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Utilization and disparities in medication treatment for opioid use disorder among patients with comorbid opioid use disorder and chronic pain during the COVID-19 pandemic

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Abstract

Background: The COVID-19 pandemic's impact on utilization of medications for opioid use disorder (MOUD) among patients with opioid use disorder (OUD) and chronic pain is unclear.

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Methods: We analyzed New York State (NYS) Medicaid claims from pre-pandemic (August 2019-February 2020) and pandemic (March 2020-December 2020) periods for beneficiaries with and without chronic pain. We calculated monthly proportions of patients with OUD diagnoses in 6-month-lookback windows utilizing MOUD and proportions of treatment-naïve patients initiating MOUD. We used interrupted time series to assess changes in MOUD utilization and initiation rates by medication type and by race/ethnicity.

Results: Among 20,785 patients with OUD and chronic pain, 49.3% utilized MOUD (versus 60.3% without chronic pain). The pandemic did not affect utilization in either group but briefly disrupted initiation among patients with chronic pain (β=−0.009; 95% CI [−0.015, −0.002]). Overall MOUD utilization was not affected by the pandemic for any race/ethnicity but opioid treatment program (OTP) utilization was briefly disrupted for non-Hispanic Black individuals (β=−0.007 [−0.013, −0.001]). The pandemic disrupted overall MOUD initiation in non-Hispanic Black (β=−0.007 [−0.012, −0.002]) and Hispanic individuals (β=−0.010 [−0.019, −0.001]).

Conclusions: Adults with chronic pain who were enrolled in NYS Medicaid before the COVID-19 pandemic had lower MOUD utilization than those without chronic pain. MOUD initiation was briefly disrupted, with disparities especially in racial/ethnic minority groups. Flexible MOUD policy initiatives may have maintained overall treatment utilization, but disparities in initiation and care continuity remain for patients with chronic pain, and particularly for racial/ethnic minoritized subgroups.

Keywords

Opioid Use Disorder (OUD); Chronic Pain; COVID-19 pandemic; Medicaid

Background

Access to medications for opioid use disorder (MOUD) has been an ongoing challenge in the United States (US), with unique barriers faced by Medicaid beneficiaries, who are disproportionately low income and represent a vulnerable group with known healthcare disparities.[1] MOUD access was further threatened by the COVID-19 pandemic beginning in March 2020, potentially posing particular challenges to Medicaid beneficiaries who generally have low socioeconomic status and limited access to resources.[2] While MOUD treatments, including methadone, buprenorphine, and injectable naltrexone, are effective at reducing risk of overdose and improving health outcomes,[3,4] these treatments have been highly regulated, requiring in-person initiation, observed dosing (in the case of methadone), and close monitoring.[5] The COVID-19 national emergency was associated with several conditions that may have disrupted MOUD treatment services, including stay-at-home orders and challenges to individuals' physical, psychological, and social wellbeing.[6] At the same time, federal regulations were enacted to expand access to MOUD treatment,[7] including Substance Abuse and Mental Health Service Administration (SAMHSA) regulations relaxing MOUD restrictions to support telehealth services for buprenorphine and increased flexibility of take-home methadone.[8] While there was variability in the uptake of these federal changes, New York State (NYS) health agencies strongly supported these flexibilities, which may have had unique implications for NYS Medicaid beneficiaries.[9,10]

The co-occurrence of chronic pain further complicates the treatment landscape for individuals with OUD, as these comorbid conditions are associated with several barriers to behavioral and pharmacologic treatments for OUD.[11-15] First, these individuals often have several physical comorbidities, psychiatric comorbidities (i.e., symptoms of fatigue, apathy, anxiety), and higher rates of cardiovascular diseases, which may complicate general health management.[16] Individuals with chronic pain may also prioritize pain alleviation, such as continued long-term opioid use, over OUD treatment, despite the potential dual opioid-agonistic and analgesic effects of MOUD.[17,18] Patients with chronic pain are also more likely to have physical disabilities, which are associated with decreased utilization of MOUD due to structural barriers and limited physical accessibility at treatment facilities, potentially exacerbating existing challenges faced by Medicaid beneficaries.[19] These individuals may also lack social support,[20] which plays an important role in optimizing health outcomes.[21]

At the same time, minoritized racial and ethnic individuals with OUD have also experienced inequitable distribution of MOUD services due to insurance authorization barriers, segregated distribution of MOUD clinic locations [22], and overall systemic racism that perpetuate healthcare inequities.[23,24] Prior research has found that Black individuals are significantly less likely than White individuals to initiate MOUD.[25] Further, buprenorphine remains disproportionately accessible to communities with a higher concentration of White residents,[26] while opioid treatment programs (OTPs), which require frequent attendance, remain more prevalent in Black and Hispanic communities.[22,27] As such, individuals of minoritized groups with chronic pain, and in particular Medicaid beneficiaries who are low-income and/or disabled, may represent an especially disadvantaged group in accessing MOUD treatment.

While literature on racial and ethnic disparities in MOUD utilization is growing, [2128] to our knowledge, no studies have assessed these disparities among individuals with comorbid chronic pain and OUD before and after the onset of the COVID-19 pandemic. A focus on the Medicaid population with comorbid chronic pain and OUD is important, as they were especially susceptible to pandemic-related disruptions in healthcare due to lockdown-related isolation, reduced health service use, and poor COVID-19 outcomes;[29] this is particularly true for NYS residents who were at the epicenter of the COVID-19 outbreak in 2020. Moreover, understanding how utilization varies by subgroups is critical to addressing health disparities. Accordingly, we assessed changes in MOUD utilization and initiation among beneficiaries who were enrolled in NYS Medicaid before the COVID-19 pandemic who had comorbid OUD and chronic pain in the months prior to and during the COVID-19 pandemic and compared these to changes among OUD patients without chronic pain; we further examined these differences across racial and ethnic groups.

Methods

1.1 Study Design

We conducted a retrospective interrupted-time-series (ITS) analysis using NYS Medicaid claims from March 1, 2019, through December 31, 2020 (i.e., study window). The pre-COVID-19 onset period was August 2019 through February 2020 (i.e., pre-pandemic) and

the post-COVID-19 onset period (i.e., pandemic period) was March through December 2020. We conducted analyses at the month level. Within each month, we evaluated monthly rates of MOUD utilization and initiation as outcomes of interest and used six-month lookback windows for eligible patients based on prior OUD diagnoses. For example, during the first month of analysis of August 2019, we identified patients who had at least one claim with an OUD diagnosis between February 2019 and August 2019 as the eligible population, described in detail below. The study protocol was reviewed and approved by the New York University Langone Health Institutional Review Board (ID: i18-01221).

1.2 Study Population

We included patients who met the following criteria: enrolled in NYS Medicaid in February 2020 (i.e., to identify a baseline population enrolled before the start of the pandemic in March 2020) and for ≥10 months between March 2019 and February 2020 (to ensure a baseline level of continuous enrollment for analytic purposes) and aged 18-64 years as of February 29, 2020. We excluded patients who met any of the following criteria: dual-eligible for Medicaid and Medicare (to ensure we did not miss healthcare encounters for patients whose claims may appear in only Medicare); missing county of residence, or recent history of cancer, palliative care, or long-term care from March 1, 2019 through February 29, 2020.

Patients were classified as having chronic pain during baseline per a previously published algorithm[30,31] if they had ≥2 claims that were 90-366 days apart with ICD-10-CM diagnosis codes from March 1, 2019 through February 29, 2020 in the inpatient or outpatient settings within the same category: arthritis; back pain; neck pain; unspecified back and/or neck pain; neurologic pain; chronic headache; or miscellaneous chronic pain. Patients were additionally classified as having active OUD and thus eligible for MOUD if they had at least one ICD-10-CM diagnosis code for OUD (F11.x) in the six-month lookback period prior to each month of analysis. To assess how MOUD utilization and initiation among OUD patients with chronic pain compared to OUD patients without chronic pain, we conducted the same analyses using a set of matched patients without diagnoses for chronic pain who were selected using a Mahalanobis distance (MD) matching technique based on demographics, including age, race and ethnicity, sex, health service area, and aged/blind/disabled status. Details on this approach, which was part of a larger parent study, have been previously described.[32] Administrative codes used to identify the study population are presented in Appendix A.

Additional collected data included patient demographic characteristics, including age, race and ethnicity, sex, health service area (as defined by NYS Department of Health[33]), and individual status of aged/blind/disabled per “community Medicaid” eligibility based on Medicaid’s benefits provision.[34] The following pre-existing comorbidities were captured from March 1, 2017 through February 29, 2020 on claims in any setting with administrative codes for the following relevant conditions (Appendix A): anxiety disorders, bipolar disorder, major depressive disorders, post-traumatic stress disorder, nicotine dependence, history of traumatic life events, heart conditions including cardiomyopathies, coronary artery disease, and heart failure, chronic kidney diseases, chronic lung diseases, chronic obstructive pulmonary disease (COPD), Down syndrome, HIV/AIDS and other immunocompromised

conditions, overweight/obesity, Sickle cell trait and disorders, diabetes mellitus Type 1 and 2, solid organ or blood stem cell transplants, and pregnancy.[35]

1.3 Outcomes

1.3.1 MOUD Utilization—MOUD was defined as having at least one outpatient pharmacy prescription filled for buprenorphine or injected naltrexone (per National Drug Code [NDC] codes) or a visit to a methadone maintenance treatment program (i.e., opioid treatment program [OTP] per rate codes; Appendix A); while methadone and buprenorphine can be distributed in OTP settings, generally, methadone is primarily dispensed.[36,37] Outcomes were reported separately for (a) outpatient pharmacy prescription fills for buprenorphine, as well as for (b) OTP visits (including MMTP/OTP). Less than 2 percent of the chronic pain cohort used injectable naltrexone during the entire study window, so due to small sample size, stratified injected naltrexone-specific results were not assessed. The number and proportion of patients with chronic pain who utilized MOUD in each month and who had an OUD diagnosis in the prior six months were reported at the month level.

1.3.2 MOUD Initiation—MOUD initiation was defined by the same criteria listed above, limiting to "treatment-naïve" patients who had an OUD diagnosis, but no previous MOUD claims in the prior six months. The number and proportion of treatment-naïve patients with chronic pain and OUD who initiated MOUD (overall and separately for buprenorphine pharmacy prescription fills, as well as OTP visits) were reported at the month level.

1.4 Statistical Analyses

First, we reported demographics and baseline clinical characteristics stratified by whether patients with chronic pain and OUD received any MOUD in the study window. To assess the impact of the COVID-19 pandemic on MOUD utilization, we performed ITS analyses, a quasi-experimental design[38] to assess changes in levels and trends in the pre-pandemic and pandemic periods for MOUD utilization and initiation overall and separately for buprenorphine prescription fills and OTP visits; the chronic pain and non-chronic pain cohorts were modeled separately.

Each model included a monthly linear time trend for the study month, an indicator variable for the pre-pandemic vs. pandemic periods, and an interaction term for the monthly linear time trend with the pre-pandemic vs. pandemic period indicator. All models were evaluated from August 2019 to December 2020, with the "interruption" in March 2020 when the pandemic was declared. We used the generalized least-squares method based on the pooled autocorrelation estimate to remove the correlation between first-order errors.[39] Values of the Durbin-Watson statistic close to 2.0 indicated the absence of serial autocorrelation.

Finally, we compared MOUD utilization and initiation among OUD patients with chronic pain during the pre-pandemic versus pandemic periods across sub-groups stratified by race and ethnicity. We categorized the sub-cohorts using Medicaid's race and ethnicity classification categories as follows: (a) non-Hispanic White, (b) non-Hispanic Black, (c) Hispanic, and (d) Other (including Asian and Other identities). Individuals with Unknown race/ethnicity (N=2,395; 11.5%) were removed from this stratified analysis. Data processing

was conducted in SAS 9.4. Data cleaning was conducted using R statistical software (version 1.4.1717), and statistical analyses were conducted using Stata (*Stata Corp. 2020. Stata Statistical Software: Release 17. College Station, TX: StataCorp, LLC.*). Statistical significance was set at $p < .05$.

Results

2.1 Chronic Pain Population with OUD

We identified 20,785 NYS Medicaid beneficiaries with chronic pain who were diagnosed with OUD diagnosis during at least one month of the entire study window (i.e., during the pre-pandemic and/or pandemic periods). More than 50% of patients with chronic pain had back pain, and almost 40% had arthritis/joint/bone pain (other than back or neck) pain; on average, patients had between 1-2 types or sites of chronic pain at baseline. Appendix Table 1 presents the distribution of chronic pain types in this cohort. The mean age of patients in the cohort was 47.1 years (SD=10.8), and 48.6% were female. Table 1 presents baseline demographic and clinical characteristics among patients with chronic pain and OUD by their MOUD receipt status (overall and by type) during the entire study period. Throughout the study period, 48.4% (N=10,050) of OUD patients with chronic pain received some type of MOUD; specifically, 26.0% received buprenorphine, and 24.0% visited an OTP (of patients with chronic pain who received any MOUD treatment, 5.6% (N=564) filled a buprenorphine prescription and visited an OTP). Patients visiting OTPs had on average, almost more than four times the number of primary care visits during baseline than buprenorphine recipients (mean [SD] 60.8[92.4] vs. 14.1[24.9]). Overall, patients with chronic pain and OUD diagnoses during the pre-pandemic and pandemic periods (non-mutually exclusive groups) had comparable characteristics (Appendix Table 2).

2.1.1. MOUD Utilization Pre-Pandemic vs Pandemic Periods—ITS results for any MOUD utilization and initiation among OUD patients with and without chronic pain are presented in Figures 1a and 1b, with numerical estimates presented in Table 2. During the first month of observation, August 2019, we identified N=14,438 patients with chronic pain and OUD and N=23,443 patients without chronic pain but with OUD. Before the pandemic, approximately 49.3% (N=7,111) of OUD patients with chronic pain received any MOUD treatment, with no significant change in monthly utilization rates during the pre-pandemic period. This was lower than the 60.3% (N=14,144) of OUD patients without chronic pain who received MOUD during the first month of the study, among whom pre-pandemic utilization rates were rising by a rate of 0.4% per month (β=0.004; 95% CI [0.001, 0.007]). As compared to before the pandemic, both groups experienced no change in MOUD utilization rates during the pandemic period regardless of MOUD type. (Table 2; Figure 1a).

2.1.2. MOUD Initiation Pre-Pandemic vs Pandemic Periods—Among MOUD-naïve OUD patients, individuals without chronic pain had twice as high the initiation rates as compared to those with chronic pain in August 2019 (5.4% vs. 2.7%). In March 2020, the monthly MOUD initiation rate among the chronic pain cohort decreased by an estimated absolute change of 0.9% (β=−0.009; 95% CI [−0.015, −0.002]), with a drop from 3.0%

immediately before to 2.2% immediately after March 2020, but remained stable for the non-chronic pain cohort (Table 3; Figure 1b); similar trends were observed for buprenorphine initiation, with an immediate absolute decline of 0.6% in the chronic pain cohort (β=−0.006; 95% CI [−0.009, −0.002]), with a drop from 1.9% immediately before to 1.4% immediately after March 2020, and no change for the non-chronic pain group. OTP initiation rates did not change from pre-pandemic to pandemic periods in both cohorts (β=−0.002; 95% CI [−0.006, 0.001] for chronic pain; β=0.000 (−0.009, 0.009) for non-chronic pain).

2.1.3. MOUD Utilization among chronic pain cohort by race and ethnicity—

Among patients with chronic pain and OUD, 40.2% identified as non-Hispanic White, 21.7% non-Hispanic Black, 21.2% Hispanic, 5.3% Other (including Asian and Other sub-groups), and 11.5% Unknown. ITS results among the chronic pain cohort stratified by race/ethnicity are presented in Figures 2a and 2b with numerical estimates presented in Appendix Tables 3-4. In August 2019, 50.0% of the White, 39.8% of Black, 62.4% Hispanic, and 39.4% Other adults utilized any MOUD. Pre-pandemic MOUD utilization rates were rising among Black individuals by 0.3% per month (β=0.003; 95% CI [0.001, 0.005]), similar to increases among White individuals (β=0.003; 95% CI [0.000, 0.006]) but were stable among individuals of Hispanic and Other subgroups. Pandemic period MOUD utilization rates increased among all racial/ethnic groups but were not significantly different from pre-pandemic rates (Figure 2a; Appendix Table 3). In March 2020, adults in the Other subgroup experienced an immediate, absolute increase in the monthly buprenorphine utilization rate of 1.5% (β=0.015; 95% CI [0.005, 0.025]), with a drop from 14.6% immediately before March 2020 to 16.1% immediately thereafter, followed by a continued increasing pandemic period rate of 0.3% per month (β=0.003; 95% CI [0.002, 0.005]); this represents a 0.6% increase in the utilization rates from pre-pandemic to pandemic period (β=0.006; 95% CI [0.004, 0.009]). Black adults experienced an initial absolute drop of 0.7% in the monthly rate of OTP utilization (β=−0.007; 95% CI [−0.013, −0.001]), from an estimated 29.0% immediately before March 2020 to 28.3% immediately thereafter, but otherwise stable pandemic vs. pre-pandemic utilization rates.

2.1.4. MOUD Initiation among chronic pain by race and ethnicity—

An estimated 3.4% of White,1.9% of Black, 2.4% of Hispanic, and 3.1% individuals in the Other race/ethnicity sub-group initiated any MOUD in August 2019. In March 2020, rates of monthly MOUD initiation immediately dropped among Black adults by an absolute of 0.7% (β=−0.007; 95% CI [−0.012, −0.002]), from 2.3% immediately before March 2020 to 1.6% immediately after March 2020, and among Hispanic adults by 1.0% (β=−0.010; 95% CI [−0.019, −0.001], from 2.9% immediately before to 1.9% after March 2020; Figure 2b; Appendix Table 4); however, subsequently for both subgroups, there was no significant change in monthly rates during the pandemic vs. pre-pandemic periods. Before the pandemic, the monthly rate of buprenorphine initiation among individuals in the Other sub-group was declining (β=−0.003; 95% CI [−0.005, −0.001]), but there was an immediate absolute increase in the rate in March 2020 (β=0.010; 95% CI [0.001, 0.019]), with a 0.3% increased rate during the pandemic vs. pre-pandemic period (β =0.003; 95% CI [0.001, 0.005]). In March 2020, among White adults, there was an immediate absolute decline of 0.8% in the rate of buprenorphine initiation (β=−0.008; 95% CI [−0.016, −0.001] from

2.8% immediately before March 2020 to 2.0% immediately thereafter, followed by stable pandemic rates, which were comparable to pre-pandemic rates. Among all racial and ethnic groups, OTP initiation was stable during the study (Appendix Table 4).

Discussion

Prior to the COVID-19 pandemic, half of pre-existing NYS Medicaid enrollees with OUD and chronic pain received MOUD treatment, with lower treatment rates than those without chronic pain. The pandemic did not have lasting impacts on overall MOUD utilization rates but led to brief disruptions by an absolute decline of approximately 1% in MOUD initiation among the chronic pain population, though not in the non-chronic pain cohort. Further, non-Hispanic Black and Hispanic individuals experienced brief but disproportionate disruptions to MOUD initiation at the pandemic onset by an absolute drop of approximately 0.7% and 1.0%, respectively; these estimated changes in already low initiation rates (<5%) indicate a significantly lower number of people in care, potentially highlighting important challenges faced by these groups. While the impact of the pandemic on MOUD utilization has been previously assessed,[5,8,40-42] to our knowledge, these impacts have not yet been evaluated among individuals with comorbid chronic pain and OUD. As the collision of the COVID-19 pandemic and opioid epidemic persists[43], understanding and improving equitable access to effective MOUD is critical.[8]

Utilization of MOUD in our study population of NYS Medicaid beneficiaries was considerably higher than national estimates among other subgroups, including a national estimate of adolescents and adults between 13-28%[3,44] and Medicare-specific estimate of 11-13%.[5] This finding might suggest that relatively high MOUD penetration is possible in a setting such as New York State, where considerable efforts have been made to increase MOUD access and utilization.[9,10] Further, this may highlight the relatively high coverage of substance use disorder treatments by Medicaid as compared to other payors.

At the same time, claims analyses may generally be biased towards individuals engaged with the healthcare system and thus more likely to receive treatment than those who are not captured in the data. Nonetheless, individuals with chronic pain had lower overall utilization rates and greater COVID-19 related disruption to their MOUD treatment initiation as compared to non-chronic pain individuals, which is concerning, given that these patients received a recent OUD diagnosis and represent a population with disproportionately high rates of underlying health challenges.[45-49] Further, when the pandemic began, patients with chronic pain may have been less physically mobile or more at risk of COVID-19 complications due to underlying health conditions than individuals without chronic pain.

We identified very low overall MOUD initiation rates among treatment-naïve individuals, particularly among patients with chronic pain, which ranged from 1.9-3.3% during the study. Prior estimates of MOUD initiation rates are limited; however, one study estimated that 15% of commercial/Medicare Advantage beneficiaries initiated MOUD both pre-pandemic and pandemic periods.[50] It is possible that we are observing a saturation pattern, where base rates of MOUD utilization among our NYS adult sample are higher than previously reported estimates among other groups; as such, it may be more difficult in NYS to achieve initiation

rates that are as high as in other subpopulations. Nonetheless, even when utilization was at its highest during our study, 44% of the chronic pain population and 31% of the non-chronic pain population remained untreated for their OUD despite having received recent, formal OUD diagnoses. The very low initiation rates we identified among Medicaid's chronic pain population may highlight an important treatment gap and opportunity to initiate individuals onto the MOUD care cascade at the point between diagnosis and linkage to care. We found that as compared to pre-pandemic levels, the pandemic appeared to maintain overall rates of MOUD utilization, potentially due to the uptake of telehealth and increased treatment access flexibilities; however, MOUD initiation did not appear to benefit from the same embracement of federal flexibilities within NYS guidance when the COVID-19 pandemic began.[9,10] Efforts, including multidisciplinary approaches, are needed to identify innovative approaches to engage individuals with chronic pain who are diagnosed with OUD in care.[14] For example, approaches could include more accessible transportation modalities, continued loosening of policies that require in-person interactions, and more integrated care models to provide services for treatment of OUD, chronic pain, and other potentially underlying health conditions.[51] Moreover, improving provider education is critical, as patients with chronic pain may be treated with prescription opioids as part of their pain management regimen, thus complicating the processes of transitioning to MOUD care. Educational improvements may include introducing in-depth training courses to empower primary care providers to integrate OUD care into their practices or requiring in-depth training as part of Continued Medical Education curricula.[52]

We identified several racial and ethnic differences in MOUD care. Members of minority groups were less likely to receive any MOUD than their non-Hispanic White counterparts, consistent with previous findings.[25] At baseline, buprenorphine prescription rates were 2-3 times higher among non-Hispanic White individuals than individuals in other racial/ethnic minority groups (34.8% among non-Hispanic White individuals versus 11.3-16.4% among the other groups). Throughout the study, buprenorphine use was greater among the non-Hispanic White individuals, while OTP was greater in racial and ethnic minority groups. This is consistent with the history of OTPs, wherein OTP facilities have been disproportionately placed in low-income, predominantly Black and Hispanic areas.[53] Buprenorphine, on the other hand, has mostly targeted higher-income, White individuals in primary care settings.[5,22,54] Additionally, individuals visiting OTPs generally appeared to be sicker than those receiving buprenorphine, with almost half of individuals visiting an OTP being of aged, blind, or disabled Medicaid status as compared to one-quarter of buprenorphine recipients. These notable differences in patient characteristics highlight inequitable distributions of specific MOUD treatment modalities (i.e., outpatient prescription versus OTP visits). We found that the COVID-19 pandemic did not substantially disrupt overall MOUD utilization rates across non-White racial and ethnic groups; however, from the pre-pandemic to pandemic period, non-Hispanic Black individuals experienced slight disruptions in OTP utilization levels, and both non-Hispanic Black and Hispanic individuals experienced initial absolute drops in overall MOUD initiation levels. Our results indicate that MOUD access continues to be differentially distributed along racial and ethnic lines[22,25], highlighting the need to identify and address barriers to MOUD initiation and utilization among communities of color.

Limitations

This study has important limitations. To measure exposures and outcomes, we used administrative billing codes in Medicaid claims, which are subject to coding errors and misclassification. Our primary population of interest was individuals with chronic pain, which is a challenging condition to diagnose and identify; we used a previously published algorithm to identify the chronic pain cohort.[30,31] Because we included beneficiaries who were enrolled in NYS Medicaid for at least ten months between March 2019 and February 2020, we did not examine how patterns of Medicaid enrollment during the pandemic may have impacted population rates of MOUD initiation or utilization. We required that patients have ≥2 claims in the inpatient or outpatient settings within the same category of chronic pain based on ICD-10-CM diagnosis codes, which, on one hand, may overestimate chronic pain, as these diagnosis codes may be utilized even in the absence of chronic pain; on the other hand, we may have missed individuals with chronic pain who were not engaged in services. We employed existing algorithms to identify a diverse group of patients with chronic pain across different body sites. Our findings demonstrate patient heterogeneity in chronic pain types. However, we did not explore potential variations in MOUD trends among these chronic pain types, emphasizing the need for future research in this area. Additionally, we used a standard approach to identify Medicaid beneficiaries who are eligible for MOUD based on having OUD diagnoses, but we may have missed individuals with OUD who did not receive a recent formal diagnosis; thus, our analyses likely under-estimated the number of eligible individuals and over-estimated rates of MOUD utilization and initiation. If so, gaps in care may be even larger than our reported estimates. We identified OTP visits using rate codes, which included codes for methadone and buprenorphine take-home prescriptions; while we did not have further granularity on whether methadone or buprenorphine was administered at the OTP, generally, methadone is more commonly prescribed in OTP settings.[36,37] Additionally, the non-chronic pain cohort was selected as part of a larger study based on a Mahalanobis Distance (MD) matching technique on demographics, and it is possible that the non-chronic pain cohort is not representative of the full NYS Medicaid non-chronic pain population. Based on our selection method, our identified non-chronic pain OUD cohort may represent a more vulnerable population with more similarities to patients with chronic pain than the general NYS Medicaid non-chronic pain OUD population. As the focus of this study was on the chronic pain population, we used a descriptive approach to provide a reference of utilization and initiation rates among a similar non-chronic pain cohort. Finally, this study assessed MOUD utilization, which may serve as a proxy for access, though further research is necessary to determine whether reasons for non-utilization were attributed to access, itself, or other reasons for which individuals may choose to not utilize available MOUD.[3]

Conclusions

During the early months of the COVID-19 pandemic, MOUD utilization remained relatively stable among pre-existing NYS Medicaid enrollees with chronic pain and OUD. Federal initiatives that allowed for greater flexibility in telehealth visits and take-home methadone doses may have mitigated what could have been a more disruptive public health emergency in New York State.[42] Our findings highlight that individuals with

chronic pain have lower utilization to MOUD compared to those without chronic pain, and very low treatment initiation rates among those who are diagnosed with OUD but not yet engaged in MOUD care. These low initiation rates were further reduced by the pandemic among minoritized populations, specifically non-Hispanic Black and Hispanic individuals. Innovative approaches to improving MOUD barriers among individuals with chronic pain are necessary, particularly as telehealth and take-home doses could be valuable to individuals living with chronic pain, including those who are less physically able. Policy must also focus on narrowing racial and ethnic disparities to address and remove systems that currently stigmatize OUD to bring equity to MOUD treatment and improve patient outcomes.[22] This study informs the need to address current MOUD barriers among individuals living with chronic pain, and moreover, those of minoritized racial and ethnic identity, to improve overall MOUD access.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Data Availability Statement:

The data that support the findings of this study are available from the New York State Department of Health, but restrictions apply to the availability of these data, which were used under license for the current study, and so are not publicly available.

Appendix

Appendix Table 1.

Distribution of Chronic Pain Type Among Chronic Pain Cohort diagnosed with OUD during Study Window

	N	%
Pain Site/Type	**N=20,785**	
Back Pain	11,644	56.0%
Neck Pain	3,488	16.8%

	N	%
Pain Site/Type	**N=20,785**	
Headache	1,634	7.9%
Neurologic	2,864	13.8%
Back/Neck Pain, Unspecified	288	1.4%
Arthritis/Joint/Bone Pain (Other than Back/Neck)	8,234	39.6%
Miscellaneous Pain	6,956	33.5%

Appendix Table 2.

Patient Characteristics among Chronic Pain Population with OUD during Pre-Pandemic and Pandemic Periods[1]

	Pre-Pandemic (N=17,995)	Pandemic Period (N=14,840)
Age (years), mean (SD)	47.138 (10.793)	47.229 (10.779)
Male Sex (%)	9378 (52.1%)	7841 (52.8%)
Aged, Blind, Disabled (%)	6404 (35.6%)	5417 (36.5%)
Race/Ethnicity		
Black	3834 (21.3%)	3024 (20.4%)
Hispanic	3978 (22.1%)	3505 (23.6%)
White	7155 (39.8%)	6051 (40.8%)
Other	956 (5.3%)	690 (4.6%)
Unknown	2072 (11.5%)	1570 (10.6%)
Pre-Existing Comorbidities (%)		
Chronic Kidney Disease	2958 (16.4%)	2465 (16.6%)
Chronic Lung Disease	4571 (25.4%)	3832 (25.8%)
Heart Conditions	3189 (17.7%)	2544 (17.1%)
Down Syndrome	7 (0.0%)	4 (0.0%)
HIV or Immunocompromised Status	1818 (10.1%)	1549 (10.4%)
Obesity	8183 (45.5%)	6715 (45.2%)
Pregnancy	185 (1.0%)	160 (1.1%)
Sickle Cell Disease	203 (1.1%)	141 (1.0%)
Smoking	14345 (79.7%)	12196 (82.2%)
Type 2 Diabetes	6472 (36.0%)	5209 (35.1%)
Anxiety	12788 (71.1%)	10784 (72.7%)
Bipolar Disorder	5467 (30.4%)	4751 (32.0%)
Major Depressive Disorder (MDD)	7042 (39.1%)	5965 (40.2%)
Post-Traumatic Stress Disorder (PTSD)	4493 (25.0%)	3778 (25.5%)
Traumatic Life Events	465 (2.6%)	382 (2.6%)
Number of Baseline Primary Care Visits, mean (SD)	25.2 (55.6)	27.9 (59.9)
≥1 Baseline Emergency Department Visit (%)	10311 (57.3%)	8452 (57.0%)
≥1 Baseline Hospitalization	6521 (36.2%)	5176 (34.9%)
Log baseline non-drug healthcare costs, $, mean (SD)	9.0 (18)	9.0 (1.8)

	Pre-Pandemic (N=17,995)	Pandemic Period (N=14,840)
Log baseline prescription drug costs, $, mean (SD)	7.5 (2.1)	7.6 (2.0)

[1]Patients with chronic pain who qualified as having OUD during at least one month of the pre-pandemic period were included in the pre-pandemic column, and patients with chronic pain who qualified as having OUD during at least one month of the pandemic period were included in the pandemic period. These columns are not mutually exclusive, as a patient with chronic pain could have received an OUD diagnosis during multiple months spanning the pre-pandemic to pandemic period.

Appendix Table 3.

Interrupted time series regression analysis of MOUD utilization[1] overall and broken down by buprenorphine and OTP among chronic pain population with OUD[2] by race/ethnicity, pre-pandemic and pandemic periods

	Non-Hispanic White	Non-Hispanic Black	Hispanic	Other[3]
	β (95% CI)	**β (95% CI)**	**β (95% CI)**	**β (95% CI)**
MOUD Utilization				
Proportion of Utilization in August 2019	0.500 (0.492, 0.508)	**0.396 (0.391, 0.401)**	**0.626 (0.618, 0.634)**	**0.398 (0.383, 0.413)**
Pre-Pandemic Slope	0.003 (0.000, 0.006)	**0.003 (0.001, 0.005)**	0.001 (−0.003, 0.004)	0.001 (−0.005, 0.007)
Pandemic Period Slope	**0.004 (0.001, 0.007)**	**0.007 (0.004, 0.010)**	0.003 (0.000, 0.006)	**0.009 (0.004, 0.015)**
Changes in slope from pre-pandemic to pandemic period	0.001 (−0.004, 0.006)	0.004 (0.000, 0.007)	0.002 (−0.003, 0.007)	0.008 (−0.001, 0.018)
Changes in level from pre-pandemic to pandemic period	0.012 (−0.006, 0.031)	−0.007 (−0.022, 0.008)	−0.002 (−0.015, 0.010)	0.013 (−0.017, 0.041)
Buprenorphine Utilization				
Proportion of Utilization in August 2019	**0.347 (0.341, 0.352)**	**0.116 (0.112, 0.120)**	**0.116 (0.112, 0.119)**	**0.170 (0.159, 0.181)**
Pre-Pandemic Slope	**0.003 (0.001, 0.004)**	0.001 (0.000, 0.002)	0.000 (−0.002, 0.001)	**−0.003 (−0.005, −0.001)**
Pandemic Period Slope	**0.002 (0.001, 0.004)**	**0.002 (0.002, 0.003)**	0.000 (−0.001, 0.000)	**0.003 (0.002, 0.005)**
Changes in slope from pre-pandemic to pandemic period	0.000 (−0.003, 0.002)	0.001 (0.000, 0.002)	0.000 (−0.001, 0.001)	**0.006 (0.004, 0.009)**
Changes in level from pre-pandemic to pandemic period	0.011 (−0.001, 0.024)	−0.003 (−0.010, 0.003)	0.001 (−0.002, 0.005)	**0.015 (0.005, 0.025)**
OTP Utilization				
Proportion of Utilization in August 2019	**0.147 (0.145, 0.149)**	**0.278 (0.275, 0.280)**	**0.512 (0.508, 0.517)**	**0.227 (0.220, 0.235)**
Pre-Pandemic Slope	0.001 (0.000, 0.002)	0.002 (0.000, 0.003)	0.001 (−0.002, 0.003)	0.004 (0.000, 0.009)
Pandemic Period Slope	0.002 (−0.001, 0.004)	**0.005 (0.002, 0.007)**	0.003 (0.000, 0.006)	**0.006 (0.002, 0.011)**
Changes in slope from pre-pandemic to pandemic period	0.001 (−0.002, 0.004)	0.003 (0.000, 0.006)	0.003 (−0.002, 0.007)	0.002 (−0.006, 0.010)
Changes in level from pre-pandemic to pandemic period	0.001 (−0.003, 0.005)	**−0.007 (−0.013, −0.001)**	−0.005 (−0.014, 0.004)	−0.001 (−0.019, 0.017)

*Note: Effect estimates significant at p<0.05 in bold.

1Utilization was defined as having ≥1 claim for MOUD in each month being evaluated.

2Patients were included if they had ≥1 diagnosis for OUD within each six-month rolling look-back window.

3The Other race/ethnicity category included Medicaid's classified Asian and Other subgroups

Appendix Table 4.

Interrupted time series regression analysis of MOUD initiation[1] overall and broken down by buprenorphine and OTP among chronic pain population with OUD[2] by race/ethnicity[3], pre- and post-COVID-19 onset period

	Non-Hispanic White	Non-Hispanic Black	Hispanic	Other
	β (95% CI)	**β (95% CI)**	**β (95% CI)**	**β (95% CI)**
MOUD Initiation				
Proportion of Utilization in August 2019	**0.032 (0.027, 0.038)**	**0.018 (0.014, 0.022)**	**0.029 (0.023, 0.036)**	**0.022 (0.013, 0.030)**
Pre-Pandemic Slope	0.001 (−0.001, 0.002)	0.001 (0.000, 0.001)	0.000 (−0.002, 0.002)	0.000 (−0.003, 0.003)
Pandemic Period Slope	0.000 (−0.001, 0.001)	0.000 (−0.001, 0.001)	**0.001 (0.000, 0.002)**	0.001 (−0.001, 0.002)
Changes in slope from pre-pandemic to pandemic period	−0.001 (−0.002, 0.001)	−0.001 (−0.002, 0.000)	0.001 (−0.001, 0.002)	0.001 (−0.003, 0.004)
Changes in level from pre-pandemic to pandemic period	−0.007 (−0.016, 0.002)	**−0.007 (−0.012, −0.002)**	**−0.010 (−0.019, −0.001)**	−0.002 (−0.020, 0.015)
Buprenorphine Initiation				
Proportion of Utilization in August 2019	**0.026 (0.020, 0.032)**	**0.009 (0.006, 0.013)**	**0.012 (0.007, 0.016)**	**0.016 (0.008, 0.024)**
Pre-Pandemic Slope	0.000 (−0.001, 0.002)	0.000 (0.000, 0.001)	0.000 (−0.001, 0.002)	**−0.002 (−0.004, −0.001)**
Pandemic Period Slope	0.000 (−0.001, 0.001)	0.000 (0.000, 0.000)	0.000 (−0.001, 0.001)	0.001 (−0.001, 0.002)
Changes in slope from pre-pandemic to pandemic period	0.000 (−0.002, 0.002)	0.000 (−0.001, 0.000)	0.000 (−0.002, 0.001)	**0.003 (0.001, 0.005)**
Changes in level from pre-pandemic to pandemic period	**−0.008 (−0.016, −0.001)**	−0.004 (−0.007, 0.000)	−0.006 (−0.012, 0.001)	**0.010 (0.001, 0.019)**
OTP Initiation				
Proportion of Utilization in August 2019	**0.004 (0.003, 0.005)**	**0.007 (0.006, 0.008)**	**0.017 (0.014, 0.020)**	0.004 (−0.003, 0.011)
Pre-Pandemic Slope	0.001 (0.000, 0.001)	0.000 (0.000, 0.001)	0.000 (−0.002, 0.001)	0.002 (0.000, 0.005)
Pandemic Period Slope	0.000 (−0.001, 0.000)	0.000 (0.000, 0.000)	0.001 (−0.001, 0.002)	0.000 (−0.001, 0.001)
Changes in slope from pre-pandemic to pandemic period	−0.001 (−0.001, 0.000)	0.000 (−0.001, 0.000)	0.001 (−0.001, 0.003)	−0.002 (−0.005, 0.000)
Changes in level from pre-pandemic to pandemic period	0.000 (−0.002, 0.002)	−0.002 (−0.005, 0.000)	−0.004 (−0.014, 0.006)	−0.013 (−0.027, 0.002)

*Note: Effect estimates significant at p<0.05 in bold.

1Initiation was defined as having ≥1 claim for MOUD in each month evaluated among individuals *without* any claims for MOUD in the six-month rolling look-back window, not including the month being evaluated.

2Patients were included if they had ≥1 diagnosis for OUD within each six-month rolling look-back window, including the month being evaluated.

[3]The Other race/ethnicity category included Medicaid's classified Asian and Other subgroups

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Highlights

- NYS Medicaid beneficiaries with chronic pain had lower MOUD access than those without chronic pain
- The COVID-19 pandemic did not affect overall MOUD access in chronic pain patients
- The pandemic briefly disrupted treatment initiation for chronic pain patients only
- COVID-19 led to brief MOUD disruptions among minoritized subgroups
- In the early pandemic months, MUD trends stabilized in NYS compared to pre-pandemic levels

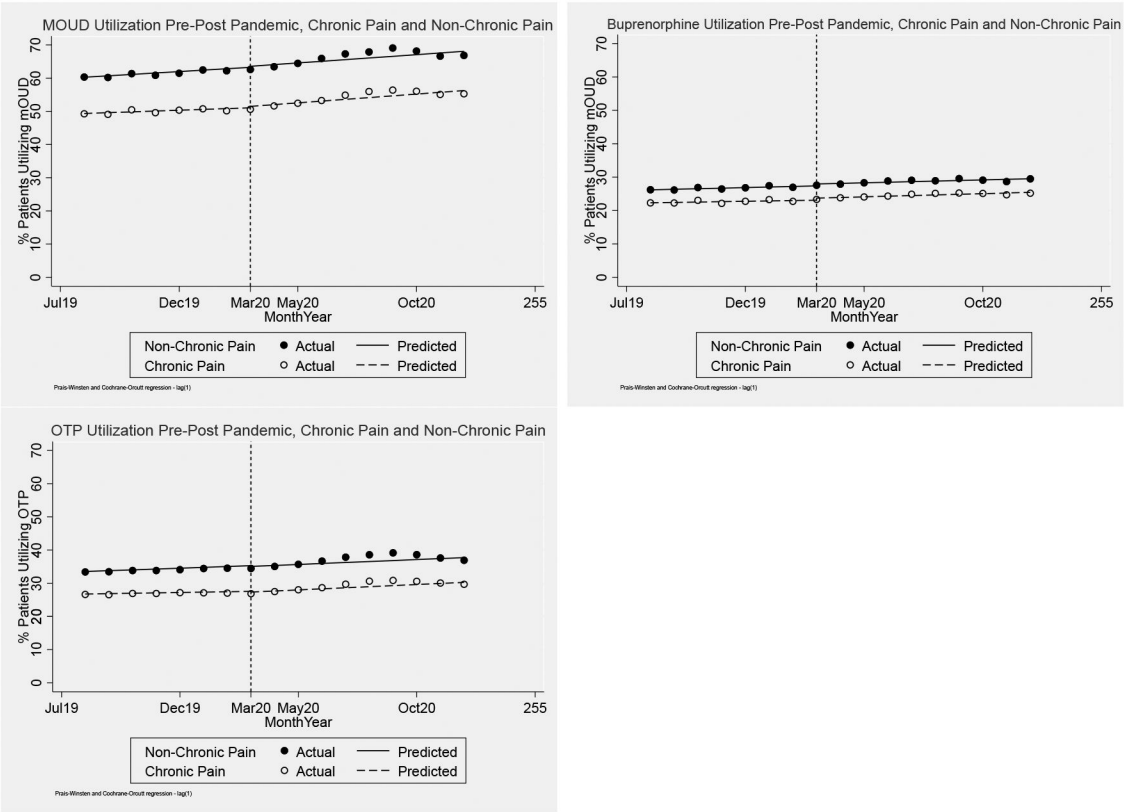

Figure 1a.

Monthly rates of MOUD utilization[1] overall and broken down by buprenorphine and OTP among individuals with OUD[3], without chronic pain vs. with chronic pain[4]

[1]Utilization was defined as having ≥1 claim for MOUD in each month being evaluated.

[2]Initiation was defined as having ≥1 claim for MOUD in each month evaluated among individuals *without* any claims for MOUD in the six-month rolling look-back window, not including the month being evaluated.

[3]Patients were included if they had ≥1 diagnosis for OUD within each six-month rolling look-back window, including the month being evaluated.

[4]The non-chronic pain cohort was selected based on Mahalanobis 5:1 matching with replacement to the cohort pain cohort on the following demographics: sex, race/ethnicity, health services area, age, and aged/blind/disabled status.

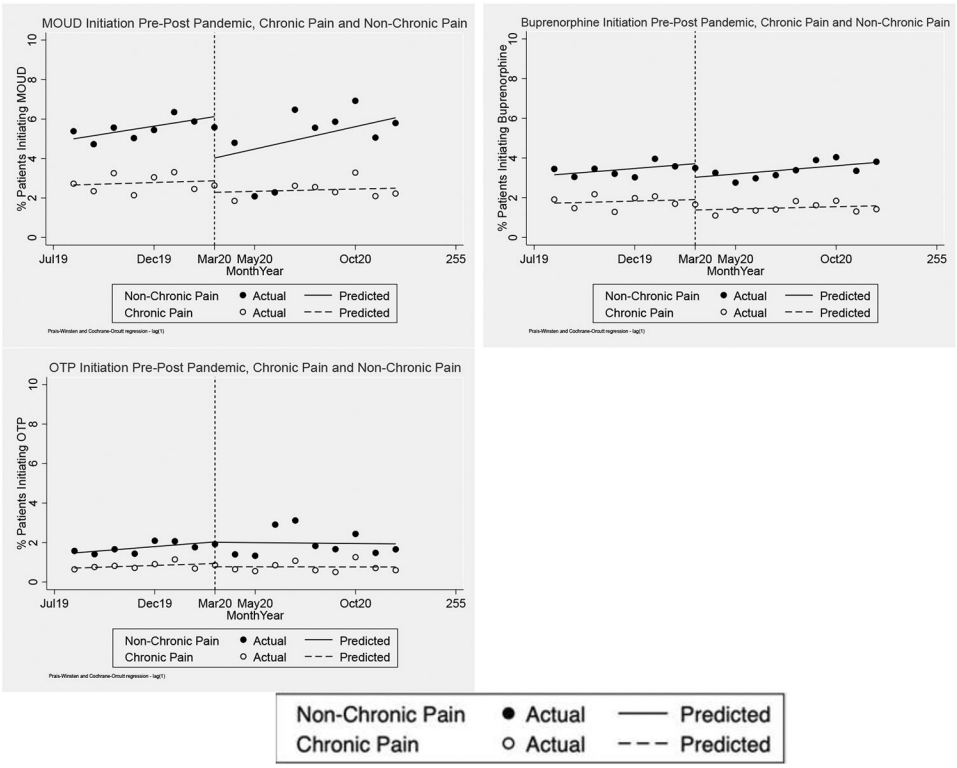

Figure 1b.

Monthly rates of initiation[2] overall and broken down by buprenorphine and OTP among individuals with OUD[3], without chronic pain vs. with chronic pain[4]

[1]Utilization was defined as having ≥1 claim for MOUD in each month being evaluated.

[2]Initiation was defined as having ≥1 claim for MOUD in each month evaluated among individuals *without* any claims for MOUD in the six-month rolling look-back window, not including the month being evaluated.

[3]Patients were included if they had ≥1 diagnosis for OUD within each six-month rolling look-back window, including the month being evaluated.

[4]The non-chronic pain cohort was selected based on Mahalanobis 5:1 matching with replacement to the cohort pain cohort on the following demographics: sex, race/ethnicity, health services area, age, and aged/blind/disabled status.

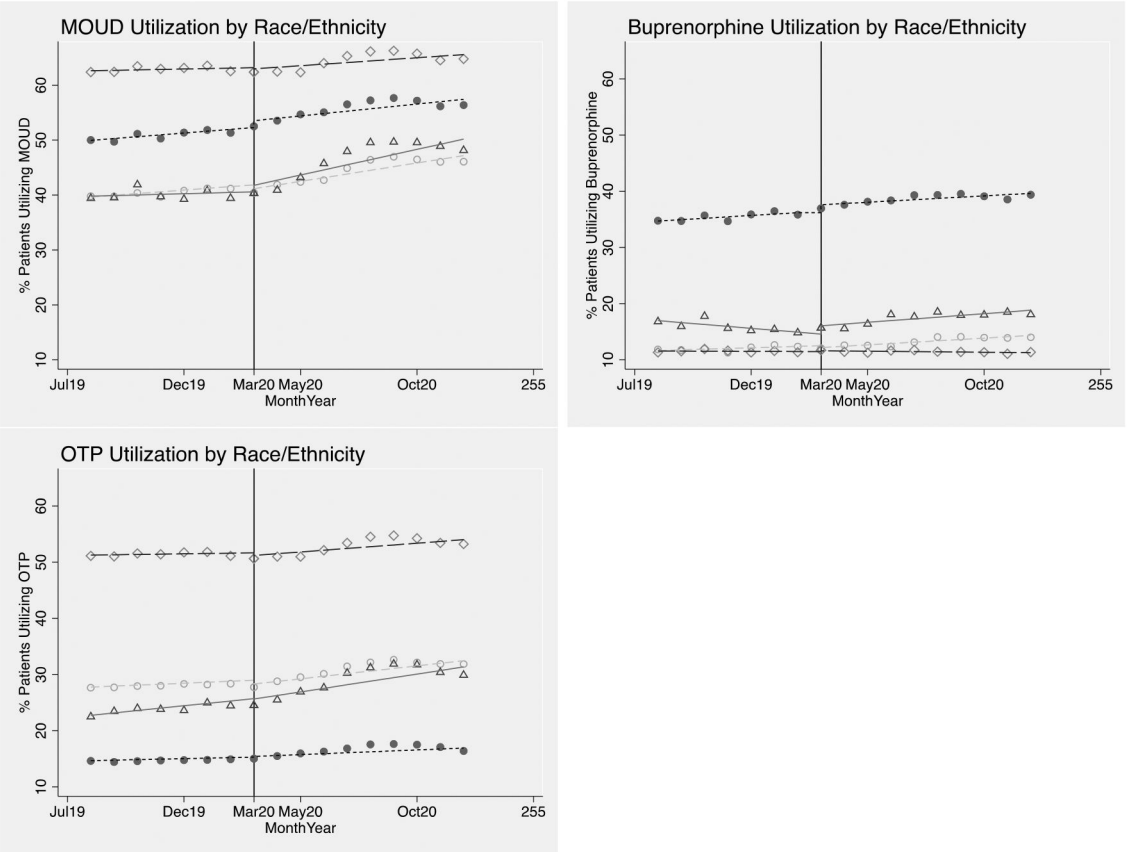

Figure 2a.

Monthly rates of MOUD utilization[1] overall and broken down by buprenorphine and OTP among chronic pain population with OUD[3], by race/ethnicity

[1]Utilization was defined as having ≥1 claim for MOUD in each month being evaluated.

[2]Initiation was defined as having ≥1 claim for MOUD in each month evaluated among individuals *without* any claims for MOUD in the six-month rolling look-back window, not including the month being evaluated.

[3]Patients were included if they had ≥1 diagnosis for OUD within each six-month rolling look-back window, including the month being evaluated.

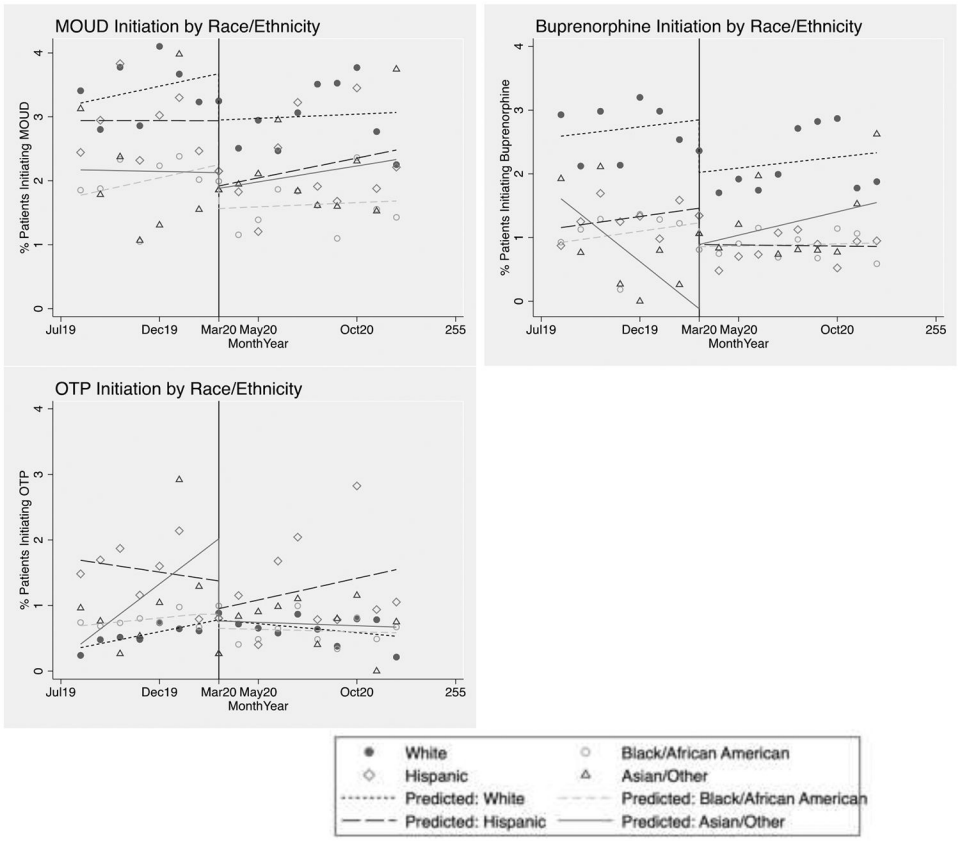

Figure 2b.

Monthly rates of MOUD initiation[2] overall and broken down by buprenorphine and OTP among chronic pain population with OUD[3], by race/ethnicity

[1]Utilization was defined as having ≥1 claim for MOUD in each month being evaluated.

[2]Initiation was defined as having ≥1 claim for MOUD in each month evaluated among individuals *without* any claims for MOUD in the six-month rolling look-back window, not including the month being evaluated.

[3]Patients were included if they had ≥1 diagnosis for OUD within each six-month rolling look-back window, including the month being evaluated.

Table 1.

Characteristics of Patients with Chronic Pain and OUD, by MOUD Receipt during Entire Study Period [1]

	No MOUD (N=10,735)	Any MOUD (N=10,050)	Buprenorphine (N=5,397)	OTP (N=4,994)
Male (%)	5140 (47.9%)	5538 (55.1%)	2832 (52.5%)	2951 (59.1%)
Age, years, mean (SD)	47.5 (10.8)	46.7 (10.9)	43.0 (10.5)	50.7 (9.8)
Race/Ethnicity (%)				
Non-Hispanic Black	2788 (26.0%)	1727 (17.2%)	725 (13.4%)	1059 (21.2%)
Hispanic	1809 (16.9%)	2606 (25.9%)	661 (12.2%)	2064 (41.3%)
Non-Hispanic White	4060 (37.8%)	4298 (42.8%)	3179 (58.9%)	1230 (24.6%)
Other[2]	682 (6.4%)	420 (4.2%)	207 (3.8%)	236 (4.7%)
Unknown	1396 (13.0%)	999 (9.9%)	625 (11.6%)	405 (8.1%)
Aged, Blind, Disabled (%)	3942 (36.7%)	3485 (34.7%)	1250 (23.2%)	2358 (47.2%)
Pre-Existing Comorbidities (%) [3]				
Chronic Kidney Disease	1715 (16.0%)	1682 (16.7%)	730 (13.5%)	1051 (21.0%)
Chronic Lung Disease[4]	2753 (25.6%)	2543 (25.3%)	1154 (21.4%)	1484 (29.7%)
Cardiovascular Conditions[5]	2053 (19.1%)	1601 (15.9%)	677 (12.5%)	996 (19.9%)
Down Syndrome	4 (0.0%)	3 (0.0%)	3 (0.1%)	1 (0.0%)
HIV or Immunocompromised	938 (8.7%)	1093 (10.9%)	324 (6.0%)	804 (16.1%)
Status[6]				
Obesity	5119 (47.7%)	4346 (43.2%)	2098 (38.9%)	2386 (47.8%)
Pregnancy[7]	112 (1.0%)	112 (1.1%)	83 (1.5%)	32 (0.6%)
Sickle Cell Disease	190 (1.8%)	50 (0.5%)	24 (0.4%)	27 (0.5%)
Smoking	7495 (69.8%)	8831 (87.9%)	4763 (88.3%)	4402 (88.1%)
Diabetes	4097 (38.2%)	3360 (33.4%)	1364 (25.3%)	2093 (41.9%)
Anxiety	7001 (65.2%)	7676 (76.4%)	4405 (81.6%)	3552 (71.1%)
Bipolar Disorder	2756 (25.7%)	3434 (34.2%)	1775 (32.9%)	1803 (36.1%)
Major Depressive Disorder	3563 (33.2%)	4415 (43.9%)	2388 (44.2%)	2187 (43.8%)
Post-Traumatic Stress	2177 (20.3%)	2853 (28.4%)	1615 (29.9%)	1370 (27.4%)
Disorder (PTSD)				
Traumatic Life Events	283 (2.6%)	260 (2.6%)	174 (3.2%)	104 (2.1%)
Number of Baseline Primary Care Visits, mean (Sd) [8]	10.5 (18.4)	36.5 (70.6)	14.1 (24.9)	60.8 (92.4)
≥1 Baseline Emergency Department Visit (%) [8]	6179 (57.6%)	5736 (57.1%)	3246 (60.1%)	2763 (55.3%)
≥1 Baseline Hospitalization [8]	3562 (33.2%)	3726 (37.1%)	2072 (38.4%)	1904 (38.1%)
Log baseline non-drug healthcare costs, $, mean (SD) [8]	8.5 (2.0)	9.3 (1.6)	8.7 (1.7)	9.9 (1.0)
Log baseline prescription drug costs, $, mean (SD) [8]	7.1 (2.1)	7.8 (1.9)	8.1 (1.5)	7.5 (2.3)

[1] All patients with chronic pain who qualified as having an OUD diagnosis during any month of the study window were included; MOUD status was evaluated during the whole study window, including the pre-pandemic and pandemic periods.

[2] The Other race/ethnicity category included Medicaid's classified Asian and Other subgroups.

[3] Three-year lookback period from March 2017 through February 2020 (inclusive)

[4] Includes chronic obstructive pulmonary disease, emphysema, bronchitis, pulmonary emphysema

[5] Includes heart failure, coronary artery disease, cardiomyopathies, Takotsubo syndrome

[6] Includes organ transplants, immunodeficiencies involving blood and blood-forming organs, immunoregulatory T-cell disorders.

[7] Based on having ≥1 diagnosis ±3 months from index date of February 29, 2020

[8] One-year lookback period from March 2019 through February 2020 (inclusive)

Table 2.

Interrupted time series regression analysis of MOUD utilization[1] overall and broken down by buprenorphine and OTP among chronic pain and nonchronic pain populations with OUD[2]. pre-pandemic and pandemic periods

	Chronic Pain	Non-Chronic Pain[3]
	β (95% CI)	β (95% CI)
MOUD Utilization		
Proportion of Utilization in August 2019	**0.493 (0.486, 0.501)**	**0.603 (0.598, 0.609)**
Pre-Pandemic Slope	0.002 (0.000, 0.005)	**0.004 (0.001, 0.007)**
Pandemic Period Slope	**0.005 (0.002, 0.008)**	**0.005 (0.001, 0.009)**
Changes in slope from pre-pandemic to pandemic period	0.002 (−0.002, 0.008)	0.001 (−0.005, 0.007)
Changes in level from pre-pandemic to pandemic period	0.005 (−0.012, 0.021)	0.003 (−0.012, 0.018)
Buprenorphine Utilization		
Proportion of Utilization in August 2019	**0.223 (0.219, 0.227)**	**0.262 (0.258, 0.265)**
Pre-Pandemic Slope	0.001 (0.000, 0.002)	0.002 (0.000, 0.003)
Pandemic Period Slope	**0.002 (0.001, 0.003)**	**0.002 (0.001, 0.003)**
Changes in slope from pre-pandemic to pandemic period	0.001 (−0.001, 0.002)	0.000 (−0.002, 0.002)
Changes in level from pre-pandemic to pandemic period	0.006 (−0.002, 0.014)	0.006 (−0.002, 0.014)
OTP Utilization		
Proportion of Utilization in August 2019	**0.267 (0.264, 0.271)**	**0.335 (0.331, 0.339)**
Pre-Pandemic Slope	0.001 (0.000, 0.003)	**0.002 (0.001, 0.004)**
Pandemic Period Slope	**0.003 (0.001, 0.006)**	0.003 (−0.001, 0.007)
Changes in slope from pre-pandemic to pandemic period	0.002 (−0.001, 0.005)	0.000 (−0.004, 0.005)
Changes in level from pre-pandemic to pandemic period	−0.002 (−0.007, 0.003)	−0.002 (−0.008, 0.003)

*Note: Effect estimates significant at p<0.05 in bold.

[1]Utilization was defined as having ≥1 claim for MOUD in each month being evaluated.

[2]Patients were included if they had ≥1 diagnosis for OUD within each six-month rolling look-back window.

[3]The non-chronic pain cohort was selected based on Mahalanobis 5:1 matching with replacement to the cohort pain cohort on the following demographics: sex, race/ethnicity, health services area, age, and aged/blind/disabled status.

Table 3.

Interrupted time series regression analysis of MOUD initiation[1] overall and broken down by buprenorphine and OTP among chronic pain and nonchronic pain populations with OUD[2], pre-pandemic and pandemic periods

	Chronic Pain	Non-Chronic Pain[3]
	β (95% CI)	β (95% CI)
MOUD Initiation		
Proportion of Initiation in August 2019	**0.026 (0.022, 0.029)**	**0.050 (0.044, 0.057)**
Pre-Pandemic Slope	0.001 (0.000, 0.002)	0.001 (0.000, 0.003)
Pandemic Period Slope	0.000 (0.000, 0.001)	0.002 (−0.001, 0.006)
Changes in slope from pre-pandemic to pandemic period	0.000 (−0.001, 0.001)	.001 (−0.003, 0.005)
Changes in level from pre-pandemic to pandemic period	**−0.009 (−0.015, −0.002)**	−0.019 (−0.045, 0.006)
Buprenorphine Initiation		
Proportion of Initiation in August 2019	**0.017 (0.014, 0.020)**	**0.032 (0.028, 0.036)**
Pre-Pandemic Slope	0.000 (0.000, 0.001)	0.001 (−0.001, 0.002)
Pandemic Period Slope	0.000 (0.000, 0.001)	0.001 (0.000, 0.002)
Changes in slope from pre-pandemic to pandemic period	0.000 (−0.001, 0.007)	0.000 (−0.001, 0.002)
Changes in level from pre-pandemic to pandemic period	**−0.006 (−0.009, −0.002)**	−0.006 (−0.014, 0.002)
OTP Initiation		
Proportion of Initiation in August 2019	**0.007 (0.006, 0.008)**	**0.015 (0.012, 0.017)**
Pre-Pandemic Slope	0.000 (0.000, 0.001)	0.001 (0.000, 0.002)
Pandemic Period Slope	0.000 (0.000, 0.000)	0.000 (−0.001, 0.001)
Changes in slope from pre-pandemic to pandemic period	0.000 (−0.001, 0.000)	−0.001 (−0.002, 0.007)
Changes in level from pre-pandemic to pandemic period	−0.002 (−0.006, 0.001)	0.000 (−0.009, 0.009)

*Note: Effect estimates significant at p<0.05 in bold.

[1]Initiation was defined as having ≥1 claim for MOUD in each month evaluated among individuals *without* any claims for MOUD in the six-month rolling look-back window, not including the month being evaluated.

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[3]The non-chronic pain cohort was selected based on Mahalanobis 5:1 matching with replacement to the cohort pain cohort on the following demographics: sex, race/ethnicity, health services area, age, and aged/blind/disabled status.