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Short communication

Initiation of medication for opioid use disorder across a health system: A retrospective analysis of patient characteristics and inpatient outcomes

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ABSTRACT

Objectives: Medication for opioid use disorder (MOUD) has gained significant momentum as an evidence-based intervention for treating opioid use disorder (OUD). The purpose of this study was to characterize MOUD initiations for buprenorphine and extended release (ER) naltrexone across all care sites at a major health system in the Midwest and determine whether MOUD initiation was associated with inpatient outcomes.

Methods: The study population comprised patients with OUD in the health system between 2018 and 2021. First, we described characteristics of all MOUD initiations for the study population within the health system. Second, we compared inpatient length of stay (LOS) and unplanned readmission rates between patients prescribed MOUD and patients not prescribed MOUD, including a pre-post comparison of patients prescribed MOUD before versus after initiation.

Results: The 3,831 patients receiving MOUD were mostly white, non-Hispanic and generally received buprenorphine over ER naltrexone. 65.5% of most recent initiations occurred in an inpatient setting. Compared to those not prescribed MOUD, inpatient encounters where patients received MOUD on or before the admission date were significantly less likely to be unplanned readmissions (13% vs. 20%, $p < 0.001$) and their LOS was 0.14 days shorter ($p = 0.278$). Among patients prescribed MOUD, there was a significant reduction in the readmission rate after initiation compared to before (13% vs. 22%, $p < 0.001$).

Conclusions: This study is the first to examine MOUD initiations for thousands of patients across multiple care sites in a health system, finding that receiving MOUD is associated with clinically meaningful reductions in readmission rates.

1. Introduction

As a consequence of the opioid use disorder (OUD) epidemic in American communities, the rates of opioid-related healthcare system encounters have risen sharply over the past decade (Botticelli et al., 2019). During these encounters, patients with OUD can face significant barriers to receiving high quality care, including stigmatization, treatment affordability, accessibility, and poor quality outcomes (Sharma et al., 2017). Consequently, these patients frequently experience adverse inpatient outcomes related to their condition (Hall et al., 2021; Rowell-Cunsolo et al., 2020). Unplanned hospital readmissions, typically defined as non-scheduled inpatient admissions for the same diagnosis within a specified short timeframe, such as 30 days post discharge (McIlvennan et al., 2015), are of particular concern for this patient population due to the prevalence of comorbidities and aforementioned barriers to treatment adherence (Gryczynski et al., 2021; Gupta et al., 2018). These readmissions are not only costly and associated with poor long-term health outcomes (McIlvennan et al., 2015), but also indicate that patients are experiencing unresolved illness, possibly due to inadequate care (Gryczynski et al., 2021).

Recognizing the ongoing adverse outcomes and barriers to treatment that people with OUD experience, there is a clear need for effective OUD treatment to reduce the financial and human costs of these negative outcomes. Medication for OUD (MOUD), viewed as the gold standard first-line intervention for treating OUD (National Institute on Drug Abuse, 2020), offers substantial potential to achieve these objectives. Notably, MOUD can be prescribed across various care settings,

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which may aid in overcoming traditional barriers to treatment that people with OUD frequently face. While MOUD is effective at reducing both illicit opioid use and mortality (National Institute on Drug Abuse, 2020; Weimer et al., 2019), studies examining the impact of MOUD initiation on subsequent hospital utilization metrics have shown mixed results (Moreno et al., 2019; Tierney et al., 2022). This existing work also tends to focus on MOUD initiation at a single care site (Tierney et al., 2022). Therefore, there are open questions about the impact of MOUD that can only be answered by studying the utilization patterns of large samples of OUD patients initiating across an entire health system.

In light of these gaps in the literature, the first goal of this study is to describe the characteristics of patients initiating MOUD for buprenorphine or extended release (ER) naltrexone and identify the site of care of each MOUD initiation at a large Midwest tertiary referral medical center that has prescribed these medications for MOUD across emergency, inpatient, and outpatient care sites since 2018. As MOUD programs continue to expand, it is critical to develop an understanding of individuals who initiate MOUD for ongoing treatment. The second goal of this study is to identify any significant changes in inpatient length of stay or unplanned readmission rate for patients with OUD following buprenorphine and ER naltrexone MOUD initiation compared to those not on medication. This work is among the first to (1) include a large population of patients who received treatment level doses of MOUD in both inpatient and outpatient settings, and (2) compare inpatient outcomes in the population of patients prescribed MOUD before versus after initiation. The findings from our inquiry may inform the value of system-wide MOUD availability on key inpatient treatment outcomes for the OUD population.

2. Methods

2.1. Setting

We conducted a retrospective study at an academic medical center (AMC) located in a large city in the Midwest, serving areas considered to be "hotspots" for the opioid epidemic (McDonald et al., 2012). The health system includes seven acute care hospitals with more than 1500 beds, including two emergency departments, 11 primary care clinics, a clinic for pregnant women with OUD, and a substance use disorder (SUD) treatment facility that provides both inpatient and outpatient comprehensive drug and addiction recovery services. Per federal regulation CFR-42, the authors obtained IRB approval for the project (IRB # 2020B0172)

2.2. Study population and variables of interest

The study population was patients with a diagnosis of OUD (DSM-5 F11) between 1/1/2018 and 12/1/2021. Within this population, a flag was created to denote if the patient had received at least one MOUD prescription for buprenorphine or ER naltrexone within the health system. PO naltrexone was excluded from the study given it is not the standard of care for MOUD. Methadone was also not included, as the medical center did not have a methadone treatment facility during the time of this study. For each MOUD initiation, date, medication type, age at initiation, and site of initiation were extracted from the AMC's Information Warehouse via an Honest Broker. Additional initiations for an individual were considered 'repeat' initiations rather than continuation of treatment if they occurred more than 90 days after a prior prescription, with no ongoing prescriptions (i.e., prescriptions for the same medication following initiation) in between. Patient characteristic variables included an individual's sex, race, and ethnicity. Next, inpatient admissions for the study population were identified, which occurred at the AMC's acute care hospitals or its dedicated SUD treatment facility. We first determined the length of stay for each admission: the raw number of days spent in the hospital as extracted from the electronic health record. We also identified all unplanned readmissions, defined as an unscheduled admission with the same primary diagnosis as an admission less than 30 days ago. This variable included a 30-day lookback from the start of the study period to ensure that unplanned readmissions occurring in the first month of study would not be mistakenly labeled as primary admissions. A binary MOUD variable was created and linked to each admission to denote if the patient had received an MOUD prescription on or before the date of that admission.

Table 1
Demographics initiation characteristics for patients with one or more MOUD initiations at the health system during the study timeframe.

Demographics	*N* = 3831
Age at Most Recent Initiation (SD)	38.6 (11.1)
Sex	
Female	1815 (47.4%)
Male	2016 (52.6%)
Racial Category	
African American / Black	599 (15.7%)
White	3115 (81.3%)
Other	107 (2.8%)
Unknown	10 (0.3%)
Ethnicity	
Hispanic	56 (1.5%)
Not Hispanic	3756 (97.9%)
Unknown	19 (0.5%)
Setting at most recent initiation	
Emergency Department (ED)	443 (11.6%)
Inpatient	2510 (65.5%)
Ambulatory (outpatient, non-ED)	878 (22.9%)
Medicine type of most recent initiation	
Buprenorphine	3680 (96.1%)
ER Naltrexone	151 (3.9%)
Number of Initiations for each unique patient	
1	3125 (81.6%)
2	511 (13.3%)
3	134 (3.5%)
4+	61 (1.9%)

2.3. Analysis

First, descriptive statistics were calculated for all the variables listed above. For admissions, we compared the percentage of unplanned readmissions (amongst all admissions) and average length of stay between (1) patients prescribed buprenorphine or ER naltrexone MOUD versus non-MOUD patients, and (2) patients prescribed MOUD before versus after initiation. We then conducted Pearson's chi-squared tests to assess whether there were significant differences in inpatient outcomes between MOUD status categories. As a measure of effect size for the unplanned readmissions findings, we calculated risk ratios, defined as the ratio of the probability of an unplanned readmission for patients who had received MOUD at that time to the probability of an unplanned readmission for patients who had not received MOUD at that time. All data analysis was performed in STATA version 16.12.

3. Results

A total of 3831 OUD patients were initiated on ER naltrexone or buprenorphine for MOUD at least one time during the study period. Participant characteristics are available in Table 1. About 80% of initiated individuals were White and 98% were non-Hispanic. Of the 3831 unique patients, 81.6% had only one MOUD initiation at the health system. The number of initiations for the remaining 18.4% ranged from two to six within the 3-year study period. Overall, about 11.6% of most recent MOUD initiations occurred in the ED, 65.5% were in inpatient settings, and 22.9% were in ambulatory settings. 96.1% of most recent initiations were of buprenorphine-containing medications, while 3.9% were for ER naltrexone. For individuals who received multiple initia-

Table 2
Characteristics of inpatient encounter by MOUD status at time of admission.

	No MOUD vs. MOUD			Pre and post MOUD		
All Admissions	*N* = 19031	*N* = 4989[1]	p*	*N* = 1632	*N* = 4989	p*
Readmission Rate	20.00%	13.05%	< 0.001*	22.22%	13.05%	< 0.001*
LOS (days)	6.76	6.61	0.278	5.92	6.61	0.002*

* denotes a significant difference between groups at $p < 0.05$.
[1] Sample size here represents number of admissions where patients received MOUD on or before admission date.

tions during the study period, site of care did not differ significantly between initiations (results not shown).

The study population of OUD patients had a total of 24,020 inpatient admissions during the selected period. For the 4989 admissions of patients prescribed buprenorphine or ER naltrexone MOUD (receiving MOUD on or before the admission date), the unplanned readmission rate was 13.05%, compared to 20.00% for the 19,031 admissions of patients who had not received MOUD at the time ($p < 0.001$, Table 2). Deriving a risk ratio from this data, admissions where a patient had received MOUD had 0.65 times the probability of requiring a readmission compared to admissions where the patient had not received MOUD. Examining only the admissions of patients who received MOUD at some point during the study, we found that the unplanned readmission rate among this group dropped from 22.22% before receiving MOUD to 13.05% after receiving MOUD ($p < 0.001$), with a risk ratio of 0.50. Table 2 also displays the length of stay (LOS) between the respective comparison groups. Admissions for patients prescribed MOUD had an average LOS of 6.61 days compared to 6.76 days for patients not on MOUD ($p = 0.278$). Looking only at the admissions of patients prescribed MOUD pre- and post-initiation, the LOS increased from 5.92 days before receiving MOUD compared to 6.61 days after receiving MOUD ($p = 0.002$).

4. Discussion

The main objectives of this study were to (1) characterize the population of patients initiated on MOUD and identify the points of care where initiations occurred at a large Midwest health system, and (2) identify the relationship between MOUD initiation and inpatient outcomes such as unplanned readmission rate. Among the 3831 OUD patients who received buprenorphine or ER naltrexone MOUD anywhere in the health system between 2018 and 2021, we identified statistically significant and operationally meaningful reductions in unplanned readmissions, both when comparing patients prescribed MOUD to those not on MOUD at the time of admission and when comparing patients prescribed MOUD before versus after their initiation. We found that admissions where the patient had MOUD were somewhat shorter than those where the patient did not have MOUD (not significant), however, when comparing patients prescribed MOUD pre and post initiation, we found a significant increase in LOS after receiving MOUD.

The finding that buprenorphine and ER naltrexone MOUD prescriptions reduced the likelihood of unplanned readmissions is an important contribution to the literature. Our findings contradict other similar studies: Tierney et al. (2022) found no significant change in hospital readmissions following MOUD initiation. The authors attribute this finding to the frequent prescription of MOUD at low doses to treat withdrawal at their study site. Tierney et al. also reported results for a much smaller sample of less than 200 patients prescribed MOUD which may have limited their power to detect significant findings. Our readmission findings are robust – highly significant both when comparing MOUD to non-MOUD groups and also comparing patients prescribed MOUD pre and post initiation – and clinically meaningful, with an on average 6.95 percentage point (53.8%) reduction in the unplanned readmission rate for patients prescribed MOUD. Our pre-post analysis also helps address concerns about potential health differences between the two populations that may otherwise explain a reduction in unplanned readmission rates. For this group, admissions after a patient received MOUD had half the probability of requiring a readmission than admissions before a patient received MOUD. Recognizing the negative consequences of readmissions for both the patient and healthcare system (Gryczynski et al., 2021), these reductions suggest that MOUD initiation, occurring across all care sites in a health system, positively impact treatment outcomes for people with OUD.

Regarding LOS, our results suggest that more follow-up work is needed to understand why and how MOUD initiation impacts LOS. The shorter LOS (albeit not at a significant level) for patients prescribed MOUD suggests that initiation may reduce the intensiveness of hospital stays. However, in light of these findings, the significant increase in LOS for patients prescribed MOUD before versus after initiation may appear contradictory. One possible explanation for this increase is that patients receiving MOUD may be more adherent to their care plan, staying in the hospital for treatment rather than leaving against medical advice and requiring additional acute care later on. Such an explanation aligns with the emerging evidence that MOUD is associated with improved engagement in post-discharge outpatient treatment (Weimer et al., 2019). Further, A 2021 analysis of endocarditis admissions found that MOUD initiation was associated with patients receiving more than 5 additional days of the gold-standard antibiotic treatment, (Jo et al., 2021) supporting the notion that LOS increases following MOUD may be driven by improved adherence to evidence-based care processes. Future studies should focus on understanding the drivers of LOS differences in these patients, perhaps in the form of detailed medical records analysis to provide an in-depth evaluation.

This study has some limitations. First, we examined MOUD initiations within a single health system, therefore, generalizing our findings to other health systems should be done with caution. Furthermore, because the data used for this study was internal, initiations or ongoing prescriptions occurring at other health systems would not be detected, which could have altered the total initiation frequency for the population. The exclusion of methadone initiations is a substantial omission given its importance in treating OUD (Barnett, 2009). Finally, we were unable to determine whether patients remained adherent on their medication following MOUD initiation. Future work will continue to explore the impact of system-wide MOUD access on the treatment of OUD patients, while also addressing some of the above limitations. A lack of adherence data can be remedied in subsequent analyses with the addition of state Medicaid data, which will aid in determining how differences in medication adherence impact associations between MOUD and inpatient outcomes. Later studies can also examine methadone initiations, as the health system now has a certified facility. Last, treatment outcomes can expand to other care modalities besides inpatient intervention, in the form of outcomes such as emergency department utilization. As the program continues to reach more patients, subgroup analyses, such as outcome comparisons across racial identities, should become possible.

Nevertheless, given the sample size and robustness of the readmission findings, this study has important implications for the treatment of individuals with OUD, from the perspective of providers and hospital systems. The clinically meaningful reduction in unplanned readmission rates associated with receiving MOUD at a health system where initiation is available at inpatient, outpatient, and emergency care sites

suggests that overarching efforts to enhance MOUD access can offer direct benefits in the form of important utilization metrics. While more work is needed to characterize the mechanism behind the length of stay changes, our analysis and existing scholarship both suggest that systematic MOUD may also facilitate treatment adherence, leading again to better care for the OUD population. This is particularly important in context of infections stemming from intravenous drug use such as sepsis that require extensive courses of antibiotics for optimal outcomes (Alrawashdeh et al., 2021). Health systems should consider the potential multifaceted benefits of widespread MOUD availability in terms of improved inpatient outcomes and reductions in intensive service utilization.

5. Conclusion

Initiating MOUD across different care settings in a health system offers the potential to improve how we treat patients with OUD. Our retrospective study contextualizes characteristics of MOUD treatment while also focusing explicitly on inpatient admission outcomes across MOUD initiation status - finding that MOUD initiation is associated with significantly lower rates of unplanned readmission. Our work suggests that wide-ranging access to MOUD across multiple care sites has the potential to meaningfully improve patient outcomes for the OUD population, particularly as it refers to the diminished likelihood of unplanned readmissions.

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Declaration of Competing Interest

No conflict declared.

CRediT authorship contribution statement

Brian P. O'Rourke: Writing – original draft, Formal analysis, Conceptualization, Methodology. **Tory H. Hogan:** Conceptualization, Methodology, Data curation, Funding acquisition. **Julie Teater:** Data curation, Funding acquisition. **Martin Fried:** Data curation, Funding acquisition. **Margaret Williams:** Data curation, Funding acquisition. **Alison Miller:** Data curation, Funding acquisition. **Aaron D. Clark:** Data curation, Funding acquisition. **Phuong Huynh:** Data curation, Funding acquisition. **Emily Kauffman:** Data curation, Funding acquisition. **Jennifer L. Hefner:** Conceptualization, Methodology, Data curation, Funding acquisition.

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