ORIGINAL ARTICLE

# Individualized opioid tapering in a community interdisciplinary pain management program with flexible care plans: Outcomes, patient retention, and follow-up

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**ABSTRACT**

***Objective:*** *To evaluate the effectiveness of an outpatient, interdisciplinary pain management (IPM) program offering individualized opioid tapering as part of flexible, patient-specific care plans, in achieving the dual goals of improved management of chronic nonmalignant pain (CNMP) and substantial reduction of opioid use.*

***Design:*** *A retrospective cohort study, comprising a cohort of patients who presented on opioid therapy and a cohort who did not.*

***Setting:*** *Community outpatient IPM program.*

***Participants:*** *Patients presenting between April 1, 2016 and September 15, 2019. From an initial pool of 402 patients, inclusion and exclusion criteria identified 300 patients for analyses.*

***Interventions:*** *Engagement in a comprehensive and flexible IPM program with patient-specific care plans that included individualized opioid tapering.*

***Main outcome measure(s):*** *Changes in pain intensity, pain interference, physical therapy (PT) metrics, patient retention, and follow-up of opioid use status at least 3 years after the end of each patient's study episode of care.*

***Results:*** *Changes in pain intensity and interference, and PT outcomes reflected notable improvements in pain management, with no significant overall differences between cohorts. During study episodes of care, all patients in the opioid cohort reduced opioid use and two-thirds discontinued opioids; patient retention was 90.9 percent. In follow-up of over 80 percent of the opioid cohort up to an average of 4.5 years, opioid use for CNMP decreased to 15.8 percent of patients.*

***Conclusions:*** *A flexible, patient-centered IPM program can improve the management of CNMP, substantially reduce opioid use, and maintain a high rate of patient retention. During follow-up, patients further reduced their use of opioids for CNMP.*

## INTRODUCTION

In the mid-2000s, interdisciplinary pain management (IPM) programs began to report success in managing chronic nonmalignant pain (CNMP) while concurrently tapering opioid therapy.[1,2] The risks and lack of evidence supporting the efficacy of opioid therapy for CNMP had been conclusively documented by 2016,[3] when the Centers for Disease Control and Prevention (CDC) published the "CDC Guidelines for Prescribing Opioids for Chronic Pain (2016 Guidelines)."[4] The guidelines established the need for opioid tapering, when risks exceeded benefits, to occur in primary care as well. Implementation

of the guidelines, however, was challenging,[5] in part because the intense, highly structured programs of fixed duration offered by IPM programs, often including protocol-driven opioid tapering,[2] did not readily translate into the primary care setting.

Despite reports of initiatives for opioid tapering specific to primary care,[6-9] many patients (30 percent in two studies[8,9]) still need pain specialty care. While there has been a resurgence of interest in IPM programs,[10] the practicality of highly structured programs is limited by life roles of patients that preclude a commitment to the required schedule of care, and patients may feel reluctant to consent to protocol-driven opioid tapering. Without sacrificing a comprehensive, interdisciplinary approach, IPM programs can offer options of flexible care of varied intensities and durations that incorporate individualized opioid tapering. Such programs provide greater accessibility for patients who require more accommodating approaches and structure care in a way that has greater potential for translation of key elements into primary care.

Outcomes of patients fully engaged in both a flexible IPM program and individualized opioid tapers have yet to be thoroughly documented. A study of an IPM program offering flexible care plans but protocol-driven opioid tapering was unable to retain enough patients to report meaningful outcomes.[11] Community pain clinics that engaged patients in voluntary, patient-specific opioid tapering reported some success, but tapering was not necessarily coupled with engagement in interdisciplinary care.[12,13]

In 2015, two large healthcare organizations collaborated to establish an outpatient, community-based IPM program offering individualized care plans of varied intensities and durations that included flexible opioid tapering. We report the results of care delivered in this program for the 4 years following the publication of the 2016 Guidelines. We examine the evidence that such a program can achieve the dual goal of improved management of CNMP and decreased use of opioids, while maintaining a high rate of patient retention. To determine whether minimization of opioid use can be sustained, we review follow-up of opioid use status at two time points.

## METHODS

### Study design

In this retrospective cohort study, we analyzed outcomes of patients participating in an outpatient, community IPM program for the management of CNMP as they engaged in individualized tapers of opioid therapy (opioid cohort). We compared these outcomes to those of patients who were not on opioid therapy (nonopioid cohort) but were otherwise engaged in comparable care in our IPM program, to test the hypothesis that, in this setting, the opioid cohort could achieve improvements in the management of CNMP to the same degree as the nonopioid cohort. Significant differences in baseline demographic and health characteristics between cohorts were considered in analyses. Patient retention was tracked in the opioid cohort, and follow-up of opioid use status in both cohorts extended to 3 years after the end of study episodes of care. The study and follow-up review were approved by our Institutional Review Board (IRB). Acquisition of follow-up data from our collaborating institution was determined by their IRB to be exempt from review.

### Participants

Participants presented to our IPM program between April 1, 2016, and September 15, 2019, and were identified through a registry of 402 IPM program patients with physical therapy (PT) outcome evaluations of Focus on Therapeutic Outcomes (FOTO; Net Health Systems, Inc, Pittsburgh Pennsylvania, USA).[14] Figure 1 illustrates inclusion and exclusion criteria leading to an opioid cohort of 135 patients and a nonopioid cohort of 165 patients. The beginning of each patient's study episode of care was defined as the date of their initial presentation, and the end was defined as the first of either the last visit at which their chief complaint was addressed or their last visit prior to March 13, 2020.

### Treatment

Pain clinicians (physicians and nurse practitioners), physical therapists, a pain psychologist, and an addiction specialist were colocated at our clinic for treatment of CNMP and, as needed, for opioid reliance and opioid use disorder (OUD). Care plans were developed collaboratively with patients, and the length and intensity of engagement were patient-driven.

Visits with a pain clinician, approximately monthly, addressed pharmacologic strategies for pain management, coordination of care for co-occurring illnesses potentially impacting a patient's

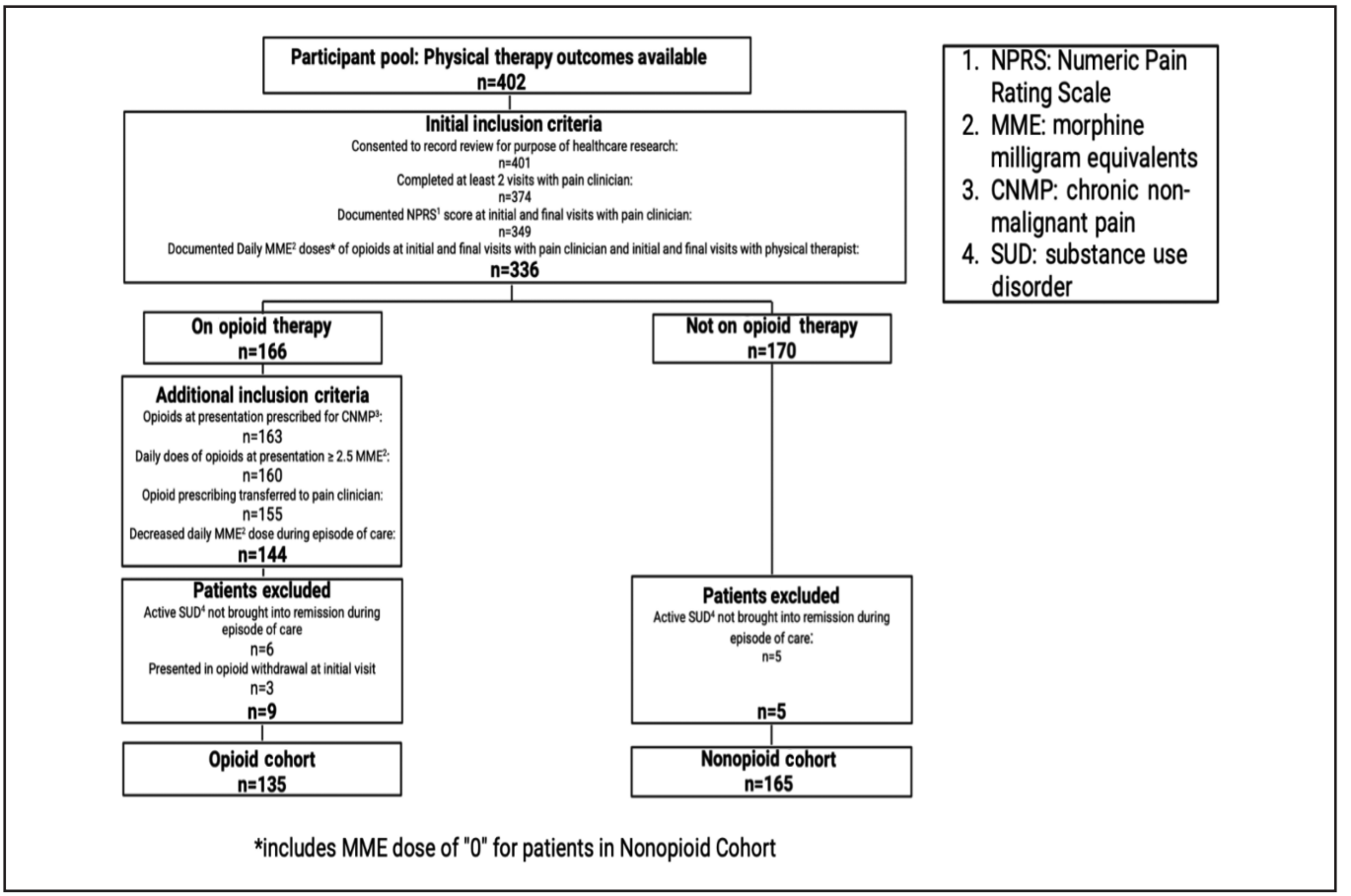


**Figure 1. Initial patient pool, inclusion and exclusion criteria, and final cohorts.**

progress, and education about the pathophysiology of pain, including central sensitization[15,16] and the role of opioids in this process.[17] Tools for self-management of CNMP, introduced at these visits, were developed through engagement in the other two primary components of the program: (1) PT, which included pain neuroscience education,[18,19] manual therapy,[20] and exercise/movement-based therapy to restore functional mobility, and (2) behavioral care, which included, as needed, pharmacologic management of major depressive and anxiety disorders and OUD, and engagement in techniques such as cognitive behavioral therapy, mindfulness, and/or eye movement desensitization and reprocessing. The frequencies of visits with physical therapists, a pain psychologist, and/or an addiction specialist varied among patients, but typically were on a weekly to monthly basis. Complementary and interventional care were available by referral.

Patients in the opioid cohort consented to the initiation of an individualized process of opioid tapering. We typically suggested a trial of morphine milligram equivalent (MME) dose decreases of 2.5-7.5 mg/day at monthly intervals. An increase in pain or decrease in function led to a pause or change of rate in the taper, and/or transfer to buprenorphine for ease of taper or stabilization on a minimum therapeutic dose of opioids.

## Measures

***Baseline characteristics.*** Cohorts were compared on baseline demographic and health characteristics as in Table 1; diagnoses were based on the International Association for the Study of Pain Classification of Chronic Pain for the International Classification of Diseases.[21] Factors that trended toward significance or were significantly different between cohorts at baseline were included in adjusted analyses to control for confounding by indication.

***Descriptions of study episodes of care.*** The average length of study episodes of care and the average number of visits with a pain clinician, pain

**Table 1. Comparison of nonopioid and opioid cohorts at baseline. Continuous variables are summarized using mean (standard deviation), and categorical variables are summarized using percentage (count)**

| Demographics | Nonopioid cohort | Opioid cohort | p-Value |
|---|---|---|---|
| Total number of patients | 165 | 135 | |
| Age | 55.2 (15.7) | 58.3 (12.5) | 0.06 |
| Sex assigned at birth | | | 0.99 |
| Intersex | 0.0 percent (0) | 0.0 percent (0) | |
| Man | 27.3 percent (45) | 26.7 percent (36) | |
| Woman | 72.7 percent (120) | 73.3 percent (99) | |
| Race | | | 0.21 |
| Non-White (Asian, Black, Native Hawaiian, other) | 3.6 percent (6) | 3.7 percent (5) | |
| White | 78.8 percent (130) | 70.4 percent (95) | |
| Unknown race | 17.6 percent (29) | 25.9 percent (35) | |
| Ethnicity | | | 0.58 |
| Non-Hispanic/Latino | 59.4 percent (98) | 55.6 percent (75) | |
| Unknown | 40.6 percent (67) | 44.4 percent (60) | |
| Body mass index | 32.0 (8.3) | 31.5 (7.2) | 0.59 |
| Extent of pain* | | | 0.99 |
| 1-2 regions | 35.2 percent (58) | 35.6 percent (48) | |
| 3-4 regions | 20.6 percent (34) | 20 percent (27) | |
| >4 regions, including widespread | 44.2 percent (73) | 44.4 percent (60) | |
| Chronic, nonmalignant pain (CNMP) diagnosis, level 1† | | | 0.51 |
| Primary pain syndrome (PPS) diagnosis | 46.7 percent (77) | 42.2 percent (57) | |
| Secondary pain syndrome (SPS) diagnosis | 53.3 percent (88) | 57.8 percent (78) | |
| Diagnosis, subcategories† | | | N/A |
| PPS-chronic widespread pain | 16.4 percent (27) | 18.5 percent (25) | |
| PPS-chronic regional pain syndromes | 2.4 percent (4) | 0 percent (0) | |
| PPS-chronic primary headache/orofacial pain | 1.8 percent (3) | 0 percent (0) | |
| PPS-chronic primary visceral pain | 1.2 percent (2) | 1.5 percent (2) | |
| PPS-chronic primary musculoskeletal pain | 24.8 percent (41) | 22.2 percent (3) | |
| SPS-chronic cancer-related pain | 1.2 percent (2) | 0 percent (0) | |
| SPS-chronic post-surgical or post-traumatic pain | 29.7 percent (49) | 34.1 percent (46) | |
| SPS-chronic neuropathic pain | 10.3 percent (17) | 8.9 percent (12) | |
| SPS-chronic secondary headache/orofacial pain | 0.6 percent (1) | 1.5 percent (2) | |
| SPS-chronic secondary musculoskeletal pain | 11.5 percent (19) | 13.3 percent (18) | |

**Table 1. Comparison of nonopioid and opioid cohorts at baseline. Continuous variables are summarized using mean (standard deviation), and categorical variables are summarized using percentage (count) (continued)**

| Demographics | Nonopioid cohort | Opioid cohort | p-Value |
|---|---|---|---|
| Central sensitization syndrome diagnoses‡ | 1.7 (1.4) | 1.7 (1.3) | 0.87 |
| Pulmonary disease | 28.5 percent (47) | 25.9 percent (35) | 0.72 |
| Cardiovascular disease | 24.2 percent (40) | 29.6 percent (40) | 0.36 |
| Hypertension | 45.5 percent (75) | 42.2 percent (57) | 0.66 |
| Diabetes, types I and II | 21.2 percent (35) | 20.7 percent (28) | 0.99 |
| Obstructive sleep apnea (OSA) | | | 0.62 |
| Diagnosed | 28.5 percent (47) | 24.4 percent (33) | |
| No dx/low risk | 44.2 percent (73) | 49.6 percent (67) | |
| At moderate/high risk, no evaluation | 27.3 percent (45) | 25.9 percent (35) | |
| OSA diagnosis, treatment compliant | 48.9 percent (23) | 54.5 percent (18) | 0.79 |
| Any sedative/hypnotic active prescription | 12.2 percent (20) | 30.4 percent (41) | 0.0002 |
| Active stimulant prescription | 4.8 percent (8) | 7.4 percent (10) | 0.49 |
| Opioid Risk Tool score[22] | 3.5 (4.0) four missing | 3.6 (3.8) two missing | 0.84 |
| History of tobacco use (self-report/EMR) | 50.3 percent (83) | 68.1 percent (92) | 0.003 |
| Active tobacco use (self-report) | 30.5 percent (25) | 47.8 percent (44) | 0.03 |
| Alcohol use disorder (self-report/EMR) | 10.9 percent (18) | 13.3 percent (18) | 0.64 |
| Alcohol use disorder, consumes alcohol in moderation (self-report) | 33.3 percent (6) | 22.2 percent (4) | 0.71 |
| Alcohol Use Disorders Identification Test-Consumption score[23] | 1.4 (1.7) | 0.85 (1.2) | 0.002 |
| History of illicit substances use (self-report/EMR) | 25.2 percent (41) two missing | 25.9 percent (35) | 0.98 |
| History of any abuse (self-report) | 47.2 percent (77) two missing | 49.3 percent (66) one missing | 0.82 |
| History of sexual abuse, child or adult (self-report) | 17.2 percent (28) two missing | 26.9 percent (36) one missing | 0.06 |
| History of childhood sexual abuse | 13.4 (22) | 22.4 (30) | 0.06 |
| History of adulthood sexual abuse | 8.6 (14) | 9.7 (13) | 0.90 |
| History of physical abuse, child or adult (self-report) | 28.2 percent (46) two missing | 23.9 percent (32) one missing | 0.48 |
| History of childhood physical abuse | 16.0 percent (26) | 17.9 percent (24) | 0.77 |
| History of adulthood physical abuse | 18.4 percent (30) | 13.4 percent (18) | 0.32 |
| History of emotional abuse, child or adult (self-report) | 41.7 percent (68) two missing | 38.8 percent (52) one missing | 0.70 |
| History of childhood emotional abuse | 23.9 percent (39) | 28.4 percent (38) | 0.46 |
| History of adulthood emotional abuse | 32.5 percent (53) | 20.9 percent (28) | 0.04 |

**Table 1. Comparison of nonopioid and opioid cohorts at baseline. Continuous variables are summarized using mean (standard deviation), and categorical variables are summarized using percentage (count) (continued)**

| Demographics | Nonopioid cohort | Opioid cohort | p-Value |
|---|---|---|---|
| History of childhood abuse, any (self-report) | 30.1 percent (49) two missing | 39.6 percent (53) one missing | 0.11 |
| History of adulthood abuse, any (self-report) | 36.2 percent (59) two missing | 25.4 percent (34) one missing | 0.06 |
| Behavioral health | | | |
| Active diagnosis of major depressive disorder | 56.4 percent (93) | 67.4 percent (91) | 0.07 |
| Active diagnosis of anxiety disorder | 46.1 percent (76) | 54.8 percent (74) | 0.16 |
| Active diagnosis of bipolar disorder | 7.3 percent (12) | 4.4 percent (6) | 0.43 |
| Active diagnosis of schizophrenia | 0.6 percent (1) | 0 percent (0) | 0.99 |
| Active diagnosis of schizoaffective disorder | 0 percent (0) | 0.7 percent (1) | 0.92 |
| Active diagnosis of obsessive-compulsive disorder | 2.4 percent (4) | 1.5 percent (2) | 0.87 |
| Active diagnosis of attention deficit disorder | 9.1 percent (15) | 6.7 percent (9) | 0.58 |
| Any active diagnosis of psychiatric disorder | 74.5 percent (123) | 80.7 percent (109) | 0.26 |
| Self-report of disability | | | 0.02 |
| Yes[§] | 27.3 percent (45) | 40.7 percent (55) | |
| No[**] | 72.7 percent (120) | 59.3 percent (80) | |
| Number of operations for CNMP | 2.1 (2.6) | 2.3 (2.6) | 0.69 |
| History of engagement in pain management modalities (self-report) | | | |
| Any prior physical therapy (pool and land) | 93.9 percent (155) | 94.8 percent (128) | 0.94 |
| Acupuncture | 29.1 percent (48) | 27.4 percent (37) | 0.85 |
| Chiropractic | 46.7 percent (77) | 48.9 percent (66) | 0.79 |
| Interventional therapy | 51.5 percent (85) | 63.7 percent (86) | 0.05 |
| Yoga | 10.3 percent (17) | 8.1 percent (11) | 0.66 |
| Behavioral therapy | 12.7 percent (21) | 22.2 percent (30) | 0.04 |

EMR: electronic medical record.
[*]Region of body is defined as one or more of five anatomical regions: head, neck, trunk, upper extremities, and lower extremities.
[†]Diagnoses are identified according to the International Association for the Study of Pain Classification of Chronic Pain for the International Classification of Disease.[21]
[‡]Includes chronic fatigue syndrome, fibromyalgia, functional urethral syndrome/interstitial cystitis, irritable bowel syndrome, migraine, tension-type headache, multiple chemical sensitivities, myofascial pain syndrome, primary dysmenorrhea/chronic pelvic pain, temporomandibular disorders, post-traumatic stress disorder, restless leg syndrome, periodic limb movements of sleep.[15]
[§]Includes, in nonopioid vs opioid cohort, part-time due to disability/permanent restrictions 2.2 percent vs 3.6 percent, limited homemaker 4.4 percent vs 5.5 percent, disabled or retired on disability 55.6 percent vs 56.4 percent, applying for disability 22.2 percent vs 7.3 percent, cannot work 15.6 percent vs 27.3 percent, p = 0.20 for this breakdown.
[**]Includes, in nonopioid vs opioid cohort, full-time work 47.5 percent vs 36.3 percent, part-time work without disability 11.7 percent vs 12.5 percent, homemaker 5 percent vs 3.3 percent, and retired 35.8 percent vs 47.5 percent, all without disability, p = 0.36 for this breakdown.

psychologist, and physical therapist are compared between cohorts. Referrals for complementary and interventional care are summarized. For the opioid cohort, the types of opioids patients were using at presentation, average changes in their daily MME doses of opioids, and rates of opioid tapering are described.

***Primary endpoints.*** Changes in pain intensity and pain interference scores between first and last visits with a pain clinician, based upon the Two Item Graded Chronic Pain Scale (Figure 2),[24,25] are primary endpoints.

Functional improvement is measured by FOTO's PT metrics, which are specific to 18 possible Body Parts[26-36] or to generalized pain, for which General Physical Function is the applied metric.[37] Reference to metrics of nonspecified Body Parts will hereafter include the General Physical Function metric. Based upon each patient's reported outcome measures regarding functional impairments, raw functional status scores on a scale of 0-100 are determined at baseline and repeatedly during PT. The difference between the initial and subsequent raw functional status scores is calculated as a raw functional status change score, and the raw final functional status change score represents progress achieved during the PT episode.

Additionally, risk adjustment based upon demographic and health information, ie, age, gender, symptom acuity, surgical history, presence of 32 comorbid conditions, exercise history, and payer source, identifies similar patients in a national outcomes database managed by FOTO.[38] This process results in predicted baseline functional status scores and predicted final functional status change scores that represent the average improvement in the functional status score achieved by similar patients in the databank at the end of PT. Raw and predicted scores are compared to assess whether the patient's baseline level of impairment is greater or less than what can be accounted for by measured baseline characteristics and whether a patient achieves the expected level of improvement.

The number of visits required to reach the predicted final functional status change score is also predicted and defines what we consider to be noncompleters of PT, ie, patients who did not reach the predicted final functional status change score but also did not complete the number of visits predicted to be needed to meet that goal.

Primary outcomes from FOTO assessments include the following: (1) comparison between the raw final functional status change score and the predicted final functional status change score, and (2) percent of patients whose raw final functional status change score met or exceeded their predicted final functional status change score. Because the FOTO scores for each Body Part were derived from their own patient-reported outcome measures, the scores may not be pooled; for Body Parts with sufficient sample size, primary endpoints were also analyzed for final functional status change scores adjusted for baseline characteristics of our study.

***Secondary endpoints.*** Secondary endpoints include changes in reported self-care between the first and last visits with pain clinicians, and, from final visits with pain clinicians, scores of the Patient Global Impression of Change Scale,[39,40] and a seven-point Likert scale of satisfaction with care (Figure 2).

For the opioid cohort, diagnoses of OUD, transfers to buprenorphine, and the final status of all patients at the end of the study period are reported as additional secondary endpoints. Transfer of opioid prescribing to a clinician in our geographical area prior to reaching what we considered a minimum therapeutic dose of opioids is considered to be a transfer of care.

***Follow-up.*** Follow-up assessments of patients determined whether patients started, restarted, stopped, or continued the use of opioids. Electronic medical records (EMRs) were reviewed at 3 years after the date of each patient's last visit in their study episode of care and at the end of the follow-up period on April 1, 2023. Since each patient's study episode of care had different start and end dates, the length of follow-up on April 1, 2023, likewise differed among patients and is reported as an average length of follow-up.

### Data collection

Data were gathered from two sources: chart audits of EMRs and computer-generated FOTO evaluations. Specifically pertaining to follow-up data, the State of Minnesota did not allow the Minnesota Prescription Monitoring Program to be used for research purposes.

**Numeric Pain Rating Scale**

In the past 4 weeks, on **AVERAGE**, how intense was your pain rated on a 0 to 10 scale where 0 is "No Pain" and 10 is "Pain as bad as could be"? (That is, your usual pain at times you were experiencing pain)

| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| No pain | | | | | | | | | | Pain as bad as it could be |

**Pain Interference**

In the past 4 weeks, how much has pain interfered with your ability to eat, walk, move, or use the bathroom rated on a 0 to 10 scale where 0 is "No interference" and 10 is "Unable to carry on any activities"?

| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| No interfere-nce | | | | | | | | | | Unable to carry on any activity |

**Self-Care Scales**

How often do you practice SELF CARE (deep breathing, relaxing, stretching, taking breaks, pacing activities and monitoring clenching, bracing, and posture) in a typical day for your pain problem?

| None | 1 x/week | 2-3 x/week | Once daily | Few times daily | Throughout each day |
|---|---|---|---|---|---|
| 0 | 2 | 4 | 6 | 8 | 10 |

How effective is your SELF CARE PROGRAM?

| Not at all | Helps if I do it | Helps a little | Helps moderately | Helps a lot | Extremely helpful |
|---|---|---|---|---|---|
| 0 | 2 | 4 | 6 | 8 | 10 |

**Patient Global Impression of Change Scale**

Since beginning treatment in this clinic, how would you describe the change (if any) in ACTIVITY LIMITATIONS, SYMPTOMS, EMOTIONS and OVERALL QUALITY OF LIFE, related to your painful condition(s)?

| Very much worse | Much worse | Minimally worse | No change | Minimally improved | Much improved | Very much improved |
|---|---|---|---|---|---|---|
| –3 | –2 | –1 | 0 | +1 | +2 | +3 |

**Satisfaction with Care Scale**

Since beginning treatment in this clinic, how satisfied were you with the care you received?

| Extremely dissatisfied | Very dissatisfied | Somewhat dissatisfied | Neutral | Somewhat satisfied | Very satisfied | Extremely satisfied |
|---|---|---|---|---|---|---|
| –3 | –2 | –1 | 0 | +1 | +2 | +3 |

**Figure 2. Patient self-reported study endpoints.**

### Statistical analysis plan

***Preliminary analysis.*** The opioid and non-opioid cohorts were descriptively compared using *t*-tests for continuous variables and Chi-square or Fisher's exact tests for categorical variables. Means with standard deviations (SDs) or counts with percentages are shown as appropriate for the variable;

all missingness is noted in summary tables. The compared variables included baseline demographic characteristics and health history, service utilization during treatment, patient-reported outcome measures, and opioid tapering. We sought to identify factors that differed between the two groups at baseline and therefore might also differentially influence their trajectory of improvement; factors that were significantly different between groups were retained as adjusters in predictive outcome models.

***Analysis of endpoints.*** The analyses of changes in pain intensity and pain interference used the same linear mixed model (LMM) framework with a subject-specific random intercept and fixed effects for opioid use (yes vs no) and time (baseline vs follow-up), and their interaction. The FOTO functional status change score (primary endpoint) for Lumbar Spine and Neck were modeled this way as well; these were the only Body Parts with sufficient sample size for this type of modeling. For the remainder of the Body Parts, an independent means *t*-test was used to test for differences in functional status change score within the Body Part. The results from unadjusted and adjusted models are presented; the model-derived means were estimated using the average or most common value of each of the adjusters in the combined dataset. The sample size was not sufficient to test interactions between opioid use and adjusters.

The analyses of whether a patient met/exceeded their predicted functional status change score at the end of PT were performed using logistic regression with an indicator for opioid versus nonopioid cohort. For the Lumbar Spine and Neck Body Parts, separate models were run to provide both an unadjusted and adjusted estimate for the effect of being in the opioid versus nonopioid cohort on the likelihood of each of the outcomes. All other Body Parts were analyzed using a Chi-square or Fisher's exact test to estimate a difference in the likelihood of the outcome by opioid use at baseline.

***Power analysis or statement of precision.*** A power analysis was performed to understand the minimum detectable between-group difference in the reduction in the primary endpoint of pain intensity, given the preliminary estimated sample sizes of 160 in the nonopioid cohort and 115 in the opioid cohort. At 80 percent power with a two-sided $\alpha$ of 0.05, the analysis was powered to detect up to a difference of 0.3 SDs. Given the pooled baseline SD of 1.82, this translated to a difference in differences of 0.546 (= 0.3 × 1.82) points on the Numeric Pain Rating Scale.

## RESULTS

### Baseline characteristics

As summarized in Table 1, there were no significant differences between cohorts in primary versus secondary pain diagnoses. Factors that trended toward significance or were significantly different ($p < 0.10$) included self-report of disability, age, tobacco use, sedative/hypnotic use, and diagnosis of major depressive disorder, all of which were higher in the opioid cohort. Alcohol Use Disorders Identification Test-Consumption (AUDIT-C)[23] score was higher in the nonopioid cohort. Several marginally significant and overlapping abuse indicators (childhood sexual abuse history, childhood or adulthood abuse history, childhood or adult sexual abuse history, and adulthood emotional abuse history) were analyzed for redundancy; childhood sexual abuse history (more common in the opioid cohort) and adulthood emotional abuse history (higher in the nonopioid cohort), determined to be the most informative, were added to the above list of confounders.

Most patients in the opioid cohort (n = 124, 91.9 percent) were on long-term opioid therapy, defined in the 2016 Guidelines as a pattern of use on most days for greater than 3 months.[4] The remainder had used opioids on most days for 1-3 months. Most patients (80.0 percent, n = 108) presented on one or more short-acting opioid analgesics; 4.4 percent (n = 6) were on a single long-acting opioid analgesic, and 15.6 percent (n = 21) were on a combination of long-acting and short-acting opioid analgesics (Appendix Table 1). None of the patients in either cohort had been diagnosed with OUD prior to presentation.

### Descriptions of study episodes of care

A comparison of the average length of study episodes of care and the number of visits is displayed in Table 2. The opioid cohort had a significantly longer average length of study episodes of care and a greater average number of visits with a pain clinician

**Table 2. Length of study episodes of care and number of visits**

| | Nonopioid cohort | Opioid cohort | p-Value |
|---|---|---|---|
| Length of engagement (months) | 5.6 (5.7) | 9.4 (8.4) | <0.0001 |
| Number of visits with pain specialist | 4.8 (3.6) | 9.4 (8.1) | <0.0001 |
| Number of visits with behavioral health | 3.6 (6.2) | 4.1 (5.7) | 0.46 |
| Number of visits with physical therapy from first through last FOTO evaluation | 9.4 (5.7) | 10.1 (7.6) | 0.41 |

FOTO: Focus on Therapeutic Outcomes.
p-Values are taken from independent means *t*-tests.

**Table 3. Daily morphine milligram equivalent (MME) doses, initial and final, opioid cohort**

| | Range | Mean | Median | Q1, Q3 | SD |
|---|---|---|---|---|---|
| MME dose at baseline | 2.9, 210 | 34.6 | 20 | 11.7, 39 | 39.9 |
| MME dose at final visit | 0, 176.2 | 10.1 | 4.3 | 0, 11.6 | 21.1 |
| Absolute change, MME dose | −180, −1.3 | −24.6 | −15 | −23.9, −7.7 | 32.2 |
| Percent change, MME dose | −100 percent, −2.1 percent | −73.1 percent | −79 percent | −100 percent, −50 percent | 28 percent |

than did the nonopioid cohort. During study episodes of care, 5.9 percent (n = 8) of patients in the opioid cohort and 7.3 percent (n = 12) in the nonopioid cohort were referred for complementary care. Interventional pain procedures were received by 5.2 percent (n = 7) of patients in the opioid cohort and 4.2 percent (n = 7) of patients in the nonopioid cohort.

Table 3 describes changes in opioid prescribing for the opioid cohort during study episodes of care.

The average rate of opioid taper of daily MME dose was −4.7 MME per month (SD = 5.7, median = −2.4). The range of daily MME dose taper rates was from −0.20 MME to −30.77 MME per month; four patients diagnosed with OUD during their episode of care were excluded from both calculations.

### Primary endpoints

***Pain intensity and pain interference.*** Changes in the scores of the Numeric Pain Rating Scale and pain interference scale between the initial and final visits with the pain clinician are shown in Table 4; both cohorts made similar progress in unadjusted and adjusted models.

*Focus on Therapeutic Outcomes.* MME dose data were tracked during the time patients engaged in PT as well as during complete study episodes of care. The average daily MME dose of opioids at the beginning of PT was 30.1 (38.1) mg, and at the end, 17.9 (31.3) mg. A mean decrease of 12.3 (21.7) mg represented a mean reduction of 43 percent (44) from the initial dose. This includes 25 patients who tapered opioids only before and/or after PT.

Lumbar Spine and Neck were the most common Body Parts in both cohorts, but there were significant differences between cohorts by presenting Body Part (p = 0.03), most notably Lumbar Spine (Appendix Table 2). For Body Parts representing 93.3 percent of the nonopioid cohort and 97.0 percent of the opioid cohort, average raw baseline functional status scores were lower than predicted, reflecting increased disability when compared to

**Table 4. Self-reported pain measures based upon two-item graded chronic pain scale. Unadjusted values are the average scores within each cohort and time period. Model-based means and p-values were derived from linear mixed model repeated measures models; all models were adjusted for age, tobacco use history, childhood sexual abuse, adulthood emotional abuse, any sedative use, major depressive disorder diagnosis, Alcohol Use Disorders Identification Test-Consumption score,[23] and a simplified working status (full time, part time, homemaker, disabled, or retired). Adjusted model-based means were estimated using the average value of each of the adjusters in the dataset**

| Self-reported pain measure | Nonopioid cohort | Opioid cohort | p-Value |
|---|---|---|---|
| Numeric Pain Rating Scale | | | |
| Unadjusted | | | |
| Baseline | 6.2 | 6.5 | 0.29 |
| Final | 5.5 | 5.4 | 0.68 |
| Change | −0.74 | −1.1 | 0.20 |
| Adjusted | | | |
| Baseline | 6.3 | 6.3 | 0.96 |
| Final | 5.6 | 5.3 | 0.18 |
| Change | −0.74 | −1.1 | 0.20 |
| Pain interference | | | |
| Unadjusted | | | |
| Baseline | 5.5<br>5/165 missing (3.0 percent) | 6.1<br>6/135 missing (4.4 percent) | 0.05 |
| Final | 3.8<br>8/165 missing (4.8 percent) | 4.1<br>6/135 missing (4.4 percent) | 0.27 |
| Change | −1.7<br>13/330 missing (3.9 percent) | −2.0<br>12/270 missing (4.4 percent) | 0.42 |
| Adjusted | | | |
| Baseline | 5.6 | 5.9 | 0.35 |
| Final | 3.9 | 4.0 | 0.91 |
| Change | −1.7 | −2.0 | 0.44 |

SD: standard deviation.

national cohorts of otherwise comparable patients; however, the difference between cohorts was not statistically significant (data not shown).

Across Body Parts, there were no significant unadjusted differences between cohorts in either average raw or predicted final functional status change scores. For most Body Parts in both cohorts, the average raw final functional status change score exceeded the average predicted final functional status change score, reflecting improvement that exceeded that of national cohorts of similar patients (Appendix Table 2). We compared adjusted final functional status change scores between cohorts in the Lumbar Spine and Neck subgroups (60.3 percent of patients); the other Body Part subgroups lacked sufficient sample size. Raw and adjusted final functional status change scores significantly increased from baseline to final assessment for both cohorts by the same amount. Sensitivity analyses wherein we (1) excluded patients who did not

**Table 5. Functional status change score outcome of physical therapy sessions by cohorts. p-Values come from the Fisher's exact test, which approximates the Chi-square test as sample size increases**

| Body Part/General Physical Function | Nonopioid cohort | Opioid cohort | p-Value |
|---|---|---|---|
| Overall outcome | N (percent) | N (percent) | |
| Exceeded/met predicted functional status change, completed PT* | 102 (61.8 percent) | 96 (71.1 percent) | 0.06 |
| Did not meet predicted functional status change, completed PT† | 14 (8.5 percent) | 7 (5.2 percent) | |
| Did not meet predicted functional status change, evaluated prior to last PT visit; completion of PT is indeterminate‡ | 12 (7.3 percent) | 2 (1.5 percent) | |
| Did not meet predicted functional status change, did not complete PT§ | 37 (22.4 percent) | 30 (22.2 percent) | |

PT: physical therapy.
*Patients may have met or exceeded the predicted functional status change score prior to completing the projected number of visits needed to meet this.
†Patients completed at minimum the number of visits projected to be needed to meet the predicted functional status change score.
‡Patients may or may not have completed the number of visits predicted to be needed to meet the predicted functional status change score, but the last score was documented prior to their last PT visit, which was also prior to the number of visits predicted to be needed to meet the functional status change score.
§Patients did not complete the number of visits predicted to be needed to meet the functional status change score, and the last functional status change score was documented at the last visit.

complete their recommended course of PT and (2) excluded 25 patients in the opioid cohort who did not taper their daily MME dose of opioids during their engagement in PT were consistent with the full dataset and robust to adjustment for confounders (data not shown).

In the aggregation of cohorts across Body Parts, there was a marginally significant trend such that in the opioid cohort, 71.1 percent of patients met or exceeded their predicted final functional status change score, while 61.8 percent of patients in the nonopioid cohort met or exceeded their predicted final functional status change score ($p = 0.06$, Table 5). There were no significant differences between cohorts in the number of patients who completed their course of PT and those who did not (Table 5). Analyses of adjusted final functional status change scores were completed for Lumbar Spine and Neck subgroups: The opioid cohort was similar to the nonopioid cohort in their likelihood of reaching their predicted final functional status change score, and when patients who did not taper opioids were excluded, there is strong evidence that the opioid cohort had a significantly better outcome than the nonopioid cohort in the Lumbar Spine subgroup (odds ratio [OR] = 2.7, $p = 0.05$) and the Neck subgroup (OR = 7.6, $p = 0.05$) (Appendix Table 3).

### Secondary endpoints

The frequency and efficacy of self-care increased in both cohorts; the difference between starting and ending values was not significant. There was not a significant difference between cohorts in improvement noted in the Patient Global Impression of Change (1.2 [1.0] vs 1.4 [1.3] on a scale from −3 to 3) or patient satisfaction at the end of episodes of care (1.9 [1.1] vs 1.8 [1.1] also on a scale of −3 to 3) (Appendix Table 4).

In the opioid cohort, 7.4 percent (n = 10) of patients were diagnosed with OUD, four at the presenting visit and six during their study episode of care. Buprenorphine was prescribed for 16.3 percent (n = 22) of patients in the opioid cohort: Eight patients were transferred to buprenorphine/naloxone therapy for OUD (two declined transfer), and 14 were transferred to buprenorphine for ease of taper or for stabilization of daily MME dose.

Two-thirds (n = 90) of patients tapered off opioids completely, receiving the last prescription of the taper either before or at their last visit; 1.5 percent (n = 2) of patients were discharged on buprenorphine/naloxone for OUD. Transfer of care occurred for 8.9 percent (n = 12) of patients. The remainder of the patients, 23 percent (n = 31), were still engaged in care on March 13, 2020, but their care

changed substantially due to the implementation of telemedicine.

### Follow-up

As noted in Figure 3, follow-up data at two points in time were available for 81.8-89.6 percent of study patients. Table 6 summarizes follow-up data. Percentages of patients with an active prescription for opioid therapy for CNMP in the opioid cohort decreased from 31.9 percent at the end of the study period to 18.2 percent at 3 years after the end of each patient's study episode of care, and to 15.8 percent at an average follow-up of 4.5 (1.1) years. In the nonopioid cohort, 2.1 percent of patients had an active opioid prescription for CNMP at 3 years, and this increased to 4.4 percent at an average follow-up of 4.5 (0.92) years.

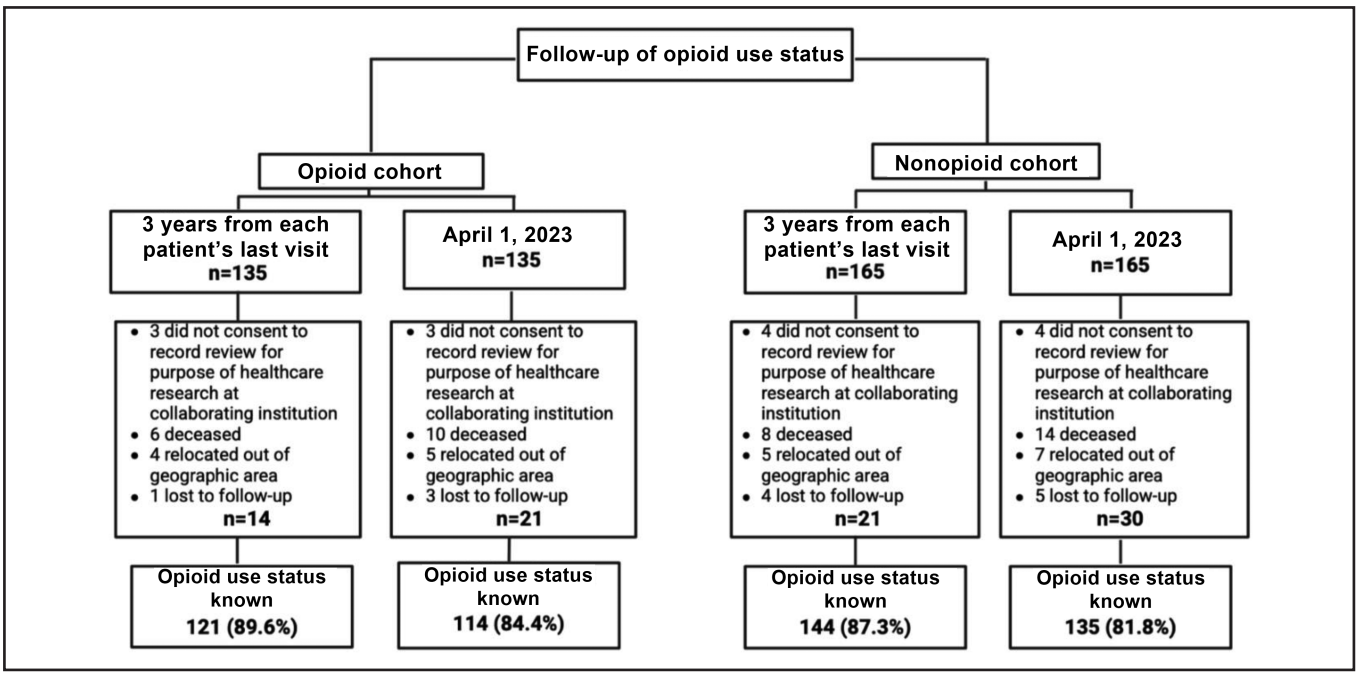


**Figure 3. Data availability for follow-up of opioid use status.**

**Table 6. Follow-up at 3 years from each patient's last visit and as of April 1, 2023**

| | Nonopioid cohort 3 years after last visit | Opioid cohort 3 years after last visit | Nonopioid cohort April 1, 2023 | Opioid cohort April 1, 2023 |
|---|---|---|---|---|
| Length of follow-up | 3 years | 3 years | Average 4.5 years (0.92) | Average 4.5 years (1.1) |
| Information available, n | 144 | 121 | 135 | 114 |
| Not on opioids | 138 (96.5 percent) | 92 (76 percent) | 127 (94.1 percent) | 90 (78.9 percent) |
| On opioids for chronic, nonmalignant pain | 3 (2.1 percent) | 22 (18.2 percent) | 6 (4.4 percent) | 18 (15.8 percent) |
| On opioids for post-op/ acute pain | 2 (1.4 percent) | 2 (1.7 percent) | 0 | 3 (2.6 percent) |
| On opioids for palliative care | 1 (0.7 percent) | 2 (1.7 percent) | 1 (0.7 percent) | 2 (1.8 percent) |
| On opioids for OUD | 0 | 3 (2.4 percent) | 1 (0.7 percent) | 1 (0.9 percent) |

OUD: opioid use disorder.

## DISCUSSION

Through engagement in an IPM program with flexible, individualized care plans, a cohort of patients presenting on opioid therapy for CNMP was able to decrease the use of opioids while making progress in pain management that was comparable to a cohort of patients not on opioids who engaged in similar care. Two-thirds of the opioid cohort discontinued opioid use, and the remainder decreased MME doses. Patient retention was over 90 percent. Follow-up data on opioid use status extended to an average of 4.5 years and was available for over 80 percent of patients. To our knowledge, this is the longest documented follow-up of opioid use in patients after engagement in opioid tapers. As evidenced by diminishing percentages of patients in the opioid cohort using opioids for CNMP during the follow-up period, minimization of opioid use was sustained.

At baseline, both cohorts had high prevalences of disability, medical comorbidities, and behavioral illnesses. Despite extensive prior utilization of medical care for CNMP, relatively few patients had engaged in behavioral strategies for pain management. These factors underscored the need for an integrated, biopsychosocial model of care. Behavioral therapy included addressing potential contributing factors across the life span, such as past traumas, to autonomic dysregulation[41] and pain. PT informed by pain neuroscience education integrated PT with cognitive behavioral strategies, encouraging patients to reconceptualize their experience to reduce catastrophizing, fear avoidance of activity, and the guarding response.[18,19] In both components, the emphasis was on self-care strategies that gave agency to patients for self-management of CNMP.

We found FOTO metrics particularly relevant, as they include both kinds of recommended functional measures for CNMP research[42,43]: (1) clinically meaningful outcomes specific to each patient's particular impairments and health characteristics, and (2) outcomes, in aggregated analyses, that can be compared across patients with great diversity in these attributes. Interestingly, when patients in the opioid cohort who did not taper opioids during PT were excluded from adjusted analyses of the Back and Neck Body Parts, there was strong evidence for significantly better outcomes for the opioid cohort than for the nonopioid cohort.

When given options for care, patients chose wide ranges of opioid tapering rates and number of patient visits. A flexible program structure that tailors care to the needs and preferences of each patient could accommodate individualized rates of tapers, which in many cases were slower than rates suggested by the CDC.[44] Varied but generally longer lengths of engagement than those at highly structured IPM programs gave patients time, if needed, to improve pain management prior to opioid tapering, and to establish habits of self-care prior to the end of engagement. These benefits of individualized care likely contributed to the high rate of patient retention, overall patient satisfaction, and the results of opioid use follow-up.

Patients often presented to our program reluctant to taper opioids, in part because they had found typically presented rationales for tapering, including government recommendations and concerns about OUD,[45,46] not to be relevant to their circumstances. In contrast, we emphasize the escalation of central sensitization by opioids,[17] leading to increased dysfunction and pain, as the primary reason to taper opioids. The efficacy of education about central sensitization has been described[47,48]; in our experience, explaining to patients the role of opioids in this process can be accomplished in brief clinician–patient interactions that patients find empathic rather than punitive, facilitating their willingness to engage in opioid tapering.

Buprenorphine was useful in opioid tapering. Benefits include its safety profile and κ-antagonism that can improve mood,[49-51] and, with buccal buprenorphine, the ability to taper in increments as small as 2.25 MME. We now routinely offer transfer to buprenorphine early in engagements.

Some patients, despite transferring to buprenorphine and fully engaging in our program, experienced deteriorating function with tapering, but subsequently improved on increased doses of buprenorphine that were generally lower than those used for OUD. This outcome supports the concept of a continuum between prescription opioid dependence and OUDs.[51,52] Continuation of buprenorphine for an indeterminate period of time is consistent with guidelines.[53,54]

We also identified a group of patients who met the criteria for OUD despite taking opioids as prescribed. After transfer to buprenorphine/naloxone, the usual formulation of buprenorphine for OUD,[55] they were able to acquire pain management skills and often requested to be tapered off buprenorphine/naloxone. Thus, the fact that only two of the

10 patients with OUD were discharged on buprenorphine/naloxone does not indicate that we dispute a standard of care that recommends pharmacologic therapy for OUD.[55]

Key components of our program can be applied in primary care, where patients of less complexity can be well-managed in a multidisciplinary versus interdisciplinary manner. Brief behavioral interventions for CNMP accessible to primary care patients have had noteworthy success[56-58] and are increasingly available online.[59,60] PT informed by pain neuroscience education has been demonstrated to be practical and superior to standard physiotherapy in primary care in the treatment of chronic pain,[61] and in and of itself integrates PT and behavioral strategies. Most of the education patients need about central sensitization is provided by pain neuroscience education, and primary care settings have alternatively used educational handouts, trusted internet sources, and group lectures to present this information.[47]

Strategies for tapering are also generalizable. Our results support individualized tapering, for which primary care is well-structured. Adding transfer to buprenorphine minimizes the risks of opioid therapy while patients engage in relatively slow tapers or stabilize on a minimum therapeutic dose of opioids. Together with issues of insurance coverage,[62] a lack of familiarity concerning the use and benefits of buprenorphine in CNMP management[49,63] has challenged widespread implementation of guidelines recommending buprenorphine's use.[53,54] Pain clinicians can assist primary care providers by advocating for appropriate insurance coverage of buprenorphine, and also by educating clinicians about its use, both informally with referring clinicians and through formal educational programs. When such education is provided, increased use of buprenorphine has been documented.[63] In that regard, national opioid settlement funds are available in every state and prioritize, among other interventions, continuing medical education addressing pain management and responsible opioid prescribing.[64] Pain programs are well-positioned to educate clinicians about buprenorphine, as well as other aspects of the management of CNMP, with assistance from this funding.

Our model of care avoids both the costs inherent in the initial development and ongoing program coordination of intensive, highly structured IPM programs and the reluctance on the part of some third-party insurance payers to authorize payment for such programs.[65] Our study does not include a cost-effectiveness analysis, but midway through the study period, our institution completed internal cost-benefit analyses on a subset of patients who were engaged in our clinic (although not necessarily part of our study). The effectiveness and persistence of opioid tapering were found to be substantial benefits of care, and average costs of care for these patients during and after engagement in our program remained essentially unchanged from average costs during the 6-month period prior to engagement.

### Limitations

Limitations of our study include a population that was predominantly White and non-Hispanic/Latino. We did not identify sexual orientation; results cannot inform care based upon that self-identification. Although patients presented with a wide range of daily MME doses, the average initial dose was lower than those reported in other studies of individualized tapering.[12,13] Importantly, the study does not include outcomes of patients who declined engagement in care and/or opioid tapering, which reduces generalizability.

Body Parts of FOTO representing a combined 40 percent of patients lacked the power to detect adjusted differences between cohorts due to small sample sizes, and it may be that true differences exist. Follow-up did not include functional evaluations, and opioid use status cannot be construed to necessarily reflect how well CNMP is managed.

## CONCLUSIONS

An IPM program offering a flexible structure that accommodates patient-driven care plans and rates of opioid tapering was effective for complex patients with CNMP in improving pain management and minimizing opioid use. Programs such as ours can maximize accessibility for patients with varying preferences and life responsibilities. By developing elements of care that more readily translate into primary care, these elements can also improve care for the many patients whose CNMP can be managed in that setting.

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| Appendix Table 1. Prescribed opioids of opioid cohort at presentation | |
|---|---|
| **Opioid(s)** | **n** |
| Short-acting opioid medication, single | |
| Hydrocodone | 36 |
| Oxycodone | 34 |
| Tramadol | 27 |
| Codeine | 1 |
| Hydromorphone | 1 |
| Morphine | 1 |
| Tapentadol | 1 |
| Subtotal | 101 |
| Short-acting opioid medications, multiple | |
| Oxycodone, tramadol | 2 |
| Codeine, tramadol | 1 |
| Hydrocodone, oxycodone | 1 |
| Hydrocodone, oxycodone, tramadol | 1 |
| Hydrocodone, tramadol | 1 |
| Hydromorphone, tramadol | 1 |
| Subtotal | 7 |
| Long-acting opioid medication, single | |
| Morphine | 2 |
| Oxycodone | 2 |
| Hydrocodone | 1 |
| Methadone | 1 |
| Subtotal | 6 |
| Combination of long-acting/short-acting medications | |
| Oxycodone/oxycodone | 9 |
| Fentanyl/oxycodone | 4 |
| Morphine/hydrocodone | 2 |
| Oxycodone/oxycodone, tramadol | 2 |
| Fentanyl/morphine | 1 |
| Morphine/hydromorphone | 1 |
| Morphine/oxycodone | 1 |
| Oxycodone/hydrocodone | 1 |
| Subtotal | 21 |
| Total | 135 |

**Appendix Table 2. Comparisons of raw and predicted functional status change scores. p-Values come from independent means *t*-tests. Functional status change scores cannot be compared across Body Parts/General Physical Function (GPF), so an overall result is not shown**

| Body Part/ GPF | Raw functional status change score* | | | | | Predicted functional status change score† | | | Ratio of raw/predicted functional status change score | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Nonopioid cohort | | Opioid cohort | | | Nonopioid cohort | Opioid cohort | | Non-opioid cohort | Opioid cohort | |
| | Mean (SD) | N | Mean (SD) | N | p-Value | Mean (SD) | Mean (SD) | p-Value | Mean (SD) | Mean (SD) | p-Value |
| Ankle | 1.0 (N/A) | 1 | 38 (N/A) | 1 | N/A | 15.0 (N/A) | 10.0 (N/A) | N/A | 0.07 (N/A) | 3.8 (N/A) | N/A |
| Cranio-facial | 14.0 (12.7) | 4 | N/A | 0 | N/A | 10.0 (2.7) | N/A | N/A | 1.3 (1.1) | N/A | N/A |
| Foot | 17.0 (20.9) | 9 | 23.2 (11.6) | 4 | 0.59 | 16.6 (9.0) | 17.3 (4.5) | 0.89 | 2.3 (4.1) | 1.4 (0.88) | 0.70 |
| Hand | N/A | 0 | 12.5 (6.6) | 4 | N/A | N/A | 13.5 (3.5) | N/A | N/A | 0.91 (0.40) | N/A |
| Hip | 19.2 (11.6) | 6 | 17.2 (15.6) | 5 | 0.82 | 10.5 (3.8) | 13.4 (3.4) | 0.22 | 1.8 (1.3) | 1.2 (0.90) | 0.36 |
| Knee | 25.6 (16.0) | 13 | 11 (12.8) | 4 | 0.12 | 17.4 (8.1) | 14.5 (17.1) | 0.53 | 1.4 (1.0) | 0.86 (1.1) | 0.33 |
| Leg, lower, w/o knee | 20.3 (3.1) | 3 | 22.5 (16.4) | 4 | 0.83 | 13.7 (4.7) | 18.0 (6.5) | 0.38 | 1.6 (0.30) | 1.2 (1.1) | 0.63 |
| Leg, upper | 23.0 (14.6) | 4 | 36.0 (14.8) | 3 | 0.30 | 11.3 (8.0) | 13.0 (5.6) | 0.76 | 2.4 (0.68) | 2.8 (0.42) | 0.36 |
| Lumbar spine | 16.8 (15.0) | 58 | 18.9 (16.8) | 71 | 0.48 | 11.3 (6.0) | 11.7 (6.5) | 0.74 | 2.5 (5.9) | 1.6 (1.8) | 0.27 |
| GPF | 12.6 (8.8) | 14 | 14.3 (8.0) | 11 | 0.62 | 9.2 (4.7) | 9.3 (13.5) | 0.99 | 1.7 (1.6) | 4.5 (6.7) | 0.15 |
| Neck | 13.7 (10.8) | 32 | 14.8 (11.5) | 19 | 0.73 | 12.5 (9.5) | 10.5 (8.4) | 0.44 | 0.89 (1.9) | 1.9 (2.0) | 0.06 |
| Pelvis | 10.5 (7.8) | 2 | N/A | 0 | N/A | 7.0 (5.7) | N/A | N/A | 2.9 (3.5) | N/A | N/A |
| Shoulder | 10.1 (14.6) | 9 | 20.5 (15.9) | 4 | 0.27 | 15.6 (12.3) | 22.3 (14.4) | 0.42 | 0.54 (0.89) | 1.7 (2.0) | 0.16 |
| Thoracic spine | 19.9 (12.6) | 10 | 23.8 (7.2) | 4 | 0.58 | 13.4 (4.1) | 11.8 (5.3) | 0.54 | 1.5 (0.83) | 2.7 (2.1) | 0.13 |

SD: standard deviation.
*Higher values indicate more improvement in unadjusted functional status scores from baseline to final assessment.
†Higher values represent more predicted achievable change in functional status score, ie, greater potential improvement.

**Appendix Table 3. Impact of opioid use on likelihood that a patient met or exceeded projected change (yes/no), collapsing the three groups who did not meet or exceed their predicted maximal functional status change score and using a logistic regression framework with an indicator for opioid use at baseline. Completers include patients who met their maximal expected improvement or did not meet their maximal expected improvement but completed predicted number of visits needed to do so. Additional baseline adjusters are those used in all models. Opioid cohort is limited to those who tapered during PT**

| | Variable | Beta | Odds ratio (OR) | p-Value |
|---|---|---|---|---|
| Lumbar spine | | | | |
| All patients (n = 119) | | | | |
| Unadjusted | Opioid cohort vs nonopioid cohort | 0.81 | 2.3 | 0.05 |
| Adjusted | Opioid cohort vs nonopioid cohort | 1.00 | 2.7 | 0.05 |
| Completers (n = 93) | | | | |
| Unadjusted | Opioid cohort vs nonopioid cohort | 1.5 | 4.7 | 0.06 |
| Adjusted* | Opioid cohort vs nonopioid cohort | 1.2 | 2.5 | 0.19 |
| Neck | | | | |
| All patients (n = 47) | | | | |
| Unadjusted | Opioid cohort vs nonopioid cohort | 0.89 | 2.4 | 0.19 |
| Adjusted | Opioid cohort vs nonopioid cohort | 2.0 | 7.6 | 0.05 |
| Completers (n = 32) | | | | |
| Unadjusted† | Opioid cohort vs nonopioid cohort | – | – | – |
| Adjusted† | Opioid cohort vs nonopioid cohort | – | – | – |

PT: physical therapy.
*Because of small N (sparsity), only adjusted for opioid use, age, tobacco history, adulthood emotional abuse, childhood sexual abuse, major depressive disorder, Alcohol Use Disorders Identification Test-Consumption,[23] and sedative use. Not adjusted for work history.
†No patients in opioid group failed to meet or exceeded projected change, so a model cannot be estimated.

**Appendix Table 4. Comparison of nonopioid and opioid cohorts' secondary endpoints. p-Values come from independent means *t*-tests**

| | Nonopioid cohort | | Opioid cohort | | |
|---|---|---|---|---|---|
| | **Mean (SD)** | **Missing, n (percent)** | **Mean (SD)** | **Missing, n (percent)** | **p-Value** |
| Self-care measures | | | | | |
| Self-care frequency | | | | | |
| Baseline | 5.9 (3.8) | 7 (2.3 percent) | 6.3 (3.9) | 11 (3.7 percent) | 0.37 |
| Final | 7.2 (2.8) | 18 (6 percent) | 8.1 (2.1) | 11 (3.7 percent) | 0.007 |
| Difference | 1.3 (3.9) | 23 (7.8 percent) | 1.8 (3.8) | 14 (4.7 percent) | 0.30 |
| Self-care efficacy | | | | | |
| Baseline | 3.1 (2.6) | 8 (2.7 percent) | 3.6 (2.8) | 14 (4.7 percent) | 0.15 |
| Final | 5.3 (2.5) | 15 (5 percent) | 5.6 (2.1) | 12 (4 percent) | 0.22 |
| Difference | 2.2 (3.1) | 22 (7.3 percent) | 2.1 (3.5) | 17 (5.7 percent) | 0.73 |
| Patient Global Impression of Change, final visit | 1.2 (1.0) | 51 (17 percent) | 1.4 (1.3) | 41 (13.7 percent) | 0.33 |
| Level of satisfaction, final visit | 1.9 (1.1) | 43 (14.3 percent) | 1.8 (1.1) | 29 (9.7 percent) | 0.75 |

SD: standard deviation.