

RUNNING OUT OF OPTIONS: IS ACCESS TO NON-PHARMACOLOGIC PAIN
MANAGEMENT TREATMENTS LINKED TO OPIOID PRESCRIPTIONS?

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ABSTRACT

Ruchir N. Karmali: Running Out of Options: Is Access to Non-Pharmacologic Pain Management Treatments Linked with Opioid Prescription?
(Under the direction of Kristen Hassmiller Lich)

The high prevalence of chronic pain and the rising opioid prescription rate impact the quality of life of older adults. Clinical guidelines recommend non-pharmacologic treatments over opioids for chronic pain. Evidence shows that opioids are used more than non-pharmacologic treatments, and opioid prescription practices differ geographically. Healthcare system characteristics can encourage or deter pain management practices. Therefore, the research objective was to understand if and how access to non-pharmacologic pain treatments is associated with opioid prescriptions patterns for older adults with a new episode of persistent musculoskeletal pain (lasting \geq three months).

From a 5% sample of fee-for-service Medicare beneficiaries enrolled from 2007-2014, we constructed a cohort of beneficiaries over 65 with a new episode of persistent musculoskeletal pain and no opioid prescriptions within the prior six months. Using claims data and the Area Health Resource File, we defined access as the provider supply and service use for two common non-pharmacologic services, physical therapy (PT) and mental health (MH). In Aim 1, greater supply of non-pharmacologic providers was associated with lower odds of an opioid prescription in the first three months of an episode. PT during the first three months of an episode was associated with lower odds of an opioid prescription in following three months. In Aim 2, greater supply of MH providers was associated with lower odds of long-term

prescriptions (≥ 90 days' supply) and high-dose prescriptions (≥ 50 Milligrams Morphine Equivalent).

In Aim 3, we explored how primary care providers in North Carolina operationalize caring for chronic pain patients as discrete responsibilities and the needs, supports, barriers, and priorities for change associated with each responsibility. Provider reported struggling to avoid prescribing opioids while trying to recommend non-pharmacologic treatments and discuss the relationship between pain and MH. Common supports included published literature, patient education, allied health professionals, electronic health records, and prescribing policies. Key barriers included poor insurance coverage and limited time. Priorities to improve chronic pain care were better patient education materials and more MH professionals.

Taken together, the findings support policies that reduce shortages and engage patients in non-pharmacologic services to improve opioid prescribing practices for chronic pain.

To Tai Aji & Aji

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LIST OF ABBREVIATIONS

AHRF	Area Health Resource File
aOR	Adjusted Odds Ratio
CDC	Centers for Disease Control and Prevention
CI	Confidence Interval
CMS	Centers for Medicare and Medicaid
CPT	Current Procedural Codes
EHR	Electronic health records
FFS	Fee for Service
FQHC	Federally Qualified Health Centers
HCPCS	Healthcare Common Procedural Coding System
HRR	Hospital Referral Region
ICD-9	International Disease Classification Code- 9 th edition
MME	Milligrams Morphine Equivalent
NC	North Carolina
NSAIDs	Nonsteroidal Anti-Inflammatory Drugs
PCP	Primary Care Provider
PT	Physical Therapy
SSI	Supplemental Security Income
SSM	System Support Mapping
TANF	Temporary Assistant for Needy Families
US	United States
WIC	Women Infants and Children

CHAPTER 1: INTRODUCTION

For over 100 million adults in the United States (US), chronic pain has a significant health and economic burden, especially for older adults (adults over 65 years old).¹ Pain is considered to be chronic when the duration of pain is more than three months, which is equivalent to the average amount of time needed for tissue to heal.² An estimated 19% to 57% of older adults suffer from chronic pain,¹ and almost two-thirds of older adults report musculoskeletal pain such as back pain, knee pain, and osteoarthritis.³ From 2012 to 2014, the direct healthcare costs and indirect costs due to lost wages for musculoskeletal pain exceeded \$320 billion dollars with older adults accounting for 37% of the cost.³

Opioids are a common strategy to relieve musculoskeletal pain, and almost a third of older adults received at least one opioid prescription in 2016.⁴ One study found that from 1999 to 2010, the opioids prescription rate for older adults with an outpatient visit increased from 4.1% to 9.0%.⁵ Short term opioid use for chronic pain management may lead to high-risk use such as long-term use and high doses which may exacerbate the harms of opioids such as overdose and mortality.⁶⁻¹⁶ Furthermore, there is a dearth of evidence supporting the efficacy of long-term and high-dose opioid use.^{9,17,18} In 2014, for every 100,000 older adults, 21 were hospitalized and nine had an emergency department visit because of opioids.⁴ In 2015, the opioid-related death rate for older adults was 1.5 deaths per 100,000 people.⁴

To prevent the risks associated with opioid prescriptions and promote safe pain practices, the Centers for Disease Control and Prevention (CDC) and the American College of Physicians have the following recommendations: 1. Use non-pharmacologic therapies and non-opioid

medications before opioids; 2. Opioids are appropriate when the potential for pain relief is greater than the potential for risks and if other treatments are unsuccessful; 3. Multi-modal treatments should be used.^{18,19}

Non-pharmacologic treatments address the biological, social, and psychological factors that contribute to the experience of pain by encouraging the development of positive self-management behaviors such as exercise, weight loss, coping strategies, and reduced reliance on medications.²⁰⁻²⁴ Such strategies improve levels of pain and functional outcomes among older adults and also have fewer side effects than medications.^{23,25-27}

Despite evidence regarding non-pharmacologic treatments and opioids for chronic pain for older adults, current trends show that opioids are used more frequently than non-pharmacologic treatments.^{26,28-32} From 2000-2007, the opioid prescription rate was twice the referral rate of psychotherapy and almost seven times the referral rate of physical therapy for ambulatory visits for chronic pain for adults.³¹ Furthermore, there is geographic variation in opioid prescriptions and opioid-related outcomes.³³⁻³⁷ In 2015, the state opioid prescribing rates ranged from 41.9 (Hawaii) to 121.0 prescriptions (Alabama) for every 100 people.³⁸ Opioid-related death rates in 2016 ranged from 0.9 (Texas) to 30.3 (New Hampshire) deaths per 100,000 persons.³⁹ Several studies have documented geographic differences in the rates of high-risk opioid prescription patterns such as long-term prescriptions and high-doses in adult populations.^{33,36,37}

Determinants of non-pharmacologic treatment use and opioid prescriptions may be due to patient, provider, and health care system characteristics.^{40,41} For example, older adults may have clinical barriers include physical and cognitive impairments associated with aging, multiple chronic conditions, multiple medications, and fragmented care.⁴²⁻⁴⁸ Furthermore, income,

knowledge, and preferences also determine non-pharmacologic service use.^{49,50} Providers may not always refer patients to non-pharmacologic services, doubt the efficacy of non-pharmacologic treatments, or lack knowledge about safe opioid prescribing practices.^{48,50-52}

Barriers in the health care system, such as insurance coverage and supply of providers, may also hinder the use of non-pharmacologic services.^{29,51,53,54}

A critical gap in research on the delivery of pain care is how the health care system may encourage or deter the use of certain pain management strategies over others, particularly the use of opioids and non-pharmacologic treatments. For example, limited availability of non-pharmacologic treatments may partially explain why non-pharmacologic services are underutilized.^{29,51,53,54} However, little is known about whether limited access to non-pharmacologic treatments is related to opioids prescription patterns. Understanding the potential sources of the geographic disparities in opioid prescriptions for pain management could inform future policies to promote safe pain management practices, implement clinical guidelines, and reduce opioid risky prescriptions.^{18,19,55}

Specific Aims

This dissertation explores whether access to non-pharmacologic treatments is associated with short-term and long-term opioid prescriptions. Access measures include (1) the supply of providers and (2) use of services. Out of the many types of non-pharmacologic treatments, physical therapy and mental health services were selected based on strong evidence supporting their use.^{18,23,26,27} The long-term goal is to study the context of treatment decisions for pain management and support decision-making in primary care settings. The overall objective is to understand if and how access to non-pharmacologic pain management treatments is associated with short-term and long-term opioid prescriptions for older adults with a new episode of musculoskeletal pain that lasts at least three months. The central hypothesis is that limited access

to non-pharmacologic providers is associated with greater opioid use. To carry out the objective, a mixed-method dissertation study with the following aims was conducted:

Quantitative Studies

Aim 1: Examine the relationship between access to non-pharmacologic providers and opioid prescription patterns during the first six months of new episode of persistent musculoskeletal pain among older adults.

- a. Hypothesis 1a: The county supply of non-pharmacologic providers will not be associated with filling an opioid prescription during Phase One (three months after an index pain diagnosis).
- b. Hypothesis 1b: A greater county supply of non-pharmacological providers will be associated with lower odds of an opioid prescription during the Phase Two (three months after Phase One).
- c. Hypothesis 1c: Mental health and physical therapy use in the Phase One will be associated with a lower odds of filling an opioid prescription in the Phase Two.
- d. Hypothesis 1d: The association between access to non-pharmacologic services and opioid prescriptions in either phase will differ by urban and rural counties.

Aim 2: Examine the relationship between access to non-pharmacologic providers and high-risk opioid prescription, such as long-term (≥ 90 days supply) and high-dose prescriptions (≥ 50 Milligrams Morphine Equivalent (MME)), during the year of new episode of persistent musculoskeletal pain among older adults.

- a. Hypothesis 1: A greater supply of non-pharmacologic providers will be associated with lower odds of high-risk opioid prescription patterns.

- b. Hypothesis 2: Use of non-pharmacologic services during the first three months of a new episode of persistent pain will be associated with lower odds of high-risk prescriptions.

Qualitative Study

Aim 3: Document the role, responsibilities, needs, supports, barriers, and priorities of primary care providers who care for older adults with chronic musculoskeletal pain and assess how these components might vary by urban and rural settings.

This study qualitatively describes how the health care context supports what providers do to care for older adults with chronic musculoskeletal pain and their priorities for how health systems can better support them. The results will guide recommendations and changes that can be applied to local settings such as changes in reimbursement, additional training, and information about best practices, or community resources.

Rationale

Significance

- a. Caring for older adults with chronic pain is a complex and significant public health challenge facing the US health care system.

Chronic pain is a prevalent condition with a significant impact on an individual's quality of life, especially for older adults.^{1,46,56} More than half of older adults suffer from chronic musculoskeletal pain, which is a subset of chronic pain.³ The burden of chronic musculoskeletal pain on the health system is significant, and one study found that adults with chronic musculoskeletal pain may use more health services (e.g. emergency department visits, hospitalizations, and opioids), and are more likely to have mental or substance use illnesses.⁵⁷

The experience of pain is described by the biopsychosocial model, which posits that physiological, psychological, and social factors can exacerbate or ameliorate pain symptoms in

chronic pain patients.²⁰ To address the biopsychosocial factors, treatment should enable self-management of pain and utilize both pharmacologic and non-pharmacologic strategies.^{1,18,19,25,58,59} Comprehensive pain management often requires the coordination of multiple providers (e.g. primary care providers, physical therapists, mental health providers, etc.) to deliver various treatment strategies (Figure 1.1).¹ However, many system and organization barriers (e.g. access to physical therapy, mental health, or pain specialists, cost of treatment, and time) impede the implementation of comprehensive and adequate pain treatment.¹ Addressing the barriers to pain care may improve patient quality of life and reduce costs.¹

Chronic pain management is complex for older adult populations because older adults are more likely to have multiple chronic conditions,⁴⁵ may use multiple medications,⁴² and may have fragmented care across multiple providers.⁴³ Furthermore, older adults may also report pain less frequently and may be at risk for under-treatment, which can worsen their quality of life.^{1,60} Furthermore, both opioid and non-opioid medications are associated with increased risk of adverse events for older adults.⁵⁵ Multiple modalities of treatment may be necessary to address the biopsychosocial factors associated with pain even if opioids are appropriate.^{18,20,25,55,59}

b. Even though opioids are the leading pain management strategy, opioids are risky and can be ineffective for long-term pain management.

Older adults are more likely have long-term opioid use to manage chronic pain.⁶¹ From 2007-2012, the rate of opioid treatment with more than 90 days' supply of opioids increased from 4.6% to 7.4% among older adults.⁶² Although the rate of misuse and abuse of opioids is lower for older adults, compared to younger adults, opioid use in older adults is associated with an increased risk of fractures, falls, cardiovascular disease, and respiratory failure.^{10,63-69} From 1999 to 2010, sales of opioids quadrupled,⁷⁰ which has led to increases in opioid-related

mortality; both trends are evident among older adults.^{5,39,66,71} While opioids may be an effective way to manage pain in the short-term, long-term opioid use is not associated with improved pain outcomes.^{9,72,73} The risk of adverse events associated with long-term opioid use is correlated with increases in opioid dose.⁷³ One fifth of Medicare beneficiaries with “chronic opioid use” have an average daily dose greater than 100 MME, more than twice the maximum dose recommended by the CDC.^{18,74} Both long-term and high-dose opioid use increase the risk of overdose and mortality.¹⁰⁻¹⁶ Opioids are especially risky for older adults who may have multiple chronic conditions, multiple medications, physical and cognitive impairments associated with aging, and fragmented care.⁴²⁻⁴⁷

c. Improving access to non-pharmacologic pain management is critical to curb opioid use and promote safe and effective pain management practice.

Implementing guideline concordant care by recommending non-pharmacologic pain treatments can reduce the use of ineffective, long-term treatments, such as opioids, and improve patient outcomes.⁷⁵⁻⁷⁸ Both physical therapy and mental health services represent evidence-based approaches to pain management that should be integrated to provide high quality pain management treatment.^{18,23,26} Evidence on non-pharmacologic treatments in older adult populations demonstrates that such services may reduce pain intensity.²⁶ For example, physical therapy not only improves physical function and reduces pain, it is associated with reductions in opioid use, emergency department use, and surgery.^{18,23,78,79} Mental health services, in various forms including cognitive behavioral therapy, relaxation training, supportive psychotherapy, group therapy, or counseling, address a patient’s pain experience and ability to perform self-management tasks.^{18,21-23} These services support patients with long-term pain management needs

by motivating patients to perform positive behaviors, such as exercise, and have been associated with reductions in opioid use.^{21,22,73,80}

Policy approaches that focus on limiting access to opioids could lead to undertreated and poorly managed pain.⁸¹ For example, the Comprehensive Addiction Recovery Act of 2016 creates a program designed to restrict individuals with high opioid use to one prescriber and pharmacy for Part D Medicare beneficiaries.⁸² The consequences of such policies may be exacerbated when there is a lack of access to non-pharmacologic services, and additional pain management strategies will be needed to support individuals with chronic pain and promote more appropriate opioid use.⁸¹ Policies that only address provider prescribing behaviors without considering the structure of the health care system may not change pain management treatment patterns.⁸³ As the US population ages, the burden of chronic pain is likely to increase and policies will need to address the health care system's capacity to support individuals with chronic pain.^{76,84} Therefore, understanding whether limited access to non-pharmacologic services promotes opioid use is critical to supporting individuals with chronic pain and preventing unintended consequences of policies restricting opioid use.

Innovation

This study was innovative in several ways. First, this study described how older adults with persistent musculoskeletal pain use of physical therapy, mental health services, and opioid prescriptions. Previous research shows that non-pharmacologic pain management strategies are used less often than opioids, especially for older adults.^{29,31,32,57} However, these studies primarily rely on self-reported data about use of non-pharmacologic services which could be subject to reporting bias or use data that does not generalize to older adults.^{29,31,32,53,57,85} While there have been several studies that have examined opioid prescriptions among Medicare beneficiaries, studies have mostly focused on disabled beneficiaries.^{33,36} Of the recent studies on opioid

prescription patterns that include older adult Medicare beneficiaries, most consider a sample of all beneficiaries who were prescribed opioids and do not isolate populations by indication (e.g. chronic musculoskeletal pain).^{62,74} Even studies on opioid use among Medicare beneficiaries with musculoskeletal pain have limited generalizability to the US population due to use of state-specific data before the rise in opioid prescriptions.^{86,87}

Second, this study explored access to non-pharmacologic services as a potential source of geographic variation in prescription opioid use among older adults with persistent musculoskeletal pain. Current research on opioid prescription patterns such as initiation of opioid treatment, long-term opioid use, and high doses of opioids have largely focused on individual factors (e.g. age, sex, comorbidities, characteristics of the first prescription, and indicators of socioeconomic status).^{6,8,33,62,74,88-93} A few studies have found lower opioid use among adults with chronic pain who use non-pharmacologic services, but evidence on older adults with persistent musculoskeletal pain is lacking.^{79,80,94,95} Some studies using county-level models have shown that the availability of healthcare measured as the supply of providers (e.g. the number of physicians, surgeons, dentists, and pharmacists) was positively associated with overall county-level opioid prescription rates.^{34,35,37,40} A previous study on older adults with an opioid prescription found significant state-level variation in long-term opioid use.⁶² Disparities in opioid prescriptions rates for urban and rural counties has also been observed, and lack of access to services may be one reason for the disparity.^{62,96} Yet, little is known about whether limited access to non-pharmacologic treatments contributes to geographic variation in opioid prescriptions rates, high-dose prescriptions, and long-term prescriptions persists among older adults with persistent musculoskeletal pain.

This dissertation was innovative because it leveraged a mixed methods study design to understand the multi-level determinants of opioid prescription patterns. This study empirically tested if access to non-pharmacologic pain management services is associated with opioid prescription patterns. Then, the qualitative results were used to bolster the empirical findings to understand what components of the health care system support or hinder safe pain management practices.

Conceptual Model

Donabedian's model for quality of care has been adapted to provide a framework for assessing the quality of care delivered to chronic pain patients as a function of the health care system's structure, the process of delivering comprehensive pain management, and the outcomes of delivering care (Figure 1.2).⁹⁷

The structure of care is defined as characteristics of the health care system in a county and characteristics of the setting of care. The structure directly influences the process of pain management, as shown by **Aim 1**, by influencing the services a provider recommends and the services a patient uses, and indirectly influences the process of care by affecting the provider's knowledge of the health care system in the short-term. The structure also directly influences high-risk prescription patterns, defined as long-term or high dose opioid prescriptions, and indirectly influences high-risk use through the process of care as shown by **Aim 2**.

Aim 3 seeks to understand the process of care defined as the care recommended by the provider and care used by the patient. The process of care influences short-term opioid use, high-risk opioid use, and ultimately, health outcomes. The process of care also reflects a feedback loop where evaluations of pain severity and health outcomes may change the pain management strategies that are used over time.

Finally, the model shows that although guideline concordance is a function of referrals, which is unobserved, actual service use was used a proxy for referrals. This study does not formally study outcomes such as overdose and mortality, but these harms are directly and significantly related to high-risk opioid use.^{12-16,69} The conceptual model also shows that substance use treatment, which addresses opioid addiction, differs from mental health care treatments recommended for chronic pain management. Finally, the model shows that both characteristics of the primary care provider and the patient may influence the care processes and opioid use.

Approach Overview

To test the hypotheses for Aims 1 and 2, we identified a cohort of Medicare beneficiaries with a new episode of persistent musculoskeletal pain. Due to ambiguous definitions of chronic pain in the literature and the desire to focus on how pain patients interact with the health care system, we refer to the presence of multiple pain diagnoses at least 90 days apart as an episode of persistent pain. A retrospective cohort study was conducted of a cohort of Medicare beneficiaries older than 65 with a new episode of persistent musculoskeletal pain that lasts more than 90 but less than 365 days. Beneficiaries did not have a pain diagnosis in the year prior to the index pain diagnosis and did not have an opioid prescription six months prior to the index pain diagnosis. This study used Medicare Fee for Service (FFS) claims for Parts A, B, and D from 2007 to 2014 to identify demographic characteristics, medical comorbidities, and health care service use (e.g. physical therapy visits, mental health service visits, and opioid prescriptions). Referencing the beneficiaries' county of residence and the index date from the claims data, the Area Health Resource File (AHRF) was used to assign county characteristics to beneficiaries.⁹⁸ Generalized estimating equations and multinomial equations were used to test the association between access to non-pharmacologic treatments and opioid prescription patterns.

For Aim 3, interviews with primary care providers from North Carolina were conducted to explore their role, responsibilities, needs, supports, barriers, and priorities using a Systems Thinking Method called System Support Mapping.⁹⁹ Differences in pain management practices for chronic musculoskeletal pain by urban and rural counties are described.

Conclusion

This research provides empirical evidence on whether access to non-pharmacologic pain management treatments, such as mental health services and physical therapy, explains the variation in opioid prescriptions for an older adult population with persistent musculoskeletal pain. By focusing on a population that is vulnerable to undertreated pain due to age-related treatment barriers, the findings can demonstrate how lack of access to alternatives may harm this population.²⁵ This dissertation innovates by focusing on two critical but potentially underutilized pieces of clinical practice, mental health services and physical therapy.⁴¹ This work is timely because it examines the intersection of two growing problems in public health: chronic pain and prescription opioid use.

This dissertation contains the following sections. Chapter 2 describes the literature about the burden of chronic pain among older adults and the evidence on chronic pain treatments, focusing on opioid and non-pharmacologic treatments. It also discusses the gaps in literature related to the predictors of opioid prescription patterns (initiation of opioids, long-term prescriptions, and high-dose prescriptions) as well as the gaps related to the practice of chronic pain management in primary care settings. Chapters 3, 4, and 5 are the manuscripts that correspond to Aims 1, 2, and 3, respectively. Chapter 6 discusses the main findings from each aim, the implications for practice and policy, limitations, and areas for future research. Tables and figures are presented at the end of each chapter, and references are at the end of the dissertation, in the numerical order that they appear in the text.

Figures

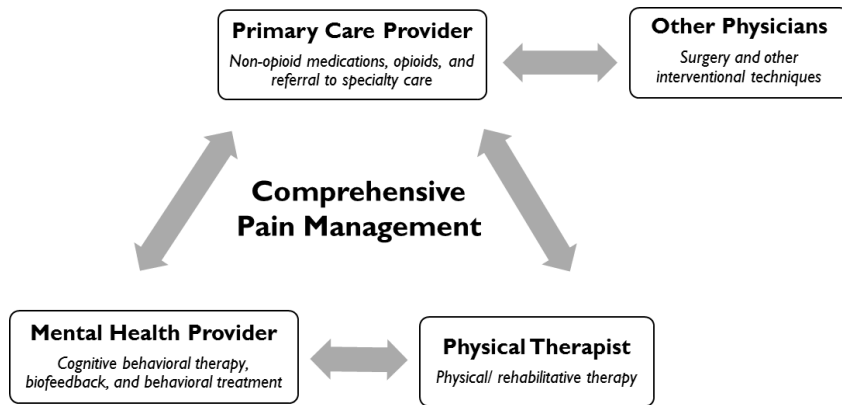


Figure 1.1: Network of providers involved with comprehensive pain management.

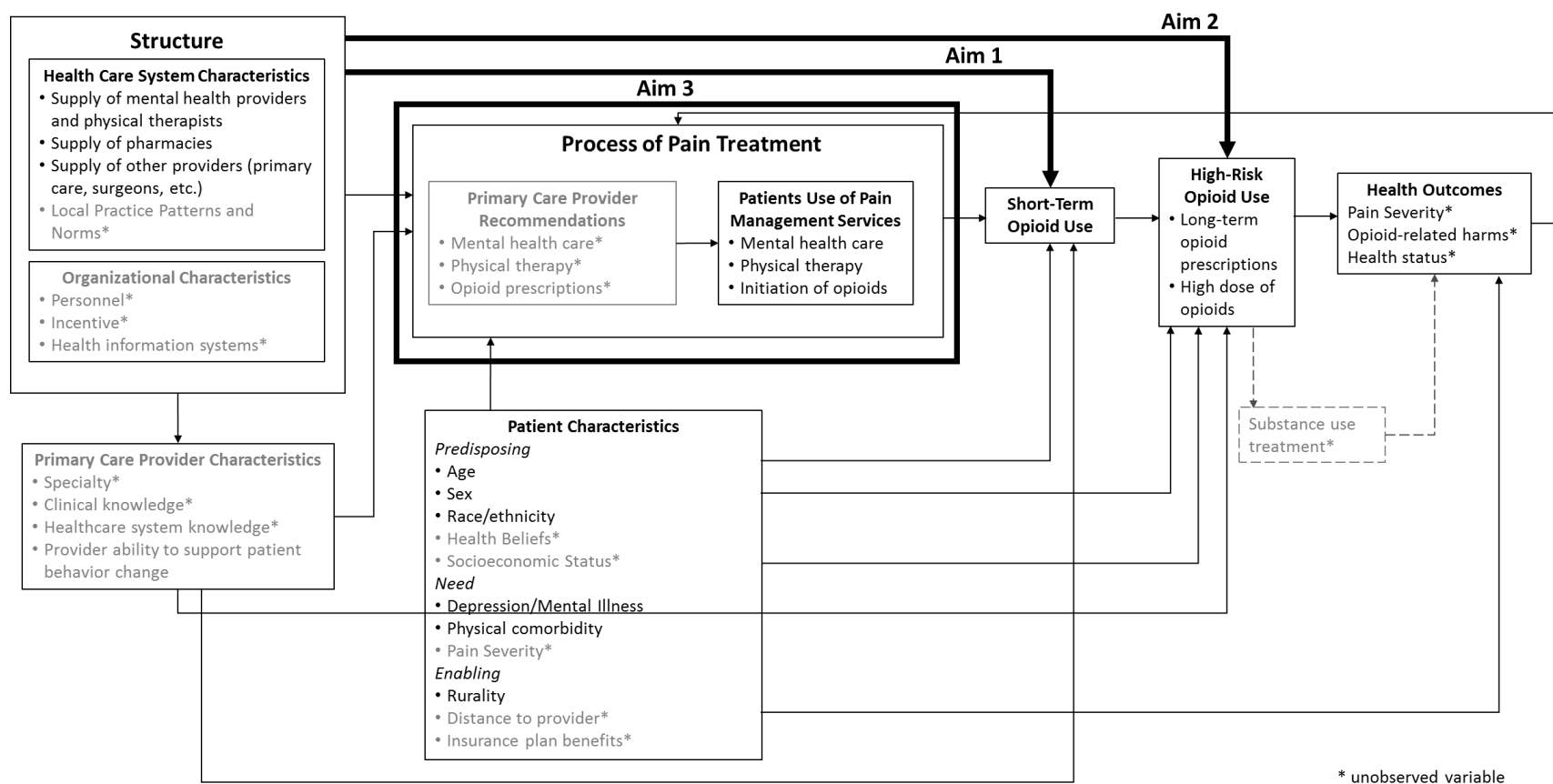


Figure 1.2: Conceptual Model adapted from Donabedian's model for quality of care.⁹⁷

CHAPTER 2: LITERATURE REVIEW

The following topics are presented in this literature review: burden of chronic pain among older adults, chronic pain treatment options and summary of clinical guidelines, trends in utilization of pain management strategies among older adults, predictors of opioid prescriptions patterns, and chronic pain management in the context of primary care.

Overview of Chronic Pain among Older Adults

One of the most significant conditions impacting older adults is chronic pain, which occurs when pain continues for at least three months or more.^{1,2} Prevalence estimates of chronic pain for older adults vary from 19% to 57%.¹ The incidence of chronic pain for older adults is 4.69 per 100 person years.¹⁰⁰ Almost two-thirds of older adults report musculoskeletal pain such as back pain, knee pain, and osteoarthritis.³ Consequences of chronic pain include decreased activity levels, falls, mood disorders, isolation, and disability, which may worsen if pain is undertreated.^{46,60,101} Furthermore, pain may become worse when other comorbidities such as obesity, diabetes, cancer, and surgery are present.^{1,60,100} Another concern for older adults is that pain may be undertreated or underreported.^{1,60,102} Chronic pain management is complex for older adult populations because older adults may have multiple chronic conditions,⁴⁵ use multiple medications,⁴² and have fragmented care across multiple providers.⁴³

Chronic pain affects all facets of quality of life for older adults.^{1,46,56} The biopsychosocial model describes the experience of chronic pain as a product of physiological, psychological, and social factors can exacerbate or ameliorate pain symptoms.²⁰ Biological factors are genetic or physical processes that occur with a pain experience.²⁰ Psychologic factors include the

emotional aspects of pain such as anxiety or depression as well as cognitive abilities.²⁰ Finally, the social factors can include aspects of an individual's environment, their social supports, and available resources (e.g. income, insurance, or transportation).²⁰

Pain is a costly condition, and in the US, chronic pain costs \$560 to 630 billion in total costs, with \$261 to \$300 billion in direct healthcare costs for chronic pain treatment.¹⁰³ Medicare pays for a quarter of all pain treatments, which was estimated to be \$65.3 billion.^{1,103} From 2012 to 2014, the direct healthcare costs and indirect costs due to lost wages for musculoskeletal pain exceeded \$320 billion dollars with 37% of the cost attributed to older adults.³ .

Treatment for Chronic Pain

The biopsychosocial factors that contribute to chronic pain can be addressed through self-management techniques and both pharmacologic (both opioid and non-opioid) and non-pharmacologic treatments.^{1,58,59} Self-management strategies for chronic pain include symptom management (e.g. pain and fatigue), emotional management (e.g. anger, depression), coping skills, and lifestyle changes (e.g. exercise, relaxation).^{104,105} Examples of non-pharmacologic treatments include exercise, acupuncture, psychological therapies, tai chi, yoga, physical therapy, and spinal manipulation.¹⁰⁶ Non-pharmacologic treatments also include Complementary and Alternative Medicine, such as acupuncture or chiropractic care.¹⁹ Pharmacologic treatments include non-opioids (e.g. acetaminophen and ibuprofen) and opioid medications (e.g. hydrocodone, oxycodone, and morphine).^{18,19,55} Multiple modalities may be more effective than a single strategy on its own.¹⁰⁷ This literature review focuses the evidence for on physical therapy, mental health services (e.g. behavioral treatments), and opioid medications.

Evidence on Non-Pharmacologic Management Strategies

Evidence on non-pharmacologic treatments (e.g. exercise, acupuncture, psychological therapies, tai chi, yoga, physical therapy, and spinal manipulation) indicates that several non-

pharmacologic treatments are associated with small, short-term pain relief, improvements in functioning, and reductions in disability.^{18,106} For patients with chronic low back pain, behavioral therapy improved short-term pain symptoms.¹⁰⁸ Another review found that cognitive behavioral therapy for patients with low back pain improved long-term outcomes such as pain, disability, and quality of life.²⁷ Benefits of exercise therapies for different conditions of chronic pain (e.g. back pain, osteoarthritis) include improved pain and function.¹⁰⁹⁻¹¹¹ Among older adults, the evidence supporting non-pharmacologic approaches is limited, but modest improvements in pain and function are associated with these treatments.^{26,112,113}

Non-pharmacologic treatments may reduce the risk of adverse events related to medications, and evidence supporting the benefits of non-pharmacologic treatments on opioid use is limited but promising.²⁶ One systematic review found that among opioid users with chronic pain, psychosocial therapies (e.g. acupuncture, mindfulness, cognitive behavioral therapy) reduced opioid use in three studies.⁸⁰ Several studies of adult populations found that early use of physical therapy was associated with lower opioid use.^{79,94,95} However, among older adults with low back pain, “early use” of physical therapy was not associated with a difference in opioid use.¹¹⁴ Although patients who received “guideline adherent physical therapy” had lower opioid use compared to patients who did not, this difference was not statistically significant.⁷⁸

Evidence on Pharmacologic Management Strategies

Both opioid and non-opioid medications are used for chronic pain management; however, both types of medications carry risk for side-effects and adverse events for older adults.^{18,55} Acetaminophen, a non-opioid medication, is considered as the first-line of treatment and has a low risk for side effects for older adults.⁵⁵ Nonsteroidal anti-inflammatory drugs (NSAIDs), another non-opioid medication, are associated with greater risk for cardiovascular and renal side effects, so they are not typically recommended for older adults.⁵⁵

The evidence regarding the efficacy of opioids is limited for older adults.⁵⁵ While short-term opioid use in older adults was improved pain and functioning, it is also associated with nausea, constipation, dizziness, falls, fractures, cardiovascular disease, respiratory failure, hospitalization, misuse/abuse, lower self-rated mental health, and opioid-related mortality.^{10,63-69} Furthermore, compared to younger populations, adverse events such as respiratory depression and overdose may occur at lower doses for older adults.¹⁸ The efficacy of long-term opioid treatments and long-acting opioids (compared to short-acting opioids) has not been studied among older adults.¹⁰

Summary of Clinical Guidelines for Chronic Pain Management

The Centers for Disease Control and Prevention (CDC) and the American College of Physicians put forth clinical guidelines for chronic pain management.^{18,19} These guidelines have a strong recommendation for non-pharmacologic and non-opioid treatment as the first-line of treatment for pain.^{18,19} If non-pharmacologic treatments or non-opioid treatments are unsuccessful or ineffective, opioids may be an option if the benefits are greater than the risks of opioids.^{18,19} Clinicians should prescribe the “lowest effective dose.”¹⁸ Opioid treatments should be supervised, especially for dose escalations and when doses exceed 50 Milligrams Morphine equivalent (MME) or 90 MME.¹⁸ Before opioid treatment, prescribers should develop treatment goals for pain and function, and determine the length of treatment.¹⁸

The American Geriatrics Society recommends that opioids can be used by older adults who have pain that interferes with activities of daily living and when pain is “moderate to severe”.⁵⁵ However, doses need to be carefully monitored since the adverse events could occur at lower doses compared to younger adults.¹⁸ Clinicians should consider potential interactions between opioids and other medications or comorbidities.¹⁸ Opioids can be risky if older adults have cognitive difficulties that could result in medication errors and overdose.^{18,46} Multimodal

treatment plans which use both pharmacologic and non-pharmacologic strategies are recommended for chronic pain management among older adults.^{25,55,59}

Trends in Chronic Pain Management among Older Adults

Patients with chronic pain use more health care services and medications compared to those without.⁵⁷ According to one study of commercially insured adults, those with chronic low back pain were prescribed opioids two times more than those without chronic low back pain.⁵⁷ Furthermore, chronic low back pain patients were more likely to visit physical therapists, orthopedists, chiropractors, and rheumatologists.⁵⁷

Despite the range of non-pharmacologic and pharmacologic treatment strategies available for chronic pain patients, almost all patients with chronic pain receive medications and only a quarter receive non-pharmacologic services.³¹ A study using nationally representative data on adults with chronic pain who had a primary care visit from 2000 to 2007 found that they use mental health services (8.6%) and physical therapy (2.7%) less frequently than opioids (14.3%).³¹ Furthermore, temporal trends from 1997-2010 indicate increases in the opioid prescription rate among adults with musculoskeletal pain while physical therapy referral rates did not fluctuate.^{32,115} Similarly, the opioids prescription rate among older adults with an outpatient visit also increased from 4% to 9% from 1999 to 2010.⁵ Older adults over 65 have the highest opioid prescriptions rates, and in 2016, there were 28.9 prescriptions for every 100 older adults.⁴ According to one study, the rate of long-term opioid use was greater for adults over 65 compared to adults younger than 65.⁶¹ Over the course of five years, long-term opioid use grew from 4.6% to 7.4% in 2012 for older adults.⁶² Among all Medicare beneficiaries, about 5% had a dose greater than 100 MME.⁷⁴ Nearly 25% of long-term users with Medicare had a dose greater than 100 MME.⁷⁴ Estimates for opioid prescription rates among older adults with musculoskeletal

pain range from 7% to 40%, with as much as 4% of beneficiaries with more than six thirty-day prescriptions in the follow-up year.^{86,87}

Utilization rates for non-pharmacologic services may differ between younger and older adults. In one study of nationally representative adults with low back pain, the physical therapy rate for adults aged 45 to 59 years was twice the referral rate for adults aged 60 to 90 years (18.9%).³² Furthermore, having Medicare was significantly associated lower odds of a physical therapy visit.³² According an analysis of the Medicare Current Beneficiary Survey, only 5% of older adults used physical therapy and the average number of visits was 10 per year (standard deviation 15 visits).⁵³ Another study found that 30% of North Carolinians with chronic low back pain used physical therapy, but utilization rates did not differ by age groups.²⁹ Among chronic pain patients, older adults used mental health services less frequently than younger adults (2% (age 60+) vs 9% (18-60 years)).^{29,85}

Predictors of Opioid Prescription Patterns

Several literature reviews have focused on opioid use behaviors such as misuse or abuse, or outcomes of opioid use such as overdose.^{11,67,116,117} However, little is known about the factors associated with initiation of prescription opioid therapies as well as high-risk opioid prescriptions such as long-term or high-doses, which are not typically categorized as misuse or abuse.

Many characteristics are associated with opioid prescriptions. In a study using nationally representative survey data of adults with chronic pain, adults older than 65 years had a lower odds of reporting an opioid prescription compared to younger adults age 18-34 years.¹¹⁸ Having Medicare (compared to private insurance), living in the South (compared to the North), and seeing a primary care provider (compared to a specialist) were all associated with greater odds of reporting an opioid prescription.¹¹⁸ In another a study of individuals with chronic pain, greater odds of an opioid prescription was also associated with living in a rural county and being non-

White minority.⁹⁶ This study hypothesized that rurality could indicate a lack of access to healthcare could contribute to the differences in opioid prescribing rates in rural and urban counties.⁹⁶

Among older adult, Medicare beneficiaries with osteoarthritis, being younger was associated with greater odds of an opioid prescription.⁸⁶ Furthermore, being female, reporting poorer health, or having functional limitations were also associated with greater odds of opioid prescriptions.⁸⁶

Prescriber specialty may also be associated with opioid prescriptions. In a study examining North Carolina Medicaid patients with chronic pain, patients who saw orthopedists, dentists, and emergency medicine providers had greater odds of filling an opioid prescription compared to patients who saw a general practitioners.¹¹⁹ However, the greatest proportion of opioid prescriptions for Medicare beneficiaries came from primary care providers (family medicine and internal medicine).⁷⁴ According to one study of older adults, primary care providers were two times more likely to prescribed opioids than surgeons.⁵

Initiation of Opioid Prescriptions

Only three studies examined characteristics associated with initiating opioid prescriptions.^{89,91,120} In one study of commercially insured adults, 9% of patients who sought healthcare for a new pain diagnosis had an opioid prescription within one week of the first visit.⁹¹ The opioid prescription rate varied by pain type: 6.6% for joint pain, 14.5% for back pain without radiculopathy, 10.2% for neck pain, 4.9% for tendonitis, 10.0% for muscles sprain/strain, and 20.2% for back pain with radiculopathy.⁹¹ While age was not significantly associated with an opioid prescription fill during the week of a first visit, the odds of an opioid prescription with more than a week's supply was greatest for older adults (adjusted OR: 1.79).⁹¹ Almost half of the patients with an opioid prescription had an opioid prescription at the first visit

for pain that covered more than seven days.⁹¹ Visits with mid-level providers (nurse practitioners or physician assistants) were associated with greater odds of an opioid prescription within the first week after a pain visit.⁹¹ While this study uses nationally representative data, the results may not generalize older adults.⁹¹ Furthermore, the study describes state level variation but does not examine potential characteristics that could lead to differences in prescribing rates across states.⁹¹

A study of Medicare beneficiaries discharged from the hospital found that filling an opioid prescriptions a week after discharge was more likely for beneficiaries in rural regions, as well as those with low socioeconomic status (e.g. low-income subsidy recipients, patients with both Medicare and Medicaid).⁸⁹ Older beneficiaries were less likely to receive an opioid prescription a week after discharge.⁸⁹ A higher proportion of patients reporting “well-managed pain” was also associated with greater hospital rates of opioid prescriptions within the week of a discharge.⁸⁹ The results from this study highlight potential factors that are associated with opioid prescriptions, but do not encompass the entire population of beneficiaries who suffer from pain, particularly those who receive outpatient care.⁸⁹

In another study of individuals with low back pain receiving workers’ compensation, a multilevel model was used to estimate the odds of filling an opioid prescription within two weeks of the diagnosis (“early”) with multi-level characteristics.¹²⁰ Characteristics such as severity of injury and individual and state level measures of socioeconomic status were associated with greater odds of an early opioid prescription.¹²⁰ The supply of physicians (including surgeons) was associated with lower odds of an early opioid prescription.¹²⁰ While this study examines the multi-level characteristics associated with early opioid prescribing, it

does not distinguish between type of physician and the results may not be generalizable to an older adult population.¹²⁰

Predictors of High-Doses of Opioids

High-doses of opioids have been associated with increased risk of overdose and other adverse events.^{11,69} One study of patients with musculoskeletal pain and opioid use for more than 90 days found positive associations with the odds of dose ≥ 100 MME/day for being male, presence of multiple comorbidities, diagnoses of mental illness, a prescription for a sedative-hypnotic, having Medicare, emergency room visits, and pain clinic visits.⁸ Another study of patients with chronic pain in a primary care clinic found that patients with resident physicians (compared to nurse practitioners or faculty physicians) were associated with lower odds of a dose ≥ 50 MME/day of opioids.¹²¹ Furthermore, age and being female were associated with lower odds of a dose ≥ 50 MME/day of opioids, while a diagnoses of mental illness were associated with greater odds of a dose ≥ 50 MME/day of opioids.¹²¹ In a study of veterans with chronic pain, having a neuropathy, back pain, and nicotine disorder were all independently associated with greater odds of a dose ≥ 180 MME/day for ≥ 90 consecutive days.⁹² Among disabled Medicare beneficiaries, opioid prescribing laws (e.x. “prescription limits, prohibiting ‘doctor shopping’, pain clinic regulations, require patient identification, requiring physical exams, requiring tamper-resistant prescription forms, prescription drug monitoring programs, and requiring pharmacist verification”) were not associated with rates of prescription ≥ 120 MME.⁹⁰ While these studies examine a range of characteristics, limitations include examining doses that are well above the CDC threshold (50 MME), studying average daily doses instead of individual prescription doses, and samples with limited generalizability to older adults.^{8,90,92,121}

Predictors of Long-Term Opioid Use

Long term-opioid use is associated with several adverse events including falls, fractures, and overdose.⁶⁹ Two recent studies examining the predictors of long-term use using national prescription claims data for commercially insured patients who were opioid-naïve and did not have cancer.^{6,93} Compared to opioid use for less than a year, long-term opioid use (opioid use for more than one year) was more likely among females, older ages, and those with Medicare or Medicaid.⁶ Characteristics of the first opioid prescription, such as high doses, greater days' supply, long-acting opioids, and tramadol prescriptions were associated with long-term opioid use.^{7,93} A greater number of opioid prescriptions and higher doses during the first month of opioid treatment was also associated with more than six fills in a year.⁷ Furthermore, a diagnosis of chronic pain is positively associated with long-term opioid use.⁹³ Compared to surgery, patients with chronic pain were less likely to discontinue opioid prescriptions.⁹³ Musculoskeletal pain patients who received an opioid prescription greater than 7 days were more likely to have opioid prescriptions for more than six months.⁹¹ One study examining self-reported outcomes found among patients with long-term opioid use, high Problem Opioid Use Risk scores at baseline and high self-rated likelihood of long-term opioid use were associated with greater odds of opioid use for more than a month.¹²² Another study of adults residing in Olmsted County, Minnesota found that greater odds of long-term use ("≥120 days' supply and ≥ 10 prescriptions") or episodic use ("≥ 90 days with ≥120 days' supply and <10 prescriptions") was associated with presence of mental illness, substance abuse, and nicotine use.¹²³

Several studies have examined predictors of long-term opioid use in the Medicare population.^{62,87-90} In one study examining opioid prescriptions for opioid naïve, Medicare beneficiaries with an emergency department visit, seeing a provider who frequently prescribed opioids was associated with greater odds of opioid use lasting longer than 180 days.⁸⁸ Another

study of Medicare beneficiaries who filled an opioid prescription within a week of a hospital discharge found that living in a rural county, low-income subsidy, and having both Medicare and Medicaid were all independently associated with greater than 90 days of opioid prescriptions after hospital discharge.⁸⁹ Long-term prescription rates (>90 days) for hospitals were positively correlated with the proportion of patients reporting well-managed pain.⁸⁹ Other hospital characteristics, such as government ownership, system affiliation, and teaching status were also associated with an opioid prescription 90 days after discharge.⁸⁹

Two studies examined long-term opioid use among older adults.^{62,87} A 2005 study found that among older adults with musculoskeletal pain, use of medications for mental illness, like benzodiazepines, greater number of doctor visits, and nursing home residence were associated with opioid use for more than 180 days (consecutively), while presence of a mental illness and being African American was associated with lower odds.⁸⁷ One study specifically examined long-term opioid use (greater than 90 days' supply) among older adult, Medicare beneficiaries who were opioid naïve and had non-cancer pain.⁶² Rates of long-term opioid use differed by state (2.84% in New York to 10.93% in Utah).⁶² The odds of long-term use were associated with greater for beneficiaries with Medicaid, living in rural counties, having more than one hospitalization, cardiovascular comorbidities, diabetes, liver disease, arthritis, obesity, drug abuse, psychoses, and depression.⁶² Older age and being a minority was associated with lower odds of long-term opioids use.⁶² This study also examined regulations relating to opioid prescriptions, and found that pain clinic regulations were associated with lower odds of long-term opioid use.⁶² While both studies examine older adults, these studies primarily focus on individual characteristics associated with various definitions of long-term use.^{62,87}

Two studies examined long-term opioid use among disabled Medicare beneficiaries.^{36,90} One study found that indicators of low socioeconomic status (household income, unemployment rate, and Gini Index) of the county were positively associated with having at least six opioid prescriptions in a year.³⁶ Another study found that opioid prescribing laws (“e.x. prescription limits, prohibiting “doctor shopping”, pain clinic regulations, require patient identification, requiring physical exams, requiring tamper-resistant prescription forms, prescription drug monitoring programs, and requiring pharmacist verification”) were not associated with lower rates of long-term use defined as an opioid prescription during every quarter within a year.⁹⁰

Geographic Variation in Opioid Prescriptions

Several studies examine sources of geographic variation including demographic characteristics, health care service characteristics, health status characteristics, and geographic characteristics. One study using national opioid prescription records from 2008 found that the amount of opioids prescribed varies greatly by county, and county characteristics account for a third of the variation in the amount of opioids prescribed.³⁵ Positive predictors of the amount of opioids prescribed per county included county size, percent of county classified as urban, percent white, percent African-American, poverty rate, percent less than 65 years and without insurance, and number of physicians.³⁵ Furthermore, percent of population with a high school diploma and number of psychiatrists were negatively associated with the amount of opioids prescribed.³⁵ The presence of a prescription drug monitoring program in the state was not associated with the amount of opioids prescribed.³⁵

In a similar study using national retail prescription data from 2006 to 2015, a greater proportion of non-Hispanic whites, proportion uninsured, proportion without a high school diploma, proportion disabled, and city residence were associated with more opioid prescriptions.³⁷ Furthermore, the supply of primary care providers and dentists were also

independently associated with greater opioid doses, along with the prevalence of diabetes, arthritis, and the suicide death rate.³⁷

In another study on national opioid prescription claims, the prescription drug monitoring program in a state and the prevalence of older adults were negatively associated with the county opioid prescription claim rate, while the supply of surgeons per capita and population illicit drug use rate were positively associated with the opioid prescription claim rate.³⁴

According to a study examining prescription data in Indiana, the percent of the population over 45 years, percent with private health insurance and under 65 years, percent with Medicaid, supply of dentists per capita, supply of pharmacists per capita, and average per capita opioid prescription rate for neighboring counties were significantly associated with greater county-level opioid prescription rates.⁴⁰

Socioeconomic indicators are also associated with opioid prescribing patterns.³⁵⁻³⁷ Based on data from 2008, one study found that the poverty rate was positively associated with the amount of opioids prescribed.³⁵ However a more recent study using data from 2006 to 2015 found that, the proportion in poverty was negatively associated with the amount of opioids prescribed.³⁷ Similarly, in a study on disabled Medicare beneficiaries, indicators of low socioeconomic status (household income, unemployment rate, and Gini Index) of the county were positively associated with greater doses of opioids.³⁶

Though these studies both use administrative data to estimate opioid prescription patterns across the country, the models use county-level analyses which limit inferences about individual behaviors.^{34,35,40} In general, the supply of health care providers was positively associated with greater opioid prescribing, with the exception of psychiatrists which was negatively associated with opioid prescribing.^{34,35,37,40} However, these studies do not investigate all types of providers

typically involved in pain care (e.g. physical therapists or pain specialists). Furthermore, these studies do not distinguish between different patient populations and indications for pain, so results may not be generalizable to an older adult population with persistent musculoskeletal pain.

Chronic Pain Management in Primary Care

Chronic pain management often begins in the primary care setting.¹⁰¹ According to one study of older adults with chronic low back pain, nearly 60% of patients received care from a primary care provider.²⁹ Therefore, primary care providers play an essential role in coordinating care between pain specialists, physical therapists, and mental health providers as well as recommending effective strategies.¹ In developing treatment plans for patients, primary care providers must consider the risk of undertreating pain, the risks of using opioids, and develop realistic goals with the patient in managing pain.^{25,101,124} Implementing guideline concordant care by recommending non-pharmacologic pain treatment strategies can reduce the use of ineffective long-term treatment strategies, such as opioid treatments, and improve patient outcomes.⁷⁵⁻⁷⁸

Failure to adhere to guidelines may be a result of characteristics of the healthcare system which create a complex system where provider decisions regarding pain management strategies are influenced by incentives, knowledge, objectives, and constraints.¹²⁵ For example, patient, provider, and community characteristics can guide specialty referral decisions.^{1,126} As a community characteristic, one of the key barriers to comprehensive, high quality, pain management is access to specialty care such as physical therapy, mental health providers, and pain specialists.^{1,126,127} Access to services may be conceptualized as provider availability, distance to the service, ease of accommodation, and patient acceptability.^{128,129} While, provider availability does not always equate to use of services, the supply of specialists may determine

whether a provider refers a patient to that service because as the supply increases, it is easier for patients to see a specialist and patients expect and demand specialty care.^{127,128}

Several qualitative studies explored the various aspects of pain management practices in primary care including opioids prescriptions and use of non-pharmacologic services from the perspectives of patients and providers. One systematic review found that most providers recommend non-pharmacologic and non-opioid treatments before prescribing opioids (98%), prescribed doses that are less than 90-200 MME/day (89%), and educate patients about the risk and benefits of long-term opioid use (76%-84%).¹³⁰ However, the majority of providers do not assess pain before and after starting long-term opioid treatment, screen for comorbidities, use urine drug screen tests, use opioid treatment agreements, or stop opioids if it does not work.¹³⁰ The following section describes the barriers and facilitators present at the following levels: patient, provider, within the patient-provider relationship, and health system.

Patient Level

Several studies found that patient characteristics interfered with pain management.^{50-52,54,131-134} For example, providers report that patients may have difficulties with various aspects of pain self-management such as motivation, finding time to relax, and exercise.^{51,52} Providers felt that patients were unwilling to change lifestyle habits or try non-pharmacologic treatments and that patients often expected to be pain free after treatment.^{51,54} Furthermore, providers were more likely to prescribe opioids when they thought patient's wanted quick pain remedies, but both patients and providers thought that opioids were not an effective long-term therapy.⁵⁴ Presence of mental illness and failure to follow treatment plans also make it difficult for providers to manage pain and prescribe opioids.^{52,54,131} The possibility that patients may diverge opioids was also another concern that providers had when they prescribed opioids.^{52,133}

Providers frequently cited the risk of addiction, misuse, and abuse as a major concern for pain management, especially when prescribing opioids.^{52,54,131-133} To address this concern, one study discussed how providers identified “red flags” by getting information from the patient about the potential for misuse, abuse, addiction, substance use history, and readiness to try non-opioid treatments.¹³⁴ However, some patients reported that they were not at risk for addiction, while others were very concern about addiction.^{54,132} Some patients also reported that opioids were the only medication that could relieve pain quickly, and others reported that opioids did not always work and that there were side effects.^{51,54,132}

There were also patient barriers to using non-pharmacologic services. For example, patients did not always believe that non-pharmacologic treatments would be effective or understand how non-pharmacologic treatments worked.^{50,51} Furthermore, non-pharmacologic treatments were difficult for patients, took time, and required motivation.^{51,54} Some patients thought non-pharmacologic services, like acupuncture and chiropractic care, provided short-term pain relief for acute pain and did not have side-effects.⁵⁴

Provider Level

Studies also described provider-related barriers that primary care providers faced when caring for patients with chronic pain.^{51,52,54,131,133-137} According to one systematic review of clinician perspectives on chronic pain guideline implementation, unfamiliarity with the creation of guidelines, the perception that guidelines do not allow for clinical judgement, time to implement guidelines, and limited access to specialty care made it difficult to implement clinical guidelines.¹³⁵ About 40% of primary care providers reported difficulties in treating pain and other comorbidities and coordinating treatments.⁵² When trying to care for patients with chronic pain, providers experienced negative emotions (e.g. frustration, inadequate success with treatment, or stress).¹³⁶ Sometimes, providers were not interested in treating pain and avoided

it.^{131,134} One major challenge for providers was assessing pain and determining whether the pain was real.^{131,133,134,136} Often, they found that it was difficult to get accurate information about pain from physical exams or tests.^{134,136}

With respect to opioid prescriptions, only 30% of providers reported that they felt comfortable prescribing opioids, and a third of providers reported that they were not sure about when to prescribe opioids.⁵² Providers thought that opioids were a fast and easy option for pain relief.⁵⁴ Furthermore, providers found it difficult to balance the risks and benefits of opioids, lacked time to fully assess pain, and had limited training about managing pain and addiction.^{131,134}

Providers also faced barriers when trying to recommend non-pharmacologic services.^{50,51,137} Two studies found that providers did not educate patients about non-pharmacologic treatments.^{50,137} For example, providers reported that limited knowledge about acupuncture and chiropractic care services which made it difficult to make referrals.¹³⁷ Furthermore, providers did not always believe that non-pharmacologic treatments would be effective, and often thought that these treatments were only effective because the placebo effect.^{51,137}

Studies also discussed facilitators for chronic pain management at the provider level.^{131,134,135} For example, facilitators to chronic pain guideline implementation include a positive perspective about the clinical guidelines, relationships with colleagues, and using imaging as a tool to set expectations and teach patients about pain.¹³⁵ Providers reported that they preferred to use their own professional experience instead of clinical guidelines to make treatment decisions.¹³⁵ Physicians used opioid treatment agreements and long-term follow up to set expectations and ensure patients adhered to treatments.¹³¹ Providers used urine drug tests to

build trust with patients.¹³⁴ They also used information about functioning to set goals and expectations about pain.¹³⁴

Patient-Provider Relationship Level

The relationship between the patient and the primary care provider is another critical component to pain management.^{50-52,54,132-134,136-138} Important elements of this relationship include empathy, trust, validation, and shared decision making.^{132,133} To facilitate a positive patient-provider relationship, patients reported that providers should listen, understand the patient's pain, have adjustable prescribing practices, understand the medication related outcomes, and educate patients about medications.¹³³ Patients reported that opioid prescriptions were the only way providers confirmed their pain, and that non-pharmacologic treatments were not effective pain management strategies.^{51,132,138} Additionally, patients reported that were sometimes uncomfortable with non-pharmacologic providers.⁵¹

Building trust and a long-term relationship made it easier for providers to determine whether opioids were appropriate.^{134,136} Providers were more likely to trust patients who adhered to recommendations and worked towards treatment goals compared to patients who failed drug screens or were did not follow recommendations.¹³² Patients who trusted their provider believed that their provider was concerned for their health and were willing to follow their provider's recommendations even when providers did not prescribe opioids or chose to discontinue them.¹³⁸ Providers reported that changes in treatment regimens and lack of patient adherence contributed to difficult patient-provider relationships.¹³⁶ Concerns about diversion and asking for disability benefits made it difficult for providers to trust patients.¹³⁶

Communication between patients and providers was another barrier.^{52,133} For example, one study found that providers felt that language barriers may also contribute to inadequate pain management.⁵² Discussing topics like misuse, abuse, addiction, and diversion made patients feel

like their providers did not trust them.¹³³ As a result, providers reported that they feared conflict and confrontation in discussions about discontinuing opioids.⁵⁴ Furthermore, patients thought it was difficult to talk about opioids because they feared that their provider perceived them as addicts or drug seekers.¹³⁸ Poor communication between patients and providers also hindered the use of non-pharmacologic treatments.⁵⁰ Patients did not always talk about non-pharmacologic treatments with their providers because they thought that providers may understand the treatment or that the information from non-pharmacologic treatments was not important for providers.^{50,137}

Healthcare System Level

Healthcare system barriers to pain management reported by both patients and providers included difficulties with accessing pain management and addiction specialty referrals, lack of patient compliance with referrals, lack of diagnostic testing, limited time in visits, long wait times for specialty services, lack of appropriate non-pharmacologic treatments, limited transportation to treatments, and poor insurance coverage for non-pharmacologic services.^{51,54,131,134} Limited access to resources like urine drug screens also made it difficult to monitor patients and provide comprehensive care.¹³⁴ In one study of patients and providers in an integrated health system, both patients and providers tried to avoid opioids but felt that there were no suitable alternatives available.⁵⁴ Providers also felt that the culture of medicine added to the pressure to prescribe medications, especially opioids.^{51,54,136}

For non-pharmacologic treatments, older adult patients discussed how a lack of resources such as community providers, lack of transportation, poor insurance coverage, and high treatment cost were all barriers to accessing those treatments.⁵⁰ Furthermore, poor communication with other non-pharmacologic providers also made it difficult for providers to complete referrals and follow-up with non-pharmacologic providers about the patient's

progress.¹³⁷ Finally, lack of social support from caregivers, other pain providers, and community resources was also another barrier for non-pharmacologic treatment use.⁵¹

Challenges with Pain Management for Older Adults

Managing pain in an older adult population may require special considerations. For example, compared to internal medicine specialists, geriatricians were more concerned about undertreating pain in older adults and less concerned about illegal activities.¹³⁹ Similarly, another study found that providers were concerned about the potential side effects and that caregivers may misuse or abuse opioids when they prescribed opioids to older adults.⁴⁸ This study also found that providers agreed that opioids should not be used as the first line of treatment but may be appropriate in some situations.⁴⁸ Providers reported that they would be more likely to prescribe opioids if both the patient and their caregivers were trustworthy and if opioids were successfully used in the past.⁴⁸ They were less likely to prescribe opioids when they could not trust the patient or caregiver, if the patient had multiple medications, and if the patient had cognitive difficulties.⁴⁸ Finally, another barrier to prescribing opioids was the patients' and caregivers' hesitation to start opioids when opioids were the appropriate treatment.⁴⁸

We did not find any studies that explored the use of non-pharmacologic treatments among older adults from the perspective of primary care providers. However, older adults reported many of the same barriers to non-pharmacologic treatment as younger populations.^{50,51,54,137} For example, patient level barriers for non-pharmacologic treatments included lack of information about treatments, expectations and acceptance of pain, presence of comorbidities (e.g. depression), and difficulties in movement for the patient.⁵⁰ Some patients, especially older adults, were also afraid that the treatment could result in pain, fatigue, or injury.^{50,51} Embarrassment and difficulties with exercise were other barriers mentioned by older

adults.⁵⁰ Facilitators included a motivation, optimism, the joy of using non-pharmacologic treatments, and social support in the form of family and community supports.⁵⁰

Conclusion

This literature review demonstrates several gaps in the literature. First, there is very little knowledge about treatment patterns for older adults with a new episode of persistent musculoskeletal pain and no recent history of opioid use. Previous studies on trends with non-pharmacologic service use have not isolated pain by acute or persistent subgroups or have been limited to older data or state-based data.^{29,32,53,85} Some studies primarily use self-reported data about use of non-pharmacologic services which could be subject to reporting bias.^{29,32,53,85} Furthermore, evidence on opioid prescription patterns for older adults, is limited to beneficiaries who are prescribed opioids, and do not examine all beneficiaries with a pain diagnosis, regardless of opioid use or differentiate between acute and persistent pain.^{5,62,74} Studies on opioid use for Medicare beneficiaries with musculoskeletal pain have limited generalizability to the current US population due to use of state-specific data before the rise in opioid prescriptions.^{86,87} Understanding utilization rates for opioid and non-pharmacologic services is important to identify potential gaps in guideline adherence.

Second, there is limited evidence on the predictors of opioid prescription patterns (initiation rates, long-term prescriptions, and high-dose prescriptions), especially among older adults with persistent musculoskeletal pain. Only a few studies examined opioid prescription patterns the older adult population, but these studies primary focused on individual predictors and do not examine multi-level risk factors.^{6-8,62,74,86-89,91-93,121} Studies have found differences in opioid prescription patterns based on rural designation, and hypothesized that lack of access to services may be one reason for the disparity.^{62,96} In studies that explored geographic variation, a greater supply of providers was associated with greater opioid use, with the exception of one

study that found a negative correlation between the supply of providers and the odds of initiating opioid treatment.^{34,35,37,40,120} However, most studies use county-level analyses which limits conclusions about individual opioid prescription behaviors.^{34,35,37,40} Furthermore, these studies do not always distinguish the subgroups or include all types of providers who might be involved in the delivery of pain care.^{34,35,37,40} While preliminary evidence regarding use of non-pharmacologic services and opioid use shows lower opioid use among adults who use non-pharmacologic services, evidence on older adults with persistent musculoskeletal pain is limited.^{79,80,94,95} While one study found that early use of physical therapy was not associated with a difference in opioid use among older adults, this study did not distinguish between acute and persistent pain and only had patients in an integrated care setting.¹¹⁴ Aims 1 and 2 fill an important gap in the research by exploring whether access to non-pharmacologic treatments, conceptualized as the supply and use of services, is related to opioid prescriptions patterns (initiation of opioid treatment, long-term prescriptions, and high-doses) for a population that is vulnerable to undertreated pain.

Third, little is known about what does and does not support providers who care for older adults with chronic pain. One systematic review showed that guideline adherence for opioid prescribing practices for providers varied greatly, and while most providers prescribe opioids after other treatments have failed, a majority do not follow all of the guidelines related to opioid treatment monitoring.¹³⁰ Previous studies explored the use of pain management strategies, such as opioid prescribing or use of non-pharmacologic services, by only examining one strategy at a time.^{48,50,51,131,132,134,137,138,140} Studies have focused on the role of patient characteristics regarding provider's decisions to prescribe opioids^{48,52,54,131,132,134} or non-pharmacologic treatments.^{51,54,137} In addition to patient characteristics, a few studies mention how access to non-pharmacologic

treatment, time, and resources, may influence PCPs' recommendations.^{51,54,131,134} The results of may have limited generalizability because they either took place in an integrated care setting, before the release of the CDC Guideline, or did not specifically focus on older adults.^{18,54,131} Two studies focused on opioid prescriptions and non-pharmacologic service use for older adults, but these studies did not consider the range of potential chronic pain treatments.^{48,50} Aim 3 extends previous research by providing a holistic understanding of the system of chronic pain care to identify the gaps between what primary care providers need to do to care for patients with chronic pain and what can accomplish. Taken together, these aims improve the understanding about the relationship between access to non-pharmacologic services and opioid use which will be important to facilitate guideline implementation and to guide future policy efforts to improve the delivery of pain care and curb opioid use.

CHAPTER 3: THE ASSOCIATION BETWEEN ACCESS TO NON-PHARMACOLOGIC PAIN MANAGEMENT TREATMENTS AND INITIAL OPIOID PRESCRIBING PATTERNS FOR MEDICARE BENEFICIARIES WITH PERSISTENT MUSCULOSKELETAL PAIN¹

Overview

In this retrospective cohort study of older adults, we explore the relationship between access to non-pharmacologic services (physical therapy and mental health services) and opioid prescriptions filled during the first six months of a new episode of persistent musculoskeletal pain. We used generalized estimating equations, Medicare claims (2007-2014) and the Area Health Resource File to estimate the association between the supply and use of non-pharmacologic services and filled opioid prescriptions during the first six months of an episode. We identified 69,456 beneficiaries 65 and over without an opioid prescription six months before a new persistent musculoskeletal pain episode. Greater supply of mental health providers [Odds Ratio (OR): 0.97, 95% CI (confidence interval) 0.96-0.98] and physical therapists [OR: 0.98, CI: 0.96-0.98] were independently associated with lower odds of filling an opioid prescription within the first three months of the episode (Phase One). Lower odds of filling an opioid prescription in the second three-month period (Phase Two) of an episode were associated with both increases in the number of mental health providers [OR: 0.97, CI: (0.96-0.98)] and physical therapy use within the first three months of the episode [OR: 2.76, CI: (2.57-2.96)]. The associations between the supply and use of non-pharmacologic services with Phase One opioid prescriptions differed for metropolitan and rural counties. Decreasing shortages and encouraging early

¹ Disclosure of conflict of interest: This research was conducted while Ruchir Karmali was a student at the University of North Carolina and a pre-doctoral fellow at the Duke Clinical Research Institute.

engagement with non-pharmacologic services may help reduce opioid prescriptions among musculoskeletal pain patients.

Perspective: We found that access to physical therapy and mental health services is significantly associated with lower odds of filling opioid prescriptions in the first 6 months of a new musculoskeletal pain episode. These results suggest that policies increasing the uptake of non-pharmacologic services could help curb future opioid prescriptions for musculoskeletal pain.

Introduction

Chronic pain, or pain that continues past three months, significantly impacts the quality of life for 20-60% of adults over 65 years old.^{1,2,46,56,60} Musculoskeletal pain is a common source of pain for almost two-thirds of older adults.³ The direct healthcare and indirect cost of musculoskeletal pain exceeds \$320 billion with older adults accounting for 37% of the cost.³ Consequences of chronic pain are inactivity, falls, mood disorders, isolation, and disability.^{46,60}

The biopsychosocial model conceptualizes how physiological, psychological, and social factors affect the experience of chronic pain.²⁰ Addressing biopsychosocial factors requires multiple strategies to encourage positive self-management behaviors.^{1,20,21,23,59} Possible treatments include opioid and non-opioid medications and non-pharmacologic strategies (e.g. physical therapy (PT) or cognitive behavioral therapy).^{18,55} The benefits of non-pharmacologic treatments for older adults include fewer side effects than medications and ability to address multiple biopsychosocial factors.^{25,26,55} For older adults with non-cancer pain, opioids are associated with a greater risk of falls, fractures, cardiac events, pneumonia, hospitalizations, and death.^{10,63-66,141} Long-term use and high doses of opioids can exacerbate these risks.^{15,16,72,73,142}

Clinical guidelines recommend non-pharmacologic treatments over opioids, especially for older adults.^{18,19,55} Patients with chronic pain are at the greatest risk for long-term opioid

use.⁹³ Recent trends indicate that older adults use opioids more frequently than non-pharmacologic treatments.²⁹ One study of adults with low back pain found that primary care visits without a PT referral were associated with greater odds of receiving an opioid prescription.³² In 2010, 17% of older adults with musculoskeletal pain received an opioid prescription.⁵ Along with rising opioid prescription rates, the incidence of long-term opioid use is increasing among older adults.^{5,62}

Underuse of non-pharmacologic treatments and overuse of opioids may result from insufficient capacity of the health care system to deliver non-pharmacologic services.¹⁴³ For example, for workers with acute low back pain, greater supply of physicians including surgeons was associated with fewer opioid prescriptions 15 days after the diagnosis.¹²⁰ Making the initiation of opioids even more important, differences in long-term opioid use may depend on the type of treatment at the time of a new pain diagnosis; for example, early PT has been shown to be associated with reduced opioid use.^{79,94,95} Conversely, a greater risk of long-term opioid use is associated with a higher days' supply for the first prescription.^{6,91,93} Little is known about the relationship between access to non-pharmacologic treatments and opioid initiation, and understanding this relationship could guide policy efforts to reduce opioid prescriptions and support chronic pain patients.

We examine the relationship between access to non-pharmacological services and opioid prescriptions during the first six months a new episode of persistent musculoskeletal pain among Medicare beneficiaries over 65 without history of recent opioid use. Due to ambiguous definitions of chronic pain in the literature and the desire to focus on how pain patients interact with the health care system, we refer to the presence of multiple pain diagnoses at least 90 days apart as an episode of persistent pain. We measure access as (1) supply of selected non-

pharmacological providers (PT and mental health) and (2) the beneficiaries' use of these non-pharmacological services. We hypothesize: (1) no association between the supply of non-pharmacologic providers and filling an opioid prescription within 3 months of a new pain episode; (2) greater supply of non-pharmacological providers will be associated with lower odds of an opioid prescription in the second 3-month period of a new episode; (3) use of mental health services and PT within 3 months of a new episode will be associated with lower odds of filling an opioid prescription in the next 3 months; and (4) the associations for opioid prescriptions in either period will differ between metropolitan and rural counties.

Methods

We conducted a retrospective cohort study of older adult, Medicare beneficiaries with a new episode of what will become persistent musculoskeletal pain. We examine two critical periods: Phase One (the first three months after the index pain diagnosis) and Phase Two (the 3 months after Phase One). The three month cutoff was based on the transition of pain from acute to chronic occurring at three months.² A diagnostic code was used as a proxy measure for pain, and only represents a time when a beneficiary sought treatment associated with a pain diagnosis, but does not indicate when the pain first began or the severity of pain.

Data Sources

This study utilized Medicare Fee-for-Service (FFS) claims and the Area Health Resource File (AHRF) datasets.⁹⁸ We used a 5% random sample of beneficiaries enrolled in Medicare FFS between January 1, 2008 and June 30, 2014. Medicare claims data from 2007 was available for the look-back period. The Master Beneficiary Summary file contains information on demographics, enrollment, and death. We used claims from Medicare Parts A, B, and D. Part A contains inpatient claims and Part B contains outpatient claims including claims from home health, hospice, and skilled nursing facilities. Both Part A and B contain information about

diagnoses, mental health services, PT visits, and service dates. The Part D Drug Event file contains claims for filled prescriptions and includes information about medications dispensed and the fill date. Referencing the beneficiaries' county of residence and their index date from the claims data, the AHRF was used to assign county characteristics to beneficiaries including the supply of non-pharmacologic providers.⁹⁸ The AHRF also contains the Rural-Urban Commuting Area codes which describe rurality for each county.^{98,144}

Study Population

Figure 3.1 depicts how we identified a new episode of what will become persistent musculoskeletal pain for the cohort using International Disease Classification Codes, 9th edition (ICD-9) (Supplemental Table 3.1).¹⁴⁵ Individuals were included if they have two claims with any musculoskeletal pain diagnosis greater than 90 days, but fewer than 365, days apart.⁵⁷ We defined a new episode of persistent musculoskeletal pain starting with the first claim with a pain diagnosis (index date) after a year without any claims with a pain diagnosis. We did not require the same pain diagnosis to define the episode. After the index date, individuals were followed for six months or until death, enrollment in Medicare Advantage, or disenrollment from Part D at which point they are censored.

We required individuals to have 12 months of claims before the index date to ensure the pain episode was new and that there was no recent history of opioid prescription (within six months, consistent with prior research).¹³ Thus, to be included in the cohort, individuals had to be 66 or older and continuously enrolled for one year before the index date. Since the focus of this analysis was a new episode of musculoskeletal pain, we excluded individuals with a trauma or surgery within the year before the index date using Current Procedural Codes (CPT) and ICD-

9 codes.^{145,146} Individuals who used hospice services or long-term care services at any time were also excluded because opioid prescription recommendations differ for these individuals.¹⁸

Outcomes

We created binary measures for receipt of an opioid prescription in Phase One (first three-month period) and Phase Two (between three and six months). We included opioids that were either in an oral or transdermal formulation with the United States' Food and Drug Administration-approved indication to treat pain. We used the National Drug Codes provided by the Centers for Disease Control and Prevention (CDC) to identify opioids.¹⁴⁷

Access Measures

We measured access to non-pharmacologic therapies in terms of (1) the supply of providers and (2) the use of services. As a measure of local availability, the supply of providers were defined as the number of mental health providers and PTs per county per year. Mental health providers included both psychiatrists and psychologists. We created per capita measures using county population from the AHRF multiplied by 10,000.⁹⁸ For missing data, values were interpolated based on existing data (Supplemental Table 3.2). We used binary indicators to measure beneficiaries' use of PT and mental health services in Phase One and/or Phase Two using CPT and Healthcare Common Procedural Coding System codes (Supplemental Table 3.1).^{28,148,149}

Covariates

Individual and county characteristics confounding the relationship between access to non-pharmacologic services and opioid prescription patterns were included based on Donabedian's Quality of Care Model.⁹⁷ Baseline characteristics were measured based on the year before the index date. Individual characteristics included age, race, sex, and Medicaid dual eligibility (a proxy for income).¹⁵⁰ Comorbidities were measured using the Deyo-Charlson comorbidity score

which accounts for 17 unique physical clinical conditions.¹⁵¹ We also identified depression and anxiety at baseline using definitions provided by the Centers for Medicare and Medicaid's (CMS) Chronic Conditions Warehouse and the Health Cost and Utilization Project (Supplemental Table 3.1).^{152,153} In the follow-up period, we defined binary indicators of opioid prescriptions, trauma, and surgery in either treatment phase.¹⁴⁵⁻¹⁴⁷ We defined a categorical variable to control for the reasons for incomplete follow-up during Phase Two, such as leaving FFS, leaving Part D, or death.

We also controlled for provider supply and population demographics of a beneficiary's county. Provider supply measures followed the same method used for the mental health and PT providers described above (Supplemental Table 3.1). We independently measured the number of primary care providers, surgeons, pain specialists, midlevel practitioners (nurse practitioners and physician assistants), and pharmacists per capita per county.⁹⁸ County socioeconomic status measured as the percent of the county population living under the Federal Poverty Limit. We also controlled for the percent of the county population over 65. Rural-Urban Commuting Area codes were used to assign metropolitan and rural designations for each county.^{98,144}

Statistical Analysis

Descriptive statistics were generated to describe the means and proportions of individual and county-level variables. T-tests and chi-square tests were conducted for three group comparisons in the cohort: beneficiaries with and without an opioid prescription in Phase One, beneficiaries with and without an opioid prescription in Phase Two, and beneficiaries in metropolitan and rural counties.

We used generalized estimating equations to test the hypotheses. This model uses a population average interpretation, where estimates apply to the entire study population.¹⁵⁴ The dependent variables correspond to binary variable for any opioid prescription fill, with two

separate models for Phase One and Two. For models with an opioid prescription fill in Phase One, we included the independent variables for access (supply of mental health providers and supply of physical therapists, use of mental health in Phase One, and use of PT in Phase One), individual characteristics (demographics, comorbidities, trauma, and surgery), and county characteristics (provider supply as separate measures and demographics). Models for opioid prescriptions filled for Phase Two included all of the variables for Phase One, reason for loss to follow up and the following variables referencing Phase One: use of non-pharmacologic services, receipt of an opioid prescription, trauma, and surgery. All models included year fixed effects. We estimated the models using different correlation structures: independent correlation with county clustered standard errors, exchangeable correlation with county standard errors, and unstructured correlation. We selected the model with the unstructured correlation based on the quasi-likelihood under the independence model criterion (QIC) goodness of fit statistic.

Finally, we conducted subgroup analyses to determine differences between metropolitan and rural counties and compared estimates to determine statistical significance using a Type III analysis to produce a score statistic.¹⁵⁵ In sensitivity analysis, we explored the relationship between the supply of non-pharmacologic providers and use of non-pharmacologic services as a positive control. We also explored the total association by excluding measures of non-pharmacologic service use from the models, and only including supply variables as a measure of access. Finally, the results of the models were converted into a figure to depict the significant associations between the measures of access and opioid prescriptions during the treatment phases to identify leverage points for action. The arrows presented in the figure indicate our hypothesized relationships based on our results, though further research needs to verify direction of relationship/causality. Analyses for this study were conducted in SAS Version 9.4 (SAS

Institute, Inc., Cary, NC). This study was approved by the Institutional Review Boards at Duke University's School of Medicine and the University of North Carolina-Chapel Hill.

Results

Figure 3.2 depicts the cohort selection process. We identified 197,827 beneficiaries with an episode of persistent musculoskeletal pain lasting at least three months who were not prescribed opioids in the six months prior to the index pain diagnosis. We excluded 80,386 beneficiaries because of surgery and 1,497 because of trauma within the 12 months before the index date, and 5,943 because of hospice use. The final cohort included 69,456 beneficiaries.

Table 3.1 presents the characteristics of the entire cohort, comparing those who filled an opioid prescription in Phase One/Two to those without a prescription in the corresponding phase. Just under 30% of the cohort was between 66 and 69 years old, 65.7% were female, 84.8% were white, 19.7% were dually eligible, and 81.4% resided in a metropolitan county. About 46% of the cohort had a Deyo-Charlson Comorbidity score of zero, and 14% had a score ≥ 3 . Only 2.1% of the cohort had anxiety and 5.9% had depression. The most prevalent musculoskeletal pain conditions included arthritis (98.2%), back pain (65.7%), and fibromyalgia (68.3%). The mean supply of providers was four mental health providers and six physical therapists per 10,000 people per county. Beneficiaries with at least one opioid prescription in either phase were more likely to be younger and female and were more likely to have a diagnosis of back pain or fibromyalgia compared to beneficiaries without an opioid prescription. Overall, the supply of mental health providers and physical therapists per county was significantly lower for beneficiaries with an opioid prescription in either phase.

About 13% (10%) of beneficiaries filled an opioid prescription in Phase One (Two). Nearly 13% (10%) of beneficiaries used PT Phase One (Two) (Table 3.1). Fewer than 2% of the cohort used mental health services. Beneficiaries used opioid and non-pharmacologic strategies

concurrently, and the most common combination was opioid prescriptions and PT. Around 25% (21%) of beneficiaries who filled an opioid prescription in Phase One (Two) also used PT in that phase. Compared to metropolitan counties, rates of opioid prescriptions were higher and rates of PT and mental health services were lower for rural counties.

Table 3.2 shows the results from multivariable models estimating the associations between the supply of non-pharmacologic providers and use of non-pharmacologic services with opioid prescriptions in Phase One. After controlling for individual and county characteristics, an additional non-pharmacologic provider per 10,000 people per county was significantly associated with lower odds of filling an opioid prescription [mental health providers adjusted odds ratio [aOR]: 0.97; 95% confidence interval (CI): 0.96-0.98; physical therapists aOR: 0.98; 95% CI: 0.97-1.00]. The odds of filling an opioid prescription in Phase One did not significantly differ by mental health service use in this phase. Beneficiary PT visits in Phase One were associated with greater odds of filling an opioid prescription in Phase One [aOR: 2.6; 95% CI: 2.64-3.36]. Beneficiaries with Medicaid had greater odds of filling an opioid prescription [aOR: 1.26; 95% CI: 1.19-1.34]. Furthermore, an additional percentage point increase in the county poverty rate was associated with greater odds of filling an opioid prescription [aOR: 11.84; 95% CI: 1.06-3.21].

For metropolitan and rural subgroup analysis, the magnitude and significance of associations between an opioid prescription in Phase One and access to non-pharmacologic providers were similar to the associations for the main analysis. The associations for the metropolitan and rural subgroups significantly differed from each other (Score statistic: 36.53, P-value: 0.019). For both metropolitan and rural counties, dual-eligible status is associated with greater odds of filling an opioid prescription. In rural counties, a percentage-point increase in the

county poverty rate was associated with greater odds of filling opioid prescriptions in Phase One [aOR: 11.2; 95% CI: 3.82-32.87].

Table 3.3 shows the association between access to non-pharmacological services and the odds of filling an opioid prescription during Phase Two. The supply of mental health providers was significantly associated with greater odds of filling an opioid prescription in Phase Two [aOR: 0.98; 95% CI: 0.96-0.98]. Use of PT in Phase One was associated with lower odds of filling an opioid in Phase Two [aOR: 0.62; 95% CI: 0.58-0.68]. However, use of mental health services [aOR: 1.20; 95% CI: 0.97-1.48] and filling an opioid prescription [aOR: 2.76; 95% CI: 3.96-4.43] in Phase One were associated with greater odds of filling an opioid prescription in Phase Two. Associations for the metropolitan and rural subgroups were not significantly different from each other (Score Statistic: 23.22, p-value: 0.56). While the supply of non-pharmacologic providers was not significantly associated with an opioid prescription for rural counties, both dual-eligible status and the county poverty rate were significantly associated with greater odds of filling an opioid prescription in Phase Two. Sensitivity analysis confirmed a positive relationship between the supply of non-pharmacologic services and use of non-pharmacologic services (Supplemental Table 3.4 and 3.5). Furthermore, results were consistent for opioid treatment outcomes for models that estimated the total association (Supplemental Table 3.6).

Figure 3.3 illustrates the direct associations found between the supply of mental health providers and opioid prescriptions in and across both treatment phases. The supply of mental health providers and physical therapists is indirectly associated with reductions in opioid prescriptions in Phase Two through the use of PT in Phase One.

Discussion

This study examines the initiation rates of pain treatments during the first six months of a new episode of persistent musculoskeletal pain among older adults. We found that while utilization rates for opioids and PT during either treatment phase were similar (about 10%), the majority of beneficiaries only used one strategy. A common combination of treatments used in both treatment phases was opioid prescriptions and PT, though the rate of concurrent use of these strategies declined from Phase One to Phase Two. These findings demonstrate that beneficiaries may be exposed to opioids early in their experience of pain, even when other strategies like PT are used. One concerning finding is that only 2% of beneficiaries used mental health services. This was consistent with a previous study that found only 2% of older adults used mental health services even though 7% needed services.⁸⁵ The low utilization rate for mental health services could indicate that psychosocial factors of pain may not be addressed, which could leave patients ill-equipped to self-manage pain.²⁰

Despite a wide variety of non-opioid treatments available, our findings indicate that the structure of the health care system has a role in the initiation of treatment and the decisions to select pharmacologic and non-pharmacologic treatments. Contrary to our hypothesis that the supply of non-pharmacologic providers would not be associated with filling an opioid prescription during Phase One, we found that a greater supply of mental health providers and physical therapists was significantly associated with lower odds of filling an opioid prescription. However, the association between the supply of non-pharmacologic providers and opioid prescription fills differed by treatment phase. The supply of physical therapists was only associated with lower odds of an opioid prescription fill in Phase One but not Phase Two. This finding indicates that the impact of the structure of the health care system is different at various time points in pain care. While PT may be important early during the experience of pain, as the

pain episode progresses it may not be considered a viable alternative to opioids, rendering the supply of physical therapists not significantly associated with opioid prescriptions in longer-term pain care.

We observed differences in opioid prescription fills in the second phases associated with the type of pain management strategy used in the first phase. PT in Phase One was associated with a lower odds of filling an opioid prescription in Phase Two. This finding differs from a previous study, which found no difference in odds of opioid use for older adults with low back pain who started PT one month after the start of a new episode.¹¹⁴ However, several studies on younger adults with musculoskeletal pain found results that were similar to ours.^{79,94,95} One possible explanation for the differences between our findings and the findings from Karvelas and colleagues could be the presence of heterogeneous treatment effects for populations with acute and persistent pain as well as populations with and without recent exposure to opioids.¹¹⁴ We also found that opioid prescriptions in Phase I were significantly associated with opioid prescriptions in Phase Two; more than a third of those prescribed opioids in Phase One continued to have opioid prescriptions filled in Phase Two. This finding is concerning because several recent studies demonstrated that the likelihood of long-term opioid use was associated with a greater days' supply for the first prescription.^{6,93}

In the subgroup analysis, we found that increases in the supply of non-pharmacologic providers was significantly but weakly associated with lower odds of opioid prescriptions in Phase One. However, for Phase Two, the supply of non-pharmacological providers in rural counties was not associated with an opioid prescription fill. A previous study using national data found that living in a rural area was associated with greater odds of an opioid prescription.¹⁵⁶ The

findings from our study show that limited access to non-pharmacologic providers may be one driver of the disparity in care between urban and rural populations.

In addition to limited access to non-pharmacologic providers, we found that indicators of low socioeconomic status were significantly associated with greater odds of an opioid prescription in metropolitan and rural counties. At the individual level, having Medicaid increased the odds of filling an opioid prescription in either treatment phase for rural and metropolitan counties. However, unlike metropolitan counties, a percentage-point increase in the county poverty rate in rural counties was associated with greater odds of filling an opioid prescription. This finding is consistent with previous literature that found an inverse relationship between opioid prescribing rates and county socioeconomic characteristics.^{36,37} These socioeconomic indicators could be a proxy for other patient barriers to accessing care such as distance to providers, lack of social support, high costs of treatments, and limited insurance coverage for non-pharmacologic treatments.^{50,51}

Figure 3.3 identifies a key intervention point to reduce opioid prescriptions: the use of PT in Phase One. Addressing workforce shortages of non-pharmacologic providers can encourage the use of PT in Phase One, and indirectly result in fewer opioid prescriptions in Phase Two. Policies that address the barriers to PT use, such as the removal of the caps on the number of PT visits for Medicare beneficiaries, may be helpful to reduce opioid prescriptions as well.¹⁵⁷ However, urban and rural counties likely need different policies, and that policies should address the financial barriers to accessing non-pharmacologic treatments.

Our study has several limitations. First, this is an observational study and the associations do not necessarily indicate causal relationships. Results may be biased because of unobserved variables at the individual (e.g. pain severity, function, and education) and county levels (e.g.

supply of substance use providers). Furthermore, we did not explicitly assess temporality of use of non-pharmacologic services and opioid prescriptions within each Phase, though we did explore the associations between use of services in Phase One and opioid prescriptions in Phase Two. Second, we lack data on whether prescribed opioids were taken as indicated. Third, we used administrative claims data, which only include services that were paid for by Medicare. Therefore, many pain treatments (e.g. over the counter medications, yoga, acupuncture, massage) are excluded from this analysis. When this study was conducted, claims with a diagnosis for substance use disorder were redacted.¹⁵⁸ The redaction could affect our estimation of the utilization of mental health services, particularly those tied to substance use diagnoses. Finally, our findings may not be generalizable to younger adults and adults with surgery or trauma.

Conclusion

We found that Medicare beneficiaries had comparable rates of opioid prescriptions and PT use but lower rates of mental health service use during the first six months of a persistent pain episode. In adjusted models, both increases in the supply of non-pharmacologic providers and use of non-pharmacologic services were associated with reductions in opioid prescriptions. However, in addition to non-pharmacologic provider shortages, socioeconomic indicators may indicate other barriers to access beyond structural characteristics of the health care system, particularly for rural counties. Policies should address both the supply of physical therapists and methods to encourage patient engagement with PT early in their care for pain. Future research should examine the association between access to non-pharmacologic services and long-term opioid use outcomes as well as determine whether these relationships persist in younger populations.

Incorporating non-pharmacologic strategies in chronic pain management minimizes the risks associated with opioid use.⁵⁵ Even when opioids are beneficial, multiple treatment

modalities may be necessary to address the biopsychosocial factors associated with pain and reduce the risk of adverse events associated with opioids.^{18,25,59} Following pain management guidelines by using non-pharmacologic pain treatment strategies can reduce the use of ineffective long-term treatment strategies, such as opioid treatments, and improve patient outcomes.^{75,77,78}

Table 3.1: Characteristics of Medicare beneficiaries with persistent musculoskeletal pain by treatment phase and county type.

	Entire Cohort (N=69,456)	Phase One			Phase Two			Rural (N=12,926)	Metropolitan (N=56,530)	P-value
		No opioid prescription (N=60,334)	Opioid prescription (N=9,122)	P-value	No opioid prescription (N=62,011)	Opioid prescription (N=7,445)	P-value			
	Mean (SD)/ No. (%)	Mean (SD)/ No. (%)	Mean (SD)/ No. (%)		Mean (SD)/ No. (%)	Mean (SD)/ No. (%)		Mean (SD)/ No. (%)	Mean (SD)/ No. (%)	
<i>Outcomes</i>										
Opioid Prescription in Phase One	9,122 (13.1)	—	9,122 (100.0)		6,530 (10.5)	2,592 (34.8)	< .001	1,756 (13.6)	7,366 (13.0)	0.09
Opioid Prescription in Phase Two	7,445 (10.7)	4,853 (8.0)	2,592 (28.4)	< .001	—	7,445 (100.0)		1,453 (11.2)	5,992 (10.6)	0.03
Physical Therapy in Phase One	9,634 (13.9)	7,297 (12.1)	2,337 (25.6)	< .001	8,472 (13.7)	1,162 (15.6)	< .001	1,467 (11.3)	8,167 (14.4)	< .001
Physical Therapy in Phase Two	7,409 (10.7)	5,490 (9.1)	1,919 (21.0)	< .001	5,787 (9.3)	1,622 (21.8)	< .001	1,101 (8.5)	6,308 (11.2)	< .001
Mental Health Services in Phase One	1,221 (1.8)	1,065 (1.8)	156 (1.7)	0.71	1,061 (1.7)	160 (2.1)	0.007	97 (0.8)	1,124 (2.0)	< .001
Mental Health Services in Phase Two	1,105 (1.6)	973 (1.6)	132 (1.4)	0.24	968 (1.6)	137 (1.8)	0.07	88 (0.7)	1,017 (1.8)	< .001
<i>Demographics</i>										
Age, continuous	75.5 (7.7)	75.5 (7.8)	74.9 (7.6)	< .001	75.5 (7.7)	75.0 (7.7)	< .001	75.3 (7.6)	75.5 (7.8)	0.01
Age										
66 – 69 years	20,159 (29.0)	17,317 (28.7)	2,842 (31.2)	< .001	17,858 (28.8)	2,301 (30.9)	< .001	3,738 (28.9)	16,421 (29.0)	0.77
70 – 74 years	16,425 (23.6)	14,184 (23.5)	2,241 (24.6)	0.03	14,562 (23.5)	1,863 (25.0)	0.003	3,183 (24.6)	13,242 (23.4)	0.004
75 – 79 years	12,595 (18.1)	10,970 (18.2)	1,625 (17.8)	0.40	11,292 (18.2)	1,303 (17.5)	0.13	2,449 (18.9)	10,146 (17.9)	0.008

	Entire Cohort (N=69,456)	Phase One			Phase Two			Rural (N=12,926)	Metropolitan (N=56,530)	P-value
		No opioid prescription (N=60,334)	Opioid prescription (N=9,122)	P-value	No opioid prescription (N=62,011)	Opioid prescription (N=7,445)	P-value			
80 – 84 years	9,911 (14.3)	8,712 (14.4)	1,199 (13.1)	< .001	8,964 (14.5)	947 (12.7)	< .001	1,738 (13.4)	8,173 (14.5)	0.003
≥ 85 years	10,366 (14.9)	9,151 (15.2)	1,215 (13.3)	< .001	9,335 (15.1)	1,031 (13.8)	0.006	1,818 (14.1)	8,548 (15.1)	0.002
Sex										
Female	45,625 (65.7)	39,697 (65.8)	5,928 (65.0)	0.13	40,822 (65.8)	4,803 (64.5)	0.02	8,470 (65.5)	37,155 (65.7)	0.67
Male	23,831 (34.3)	20,637 (34.2)	3,194 (35.0)	0.13	21,189 (34.2)	2,642 (35.5)	0.02	4,456 (34.5)	19,375 (34.3)	0.67
Race										
White	58,871 (84.8)	51,094 (84.7)	7,777 (85.3)	0.16	52,553 (84.7)	6,318 (84.9)	0.8	11,851 (91.7)	47,020 (83.2)	< .001
Black	4,751 (6.8)	4,093 (6.8)	658 (7.2)	0.13	4,176 (6.7)	575 (7.7)	0.001	727 (5.6)	4,024 (7.1)	< .001
Other Race	5,834 (8.4)	5,147 (8.5)	687 (7.5)	0.001	5,282 (8.5)	552 (7.4)	0.001	348 (2.7)	5,486 (9.7)	< .001
Medicaid dual eligible	13,662 (19.7)	11,690 (19.4)	1,972 (21.6)	< .001	11,953 (19.3)	1,709 (23.0)	< .001	2,336 (18.1)	11,326 (20.0)	< .001
Metropolitan county	56,530 (81.4)	49,164 (81.5)	7,366 (80.7)	0.09	50,538 (81.5)	5,992 (80.5)	0.03	—	56,530 (100.0)	
Comorbidities										
Deyo-Charlson Comorbidity Score (mean)	1.1 (1.4)	1.1 (1.4)	1.1 (1.5)	0.18	1.1 (1.4)	1.1 (1.5)	0.62	0.9 (1.3)	1.1 (1.5)	< .001
0	32,774 (47.2)	28,415 (47.1)	4,359 (47.8)	0.22	29,300 (47.2)	3,474 (46.7)	0.34	6,813 (52.7)	25,961 (45.9)	< .001
1	17,877 (25.7)	15,532 (25.7)	2,345 (25.7)	0.94	15,900 (25.6)	1,977 (26.6)	0.09	3,300 (25.5)	14,577 (25.8)	0.55
2	9,108 (13.1)	7,925 (13.1)	1,183 (13.0)	0.66	8,145 (13.1)	963 (12.9)	0.63	1,447 (11.2)	7,661 (13.6)	< .001
≥3	9,697 (14.0)	8,462 (14.0)	1,235 (13.5)	0.21	8,666 (14.0)	1,031 (13.8)	0.77	1,366 (10.6)	8,331 (14.7)	< .001
Alcohol Disorder	155 (0.2)	116 (0.2)	39 (0.4)	< .001	125 (0.2)	30 (0.4)	< .001	25 (0.2)	130 (0.2)	0.43

	Entire Cohort (N=69,456)	Phase One			Phase Two			Rural (N=12,926)	Metropolitan (N=56,530)	P-value
		No opioid prescription (N=60,334)	Opioid prescription (N=9,122)	P-value	No opioid prescription (N=62,011)	Opioid prescription (N=7,445)	P-value			
Anxiety	1,475 (2.1)	1,274 (2.1)	201 (2.2)	0.57	1,304 (2.1)	171 (2.3)	0.27	239 (1.8)	1,236 (2.2)	0.02
Depression	4,069 (5.9)	3,519 (5.8)	550 (6.0)	0.46	3,624 (5.8)	445 (6.0)	0.64	625 (4.8)	3,444 (6.1)	< .001
Schizophrenia	555 (0.8)	508 (0.8)	47 (0.5)	0.00	510 (0.8)	45 (0.6)	0.046	74 (0.6)	481 (0.9)	0.001
Substance Use Disorder	34 (0.0)	31 (0.1)	—	0.46	28 (0.0)	—	0.19	—	28 (0.0)	0.89
Post-traumatic stress disorder	14 (0.0)	14 (0.0)	—	0.15	12 (0.0)	—	0.67	—	11 (0.0)	0.79
Trauma in Phase One	1,354 (1.9)	941 (1.6)	413 (4.5)	< .001	1,112 (1.8)	242 (3.3)	< .001	233 (1.8)	1,121 (2.0)	0.18
Trauma in Phase Two	1,213 (1.7)	952 (1.6)	261 (2.9)	< .001	885 (1.4)	328 (4.4)	< .001	217 (1.7)	996 (1.8)	0.52
Surgery in Phase One	46 (0.1)	32 (0.1)	14 (0.2)	< .001	37 (0.1)	—	0.05	—	42 (0.1)	0.08
Surgery in Phase Two	46 (0.1)	42 (0.1)	—	0.37	32 (0.1)	14 (0.2)	< .001	—	42 (0.1)	0.08
Pain Type										
Arthritis	68,193 (98.2)	59,259 (98.2)	8,934 (97.9)	0.06	60,866 (98.2)	7,327 (98.4)	0.11	12,719 (98.4)	55,474 (98.1)	0.04
Back pain	45,664 (65.7)	39,140 (64.9)	6,524 (71.5)	< .001	40,196 (64.8)	5,468 (73.4)	< .001	8,510 (65.8)	37,154 (65.7)	0.81
Chronic pain	10,743 (15.5)	8,466 (14.0)	2,277 (25.0)	< .001	8,798 (14.2)	1,945 (26.1)	< .001	2,076 (16.1)	8,667 (15.3)	0.04
Neck pain	8,201 (11.8)	6,919 (11.5)	1,282 (14.1)	< .001	7,124 (11.5)	1,077 (14.5)	< .001	1,326 (10.3)	6,875 (12.2)	< .001
Psychogenic pain	852 (1.2)	731 (1.2)	121 (1.3)	0.35	741 (1.2)	111 (1.5)	0.03	126 (1.0)	726 (1.3)	0.004
Sprain or strain	19,796 (28.5)	16,741 (27.7)	3,055 (33.5)	< .001	17,406 (28.1)	2,390 (32.1)	< .001	3,647 (28.2)	16,149 (28.6)	0.42

	Entire Cohort (N=69,456)	Phase One			Phase Two			Rural (N=12,926)	Metropolitan (N=56,530)	P-value
		No opioid prescription (N=60,334)	Opioid prescription (N=9,122)	P-value	No opioid prescription (N=62,011)	Opioid prescription (N=7,445)	P-value			
Fibromyalgia	47,425 (68.3)	41,043 (68.0)	6,382 (70.0)	< .001	42,066 (67.8)	5,359 (72.0)	< .001	8,611 (66.6)	38,814 (68.7)	< .001
Other musculoskeletal pain	21,269 (30.6)	17,805 (29.5)	3,464 (38.0)	< .001	18,589 (30.0)	2,680 (36.0)	< .001	3,812 (29.5)	17,457 (30.9)	0.002
<i>County Demographics</i>										
Mental Health Providers, (Mean, IQR) †	3.3 (1.6, 5.7)	3.3 (1.6, 5.8)	3.0 (1.4, 5.5)	< .001	3.3 (1.6, 5.8)	2.9 (1.4, 5.4)	< .001	1.0 (0.3, 2.1)	3.9 (2.1, 6.1)	< .001
Physical Therapists, (Mean, IQR) †	5.9 (4.0, 7.6)	6.0 (4.0, 7.7)	5.6 (3.8, 7.4)	< .001	6.0 (4.0, 7.7)	5.6 (3.8, 7.4)	< .001	3.6 (2.2, 5.4)	6.4 (4.4, 7.9)	< .001
Primary care providers, (Mean, IQR) †	6.8 (5.0, 8.9)	6.9 (5.1, 8.9)	6.6 (4.9, 8.5)	< .001	6.9 (5.1, 8.9)	6.6 (4.8, 8.5)	< .001	5.0 (3.8, 6.6)	7.2 (5.5, 9.3)	< .001
Surgeons, (Mean, IQR) †	5.7 (3.5, 8.0)	5.7 (3.5, 8.1)	5.5 (3.3, 7.9)	< .001	5.7 (3.5, 8.1)	5.5 (3.3, 7.9)	< .001	2.8 (1.1, 4.5)	6.4 (4.2, 8.3)	< .001
Pain specialist, (Mean, IQR) †	0.3 (0.1, 0.5)	0.3 (0.1, 0.5)	0.2 (0.1, 0.4)	< .001	0.3 (0.1, 0.5)	0.2 (0.1, 0.4)	< .001	0.0 (0.0, 0.1)	0.3 (0.2, 0.5)	< .001
Pharmacists, (Mean, IQR) †	8.9 (7.2, 11.2)	8.9 (7.2, 11.2)	8.7 (7.2, 11.1)	< .001	8.9 (7.2, 11.3)	8.7 (7.1, 11.0)	< .001	7.4 (5.7, 9.3)	9.3 (7.5, 11.7)	< .001
Midlevel providers, (Mean, IQR) †	4.9 (3.3, 7.2)	4.9 (3.3, 7.2)	4.9 (3.3, 7.2)	0.03	4.9 (3.3, 7.2)	4.8 (3.3, 7.1)	0.005	4.1 (2.5, 6.1)	5.1 (3.5, 7.5)	< .001
Proportion of population over 65	0.1 (0.0)	0.1 (0.0)	0.1 (0.0)	0.03	0.1 (0.0)	0.1 (0.0)	0.00	0.2 (0.0)	0.1 (0.0)	< .001
Proportion of population in poverty	0.1 (0.1)	0.1 (0.1)	0.1 (0.1)	< .001	0.1 (0.1)	0.1 (0.1)	< .001	0.2 (0.1)	0.1 (0.0)	< .001

† Providers per 10,000 people

Table 3.2: Association between the access to non-pharmacologic pain treatments and fill of opioid prescriptions in Phase One and subgroup analysis for comparing metropolitan and rural counties.

Variable		aOR	Full cohort	Metropolitan Counties			Rural Counties			
			95% CI	aOR	95% CI	aOR	95% CI			
Mental Health Providers†		0.97	(0.96, 0.98)	***	0.98	(0.96, 0.99)	***	0.96	(0.93, 1.00)	*
Physical Therapists†		0.98	(0.97, 1.00)	**	0.98	(0.97, 1.00)	*	0.98	(0.95, 1.00)	*
Metropolitan county		1.06	(0.99, 1.14)	*	—			—		
Used Mental Health Services in Phase One		0.89	(0.75, 1.06)		0.92	(0.77, 1.11)		0.69	(0.36, 1.31)	
Used Physical Therapy in Phase One		2.60	(2.47, 2.75)	***	2.50	(2.36, 2.65)	***	3.19	(2.80, 3.64)	***
Medicaid dual eligible		1.26	(1.19, 1.34)	***	1.24	(1.16, 1.33)	***	1.38	(1.20, 1.57)	***
Proportion of population in poverty		1.84	(1.06, 3.21)	**	1.07	(0.55, 2.07)		11.2	(3.82, 32.87)	***
Age Category	70 – 74 years	0.98	(0.92, 1.05)		0.97	(0.91, 1.04)		1.03	(0.90, 1.19)	
	75 – 79 years	0.92	(0.86, 0.99)	**	0.93	(0.86, 1.00)	*	0.88	(0.76, 1.03)	
	80 – 84 years	0.87	(0.81, 0.94)	***	0.88	(0.81, 0.96)	**	0.83	(0.70, 1.00)	**
	≥ 85 years	0.82	(0.76, 0.89)	***	0.83	(0.77, 0.91)	***	0.78	(0.65, 0.93)	**
	66 – 69 years	-Ref			-Ref			-Ref		
Female		1.00	(0.95, 1.05)		1.00	(0.94, 1.05)		1.02	(0.91, 1.13)	
Race	Black	1.04	(0.95, 1.14)		1.05	(0.95, 1.16)		0.98	(0.78, 1.23)	
	Other	0.80	(0.72, 0.87)	***	0.80	(0.72, 0.88)	***	0.91	(0.65, 1.28)	
	Unknown	1.19	(0.85, 1.67)		0.97	(0.67, 1.42)		5.25	(2.15, 12.84)	***
	White	-Ref			-Ref			-Ref		
Deyo-Charlson Comorbidity Score		1.01	(0.99, 1.02)		1.01	(0.99, 1.02)		1.02	(0.98, 1.06)	

Variable	aOR	Full cohort		Metropolitan Counties			Rural Counties	
		95% CI		aOR	95% CI		aOR	95% CI
Depression	1.02	(0.92, 1.12)		0.99	(0.89, 1.10)		1.16	(0.92, 1.46)
Anxiety	1.03	(0.88, 1.21)		1.03	(0.87, 1.22)		1.06	(0.72, 1.55)
Trauma in Phase One	2.98	(2.64, 3.36)	***	2.83	(2.48, 3.24)	***	3.66	(2.76, 4.84) ***
Surgery in Phase One	2.93	(1.54, 5.56)	**	2.36	(1.17, 4.76)	*	20.73	(2.13, 201.37) **
Year	2009	1.00		0.99	(0.93, 1.06)		1.00	(0.87, 1.14)
	2010	0.98		0.95	(0.88, 1.04)		1.09	(0.92, 1.28)
	2011	1.07		1.04	(0.95, 1.15)		1.22	(1.01, 1.47) *
	2012	0.99		1.00	(0.90, 1.11)		0.94	(0.75, 1.17)
	2013	0.96		0.98	(0.88, 1.09)		0.83	(0.66, 1.06)
	2014	1.13	*	1.11	(0.96, 1.28)		1.22	(0.90, 1.65)
	2008	-Ref		-Ref			-Ref	
Primary care providers †	0.98	(0.97, 1.00)	*	0.98	(0.96, 0.99)	**	1.00	(0.98, 1.03)
Surgeons †	1.02	(1.00, 1.03)	*	1.02	(1.00, 1.03)	**	1.03	(1.00, 1.06) *
Pain specialist†	0.82	(0.71, 0.94)	**	0.82	(0.70, 0.95)	**	0.89	(0.64, 1.25)
Pharmacists†	1.01	(1.00, 1.02)	*	1.00	(0.99, 1.01)		1.01	(0.99, 1.03)
Midlevel providers†	1.00	(0.99, 1.01)		1.01	(1.00, 1.02)	*	0.98	(0.96, 1.00) *
Proportion of population over 65	0.60	(0.33, 1.11)		0.44	(0.22, 0.85)	**	3.57	(0.74, 17.16)
Intercept	0.14	(0.12, 0.17)	***	0.18	(0.15, 0.22)	***	0.07	(0.05, 0.10) ***
Scale	2.72	(2.72, 2.72)		2.72	(2.72, 2.72)		2.72	(2.72, 2.72)

***P <0.01, **P <0.05, *P<0.1

†Providers per 10,000 people

aOR: adjusted Odds ratio

95% CI: 95% confidence interval

Ref: Reference Category

Table 3.3: Association between the access to non-pharmacologic pain treatments and opioid prescription fill in Phase Two of a pain episode and subgroup analysis for comparing metropolitan and rural counties.

		Full cohort			Metropolitan Counties			Rural Counties	
		(N=69,456)			(n=56,530)			(N=12,926)	
Variable		aOR	95% CI		aOR	95% CI		aOR	95% CI
Mental Health Providers†		0.97	(0.96, 0.98)	***	0.96	(0.95, 0.98)	***	1.01	(0.97, 1.04)
Physical Therapists†		1.00	(0.98, 1.01)		0.99	(0.97, 1.01)		1.00	(0.97, 1.03)
Metropolitan county		1.02	(0.94, 1.10)		—			—	
Used Mental Health Services in Phase One		1.20	(0.97, 1.48)	*	1.19	(0.95, 1.49)		1.32	(0.68, 2.57)
Used Physical Therapy in Phase One		0.62	(0.58, 0.67)	***	0.62	(0.57, 0.68)	***	0.63	(0.52, 0.76) ***
Opioid Prescription in Phase One		4.18	(3.95, 4.43)	***	4.18	(3.93, 4.45)	***	4.19	(3.68, 4.77) ***
Used Mental Health Services in Phase Two		1.00	(0.79, 1.25)		0.99	(0.78, 1.27)		1.16	(0.58, 2.31)
Used Physical Therapy in Phase Two		2.75	(2.56, 2.96)	***	2.67	(2.47, 2.89)	***	3.17	(2.67, 3.76) ***
Medicaid dual eligible Buy-in		1.28	(1.20, 1.37)	***	1.27	(1.18, 1.37)	***	1.35	(1.16, 1.56) ***
Proportion of population in poverty		2.75	(2.56, 2.96)	***	2.67	(2.47, 2.89)	***	3.17	(2.67, 3.76) ***
Age Category	70 – 74 years	0.98	(0.91, 1.05)		0.99	(0.91, 1.06)		0.96	(0.82, 1.12)
	75 – 79 years	0.89	(0.82, 0.96)	***	0.86	(0.79, 0.94)	***	0.99	(0.84, 1.18)
	80 – 84 years	0.82	(0.76, 0.90)	***	0.81	(0.74, 0.89)	***	0.89	(0.73, 1.08)
	≥ 85 years	0.85	(0.78, 0.92)	***	0.84	(0.76, 0.92)	***	0.89	(0.73, 1.08)
	66 – 69 years	-Ref			-Ref			-Ref	

		Full cohort		Metropolitan Counties		Rural Counties		
		(N=69,456)		(n=56,530)		(N=12,926)		
Variable		aOR	95% CI	aOR	95% CI	aOR	95% CI	
Female	Female	0.96	(0.91, 1.01)	0.98	(0.92, 1.04)	0.88	(0.78, 1.00)	**
Race	Black	1.05	(0.95, 1.16)	1.05	(0.94, 1.17)	1.01	(0.79, 1.29)	
	Other	0.82	(0.73, 0.91)	*** 0.82	(0.74, 0.92)	*** 0.81	(0.55, 1.19)	
	Unknown	0.81	(0.53, 1.24)	0.77	(0.49, 1.23)	1.16	(0.38, 3.54)	
	White	-Ref		-Ref		-Ref		
Deyo-Charlson Comorbidity Score		1.01	(0.99, 1.02)	1.01	(0.99, 1.03)	0.99	(0.95, 1.04)	
Depression		0.95	(0.86, 1.07)	0.93	(0.83, 1.06)	1.04	(0.81, 1.36)	
Anxiety		1.06	(0.89, 1.26)	1.01	(0.83, 1.22)	1.29	(0.87, 1.91)	
Year	2009	0.99	(0.93, 1.06)	1.01	(0.94, 1.09)	0.93	(0.80, 1.08)	
	2010	0.89	(0.82, 0.97)	*** 0.89	(0.81, 0.98)	** 0.92	(0.77, 1.11)	
	2011	0.89	(0.81, 0.98)	** 0.89	(0.79, 0.99)	** 0.95	(0.77, 1.18)	
	2012	0.91	(0.82, 1.01)	* 0.91	(0.81, 1.02)	0.95	(0.75, 1.22)	
	2013	0.88	(0.79, 0.98)	** 0.9	(0.80, 1.01)	* 0.82	(0.62, 1.06)	
	2014	0.89	(0.77, 1.04)	0.89	(0.76, 1.06)	0.93	(0.65, 1.32)	
	2008	-Ref		-Ref		-Ref		
Trauma or surgery, Phase One		1.01	(0.87, 1.18)	1.04	(0.88, 1.23)	0.86	(0.59, 1.25)	
Trauma or surgery, Phase Two		2.78	(2.42, 3.19)	*** 2.66	(2.28, 3.11)	*** 3.37	(2.44, 4.66)	***
Censored	Full follow up	0.36	(0.27, 0.46)	*** 0.33	(0.25, 0.44)	*** 0.49	(0.25, 0.97)	**
	Left FFS	0.47	(0.33, 0.66)	*** 0.42	(0.29, 0.61)	*** 0.75	(0.32, 1.74)	

Variable		Full cohort (N=69,456)			Metropolitan Counties (n=56,530)			Rural Counties (N=12,926)	
		aOR	95% CI		aOR	95% CI		aOR	95% CI
	Died	-Ref			-Ref			-Ref	
Primary care providers†		0.98	(0.96, 1.00)	**	0.98	(0.96, 1.00)		0.98	(0.95, 1.01)
Surgeons†		1.02	(1.00, 1.03)	**	1.02	(1.01, 1.04)	***	0.99	(0.96, 1.03)
Pain specialists†		0.97	(0.84, 1.12)		0.92	(0.78, 1.08)		1.19	(0.84, 1.67)
Pharmacists†		1.00	(0.99, 1.01)		1.00	(0.99, 1.01)		1.00	(0.98, 1.02)
Midlevel providers†		1.00	(0.99, 1.01)		1.00	(0.99, 1.02)		0.99	(0.97, 1.01)
Proportion of population over 65		0.56	(0.29, 1.11)	*	0.69	(0.33, 1.46)		0.23	(0.04, 1.36)
Intercept		0.30	(0.22, 0.42)	***	0.35	(0.24, 0.49)	***	0.21	(0.10, 0.48)
Scale		2.72	(2.72,2.72)		2.72	(2.72,2.72)		2.72	(2.72,2.72)

***P <0.01, **P <0.05, *P<0.1

†Providers per 10,000 people

aOR: adjusted Odds ratio

95% CI: 95% confidence interval

Ref: Reference category

Sensitivity Analysis

Table 3.4: Association between the access to non-pharmacologic pain treatments and physical therapy use during the Phase One and Two after a pain diagnosis.

Variable		Phase One			Phase Two		
		aOR	95% CI		aOR	95% CI	
Mental Health Providers†		1.02	(1.01, 1.03)	***	1.02	(1.01, 1.03)	**
Physical Therapists †		1.02	(1.01, 1.04)	***	1.02	(1.00, 1.03)	*
Metropolitan county		1.13	(1.06, 1.21)	***	1.07	(0.98, 1.16)	
Used Mental Health Services in Phase One		2.59	(2.45, 2.73)	***	1.22	(0.98, 1.52)	
Opioid Prescription in Phase One		1.21	(1.03, 1.42)	*	1.64	(1.54, 1.76)	***
Used Physical Therapy in Phase One		—			9.3	(8.80, 9.83)	***
Opioid Prescription in Phase Two		—			2.77	(2.58, 2.97)	***
Used Mental Health Services in Phase Two		—			1.55	(1.25, 1.93)	***
Age Category	70 – 74 years	0.87	(0.82, 0.93)	***	0.96	(0.90, 1.03)	
	75 – 79 years	0.83	(0.78, 0.88)	***	0.89	(0.82, 0.96)	**
	80 – 84 years	0.72	(0.67, 0.78)	***	0.82	(0.75, 0.90)	***
	≥ 85 years	0.70	(0.65, 0.76)	***	0.74	(0.67, 0.81)	***
	66 – 69 years	-Ref			-Ref		
Female		1.01	(0.96, 1.06)		1.06	(1.01, 1.13)	*

		Phase One			Phase Two		
Variable		aOR	95% CI		aOR	95% CI	
Race	Black	0.52	(0.46, 0.59)	***	0.76	(0.66, 0.86)	***
	Other	0.98	(0.90, 1.08)		0.97	(0.86, 1.08)	
	Unknown	0.92	(0.67, 1.26)		1.07	(0.72, 1.57)	
	White	-Ref			-Ref		
Medicaid dual eligible		0.67	(0.62, 0.72)	***	0.79	(0.73, 0.86)	***
Deyo-Charlson Comorbidity Score		0.95	(0.93, 0.96)	***	0.99	(0.97, 1.01)	
Depression		1.02	(0.93, 1.13)		1.05	(0.94, 1.18)	
Anxiety		0.98	(0.84, 1.14)		0.94	(0.78, 1.14)	
Trauma in Phase One		1.13	(0.97, 1.31)		1.35	(1.14, 1.59)	***
Surgery in Phase One		0.23	(0.06, 0.96)	*	0.71	(0.21, 2.35)	
Trauma in Phase Two		—			1.52	(1.27, 1.81)	***
Surgery in Phase Two		—			0.19	(0.02, 1.38)	
Year	2009	1.05	(0.99, 1.11)		1.05	(0.98, 1.13)	
	2010	1.12	(1.05, 1.21)	**	1.08	(0.98, 1.18)	
	2011	1.15	(1.06, 1.25)	***	1.12	(1.01, 1.24)	*
	2012	1.22	(1.11, 1.33)	***	1.29	(1.16, 1.44)	***
	2013	1.31	(1.20, 1.43)	***	1.25	(1.13, 1.40)	***

		Phase One			Phase Two		
Variable		aOR	95% CI		aOR	95% CI	
Censored	2014	1.58	(1.42, 1.76)	***	1.66	(1.44, 1.91)	***
	2008	-Ref			-Ref		
	Full follow up	—			2.04	(1.27, 3.27)	**
	Left FFS	—			2.01	(1.17, 3.45)	*
	Died	—			-Ref		
Primary care providers†		1.02	(1.00, 1.03)	**	1.03	(1.01, 1.04)	**
Surgeons†		1.01	(1.00, 1.02)	*	0.99	(0.98, 1.01)	
Pain specialist†		0.89	(0.79, 0.99)	*	1.05	(0.92, 1.21)	
Pharmacists†		0.99	(0.98, 1.00)	**	0.98	(0.98, 0.99)	**
Midlevel providers†		1.00	(0.99, 1.01)		0.99	(0.98, 1.00)	*
Proportion of population over 65		0.80	(0.44, 1.44)		0.26	(0.12, 0.53)	***
Proportion of population in poverty		0.20	(0.11, 0.36)	***	0.25	(0.13, 0.51)	***
Intercept		0.15	(0.13, 0.18)	***	0.03	(0.02, 0.05)	***
Scale		2.72	(2.72, 2.72)	***	2.72	(2.72, 2.72)	***

***P <0.01, **P <0.05, *P<0.1

†Providers per 10,000 people

aOR: adjusted Odds ratio

95% CI: 95% confidence interval

Table 3.5: Association between the access to non-pharmacologic pain treatments and mental health service use during the Phase One and Two of new episode of persistent musculoskeletal pain.

Variable		Phase One				Phase Two			
		aOR	95% CI	P-value		aOR	95% CI	P-value	
Mental Health Providers per 10k people		1.05	(1.02, 1.07)	<.0001	***	0.97	(0.94, 1.00)	0.0438	**
Physical Therapists per 10k people		1.06	(1.02, 1.10)	0.0024	**	0.99	(0.94, 1.03)	0.5793	
Metropolitan county		2.04	(1.62, 2.57)	<.0001	***	0.59	(0.45, 0.78)	0.0002	***
Used Mental Health Services in Phase One		—				0.01	(0.01, 0.01)	<.0001	***
Used Physical Therapy in Phase One		1.21	(1.04, 1.43)	0.0172	**	0.82	(0.66, 1.01)	0.0678	*
Opioid Prescription in Phase One		0.91	(0.77, 1.09)	0.3169		1.18	(0.94, 1.49)	0.1542	
Opioid Prescription in Phase Two		—				0.95	(0.75, 1.21)	0.7006	
Used Mental Health Services in Phase Two		—				0.66	(0.53, 0.82)	0.0002	***
Age Category	70 – 74 years	0.88	(0.74, 1.04)	0.126		1.06	(0.85, 1.31)	0.621	
	75 – 79 years	0.84	(0.70, 1.01)	0.0621	*	1.12	(0.89, 1.42)	0.344	
	80 – 84 years	0.87	(0.71, 1.05)	0.153		1.06	(0.83, 1.36)	0.6367	
	≥ 85 years	1.06	(0.88, 1.27)	0.553		0.87	(0.69, 1.10)	0.247	
	66 – 69 years	-Ref				-Ref			
Female		1.11	(0.97, 1.27)	0.1174		1.12	(0.95, 1.33)	0.1682	
Race	Black	1.16	(0.93, 1.44)	0.1973		0.96	(0.72, 1.28)	0.7599	
	Other	0.50	(0.38, 0.65)	<.0001	***	1.79	(1.27, 2.52)	0.0009	***
	Unknown	0.34	(0.10, 1.11)	0.0738		1.11	(0.33, 3.72)	0.8668	

Variable		Phase One				Phase Two			
		aOR	95% CI	P-value		aOR	95% CI	P-value	
	White	-Ref				-Ref			
Medicaid dual eligible		1.67	(1.45, 1.92)	<.0001	***	0.63	(0.52, 0.75)	<.0001	***
Deyo-Charlson Comorbidity Score		1.1	(1.07, 1.14)	<.0001	***	0.94	(0.90, 0.98)	0.0073	**
Depression		9.64	(8.48, 10.95)	<.0001	***	0.24	(0.20, 0.29)	<.0001	***
Anxiety		3.46	(2.87, 4.19)	<.0001	***	0.4	(0.30, 0.52)	<.0001	***
Year	2009	1.00	(0.86, 1.18)	0.9639		0.9	(0.74, 1.10)	0.3061	
	2010	1.04	(0.85, 1.28)	0.6834		1.18	(0.91, 1.54)	0.2168	
	2011	1.14	(0.90, 1.43)	0.2743		1.08	(0.80, 1.46)	0.6078	
	2012	1.16	(0.90, 1.50)	0.2445		1.01	(0.73, 1.38)	0.9632	
	2013	1.61	(1.28, 2.04)	<.0001	***	1.23	(0.89, 1.69)	0.2044	
	2014	1.53	(1.13, 2.06)	0.0059	**	0.88	(0.58, 1.32)	0.524	
	2008	-Ref				-Ref			
Trauma in Phase One		2.99	(2.29, 3.91)	<.0001	***	0.88	(0.60, 1.30)	0.5319	
Surgery in Phase One		2.65	(0.76, 9.22)	0.1248		0.51	(0.09, 2.73)	0.4283	
Trauma in Phase Two		—				0.37	(0.25, 0.54)	<.0001	***
Surgery in Phase Two		—				0.22	(0.05, 1.03)	0.0551	
Censored	Full follow up	—				0.52	(0.23, 1.20)	0.1273	
	Left FFS	—				1.14	(0.34, 3.82)	0.8377	
	Died	—				-Ref			

Variable	Phase One			Phase Two			
	aOR	95% CI	P-value	aOR	95% CI	P-value	
Primary care providers†	0.97	(0.93, 1.01)	0.1839	1.06	(1.01, 1.12)	0.0288	*
Surgeons†	1.01	(0.98, 1.05)	0.4457	0.98	(0.94, 1.02)	0.3061	
Pain specialist†	1.33	(0.98, 1.80)	0.0638	0.97	(0.66, 1.45)	0.8996	*
Pharmacists†	0.99	(0.97, 1.01)	0.3434	1.01	(0.98, 1.04)	0.463	
Midlevel providers†	0.95	(0.93, 0.97)	<.0001	0.98	(0.95, 1.01)	0.18	***
Proportion of population over 65	1.20	(0.23, 6.15)	0.8304	0.32	(0.04, 2.45)	0.2728	
Proportion of population in poverty	3.32	(0.70, 15.81)	0.1312	2.83	(0.38, 21.15)	0.3112	
Intercept	0	(0.00, 0.00)	<.0001	626.17	(215.24, 1821.67)	<.0001	***
Scale	2.72	(2.72, 2.72)	—	2.72	(2.72, 2.72)	—	***

***P <0.001, **P <0.01, *P<0.05

†Providers per 10,000 people

aOR: adjusted Odds ratio

95% CI: 95% confidence interval

Table 3.6: Association between supply of non-pharmacologic providers and opioid prescriptions fills in Phase One and Phase Two (Total Association).

Variable		Phase One				Phase Two			
		aOR	95% CI	P-value		aOR	95% CI	P-value	
Mental Health Providers per 10k people		0.98	(0.97, 0.99)	<.0001	***	0.97	(0.96, 0.98)	<.0001	***
Physical Therapists per 10k people		0.99	(0.97, 1.00)	0.0491	**	0.99	(0.98, 1.01)	0.4843	
Metropolitan county		1.08	(1.01, 1.15)	0.0324	**	1.04	(0.97, 1.12)	0.318	
Age Category	70 – 74 years	0.96	(0.91, 1.02)	0.2403		0.97	(0.91, 1.04)	0.3524	
	75 – 79 years	0.90	(0.84, 0.96)	0.0018	***	0.86	(0.80, 0.92)	<.0001	***
	80 – 84 years	0.84	(0.78, 0.90)	<.0001	***	0.78	(0.72, 0.85)	<.0001	***
	≥ 85 years	0.79	(0.73, 0.85)	<.0001	***	0.78	(0.72, 0.85)	<.0001	***
	66 – 69 years	-Ref				-Ref			
Female		1.00	(0.95, 1.05)	0.9591		0.97	(0.92, 1.02)	0.2529	
Race	Black	0.98	(0.89, 1.07)	0.6147		1.02	(0.93, 1.13)	0.6261	
	Other	0.79	(0.72, 0.87)	<.0001	***	0.77	(0.70, 0.86)	<.0001	***
	Unknown	1.20	(0.86, 1.67)	0.2811		0.86	(0.57, 1.30)	0.4856	
	White	-Ref				-Ref			
Medicaid dual eligible		1.20	(1.13, 1.27)	<.0001	***	1.30	(1.22, 1.39)	<.0001	***
Deyo-Charlson Comorbidity Score		1.00	(0.98, 1.02)	0.9726		1.00	(0.99, 1.02)	0.6275	
Depression		1.01	(0.92, 1.11)	0.8354		0.98	(0.88, 1.09)	0.7375	
Anxiety		1.02	(0.88, 1.19)	0.7789		1.08	(0.91, 1.27)	0.3647	

		Phase One				Phase Two		
Variable		aOR	95% CI	P-value		aOR	95% CI	P-value
Year	2009	1.00	(0.94, 1.06)	0.9814		1.00	(0.94, 1.07)	0.982
	2010	0.99	(0.92, 1.07)	0.8381		0.9	(0.83, 0.98)	0.0144 **
	2011	1.09	(1.00, 1.19)	0.0412 **		0.93	(0.84, 1.02)	0.1062
	2012	1.02	(0.93, 1.12)	0.676		0.95	(0.86, 1.05)	0.2901
	2013	1.00	(0.91, 1.10)	0.9375		0.91	(0.82, 1.01)	0.074 *
	2014	1.19	(1.05, 1.35)	0.0077 ***		1.00	(0.86, 1.15)	0.9849
	2008	-Ref				-Ref		
Trauma in Phase One		3.03	(2.69, 3.41)	<.0001 ***		—		
Surgery in Phase One		2.57	(1.35, 4.87)	0.0039 ***		—		
Trauma in Phase One or Two		—				1.41	(1.22, 1.63)	<.0001 ***
Surgery in Phase One or Two		—				2.96	(2.60, 3.38)	<.0001 ***
Censored	Full follow up	—				0.35	(0.27, 0.45)	<.0001 ***
	Left FFS	—				0.46	(0.33, 0.64)	<.0001 ***
	Died	—				-Ref		
Primary care providers†		0.98	(0.97, 1.00)	0.0395 **		0.98	(0.96, 1.00)	0.0126 **
Surgeons†		1.02	(1.00, 1.03)	0.0072 ***		1.02	(1.01, 1.04)	0.0046 ***
Pain specialist†		0.81	(0.70, 0.92)	0.0018 ***		0.93	(0.81, 1.08)	0.342
Pharmacists†		1.01	(1.00, 1.01)	0.1909		1.00	(0.99, 1.01)	0.6824
Midlevel providers†		1.00	(0.99, 1.01)	0.7083		1.00	(0.99, 1.01)	0.8181

Variable	Phase One				Phase Two			
	aOR	95% CI	P-value		aOR	95% CI	P-value	
Proportion of population over 65	0.58	(0.32, 1.06)	0.0778	*	0.45	(0.23, 0.88)	0.0196	**
Proportion of population in poverty	1.50	(0.87, 2.60)	0.1479		1.30	(0.72, 2.37)	0.3863	
Intercept	0.18	(0.15, 0.21)	<.0001	***	0.47	(0.34, 0.65)	<.0001	***
Scale	2.72	(2.72, 2.72)			2.72	(2.72, 2.72)		

***P <0.001, **P <0.01, *P<0.05

†Providers per 10,000 people

aOR: adjusted Odds ratio

95% CI: 95% confidence interval

Ref: Reference

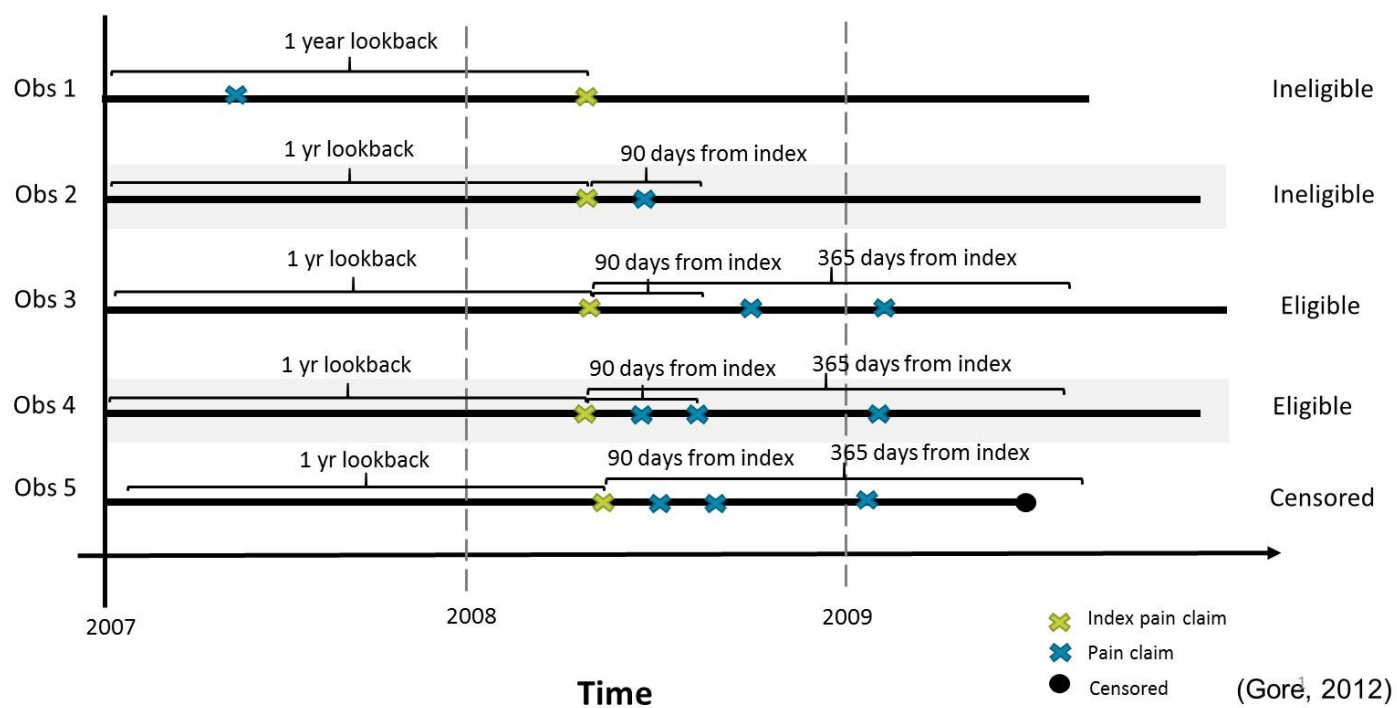


Figure 3.1: Algorithm used to identify a new episode of persistent musculoskeletal pain.⁵⁷

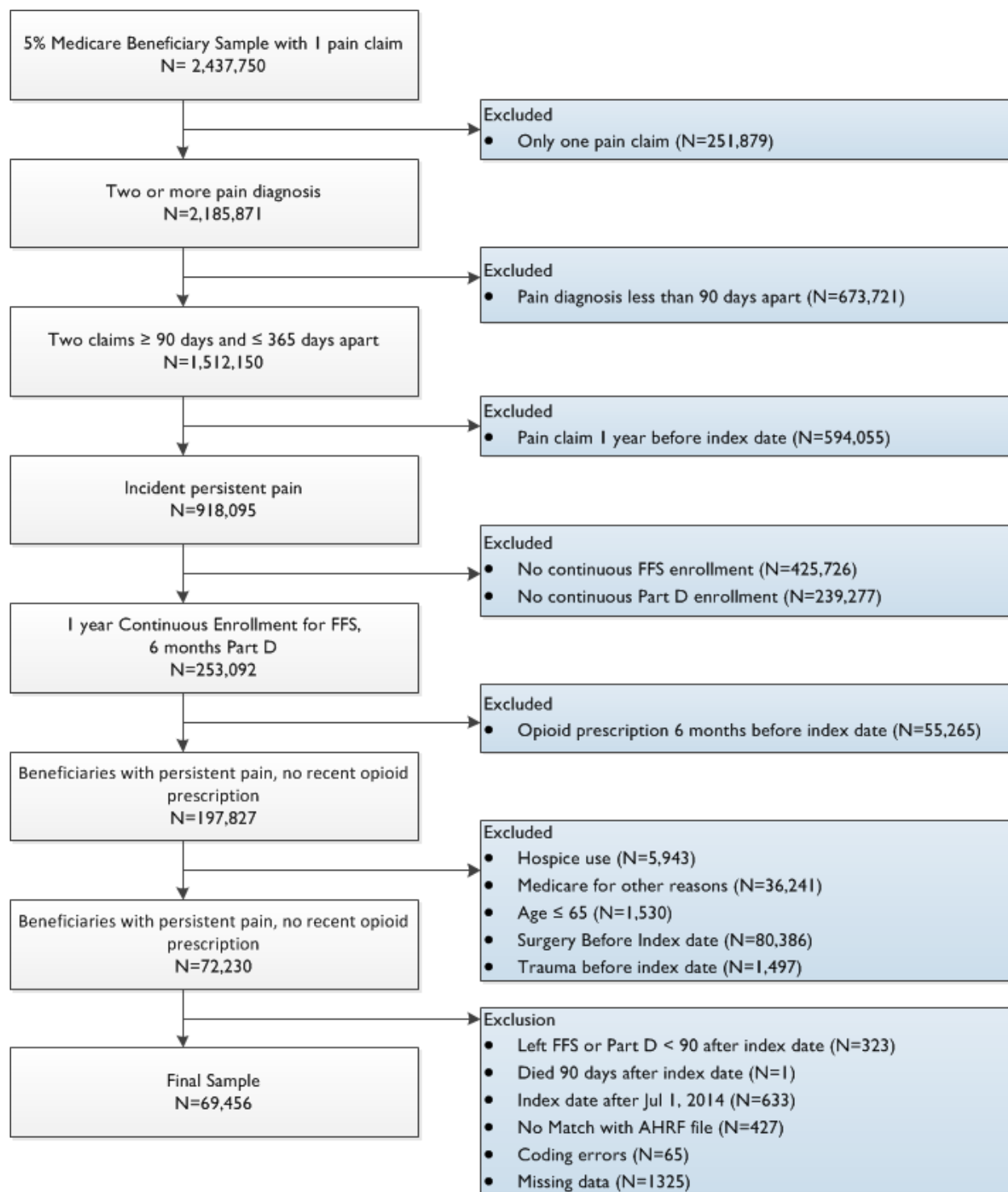


Figure 3.2: Cohort selection process.

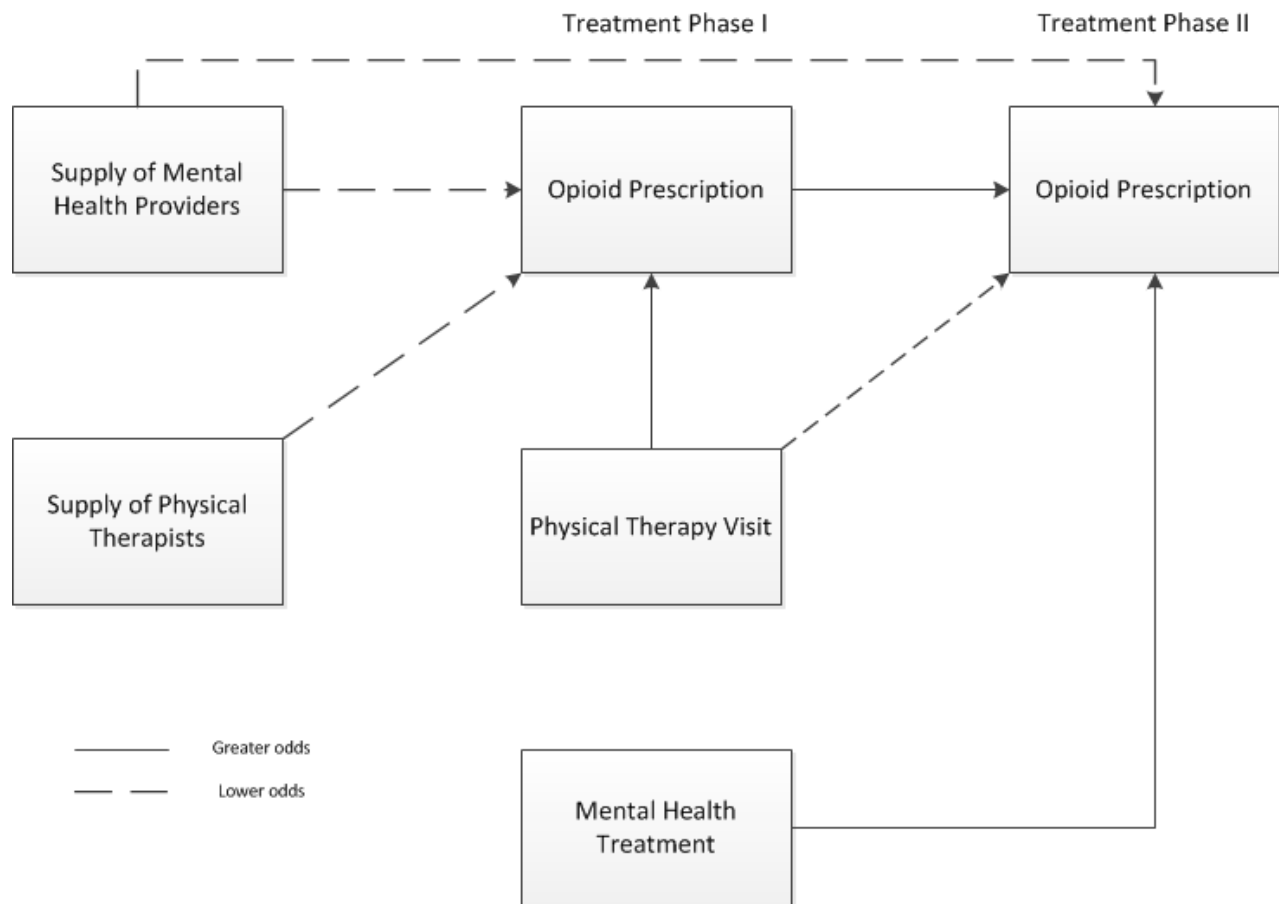


Figure 3.3: Significant associations between supply and use of non-pharmacologic services and opioid prescriptions during the transition from Phase One to Two.

Supplemental Tables

Supplemental Table 3.1: ICD-9/Current Procedural Codes/ Healthcare Common Procedure Coding System.

Measure	ICD-9/CPT/HCPCS
Musculoskeletal Pain ¹⁴⁵	3078, 30789, 338, 3382, 3384, 7100, 7103, 7104, 7105, 7109, 712, 713, 714, 715, 716, 717, 718, 719, 7200, 7201, 7202, 7208, 7209, 7210, 7211, 7212, 7213, 7214, 7219, 722, 7230, 7231, 7239, 7240, 7241, 7242, 7243, 7244, 7245, 7246, 7247, 725, 726, 72700, 7273, 7276, 7279, 7289, 729, 7291, 7292, 7294, 7295, 7298, 7328, 7329, 7371, 7373, 7382, 7383, 7384, 7385, 7386, 7398, 7399, 78096, 8052, 8054, 8056, 8058, 8080, 8082, 8084, 80841, 80842, 80843, 80844, 80849, 8088, 8090, 8100, 8110, 8120, 8122, 8124, 8130, 8132, 8134, 8138, 8140, 8150, 8160, 8170, 8180, 8190, 8200, 8202, 8208, 8210, 8212, 8220, 8230, 8232, 8238, 8240, 8242, 8244, 8246, 8248, 8250, 82520, 82521, 82522, 82523, 82524, 82525, 82529, 8260, 8270, 8290, 8310, 8320, 8330, 8340, 8350, 83600, 8361, 8362, 8363, 8365, 8366, 8370, 8380, 8390, 8392, 8394, 8396, 8398, 840, 8409, 841, 842, 843, 844, 845, 846, 847, 848, 959, 7391, 7392, 7393, 7394, 7395, 7396, 7397, 72703, 72704, 72705, 72706, 72709
Trauma ¹⁴⁵	875, 876, 877, 879, 880, 881, 882, 883, 884, 885, 886, 887, 890, 891, 892, 893, 894, 895, 896, 897, 926, 927, 928, 929, 996
Physical Therapy ¹⁴⁸	97110, 97350, 97535, 97112, 97150, 97035, 97010, 97032, 97012, 97140, 97001, 97002, 97124, 99070, 97750, 97113, 97116
Mental Health Services ^{28,149}	90832, 90833, 90834, 90836, 90837, 90838, 90791, 90792, 90804, 90805, 90806, 90807, 90808, 90809, 90810, 90811, 90812, 90813, 90814, 90815, 90816, 90817, 90818, 90819, 90820, 90821, 90822, 90823, 90824, 90825, 90826, 90827, 90828, 90829, 90845, 90847, 90849, 90853, 90857, 90865, 90870, G0409, G0410, G0411, 90839, 99354, 90840
Depression ¹⁵² (one inpatient or one outpatient diagnosis)	29620, 29621, 29622, 29623, 29624, 29625, 29626, 29630, 29631, 29632, 29633, 29634, 29635, 29636, 29650, 29651, 29652, 29653, 29654, 29655, 29656, 29660, 29661, 29662, 29663, 29664, 29665, 29666, 29689, 2980, 3004, 3091, 311
Anxiety ¹⁵³ (one inpatient or two outpatient diagnoses)	29384, 30000, 30001, 30002, 30009, 30010, 30020, 30021, 30022, 30023, 30029, 3003, 3005, 30089, 3009, 3080, 3081, 3082, 3083, 3084, 3089, 30981, 3130, 3131, 31321, 31322, 3133, 31382, 31383

Supplemental Table 3.2: Construction of variables from the Area Health Resource File.⁹⁸

Variable in Model	AHRF variable used	Years used	Method to account for missing years
Mental Health Providers	Psychiatrists Psychologists	2008, 2010-2013 2009	Linear Interpolation Carry Forward, Backward
Physical Therapists	Physical Therapists	2009	Carry Forward, Backward
Primary Care Providers	Internal Medicine, General Practice, Geriatrics specialties with MD or DO training in office based settings, hospital staff, hospital residents, and clinical fellows	2008, 2010-2013	Linear Interpolation
Surgeons	General and “other” surgery with MD or DO training in Office based settings, hospital staff, hospital residents, and clinical fellows	2008, 2010-2013	Linear Interpolation
Pain specialist	Physical Medicine/Rehabilitation MD or DO training in Office based settings, hospital staff, hospital residents, and clinical fellows	2008, 2010-2013	Linear Interpolation
Pharmacists		2009	Carry Forward, Backward
Midlevel providers	Nurse Practitioners Physicians assistants	2009 2009	Carry Forward, Backward

CHAPTER 4: THE ASSOCIATION BETWEEN ACCESS TO NON-PHARMACOLOGIC PAIN MANAGEMENT TREATMENTS AND HIGH-RISK OPIOID PRESCRIPTION PATTERNS FOR MEDICARE BENEFICIARIES WITH PERSISTENT MUSCULOSKELETAL PAIN².

Overview

Background

Contrary to clinical guidelines, recent trends in pain management indicate that opioids are prescribed more frequently than non-pharmacologic treatments. Significant geographic variation in opioid use persists, and high-risk opioid use – both high-dose and long-term use – are prevalent. Understanding how access to non-pharmacologic treatment affects these high-risk prescription patterns could inform policies to prevent them.

Objectives

We present temporal and geographic trends in high-risk opioid prescription patterns among Medicare beneficiaries with persistent musculoskeletal pain and estimate the association between access to two key non-pharmacologic services (Physical Therapy (PT) and mental health services) and high-risk opioid prescription patterns.

Subjects

Using claims from Medicare beneficiaries over age 65 enrolled in fee-for-service and Part D between 2007 and 2013, we constructed a cohort of beneficiaries with a new persistent musculoskeletal pain episode and no opioid prescription within the prior six months.

² Disclosure of conflict of interest: This research was conducted while Ruchir Karmali was a student at the University of North Carolina and a pre-doctoral fellow at the Duke Clinical Research Institute.

Measures and Research Design

We used four measures of access to non-pharmacologic services: supply of PT and mental health providers per 10,000 people per county and any use of PT and mental health services during the first three months of a new episode of pain (early use). Outcomes include long-term prescription (≥ 90 days' supply within a year) and high-dose prescription (any prescription ≥ 50 Milligrams Morphine Equivalent). For the outcomes, annual incidence rates and hospital referral region prevalence rates were calculated. Using multinomial regression and generalized estimating equations, we estimated the association between access to non-pharmacologic services and high-risk prescription patterns, controlling for individual and county characteristics.

Results

Geographic variation in high-risk opioid prescription patterns was substantial. Across models, greater supply of mental health providers and pain specialists was associated with lower odds of high-risk prescriptions. Evidence on early non-pharmacologic services use was mixed, but an early opioid prescriptions was associated with greater odds of high-risk prescriptions.

Conclusion

Improving access to mental health services can help providers follow clinical recommendations, and is likely to decrease high-risk prescriptions.

Introduction

Chronic pain, or pain that continues past three months, significantly impacts the quality of life for adults over age 65.^{1,2,46,56,60} One common chronic pain condition is musculoskeletal pain, which affects almost 60% of older adults.³ The direct healthcare and indirect cost of musculoskeletal pain exceeds \$320 billion with older adults accounting for 37% of the cost.³ Consequences of chronic pain include inactivity, falls, mood disorders, isolation, and

disability.^{2,46,60} For long-term treatment, clinical guidelines recommend non-pharmacologic (e.g. mental health services or physical therapy (PT)) and/or multimodal treatments for chronic pain, even when opioids are appropriate.^{18,19,55} Both mental health services (e.g. cognitive behavioral therapy) and PT improve pain symptoms, functioning, and opioid use, especially among older adults.^{26,79,80,94,95,112,113}

Opioids may be effective for acute pain, but limited evidence exists to support long-term opioid use and high-dose prescriptions.^{9,17} Compared acute pain diagnoses (e.g. surgery, trauma), patients with a chronic pain diagnosis have the greatest risk of long-term opioid use.⁹³ From 2007 to 2012, the rate of prescriptions with ≥ 90 days' supply almost doubled from 4% to 7% among older adults.⁶² Approximately 16% of Medicare beneficiaries are prescribed daily doses greater than 100 milligrams morphine equivalent (MME) -- more than twice the maximum dose recommended by the Centers for Disease Control and Prevention (CDC).^{18,74} Long-term opioid use, which could be necessary for chronic pain, can lead to opioid tolerance and need for increasingly high doses.¹⁸ About 25% of Medicare beneficiaries have ≥ 90 consecutive days of opioid prescriptions and daily doses greater than 100 MME.⁷⁴ Both long-term and high-dose opioid use increase the risk of overdose and mortality.^{10-13,15,16,69} Furthermore, opioid use in older adults is associated with a greater risk of adverse events (e.g. falls, fractures, and respiratory illness).^{10,63-66,141} The combination of long-term and high-dose opioid use also increases the risk of adverse events.⁷³

Among older adults, opioids are used more frequently than non-pharmacologic services.²⁹ Underuse of non-pharmacologic treatments and overuse of opioids may result from insufficient capacity of the health care system to deliver non-pharmacologic services.¹⁴³ Previous studies demonstrate a positive relationship between the supply of providers, such as primary care and

surgeons, and opioid prescription rates in adult populations.^{34,35,37} Little is known about the relationship between access to non-pharmacologic services and these high-risk prescription patterns among older adults with chronic pain. Understanding the drivers of high-risk prescription patterns can help inform efforts to prevent these patterns.

In this study, we sought to (1) examine the temporal and geographic trends in high-risk opioid prescription among older-adult Medicare beneficiaries with a new episode of persistent musculoskeletal pain and (2) estimate the association between access to non-pharmacologic services and high risk prescribing. Due to ambiguous definitions of chronic pain in the literature and the desire to focus on how pain patients interact with the health care system, we refer to the presence of multiple pain diagnoses at least 90 days apart as an episode of persistent pain. We measure access to non-pharmacologic services using four independent variables: per capita: county supply of mental health providers and physical therapists and any individual use of mental health services and PT during the first three months after the index pain diagnosis (early use after new claims indicating pain). Outcomes include two high-risk prescription patterns: receiving long-term and high-dose prescriptions. We hypothesize that (1) greater supply of non-pharmacologic providers is associated with lower odds of high-risk opioid prescribing, and (2) early use of non-pharmacologic services is associated with lower odds of high-risk prescribing.

Methods

This retrospective cohort study examined the relationship between access to non-pharmacological services and high-risk opioid prescription patterns for older adult, Medicare beneficiaries with what will become a new episode of persistent musculoskeletal pain. A diagnostic code was used as a proxy measure for pain; we acknowledge it represents a time when a beneficiary sought treatment for pain and not the onset of pain or the severity of pain.

Data Sources

This study utilized Medicare Fee-for-Service (FFS) claims and the Area Health Resource File (AHRF) datasets.⁹⁸ We used a 5% sample of beneficiaries enrolled in Medicare FFS during January 1, 2008 and December 31, 2013. Medicare claims data from 2007 was available for the look-back period. The Master Beneficiary Summary file contains information on demographics, enrollment, and death. We used claims from Medicare Parts A, B, and D. Part A contains inpatient claims and Part B contains outpatient claims, including home health, hospice, and skilled nursing facilities. Both Medicare Part A and B contained information about diagnoses, mental health services and PT visits, and dates of service. The Part D Drug Event file contains claims for filled prescriptions which include information about the amount of medication dispensed, the days' supply, and the fill date. Referencing the beneficiaries' county of residence and index date from the claims data, the AHRF was used to assign county characteristics to beneficiaries including the supply of non-pharmacologic providers in their county of residence.⁹⁸ The AHRF also contains the Rural-Urban Commuting Area codes which describe rurality for each county.^{98,144}

Study Population

Supplemental Figure 4.1 depicts how we identified a new episode of what will become persistent musculoskeletal pain for the cohort using International Disease Classification Codes, 9th edition (ICD-9) (Supplemental Table 4.1).¹⁴⁵ Individuals were included if they have two claims with diagnoses of musculoskeletal pain that are greater than 90, but fewer than 365 days apart.⁵⁷ We defined an episode of persistent musculoskeletal pain using the first claim with a pain diagnosis (index date) after a year without any claims with a pain diagnosis. Pain diagnoses did not have to be the same to identify an episode. After the index date, individuals were

followed for one year or death, enrollment in Medicare Advantage, or disenrollment from Part D, at which point they were censored.

We required individuals to have 12 months of claims before the index date, to ensure the pain episode was new and that there was no recent history of opioid prescription (within six months, consistent with prior research).¹³ Thus, to be in the cohort, individuals were 66 or older and continuously enrolled in Medicare FFS for one year before the index date. Since the focus of this analysis was a new episode of persistent musculoskeletal pain, we excluded individuals with a trauma diagnosis or surgery in the year before the index date (defined by Current Procedural Codes (CPT) and ICD-9 codes).^{145,146} Individuals with hospice or long term care services at any time were excluded because opioid prescription guidelines differ for these individuals.¹⁸

Outcomes

We identified long-term and high-dose prescriptions during the year after the index date using Medicare Part D claims. Both oral or transdermal formulations of opioids were included to reflect the United States' Food and Drug Administration-approved indication to treat pain. Opioids were identified by the National Drug Codes provided by the CDC.¹⁴⁷

Beneficiaries were coded with a long-term prescription if their total days' supply exceeded 90 during the one-year follow-up period (less if censored).⁶² The total days' supply is the sum of days for each prescription filled during follow-up. To identify high-dose prescriptions, we calculated the average daily MME for each prescription by multiplying the quantity prescribed, the drug strength, and the morphine equivalent conversion factor and dividing this by the days' supplied.^{147,159} Beneficiaries had a high dose prescription if the dose of any prescription filled during the follow-up period was ≥ 50 MME.¹⁸ We created a five-category, beneficiary level outcome for high-risk prescription fills: no opioid prescriptions, ≥ 1 opioid

prescription but no long-term or high dose prescriptions, long-term prescription only, high-dose prescription only, and both long-term and high-dose prescription.

Access Measures

We operationalized access to non-pharmacologic services in terms of the supply of providers in individuals' county of residence and individuals' early use of mental health and PT services. As a measure of local availability, the supply of providers were defined as the number of mental health providers and PT per county per year. Mental health providers includes both psychiatrists and psychologists. We created per capita measures using county population from the AHRF multiplied by 10,000.⁹⁸ When annual county supply variables were missing, we interpolated values based on existing data (Supplemental Table 4.2). Beneficiaries' early use of pain management services was a binary indicator for any opioid prescriptions, mental health services, and PT visits within three months of the index pain diagnosis using the CPT and Healthcare Common Procedural Coding System (Supplemental Table 4.1).^{28,148,149}

Covariates

Individual and county characteristics confounding the relationship between access to non-pharmacologic services and opioid prescription patterns were included based on Donabedian's Quality of Care Model.⁹⁷ Individual characteristics, measured at baseline and one year before the index date, included age, race, sex, and Medicaid dual eligibility (proxy for income).¹⁵⁰ Comorbidities were measured using the Deyo-Charlson comorbidity score.¹⁵¹ We also identified depression and anxiety at baseline using the ICD-9 codes identified by the Centers for Medicare and Medicaid's (CMS) Chronic Conditions Warehouse and the Health Cost and Utilization Project.^{145,152,153} In the follow up period, we controlled for trauma diagnosis and surgery.^{145,146} To account for loss to follow up, models included binary indicators for death and leaving FFS

Medicare during the year after the index date. Counts of the total number of prescribers and pharmacies seen by the individual during the follow up period were also included.³

For county characteristics, we independently controlled for the supply of primary care providers, surgeons, pain specialists, midlevel practitioners (nurse practitioners and physician assistants), and pharmacists.⁹⁸ Provider supply per capita measures followed the same method used for non-pharmacologic provider supply described above (Supplemental Table 4.1). We controlled for the county socioeconomic status (percent of the population below the Federal Poverty Limit) and percent of the county population over 65. Rural-Urban Commuting Area codes were used to assign counties to metropolitan and rural designations.⁹⁸

Statistical Analysis

We describe the trends in opioid prescription patterns over time and geographically. The annual opioid prescription rate from 2008 to 2014 was calculated by dividing the number of beneficiaries with the outcome at the end of each year by the total number of beneficiaries who completed follow up in that year. We describe the unadjusted, geographic rates in any opioid prescriptions, long-term prescription, or high-dose prescriptions. Because many counties had \leq ten beneficiaries, we calculated the rates by hospital referral regions (HRR). Beneficiaries were assigned to HRR based on their zip code of residence. We calculated the rate of opioid prescribing patterns by HRR which reflect market for healthcare in an area.¹⁶⁰ HRRs with fewer than 10 beneficiaries overall or fewer than 10 beneficiaries with an opioid prescription pattern were censored.

³ The Centers for Medicare and Medicaid changed the encryption method to identified unique prescribers and pharmacies in 2014. To obtain the total number of prescribers for beneficiaries with a 2013 index date, we counted each prescriber or pharmacy as unique, which may lead to double counting. However, time trends in the model should adjust for this difference.

We calculated means and proportions for individual and county-level variables. T-tests and chi-square tests were used to compare individual and county characteristics of beneficiaries with an opioid prescription, long-term prescriptions, and high-dose prescriptions to those without those outcomes, separately.

We used a multinomial logistic regression to test hypotheses using data from the entire cohort. The outcome was the five-category high-risk prescribing pattern measure, with the reference category as any opioid prescription during the follow-up period to allow for comparisons with subsequent subgroup analyses. The model included measures of access (supply of mental health providers and supply of physical therapists, early use of mental health services, and early use of physical therapy), individual characteristics (demographics, comorbidities, trauma, and surgery), and county characteristics (provider supply and demographics).

Subgroup analyses of beneficiaries with an opioid prescription in the follow-up period were conducted to address potential selection bias issues by controlling for opioid prescription characteristics. We used generalized estimating equations and selected the model with the unstructured correlation based on the quasi-likelihood under the independence model criterion (QIC) goodness of fit statistic (unstructured). The dependent variables were long-term prescriptions and high-dose prescriptions. The independent variables from the multinomial model were included along with an indicator for an early opioid prescription, the number of prescribers, and the number of pharmacies visited. For both models, we used the definition for high dose prescriptions as 90 MME in sensitivity analysis. Since the association between the supply of non-pharmacologic providers and opioid prescribing outcomes is mediated by use, we also examined the “total association” between the supply and the outcomes in another sensitivity

analysis. The subgroup analyses using different definitions for long-term and high-dose prescriptions were replicated. Analyses were conducted in SAS Version 9.4 (SAS Institute, Inc., Cary, NC) and Stata version 15.1 (StataCorp). The Institutional Review Boards at Duke University School of Medicine and the University of North Carolina-Chapel Hill approved this study.

Results

We identified 197,827 beneficiaries with a new episode of persistent musculoskeletal pain without an opioid prescription within six months of the index date. After excluding 80,386 beneficiaries because of surgery, 1,497 because of a trauma diagnosis before the index date, and 5,943 because of hospice use, the final cohort included 67,183 beneficiaries (Figure 4.1).

Descriptive Statistics

One third of the cohort filled an opioid prescription during the one year follow-up period (Table 4.1). Overall, 12% had high-dose prescriptions, and 2.4% had long-term prescriptions. About 28% of the cohort was 66 to 69 years old, 66% was female, 84.8% was White, 19.9% were dually eligible, and 81.3% resided in a metropolitan county. The mean Charlson Comorbidity Score was 1.1. Only 2.1% of the cohort had anxiety and 5.8% had depression at baseline. The most prevalent musculoskeletal pain conditions include arthritis (98.4%), back pain (66.5%), and fibromyalgia (69.1%). On average, there were four mental health providers and six physical therapists per 10,000 people per county.

Compared to beneficiaries without an opioid prescription after the index date, beneficiaries with an opioid prescription were more likely to be younger, have Medicaid, live in rural counties, and have depression at baseline (Table 4.1). The average daily dose was 43.7 MME/day and average days' supply was 28.2 days. During the first three months of the

persistent pain episode, 17.3% used PT, 1.7% used mental health services, and 41.9% filled an opioid prescription. Beneficiaries has an average of 1.4 prescribers and 1.2 pharmacies.

Long-Term and High-Dose Prescriptions

Among beneficiaries with an opioid prescription during the follow up period, 7.6% had a long-term prescription, 38.3% had a high-dose prescription, and 3% had both long-term and high dose prescriptions (Table 4.2). The average daily dose for beneficiaries with a long-term prescription was a significantly lower than average daily dose for beneficiaries without a long-term prescription. (32.7 MME/day vs 44.6 MME/day, $p \leq 0.001$). About 44% of beneficiaries with long-term prescription had a prescription dose ≥ 50 MME. Beneficiaries with long-term prescriptions were more likely to be female, Black, have Medicaid, have depression and anxiety at baseline, have more prescribers and pharmacies, and use mental health services early than those without long-term prescriptions. Beneficiaries with high-dose prescriptions were more likely to be younger, male, White, live in a rural county, and use PT but less likely to have Medicaid early compared to beneficiaries without high-dose prescriptions. Early opioid prescriptions were significantly more likely among beneficiaries with long-term (65.5%) or high-dose prescriptions (46.8%). The median supply of providers for beneficiaries with long-term prescriptions and high-doses was lower compared to beneficiaries without a long-term prescription or high-doses, respectively.

Temporal and Geographic Variation

While the opioid prescription and the long-term prescription rates for the entire cohort were stable over the study period, the high-dose prescriptions rate decreased by 35% (Figure 4.2). The opioid prescription rate by HRR ranged from 12% to 52% (Figure 4.3). The rate of long-term prescriptions by HRR ranged from 0% to 8%, and the rate of high-dose prescriptions by HRR ranged from 2% to 35%.

Access to Non-Pharmacologic Services and High-Risk Prescription Patterns

Compared to beneficiaries with an opioid prescription during follow-up, an additional non-pharmacologic provider was associated with greater odds of not filling an opioid prescription [mental health providers: adjusted odds ratio (aOR): 1.01, 95% Confidence interval (CI): 1.00-1.02, PT aOR: 1.02, 95% CI: 1.01-1.03] (Table 4.3). A greater supply of mental health providers and pain specialists were associated with lower odds of long-term and high-dose prescriptions. An additional physical therapists was significantly associated with greater odds of long-term prescriptions [aOR: 1.04, 95% CI: 1.00-1.09]. The supply of physical therapists was not significantly associated with high-dose or concurrent high-dose and long-term prescriptions. Relative to beneficiaries with an opioid prescription, early use of mental health services was associated with greater odds of long-term prescriptions [aOR: 1.94, 95% CI: 1.32-2.86. Early use of PT was associated with greater odds of high-dose [aOR: 1.28, 95% CI: 1.19-1.38] and concurrent long-term and high-dose prescriptions [aOR: 1.19, CI: 0.97-1.46].

Among beneficiaries with an opioid prescription during the follow-up year (Table 4.4 and Table 4.5), greater supply of mental health providers and pain specialists was significantly associated with lower odds of a long-term prescription and high-dose prescriptions. The supply of physical therapists was not significantly associated with the odds of long-term prescriptions or high-dose prescriptions. An early opioid prescription was associated with greater odds of long-term prescriptions and high-dose prescriptions. An additional prescriber or pharmacy was associated with greater odds of long-term and high-dose prescriptions.

Sensitivity analyses which examined the total association between the supply of non-pharmacologic providers and opioid prescription patterns were consistent with the main analysis (Table 4.6 and 4.7). Associations were consistent across definitions of high-doses (Table 4.8).

Discussion

This study examined high-risk opioid prescription patterns for Medicare beneficiaries over 65 with a new episode of persistent musculoskeletal pain. We found that a third of the cohort filled an opioid prescription during the one year follow-up period, and almost half of those prescriptions occurred three months into a new episode. The average daily dose for beneficiaries with long-term prescriptions was lower than estimates reported from a recent study of all Medicare beneficiaries with long-term prescriptions.⁷⁴ A concerning finding is that about 3% of this cohort had long-term and high-dose prescriptions concurrently. Furthermore, almost 40% of beneficiaries with a long-term prescription had a prescription ≥ 50 MME. These results suggest that while many beneficiaries with long-term prescriptions have relatively low average doses of opioids, the doses of individual prescriptions may exceed the CDC thresholds, which could represent an increase in pain and expose beneficiaries to adverse events.^{18,62,161} Long-term, high-dose opioids may be appropriate for certain patients, but require careful monitoring and clear understanding of associated risks.¹⁸

We found patterns of high-risk opioid prescriptions for older adults with persistent musculoskeletal pain were distinct from populations that have previously been studied. For example, unlike previous studies which found rising rates of long-term prescriptions among Medicare beneficiaries, the rate of long-term prescriptions was stable in this cohort.^{62,74} However, the rate of high-dose prescriptions fell by about 35% from 2008 to 2014, which is slower than the rate of change observed for all Medicare beneficiaries.⁷⁴ Comparable to previous studies with different populations, the rates of high-risk patterns varied across the country.^{33,35-37} The greatest concentration of high-dose prescriptions was the South and the West, while the long-term prescription rate was highest in the Midwest. This substantial geographic variation may indicate variations in care for patients with musculoskeletal pain, differences in available

resources, and policy differences, especially for preventing and addressing high-risk prescribing patterns.^{33,35,37}

The supply of mental health providers and pain specialists were both strongly associated with lower odds of high-risk prescription patterns across models while the supply of physical therapists was not significantly associated. This finding could reflect the differences in needs of beneficiaries when pain persists. For example, compared to physical therapists, pain specialists may be better equipped to manage long-term pain episodes and manage long-term opioid treatments.¹ Furthermore, mental health providers can address the mental health needs that may develop during a pain episode.¹ We found mixed evidence for early use of non-pharmacologic services and high-risk prescribing patterns. Without information about duration and dose of non-pharmacologic services use as well as the patient's pain severity, function, and psychosocial characteristics, it is difficult to conclude whether early use of non-pharmacologic services increases high-risk prescribing patterns or if associations indicate a greater need for pain treatments.

This study extends previous literature which found that the characteristics of initial opioid prescriptions such as dose and duration are associated with long-term opioid prescriptions.^{6,93} We found that opioid prescriptions filled within three months of a new pain episode is associated with greater odds of high-risk prescription patterns. Based on this finding, timing of the opioid prescription with respect to the onset of a new episode of pain may be an important consideration to prevent high-risk patterns.

Recent policy approaches which target prescribing behaviors or limit access to narcotics have limited evidence demonstrating reductions in opioid prescriptions.^{62,90,162} These policies take a myopic approach to the opioid epidemic by doing little to increase access to alternative

pain management strategies. We found preliminary evidence supporting policies that address shortages for mental health professionals and pain specialists. The independent association of the supply of providers, after controlling for use of these services, suggests that these providers are valuable resources to the health care system. For example, integrating mental health providers and pain specialists in primary care settings may provide additional organizational and practice level support for primary care providers who care for chronic pain patients.¹⁶³⁻¹⁶⁵

Our study has several limitations. First, this is an observational study and the associations are not causal. Results may be biased because of unobserved variables (e.g. pain severity, function, education, and supply of substance use providers). Second, we lack data on whether prescribed opioids were taken as indicated. Third, we used administrative claims data which only include services that were paid for by Medicare. Therefore, many pain treatments (e.g. over the counter medications, yoga, acupuncture, massage) are excluded from this analysis. When this study was conducted, claims with a diagnosis for substance use disorder were redacted.¹⁵⁸ The redaction could affect our estimation of the utilization of mental health services, particularly those tied to substance use diagnoses. Finally, our findings may not be generalizable to younger adults and adults with surgery or trauma.

Conclusion

Clinical guidelines recommend non-pharmacologic services over opioids for patients with chronic pain.^{18,19} We examined access to two common non-pharmacologic services, PT and mental health services, and found that only the supply of mental health providers was significantly associated with lower odds of high-risk patterns. Early opioid prescriptions was associated with greater odds of high-risk patterns. Future research should examine how the

timing, dose, and duration of non-pharmacologic services may impact high-risk prescriptions.

Improving access to mental health services, particularly to communities with the greatest rates of high-risk patterns, is a critical to increase guideline adherence and patient safety.

Table 4.1: Characteristics of Medicare beneficiaries with a new episode of persistent musculoskeletal pain who received an opioid prescription during one year follow up.

Characteristics	Entire Cohort (N=67,183)	No Opioid prescription (N= 46,221)	Opioid prescription (N= 20,962)	P- value
	Mean (SD)/No. (%)	Mean (SD)/No. (%)	Mean (SD)/No. (%)	
<i>Outcomes</i>				
Opioid prescription during follow up	20,962 (31.2)	—	20,962 (100.0)	
Prescription dose \geq 50 MME	8,024 (11.9)	—	8,024 (38.3)	
Prescription Dose \geq 90 MME	3,953 (5.9)	—	3,953 (18.9)	
Average Dose \geq 50 MME, as prescribed•	5,868 (8.7)	—	5,868 (28.0)	
Average Dose \geq 50 MME•	4,055 (6.0)	—	4,055 (19.3)	
Days' supply \geq 90 days	1,597 (2.4)	—	1,597 (7.6)	
Days' supply \geq 90, accounting for overlap•	1,409 (2.1)	—	1,409 (6.7)	
Chronic long-term opioid prescription•	707 (1.1)	—	707 (3.4)	
<i>Opioid prescription characteristics</i>				
Early Opioid Prescription	8,776 (13.1)	—	8,776 (41.9)	
Average daily MME	13.6 (29.0)	—	43.7 (37.2)	
Total days' supply	8.8 (31.0)	—	28.2 (50.2)	
Total opioid days covered	8.2 (27.2)	—	26.1 (43.5)	
<i>Demographics</i>				
Age (categories)				
66 – 69 years	18,850 (28.1)	12,603 (27.3)	6,247 (29.8)	< .001
70 – 74 years	16,006 (23.8)	10,793 (23.4)	5,213 (24.9)	< .001
75 – 79 years	12,355 (18.4)	8,531 (18.5)	3,824 (18.2)	0.51
80 – 84 years	9,752 (14.5)	6,935 (15.0)	2,817 (13.4)	< .001
\geq 85 years	10,220 (15.2)	7,359 (15.9)	2,861 (13.6)	< .001
Age, continuous	75.6 (7.7)	75.8 (7.8)	75.1 (7.6)	< .001
Sex				
Female	44,326 (66.0)	30,704 (66.4)	13,622 (65.0)	< .001

Characteristics	Entire Cohort (N=67,183)	No Opioid prescription (N= 46,221)	Opioid prescription (N= 20,962)	P- value
Male	22,857 (34.0)	15,517 (33.6)	7,340 (35.0)	< .001
Race				
White	56,959 (84.8)	39,042 (84.5)	17,917 (85.5)	< .001
Black	4,602 (6.8)	3,132 (6.8)	1,470 (7.0)	0.26
Other Race	5,622 (8.4)	4,047 (8.8)	1,575 (7.5)	< .001
Medicaid dual eligible	13,371 (19.9)	8,994 (19.5)	4,377 (20.9)	< .001
Metropolitan county	54,636 (81.3)	37,773 (81.7)	16,863 (80.4)	< .001
<i>Comorbidities</i>				
Deyo-Charlson Comorbidity Score (mean)	1.1 (1.4)	1.1 (1.4)	1.1 (1.5)	0.49
0	31,533 (46.9)	21,675 (46.9)	9,858 (47.0)	0.75
1	17,302 (25.8)	11,860 (25.7)	5,442 (26.0)	0.41
2	8,886 (13.2)	6,118 (13.2)	2,768 (13.2)	0.91
≥3	9,462 (14.1)	6,568 (14.2)	2,894 (13.8)	0.16
Anxiety	1,408 (2.1)	967 (2.1)	441 (2.1)	0.92
Depression	3,909 (5.8)	2,653 (5.7)	1,256 (6.0)	0.2
Trauma during follow up	4,248 (6.3)	2,339 (5.1)	1,909 (9.1)	< .001
Surgery during follow up	17,122 (25.5)	9,541 (20.6)	7,581 (36.2)	< .001
Pain type				
Arthritis	66,076 (98.4)	45,459 (98.4)	20,617 (98.4)	0.98
Back pain	44,659 (66.5)	29,408 (63.6)	15,251 (72.8)	< .001
Chronic pain	10,571 (15.7)	5,596 (12.1)	4,975 (23.7)	< .001
Neck pain	8,087 (12.0)	5,076 (11.0)	3,011 (14.4)	< .001
Psychogenic pain	844 (1.3)	550 (1.2)	294 (1.4)	0.02
Sprain or strain	19,430 (28.9)	12,435 (26.9)	6,995 (33.4)	< .001
Fibromyalgia	46,441 (69.1)	31,434 (68.0)	15,007 (71.6)	< .001
Other pain type	20,955 (31.2)	13,241 (28.6)	7,714 (36.8)	< .001

Characteristics	Entire Cohort (N=67,183)	No Opioid prescription (N= 46,221)	Opioid prescription (N= 20,962)	P- value
<i>Utilization during follow up</i>				
Use Mental Health Services	2,181 (3.2)	1,453 (3.1)	728 (3.5)	0.03
Used Physical Therapy	17,708 (26.4)	10,076 (21.8)	7,632 (36.4)	< .001
Number of pharmacists	0.4 (0.6)	—	1.2 (0.4)	
Number of prescribers	0.4 (0.8)	—	1.4 (0.8)	
Early use of Physical Therapy	9,201 (13.7)	5,565 (12.0)	3,636 (17.3)	< .001
Early use of Mental Health Services	1,165 (1.7)	802 (1.7)	363 (1.7)	0.97
<i>County Characteristics (Median, Interquartile Range)</i>				
Mental Health Providers †	3.3 (1.6, 5.7)	3.4 (1.7, 6.0)	3.0 (1.4, 5.5)	< .001
Physical Therapists †	5.9 (4.0, 7.6)	6.0 (4.1, 7.7)	5.7 (3.8, 7.4)	< .001
Primary care providers †	6.8 (5.0, 8.9)	6.9 (5.1, 9.0)	6.6 (4.9, 8.6)	< .001
Surgeons †	5.7 (3.5, 8.0)	5.8 (3.6, 8.1)	5.5 (3.3, 7.9)	< .001
Pain specialist †	0.3 (0.1, 0.4)	0.3 (0.1, 0.5)	0.2 (0.1, 0.4)	< .001
Pharmacists †	8.9 (7.2, 11.2)	8.9 (7.2, 11.3)	8.8 (7.2, 11.1)	< .001
Midlevel providers †	4.8 (3.3, 7.1)	4.8 (3.3, 7.2)	4.8 (3.2, 7.1)	< .001
Proportion of population over 65	0.1 (0.1, 0.2)	0.1 (0.1, 0.2)	0.1 (0.1, 0.2)	< .001
Proportion of population in poverty	0.1 (0.1, 0.2)	0.1 (0.1, 0.2)	0.1 (0.1, 0.2)	< .001

† per 10,000 people

• Average daily dose as prescribed: total MME/total days' supply

Average daily dose: total MME/ total days' supply accounting for overlapping prescriptions

Days' supply ≥ 90, accounting for overlap: ≥ 90 total days' supply accounting for any overlapping prescription

Chronic long-term opioid prescription: ≥ continuous days' supply, allowing for gap between prescriptions of 7 days.

Table 4.2: Characteristics of Medicare beneficiaries with a new episode of persistent musculoskeletal pain with high-risk opioid prescription patterns.

	Long-term opioid prescriptions			High-dose prescriptions		
	No Long-term prescription (N=19,365)	Long-term prescription (N= 1,597)	P-value	No high dose prescription (N=12,938)	High-dose prescription (N= 8,024)	P-value
<i>Outcomes</i>						
Dose \geq 50 MME	7,316 (37.8)	708 (44.3)	< .001	—	8,024 (100.0)	
Average Dose \geq 50 MME, as prescribed	5,581 (28.8)	287 (18.0)	< .001	—	5,868 (73.1)	
Average Dose \geq 50 MME	4,040 (20.9)	15 (0.9)	< .001	—	4,055 (50.5)	
Days' supply \geq 90 days	—	1,597 (100.0)		889 (6.9)	708 (8.8)	< .001
Days' supply \geq 90, accounting for overlap	—	1,409 (88.2)		812 (6.3)	597 (7.4)	0.001
Chronic long-term opioid prescription	—	707 (44.3)		383 (3.0)	324 (4.0)	< .001
<i>Opioid prescription characteristics</i>						
Average daily MME	44.6 (37.6)	32.7 (30.0)	< .001	25.3 (10.6)	73.2 (45.0)	< .001
Total days' supply	16.5 (17.2)	171.0 (86.3)	< .001	26.2 (45.9)	31.5 (56.3)	< .001
Total opioid days covered	15.8 (16.3)	151.0 (69.3)	< .001	25.1 (42.6)	27.8 (44.9)	< .001
<i>Demographics</i>						
Age (categories)						
66 – 69 years	5,822 (30.1)	425 (26.6)	0.004	3,768 (29.1)	2,479 (30.9)	0.006
70 – 74 years	4,879 (25.2)	334 (20.9)	< .001	3,114 (24.1)	2,099 (26.2)	< .001
75 – 79 years	3,516 (18.2)	308 (19.3)	0.26	2,385 (18.4)	1,439 (17.9)	0.36
80 – 84 years	2,578 (13.3)	239 (15.0)	0.06	1,804 (13.9)	1,013 (12.6)	0.007
\geq 85 years	2,570 (13.3)	291 (18.2)	< .001	1,867 (14.4)	994 (12.4)	< .001
Age, continuous	75.0 (7.5)	76.3 (8.0)	< .001	75.3 (7.7)	74.8 (7.4)	< .001
Sex						
Female	12,561 (64.9)	1,061 (66.4)	0.21	8,488 (65.6)	5,134 (64.0)	0.02
Male	6,804 (35.1)	536 (33.6)	0.21	4,450 (34.4)	2,890 (36.0)	0.02
Race						

	Long-term opioid prescriptions			High-dose prescriptions		
	No Long-term prescription (N=19,365)	Long-term prescription (N= 1,597)	P- value	No high dose prescription (N=12,938)	High-dose prescription (N= 8,024)	P- value
White	16,605 (85.7)	1,312 (82.2)	< .001	10,763 (83.2)	7,154 (89.2)	< .001
Black	1,321 (6.8)	149 (9.3)	< .001	994 (7.7)	476 (5.9)	< .001
Other Race	1,439 (7.4)	136 (8.5)	0.11	1,181 (9.1)	394 (4.9)	< .001
Medicaid dual eligible	3,821 (19.7)	556 (34.8)	< .001	3,046 (23.5)	1,331 (16.6)	< .001
Metropolitan county	15,604 (80.6)	1,259 (78.8)	0.09	10,460 (80.8)	6,403 (79.8)	0.06
<i>Comorbidities</i>						
Deyo-Charlson Comorbidity Score (mean)	1.1 (1.5)	1.2 (1.6)	0.002	1.1 (1.5)	1.0 (1.5)	< .001
0	9,170 (47.4)	688 (43.1)	0.001	5,930 (45.8)	3,928 (49.0)	< .001
1	4,993 (25.8)	449 (28.1)	0.04	3,435 (26.5)	2,007 (25.0)	0.01
2	2,551 (13.2)	217 (13.6)	0.64	1,738 (13.4)	1,030 (12.8)	0.21
≥3	2,651 (13.7)	243 (15.2)	0.09	1,835 (14.2)	1,059 (13.2)	0.04
Alcohol Disorder	53 (0.3)	17 (1.1)	< .001	36 (0.3)	34 (0.4)	0.08
Anxiety	393 (2.0)	48 (3.0)	0.009	289 (2.2)	152 (1.9)	0.1
Depression	1,128 (5.8)	128 (8.0)	< .001	774 (6.0)	482 (6.0)	0.94
Trauma in year after index date	1,734 (9.0)	175 (11.0)	0.007	1,045 (8.1)	864 (10.8)	< .001
Surgery in year after index date	6,778 (35.0)	803 (50.3)	< .001	4,333 (33.5)	3,248 (40.5)	< .001
<i>Pain type</i>						
Arthritis	19,045 (98.3)	1,572 (98.4)	0.79	12,685 (98.0)	7,932 (98.9)	< .001
Back pain	13,963 (72.1)	1,288 (80.7)	< .001	9,470 (73.2)	5,781 (72.0)	0.07
Chronic pain	4,364 (22.5)	611 (38.3)	< .001	2,654 (20.5)	2,321 (28.9)	< .001
Neck pain	2,744 (14.2)	267 (16.7)	0.005	1,802 (13.9)	1,209 (15.1)	0.02
Psychogenic pain	273 (1.4)	21 (1.3)	0.76	176 (1.4)	118 (1.5)	0.51
Sprain or strain	6,531 (33.7)	464 (29.1)	< .001	4,134 (32.0)	2,861 (35.7)	< .001
Fibromyalgia	13,793 (71.2)	1,214 (76.0)	< .001	9,155 (70.8)	5,852 (72.9)	< .001
Other pain type	7,090 (36.6)	624 (39.1)	0.05	4,577 (35.4)	3,137 (39.1)	< .001

	Long-term opioid prescriptions			High-dose prescriptions		
	No Long-term prescription (N=19,365)	Long-term prescription (N= 1,597)	P-value	No high dose prescription (N=12,938)	High-dose prescription (N= 8,024)	P-value
<i>Utilization during follow up</i>						
Any Use of Mental Health Services	627 (3.2)	101 (6.3)	< .001	460 (3.6)	268 (3.3)	0.41
Any Use of Physical Therapy	7,080 (36.6)	552 (34.6)	0.11	4,185 (32.3)	3,447 (43.0)	< .001
Number of pharmacists	1.1 (0.4)	1.5 (0.8)	< .001	1.1 (0.4)	1.2 (0.5)	< .001
Number of prescribers	1.4 (0.7)	2.3 (1.5)	< .001	1.3 (0.6)	1.7 (1.0)	< .001
Early use of Physical Therapy	3,387 (17.5)	249 (15.6)	0.05	2,054 (15.9)	1,582 (19.7)	< .001
Early use of Mental Health Services	307 (1.6)	56 (3.5)	< .001	229 (1.8)	134 (1.7)	0.59
Early Opioid Prescription	7,729 (39.9)	1,047 (65.6)	< .001	5,022 (38.8)	3,754 (46.8)	< .001
<i>County Characteristics</i>						
Mental Health Providers †	3.0 (1.4, 5.5)	2.7 (1.2, 4.9)	< .001	3.1 (1.4, 5.5)	2.9 (1.3, 5.2)	< .001
Physical Therapists †	5.7 (3.9, 7.5)	5.3 (3.5, 7.3)	< .001	5.7 (3.8, 7.4)	5.7 (3.9, 7.6)	0.04
Primary care providers †	6.6 (4.9, 8.6)	6.4 (4.7, 8.4)	0.002	6.6 (4.9, 8.6)	6.6 (4.8, 8.5)	0.03
Surgeons †	5.5 (3.4, 7.9)	5.2 (3.1, 7.7)	0.003	5.5 (3.3, 7.9)	5.5 (3.3, 7.9)	0.99
Pain specialist †	0.2 (0.1, 0.4)	0.2 (0.0, 0.4)	0.001	0.2 (0.1, 0.4)	0.2 (0.1, 0.4)	< .001
Pharmacists †	8.8 (7.2, 11.1)	8.5 (6.8, 10.9)	< .001	8.7 (7.1, 11.0)	8.9 (7.2, 11.2)	< .001
Midlevel providers †	4.8 (3.2, 7.1)	4.6 (3.2, 6.9)	0.12	4.7 (3.2, 7.1)	4.8 (3.2, 7.0)	0.43
Proportion of population over 65	0.1 (0.1, 0.2)	0.1 (0.1, 0.2)	0.94	0.1 (0.1, 0.2)	0.1 (0.1, 0.2)	0.17
Proportion of population in poverty	0.1 (0.1, 0.2)	0.1 (0.1, 0.2)	< .001	0.1 (0.1, 0.2)	0.1 (0.1, 0.2)	< .001

† per 10,000 people

• Average daily dose as prescribed: total MME/total days' supply

Average daily dose: total MME/ total days' supply accounting for overlapping prescriptions

Days' supply ≥ 90, accounting for overlap: ≥ 90 total days' supply accounting for any overlapping prescription

Chronic long-term opioid prescription: ≥ continuous days' supply, allowing for gap between prescriptions of 7 days.

Table 4.3: Association between access to non-pharmacologic pain treatments and opioid prescribing patterns compared to Medicare beneficiaries without opioid prescriptions.

		No opioids •			Long term prescription • High-dose prescription•			Long term and high dose					
		aOR	P-value		aOR	P-value		aOR	P-value		aOR	P-value	
Mental Health Providers	†	1.01	0.01	***	0.96	0.02	**	0.97	0.00	***	0.97	0.12	
Physical Therapists	†	1.02	0.00	***	1.04	0.07	*	1.01	0.25		1.00	0.97	
Early Use of Mental Health Services		1.22	0.02	**	1.94	0.00	***	0.94	0.59		1.45	0.11	
Early Use of Physical Therapy		0.70	<.0001	***	0.95	0.61		1.28	<.0001	***	1.19	0.09	*
Metropolitan County		1.03	0.32		0.90	0.29		0.97	0.52		1.09	0.45	
Age Category	70 – 74 years	1.02	0.44		0.87	0.20		0.95	0.22		0.87	0.22	
	75 – 79 years	1.11	0.00	***	1.10	0.38		0.83	<.0001	***	0.87	0.24	
	80 – 84 years	1.23	<.0001	***	1.21	0.09	*	0.76	<.0001	***	0.73	0.02	**
	≥ 85 years	1.37	<.0001	***	1.21	0.09	*	0.65	<.0001	***	0.82	0.11	
	66 – 69 years	-Ref			-Ref			-Ref			-Ref		
Female	Female	0.95	0.04	**	1.11	0.20		0.97	0.40		0.94	0.45	
Race	Unknown	0.89	0.52		0.59	0.47		0.64	0.15		0.42	0.40	
	Other	1.03	0.55		0.84	0.18		0.62	<.0001	***	0.69	0.03	**
	Black	0.96	0.28		1.13	0.33		0.85	0.01	**	0.84	0.27	
	White	-Ref			-Ref			-Ref			-Ref		
Medicaid dual eligible		0.87	<.0001	***	2.08	<.0001	***	0.72	<.0001	***	1.42	0.00	***
Deyo-Charlson Comorbidity Score		0.99	0.03	**	1.00	0.96		0.97	0.02	**	1.03	0.28	
Depression		1.03	0.50		1.22	0.14		1.02	0.78		1.04	0.83	
Anxiety		0.94	0.41		1.30	0.20		0.89	0.27		1.13	0.62	
Year	2012	0.97	0.48		0.93	0.67		1.02	0.83		1.25	0.33	
	2008	0.85	0.00	**	0.90	0.52		0.86	0.05	*	0.93	0.76	
	2011	1.02	0.67		0.82	0.24		1.30	0.00	***	1.54	0.04	**
	2009	1.06	0.19		1.03	0.86		1.85	<.0001	***	2.32	<.0001	***
	2010	1.04	0.40		0.96	0.78		1.71	<.0001	***	2.23	<.0001	***
	2013	-Ref			-Ref			-Ref			-Ref		

			No opioids •		Long term prescription •		High-dose prescription•		Long term and high dose •		
			aOR	P-value		aOR	P-value		aOR	P-value	
Trauma after index date			0.68	<.0001	***	0.85	0.23		1.29	<.0001	***
Surgery after index date			1.88	<.0001	***	0.72	<.0001	***	0.75	<.0001	***
Censor	1 year Follow up		0.97	0.76		1.88	0.09	*	0.68	0.00	**
	Left FFS or Part D		1.05	0.67		1.83	0.13		0.74	0.04	**
	Died		-Ref			-Ref			-Ref		
Primary care providers †			1.01	0.10	*	0.99	0.74		0.97	0.00	**
Surgeons †			0.99	0.31		1.03	0.23		1.04	<.0001	***
Pain specialist †			1.08	0.20		0.65	0.07	*	0.76	0.00	**
Pharmacists †			1.00	0.79		0.98	0.19		1.02	0.01	**
Midlevel providers †			1.00	0.41		1.00	0.93		1.01	0.45	
Proportion of population over 65			2.40	0.00	**	2.22	0.41		2.01	0.08	*
Proportion of population in poverty			0.65	0.10	*	3.20	0.16		0.79	0.54	

† per 10,000 people

• Reference group is any opioid prescription during follow up

P < 0.01 ***; P < 0.05 **; P < 0.1 *

aOR: adjusted Odds ratio

Ref: Reference

Table 4.4: Association between access to non-pharmacologic pain treatments and long-term prescriptions.

			Chronic Opioid prescribing				Long term, as prescribed, ≥ 90 days			
			Days' Supply ≥ 90 days		(≥ 90 days, ≤7 day gap)					
			aOR	P-value		aOR	P-value		aOR	
Mental Health Providers †			0.97	0.0555	*	0.99	0.6965		0.98	0.1371
Physical Therapists †			1.03	0.1011		1.05	0.0594	*	1.04	0.0498 **
Metropolitan County			0.97	0.6952		0.86	0.1963		0.92	0.3653
Age Category	70 – 74 years		0.93	0.3999		0.86	0.2323		0.9	0.2485
	75 – 79 years		1.18	0.0529	*	1.07	0.5754		1.14	0.1365
	80 – 84 years		1.33	0.0024	***	1.57	0.0005	***	1.27	0.0152 **
	≥ 85 years		1.63	<.0001	***	2.17	<.0001	***	1.61	<.0001 ***
	66 – 69 years		-Ref			-Ref			-Ref	
Female	Female		0.99	0.9242		0.94	0.4888		1.02	0.7443
Race	Black		1.04	0.7391		0.92	0.6039		1.06	0.5876
	Other		0.93	0.4968		0.91	0.5443		0.84	0.1498
	Unknown		0.53	0.3275		0.42	0.4006		0.60	0.4282
	White		-Ref			-Ref			-Ref	
Medicaid dual eligible			1.89	<.0001	***	1.87	<.0001	***	1.94	<.0001 ***
Deyo-Charlson Comorbidity Score			1.03	0.1362		1.04	0.1431		1.03	0.1188
Depression			1.21	0.0798	*	1.29	0.0852	*	1.11	0.3688
Anxiety			1.39	0.0551	*	1.29	0.2909		1.29	0.1722

				Chronic Opioid prescribing			Long term, as prescribed, ≥ 90 days		
Days' Supply ≥ 90 days				$(\geq 90$ days, ≤ 7 day gap)					
				aOR	P-value		aOR	P-value	
Early Opioid Prescription				2.08	<.0001	***	1.83	<.0001	***
Early Use of Mental Health Services				1.78	0.0006	***	2.16	0.0002	***
Early Use of Physical Therapy				0.76	0.0005	***	0.84	0.1271	
Year	2009	0.92	0.2279				1.08	0.4309	
	2010	0.81	0.0273	**			0.96	0.7738	
	2011	0.80	0.0395	**			1.02	0.9001	
	2012	0.81	0.0772	*			1.06	0.7032	
	2013	0.64	0.0007	***			0.87	0.4229	
	2008	-Ref					-Ref		
Trauma after index date				0.79	0.0142	**	0.94	0.5956	
Surgery after index date				1.22	0.0007	***	1.51	<.0001	***
Number of pharmacies				1.79	<.0001	***	1.76	<.0001	***
Number of prescribers				1.91	<.0001	***	1.58	<.0001	***
Censor	1 year Follow up	0.81	0.0631	*			0.65	0.0028	***
	Left Part D or FFS	0.93	0.7405				0.9	0.7055	
	Died	-Ref					-Ref		
Primary care providers †				1.00	0.9562		1.05	0.0791	*
Surgeons †				1.02	0.1511		0.98	0.297	

				Chronic Opioid prescribing		Long term, as prescribed, ≥ 90 days		
	Days' Supply ≥ 90 days			(≥ 90 days, ≤7 day gap)				
	aOR	P-value		aOR	P-value		aOR	
Pain specialist †	0.73	0.0637	*	0.85	0.4848		0.74	0.0897
Pharmacists per †	0.98	0.0845	*	0.98	0.1156		0.98	0.0984
Midlevel providers †	0.99	0.446		0.99	0.6337		0.99	0.6734
Proportion of population over 65	1.32	0.7129		0.92	0.9353		1.06	0.9385
Proportion of population in poverty	3.97	0.0468	**	1.76	0.5709		4.82	0.0302
Intercept	0.01	<.0001	***	0	<.0001	***	0.01	<.0001
Scale	2.72			2.72			2.72	

† per 10,000 people

unstructured correlation

P < 0.01 ***; P < 0.05 **; P < 0.1 *

aOR: adjusted Odds ratio

Ref: Reference

“as prescribed”: total number of opioid days covered, accounting for overlapping prescriptions

Table 4.5: Association between access to non-pharmacologic pain treatments and high-dose prescriptions.

			High Dose Prescriptions ≥ 50 MME			Average dose as prescribed, ≥ 50 MME			Average dose, ≥ 50 MME		
			aOR	P-value		aOR	P-value		aOR		
Mental Health Providers †			0.98	0.001	***	0.98	0.004	***	0.98	0.03	**
Physical Therapists †			1.01	0.45		1.02	0.02	**	1.02	0.04	**
Metropolitan County			0.97	0.49		1.00	0.98		1.07	0.22	
Age Category	70 – 74 years		0.96	0.28		0.93	0.09	*	0.97	0.47	
	75 – 79 years		0.82	<.0001	***	0.82	<.0001	***	0.86	0.01	***
	80 – 84 years		0.76	<.0001	***	0.78	<.0001	***	0.85	0.01	***
	≥ 85 years		0.71	<.0001	***	0.72	<.0001	***	0.74	<.0001	***
	66 – 69 years		-Ref			-Ref			-Ref		
Female	Female		0.94	0.07	*	0.96	0.26		0.98	0.69	
Race	Black		0.82	0.00	***	0.83	0.01	***	0.84	0.03	**
	Other		0.65	<.0001	***	0.65	<.0001	***	0.72	0.00	***
	Unknown		0.64	0.16		0.79	0.48		1.24	0.55	
	White		-Ref			-Ref			-Ref		
Medicaid dual eligible			0.67	<.0001	***	0.69	<.0001	***	0.62	<.0001	***
Deyo-Charlson Comorbidity Score			0.98	0.02	**	0.96	0.00	***	0.96	0.01	***
Depression			1.00	0.96		0.96	0.54		1.02	0.76	
Anxiety			0.91	0.41		0.83	0.12		0.95	0.68	
Early Opioid Prescription			1.12	0.00	***	1.03	0.36		0.95	0.18	

			High Dose Prescriptions ≥ 50 MME			Average dose as prescribed, ≥ 50 MME			Average dose, ≥ 50 MME	
			aOR	P-value		aOR	P-value		aOR	
Early Use of Mental Health Services			0.89	0.35		0.85	0.22		0.97	0.83
Early Use of Physical Therapy			1.20	<.0001	***	1.15	0.00	***	1.12	0.02 **
Year	2009		0.91	0.01	**	0.88	0.00	***	0.89	0.01 ***
	2010		0.69	<.0001	***	0.67	<.0001	***	0.68	<.0001 ***
	2011		0.43	<.0001	***	0.42	<.0001	***	0.43	<.0001 ***
	2012		0.51	<.0001	***	0.46	<.0001	***	0.50	<.0001 ***
	2013		0.46	<.0001	***	0.45	<.0001	***	0.55	<.0001 ***
	2008		-Ref			-Ref			-Ref	
Trauma after index date			1.22	0.00	***	1.09	0.10	*	1.17	0.01 **
Surgery after index date			1.20	<.0001	***	1.15	<.0001	***	1.05	0.26
Number of pharmacies			1.15	0.0003	***	1.03	0.54		0.66	<.0001 ***
Number of prescribers			1.88	<.0001	***	0.98	0.45		0.36	<.0001 ***
Censor	1 year Follow up		0.86	0.02	**	1.04	0.63		0.95	0.52
	Left Part D or FFS		1.54	0.00	***	1.68	0.00	***	1.54	0.01 **
	Died		-Ref			-Ref			-Ref	
Primary care providers †			0.97	0.001	***	0.96	0.00	***	0.95	<.0001 ***
Surgeons †			1.04	<.0001	***	1.04	0.00	***	1.04	0.00 ***
Pain specialist †			0.73	0.00	***	0.78	0.01	***	0.78	0.03 **
Pharmacists per †			1.02	0.00	***	1.01	0.01	***	1.02	0.00 ***
Midlevel providers †			1.00	0.71		1.00	0.90		1.00	0.68

	High Dose Prescriptions ≥ 50 MME			Average dose as prescribed, ≥ 50 MME			Average dose, ≥ 50 MME		
	aOR	P-value		aOR	P-value		aOR		
Proportion of population over 65	2.01	0.08	*	2.21	0.05	*	2.37	0.06	*
Proportion of population in poverty	0.54	0.11		1.38	0.42		2.18	0.10	*
Intercept	0.35	<.0001	***	0.48	<.0001	***	1.66	0.01	***
Scale	2.72	—	***	2.72	—	***	2.72	—	***

† per 10,000 people
unstructured correlation
P < 0.01 ***; P < 0.05 **, P < 0.1 *
aOR: adjusted Odds ratio
Ref: Reference

Table 4.6: Association between supply of non-pharmacologic providers and opioid prescribing patterns compared to Medicare beneficiaries without opioid prescriptions (Total Association).

		No opioids •			Long term prescription • High-dose prescription• Long term and high dose •								
		aOR	P-value		aOR	P-value		aOR	P-value		aOR	P-value	
Mental Health Providers	†	1.01	0.02	**	0.96	0.02	**	0.98	0.00	***	0.97	0.12	
Physical Therapists	†	1.02	0.00	***	1.04	0.07	*	1.01	0.21		1.00	1.00	
Metropolitan county		1.04	0.28		0.89	0.27		0.97	0.47		1.08	0.48	
Age Category	70 – 74 years	1.03	0.34		0.87	0.19		0.95	0.18		0.87	0.21	
	75 – 79 years	1.11	0.00	***	1.10	0.39		0.82	<.0001	***	0.87	0.23	
	80 – 84 years	1.25	<.0001	***	1.21	0.09	*	0.75	<.0001	***	0.73	0.02	**
	≥ 85 years	1.38	<.0001	***	1.21	0.09	*	0.65	<.0001	***	0.81	0.10	
	66 – 69 years	-Ref			-Ref			-Ref			-Ref		
Female	Female	0.95	0.03	**	1.11	0.19		0.97	0.42		0.94	0.47	
Race	Unknown	0.90	0.53		0.58	0.46		0.64	0.15		0.41	0.39	
	Other	1.02	0.56		0.83	0.16		0.62	<.0001	***	0.69	0.03	**
	Black	0.98	0.55		1.13	0.31		0.83	0.00	***	0.84	0.24	
	White	-Ref			-Ref			-Ref			-Ref		
Medicaid dual eligible		0.88	<.0001	***	2.11	<.0001	***	0.71	<.0001	***	1.42	0.00	***
Deyo-Charlson Comorbidity Score		0.99	0.07	*	1.00	0.95		0.97	0.01	***	1.03	0.27	
Depression		1.05	0.29		1.32	0.04	**	1.01	0.86		1.08	0.62	
Anxiety		0.96	0.53		1.36	0.13		0.89	0.27		1.17	0.54	
Year	2012	0.97	0.51		0.92	0.63		1.02	0.83		1.25	0.34	
	2008	1.07	0.11		1.02	0.90		1.83	<.0001	***	2.29	<.0001	***
	2011	0.86	0.00	***	0.89	0.49		0.86	0.05	**	0.93	0.74	
	2009	1.05	0.29		0.95	0.74		1.70	<.0001	***	2.21	<.0001	***
	2010	1.03	0.58		0.82	0.22		1.29	0.00	***	1.53	0.04	**
	2013	-Ref			-Ref			-Ref			-Ref		
Trauma after index date		0.68	<.0001	***	0.86	0.26		1.29	<.0001	***	1.40	0.00	***
Surgery after index date		1.88	<.0001	***	0.71	<.0001	***	0.74	<.0001	***	0.36	<.0001	***

		No opioids •		Long term prescription •		High-dose prescription•		Long term and high dose •	
		aOR	P-value	aOR	P-value	aOR	P-value	aOR	P-value
Censor	1 year Follow up	0.96	0.70	1.83	0.10	0.69	0.00 ***	0.43	<.0001 ***
	Left FFS or Part D	1.04	0.70	1.79	0.14	0.75	0.04 **	0.84	0.47
	Died	-Ref		-Ref		-Ref		-Ref	
Primary care providers †		1.01	0.12	0.99	0.74	0.97	0.00 ***	1.00	0.84
Surgeons †		0.99	0.29	1.02	0.24	1.04	<.0001 ***	1.01	0.67
Pain specialist †		1.08	0.18	0.66	0.07 *	0.75	0.00 ***	0.89	0.63
Pharmacists †		1.00	0.71	0.98	0.18	1.01	0.01 ***	1.00	0.81
Midlevel providers †		1.00	0.40	1.00	0.89	1.00	0.47	1.02	0.29
Proportion of population over 65		2.43	0.00 ***	2.24	0.40	1.99	0.09 *	1.88	0.55
Proportion of population in poverty		0.69	0.15	3.27	0.15	0.75	0.44	1.57	0.63

† per 10,000 people

• Reference group is any opioid prescription during follow up

P < 0.01 ***; P < 0.05 **; P < 0.1 *

aOR: adjusted Odds ratio

Ref: Reference

Table 4.7: Association between supply of non-pharmacologic providers and high-risk opioid prescriptions (Total Association).

		High Dose Prescriptions ≥ 50 MME			Long-Term Prescription (≥ 90 Days' Supply)	
		aOR	P-value		aOR	P-value
Mental Health Providers †		0.98	0.0012	***	0.97	0.0592 *
Physical Therapists †		1.01	0.4493		1.03	0.0982 *
Metro		0.97	0.479		0.98	0.7798
Age Category	70 – 74 years	0.95	0.2561		0.93	0.4035
	75 – 79 years	0.82	<.0001	***	1.18	0.0553 *
	80 – 84 years	0.76	<.0001	***	1.33	0.0019 ***
	≥ 85 years	0.71	<.0001	***	1.65	<.0001 ***
	66 – 69 years	-Ref			-Ref	
Female		0.94	0.0657	*	1.00	0.977
Race	Black	0.81	0.0013	***	1.05	0.6228
	Other	0.66	<.0001	***	0.91	0.4161
	Unknown	0.63	0.1496		0.53	0.3286
	White	-Ref			-Ref	
Medicaid dual eligible		0.66	<.0001	***	1.94	<.0001 ***
Deyo-Charlson Comorbidity Score		0.98	0.0156	**	1.03	0.09 *
Depression		0.98	0.8096		1.28	0.0207 **
Anxiety		0.91	0.3777		1.44	0.0348 **
Early Opioid Prescription		1.15	<.0001	***	2.01	<.0001 ***

		High Dose Prescriptions ≥ 50 MME			Long-Term Prescription (≥ 90 Days' Supply)		
		aOR	P-value		aOR	P-value	
Year	2009	0.91	0.0137	**	0.91	0.1944	
	2010	0.69	<.0001	***	0.81	0.0249	**
	2011	0.44	<.0001	***	0.8	0.0387	**
	2012	0.52	<.0001	***	0.81	0.0725	*
	2013	0.46	<.0001	***	0.65	0.0008	***
	2008	-Ref			-Ref		
Trauma after index date		1.22	0.0001	***	0.8	0.0184	**
Surgery after index date		1.2	<.0001	***	1.23	0.0004	***
Number of pharmacies		1.15	0.0004	***	1.79	<.0001	***
Number of prescribers		1.88	<.0001	***	1.91	<.0001	***
Censor	1 year Follow up	0.86	0.0291	**	0.8	0.0483	**
	Left Part D or FFS	1.53	0.0027	***	0.94	0.7937	
	Died	-Ref			-Ref		
Primary care providers †		0.97	0.0015	***	1.00	0.8882	
Surgeons †		1.04	<.0001	***	1.02	0.1691	
Pain specialist †		0.73	0.0005	***	0.74	0.0763	*
Pharmacists per †		1.02	0.0042	***	0.98	0.0954	*
Midlevel providers †		1.00	0.6887		0.99	0.3951	
Proportion of population over 65		2.01	0.077	*	1.33	0.7086	

	High Dose Prescriptions ≥ 50 MME			Long-Term Prescription (≥ 90 Days' Supply)		
	aOR	P-value		aOR	P-value	
Proportion of population in poverty	0.51	0.0807	*	4.27	0.036	**
Intercept	0.36	<.0001	***	0.01	<.0001	***
Scale	2.72			2.72		

† per 10,000 people
 unstructured correlation
 $P \leq 0.01$ ***; ≤ 0.05 **, $P \leq 0.1$ *
 aOR: adjusted Odds ratio
 Ref: Reference

Table 4.8: Association between access to non-pharmacologic pain treatments and high-dose prescriptions ≥ 90 MME.

		High Dose Prescriptions ≥ 90 MME	
		aOR	P-value
Intercept		0.17	<.0001 ***
Mental Health Providers †		0.96	<.0001 ***
Physical Therapists †		1.03	0.0066 ***
Metropolitan County		0.97	0.6368
Age Category	70 – 74 years	1.00	0.9397
	75 – 79 years	0.91	0.1018
	80 – 84 years	0.95	0.444
	≥ 85 years	1.00	0.9388
	66 – 69 years	-Ref	
Female	Female	1.14	0.001 ***
	Male	-Ref	
Race	Black	0.96	0.5816
	Other	0.69	<.0001 ***
	Unknown	1.05	0.9001
	White	-Ref	
Medicaid dual eligible		0.75	<.0001 ***
Deyo-Charlson Comorbidity Score		0.99	0.296
Depression		1.09	0.285

			High Dose Prescriptions	
			≥ 90 MME	
			aOR	P-value
Anxiety			1.03	0.861
Early Opioid Prescription			1.12	0.0029 ***
Early Use of Mental Health Services			0.91	0.526
Early Use of Physical Therapy			1.12	0.0167 **
Year	2009		0.84	<.0001 ***
	2010		0.52	<.0001 ***
	2011		0.22	<.0001 ***
	2012		0.27	<.0001 ***
	2013		0.22	<.0001 ***
	2008		-Ref	
Trauma after index date			1.07	0.31
Surgery after index date			1.10	0.022 ***
Number of pharmacies			1.19	<.0001 ***
Number of prescribers			1.63	<.0001 ***
Censor	1 year Follow up		0.49	<.0001 ***
	Left Part D or FFS		0.59	0.0009 ***
	Died		-Ref	
Primary care providers †			0.97	0.0156 **
Surgeons †			1.03	0.002 ***

High Dose Prescriptions			
≥ 90 MME			
	aOR	P-value	
Pain specialist †	0.8	0.0459	**
Pharmacists per †	1.02	0.0068	***
Midlevel providers †	0.99	0.3355	
Proportion of population over 65	2.58	0.0476	**
Proportion of population in poverty	4.09	0.0029	***
Scale	2.72	—	***
† per 10,000 people unstructured correlation $P \leq 0.01$ ***; $P \leq 0.05$ **, $P \leq 0.1$ * aOR: adjusted Odds ratio Ref: Reference			

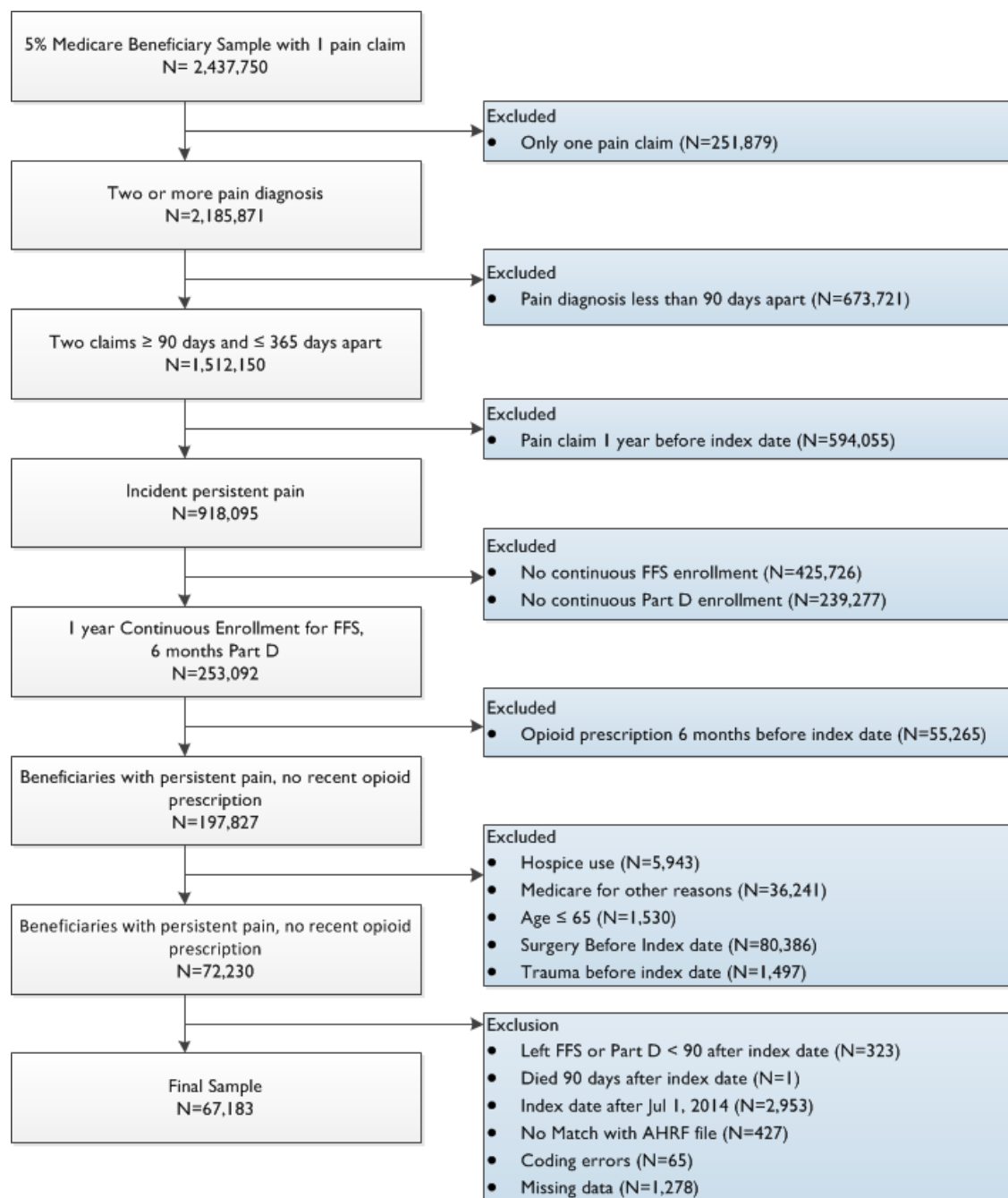
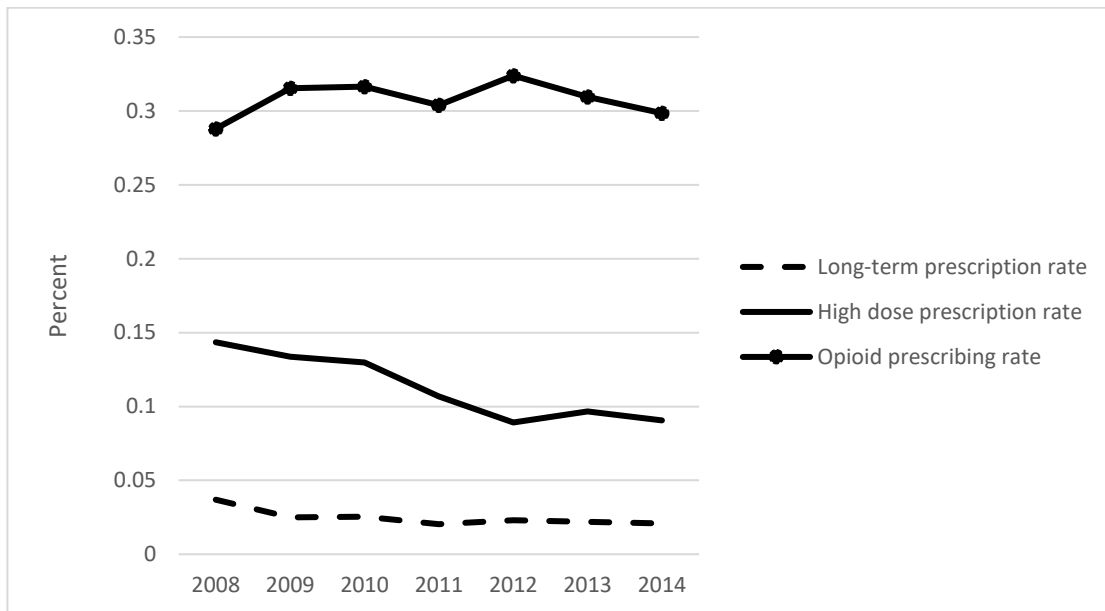
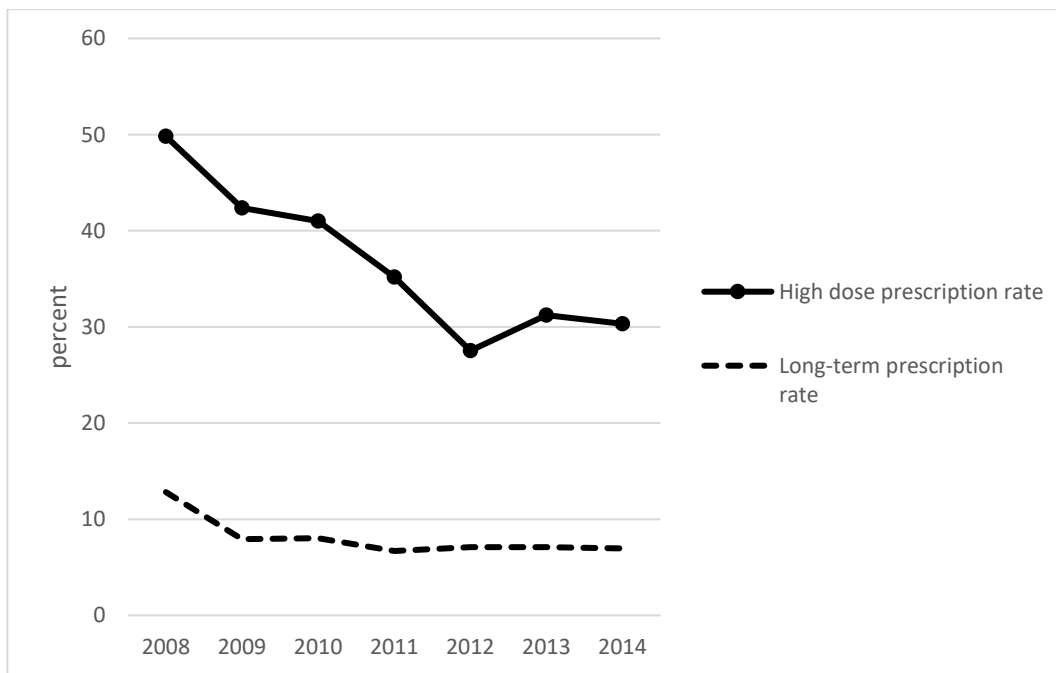


Figure 4.3: Cohort Selection process of Medicare beneficiaries with a new episode of persistent musculoskeletal pain.

Panel A



Panel B



Panel A: Annual Rate for the entire cohort

Panel B: Annual Rate for only beneficiaries with >1 opioid prescription during follow up.

N= 68,949

Figure 4.4: Trends of opioid prescribing patterns for Medicare beneficiaries with a new episode of persistent musculoskeletal pain from 2008-2014.

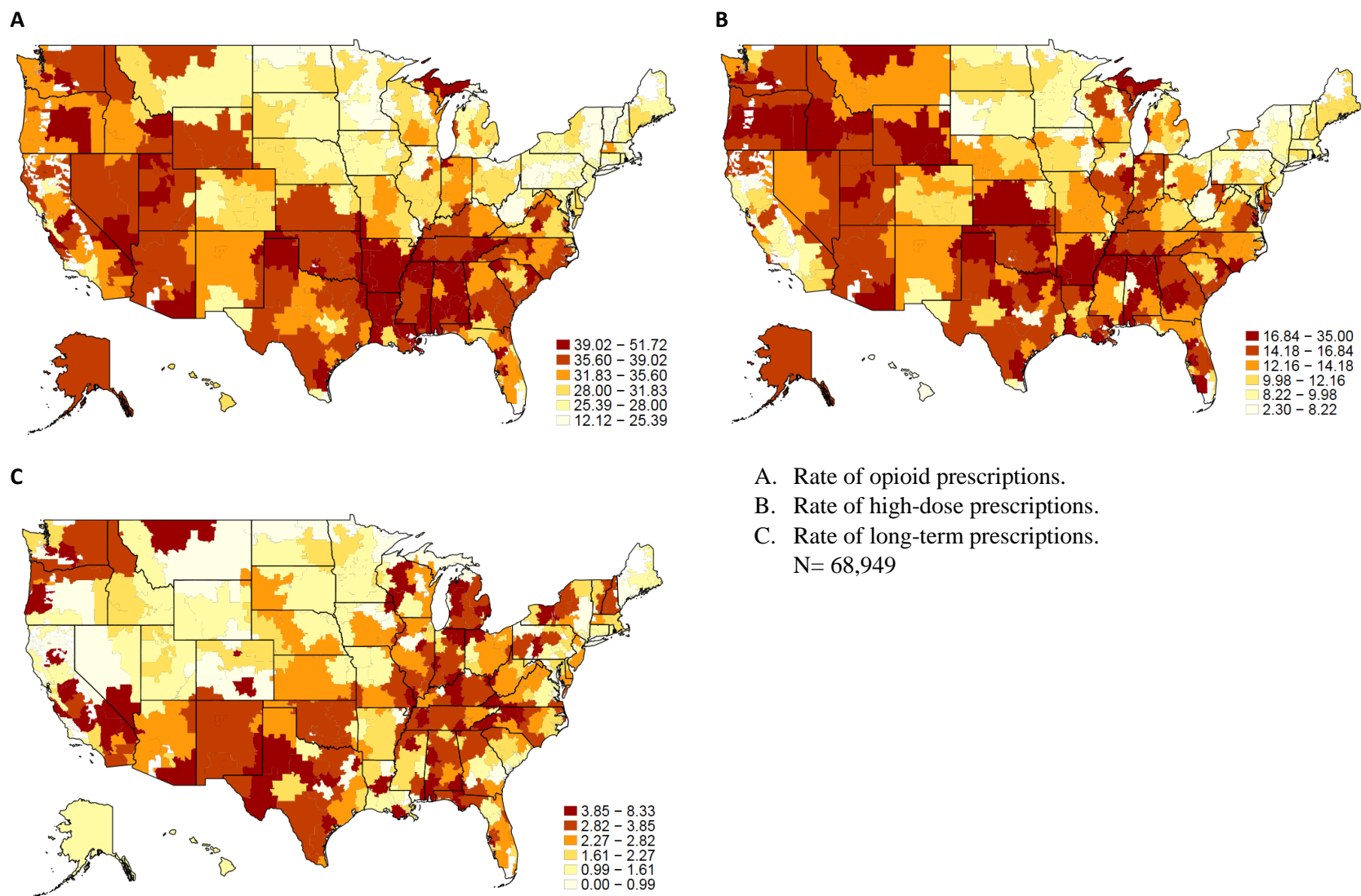
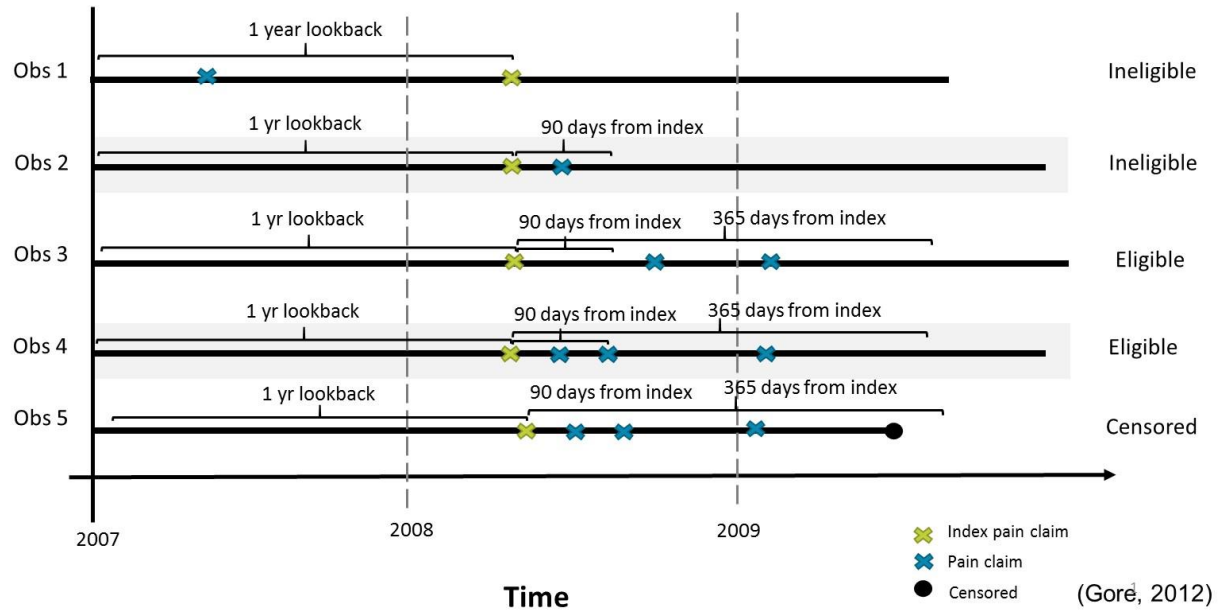


Figure 4.5: Geographic variation in opioid prescription patterns among Medicare beneficiaries with a new episode of persistent musculoskeletal pain 2008-2014.

Supplemental Figures and Tables



Supplemental Figure 4.1: Algorithm used to identify a new episode of persistent musculoskeletal pain.⁵⁷

Supplemental Table 4.1: ICD-9/Current Procedural Codes/ Healthcare Common Procedure Coding System.

Measure	ICD-9/CPT/HCPCS
Musculoskeletal Pain ¹⁴⁵	3078, 30789, 338, 3382, 3384, 7100, 7103, 7104, 7105, 7109, 712, 713, 714, 715, 716, 717, 718, 719, 7200, 7201, 7202, 7208, 7209, 7210, 7211, 7212, 7213, 7214, 7219, 722, 7230, 7231, 7239, 7240, 7241, 7242, 7243, 7244, 7245, 7246, 7247, 725, 726, 72700, 7273, 7276, 7279, 7289, 729, 7291, 7292, 7294, 7295, 7298, 7328, 7329, 7371, 7373, 7382, 7383, 7384, 7385, 7386, 7398, 7399, 78096, 8052, 8054, 8056, 8058, 8080, 8082, 8084, 80841, 80842, 80843, 80844, 80849, 8088, 8090, 8100, 8110, 8120, 8122, 8124, 8130, 8132, 8134, 8138, 8140, 8150, 8160, 8170, 8180, 8190, 8200, 8202, 8208, 8210, 8212, 8220, 8230, 8232, 8238, 8240, 8242, 8244, 8246, 8248, 8250, 82520, 82521, 82522, 82523, 82524, 82525, 82529, 8260, 8270, 8290, 8310, 8320, 8330, 8340, 8350, 83600, 8361, 8362, 8363, 8365, 8366, 8370, 8380, 8390, 8392, 8394, 8396, 8398, 840, 8409, 841, 842, 843, 844, 845, 846, 847, 848, 959, 7391, 7392, 7393, 7394, 7395, 7396, 7397, 72703, 72704, 72705, 72706, 72709
Trauma ¹⁴⁵	875, 876, 877, 879, 880, 881, 882, 883, 884, 885, 886, 887, 890, 891, 892, 893, 894, 895, 896, 897, 926, 927, 928, 929, 996
Physical Therapy ¹⁴⁸	97110, 97350, 97535, 97112, 97150, 97035, 97010, 97032, 97012, 97140, 97001, 97002, 97124, 99070, 97750, 97113, 97116
Mental Health Services ^{28,149}	90832, 90833, 90834, 90836, 90837, 90838, 90791, 90792, 90804, 90805, 90806, 90807, 90808, 90809, 90810, 90811, 90812, 90813, 90814, 90815, 90816, 90817, 90818, 90819, 90820, 90821, 90822, 90823, 90824, 90825, 90826, 90827, 90828, 90829, 90845, 90847, 90849, 90853, 90857, 90865, 90870, G0409, G0410, G0411, 90839, 99354, 90840
Depression ¹⁵² (one inpatient or one outpatient diagnosis)	29620, 29621, 29622, 29623, 29624, 29625, 29626, 29630, 29631, 29632, 29633, 29634, 29635, 29636, 29650, 29651, 29652, 29653, 29654, 29655, 29656, 29660, 29661, 29662, 29663, 29664, 29665, 29666, 29689, 2980, 3004, 3091, 311
Anxiety ¹⁵³ (one inpatient or two outpatient diagnoses)	29384, 30000, 30001, 30002, 30009, 30010, 30020, 30021, 30022, 30023, 30029, 3003, 3005, 30089, 3009, 3080, 3081, 3082, 3083, 3084, 3089, 30981, 3130, 3131, 31321, 31322, 3133, 31382, 31383

Supplemental Table 4.2: Construction of variables from the Area Health Resource File.⁹⁸

Variable in Model	AHRF variable used	Years used	Method to account for missing years
Mental Health Providers	Psychiatrists	2008, 2010-2013	Linear Interpolation
	Psychologists	2009	Carry Forward, Backward
Physical Therapists	Physical Therapists	2009	Carry Forward, Backward
Primary Care Providers	Internal Medicine, General Practice, Geriatrics specialties with MD or DO training in office based settings, hospital staff, hospital residents, and clinical fellows	2008, 2010-2013	Linear Interpolation
Surgeons	General and “other” surgery with MD or DO training in Office based settings, hospital staff, hospital residents, and clinical fellows	2008, 2010-2013	Linear Interpolation
Pain specialist	Physical Medicine/Rehabilitation MD or DO training in Office based settings, hospital staff, hospital residents, and clinical fellows	2008, 2010-2013	Linear Interpolation
Pharmacists		2009	Carry Forward, Backward
Midlevel providers	Nurse Practitioners	2009	Carry Forward, Backward
	Physicians assistants	2009	

CHAPTER 5: UNDERSTANDING HOW PRIMARY CARE PROVIDERS FROM DIVERSE PRACTICE SETTINGS APPROACH CHRONIC PAIN IN OLDER ADULTS: A SYSTEMS SCIENCE STUDY ⁴

Overview

Caring for older adults with chronic musculoskeletal pain is a complex and difficult task for primary care providers. We interviewed 16 primary care providers across North Carolina to understand how they approach this, and how well supported they are in doing so. Using a structured systems thinking approach called System Support Mapping, we asked providers to operationalize their approach to caring for chronic pain patients in terms of discrete responsibilities and the key needs, supports, barriers, and priorities for change associated with each responsibility. Providers struggled to avoid prescribing opioids and prioritize recommending non-pharmacologic treatments and discussing the relationship between pain and mental health. Common needs included an engaged patient, alternatives to opioids, and being able to set expectations about pain. Common supports to meet their needs included published literature, conversations with the patient about their pain, allied health professionals, electronic health records, and policies and guidelines. Key barriers included poor insurance coverage and limited time to address pain. Priorities to improve chronic pain care were: better patient education materials and more mental health professionals. This study illuminates the need for

⁴ National Center for Advancing Translational Sciences (NCATS), National Institutes of Health, through Grant Award Number UL1TR001111. The content is solely the responsibility of the authors and does not necessarily represent the official views of the NIH.

The following authors are mentioned in the manuscript by their initials. Ruchir N. Karmali (RNK), Kristen Hassmiller Lich (KHL), Deanna Befus (DB), and Mikeala Roberson (MR).

comprehensive policy approaches that go beyond opioid prescription regulations for addressing the opioid epidemic.

Introduction

Among older adults, the health and economic impact of chronic pain is significant.^{1,46,56,60} The estimated percent of older adults suffering from chronic pain ranges from 20 to 60% .¹ Chronic pain management is complex for older adults because they may have multiple pain sites, comorbidities and medications, physiologic changes, cognitive impairments, and fragmented care.^{42-47,56,124} A web of biological (e.g. physical symptoms), psychological (e.g. anxiety, depression, anger), and social factors (e.g. work history, social support, insurance) affect pain and multiple treatments are needed to address these factors.^{1,20,25,58,59} Without a biopsychosocial approach to pain treatment, pain may be undertreated in older adults which leads to inactivity, isolation, mood disorders, and disability.⁶⁰

Clinical guidelines for chronic pain management rely on three principles for chronic pain treatment: non-pharmacologic strategies (e.g. physical therapy or cognitive behavioral therapy) and non-opioid medications (e.g. acetaminophen) should be used before opioids; 2. Opioids should only be used if the benefits of pain relief override the risks; 3. Use of multi-modal strategies (e.g. opioids with non-pharmacologic treatments) for older adults.^{18,19,55} Selecting appropriate treatments for older adults is difficult because opioid and non-opioid medications are associated with an increased risk of adverse events.¹⁸ Despite the fact that non-pharmacologic services can be appropriate and effective for older adults,^{26,59} older adults report that their providers do not discuss or recommend non-pharmacologic strategies.⁵⁰ Non-pharmacologic treatments are critical for chronic pain management because they can minimize the risk of side effects from medications, reduce the use of ineffective long-term treatments, such as opioids, and improve pain outcomes.⁷⁵⁻⁷⁸

Primary care providers (PCPs) deliver the majority of pain management services, which include recommendations for self-management practices, prescription medication, and referral to specialty care (e.g. physical therapy, mental health, orthopedics, and pain specialists).^{1,124} More than half of all opioid prescriptions for Medicare beneficiaries are dispensed by PCPs.⁷⁴ While providers often report that opioids are only prescribed when alternative strategies are unsuccessful as recommended by the guidelines,^{48,130} previous studies suggest that PCPs may rely on opioids for pain management if they perceive that opioids can improve functions and if opioids have relieved pain before.^{51,134} Recent trends in chronic pain management show that opioids are used more frequently than non-pharmacologic treatment, especially among older adults.^{29,31,85} One study showed that having Medicare insurance is associated with a lower odds of a physical therapy referral.³²

Encouraging adherence to the clinical guidelines requires an understanding of how PCPs approach caring for patients with pain and what factors affect their approach. Previous studies have focused on the role of patient characteristics regarding provider's decisions to prescribe opioids^{48,52,54,131,132,134} or non-pharmacologic treatments.^{51,54,137} In addition to patient characteristics, access to non-pharmacologic treatments, time, and resources, may influence PCPs' recommendations.^{51,131,134} However, these studies do not capture the full range of pain management activities performed by PCPs. Little is known about what factors contribute to the difference between what PCPs intend to do and what is actually done, and how/whether these differences depend on the incentives and constraints innate in different practice settings and geographic locations. Therefore, we sought to 1. To document how PCPs approach caring for older adults with chronic musculoskeletal pain in terms of discrete responsibilities or tasks they engage in; 2. Determine the supports and barriers associated with these responsibilities, linking

each to specific responsibilities and core needs to complete it; 3. Identify priorities for being better supported in caring for these older adults, with “wishes” for how change linked to specific responsibilities, needs, supports/barriers; and, 4. Illuminate key differences across rural and urban settings.

Methods

We used a structured systems thinking method called System Support Mapping (SSM) developed by the senior author (KHL) to document how PCPs approach delivery of pain care to older adult patients and how well supported they are in this work.⁹⁹

Study Population

In the spring of 2018, we recruited PCPs across North Carolina (NC) using internet searches, professional organizations, and personal referrals. To be included in the study, providers had to be licensed in NC and provide care for patients over 65 years old. Physicians (both MD and DOs), nurse practitioners, and physician assistants were eligible to participate. Both purposive and snowball sampling were used to select PCPs in rural and urban counties. We sampled providers until concept saturation was achieved for the overall sample.¹⁶⁶ This study was approved by the Institutional Review Board at the University of North Carolina-Chapel Hill.

Data Collection

Data collection occurred in two phases. First, interested providers completed a ten minute survey that collected information on their patient population (Appendix 1), their professional background, their level of comfort in caring for patients with chronic musculoskeletal pain, and years of practice. We also asked providers about their practice setting (e.g. safety net or private practice). Safety net settings were defined as Federally Qualified Health Centers (FQHCs), FQHC look-alikes, rural health centers, free clinics, and academic resident clinics. Private practice was defined as physician-owned practices and academically-affiliated, community-

based primary care clinics. For the purpose of subgroup analysis, rural and urban designations were based on the Rural-Urban Continuum Codes for counties in NC.¹⁶⁷ The survey collected information about the providers' patient population, including insurance status, percent non-White minorities, and percent "vulnerable" defined as low health literacy, low income, and users of social safety net programs such as Temporary Assistant for Needy Families (TANF), Supplemental Security Income (SSI), and Women Infants and Children (WIC). The survey also asked about the burden of chronic musculoskeletal pain for their patient population (overall and older adults only).

Based on this survey, we purposively invited providers to participate in a one-on-one, semi-structured interview. The interview guide was adapted from a systems science methodology called System Support Mapping described in detail below.⁹⁹ This method seeks to diagrammatically describe a participant's experience in a bounded system, in this case providing care to older adult patients with chronic musculoskeletal pain. The guide asks participants to clarify their role in general terms (the context in which they provide pain care), how they conceptualize this work in discrete responsibilities or tasks, what they need to complete each responsibility, resources that support them, barriers, and wishes. This method has been used in a variety of system strengthening projects, to support public health workforce capacity building, and as the foundation for patient-centered health behavior research.⁹⁹ SSMs were developed during interviews, conducted both in person and over the phone. For phone interviews, web-conferencing was used so interviewees could see how their responses were being documented in the SSM during the course of the interview.

To set the boundary for the system, participants were prompted to consider their experiences caring for patients older than 65 with chronic musculoskeletal pain, defined as pain

like backaches or knee pain that lasts longer than three months. We instructed participants to describe their approach in general practice, and not to base their approach on any specific patient or any extreme cases.

Participants were shown a blank map with four concentric rings; the content to be placed in each ring throughout the course of the interview was described as follows (starting with the inner most ring):

1. *Role*: The role is defined by the participant's specialty, practice setting, and patient population. We used information from the survey to define the participant's role, and asked them to clarify their role for the in-person interview. To further define the participant's role, we asked providers to describe their philosophy on caring for patients with musculoskeletal pain.
2. *Responsibilities*: Responsibilities are the discrete activities that participants do to care for patients with chronic musculoskeletal pain. To elicit a comprehensive list of activities, we asked participants what they did to support their patients over time. Among those listed, participants then selected the two responsibilities they found to be the most difficult and the one they found the easiest. We completed the rest of the mapping exercise based on these difficult and easy responsibilities.
3. *Needs*: For each selected responsibility, providers were asked about the conditions or inputs necessary to fulfill each responsibility. Needs are defined as both internal needs (e.g. patience, energy, or understanding) as well as external needs (e.g. information, professional network, or education).
4. *Supports and Barriers*: For each need, participants were then asked to identify the past and current resources they have used to meet each need. In general, supports were described as

resources that help providers in their practice. Barriers were identified when resources were missing and when providers described something that prevented them from fulfilling their responsibilities.

5. *Wishes*: Lastly, participants were asked what would better support them to successfully completing their responsibilities and meet their needs. Wishes could be anything from physical improvements, social changes, or immediate or long-term changes.

To illustrate the connections between responsibilities, needs, supports, barriers, and wishes arrows are drawn from the responsibility to the needs each generates, from the resources to the needs they address, and from the wishes to the needs they address. The interviewer (RNK) created three maps with each participant, two maps documenting needs, resources, and wishes associated with difficult responsibilities, and one map documenting needs, resources, and wishes associated with an easy responsibility. When possible, a note taker was present to help the interviewer create the maps during the interview. All interviews were recorded and transcribed.

Validation

Several steps were taken to validate the data collected during the mapping exercise. After each map was created, the interviewer asked the participant to verify the completeness and accuracy of information. Next, the interviewer compared the maps to the interview transcripts to ensure that the maps accurately reflected what was said and made clarifications as necessary. Finally, a sample of the maps (N=4) were reviewed by another researcher (MR), who compared the maps to the transcripts and made notes on any discrepancies. Discrepancies were resolved using a consensus process.

Analysis

Once the maps were verified, the maps were treated as “raw” data. First, an aggregated list of responses by ring was created. We used qualitative content analysis to develop codes

describing distinct constructs identified by participants.¹⁶⁸ The list of responses were sorted by ring into distinct codes. To retain the richness of the data, responses were only combined into a single code based on similarity and to reduce redundancy. Codes were named using “in vivo” coding to make sure the code retained the original meaning of the data.¹⁶⁹ Two researchers (RNK and DB) used an iterative coding process to examine the codes with and without responses and ensure that the codes stood on their own without the maps or transcripts.

The sorted lists were used to generate two datasets: a dataset describing the frequency a code appeared in a map (up to three maps per participant) and a dataset describing the frequency of connections between the codes. Descriptive statistics were calculated based off of the dataset with the code frequencies. Percentages were calculated as the total number of times the code appeared across the maps divided by the total number of codes in the ring for the needs, resources, and wishes ring. For this analysis, we present the aggregated results for all responsibilities (difficult and easy), and by “difficult” responsibilities for urban and rural providers. No statistical comparisons were made between the subgroups because of small sample size.

For the urban and rural providers, we generated aggregated System Support Maps for the responsibilities that related to “avoiding or minimizing opioids” and recommend non-pharmacologic treatments using Kumu, an online visualization software.¹⁷⁰ The maps were generated based off of data describing the frequency of connections between codes, and the frequency of codes across the maps. To simplify the maps, we retained pairs of codes with two or more connections for the urban providers for all rings and two connections for the rural providers for the needs, supports, and barrier rings.

Results

We interviewed 16 primary care providers across NC, including 10 providers from an urban setting, 5 providers from a rural setting, and 1 provider who practiced in both. Two interviews were completed in-person, and 14 interviews were completed over the phone with web conferencing for ten of those providers.

Most providers were MDs (N=14), and practiced in diverse practice settings including safety net (N=10) and private practice (N=5). The majority of providers in rural counties practiced in a safety net setting (N=5). On average, providers practiced for 13 years (standard deviation (SD): 11.6 years), and urban providers practiced longer than rural ones (urban: 15.0 vs rural: 9.5). On a scale of one to ten, with one being the least comfortable, PCPs in urban counties were more comfortable treating pain than those in rural counties (urban: 6.9 vs rural: 5.7).

The providers served diverse clinic populations. Two-thirds of providers had populations where the majority were vulnerable (e.g. low health literacy, low income, or users of social safety net programs). About 40% of providers served populations where 26-50% had Medicaid, and 56.3% of providers served populations where 26-50% had Medicare. More than half of the providers reported that less than 25% of their clinic population had private insurance or were uninsured. Compared to the majority of clinic populations of urban providers, the majority of clinic populations for rural providers were “vulnerable” or had Medicaid. Two-thirds of providers reported that chronic musculoskeletal pain occurred in 26-50% of their clinic population, but more than half said that fewer than 25% of their populations over 65 and have chronic musculoskeletal pain. The burden of chronic musculoskeletal pain in the clinical population was similar for urban and rural providers.

System Support Map

The aggregate SSM maps are shown for urban providers (Figure 5.1) and rural providers (Figure 5.2) to illustrate the relationship between opioid prescriptions and non-pharmacologic treatment recommendations (e.g. engaging patients in alternatives to opioids such as non-pharmacologic treatments and behavior change). For the urban PCPs, there were none of the needs overlapped and each need had distinct resources. However, there were several barriers that were common to needs across activities. For example, providers had limited time to talk to patients when they needed to educate patients about behavior change and pain treatment options. Another overlapping barrier was poor insurance coverage for treatment options which linked to needs such as geographic access and having options available.

Most of their wishes concerned having more options for alternatives to opioids.

For rural PCPs, needs and resources for avoiding opioids and recommending non-pharmacologic treatments overlapped significantly. Similar to urban PCPs, rural PCPs needed affordable and available alternatives to avoid opioids and recommend non-pharmacologic treatments. Other needs reported by rural providers for these responsibilities included patient education, understanding the patient's background (e.g their history, resources, "red flags"). Furthermore, resources were used to meet multiple needs and often relied on other people to help support the patients (e.g. health professionals, patient's family). Overlapping barriers included lack of transportation, poor insurance coverage, and the perception that patients want quick fixes. As a result, their wishes related to improving access to treatments and community resources.

Responsibilities

Table 5.2 shows the ten most common responsibility codes out of the 38 codes described. Common responsibilities include: "Get patients to use physical therapy" (75.0%), "Avoid or minimize opioid treatments" (present in 75.0% of maps), "Recommend non-pharmacologic and

multimodal therapies” (75.0%), “Recommend and encourage patients to lose weight or exercise” (56.3%), “Prescribe both opioids and non-opioid medications” (56.3%), “Get patient history with pain treatments” (56.3%), and “Create treatment plan” (56.3%). Responsibilities were similar across urban and rural providers, though more urban providers referred patients to physical therapy, recommended behaviors changes for weight loss and exercise, perform diagnostic evaluations, and ensure follow up visits.

The 16 providers completed 33 maps for difficult responsibilities, and 13 maps for easy activities. Table 5.2 describes the most frequently identified “difficult” and ‘easy’ responsibilities in urban and rural settings. Providers in urban and rural settings struggled with getting patients to use physical therapy:

It's a big time commitment for them [patients] to go to all of these visits and it typically tends to be fairly expensive. It's not an immediate payoff. Medications immediately makes them feel better, whereas physical therapy, might take six weeks to help. - Provider in Urban Setting

Both urban and rural providers found it difficult to “avoid or minimize opioids for long-term pain management.” Providers said they may feel pressured to prescribe opioids when patients see them as the only valid treatment and because patients’ expectations about pain may be unrealistic.

If I don't feel that they should be on opiates, I'm not gonna prescribe them, and I will have that tough discussion. What I think you don't wanna do or does not work well is try to have the patient agree with you. The patient certainly might not agree with you, particularly, if addiction or diversion is the issue. But being honest, transparent but empathic, and know what you are willing to do based on your assessment of the medical situation. If it's a back and forth with the patient, that often goes nowhere good. Because the patient will be arguing for why they want opiates and then you're trying to justify why they shouldn't have opiates and that my 20 years of experience of doing it is a no-win situation. - Provider in Urban Setting

Unlike urban providers, rural providers thought it was difficult to “recommend non-pharmacologic and multi-model approaches” because patients may not be receptive to alternatives to opioids:

It's very difficult if a patient has come to me with something that they want from me. So if they've come to me with the purpose of getting opioids, it's really difficult to sell an alternative treatment plan...Because I think a lot of those patients have tried it, but maybe not in the proper treatment management -Provider in Rural Setting

“Assessing and educating patients about the relationship between pain and mental health” was also difficult. One PCP said,

A lot of patients don't attribute their pain to a mental health cause or they don't understand that the chronic pain is being exacerbated by their mental health condition. So establishing that link with them can be very, very difficult. I worked with a bunch of patients that making that link takes multiple visits, and years, sometimes, to get them to understand that link. - Provider in Urban Setting

Providers also struggled with “setting expectations and creating treatment goals” because older adults often expect to be pain free or to be able to do the same things they could when they were younger. Patients’ resistance to change made it difficult for providers to taper opioid doses. Another difficult responsibility for urban providers was “recommending and encouraging patients to exercise and lose weight.” Rural providers struggled with “monitoring opioid treatment” which often includes pain contracts, follow up visits, monitoring refills, and performing drug screens. Both urban and rural providers reported that “prescribing medications” was an easy responsibility, but this could be challenging in an older adult population because of comorbidities or interactions with other medications.

Needs

Table 5.3 shows the ten most frequently described needs among urban and rural providers for the “difficult” responsibilities. About 6% of the need codes for urban providers and 4.5% of the codes for rural providers described “an engaged patient”. Other needs included “availability

of other options to use instead of opioids” (Urban: 5.5%; Rural: 6.0%), “set expectations about pain” (Urban: 5.5%; Rural: 4.5%), “evidence about different pain management treatments” (Urban: 4.4%; Rural: 4.5%), and “knowledge of patient resources” (Urban: 4.4%; Rural: 4.5%).

Providers in urban settings reported that they needed to talk to patients about their goals (6.8%) and about pain and treatments (6.8%). Institutional support (5.5%) was another common need, which one provider described it as “I’m not standing alone. I have someone behind [me].” Other needs included “access to treatments” (4.4%), “knowledge of the patient’s history” (4.4%), and “a patient who wants to change behaviors” (6.6%).

Rural providers reported that they needed to “educate patients about pain and mental health” (4.5%). Providers also needed a “good relationship with the patient” (6.0%). “Tolerance for conflict” was also reported (4.5%), and described as

I need a stronger spine at times for changing perception of pain management, and how do you balance patients who were started on pain medication under this concept, does it fit vital sign, with now a greater understanding of the consequences of opiate medications. And how do you deal with your own internal guilt about the fact that you're probably one of the people who has been prescribing the pain medicine to this patient for five, 10 years, and now you're saying, 'I'm taking it away.'

Other needs for rural providers include “affordable pain treatments” (10.4%) and “identification of red flags” (6.0%). Providers looked for red flags like “doctor shopping” and willingness to comply with the rule of treatments.

Providers reported that they also needed to educate patients about opioids, the relationship between pain and mental health, and pain and obesity. Many needs also centered on the interaction with the patient which includes establishing a partnership, developing a good relationship with the patient, and having good communication. Providers also discussed needs that the patient might have, including money to pay for treatment, time to do treatments,

transportation to treatments, and available providers (e.g. mental health or pain specialist) (Supplemental Table 5.2).

Resources: Supports and Barriers

Table 5.3 describes the 10 most frequent supports and barriers that providers in urban and rural settings reported met their needs. Both urban and rural providers reported that they used published literature in two ways (Urban: 1.6%; Rural: 1.8%): to learn about the evidence on pain treatments and opioids and to educate evidence on treatments, particularly opioids, to patients.

Primary care providers in urban settings used a variety of supports for their practice (Table 5.3; Supplemental Table 5.3). The primary supports used by providers included conversations about the risk of opioids (2.2%), goals (1.8%), and setting expectations with pain and treatment (1.4%). Many providers used Motivational Interviewing to talk to patients (1.4%) as well as family caregivers (1.4). Providers spoke with other colleagues to review cases and discuss treatment strategies (1.8%). They often referred patients to specialty services (1.6%). For opioid treatments, providers used the NC Controlled Substances Database (1.4%) and opioid treatment agreements (1.4%). Providers used previous patient records and outside records to learn about the patient's history with pain and previous treatments (1.4%).

The most frequent supports in rural settings differed from the most frequent supports in urban settings. Providers in rural settings often worked with allied health professionals to facilitate patient care. For example, care managers facilitated the pain contracts and connected patients to non-pharmacologic services and other community resources. Providers referred patients to behavioral health specialists (2.2%) to teach patients about coping strategies or get referrals for other health services. Pharmacists (1.8%) helped providers monitor opioid prescriptions. Point of care references (1.8%) and prescribing guidelines (2.2%) were also useful to support provider's knowledge about pain treatments. Providers also use multiple visits (2.2%)

to monitor treatments and build relationships. Providers educated patients about pain and treatments through stories about other patients (2.2%).

Providers also mentioned that many of their supports involved talking to the patient about the patient's treatment goals, exercise, long term benefits, physical therapy, mental health, and obesity. Forms of patient education included online sources, classes, videos, and handouts. Though sometimes, the patient education materials were not helpful because patients may have difficulty understanding them or because patients did not use them. They frequently worked with and referred patients to other providers such as social workers, behavioral health specialists, clinic staff, home health nurses, pharmacists, physical therapists, psychologists, as well as pain specialists. Electronic health records (EHR) were used in a variety of ways including as a way to note the patient's medical history, history with treatments, to track longitudinal progress, referrals, and to access patient education materials. However, the EHR also had some downsides including taking time away from the patient and incomplete patient histories. Providers used a variety of resources to support their knowledge about pain treatments including medical school and residency training, conferences, continuing medical education, and supplemental trainings. Providers generally felt that clinic and state policies, in addition to the clinical guidelines on prescribing limits, helped them say no to patients who demanded opioids. Some providers even had a pain committee in the clinic to help them make decisions about pain treatments.

The barriers reported by providers in urban and rural settings also differed. For example, among urban PCPs, patients' resistance to changes (1.6%) and poor insurance coverage for alternatives to opioids (1.6) were also common barriers. One of the most common barriers for these providers was that there was not enough time to talk about pain when there are other health concerns (1.6%). According to one provider,

[With] 20 minutes, and especially when you're meeting someone, [pain] is like the fifth issue of the visit. So it's like, diabetes, hypertension, high cholesterol, history of cancer, and pain. So by the time you get to pain, you don't have any time to think about to even do all the [treatments and education].

There were two barriers that rural providers reported: transportation (3.7%) and difficulties doing the urine drug screen (1.8%). Other barriers could be categorized as barriers that providers faced and barriers that patients faced. Some of the barriers providers faced included a lack of training on pain and addiction, limited time with the patient, patient satisfaction scores, and poor patient education materials. The culture of medicine was also a barrier because it was perceived to promote a pill based approach to pain. Providers reported that patients often faced barriers to accessing treatments and had poor insurance coverage. Furthermore, providers thought that patients' limited time for treatment may encourage patients to seek out "quick fixes" for pain such as medications.

Wishes

The top 10 most frequently reported wishes are described in Table 5.4. Both urban and rural providers wished for better patient education materials about pain and treatments (Urban 7.9%; Rural 9.5%) and more mental health providers (Urban 6.6%, Rural 7.1%). Primary care providers in urban settings wished for more time to talk about pain (7.9%), improved access to pain treatments (e.g pain psychiatry, orthopedics, physical therapy, and addiction medicine providers) (9.2%), better access to interventions for obesity (6.6%), and better medications for pain (6.6%). In rural settings, providers wished for more allied health professionals (e.g. social workers, nutritionists, and pharmacists) to address the concerns of pain (9.5%), more training on pain diagnosis and treatments (7.1%), use more non-pharmacologic options for pain (7.1%), and more community resources (e.g support groups or physical activity resources) (9.5%).

Discussion

This study extends previous work^{54,131} examining pain management practices in primary care by exploring the process of pain care as a whole rather than isolating specific strategies and examining how practices vary by setting.

A primary finding was that PCPs undertake diverse responsibilities to care for patients with chronic musculoskeletal pain, many of which were similar in urban and rural settings. Many responsibilities corresponded to the content present in clinical guidelines.^{18,19,55,171} Both urban and rural primary care providers struggled with several of the same responsibilities which were rooted in making recommendations about different pain treatments. Treatment recommendations went beyond prescribing medications, and encompassed non-pharmacologic approaches (e.g. physical therapy, mental health treatments, and acupuncture) and behavior changes (e.g. exercise and weight loss). Difficulties in these responsibilities may result from the fact that they require more time from the patient and provider and entails the patient to learn and practice self-management strategies.^{51,54} Non-pharmacologic strategies often involve other providers (e.g. physical therapists or behavioral health specialists) which can be challenging to coordinate.^{51,54}

Comparable to a previous study examining opioid prescribing for older adults, most providers in this study reported that they prescribe opioids only after trying other approaches.⁴⁸ While many providers reported that prescribing medications was easy for them to do, it was more difficult to avoid or minimize opioid prescriptions. Providers often mentioned avoiding opioids along with difficulties providers found in engaging patients with non-pharmacologic approaches to pain. This indicates that the two responsibilities are related, and if providers try to avoid opioids, then they also have to offer other treatments.⁵⁴

Providers reported their own needs and what they need from their patients. For example, providers need knowledge of the patient's history and resources, evidence of pain treatments,

and knowledge about pain the appropriate treatments. They also need patients to be engaged in care, ready to change behaviors, as well as have the means to follow recommendations (e.g. time and money). Similar to other studies, these two categories of needs illustrate that providers are somewhat limited in their ability to fulfill their most difficult responsibilities since many needs depend on the patient.^{50,54,134} Providers reported that a good patient-provider relationship, trust, and empathy are frequent needs to meet many responsibilities. While the decision to prescribe opioids can strain the patient-provider relationship, aspects of the patient-provider relationship that foster shared decision-making and patient-centered care, such as empathy, trust, understanding, and communication support many of the PCP's needs.^{25,54,132,133,136,138}

The availability and affordability of alternatives to opioids was frequently described as a major need and barrier to meet multiple responsibilities including avoiding or minimizing opioids, recommending non-pharmacologic modalities for treatment, and encouraging behavior changes. Because these needs overlap over these responsibilities, policies or interventions that address these needs could change the way that multiple responsibilities are completed. Though availability and affordability of alternatives to opioids has been frequently viewed as a patient-level barrier,^{50,51} this finding reveals that patient-level barriers also impact how providers practice which is consistent with findings from a previous study of PCPs who manage chronic pain.¹³¹ While providers may attempt to follow clinical guidelines by recommending alternatives to opioids for pain management, absence of patient resources may hinder providers' abilities to implement the guidelines and ultimately affect the number of options that are available to patients to treat pain.^{18,19,54,55,131} Beyond patient characteristics such as potential for side-effects, addiction, or "red flag" behaviors (e.g., diversion), this study confirms findings from previous

studies which show that presence of patient resources frequently impacts opioid prescribing decisions.^{48,52,54}

Providers discussed clinical guidelines, legislation, and clinic policies as resources that helped providers shift practices away from opioids. However, these policies have failed to address a barrier NC providers face while caring for patients with chronic pain: lack of access to non-pharmacologic treatments. For example, in NC, policies such as the Strengthen Opioid Misuse and Prevention Act (STOP ACT) and the Medicaid-Lock In Program have largely focused on opioids prescribing limits.^{81,172} Though the trend in opioid prescriptions is decreasing in NC, there has been little action to strengthen the delivery of pain care by improving access to evidence based treatment modalities such as physical therapy and mental health services.¹⁷³ This directly links to priorities identified by providers to strengthen the health system such as having more mental health providers and allied health professionals as well as improving access to alternative pain treatments.

We found that some codes overlapped across the rings, which could indicate the participants view these codes as interconnected and related. For example, some providers viewed “setting expectations for pain and treatment” as a responsibility but other described it as a need to meet other responsibilities such as “avoiding or minimizing opioids” and “recommending non-pharmacologic and multimodal treatment strategies” This demonstrates that in order to avoid or minimize opioid use, there are potentially several additional responsibilities that providers have. Similarly, providers often discussed having conversations about different topics in pain care (e.g. “conversations about goals”) as both a need and a resource. The overlap between needs and resources could indicate that the lack of formal resources or that providers use their own professional experience to support themselves. Furthermore, it could imply that providers may

need more training or support from allied health professionals such as social workers, to assist providers in engaging patients in care.

There are several limitations to this study. We recruited enough PCPs to reach theme saturation for the study sample; however, it is difficult to conclude whether saturation was reached for the urban and rural subgroups. Second, while we employed recruitment strategies to invite providers from across NC to participate in this study, we had limited representation of providers from the Western and Eastern parts of the state, where the opioid epidemic has hit the hardest.¹⁷³ Furthermore, selection bias in the study sample could indicate that the providers who participated were likely to be the most eager and interested in pain management practices. Finally, we did not explicitly instruct providers to consider clinical guidelines during the interview so that we could capture the lived experience of providers. However, this could result in social desirability bias and providers may not describe their true pain management practices.

Conclusion

The findings from this study illustrate the scope of pain practices for PCPs in urban and rural settings. Comprehensive policy approaches are necessary to address the opioid epidemic because pain practices are interrelated. Future research should investigate what patients suffering from chronic musculoskeletal pain do to manage their pain and how the system supports their health. Without addressing the significant systemic barriers to the delivery of alternatives for pain care, it will be difficult to sustain policies that restrict opioids, and both patients may not have access to adequate pain treatments.

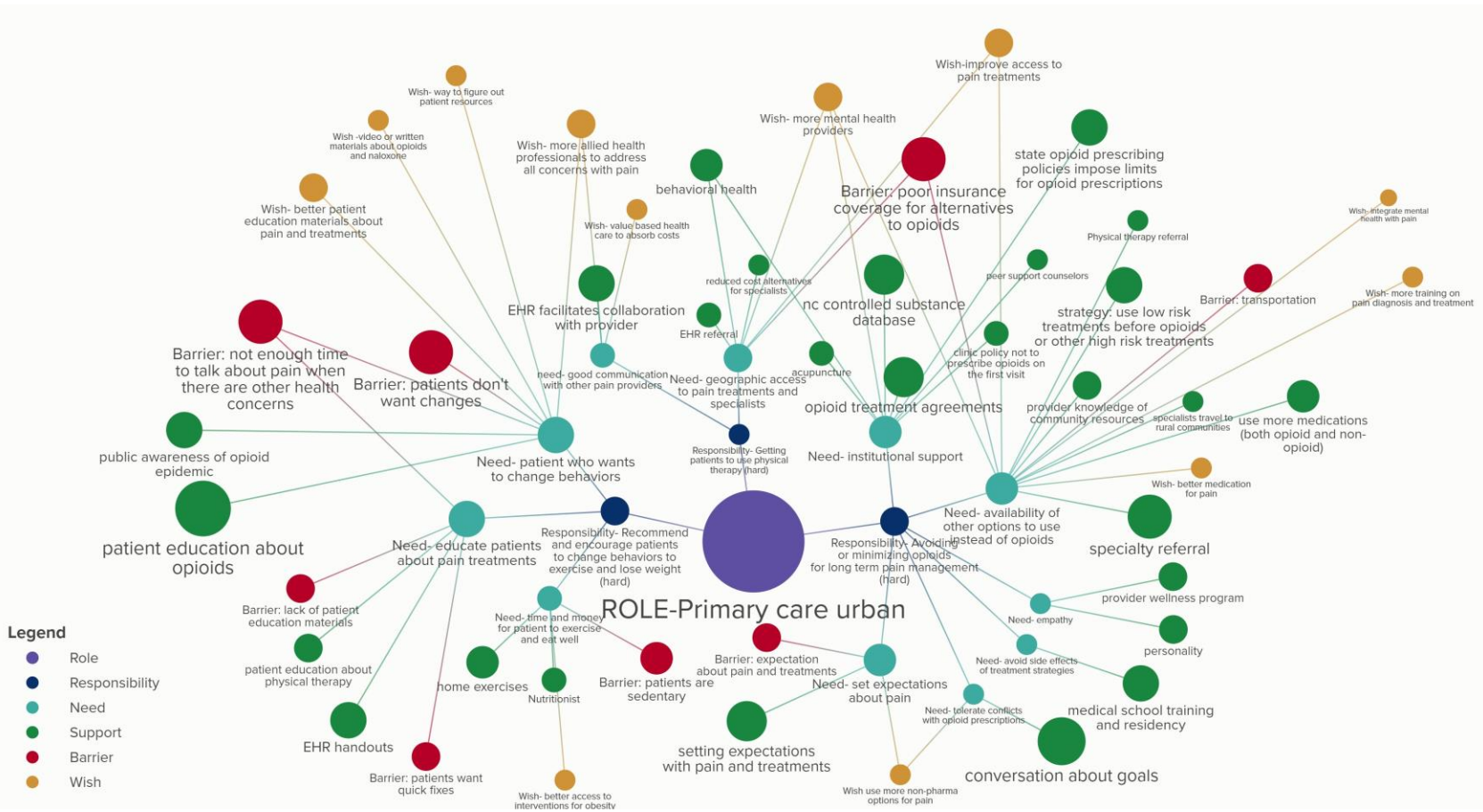


Figure shows only connections between codes that were mentioned more than once, with exception of wishes. Node size indicates prevalence of code.

Online access: <https://kumu.io/rkarmali/primary-care-urban-hard-jul10#map-ySXo3cPh>

Figure 5.1: Aggregate system support map for urban primary care providers.

Online access: <https://kumu.io/rkarmali/primary-care-rural-hard-jul-10th#map-TVusPgRS>

Figure 5.2: Aggregate system support map for rural primary care providers.

Table 5.1: Sample characteristics of North Carolina Primary Care Providers Who Care for Chronic Pain Patients.

	Total		Primary Care Urban		Primary Care Rural	
<i>Provider demographics N (%)</i>						
Sample Size*	16		11	68.8%	6	37.5%
Provider type						
MD or DO	14	87.5%	10	90.9%	5	83.3%
Nurse practitioner	2	12.5%	1	9.1%	1	16.7%
Setting**						
Safety Net	10	62.5%	6	54.5%	5	83.3%
Private Practice	5	31.3%	4	36.4%	1	16.7%
Other	1	6.3%	1	9.1%	0	0.0%
Average number of years of experience (mean, standard deviation)	13.31	11.6	15.05	10.51	9.5	11.07
Level of comfort with treating pain (mean, standard deviation)	6.5	1.71	6.91	1.76	5.67	1.21
<i>Clinic Population Characteristics</i>						
Percent vulnerable***						
Less than 25%	3	18.8%	3	27.3%	0	0.0%
26-50%	4	25.0%	2	18.2%	2	33.3%
51-75%	4	25.0%	3	27.3%	1	16.7%
Greater than 76%	6	37.5%	3	27.3%	3	50.0%
Percent with Medicaid						
Less than 25%	6	37.5%	5	45.5%	1	16.7%
26-50%	7	43.8%	4	36.4%	4	66.7%
51-75%	2	12.5%	2	18.2%	0	0.0%
Greater than 76%	0	0.0%	0	0.0%	0	0.0%
Unsure	1	6.3%	0	0.0%	1	16.7%
Percent with Medicare						
Less than 25%	3	18.8%	3	27.3%	1	16.7%
26-50%	9	56.3%	6	54.5%	3	50.0%
51-75%	3	18.8%	2	18.2%	1	16.7%
Greater than 76%	0	0.0%	0	0.0%	0	0.0%
Unsure	1	6.3%	0	0.0%	1	16.7%
Percent with Private Insurance						
Less than 25%	9	56.3%	5	45.5%	5	83.3%
26-50%	3	18.8%	3	27.3%		0.0%
51-75%	4	25.0%	3	27.3%	1	16.7%
Greater than 76%	0	0.0%	0	0.0%		0.0%
Unsure	0	0.0%	0	0.0%		0.0%
Percent Uninsured						
Less than 25%	10	62.5%	8	72.7%	2	33.3%

	Total		Primary Care Urban		Primary Care Rural	
26-50%	4	25.0%	3	27.3%	2	33.3%
51-75%	2	12.5%	0	0.0%	2	33.3%
Greater than 76%	0	0.0%	0	0.0%	0	0.0%
Unsure	0	0.0%	0	0.0%	0	0.0%
Percent Non-White Minorities						
Less than 25%	2	12.5%	1	9.1%	1	16.7%
26-50%	6	37.5%	5	45.5%	2	33.3%
51-75%	5	31.3%	4	36.4%	1	16.7%
Greater than 76%	2	12.5%	0	0.0%	2	33.3%
Unsure	1	6.3%	1	9.1%	0	0.0%
Percent with chronic musculoskeletal pain						
Less than 25%	4	25.0%	3	27.3%	2	33.3%
26-50%	10	62.5%	7	63.6%	3	50.0%
51-75%	2	12.5%	1	9.1%	1	16.7%
Greater than 76%	0	0.0%	0	0.0%	0	0.0%
Unsure	0	0.0%	0	0.0%	0	0.0%
<i>Characteristics of clinic population with chronic musculoskeletal pain</i>						
Percent over 65 years						
Less than 25%	9	56.3%	6	54.5%	4	66.7%
26-50%	4	25.0%	2	18.2%	2	33.3%
51-75%	3	18.8%	3	27.3%	0	0.0%
Greater than 76%	0	0.0%	0	0.0%	0	0.0%
Unsure	0	0.0%	0	0.0%	0	0.0%
Percent seen monthly						
Less than 25%	12	75.0%	8	72.7%	4	66.7%
26-50%	3	18.8%	2	18.2%	2	33.3%
51-75%	1	6.3%	1	9.1%	1	16.7%
Greater than 76%	0	0.0%	0	0.0%	0	0.0%
Unsure	0	0.0%	0	0.0%	0	0.0%

* One provider worked in both rural and urban settings and was counted in both totals

**Safety Net: FQHC, FQHC look alike, rural health centers, free clinics, and academic resident clinics.

Private practice: physician owned practices and academically-affiliated, community based, primary care clinics

***Low health literacy, low income, uses social safety net programs such as TANF, SSI, WIC

Table 5.2: Top ten responsibilities for all providers and by urban and rural practice settings.

Activities	Total (N=16)	Percent of Urban providers (N=11)	Percent of Rural providers (N=6)
Get patients to use physical therapy	75.0%	81.8% ^D	50.0% ^D
Recommend non-pharmacological and multimodal approaches	75.0%	72.7% ^E	83.3% ^{D, E}
Avoid or minimize opioids for long term pain management	75.0%	63.6% ^D	100.0% ^D
Recommend and encourage patients to change behaviors to exercise and lose weight	56.3%	63.6% ^D	33.3%
Get patient history with pain treatments	56.3%	63.6%	33.3%
Create treatment plan	56.3%	45.5% ^{D, E}	83.3%
Prescribing medications (opioid and non-opioid)	56.3%	45.5% ^E	66.7% ^E
Set goals for pain treatment	50.0%	63.6%	33.3%
Physical exam	43.8%	54.5% ^{D, E}	16.7%
Set expectations about pain and treatments	43.8%	45.5% ^D	50.0% ^D
Diagnostic evaluation	43.8%	45.5% ^D	33.3%
Get patient history (comorbidities and medications)	43.8%	45.5%	33.3%
Assess and educate patients about the relationship between pain and mental health	43.8%	36.4% ^D	66.7% ^{D, E}
Ensure follow-up visit	37.5%	45.5% ^D	16.7%
Understand how pain affects daily life	37.5%	45.5%	16.7%
Identify root cause of pain and history with pain	37.5%	36.4%	50.0%
Partner with the patient	37.5%	36.4% ^E	33.3%
Monitor opioid treatment	31.3%	27.3% ^D	33.3% ^D
Refer to specialists	31.3%	27.3%	33.3%
Taper opioid use	31.3%	18.2% ^D	50.0% ^D
Change Medication treatments	6.3%	9.1% ^D	0.0%
Educate patients about opioids	12.5%	18.2% ^D	0.0%
Get patient to sign pain contract	18.2%	9.1%	16.7% ^E
Education patients about naloxone	6.3%	0.0%	17.7% ^E

Grayed percentages indicate that it was not a top ten responsibility.

Proportions are calculated by dividing the number of providers who reported the responsibility by the total number in that group.

D= Difficult responsibility; E= Easy Responsibility

Table 5.3: Top 10 needs, barriers, and supports for difficult responsibilities for primary care providers in urban and rural settings.

	Needs for Difficult Responsibilities	
	Urban	Rural
<i>Total Number of Codes</i>	<i>129</i>	<i>67</i>
Engaged patient	6.6%	4.5%
Availability of other options to use instead of opioids	5.5%	6.0%
Set expectations about pain	5.5%	4.5%
Knowledge of patient resources	4.4%	4.5%
Evidence about different pain management treatments	4.4%	4.5%
Patient medical history (comorbidities including, medications)	4.4%	1.5%
Conversation about patient goals	6.6%	1.5%
Knowledge of patient history with pain treatments	4.4%	3.0%
Educate patients about pain treatments	6.6%	3.0%
Patient who wants to change behaviors	6.6%	0.0%
Institutional support	5.5%	3.0%
Patient trust	5.5%	0.0%
Geographic access to pain treatments and specialists	4.4%	0.0%
Affordable pain treatments	2.2%	10.4%
Good patient provider relationship	2.2%	6.0%
Identify red flags	0.0%	6.0%
Tolerate conflicts with opioid prescriptions	2.2%	4.5%
Educate patients about pain and mental health	1.1%	4.5%
	Supports and Barriers for Difficult Responsibilities	
	Urban	Rural
<i>Total Number of Codes</i>	<i>504</i>	<i>272</i>
Published literature	1.6%	1.8%
Conversations with colleagues	1.8%	1.5%
Patient education about opioids	2.2%	0.4%
Previous patient records and outside records	1.4%	0.7%
Conversation about goals	1.8%	0.7%
Barrier: poor insurance coverage for alternatives to opioids	1.6%	1.5%
NC controlled substance database	1.4%	1.5%
Social worker	1.4%	0.4%
Family caregivers	1.4%	1.1%
Opioid treatment agreements	1.4%	0.7%
Specialty referral	1.6%	0.7%
Barrier: not enough time to talk about pain when there are other health concerns	1.6%	0.7%
Motivational interviewing	1.4%	0.7%

Barrier: patients don't want changes	1.6%	0.0%
Setting expectations with pain and treatments	1.4%	0.0%
Patient stories	1.2%	2.2%
Barrier: transportation	0.8%	3.7%
Behavioral health	1.0%	2.2%
Use multiple visits to explore pain (follow up)	1.2%	2.2%
Care manager	0.0%	3.3%
Point of care references	1.2%	1.8%
Prescribing guidelines to inform safe opioid prescribing	1.0%	2.2%
Pharmacists	0.0%	1.8%
Barrier: hard to get and interpret urine drug screen	0.0%	1.8%

Percent calculated by dividing the total number of times the code appears in a map by the total number of codes for the provider category.

Shaded cells indicate the top 10 codes for the group

Table 5.4: Wishes for easy and difficult responsibilities for primary care providers in urban and rural settings.

	Total	Urban	Rural
<i>Total codes</i>	<i>100</i>	<i>76</i>	<i>42</i>
Better patient education materials about pain and treatments	6.0%	7.9%	9.5%
More mental health providers	6.0%	6.6%	7.1%
More time to talk about pain	8.0%	7.9%	4.8%
Improve access to pain treatments	7.0%	9.2%	4.8%
More allied health professionals to address all concerns with pain	8.0%	5.3%	9.5%
Better medication for pain	5.0%	6.6%	4.8%
Better access to interventions for obesity	5.0%	6.6%	0.0%
More training on pain diagnosis and treatment	5.0%	5.3%	7.1%
Use more non-pharmacologic options for pain	5.0%	5.3%	7.1%
Better insurance coverage	4.0%	1.3%	7.1%
More community resources	4.0%	0.0%	9.5%

Percent calculated by dividing the total number of times the code appears in a map by the total number of codes for the provider category.

Shaded cells indicate top 10 wishes for the group

Table 5.5: Illustrative quotes for the top 5 responsibilities and wishes for urban and rural providers.

Responsibility	Illustrative Quote
Avoid or minimize opioids for long term pain management	I'm responsible for what I prescribe, so if I don't feel that they should be on opiates, I'm not gonna prescribe them, and I will have that tough discussion. What I think you don't wanna do or does not work well is try to have the patient agree with you. The patient certainly might not agree with you, particularly, obviously if addiction or diversion is the issue. But being honest, transparent but empathic, and knowing what you are willing to do based on your assessment of the medical situation. If it's a back and forth with the patient, that often goes nowhere good. Because the patient will be arguing for why they want opiates and then you're trying to justify why they shouldn't have opiates and that my 20 years of experience of doing it is a no-win situation. - <i>Provider in Urban Setting</i>
Recommend non-pharmacological and multimodal approaches	A lot of times it's very difficult if a patient has come to me with something that they want from me. So if they've come to me with the purpose of getting opioids, it's really difficult to sell an alternative treatment plan... And so, trying to convince a patient to try that before we would move to an opioid is challenging. Because I think a lot of those patients have tried it, but maybe not in the proper treatment management - <i>Provider in Rural Setting</i>
Assess and educate patients about the relationship between pain and mental health	The hardest thing is mental health, in the sense that, a lot of patients don't attribute their pain to a mental health cause or that they don't understand that the chronic pain is being exacerbated by their mental health condition. So establishing that link with them can be very, very difficult. I worked with a bunch of patients that making that link takes multiple visits, and years, sometimes, to get them to understand that link. But, it's also just access to mental health resources. Most of these patients with chronic pain would benefit from cognitive behavioral therapy, or biofeedback therapy, but it is really difficult financially. - <i>Provider in Urban Setting</i>
Recommend and encourage patients to change behaviors to exercise and lose weight	I think always making lifestyle modifications can be very difficult, especially for older patients that have really developed severe deconditioning and severe weight issues. Getting them to even do minimal movement can be very difficult for them... You can beg them, plead them, tell them how at risk they are, it's just really hard to move them off that set point that they've established over decades. - <i>Provider in Urban Setting</i>
Set expectations and create treatment goals	It's a hard thing to do to say to somebody, "I know you want to be pain-free, and I don't know if that's gonna be possible.": How do you have that conversation? How do you frame it in a productive way, and not just a, "It's not gonna be possible. Stop asking." - <i>Provider in Urban and Rural Setting</i>
Get patients to use physical therapy	I would also say physical therapy is actually one of my most difficult things. It's a big time commitment for them [patients] to go to all of these visits and it typically tends to be fairly expensive. It's kind of not a immediate payoff. Medications immediately makes them feel better, whereas physical therapy, might take six weeks to help. - <i>Provider in Urban Setting</i>

<p>Tapering opioid use</p>	<p>I struggle to take them off of their pain medications, to decrease that dose. I've been here 12 years, and so some of my patients have gone from being 60 and still fixing their own cars, and bringing in their firewood, to 72 and approaching the need for hospice care. And so to start talking about, "Well, you weigh 20% less than you did 10 years ago when we first started this, how do we taper it down?" Because I then get the granddaughter calling and saying, "Grandpa hurts so much. He won't sleep in bed anymore." That multi-generational family stuff is challenging to work with because rarely do I see these patients in isolation. I see several generations of the family. - <i>Provider in Rural Setting</i></p>
<p>Monitor opioid treatment (rural)</p>	<p>Oftentimes the drug screens are more difficult than I want them to be. And that sometimes is a red flag to me. But a lot of times they'll be like, "Oh, I just peed." Or lab error, my lab technician accidentally throws it out, or my medical assistant doesn't give them the urine cup. But a lot of times, that is difficult in those first steps. - <i>Provider in Rural Setting</i></p>

Wish	Illustrative Quote
<p>More allied health professionals to address all concerns with pain</p>	<p>I think again, when you have more continuity with staff, whether it's medical staff, nursing staff, whatever, patients develop more trust, that they trust people that they've been coming to see for a long time. -<i>Provider in Rural Setting</i></p>
<p>More time to talk about pain</p>	<p>So dedicated visit for pain, in my mind, would be like a pain clinic within a primary care setting. So we have a smoking cessation clinic, we have... It's sort of these ideas like within primary care you offer these smaller areas that are specialized to help people out. -<i>Provider in Urban Setting</i></p>
<p>Improve access to pain treatments</p>	<p>I think that there are models where the cardiologist will come one Saturday a month out to somewhere rural. I think that having a similar model for orthopedics, or maybe this is a gold star, orthopedics, or pain, or psychiatry to travel to rural places, not every day, but on a regular basis, on a scheduled basis to see patients, would be awesome. - <i>Provider in Urban and Rural Setting</i></p>
<p>Better patient education materials about pain and treatments</p>	<p>I would love to have more educational options for patients about how chronic pain works, why it perpetuates itself, how different therapies work, not just opiates, but how many adjunct therapies work, how it interplays with their mental health... that's a video you can show. -<i>Provider in Urban and Rural Setting</i></p>
<p>More mental health providers</p>	<p>More mental health support on the day of the visit. So a pain psychologist, we don't really have one of those at our clinic, and they take forever to get into, for other clinics. It can be really challenging. And I think we're very capable to do that. I'm not saying that I know more or I'm more capable than a pain psychologist, but to just ask like, "So, tell me about your pain. How is it going?" or like, "What are your goals? Where are you? Where would you like to be? From a one to a 10? Where are you? Oh, you're a nine. Why are you a nine?" It's like, we can do that, we just don't have time. - <i>Provider in Urban Setting</i></p>
<p>Better access to interventions for obesity</p>	<p>I mean, the obesity thing is gigantic societal changes [chuckle] would make that a lot easier. The government subsidizes healthy food, instead of unhealthy corn products, and our society moving away from kind of a workaholic culture into people having more of a work/life balance, where they have time for exercise, and schools including more exercise time in their curriculum, rather than less, and kids getting better education in schools about nutrition. - <i>Provider in Urban Setting</i></p>
<p>Better medication for pain</p>	<p>There are new drugs coming out they're talking about that target pain receptors without giving...the sense of euphoria that is so addictive. And so I think, in the future, when we talk about effective treatments, alternatives that aren't as psychologically addictive, but still they are effective for pain. -<i>Provider in Urban and Rural Setting</i></p>

More training on pain diagnosis and treatment	I wish I had gotten better training during residency [on pain management] to be honest. I think that would give me a better foundation to go out and practice. - <i>Provider in Rural Setting</i>
Use more non-pharmacologic options for pain	I wish there was a better system for universal healthcare that would let our patients seek alternative treatments more easily, such as therapy and specialist consultation and physical therapy and whatnot 'cause I think that that would really reinforce that these alternative treatment plans actually work by allowing patients to actually do them and complete them. -Provider in Rural Setting
Better insurance coverage	Medicaid expansion in NC. We had a legislature who cared for the half million people or more who could benefit from Medicaid expansion. It would help our patients, it would help us. It would probably help us not have the tremendous turnover that we've had. - <i>Provider in Rural Setting</i>
More community resources	It's harder with older people, I think, 'cause they're not as probably connected on the internet as younger people are, but some sort of way to put people in touch with other similar, or people in similar situations where they can have support groups, or... Not necessarily like a guided support group, but just build them on their own. Just someone to walk with, even, so you can't use an excuse of, "I don't wanna walk by myself" or something. Just something like that would be helpful. - <i>Provider in Rural Setting</i>

Supplemental Tables

Supplemental Table 5.1: Responsibilities of primary care providers by urban and rural settings.

Activities	Total (N=16)	Percent of Urban Providers (N=11)	Percent of Rural Providers (N=6)
Avoid or minimize opioids for long term pain management	75.0%	63.6%	100.0%
Recommend non-pharmacological and multimodal approaches	75.0%	72.7%	83.3%
Get patient history with pain treatments	56.3%	63.6%	33.3%
Get patients to use physical therapy	75.0%	81.8%	50.0%
Recommend and encourage patients to change behaviors to exercise and lose weight	56.3%	63.6%	33.3%
Create treatment plan	56.3%	45.5%	83.3%
Prescribing medications (opioid and non-opioid)	56.3%	45.5%	66.7%
Set goals for pain treatment	50.0%	63.6%	33.3%
Assess and educate patients about the relationship between pain and mental health	43.8%	45.5%	33.3%
Add flag for chronic pain in electronic health record	43.8%	45.5%	33.3%
Avoid asking patients about pain	43.8%	45.5%	50.0%
Be curious with the patient	43.8%	54.5%	16.7%
Change medication treatments	43.8%	36.4%	66.7%
Determine whether patient's need for treatment is legitimate (e.g. no doctor shopping or inappropriate medication use)	37.5%	45.5%	16.7%
Diagnostic evaluation	37.5%	45.5%	16.7%
Educate patients about naloxone	37.5%	36.4%	50.0%
Educate patients about opioids	31.3%	27.3%	33.3%
Educate patients about treatment options	37.5%	36.4%	33.3%
Ensure follow-up visit	31.3%	27.3%	33.3%
Follow opioid prescribing guidelines	31.3%	18.2%	50.0%
Get patient history (comorbidities and medications)	6.3%	0.0%	16.7%
Get patient to sign pain contract	6.3%	0.0%	16.7%
Get urine drug test	6.3%	9.1%	0.0%
Identify "red flags" for opioid behaviors	6.3%	9.1%	0.0%
Identify patient resources	6.3%	9.1%	0.0%
Identify root cause of pain and history with pain	6.3%	0.0%	16.7%
Minimize or avoid non-opioid medications	12.5%	18.2%	0.0%
Monitor opioid treatment	6.3%	9.1%	0.0%
Partner with the patient	12.5%	9.1%	16.7%

Activities	Total (N=16)	Percent of Urban Providers (N=11)	Percent of Rural Providers (N=6)
Physical exam	12.5%	9.1%	16.7%
Prepare for potential conflicts with pain management	12.5%	9.1%	16.7%
Reduce all medication use	18.8%	18.2%	16.7%
Refer to specialists	12.5%	18.2%	0.0%
Set expectations about pain and treatments	12.5%	9.1%	16.7%
Taper opioid use	6.3%	9.1%	0.0%
Teach coping strategies	12.5%	18.2%	0.0%
Try all other options before prescribing opioids	6.3%	9.1%	0.0%
Understand how pain affects daily life	18.8%	18.2%	16.7%

Gray font indicates responsibility was not in the top 10 for the group.

Proportions are calculated by dividing the number of providers who reported the responsibility by the total number in that group

Supplemental Table 5.2: Needs for difficult and easy responsibilities for primary care providers in urban and rural settings.

	Needs for Difficult and Easy Responsibilities		Needs for Difficult Responsibilities	
	Urban	Rural	Urban	Rural
<i>Total Number of Codes</i>	<i>162</i>	<i>91</i>	<i>129</i>	<i>67</i>
Engaged patient	4.3%	6.6%	6.6%	4.5%
Availability of other options to use instead of opioids	3.7%	6.6%	5.5%	6.0%
Set expectations about pain	4.3%	4.4%	5.5%	4.5%
Knowledge of patient resources	2.5%	4.4%	4.4%	4.5%
Evidence about different pain management treatments	3.1%	4.4%	4.4%	4.5%
Patient medical history (comorbidities including, medications)	4.3%	4.4%	4.4%	1.5%
Conversation about patient goals	4.9%	1.1%	6.6%	1.5%
Knowledge of patient history with pain treatments	4.3%	2.2%	4.4%	3.0%
Educate patients about pain treatments	3.7%	2.2%	6.6%	3.0%
Patient who wants to change behaviors	3.7%	0.0%	6.6%	0.0%
Institutional support	3.7%	2.2%	5.5%	3.0%
Patient trust	3.1%	0.0%	5.5%	0.0%
Geographic access to pain treatments and specialists	3.1%	0.0%	4.4%	0.0%
Affordable pain treatments	1.9%	9.9%	2.2%	10.4%
Good patient provider relationship	1.9%	4.4%	2.2%	6.0%
Identify red flags	0.0%	0.0%	0.0%	6.0%
Tolerate conflicts with opioid prescriptions	1.2%	3.3%	2.2%	4.5%
Educate patients about pain and mental health	0.6%	3.3%	1.1%	4.5%
Educate patients about opioids	1.9%	3.3%	3.3%	1.5%
Patients need transportation to treatment	1.9%	2.2%	3.3%	3.0%
Patient needs to be able to afford pain treatments	2.5%	0.0%	3.3%	0.0%
Time to talk to patients	1.2%	2.2%	2.2%	3.0%
Good communication with the patient	1.9%	1.1%	2.2%	1.5%
Good communication with other pain providers	1.9%	0.0%	3.3%	0.0%
Time and money for patient to exercise and eat well	1.9%	0.0%	3.3%	0.0%
Time for patient follow up	1.9%	0.0%	3.3%	0.0%

	Needs for Difficult and Easy Responsibilities		Needs for Difficult Responsibilities	
	Urban	Rural	Urban	Rural
Avoid side effects of treatment strategies	1.2%	1.1%	2.2%	1.5%
Listening skills	1.9%	0.0%	2.2%	0.0%
Provider needs to be honest and transparent	1.9%	0.0%	1.1%	0.0%
Access to addiction treatment	1.2%	1.1%	2.2%	1.5%
Empathy	1.2%	1.1%	2.2%	1.5%
Do a physical exam	1.2%	0.0%	2.2%	0.0%
Patient acceptance of treatments	1.2%	0.0%	2.2%	0.0%
Address isolation	0.6%	1.1%	1.1%	1.5%
Knowledge about pain management strategies	1.2%	0.0%	1.1%	0.0%
Medication that is appropriate for the condition	1.2%	0.0%	1.1%	0.0%
Provider knowledge about pain	0.6%	0.0%	1.1%	0.0%
Support staff	0.0%	2.2%	0.0%	3.0%
Way to evaluate progress with treatment	0.0%	2.2%	0.0%	3.0%
Determine what is safe for the patient	0.6%	1.1%	0.0%	1.5%
Educate patients about pain contract	0.0%	2.2%	0.0%	1.5%
Knowledge about non-pharma modalities	0.6%	2.2%	0.0%	1.5%
Method to prescribe medications	1.2%	0.0%	0.0%	0.0%
Provider training about managing expectation	0.6%	1.1%	1.1%	1.5%
Ask the right questions	0.6%	0.0%	1.1%	0.0%
Convince patients to get off of opioids	0.6%	0.0%	1.1%	0.0%
Educate patients about pain and obesity	0.6%	0.0%	1.1%	0.0%
Establish partnership with patient	0.6%	0.0%	1.1%	0.0%
Ethical obligation to not prescribe opioids	0.6%	0.0%	1.1%	0.0%
Good communication with patient and physical therapist	0.6%	0.0%	1.1%	0.0%
Home environment assessment	0.6%	0.0%	1.1%	0.0%
Identify drug seekers	0.6%	5.5%	1.1%	0.0%
Knowledge about how to do physical exam	0.6%	0.0%	1.1%	0.0%
Non-judgmental attitude	0.6%	0.0%	1.1%	0.0%
Patient and provider have to agree	0.6%	0.0%	1.1%	0.0%
Patient clothes	0.6%	0.0%	1.1%	0.0%

	Needs for Difficult and Easy Responsibilities		Needs for Difficult Responsibilities	
	Urban	Rural	Urban	Rural
Patient needs place to exercise	0.6%	0.0%	1.1%	0.0%
Place to do physical exam	0.6%	0.0%	1.1%	0.0%
Provider knowledge about how to implement modifications	0.6%	1.1%	1.1%	0.0%
Provider's goals for the patient	0.6%	0.0%	1.1%	0.0%
Provider's self-awareness about potential burn out	0.6%	0.0%	1.1%	0.0%
Set boundaries on treatment	0.6%	0.0%	1.1%	0.0%
Convince family members	0.0%	1.1%	0.0%	1.5%
Patient satisfaction	0.0%	1.1%	0.0%	1.5%
Reasons to counter patient excuses	0.0%	1.1%	0.0%	1.5%
Work with patient early in pain experience	0.0%	1.1%	0.0%	1.5%
Assess whether opioid therapy is appropriate	0.0%	1.1%	0.0%	0.0%
Confidence in care plan	0.6%	1.1%	0.0%	0.0%
Develop treatment plan	0.0%	1.1%	0.0%	0.0%
Educate family about naloxone	0.0%	1.1%	0.0%	0.0%
Educate patients about physical exam	0.6%	0.0%	0.0%	0.0%
Literacy	0.0%	1.1%	0.0%	0.0%
Patient who has done their research about their provider	0.6%	0.0%	0.0%	0.0%
Provider's acceptance about what they can do about pain	0.6%	0.0%	0.0%	0.0%
Time to get undressed	0.6%	0.0%	0.0%	0.0%

Percent calculated by dividing the total number of times the code appears in a map by the total number of codes for the provider category.

Gray font indicates need was not in the top 10 for the group

Supplemental Table 5.3: Supports, and barriers for difficult responsibilities for primary care providers in urban and rural settings.

	Resources for Difficult and Easy Responsibilities		Resources for Difficult Responsibilities	
	Urban	Rural	Urban	Rural
<i>Total Number of Codes</i>	592	366	504	272
Published literature	1.9%	2.5%	1.6%	1.8%
Conversations with colleagues	2.4%	1.6%	1.8%	1.5%
Patient education about opioids	2.2%	1.1%	2.2%	0.4%
Previous patient records and outside records	1.5%	1.4%	1.4%	0.7%
Conversation about goals	1.7%	1.1%	1.8%	0.7%
Barrier: poor insurance coverage for alternatives to opioids	1.7%	1.6%	1.6%	1.5%
NC controlled substance database	1.4%	1.4%	1.4%	1.5%
Social worker	1.5%	0.5%	1.4%	0.4%
Family caregivers	1.2%	0.8%	1.4%	1.1%
Opioid treatment agreements	1.2%	1.1%	1.4%	0.7%
Specialty referral	1.4%	0.8%	1.6%	0.7%
Barrier: not enough time to talk about pain when there are other health concerns	1.4%	0.5%	1.6%	0.7%
Motivational interviewing	1.4%	0.5%	1.4%	0.7%
Barrier: patients don't want changes	1.4%	0.0%	1.6%	0.0%
Setting expectations with pain and treatments	1.2%	0.0%	1.4%	0.0%
Patient stories	1.4%	2.5%	1.2%	2.2%
Barrier: transportation	1.0%	3.3%	0.8%	3.7%
Behavioral health	0.8%	2.7%	1.0%	2.2%
Use multiple visits to explore pain (follow up)	1.2%	2.2%	1.2%	2.2%
Care manager	0.0%	3.0%	0.0%	3.3%
Point of care references	1.2%	1.9%	1.2%	1.8%
Prescribing guidelines to inform safe opioid prescribing	1.0%	1.9%	1.0%	2.2%
Pharmacists	0.0%	1.9%	0.0%	1.8%
Barrier: hard to get and interpret urine drug screen	0.0%	1.4%	0.0%	1.8%
Strategy: use low risk treatments before opioids or other high risk treatments	2.2%	2.7%	1.2%	1.5%
Medical school training and residency	1.4%	1.4%	1.2%	1.5%
Barrier: stigma associated with mental health	0.8%	1.4%	0.8%	1.1%
Public awareness of opioid epidemic	1.2%	0.8%	1.2%	0.0%
Strategy: be transparent	1.2%	0.8%	1.2%	0.4%
Barrier: patients want quick fixes	0.8%	1.1%	0.8%	1.5%
EHR handouts	1.0%	0.8%	1.2%	0.7%
Online resources	0.8%	1.1%	0.6%	1.5%
Professional experience	1.4%	0.3%	1.2%	0.4%
Charity care programs	1.0%	1.4%	0.8%	1.1%
Scale for evaluating mental health	0.7%	1.1%	0.8%	0.7%

	Resources for Difficult and Easy Responsibilities		Resources for Difficult Responsibilities	
	Urban	Rural	Urban	Rural
EHR visit planning	0.7%	1.1%	0.6%	1.5%
Home exercises	1.0%	0.8%	1.0%	0.7%
State opioid prescribing policies impose limits for opioid prescriptions	1.2%	0.0%	1.2%	0.0%
Strategy: understand and tailor treatment to preferences	0.7%	0.8%	0.6%	1.1%
Strategy: validating patient pain	0.5%	1.1%	0.6%	1.1%
Teaching aids (analogies, models)	0.7%	0.8%	0.8%	0.7%
Barrier: conflict between patient and provider over pain management	0.3%	1.4%	0.4%	1.5%
Barrier: expectation about pain and treatments	0.7%	0.8%	0.8%	1.1%
Barrier: lack of training about specialty services for pain and addiction	0.8%	1.6%	0.6%	1.5%
Barrier: poor insurance coverage for physical therapy	0.3%	1.1%	0.4%	1.5%
Clinic staff	0.7%	0.5%	0.8%	0.7%
EHR facilitates collaboration with provider	1.0%	0.0%	1.2%	0.0%
Patient education about physical therapy	0.7%	0.5%	0.8%	0.7%
Provider knowledge of community resources	0.8%	0.3%	0.8%	0.4%
Strategy: use physical exam	1.0%	0.0%	0.4%	0.0%
Use more medications (both opioid and non-opioid)	1.0%	1.1%	1.0%	1.1%
Acupuncture	0.8%	1.1%	0.6%	1.1%
Barrier: lack of patient trust	0.8%	0.3%	1.0%	0.4%
Barrier: patients are sedentary	0.8%	0.0%	1.0%	0.0%
Gives more time to the patient	0.7%	0.3%	0.4%	0.4%
Barrier: belief that there could be inconclusive evidence from test or exam	0.7%	0.0%	0.8%	0.0%
Barrier: lack of patient education materials	0.7%	0.0%	0.8%	0.0%
Barrier: poor insurance coverage for mental health	0.3%	0.5%	0.4%	0.4%
Chronic pain support group	0.7%	0.5%	0.6%	0.4%
Clinic policy not to prescribe opioids on the first visit	0.5%	0.8%	0.6%	1.1%
Continuing Medical Education courses	0.5%	0.3%	0.4%	0.4%
Conversation about costs	0.5%	0.3%	0.4%	0.4%
EHR to find comorbidities and medications	0.7%	0.0%	0.4%	0.0%
Pain specialists	0.0%	1.1%	0.0%	0.0%
Patient education about pain and appropriate medications	0.0%	1.1%	0.0%	0.4%
Patient education about pain and obesity	0.5%	0.3%	0.6%	0.0%
Personality	0.7%	0.3%	0.8%	0.4%
Pharmacy assistance	0.3%	1.1%	0.2%	0.7%
Physical therapist	0.7%	0.0%	0.8%	0.0%
Provider wellness program	0.7%	0.8%	0.8%	1.1%
Screening for opioid risk behaviors	0.3%	0.5%	0.4%	0.7%
Second opinion	0.3%	0.5%	0.4%	0.7%

	Resources for Difficult and Easy Responsibilities		Resources for Difficult Responsibilities	
	Urban	Rural	Urban	Rural
Sliding scale for services	0.3%	1.1%	0.2%	0.7%
Strategy: build relationship with patient	0.3%	0.5%	0.0%	0.4%
Barrier: burnout	0.5%	0.3%	0.6%	0.4%
Barrier: cost of testing	0.5%	0.0%	0.6%	0.0%
Barrier: culture of medicine leans toward pills	0.5%	0.0%	0.6%	0.0%
Barrier: EHR diverts attention from the patient	0.0%	0.8%	0.0%	1.1%
Barrier: family caregivers	0.0%	0.8%	0.0%	1.1%
Barrier: lack of access to mental health services	0.5%	0.0%	0.6%	0.0%
Barrier: lack of data about patient history	0.5%	0.0%	0.6%	0.0%
Barrier: lack of standards for opioid therapy	0.0%	0.8%	0.0%	1.1%
Barrier: patient clothing for physical exam	0.5%	0.0%	0.6%	0.0%
Barrier: patient needs time for treatments	0.5%	0.0%	0.6%	0.0%
Barrier: patient won't schedule appointment	0.3%	0.3%	0.4%	0.0%
Barrier: patients don't think physical therapy with help	0.3%	0.3%	0.4%	0.4%
Barrier: patients may not understand education materials	0.2%	0.8%	0.2%	1.1%
Barrier: poor insurance coverage for specialists	0.3%	0.3%	0.4%	0.4%
Barrier: provider needs time to schedule visit for the patient	0.5%	0.0%	0.6%	0.0%
Community mental health provider	0.0%	0.8%	0.0%	0.0%
EHR referral	0.5%	0.0%	0.6%	0.0%
Imaging	0.3%	0.3%	0.4%	0.0%
Learn strategies from pain clinic	0.5%	0.0%	0.6%	0.0%
Mentors	0.3%	0.8%	0.4%	1.1%
Nurses	0.0%	0.8%	0.0%	0.7%
Nutritionist	0.5%	0.0%	0.6%	0.0%
Pain committee	0.0%	0.8%	0.0%	1.1%
Patient education about pain and mental health	0.2%	0.5%	0.2%	0.7%
Peer support counselors	0.5%	0.8%	0.4%	0.7%
Professional conferences	0.5%	0.0%	0.6%	0.0%
Physical therapy referral	0.3%	0.3%	0.4%	0.0%
Reputation of family medicine	0.3%	0.3%	0.4%	0.4%
Specialists travel to rural communities	0.5%	0.8%	0.4%	0.7%
Strategy: only manage pain/prescribe opioids for certain patients	0.5%	0.0%	0.6%	0.0%
Strategy: prioritizing patient's concerns about pain over other medical concerns	0.5%	0.0%	0.6%	0.0%
Substance use treatment providers	0.5%	0.3%	0.6%	0.4%
Urine drug test	0.3%	0.3%	0.4%	0.4%
After visit summary	0.3%	0.0%	0.2%	0.0%
Barrier: hard to convince patients to consider treatment	0.2%	0.3%	0.2%	0.4%
Barrier: hard to keep track of progress over time	0.0%	0.5%	0.0%	0.7%

	Resources for Difficult and Easy Responsibilities		Resources for Difficult Responsibilities	
	Urban	Rural	Urban	Rural
Barrier: lack of access to substance use services	0.3%	0.5%	0.4%	0.7%
Barrier: no place to exercise	0.2%	0.3%	0.2%	0.4%
Barrier: patient cognitive abilities	0.3%	0.0%	0.4%	0.0%
Barrier: patient communication about goals	0.3%	0.0%	0.4%	0.0%
Barrier: patients don't respond to data	0.3%	0.0%	0.4%	0.0%
Being a parent	0.3%	0.0%	0.2%	0.0%
Case worker	0.3%	0.0%	0.4%	0.0%
Clinic protocols for opioid treatment	0.0%	0.5%	0.0%	0.7%
Community gyms	0.3%	0.0%	0.4%	0.7%
Drive around to learn about community resources	0.0%	0.5%	0.0%	0.7%
EHR alerts	0.3%	0.0%	0.2%	0.0%
EHR notes to self	0.3%	0.0%	0.0%	0.0%
EHR to document strategies patient has tried before	0.3%	0.0%	0.2%	0.0%
EHR tracks problems and progress over time	0.3%	0.0%	0.4%	0.0%
Empathy	0.0%	0.5%	0.0%	0.7%
Epocrates	0.3%	0.0%	0.2%	0.0%
Family systems theory	0.0%	0.5%	0.0%	0.7%
High level of suspicion	0.3%	0.0%	0.4%	0.0%
Home visit	0.3%	0.0%	0.4%	0.0%
Internet searches	0.0%	0.5%	0.0%	0.7%
Non-judgmental attitude	0.3%	0.0%	0.4%	0.0%
Patience	0.2%	0.3%	0.2%	0.4%
Patient conversation to find red flag	0.3%	0.0%	0.4%	0.0%
Patient education classes about pain	0.3%	0.0%	0.4%	0.0%
Patient portal	0.3%	0.0%	0.2%	0.0%
Reduced cost alternatives for specialists	0.3%	0.0%	0.4%	0.0%
Self-reflection	0.0%	0.5%	0.0%	0.7%
Strategy: practice consistency with patients	0.2%	0.3%	0.2%	0.4%
Strategy: wait to discuss reduction in opioids until patient trusts provider	0.3%	0.0%	0.4%	0.0%
Strategy: skipping other health concerns	0.3%	0.0%	0.4%	0.0%
Surgery or injection	0.3%	0.0%	0.4%	0.0%
Telemedicine	0.3%	0.5%	0.2%	0.4%
Time to develop the relationship	0.3%	0.0%	0.4%	0.0%
Walking assistance devices	0.3%	0.0%	0.4%	0.0%
Aqua exercises	0.2%	0.0%	0.2%	0.0%
Ask about pain at every visits	0.0%	0.3%	0.0%	0.4%
Ask about patient medical history	0.0%	0.3%	0.0%	0.4%
Ask about social supports	0.2%	0.0%	0.2%	0.0%
Barrier: clinic funding	0.2%	0.0%	0.2%	0.0%

	Resources for Difficult and Easy Responsibilities		Resources for Difficult Responsibilities	
	Urban	Rural	Urban	Rural
Barrier: costly and side effects and patient preferences	0.2%	0.0%	0.2%	0.0%
Barrier: difficult to collaborate with mental health providers	0.2%	0.0%	0.2%	0.0%
Barrier: EHR does not have alert	0.0%	0.3%	0.0%	0.4%
Barrier: exam room furniture does not support patient during physical exam	0.2%	0.0%	0.2%	0.0%
Barrier: expected to build relationship immediately	0.2%	0.0%	0.2%	0.0%
Barrier: hard to explain how pain relates to obesity	0.2%	0.0%	0.2%	0.0%
Barrier: hard to find records for patients who go outside the system	0.2%	0.0%	0.2%	0.0%
Barrier: hard to interpret results from database	0.0%	0.3%	0.0%	0.4%
Barrier: hard to navigate health system	0.2%	0.0%	0.2%	0.0%
Barrier: isolation	0.0%	0.3%	0.0%	0.4%
Barrier: lack of access to social services	0.2%	0.0%	0.2%	0.0%
Barrier: lack of data on non-pharma modalities	0.0%	0.3%	0.0%	0.4%
Barrier: lack of educational material about opioids	0.0%	0.3%	0.0%	0.0%
Barrier: lack of internet access	0.0%	0.3%	0.0%	0.4%
Barrier: lack of provider confidence	0.2%	0.0%	0.2%	0.0%
Barrier: lack of training about pain	0.2%	0.0%	0.2%	0.0%
Barrier: legislation turns provider into a cop	0.0%	0.3%	0.0%	0.0%
Barrier: level of pain makes it difficult to complete physical exam	0.2%	0.0%	0.2%	0.0%
Barrier: limited time	0.0%	0.3%	0.0%	0.4%
Barrier: managing patient's emotions and pain treatment at the same time	0.0%	0.3%	0.0%	0.4%
Barrier: negative patient satisfaction	0.0%	0.3%	0.0%	0.4%
Barrier: negative patient satisfaction scores	0.2%	0.0%	0.2%	0.0%
Barrier: no way to recommend for patients to keep track of progress	0.0%	0.3%	0.0%	0.4%
Barrier: opioid prescribing policies which limit prescriptions shifts burden of long-term pain management to primary care providers	0.2%	0.0%	0.2%	0.0%
Barrier: pain clinic can't handle volume of patients so primary care has to	0.2%	0.0%	0.2%	0.0%
Barrier: patient literacy and SES	0.2%	0.0%	0.2%	0.0%
Barrier: patient want doctor to have all the answers	0.2%	0.0%	0.2%	0.0%
Barrier: provider doesn't think patients benefit from mental health care	0.0%	0.3%	0.0%	0.4%
Barrier: provider has to focus on meeting quality measures	0.2%	0.0%	0.2%	0.0%
Barrier: staff turn over	0.0%	0.3%	0.0%	0.4%
Barrier: the patient's other provider recommendations for pain	0.2%	0.0%	0.2%	0.0%
Barrier: unhealthy food is cheap	0.2%	0.0%	0.2%	0.0%
Barrier; regulation	0.0%	0.3%	0.0%	0.0%
Beers criteria	0.0%	0.3%	0.0%	0.0%

	Resources for Difficult and Easy Responsibilities		Resources for Difficult Responsibilities	
	Urban	Rural	Urban	Rural
Blank need	0.2%	0.0%	0.0%	0.0%
Clinic late policy	0.2%	0.0%	0.2%	0.0%
Clustering appointments	0.2%	0.0%	0.2%	0.0%
Confirm contact information	0.2%	0.0%	0.2%	0.0%
Conversation about patient history with pain treatment	0.0%	0.3%	0.0%	0.4%
Conversation about what worked in the past and what could work now	0.2%	0.0%	0.0%	0.0%
Demonstrate exercises	0.0%	0.3%	0.0%	0.4%
Education about insurance navigation	0.2%	0.0%	0.2%	0.0%
EHR to order medication	0.2%	0.0%	0.0%	0.0%
End of visit patient education	0.2%	0.0%	0.2%	0.0%
Exercise to avoid burnout	0.2%	0.0%	0.2%	0.0%
Family life cycle tool	0.0%	0.3%	0.0%	0.4%
Federal drug pricing	0.0%	0.3%	0.0%	0.0%
Finance department	0.2%	0.0%	0.2%	0.0%
Functional goals assessment	0.2%	0.0%	0.2%	0.0%
Handout about opioids	0.2%	0.0%	0.2%	0.0%
Have awareness that provider is doing the right thing	0.2%	0.0%	0.2%	0.0%
Have patient get undressed before provider arrives	0.2%	0.0%	0.0%	0.0%
Have students see patients	0.2%	0.0%	0.2%	0.0%
Home health nurses	0.2%	0.0%	0.2%	0.0%
Internal medicine podcast	0.2%	0.0%	0.2%	0.0%
Intuition	0.0%	0.3%	0.0%	0.4%
Inventory of activities	0.2%	0.0%	0.2%	0.0%
Lab staff	0.0%	0.3%	0.0%	0.4%
Local health department	0.2%	0.0%	0.2%	0.0%
Mayo clinic	0.0%	0.3%	0.0%	0.4%
Mental health econsults	0.2%	0.0%	0.2%	0.0%
Mm calculation formula	0.2%	0.0%	0.2%	0.0%
Not afraid of conflict	0.2%	0.0%	0.2%	0.0%
Nurse practitioner	0.2%	0.0%	0.2%	0.0%
PACE program for physical therapy	0.2%	0.0%	0.2%	0.0%
Pain scale	0.2%	0.0%	0.2%	1.5%
Patient education about exercise	0.2%	0.0%	0.2%	0.0%
Patient education about long term benefits	0.2%	0.0%	0.2%	0.0%
Patient education about tests	0.2%	0.0%	0.2%	0.0%
Patient education about the mechanisms of pain	0.2%	0.3%	0.2%	0.4%
Patient education about treatment plan	0.2%	0.0%	0.0%	0.0%
Patient education about violations of opioid treatment	0.0%	0.3%	0.0%	0.4%
Patient education video	0.2%	0.0%	0.2%	0.0%

	Resources for Difficult and Easy Responsibilities		Resources for Difficult Responsibilities	
	Urban	Rural	Urban	Rural
Patient recommendations about providers	0.0%	0.3%	0.0%	0.4%
Patient reviews	0.0%	0.3%	0.0%	0.0%
Patients get meds from other source	0.0%	0.3%	0.0%	0.4%
Patient's resources	0.0%	0.3%	0.0%	0.0%
Pharmacy educators	0.2%	0.0%	0.2%	0.0%
Population health specialist	0.2%	0.0%	0.2%	0.0%
Pre authorization	0.0%	0.3%	0.0%	0.4%
Print out from controlled substance database	0.2%	0.0%	0.0%	0.0%
Print out from previous visit	0.2%	0.0%	0.2%	0.0%
Print out of yoga and mindfulness	0.2%	0.0%	0.2%	0.0%
Psychologist	0.2%	0.0%	0.2%	0.0%
PT will see patients after 3 visit limit with Medicaid	0.2%	0.0%	0.2%	0.0%
Referral list	0.2%	0.0%	0.2%	0.0%
Referral resource	0.0%	0.3%	0.0%	0.4%
Screening brief intervention referral therapy	0.0%	0.3%	0.0%	0.4%
Strategy- provider recognizes what he can and cannot do	0.0%	0.3%	0.0%	0.4%
Strategy: limit diagnostic testing to save costs	0.2%	0.0%	0.2%	0.0%
Strategy: no discussion on why opioids are not prescribed	0.2%	0.0%	0.2%	0.0%
Strategy: normalize the relationship between pain and mental health	0.0%	0.3%	0.0%	0.0%
Strategy: Does not accept new patients	0.2%	0.0%	0.2%	0.0%
Strategy: patient conversation to assess readiness for change	0.2%	0.0%	0.2%	0.0%
Strong home support system for provider	0.2%	0.0%	0.0%	0.0%
Substance use task force	0.0%	0.3%	0.0%	0.0%
Teaching residents and students	0.2%	0.0%	0.2%	0.0%
Time off	0.2%	0.3%	0.2%	0.4%
Training on communication	0.2%	0.0%	0.2%	0.0%
Training on falls prevention	0.2%	0.0%	0.2%	0.0%
Training on musculoskeletal pain	0.2%	0.0%	0.2%	0.0%
Training on opioid prescribing	0.2%	0.0%	0.2%	0.0%
Van to transport patients	0.0%	0.3%	0.0%	0.4%
Walk club	0.2%	0.0%	0.2%	0.0%
Work hour restrictions	0.2%	0.3%	0.2%	0.4%

Percent calculated by dividing the total number of times the code appears in a map by the total number of codes for the provider category.

Gray font indicates support or barrier was not in the top 10 for the group

Supplemental Table 5.4: Wishes for easy difficult responsibilities for primary care providers in urban and rural settings.

	Total	Urban	Rural
Better patient education materials about pain and treatments	6.0%	7.9%	9.5%
More mental health providers	6.0%	6.6%	7.1%
More time to talk about pain	8.0%	7.9%	4.8%
Improve access to pain treatments	7.0%	9.2%	4.8%
More allied health professionals to address all concerns with pain	8.0%	5.3%	9.5%
Better medication for pain	5.0%	6.6%	4.8%
Better access to interventions for obesity	5.0%	6.6%	0.0%
More training on pain diagnosis and treatment	5.0%	5.3%	7.1%
Use more non-pharmacologic options for pain	5.0%	5.3%	7.1%
Better insurance coverage	4.0%	1.3%	7.1%
More community resources	4.0%	0.0%	9.5%
Video or written materials about opioids and naloxone	5.0%	3.9%	4.8%
Learn more strategies from pain clinic	4.0%	5.3%	0.0%
Integrate mental health with pain	2.0%	2.6%	4.8%
More evidence supporting efficacy for pain treatments	2.0%	2.6%	4.8%
More standardization for pain management and opioid therapy	2.0%	0.0%	4.8%
Address social determinants of pain	1.0%	0.0%	2.4%
Better collaboration with primary care and emergency departments	2.0%	2.6%	0.0%
Better reimbursement for mental health providers	2.0%	2.6%	0.0%
Care coordination team	1.0%	1.3%	0.0%
Diagnostic test to track pain over time	2.0%	2.6%	0.0%
Easier access to Narcan	2.0%	2.6%	0.0%
Fewer policies that are a one size fits all approach	1.0%	1.3%	0.0%
Identify high-risk patients who use ER	2.0%	2.6%	0.0%
Improve EHR functionality	3.0%	2.6%	2.4%
Safe space for physicians to talk about pain management	1.0%	0.0%	2.4%
Value based health care to absorb costs	2.0%	2.6%	0.0%
Way to figure out patient resources	3.0%	2.6%	2.4%

Percent calculated by dividing the total number of times the code appears in a map by the total number of codes for the provider category.

Gray font indicates wish was not in the top 10 for the group

CHAPTER 6: CONCLUSION

The goal of this research was to understand if and how access to non-pharmacologic pain management treatments is associated with opioid prescriptions patterns for older adults suffering from chronic musculoskeletal pain. This study used quantitative and qualitative methods to examine whether access to two key, evidence based non-pharmacologic treatments (physical therapy and mental health services) are associated with short-term and long-term opioids prescription patterns among older adults with persistent musculoskeletal pain. Aims 1 and 2 used a retrospective cohort study design to empirically test the relationship between measures of access (supply of non-pharmacologic providers in a county and use of non-pharmacologic services) and opioid prescription patterns. Aim 3 used Systems Support Mapping, a Systems Thinking Method, to qualitatively describe the discrete tasks primary care providers do to care for older adults with chronic musculoskeletal pain, the resources support their practice, the barriers that block their practice, and their priorities for being better supported in the system.⁹⁹

Aim 1 (Chapter 3) examined the relationship between access to non-pharmacologic services and the use of different pain management strategies during the Phase One (three months after the index pain diagnosis) and Phase Two (three months after Treatment Phase One). During both phases, about 10% of the cohort filled an opioid prescription or used physical therapy, but fewer than 2% of the cohort used mental health services. Greater supply of non-pharmacologic providers was associated with lower odds of filling an opioid prescription in Phase One (mental health adjusted odds ratio (aOR): 0.97, 95% confidence interval (CI): 0.96-0.98; physical therapy aOR: 0.98, 95% CI: 0.97-1.00). In Phase Two, greater supply of mental health providers (aOR:

0.97, 95% CI: 0.96-0.98) and use of physical therapy (aOR: 0.62, 95% CI: 0.58-0.67) in Phase One was significantly associated with lower odds of filling an opioid prescription in Phase Two. For both phases, measures of socioeconomic status (Medicaid Buy-in and county poverty rates) were significantly associated with greater odds of filling an opioid prescription. The estimates significantly differed between metropolitan and rural counties in Phase One but not Phase Two.

Aim 2 (Chapter 4) examined the geographic and temporal variations of long-term and high-dose prescriptions for Medicare beneficiaries with persistent musculoskeletal pain. About 2.4% of the cohort had a long-term prescription, but about 12% had a high-dose prescription. The long-term prescription rate for beneficiaries with a new episode of persistent musculoskeletal pain was relatively stable from 2008 to 2014, but the rate of high dose prescriptions decreased by 35%. Rates of long-term and high-dose prescriptions varied substantially by hospital referral region. Across models, greater supply of mental health providers and pain specialists was associated with lower odds of long-term and high-dose prescriptions. In most models, the supply of physical therapists was not significantly associated with the odds of high-risk prescriptions. Evidence about the association between high-risk prescription patterns and the use of non-pharmacologic services during the first three months of a new episode of persistent musculoskeletal pain was mixed. However, filling an opioid prescription in the first three months of a new episode was significantly associated with greater odds of high-risk prescription patterns.

Aim 3 (Chapter 5) further explores the delivery of pain care by focusing on the experiences of North Carolina primary care providers who care for older adults with chronic musculoskeletal pain. We interviewed 16 primary care providers across North Carolina with varying levels of training and experience and who serve diverse populations. Primary care

providers reported that they try to avoid or minimize opioid therapies for older adults, recommend non-pharmacologic treatments (e.g. mental health treatment or physical therapy), encourage changes in health behaviors like weight loss and exercise, and assess and educate patients about the relationship between mental health and pain. To fulfill these responsibilities, providers' needs included an engaged patient, alternatives to opioids, and setting expectations about pain. Common supports linked to their needs included published literature, conversations to education patients about opioids and other pain related topics, electronic health records, and allied health professionals. Barriers included lack of insurance coverage for the patient and limited time to educate patients. Primary care providers expressed that better patient education materials, more mental health providers, and better access to pain management treatments would help them in delivering care.

The findings from this research addressed the three gaps in literature in the following ways:

1. **Opioid prescriptions were more frequent than physical therapy or mental health services among older adults with persistent musculoskeletal pain, a large subset of the population suffering from persistent pain in the US.**

This is the first study to our knowledge to use population-based data to examine the initiation of pain treatments from the onset of a new episode of persistent musculoskeletal pain. Aims 1 and 2 show that opioids and physical therapy are used about five to ten times more than mental health services. While initiation rates of opioid prescriptions and physical therapy visits are relatively similar during the first six months of a new episode, during the year after the index pain diagnosis, the opioid prescription rate was six percentage points higher than the physical therapy use rate and 28 percentage points higher than the mental health service use rate.

The utilization rates for non-pharmacologic treatments from Aims 1 and 2 are similar to previous estimates of utilization rates for older adults with chronic pain.^{29,85} Compared to younger adults with chronic pain, older adults with chronic pain were more likely to use physical therapy and less likely to use mental health services.^{29,57} The data show that beneficiaries may be exposed to opioids early in their experience of pain, even when non-pharmacologic treatments like physical therapy are used. Furthermore, long-term pain management treatments often incorporate opioids over physical therapy or mental health services.

High-dose prescriptions and long-term prescriptions occurred in 11.9% and 2.4%, respectively, of the cohort. However, among beneficiaries with at least one opioid prescription, the proportion of high dose prescriptions was about three times greater than long-term prescriptions (38.3% vs 7.6%). The average dose was 32.7 MME/ day for long-term users. While the rate of long-term prescriptions is similar to a previous study on all older adults with an opioid prescription,⁶² the average daily dose for long-term prescriptions was lower than previous estimates.^{33,74} High-dose prescriptions were common among beneficiaries with a long-term prescription (approximately 44%), but only lasted about a month on average. This suggests that while older adults may typically have low average doses of opioids, there may be temporary dose increases which could lead to periods of long-term prescriptions that are risky.

Consistent with previous studies of chronic pain management, the rate of opioid prescriptions was greater than the utilization rate of physical therapy and mental health services use.^{29,31,57} This finding could indicate that the psychosocial factors that are typically addressed with non-pharmacologic treatments may not be addressed in pain treatments for older adults.²⁵ It could also indicate that older adults may be exposed to potentially risky treatments such as opioids, over safer alternatives like non-pharmacologic treatments. However, without knowledge

of the severity, function, and psychosocial characteristics, it is difficult to conclude whether the utilization rates for either opioids or non-pharmacologic services are ideal. Opioids may be appropriate for certain patients, but require careful monitoring and clear understanding of associated risks.¹⁸

2. Measures of access to non-pharmacologic services were associated with initiation of opioid prescriptions and high-risk prescriptions among older adults with a new episode of persistent musculoskeletal pain.

The supply of mental health providers was significantly associated with greater odds of filling an opioid prescription during Phase One and Two as well as long-term prescriptions, and high-dose prescriptions. However, the supply of physical therapists was only associated with greater odds of an opioid prescription in the Phase I, and was not significantly associated long-term or high-dose prescriptions. These finding extend the evidence from previous studies by demonstrating that the association between the supply of providers and opioid prescription outcomes depends on the type of provider and study population.^{34,35,40}

The results from Aims 1 and 2 regarding the use of non-pharmacologic services during the first three months of an episode of persistent musculoskeletal pain and opioid prescription outcomes were mixed. While the use of physical therapy during the first three months of an episode was associated with lower odds of an opioid prescription in the next three months which is consistent with previous literature, these results were not consistent for high-dose and long-term opioid prescriptions.^{79,94,95} Furthermore, contrary to previous literature, use of mental health services during the first three months of an episode was associated with greater odds of opioid prescriptions in Phase Two, but inconsistent for high risk prescriptions.⁸⁰ We also found that an opioid prescription during the first three months of a new pain episode was significantly

associated with greater odds of an opioid prescription during Phase Two, long-term prescriptions, and high-dose prescriptions. Extending the literature on predictors of high-risk prescriptions, this finding shows that timing of the first opioid prescription with respect to the start of a new persistent pain episode may be a modifiable factor to prevent high-risk patterns like long-term and high-dose prescriptions.^{6-8,93}

The differences in the association between access to non-pharmacologic treatments and short and long-term opioid prescriptions outcomes may indicate difference in treatment needs as pain progresses over time. Specifically, these studies showed that a greater supply and use to physical therapists was associated with lower odds of short-term opioid initiation, while a greater supply of mental health services was significantly associated with lower odds of both short-term and high-risk opioid prescription patterns. Therefore, access, in terms of supply and use, to physical therapy might be especially important to prevent early opioid prescriptions, but the supply of mental health providers might be important to throughout the course of a pain episode.

3. After controlling for indicators of health status and measures of access to health care resources, socioeconomic indicators at the individual (Medicaid buy-in) and county-level (poverty rate) were positively associated with initiation of opioid prescriptions and long-term prescription patterns.

Having Medicaid insurance was significantly associated with greater odds of opioid prescriptions in Phase One and Two as well as long-term opioid prescriptions. Increases in the county level poverty rate was associated with greater odds of an opioid prescription in Phase One and long-term prescriptions. This relationship between socioeconomic indicators and opioid prescriptions in Phase One and Two persisted in subgroup analyses for rural counties. Our findings are similar to previous studies which a similar relationship between socioeconomic

indicators and opioid prescription patterns among different adult populations.^{35,36} Beyond availability of non-pharmacologic providers, patients may have other barriers to accessing non-pharmacologic care such as high costs of treatments, limited insurance coverage for non-pharmacologic treatments, and few community resources.^{50,51,54}

4. Primary care providers reported that they struggle with avoiding or minimizing opioid prescriptions and encouraging non-pharmacologic service use when they care for patients with chronic musculoskeletal pain.

In the both urban and rural settings, primary care providers reported that they struggled to fulfill several responsibilities: minimizing or avoiding opioid prescriptions, encouraging use of non-pharmacologic treatments, referring patients to physical therapy, and educating patients about pain and mental health. These responsibilities align with the content present in clinical guidelines.^{18,19,55,171} Common needs linked to these responsibilities include an engaged patient, a good patient provider relationship, and setting expectations about pain, and alternatives to opioids to meet their responsibilities. Furthermore, common resources include allied health professionals (e.g. physical therapists, behavioral health specialists, and social workers) and policies and guidelines for opioid prescribing are critical to support their practices.

These qualitative results provide context to explain the treatment patterns for opioid prescriptions and non-pharmacologic service use from Aims 1 and 2. Specifically, it shows that recommendations are interrelated: avoiding opioid prescriptions necessitates substitution with alternative treatments. Similar to a previous study, we found that while providers try to recommend non-pharmacologic treatments, these treatments require commitment and interest from the patient, which differs for opioid treatments.⁵⁴ Confirming the findings from Aims 1 and 2, limited access to alternatives to opioids (e.g. available providers, transportation, and

insurance) was reported as a common barrier for providers. Lack of insurance coverage for alternatives to opioids was a common barrier for providers, and in rural settings, affordable treatments was the most frequent need. Not only do these results support the findings about socioeconomic indicators and opioid prescription patterns from Aims 1 and 2, but it demonstrates that limited patient resources hinders providers' ability to follow guidelines for chronic pain treatment.

Policy Implications

This research reinforces the need for a comprehensive, systems-based policy approach to support patients who suffer from chronic musculoskeletal pain and the providers who care for them. Policies designed to reduce shortages of non-pharmacological providers such as mental health providers and physical therapists are a promising approach to addressing opioid prescription patterns. Based on this research, the modest improvements in opioid prescription patterns associated with increases in the supply of non-pharmacologic providers suggest that even after controlling for use of services, the presence of non-pharmacologic providers is a critical resource in the health care delivery system for pain. Increasing the number of non-pharmacologic providers could not only increase the availability of alternatives to opioids and non-opioid medications, but it can also make it easier for providers to follow clinic guidelines for opioid prescriptions.^{18,19,55}

In addition to increasing the local availability of non-pharmacologic providers, engaging patients in non-pharmacologic services is also needed to impact opioid prescribing patterns. For example, the recent removal of the caps on physical therapy visits in February 2018 could improve access to physical therapy and potentially reduce opioid use.¹⁵⁷ Furthermore, an integrated approach to care where physical therapists and mental health providers are closely linked to primary care providers may be another way to improve patient uptake of non-

pharmacologic services.^{124,163} Not only could this approach improve access to non-pharmacologic providers for the patients, but it can also provide additional organizational and practice-level support for primary care providers.^{163,164} The patient centered medical home model could be one approach to improve the coordination of services for pain patients.¹⁷⁴ This model may be better equipped to address the multiple biopsychosocial factors that address pain and steer patients towards non-pharmacologic or multimodal approaches.^{124,174}

Addressing shortages of non-pharmacologic providers is a promising policy option to reduce opioid prescription and improve pain care because current approaches for opioid prescription policies (e.x. “prescription drug monitoring programs, patient review and restriction programs, prior authorization, pain clinic regulations, prescription limits, physical exams, clinical guidelines, and education for patients and providers”) have limited evidence for improving health care utilization patterns, high-risk opioid prescription patterns, and mortality, especially among older adults.^{62,83,162} As the Centers for Medicare and Medicaid considers policies like restricting Part D beneficiaries with high opioid use to one prescriber and pharmacy or denying coverage for prescriptions that exceed 90 MME, little attention has been given to providing alternatives to opioids and encouraging the use of non-pharmacologic services.^{82,175} Furthermore, it is unclear whether current policy approaches result in harms such as undertreated pain, or whether they support safer care pathways like use of non-pharmacologic pain treatments instead of creating barriers to opioids as a treatment option. Therefore, improving access to non-pharmacologic treatments would be one way to better support patients with chronic pain and their providers.

Limitations

There are several limitations to this study. First, this is an observational study which indicates that the results do not represent causal relationships. Omitted variable bias could also

occur as several variables at the individual and county levels were not observed or included in the model. For example, we lacked data on pain severity, function, education, and socioeconomic status for the beneficiary as well as data on the supply of substance use providers and information about physician networks at the county-level. However, previous studies have shown that pain severity did not significantly affect the prescription opioid use.^{176,177} Furthermore, we did not assess temporality of use of non-pharmacologic services and opioid prescriptions. The hypothesized causal mechanism assumes that the pathway to individual prescription opioid use behaviors is mediated by the provider behaviors, which is not formally tested.

The data used for this study also had several limitations. First, claims for individuals who received substance abuse treatment are redacted.¹⁵⁸ While we can observe opioid prescriptions, we cannot observe services with a substance use diagnosis and control for comorbidities relating to substance use diagnoses. The redaction could affect our estimation of the utilization of mental health services, particularly those tied to substance use diagnoses. We also lack data on referral to mental health and physical therapy services, which may introduce selection bias as patients in certain counties may be more or less likely to choose certain pain management strategies even when they receive a referral. We used individual and county-level characteristics to control for this selection, but do not have data on patient beliefs and preferences which would likely confound the associations observed in this research. Similarly, individuals may use non-pharmacologic services that may not be observed with claims data either because they pay for services out of pocket or because services are delivered outside of the health care system. The results of Aims 1 and 2 may not be generalizable to all adults with chronic musculoskeletal pain.

Furthermore, because we excluded patients with trauma and surgery from the cohort, these results may not be generalizable to such populations.

The results presented in Aims 1 and 2 should be interpreted as population averages because they were estimated using generalized estimating models.¹⁵⁴ In this case the population average implies that the associations applies across counties, and accounts for correlations between beneficiaries who live in similar counties.¹⁵⁴ Therefore, inferences about the associations for specific counties cannot be made because the county-specific random parameters are not estimated.¹⁵⁴

There are several limitations for Aim 3. First, the results may not be generalizable to providers outside of North Carolina or providers that are not in a primary care setting such as post-operative pain providers or pain specialists. The comparisons between urban and rural providers is also limited. The sample size for the rural providers is small which may mean that thematic saturation was not achieved for that subgroup. The results are subject to selection bias because providers who participated may be the most eager and interested in pain management, and may not reflect the views of all providers. Furthermore, social desirability bias could affect the responses. Providers might have been wary with sharing information about their practice or may share information about what they think best practice might be because of the public awareness surrounding the current opioid epidemic.

Future Research

There are several areas for future research that stem from the findings of this research. First, it is important to determine if the associations between access to non-pharmacologic services and opioid prescription outcomes persist in populations with commercial insurance or Medicaid. Examining the role of access in other populations who suffer from chronic musculoskeletal pain can help determine whether these populations may benefit from

improvements in the health system (e.g. increasing the supply of providers or programs designed to engage patients in non-pharmacologic services). Furthermore, because we found strong associations between socioeconomic factors and opioid prescribing patterns, it is important to determine the role of access to non-pharmacologic providers in a low-income population such as individuals with Medicaid.

Another area for future research would be to examine whether policies that are aimed to curb opioid prescribing encourage the use of non-pharmacologic services. While opioid prescribing policies may encourage safer prescribing practices, they could also lead to undertreatment of pain. Therefore, investigating how policies aimed at opioid prescriptions affect the use of non-pharmacologic services is needed. Furthermore, a greater understanding on the role of access to non-pharmacologic services after opioid prescribing policies have been implemented could inform future efforts to strengthen the delivery of pain care.

Since this study did not explicitly assess the association between time, dose, and duration of non-pharmacologic services with opioid prescriptions, more research is needed to understand how and when patients should use physical therapy and mental health services, especially for patients who may be at risk for chronic pain or patients considering long-term opioid treatments. Such studies could examine the real-world effectiveness of the delivery of care to determine optimal treatment pathways.

Finally, another area of research is assessing how access to substance use treatments may impact long-term treatments strategies. Specifically, examining whether access to substance use treatments is associated with tapering opioid doses and discontinuation of long-term opioid therapies. This information could help inform future effort to strengthen the health care system across the spectrum of pain management.

Conclusion

As the US population ages, the burden of chronic pain is likely to increase and policies will need to address the health care system's capacity to support individuals with chronic pain.^{58,76,84} To inform future policies, we found that support for the overall hypothesis that limited access to non-pharmacologic services, as measured by the supply and use of non-pharmacologic services, is associated with greater opioid prescriptions. We also found that other system-level factors such as the supply of pain specialists and county poverty rates were also significantly associated with opioid prescription patterns. Through interviews, we learned the primary care providers struggle to avoid and minimize opioids, recommend non-pharmacologic treatments, and educate patients about mental health. The interviews confirmed that providers perceive that patient's ability to afford treatment and availability of non-pharmacologic providers makes these tasks difficult. Taken together, these findings demonstrate the need for a comprehensive policy approach to strengthen the delivery of a pain care, instead of piecemeal approach that only focuses on opioid prescribing.⁸³

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