared to those reviving pain medications ordered as-needed. While this is true, research has found scheduled opioids resulted in higher percentages of the daily ordered dose, the amount of opioid ordered, and the amount of opioid administered did not change in scheduled versus as-needed opioid administration (Paice et al., 2005). More research is needed to better capture provider strategies in ordering scheduled versus as-needed analgesics coupled with information regarding nurses' decisions to provide as-needed analgesics.

As stated above, strong clinical trials examining pain management in cognitively impaired hospitalized geriatric patients remains sparse. Alternatively, palliative-care research focusing on pain management strategies at end of life remains robust. Many palliative-care publications widely accept the use of scheduled pain medications for non-verbal individuals at end of life, and assert that opioids are the safest most effective pain medication for moderate and severe pain (Fine et al., 2007). Given traumatically injured patients often have moderate to severe acute and chronic pain, it is reasonable to incorporate some palliative-care strategies in managing hospitalized cognitively impaired traumatically injured geriatric patients.

Incorporating palliative-care pain management strategies, like scheduling opioid and non-opioid analgesics in the acute care setting for traumatically injured, cognitively impaired, geriatric patients, may improve patient outcomes and reduce hospital cost. A single-center trial comparing palliative-care pain management strategies to traditional long-term-care pain management strategies in nursing home residents with severe dementia found palliative management strategies lead to reduced pain discomfort scores, decreased patient transfers to acute care hospitals, and lower overall cost (Volicer, Collard, Hurley, Bishop, Kern, & Karon, 1994). The Hospice and Palliative Nurses Association (2012) advocates for the use of opioids in

pain management as recommended by American Geriatrics Society and the American Pain Society. Yet patients with cognitive impairments continue to have their pain go under-treated, often due to misconceptions about opioid use regardless of well-established guidelines with more than 20 years of supporting evidence.

DNP Project Summary

In summary, pain in cognitively impaired hospitalized geriatric patients remains prevalent and is often under-treated. Strong evidence-based publications examining pain management strategies in this subgroup remains limited. Pain management guidelines continue to support the use of non-pharmacological and pharmacological interventions with frequent pain assessments catered to the needs of the individual. The use of non-opioid analgesics continues to be the first-line approach for those in pain with dementia, excluding NSAIDs due to adverse side effects (Ferrell et al., 2009; Herr et al., 2019; Horgas et al., 2012). Opioids are effective in the treatment of acute and chronic pain in elderly patients and low dose scheduled opioids were shown to reduce agitation that may be a pain indicator in this population. The utility of scheduled versus as-needed pain medications are not well studied in this group. However, palliative-care pain management strategies for non-verbal patients at the end-of-life remain robust. Therefore, it is reasonable to consider the benefit of incorporating palliative-care pain management strategies like scheduling opioid and non-opioid analgesics for cognitively impaired geriatric patients unable to verbally report their pain. The purpose of this DNP project was to compare current practice to evidence-based guidelines and literature about the assessment, treatment, and management of pain in traumatically injured geriatric patients with cognitive impairment admitted to the trauma service at OHSU. The project aimed to identify if cognitively impaired geriatric patients receive similar pain management regimens to cognitively intact geriatric

patients. This project also identified gaps in the clinical application of pain management in this population and made recommendations for future practice as indicated.

Approach to the Conduct of the Project

Based on the review of research, the most common form of cognitive impairment noted in the hospital setting is dementia and delirium. As stated previously, this subgroup is at a high risk for under-treated pain. It is important to note that cognitively impaired patients admitted through the trauma service are likely experiencing additional acute pain related to their injury. Research demonstrates that hospitalized traumatically injured patients aged 65 and older are at a higher risk of being under-triaged and medically mismanaged upon hospital admit (Llompart-Pou, Pérez-Bárcena, Chico-Fernández, Sánchez-Casado, Raurich, 2017). Therefore, this subgroup is at an even higher risk of having their acute and/or chronic pain go under-treated. Current OHSU geriatric pain management guidelines are in-line with recommendations from the American Pain Society and the American Geriatric Society. Therefore, pain management regimens among intact versus impaired patients should be adequate and similar. The focus of this project was to first identify if variability exists in the way health care providers manage pain in cognitively impaired patients to those who are cognitively intact.

Setting

The setting for this project focused on geriatric patients admitted through the trauma department at OHSU. OHSU is a level 1 trauma center in Portland, Oregon, serving more than 2,500 trauma entry patients annually. Primary data collection was a retrospective chart review. Study participants included patients aged 65 and older admitted to the trauma service Intermediate Care Unit, 13A, from October 2018 to October 2019. Patients were selected due to the frequency of their established cognitive impairment and acute/chronic pain management

regime. Eligibility criteria included: 1) age 65 and older, 2) acute or chronic pain treatment as seen through medication order set and drug administration, and 3) hospital admission to the trauma service.

Project sample size was limited due to the selected timeframe of approximately one year of trauma entry data. The number of participants were selected to ensure timely completion of the DNP project. Although the sample size was limited, the project aimed to assemble a number of participants large enough to assess for differences between groups and study outcomes. Given the size of this study, if variability exists among groups, a second retrospective analysis comprising a larger dataset is indicated. No barriers were identified in the data retrieval phase of this project. A subsequent root cause analysis may be beneficial to identify system-wide institutional gaps in patient care as indicated.

Protection of Participants

All recorded information was de-identified. No items of information that would enable the identification of any subject was recorded or stored, and no linking list of any sort was kept that would enable someone to look up the code number associated with a subject and determine the identity of the subject. On January 13, 2020, the IRB determined that the proposed DNP project was not research involving human subjects, therefore, IRB approval was not required. All HIPAA requirements for patient protection and privacy were maintained throughout the duration of the project.

Proposed Implementation and Outcome Evaluation

Data retrieval was aimed toward identifying trauma entry patients aged 65 and older with and without cognitive impairment with a subsequent evaluation of pain medication regimens in each group. Patients were deemed cognitively impaired if they had one or more of the following:

a documented history of dementia, a diagnosis of cognitive impairment, and/or a diagnosis of delirium as noted through a CAM positive nursing assessment or via provider documentation. All participants were deemed painful as evident through medication order-sets, drug administration patterns, and documented acute or chronic pain diagnoses. Both groups were evaluated for the type of pain assessment tool utilized and severity of pain with numeric scale. Pharmacologic pain management strategies were also reviewed in each group. Chi-square tests were used as appropriate to assess for associations between subgroups. Due to limited time and resources, non-pharmacological management strategies were not reviewed. Based on experience in managing trauma entry patients, it was suspected that the majority of participants would receive scheduled non-opioid analgesics and as-needed opioids for pain control. It was unknown if variability would be detected among groups regarding pain assessment and pharmacological management strategies.

Measures/Outcomes

Electronic medical records were reviewed to identify patients that met stated inclusion criteria. Most of the medical records were computer-generated documents, although some documents were scanned medical records from outside hospitals (OSH). All day-of-discharge progress notes and discharge summaries documented by the provider were reviewed. All day-of-admit H/P trauma notes documented by the admitting trauma chief were reviewed for Glasgow Coma Scale (GCS) scores upon arrival. OSH records were reviewed under Care Everywhere located in Epic for medication history, cognitive impairment diagnosis, and chronic pain diagnosis. Flowsheets under nursing documentation in Epic were reviewed for level of orientation, CAM assessment, and pain assessment tool with severity scale throughout patient admit. All data collection was obtained and evaluated. The DNP project chair and advisers meet

with the DNP candidate for evaluation and mentorship bimonthly. No other members were involved in data collection or evaluation. Each data-point was reviewed on two separate occasions to ensure accuracy. The projected cost of this DNP project was time, no monetary value was required for completion.

A sample of 97 patients met criteria for review. Twenty-three of the initial 97 participants were excluded for the following reasons: transfer to Internal Medicine (IM) service upon hospital admit (n=8), transfer to Orthopedic Surgery service upon hospital admit (n=1), transfer to Cardiology service upon hospital admit (n=2), transfer to Plastic Surgery service upon hospital admit (n=1), transfer to Emergency General Medicine (EGS) service upon hospital admit (n=1), classified as Emergency Department (ED) observation status with discharge from ED (n=9), and deceased upon arrival (n=1). Seventy-four patients met inclusion criteria and were eligible for review.

Data Abstraction

Descriptive data including patient gender, age, and total number of days admitted to the trauma service was obtained. Provider admission notes were reviewed to identify cognitive impairment, pain medications ordered, and injuries that could contribute to altered mentation. Patients were deemed cognitively impaired if they had one or more of the following: a documented history of dementia, a diagnosis of cognitive impairment, and/or a diagnosis of delirium as noted through a CAM positive nursing assessment or via provider documentation. Provider notes were reviewed for evidence of traumatic brain injury (TBI) diagnoses and GCS score documentation for evidence of altered mentation upon hospital admission. Patients found to have a GCS score less than 15 upon arrival but demonstrated intact cognition in all other assessments throughout their hospitalization were deemed to be a cognitively intact participant.

Individuals with a TBI diagnosis were also deemed cognitively intact if no other cognitive impairments were identified.

Nursing flow sheet documentation was reviewed for pain assessment, numeric pain score range, and CAM tool documentation. Type of pain assessments were evaluated for use of verbal assessment tools, non-verbal assessment tools, or both. For patients able to report pain, numeric pain score ranges between 0-10 were abstracted from lowest to highest scores on day-of-admission to day-of-discharge. For non-verbal patients, a nonverbal pain score was abstracted from lowest to highest scores on day-of-admission to day-of-discharge. All outcome measures were recorded one time for each participant. All non-opioid, opioid, and adjuvant pain medications dosages, scheduling, and frequency were recorded. Perioperative and ED administered one-time dose analgesics were not recorded.

Data Analysis

Descriptive statistics were employed to demonstrate participants' pain treatment regimens and demographic factors. Chi-square tests were chosen to assess for associations between participants (cognitively intact vs. cognitively impaired) and five primary outcomes: 1) non-opioid medications, 2) opioid medications, 3) adjuvant analgesic medications, 4) as-needed ordering, and 5) scheduled ordering.

Results

The study population's mean age was 79.3 years. Slightly more than half of the participants were male (53.2%) and less than half of the participants were female (46.8%) (See Appendix A). 35.1% percent (n=26) of participants were deemed cognitively impaired with a diagnosis of dementia (31.0%), delirium (4.1 %), mild cognitive impairment (1.4%), or were documented CAM positive (12.2%), and 64.9% (n=48) of participants were cognitively intact

(See Appendix B). Fifty-four percent (n=40) of study participants had nursing recorded CAM assessments for delirium, of this group 22.5% (n=9) were found to be CAM positive and 77.5% (n=31) were CAM negative (See Appendix B). Two of the study cohort (2.7%) were identified to be cognitively impaired and were not CAM assessed by nursing (See Appendix B). TBI was identified in 13.5% (n=10) of the study participants, of that sample, 40% (n=4) were cognitively intact participants, and 60% (n=6) were cognitively impaired participants (See Appendix B). All participants were GCS assessed by the admitting medical provider. 16.2 % (n=12) of the study group were identified with a GCS score less than 15 due verbal response; of that sample, 16.7% (n=2) were cognitively intact participants and 83.3% (n=10) were cognitively impaired participants (See Appendix B).

All participants (100%) were deemed painful as evident through pain medication order-sets, drug administration patterns, and documented acute or chronic pain diagnoses. One hundred percent of study participants had documented nursing pain assessments during hospital admit (See Appendix B). Non-verbal pain assessment scales were used in 51.4% (n=38) of participants. Of that sample, 50% (n=19) were cognitively intact participants and 50% were cognitively impaired participants (See Appendix B). Verbal pain assessment scales were used in 90.1% (n=67) of participants. Of that sample, 73.1% (n=49) were cognitively intact participants and 26.9% (n=18) were cognitively impaired participants (See Appendix B). Both Non-verbal and Verbal pain assessment scales were used in 41.9% (n=31) of study participants, of that sample, 61.3% (n=19) were cognitively intact participants and 38.7% (n=12) were cognitively impaired participants (See Appendix B). Twenty-seven percent (n=7) of those identified with cognitive impairment were not assessed with a non-verbal pain assessment scale during hospital admit (See Appendix B). All participant non-verbal and verbal numeric pain scales were

documented values ranging between 2-10. Medical providers did not document the use of pain assessment scales or numeric pain ratings.

One-hundred percent of participants were prescribed and received a form of non-opioid analgesics as follows: Tylenol (100%), ibuprofen (8.1%), topical NSAID (20.0%), lidocaine patch (27.0%), Toradol (2.7%), ketamine infusion (1.3%), and Ropivacaine PNB (4.0%). 91.8% (n=68) of study participants were prescribed and administered a form of opioid analgesics as follows: oral oxycodone (94.5%), oral hydromorphone (12.2%), tramadol (2.7%), oral morphine (2.7%), Norco (2.7%), intravenous morphine (6.7%), intravenous hydromorphone (68.9%), morphine PCA (1.3%), and fentanyl patch (1.3%). Of this sample, 67.6% (n=46) were cognitively intact and 32.4% (n=22) were cognitively impaired. 21.6 % (n=16) of participants were prescribed and administered the following adjuvant analgesics: muscle relaxants (13.5%), gabapentinoid (13,5%), or SSRI (4.0%). Of this sample, 68.7% (n=11) of the participants were cognitively intact and 31.3% (n=5) were cognitively impaired. Three (0.04%) of the cognitively intact study participants received zero pain medications (non-opioid, opioid, or adjuvant) and were therefore excluded from all calculations.

The chi-square analyses did not show statistically significant ($P<0.05$) associations between cognitively intact versus cognitively impaired participants and the five primary outcomes (non-opioid medications, opioid medications, adjuvant analgesic medications, as-needed ordering, and scheduled ordering). The non-opioid analgesics chi-square analysis is as follows: Tylenol - ordered (p=0.51), as-needed (p=0.29), and scheduled (p=0.32), ibuprofen - ordered (p=0.32), as-needed (p=0.45), scheduled (p=0.19), Toradol - ordered (p=0.29), as-needed (no p-value analysis due to constant variable), scheduled (0.29), topical NSAID (p=0.87), as-needed (p=0.19), scheduled (0.61), and lidocaine patch - ordered (p=0.57), as-needed (no p-

value analysis due to constant variable), scheduled (p=0.57) (See Appendix C). The opioid analgesics chi-square analysis is as follows: oral oxycodone - ordered (p=0.91), as-needed (p=0.20), scheduled (p=0.65), oral hydromorphone - ordered (p=0.90), as-needed (p=0.90), scheduled (p=0.65), intravenous hydromorphone - ordered (p=0.25), as-needed (p=0.06), scheduled (no p-value analysis due to constant variable), tramadol - ordered (p=0.65), as-needed (p=0.65), scheduled (no p-value analysis due to constant variable), intravenous morphine - ordered (p=0.13), as-needed (p=0.16), scheduled (no p-value analysis due to constant variable), oral morphine - ordered (p=0.15), as-needed (p=0.06), scheduled (no p-value analysis due to constant variable), and Norco - ordered (p=0.29), as-needed (p=0.29), scheduled (no p-value analysis due to constant variable) (See Appendix D). The adjuvant analgesic medication chi-square analysis is as follows: gabapentin - ordered (p=0.73), as-needed (no p-value analysis due to constant variable), scheduled (p=0.73), and muscle relaxant - ordered (p=0.28), as-needed (p=0.28), scheduled (no p-value analysis due to constant variable) (See Appendix E).

Discussion

Cognitive impairment poses a severe threat to successful pain management in hospitalized geriatric patients. Mental status alterations diminish the patient's ability to self-report pain, where the means to acquire an accurate verbal pain assessment decreases with the severity of cognitive impairment. Pain is understood to be a subjective experience with evidence supporting the patient's verbal description of pain with a numeric rating to be the most reliable source (Karcioglu et al., 2018). With respect to pain assessments, this project remains in line with previous publications supporting that most cognitively impaired geriatric patients are able to verbally report their pain (Karcioglu et al., 2018;Lichtner et al., 2014), although the severity of their cognitive impairment may jeopardize the accuracy of an independent verbal pain

assessment tool. The project further demonstrates that recorded pain assessments differed among medical provider types. Medical providers (NPs, PAs, physicians) documented zero pain assessment types or numeric scales, whereas nursing staff documented the type of pain assessment used with numeric scales in 100% of participants.

While nursing demonstrated 100% documentation of pain assessment scale (verbal, non-verbal, or both) use for all studied participants, the decision around implementing the use of a verbal pain assessment tool versus an observation-based pain assessment tool remains unclear. The project further demonstrates that as high as 27% (n=7) of those found to be cognitively impaired were not assessed with a nursing implemented observation-based pain assessment scale for the entirety of their hospitalization. Choosing the most accurate and reliable pain assessment tool is an essential first step in providing patients with effective pain management regimens. The correct pain assessment tool can lead to appropriate decision-making for pain management in hospitalized cognitively impaired patients (Gélinas, 2016). Therefore, implementing an effective and appropriate pain assessment evaluation should be a part of routine nursing care.

Observation-based pain assessment tools are considered best practice in those unable to provide a reliable verbal assessment pain measure due to their cognitive impairment (Karcioglu et al., 2018). For this reason, relying on only verbal pain assessment scales in persons deemed to be cognitively impaired is not appropriate, as it could lead to mistreated or under-treated pain. OHSU does not currently have a protocol to assist nursing in the decision-tree required for appropriate implementation of verbal versus observation-based pain assessment scales. Given the findings of this project, creating a guideline directing healthcare providers on how and when to implement verbal versus observation-based pain assessment tools for hospitalized cognitively impaired geriatric patients is advised.

Previously reviewed pain management publications did not focus on medical provider documentation of pain assessments in this patient population. The lack of provider pain assessment with a numeric scale may represent a general belief that pain assessment tools do not accurately reflect the occurrence or severity of pain in this population. Furthermore, these findings could suggest that providers do not prioritize either assessing or documenting pain, thereby relying on nursing assessments and/or documentation. Further study focusing on nursing to provider documentation and assessments of pain in this population is merited.

Cognitive Assessment

Identifying cognitive impairment in hospitalized traumatically injured geriatric patients is paramount for proving optimal pain management regimens to this high-risk population. The CAM is a well-established and useful clinical instrument that is highly specific and sensitive for the detection of delirium in the acute care setting. OHSU is in accordance with the use of the CAM as a nursing driven assessment tool for the detection of delirium in the acute care setting. However, no current OHSU protocols exist with regard to when nursing should implement a CAM assessment for high risk patients. With respect to CAM positive assessments, the DNP project supports previous findings of CAM assessments to be implemented as the gold standard in delirium detection at OHSU in the hospitalized participants. While the project found that the majority of participants were CAM assessed by nursing, 7.7% (n=2) were found to be cognitively impaired without a previous CAM assessment. The limited sample size of this

project jeopardizes its generalizability into clinical practice. Future research is indicated to evaluate how and when nursing CAM assessments are utilized in the acute care setting.

Pharmaceutical Management

Pharmacological treatment is an intrinsic element of pain management for traumatically injured cognitively impaired geriatric patients. Drug administration patterns in this study group remain in accordance with current OHSU guidelines, the American Geriatric Society, and the American Pain Society for non-opioid analgesics as first-line treatment in those deemed painful with cognitive impairment. The project further demonstrates that 100% of participants were ordered and administered non-opioid analgesics for pain. Current guidelines support that the use of non-opioid analgesics like NSAIDs should be avoided in geriatric patients due to the risk of adverse side effects. The project found minimal use of NSAIDs for those with and without cognitive impairment. Further study is indicated to determine if geriatric patients prescribed NSAIDS were also placed on a gastro-protective agent to prevent adverse side effects.

Additionally, current guidelines state that psychoactive drugs should be avoided in this population. No participants in the study cohort were prescribed high-risk psychoactive drugs for pain management. Instead, providers were in accordance with current guidelines and appropriately ordered safer alternatives like SSRI, opioids, and gabapentinoids. Lastly, no statistical significance was found between non-opioid or adjuvant analgesic drug ordering or drug administration (as-needed or scheduled) and cognitively intact versus impaired participants. These findings suggest that OHSU healthcare providers are in accordance with current guidelines for the use of non-opioid and adjuvant analgesic medication regimens in hospitalized geriatric patients.

The use of opioids (scheduled and as-needed) for traumatically injured cognitively impaired geriatric patients is not well studied. Although, limited evidence supports that those with cognitive impairment are at higher risk of having their pain go under-treated and are less likely to receive analgesics (Feldt et al., 1998; Morrison et al., 2000; Titler et al., 2003). The results of this project demonstrated that greater than 90% of participants received some form of opioid for pain management during their hospitalization, and no statistical significance was found between drug ordering or drug administration (as-needed or scheduled) in cognitively intact versus impaired participants. These findings suggest that OHSU healthcare providers are in accordance with current guidelines in the pharmaceutical management of hospitalized geriatric patients. Further study of medication dosage to quantify use among cognitively intact to cognitively impaired participants during hospital admit is recommended.

Study Limitations

The DNP project had several study limitations. First, while the design of the study allows for identification of outcome associations via chi-square analysis, the design cannot define causality. Also, the inability to clearly define the severity of cognitive impairment further weakens the study. Without a clear way to identify the severity of cognitive impairment, it is difficult to interpret pain assessment and treatment effectiveness. The cohort study sample, based on resources and time, is small, and originated from one hospital, thereby limiting the study generalizability. Lastly, all data was retrieved by a review of documentation, which may not accurately reflect actual healthcare provider practice.

Conclusion

In summary, pain in cognitively impaired hospitalized geriatric patients remains prevalent and is often under-treated. Strong evidence-based publications examining pain

management strategies in this population remains limited. Based on the findings of this project, OHSU healthcare providers are in accordance with current guidelines in the pharmacological management of pain for these patients. Potential gaps in practice were identified in pain and cognitive nursing assessments and limited provider documented pain assessments. The appropriate use of pain and cognitive assessments are paramount in identifying high-risk patients in pain. The findings of this project suggest a need for future study to evaluate nurses' and providers' decision-making regarding pain and cognitive assessments in hospitalized geriatric patients. Additional large sample, multi-site, randomized control trials specific to this population are also needed to further evaluate pain management treatment strategies in cognitively intact versus cognitively impaired hospitalized geriatric patients. Cognitively impaired hospitalized geriatric patients will benefit from future study and the application of best treatment practices.

Appendix A

Descriptive Statistics

Descriptive Statistics					
	N	Minimum	Maximum	Mean	Std. Deviation
Age	74	65.2	100.1	79.377	9.6457
Length of hospital stay	74	0	19	4.54	3.485
Gender	74	1	2	1.51	.503
GCS < 15 (due to verbal response)	74	0	2	1.73	.556
Dx of TBI	74	1	2	1.86	.344
Dx of Dementia (upon arrival, during admit, or medications)	74	1	2	1.77	.424
Dx Delirium (upon arrival, during admit, CAM positive)	74	1	2	1.88	.329
Impraied vs. Intact cognition	74	1	2	1.65	.481
Valid N (listwise)	74				

Appendix B

Frequency Tables

Impaired versus Intact Cognition					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes (Impaired)	26	27.1	35.1	35.1
	No (Intact)	48	50.0	64.9	100.0
	Total	74	77.1	100.0	
Missing	System	22	22.9		
Total		96	100.0		

Dx of Dementia (upon arrival, during admit, or current medications)					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	17	17.7	23.0	23.0
	No	57	59.4	77.0	100.0
	Total	74	77.1	100.0	
Missing	System	22	22.9		

Total		96	100.0		

Dx of Delirium
(upon arrival, during admit, or CAM positive)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	9	9.4	12.2	12.2
	No	65	67.7	87.8	100.0
	Total	74	77.1	100.0	
Missing	System	22	22.9		
Total		96	100.0		

GCS < 15
(due to verbal response)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	12	12.5	16.2	21.6
	No	58	60.4	78.4	100.0
	Total	74	77.1	100.0	
Missing	System	22	22.9		

Total		96	100.0		

Dx of TBI					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	10	10.4	13.5	13.5
	No	64	66.7	86.5	100.0
	Total	74	77.1	100.0	
Missing	System	22	22.9		
Total		96	100.0		

Pain Assessment Nursing Flow Sheet Documentation					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Both	31	32.3	41.9	41.9
	Non-verbal pain scale	7	7.3	9.5	51.4
	Verbal pain scale	36	37.5	48.6	100.0
	Total	74	77.1	100.0	

Missing	System	22	22.9		
Total		96	100.0		

Pain assessment Nursing Flow Sheet Documentation (verbal, non-verbal, both)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	74	77.1	100.0	100.0
Missing	System	22	22.9		
Total		96	100.0		

CAM Nursing Assessment During Admit

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	40	41.7	54.1	54.1
	No	34	35.4	45.9	100.0
	Total	74	77.1	100.0	
Missing	System	22	22.9		
Total		96	100.0		

CAM Positive versus CAM Negative (positive = delirium)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not assessed	34	35.4	45.9	45.9
	CAM Positive	9	9.4	12.2	58.1
	CAM Negative	31	32.3	41.9	100.0
	Total	74	77.1	100.0	
Missing	System	22	22.9		
Total		96	100.0		

Nursing and Provider Assessments
(A/O x 4/4 (intact) = no: A/O less than 4 (impaired) = yes)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	21	21.9	28.4	28.4
	No	53	55.2	71.6	100.0
	Total	74	77.1	100.0	
Missing	System	22	22.9		
Total		96	100.0		

Appendix C

Chi-Square Tests: Non-opioid Medications

Impaired versus Intact Cognition * Tylenol: Ordered Chi-Square Tests					
	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	3.795[a]	1	.051		

Impaired versus Intact Cognition * Tylenol Administered: As-needed Chi-Square Tests					
	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	1.455[a]	1	.228		

Impaired versus Intact Cognition * Tylenol Administered: Scheduled Chi-Square Tests					
	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.977[a]	1	.323		

Impaired versus. Intact Cognition * Ibuprofen: Ordered
Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.977[a]	1	.323		

Impaired versus Intact Cognition * Ibuprofen Administered: Scheduled
Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.549[a]	1	.459		

Impaired versus Intact Cognition * Ibuprofen Administered: As-needed
Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	1.694[a]	1	.193		
N of Valid Cases	74				

Impaired versus Intact Cognition * Toradol: Ordered

Chi-Square Tests					
	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	1.113[a]	1	.291		

Impaired versus Intact Cognition * Toradol Administered: As-needed Chi-Square Tests		
	Value	
Pearson Chi-Square	.[a]	
N of Valid Cases	74	

a. No statistics are computed because Toradol administered: as-needed is a constant.

Impaired versus Intact Cognition * Toradol Administered: Scheduled Chi-Square Tests					
	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	1.113[a]	1	.291		

Impaired versus Intact Cognition * Topical NSAID: Ordered Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.057[a]	1	.870		

Impaired versus Intact Cognition * Topical NSAID Administered: As-needed
Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	1.694[a]	1	.193		

Impaired versus. Intact Cognition * Topical NSAID Administered: Scheduled
Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.268[a]	1	.605		

Impaired versus Intact Cognition * Lidocaine Patch: Ordered
Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.317[a]	1	.573		

Impaired versus Intact Cognition * Lidocaine Patch Administered: As-needed Chi-Square Tests	
	Value
Pearson Chi-Square	.[a]
N of Valid Cases	74

a. No statistics are computed because Lidocaine patch administered: as-needed is a constant.

Impaired versus Intact Cognition * Lidocaine Patch Administered: Scheduled Chi-Square Tests					
	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.317[a]	1	.573		

Appendix D

Chi-Square Tests: Opioid Medications

Impaired versus Intact Cognition * Oxycodone: Ordered Chi-Square Tests					
	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	2.848[a]	1	.091		

Impaired versus Intact Cognition * Oxycodone Administered: As-needed Chi-Square Tests					
	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	1.643[a]	1	.200		

Impaired versus Intact Cognition * Oxycodone Administered: Scheduled Chi-Square Tests					
	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.202[a]	1	.653		

Impaired versus Intact Cognition * Oral hydromorphone: Ordered
Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.055[a]	1	.904		

Impaired versus Intact Cognition * Oral hydromorphone Administered: As-needed
Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.065[a]	1	.904		

Impaired versus Intact Cognition * Oral hydromorphone Administered: Scheduled
Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.199[a]	1	.655		

Impaired versus Intact Cognition * Intravenous Hydromorphone: Ordered
Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	1.302[a]	1	.254		

Impaired versus Intact Cognition * Intravenous Hydromorphone Administered: As-needed Chi-Square Tests					
	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.234[a]	1	.629		

Impaired versus Intact Cognition * Intravenous Hydromorphone Administered: Scheduled Chi-Square Tests	
	Value
Pearson Chi-Square	.[a]
N of Valid Cases	74

a. No statistics are computed because Intravenous hydromorphone administered: scheduled is a constant.

Impaired versus Intact Cognition * Tramadol: Ordered Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.199[a]	1	.655		

Impaired versus Intact Cognition * Tramadol Administered: As-needed
Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.199[a]	1	.655		

Impaired versus Intact Cognition * Tramadol Administered: Scheduled
Chi-Square Tests

	Value
Pearson Chi-Square	.[a]
N of Valid Cases	74

a. No statistics are computed because Tramadol administered: scheduled is a constant.

Impaired versus Intact Cognition * Intravenous Morphine: Ordered
Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	4.736[a]	1	.130		

Impaired versus Intact Cognition * Intravenous Morphine Administered: As-needed Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	4.736[a]	1	.061		

Impaired versus Intact Cognition * Intravenous Morphine Administered: Scheduled Chi-Square Tests

	Value
Pearson Chi-Square	.[a]
N of Valid Cases	74

a. No statistics are computed because Intravenous Morphine administered: Scheduled is a constant.

Impaired versus Intact Cognition * Oral Morphine: Ordered Chi-Square Tests					
	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	3.795[a]	1	.051		

Impaired versus Intact Cognition * Oral Morphine Administered: As-needed Chi-Square Tests					
	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	3.795[a]	1	.051		

Impaired versus. Intact Cognition * Oral Morphine Administered: Scheduled Chi-Square Tests	
	Value
Pearson Chi-Square	.[a]
N of Valid Cases	**74**

a. No statistics are computed because Oral Morphine administered: scheduled is a constant.

Impaired versus Intact Cognition * Norco: Ordered Chi-Square Tests					
	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	1.113[a]	1	.291		

Impaired versus Intact Cognition * Norco Administered: As-needed Chi-Square Tests					
	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	1.113[a]	1	.291		

Impaired versus Intact Cognition * Norco Administered: Scheduled Chi-Square Tests	
	Value
Pearson Chi-Square	.[a]
N of Valid Cases	74

a. No statistics are computed because Norco administered: scheduled is a constant.

Appendix E

Chi-Square Tests: Adjuvant analgesic medications

Impaired versus Intact Cognition * Gabapentin: Ordered Chi-Square Tests					
	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.120[a]	1	.729		

Impaired versus Intact Cognition * Gabapentin Administered: As-needed Chi-Square Tests	
	Value
Pearson Chi-Square	.[a]
N of Valid Cases	74

a. No statistics are computed because Muscle relaxant administered: scheduled is a constant

Impaired versus Intact Cognition * Gabapentin Administered: Scheduled Chi-Square Tests					
	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)

Pearson Chi-Square	.120[a]	1	.729		

Impaired versus Intact Cognition * Muscle Relaxant: Ordered Chi-Square Tests					
	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	1.162[a]	1	.281		

Impaired versus Intact Cognition * Muscle Relaxant Administered: As-needed Chi-Square Tests					
	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	1.162[a]	1	.281		

Impaired versus Intact Cognition * Muscle Relaxant Administered: Scheduled Chi-Square Tests	
	Value
Pearson Chi-Square	.[a]

N of Valid Cases	74

a. No statistics are computed because Muscle relaxant administered: scheduled is a constant

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