Drug and Alcohol Dependence Reports 12 (2024) 100276

Contents lists available at ScienceDirect

Drug and Alcohol Dependence Reports

journal homepage: www.elsevier.com/locate/dadr

Impact of COVID-19 on MOUD retention in a sample of rural primary care patients: A secondary analysis of electronic health records

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HIGHLIGHTS

- Increased retention challenges among those starting a MOUD prescription near the beginning of COVID-19.
- Elevated risk of a MOUD prescription break among those in clinics with limited MOUD capacity.
- Chronic pain diagnosis and male gender associated with a reduced risk of a MOUD prescription break.

ARTICLE INFO

Keywords:
COVID-19
Opioid use disorder
Medication for opioid use disorder
Rural community
Primary care

ABSTRACT

Introduction: There is limited research examining factors impacting MOUD retention in rural settings, especially within the context of the COVID-19 pandemic. Using electronic health records data collected as part of a NIDA Clinical Trials Network study (CTN-0102), this study explored how the onset of the COVID-19 pandemic may have impacted MOUD retention in a sample of 563 rural primary care patients.

Methods: Cox regression model was applied to examine if COVID-19 was related to treatment retention, controlling for demographics, clinic, insurance type, and other diagnoses. The independent variable was the number of days between the patient's first MOUD prescription date during the pre-COVID observation period (10/1/2019–3/13/2020) and the start of the COVID-19 pandemic. The dependent variable was retention on MOUD, defined as the time from the first MOUD prescription documented during the pre-COVID observation period to the first break in consecutive MOUD prescriptions (right censored at 180 days).

Results: The findings demonstrated that there was a reduced risk of a prescription break for every 10-day increase in the time from the first documented MOUD prescription to the onset of the COVID-19 pandemic (HR = 0.96, 95 % CI = 0.92–0.99; $p = 0.011$).

Conclusions: While the data did not include complete treatment histories to determine who was new to MOUD treatment, the findings suggest that patients whose first documented MOUD prescription in the dataset was closer to the onset of the pandemic had a greater likelihood of experiencing retention challenges. This underscores the importance for clinics to establish comprehensive contingency plans for future emergencies to ensure uninterrupted MOUD treatment and support, particularly for individuals in the early stabilization phase of their recovery.

1. Introduction

The opioid crisis remains a major public health issue impacting communities across the United States, with over 105,000 overdose deaths recorded between December 2022 and January 2023 (Ahmad et al., 2023). While the opioid crisis has not been limited to a specific region, rural communities have been particularly hit hard (Mack et al., 2017). Medications for opioid use disorder (MOUD) have been identified

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https://doi.org/10.1016/j.dadr.2024.100276
Received 28 November 2023; Received in revised form 4 August 2024; Accepted 14 August 2024
Available online 23 August 2024

as an effective treatment approach in reducing opioid use (Connery, 2015; Volkow et al., 2014). However, they tend to be significantly underutilized, especially in rural communities (Amiri et al., 2021; Showers et al., 2021). Individuals with OUD in rural communities face significant challenges in accessing MOUD treatment, largely due to geographical isolation, limited transportation infrastructure, and a shortage of providers (Bommersbach et al., 2023; Lister et al., 2020).

Barriers to MOUD treatment in rural areas extend beyond initial access and include challenges in retaining individuals with OUD in treatment, which is crucial for achieving sustained recovery. Although there is a scarcity of research specifically examining barriers to MOUD retention in rural settings, several factors have been found to impact treatment retention among rural patients. These factors include long travel distances to treatment centers, lack of social support networks, stigma associated with addiction, and limited availability of ancillary services, such as counseling, and mental health support (Poulsen et al., 2022). The opioid crisis has brought into greater focus some of the challenges to MOUD access and retention that need to be addressed in rural communities.

The COVID-19 pandemic, declared a public health emergency in the United States on March 13, 2020, profoundly impacted various aspects of healthcare delivery and patient outcomes (Alexander et al., 2021). The period of transition during the early part of the COVID-19 pandemic was characterized by rapid changes in the delivery of MOUD services within clinics, including a shift towards telehealth visits, modified clinic operations, and adjustments to medication dispensing and monitoring protocols (Parker et al., 2023). The disruptions caused by the pandemic raised concerns about the continuity of MOUD treatment and patient outcomes during this time (Linas et al., 2021). Even though the adoption of telehealth helped address some of the barriers to MOUD in rural communities, technological barriers and other changes to clinic operations during the pandemic may have introduced new challenges to treatment engagement and continuity of care, especially during the early months of the pandemic (Hser et al., 2021; Kedia et al., 2021; Jenkins et al., 2021; Lin et al., 2023).

Given that there has been limited research on the factors impacting MOUD treatment retention in rural populations, especially within the context of the pandemic, this study adds to this literature by exploring how the onset of the COVID-19 pandemic may have influenced MOUD retention in rural primary care settings. We conducted a secondary analysis of electronic health record (EHR) data collected as part of a NIDA Clinical Trials Network study (CTN-0102) to explore how the timing of the first MOUD prescription documented in the medical records during the pre-COVID observation period (October 1, 2019 to March 13, 2020) impacted treatment retention in a sample of rural primary care patients with OUD. Given the unanticipated changes to clinic operations during the pandemic, we hypothesized that patients with a first MOUD prescription closer to the onset of the COVID-19 pandemic in the United States would have an increased risk of having a break in their prescriptions, compared to those whose first MOUD prescription during the pre-COVID observation period occurred several months before the pandemic.

2. Methods

2.1. CTN-0102 study overview

The CTN-0102 study was a prospective, single-arm, study that examined the feasibility of implementing a care coordination model involving MOUD delivered via an external telemedicine provider for the purpose of expanding access to MOUD for patients in rural settings (Hser et al., 2023). Six rural sites (consisting of 7 rural primary care clinics) in 3 states (Maine, Washington, and Idaho) participated in the study. Two of the clinics were combined as one site due to small numbers of patients with OUD at each clinic. The primary care clinics included in the study were required to meet the rural definition set by the Health Resources and Services Administration (HRSA), as outlined in the Rural Health Information Hub (2023). The participating clinics had varying levels of MOUD capacity, defined as the number of buprenorphine-prescribing clinicians at the clinic: 1, 2–3, or more than 3. The study was approved by the BRANY Institutional Review Board (IRB) as the Single IRB and registered at Clinicaltrials.gov (NCT04418453).

2.2. Study sample

Data from the participating sites' electronic health records (EHRs) were extracted for all primary care patients 18–80 years old with at least one visit to the participating clinics during the study observation period (October 2019 to January 2021). These records contain data on patient demographics, clinical diagnoses, and insurance status. For the current study, data from 563 rural primary care patients who had a documented MOUD prescription in their medical records during the pre-COVID observation period (October 1, 2019 to March 13, 2020) were included in the analysis.

2.3. Measures

Patients with OUD were defined as having at least one diagnosis code (International Classification of Diseases, 10th revision, Clinical Modification (ICD-10) that could be associated with OUD in the EHR data during the observation period. MOUD was defined as > 1 medication prescription for buprenorphine (sublingual or extended-release subcutaneous injection) or injectable naltrexone. The main independent variable (COVID Gap) was the number of days between the patient's first MOUD prescription date during the pre-COVID observation period (October 1, 2019 to March 13, 2020) and the start of the COVID-19 pandemic. It is important to note that patients with a first MOUD prescription recorded in October 2019 may have already been on treatment prior to this date, as the dataset does not include complete treatment histories. Retention on MOUD was the dependent variable in this study, which was defined as the time from a patient's first prescription in the EHRs during the pre-COVID observation period to the first prescription break during MOUD treatment. A break during MOUD treatment was defined as an interruption between two consecutive MOUD prescriptions of more than 28 days from the last date of prescribed MOUD or from the last monthly injection, a definition in line with the guidelines provided by the RAND Corporation in their "Quality Metrics Technical Documentation"(RAND Corporation, 2021). The duration of a patient's stay in MOUD treatment without a break was censored at 180 days, as all patients were followed for at least 6 months.

The covariates included in the analysis were selected based on the data available for the current study and guided by the existing literature. The sociodemographic variables included in the analysis as covariates included sex, race and ethnicity, age, and health insurance status. Health insurance status at the time of their first prescription was classified as None, Medicaid, Medicare, Private, or Other. Clinical variables were defined from ICD-10 diagnoses for pain-related conditions, mental health conditions, and alcohol use disorder (AUD). For each clinical category, ICD-10 codes were identified through a thorough examination of pertinent literature, cross-referencing with documents supplied by the Centers for Medicare & Medicaid Services (CMS), and evaluation by subject matter experts. We have included the list of ICD-10 codes used in this study in the Supplemental Materials. In our analysis, clinics were included as a covariate to explore the potential influence of the treatment setting on retention.

2.4. Statistical analysis

Quantitative data were analyzed using SAS software version 9.4 (SAS Institute, Inc., Cary, NC). We first calculated descriptive statistics (e.g., means, standard deviations (SD), frequencies) for patient characteristics. A Cox proportional hazard model was applied to assess whether

patients with a first MOUD prescription closer to the onset of the COVID-19 pandemic had a higher risk of a prescription break, in comparison to those who had their first prescription documented in the dataset several months prior to the pandemic. The COVID gap days were divided by 10 in the regression analysis to better illustrate how longer periods between the first prescription and the start of the COVID pandemic influence patient outcomes. Regression covariates included demographic variables (age, gender, race/ethnicity), insurance types, diagnosis status (AUD, mental health disorder, and chronic pain), and the indicators for the six clinics. A Kaplan-Meier survival curve was constructed to describe the probability of a patient staying in MOUD treatment without experiencing a prescription break. Since there is a possibility that some of the patients with a first prescription in October 2019 were already on MOUD, this could potentially bias our results due to their higher likelihood of being retained in treatment longer. Thus we conducted a sensitivity analysis that excluded these patients in the Cox proportional hazards regression model to see if significant associations found in the original model remained. All statistical tests were two-sided with a significance level of 0.05.

3. Results

3.1. Sample characteristics

This study included 563 rural primary care patients with a MOUD prescription during the pre-COVID observation period. The patients in this sample were predominantly White with a mean age of 39 years. A little more than half of the patients were male. The majority of the patients came from clinics 1 and 2, and their insurance coverage varied greatly, with Medicaid being the most common. Comorbid conditions were prevalent in this sample, with the majority of patients diagnosed with a mental health disorder, less than half experiencing chronic pain, and less than one-quarter with AUD. The majority of first prescriptions occurred in October and November of 2019, followed by a decrease in the subsequent months. The decrease in prescriptions during the subsequent months may be attributed to seasonal variations, particularly the impact of holiday periods at the end of the year. For detailed demographic and clinical characteristics of the study population, please see Table 1.

Fig. 1 presents the Kaplan-Meier survival curve, illustrating the probability of patients remaining in treatment without experiencing a prescription break over time. The horizontal axis represents the duration of treatment, measured in days, while the vertical axis shows the probability of not experiencing a prescription break. On average, patients were in MOUD treatment for 65.74 days (SD = 46.33) before experiencing their first break.

3.2. Cox proportional hazard model predicting MOUD prescription break

The findings showed that a risk of a prescription break decreased as the number of days between the first prescription and the start of the COVID-19 pandemic increased. The unadjusted hazard ratio for a prescription break associated with the COVID gap was 0.99 (95 % CI = 0.99–1.00, p = 0.000). The adjusted hazard ratio was 0.96 (95 % CI = 0.92–0.99, p = 0.011) when controlling for covariates in the Cox model (Table 2), demonstrating that each additional 10-day increase between the first prescription and the start of COVID-19 was associated with a significantly lower risk of a prescription break. Patients in clinics 5 and 6 had a significantly increased risk of a prescription break. Regarding comorbid diagnoses, patients with chronic pain had a significantly lower risk of a prescription break than those who did not have a chronic pain condition (HR = 0.62, 95 % CI =0.46–0.84; p =0.002). The findings also showed that males demonstrated a significantly lower risk of experiencing a prescription break compared to females (HR = 0.73, 95 % CI = 0.56–0.95; p = 0.018). The results of our sensitivity analysis, which excluded patients whose first prescription was in October 2019, yielded similar results for the COVID gap variable as the adjusted hazard ratio was 0.99 (95 % CI: 0.9873–0.9940; p < 0.001).

Table 1
Background characteristics (N=563).

Variable	N(%)/ Mean(SD)
Sex, n (%)	
Male	313 (55.6)
Female	250 (44.4)
Race and Ethnicity, n (%)	
White	520 (92.3)
Hispanic	10 (1.8)
Black	3 (0.6)
Other	30 (5.3)
Age, Mean (SD)	38.63 (0.48)
Clinic, n (%)	
Clinic 1	319 (56.7)
Clinic 2	204 (36.2)
Clinic 3	11 (2.0)
Clinic 4	22 (3.9)
Clinic 5	5 (0.9)
Clinic 6	2 (0.4)
Insurance, n (%)	
None	62 (11.0)
Medicaid	354 (62.9)
Medicare	39 (6.9)
Private	99 (17.6)
Other	9 (1.6)
Other Diagnoses, n (%)	
Alcohol Use Disorder	105 (18.6)
Mental Health Disorder	402 (71.4)
Chronic Pain	243 (43.2)
First MOUD Prescription Month, n (%)	
October 2019	185 (32.9)
November 2019	241 (42.8)
December 2019	61 (10.8)
January 2020	40 (7.1)
February 2020	23 (4.1)
March 2020	13 (2.3)
MOUD Treatment Days*, Mean (SD)	65.74 (46.33)

* Number of days between the first MOUD prescription date and the first prescription break (Right censored at 180 days)

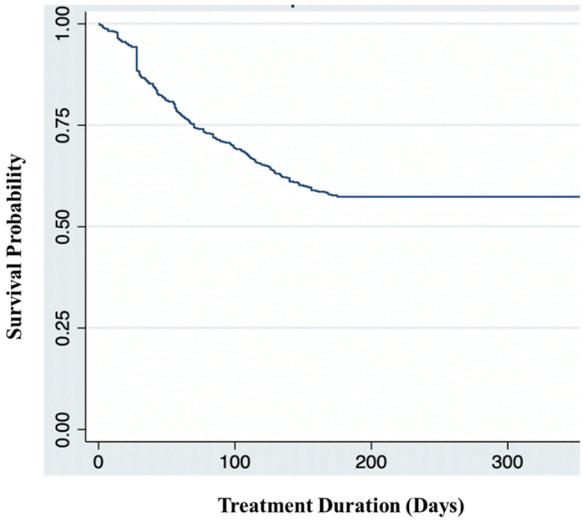

Fig. 1. Kaplan-Meier survival curve of MOUD treatment retention (Right Censored at 180 days).

4. Discussion

In this study, we examined the relationship between the timing of patients' first MOUD prescription during the pre-COVID observation

Table 2
Cox proportional hazard model predicting MOUD prescription break.

	Hazard Ratios	95 % Confidence Interval
COVID Gap[a]**	0.96	0.92 – 0.99
Sex (ref=female)		
*Male**	0.73	0.56–0.95
Race and Ethnicity (ref = white)		
Hispanic	0.61	0.19–1.93
Black	1.02	0.14–7.34
Other	1.24	0.70–2.19
Age	1.00	0.99–1.02
Clinic (ref = clinic 1)		
Clinic 2	1.09	0.79–1.50
Clinic 3	1.01	0.43–2.36
Clinic 4	0.95	0.56–0.95
*Clinic 5***	5.31	2.04–13.87
*Clinic 6***	73.42	13.75–392.16
Insurance (ref = Medicaid)		
None	0.82	0.51–1.31
Medicare	1.16	0.62–2.14
Private	1.11	0.78–1.57
Other	1.58	0.62–4.02
Other Diagnoses		
Alcohol Use Disorder	0.99	0.69–1.42
Mental Health Disorder	0.81	0.61–1.08
*Chronic Pain***	0.62	0.46–0.84

[a] Number of days between the first MOUD prescription date and the start of the COVID-19 pandemic
*$p < 0.05$; **$p < 0.01$

period and the risk of a prescription break, controlling for demographics, clinic, insurance type, and other diagnoses. Findings from our study revealed a significant association between the timing of the first MOUD prescription in the dataset and a break in treatment, suggesting that patients who started their MOUD treatment closer to the onset of COVID-19 encountered challenges in retention compared to those who initiated treatment months before the pandemic started. Given that this is a secondary analysis of data collected for a different study, we were not able to determine the MOUD treatment history of the patients in our sample due to the limitations of the dataset. Thus, it is possible that some of the patients included in our sample may represent patients who were already on MOUD prior to October 2019 or were returning to MOUD after a previous break. For those patients whose first prescription in our dataset appears between November 2019 and March 2020 (n=378), we can assume that, even if they were on MOUD at some point prior to October 2019, they would have experienced a break of 28 days or more. Nevertheless, the findings could suggest that those whose first prescription in the dataset were noted several months before the pandemic were better established in their treatment and thus less susceptible to disruptions brought on by the pandemic. Furthermore escalations in substance use and adverse mental health symptoms observed during the COVID-19 pandemic (Czeisler et al., 2020), could have also negatively impacted retention on MOUD among the newer patients. Another possible explanation for the worse retention outcomes among individuals starting closer to the onset of COVID-19 may be attributed to the substantial adaptations and changes that clinics had to quickly implement in response to pandemic restrictions (Parker et al., 2023), which likely created a chaotic environment in the early stages of the pandemic. While telemedicine emerged as a critical tool in ensuring the continuity of MOUD treatment and reducing the risk of exposure to the virus during the pandemic, both clinics and patients encountered numerous challenges in effectively utilizing telehealth for MOUD treatment as limited access to reliable internet connections, technological barriers, and disparities in digital literacy continued to pose significant hurdles for rural communities during the pandemic (Hser et al., 2021).

In our Cox regression analysis, clinics were incorporated as a covariate to account for potential variations across the clinics. The patient distribution varied considerably across the clinics, with Clinics 5 and 6 having a notably low patient count. Despite their small sizes, there was a heightened risk of a MOUD prescription break in clinics 5 and 6. This finding may be attributed to variations in each clinic's capacity to deliver MOUD at the start of the pre-COVID observation period. Clinics 1 and 2 had more than three buprenorphine-prescribing clinicians, indicating a higher capacity for providing MOUD services. Clinics 3 and 4 had 2–3 buprenorphine-prescribing clinicians, reflecting a moderate level of capacity. Lastly, Clinics 5 and 6 had one buprenorphine-prescribing clinician, indicating a lower capacity for offering MOUD services. Thus, clinics with one buprenorphine-prescribing clinician may have experienced greater challenges in ensuring continuity in MOUD treatment during the transitional period than clinics that had more buprenorphine-prescribing clinicians on staff. However, given the small patient counts, these results may not be as robust, and interpretation should be approached with caution. Nevertheless, these findings underscores the importance of improving the infrastructure for MOUD treatment in primary care clinics, particularly by increasing the number of clinicians who are capable and willing to prescribe buprenorphine. Additionally, this points towards the potential benefits of adopting collaborative approaches among clinics. Considering the unpredictability of emergencies, fostering arrangements or agreements between other clinics and external telemedicine providers could potentially serve as a safeguard to maintaining continuinty of care. These partnerships have the potential to ensure the continuity of care through the facilitation of a smooth transfer or referral of patients to alternative clinics or telemedicine providers during periods of disruption.

Our study also revealed a significant association between concurrent chronic pain diagnosis and treatment retention. Specifically, patients with documented chronic pain diagnoses demonstrated a significantly reduced risk of experiencing a MOUD prescription break when compared to those without such a diagnosis. This finding is in line with what has been found in other studies examining factors associated with MOUD retention (Biondi et al., 2022; Stein et al., 2022). This might suggest that patients with chronic pain conditions might be more likely to continue their MOUD prescriptions as prescribed, possibly due to established routines or heightened awareness of the implications of medication discontinuity, and the analgesic properties of buprenorphine.

Finally, a significant difference was found between men and women that warrants attention. Specifically, men had a significantly reduced risk of a prescription break when compared to women. The findings around sex-based differences in MOUD retention have not been consistent across studies with some studies showing no differences (Hochheimer and Unick, 2022) while others showing significant differences in discontinuation risk (Samples et al., 2018). The inconsistent findings on sex-based differences in MOUD retention across studies might be due to variations in the demographic and clinical characteristics of the participants and differences in study design. Thus, the sex-based difference found in this study raises questions about the potential underlying factors in rural primary care settings. Sex-based differences in social, behavioral, or physiological factors may have a role in treatment adherence. For example, socio-cultural expectations, variations in healthcare-seeking behavior between males and females, or even differential responses to the pressures of the pandemic could all be factors that contribute to the sex-based difference found in this study. Identifying sex-based differences in MOUD treatment retention is important, as it may suggest the need for customized intervention approaches that address the distinct challenges and needs associated with each sex.

While our findings offer valuable insights, several limitations merit attention in the interpretation of the results. First, a secondary analysis was conducted on EHR data that was originally collected for clinical, rather than research purposes. While EHR data contains rich clinical information, it may not capture all pertinent variables or contextual factors that directly influence MOUD retention during the COVID-19 pandemic. In this study, we determined whether someone was on

MOUD based on MOUD prescription records documented in the EHR, which did not include verified details confirming if the medication was actually consumed by the patient. Furthermore, this study did not account for variations in prescription length, which can be an important factor in understanding treatment patterns. Future studies should consider analyzing the impact of prescription length on retention, particularly in the context of external disruptions like the COVID-19 pandemic. In terms of demographic representation, the majority of the patients included in our sample identified as White, potentially limiting the generalizability of our findings to other race and ethnic groups residing in rural areas. Additionally, the absence of comprehensive treatment history prior to October 2019 restricts our ability to fully understand each patient's treatment trajectory and how it may have been impacted by the pandemic. Finally, while the data for this study was collected from several rural primary care clinics in three states, caution should be exercised when applying these conclusions to other states or different regional contexts. Notwithstanding the inherent limitations, this study presents empirical evidence of the potential impact that an evolving pandemic had on MOUD retention in rural primary care settings, underscoring the critical importance of emergency preparedness in rural healthcare systems to ensure uninterrupted treatment during unforeseen events.

5. Conclusion

This study sheds light on factors that were found to impact MOUD retention in rural healthcare settings within the context of the COVID-19 pandemic, adding to the larger literature on MOUD retention in rural settings. The findings from our study showed that patients with their first MOUD prescription closer to the pandemic onset experienced increased retention challenges. This could indicate potential vulnerabilities in the ability of rural primary care clinics to sustain MOUD services during the pandemic. In general, the COVID-19 pandemic revealed many challenges that rural primary care clinics face when delivering MOUD services during a public health emergency. To address these challenges, clinics must develop comprehensive emergency preparedness protocols to ensure continuity of MOUD treatment during future public health emergencies and disasters. These protocols can help equip clinics with strategies they can employ to maintain essential MOUD services, such as providing technology support to improve telemedicine access during significant disruptions or transferring patients to alternative clinics. By proactively developing and implementing these protocols, rural primary care clinics can enhance their resilience and ensure the continuity of vital MOUD services during future public health emergencies, thereby safeguarding the well-being of individuals relying on these services.

Role of funding source

Nothing declared.

CRediT authorship contribution statement

Huiying Guo: Writing – review & editing, Writing – original draft, Methodology, Investigation, Formal analysis. **Zhe Fei:** Writing – review & editing, Methodology. **Stacy Calhoun:** Writing – review & editing, Writing – original draft, Methodology, Investigation, Conceptualization. **Yih-Ing Hser:** Writing – review & editing, Supervision, Methodology, Funding acquisition. **Yuhui Zhu:** Writing – review & editing. **Larissa Mooney:** Writing – review & editing, Funding acquisition. **Chunqing Lin:** Writing – review & editing. **Sarah Clingan:** Writing – review & editing.

Declaration of Competing Interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: Larissa J. Mooney reports a relationship with Aelis Farma that includes: funding grants. If there are other authors, they declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgement

Research reported in this publication was supported by the National Institute on Drug Abuse of the National Institutes of Health under Award Number UG1DA049435. The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institutes of Health.

Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at doi:10.1016/j.dadr.2024.100276.

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