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## Social determinants of health and continuity of medications for opioid use disorder among patients receiving treatment in rural primary care settings

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### Abstract

**Objectives:** Factors associated with treatment retention on medications for opioid use disorder (MOUD) in rural settings are poorly understood. This study examines associations between social determinants of health (SDoH) and MOUD retention among patients with opioid use disorder (OUD) in rural primary care settings.

**Methods:** We analyzed patient electronic health records from six rural clinics. Participants (N=575) were adult patients with OUD and had any prescription for MOUD from October 2019 to April 2020. MOUD retention was measured by MOUD days and continuity defined as continuous 180 MOUD days with no more than a 7-day gap. Mixed-effect regressions assessed associations between the outcomes and SDoH (Medicaid insurance, social deprivation index [SDI], driving time from home to the clinic), telehealth use, and other covariates.

**Results:** Mean patient MOUD days was 127 days (SD=50.7). Living in more disadvantaged areas (based on SDI) (adjusted Relative Risk (aRR): 0.98, 95% CI: 0.98-0.99) and having more than an hour (compared to an hour or less) driving time from home to clinic (aRR: 0.95, 95% CI: 0.93-0.97) were associated with fewer MOUD days. Using telehealth was associated with more MOUD days (aRR: 1.23, 95% CI: 1.21-1.26). In this cohort, 21.7% of the participants were retained on MOUD for at least 180 days. SDoH and use of telehealth were not associated with having continuity of MOUD.

**Conclusions:** Addressing SDoH (e.g., SDI) and providing telehealth (e.g., improvements in public transportation, internet access) may improve MOUD days in rural settings.

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**Conflict of interest:** No

## Keywords

Social determinants of health; retention; medications; rural; primary health care

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## INTRODUCTION

Rural areas in the United States have had an increasing number of overdose fatalities since 1999 and more overdose deaths involving prescription opioids compared to urban areas in the mid-2000s through 2017 and in 2020.<sup>1,2</sup> Medications for opioid use disorder (MOUD) are effective in reducing drug use and risk of overdose deaths,<sup>3</sup> but retention on MOUD is crucial to achieving improved outcomes.<sup>4,5</sup> MOUD retention for at least 180 days is a quality measure endorsed by the National Quality Forum (NQF).<sup>6</sup>

Previous studies have indicated that social determinants of health (SDoH), defined as “circumstances in which people grow, live, work, and age” impact various aspects of health,<sup>7</sup> including MOUD retention. Limited research exists on SDoH and MOUD retention in rural areas. The objective of this study fills this gap by examining the association between SDoH and several other factors with MOUD retention among patients with OUD in rural primary care settings.

## METHODS

### Study Population

This study conducted a secondary analysis using patient electronic health record (EHR) data from six rural clinics located in Maine, Washington, and Idaho. These clinics participated in a feasibility study (NIDA CTN-0102) aimed at expanding MOUD in rural areas,<sup>8</sup> and provided EHR data from October 2019 to October 2020. The parent study applied the Health Resources and Services Administration’s rural definition and verified the clinics’ rural location using the “Am I Rural” tool.<sup>8</sup> Study participants (N=575) included adult patients with an OUD diagnosis, using the ICD-10-CM and SNOMED code lists (Supplement C) and at least one MOUD prescription between October 2019 and April 2020. Most participants (99%) received buprenorphine, with only 1% prescribed naltrexone. The study was approved by the BRANY Institutional Review Board (IRB) and registered as [NCT04418453](https://clinicaltrials.gov/ct2/show/study/NCT04418453) at [Clinicaltrials.gov](https://clinicaltrials.gov).<sup>8</sup>

### Measures

We examined MOUD retention using two measures: 1) total number of MOUD days during the 180 days after the first MOUD prescription, and 2) continuity of MOUD (Y/N), defined as having continuous MOUD for 180 days without a gap of more than 7 days, based on the NQF definition (Supplement A).<sup>6</sup>

Patient-level data included age groups, sex, race, diagnosis of chronic pain, a mental health disorder (MHD), or other substance use disorder (SUD), and telehealth use. SDoH variables included Medicaid insurance coverage, participants’ driving time, and social deprivation index (SDI) scored from 1 (least deprived) to 100 (most deprived), and then rescaled by

dividing by 10.<sup>9</sup> To control for MOUD treatment initiation before the observation period, we measured whether a patient's first prescription was within October to November 2019 ("group 1 initiators") vs. initiated later ("group 2 initiators"). Clinic-level data included numbers of buprenorphine providers in the clinic ZIP code and high-need area scores (see Supplement B).<sup>10</sup>

### Statistical Analysis

Univariate group differences were tested by Chi-square or Fisher exact tests for categorical variables and t-test or ANOVA for continuous measures. To account for clustering within clinic sites, we used mixed-effect logistic regression analysis to calculate adjusted Odds Ratio (aOR) estimates for the continuity of MOUD. Additionally, mixed-effect Poisson regression was used to calculate the adjusted Relative Risk (aRR) estimates for the number of MOUD days (Model 1). To explore potential different effects due to participant heterogeneity, we included interaction terms between initiator group and SDoH factors and telehealth use if the main effect was significant (Model 2). All analyses were conducted using SAS 9.4 (SAS Institute, Cary, North Carolina, USA). Two-sided  $p < .05$  was interpreted as statistically significant.

## RESULTS

Descriptive statistics are shown in Table 1. Mean MOUD days was 127 (SD=50.7). Median MOUD days was 144, with an interquartile range (IQR) from 92 to 172. In this cohort, 125 (21.7%) participants met the continuity of MOUD care definition.

In Model 1 (Table 2), SDI and driving more than an hour to the clinic were associated with lower MOUD days, while use of telehealth was positively associated with MOUD days. In Model 2 (Table 2), participant group did not impact SDI-MOUD days relationship. Driving 60 minutes or more to the clinic was associated with fewer MOUD days in group 2 initiators. Telehealth use was associated with increases in MOUD days for both patient groups, and the increase was higher in group 2 initiators than in group 1 initiators. Regarding continuity of care, participants in group 1 initiators were more likely to meet the continuity of MOUD criterion compared to those in group 2 initiators (aOR: 2.2, 95% CI: 1.2-4.1). None of the SDoH or telehealth use were related to MOUD continuity.

## DISCUSSION

This study sheds light on associations between SDoH and MOUD retention in rural areas and has identified additional factors related to MOUD retention. While NQF-endorsed continuity of MOUD ensures a standardized quality criterion, MOUD days are more sensitive to variations in predictors, which is critical for risk factor identification. We find that living in disadvantaged areas was associated with shorter MOUD duration. Consistent with previous studies, longer distance from clinics negatively affected treatment retention,<sup>11</sup> while telehealth utilization increases MOUD days, emphasizing its importance for treatment retention in rural settings.<sup>12</sup> However, these relationships may depend on MOUD stability (measured by the initiators group). It is possible that participants in the group 1 initiators demonstrating longer treatment retention had been previously maintained on MOUD and

thus had greater stability in their treatment. This is consistent with the finding that longer driving distance was associated with fewer MOUD days among group 2 initiators but not the group 1 initiators, and that group 2 initiators benefitted more from the telehealth use than group 1 initiators.

In our study, 21.7% of participants met the NQF-endorsed quality measure for the continuity of MOUD care. Previous studies have used varying definitions for premature discontinuation of MOUD, making comparisons challenging.<sup>13,14</sup> Using the NQF definition, Cole et al. reported a 49% retention rate<sup>11</sup> while Johnson et al. reported a 38% retention rate.<sup>14</sup> Although there could be many reasons for this variation (e.g., target population, geographical location), the present study covers a period heavily impacted by COVID-19, which could result in its lower retention rate. Overall, the low treatment retention rate in this study highlights challenges faced by rural settings in treating patients with OUD. Considering that MOUD treatment retention is likely to lower the risk of overdose,<sup>4</sup> enhancing the retention rate in rural areas is of utmost importance.

### Limitations

First, this analysis did not account for the study intervention that started in August of 2020 which may have influenced retention for those who started MOUD later in the observation period. However, the intervention influence is expected to be minor,<sup>8</sup> as it had limited overlap with observation timeframe. Second, more than 90% of the study sample were White, limiting our ability to investigate race-related differences. Further studies are needed to establish causality between study factors and MOUD treatment retention in rural areas. Future studies should also explore the impact of other factors (e.g., medication dosage and behavioral treatment) on MOUD retention.

### CONCLUSIONS

This study highlights that SDoH are associated with MOUD treatment retention in rural areas, and telehealth utilization facilitates MOUD retention. These findings indicate that addressing SDoH and incorporating telehealth (e.g., improvements in public transportation, internet access) may improve MOUD care in rural settings.

### Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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**Table 1.**

Patient characteristics of continuity of care group (N=575)

	Total		Total MOUD days		Continuity of MOUD care (yes)	
	N	% of total/mean(SD)	Mean (SD)	P value	N (row%)/Mean (SD)	P value
	<b>575</b>	100%	<b>127 (50.7)</b>		<b>125 (21.7%)</b>	
<b>Age</b>	<b>575</b>					
18-34	250	43%	125.1 (50.9)	0.15	50 (20%)	0.4
35-49	224	39%	125 (52.1)		48 (21.4%)	
50	101	18%	135.9 (46.9)		27 (26.7%)	
<b>Gender</b>	<b>575</b>					
Female	249	43%	134.3 (46.8)	<b>0.002</b>	62 (24.9%)	0.11
Male	326	57%	121.4 (52.9)		63 (19.3%)	
<b>Race</b>	<b>557</b>					
White	518	93%	128.7 (49.8)	0.15	117 (22.6%)	0.3
Non-white	39	7%	116.5 (57.1)		6 (15.4%)	
<b>Other SUD diagnoses</b>	<b>575</b>					
No	484	84%	124.9 (52.0)	<b>0.009</b>	106 (21.1%)	0.4
Yes	91	26%	138.0 (41.9)		29 (25.3%)	
<b>Chronic pain diagnoses</b>	<b>575</b>					
No	379	66%	122.3 (52.3)	<b>0.002</b>	74 (19.5%)	0.07
Yes	196	34%	135.9 (46.4)		51 (26.0%)	
<b>Any mental health disorders</b>	<b>574</b>					
No	255	44%	118.4 (55.3)	<b>&lt;.001</b>	56 (21.9%)	0.33
Yes	319	56%	133.8 (45.7)		69 (21.6%)	
<b>Insurance</b>	<b>575</b>					
Not Medicaid	219	38%	125.4 (50.4)	0.56	46 (21%)	0.2
Medicaid	356	62%	127.9 (51.0)		79 (22.2%)	
<b>Social deprivation</b>	<b>574</b>					
Total SDI score		4.8(1.8)	NA	NA	4.9 (1.6)	0.46
<b>Driving time from home to clinic (t)</b>	<b>575</b>					
t≤60 min	429	75%	128.0 (49.6)	0.38	96 (22.4%)	0.53
t>60 min	146	25%	123.7 (54.1)		29 (19.9%)	
<b>Telehealth utilization</b>	<b>574</b>					
No	241	42%	113.8 (57.3)	<b>&lt;.001</b>	47 (19.5%)	0.27
Yes	333	58%	136.5 (43.0)		78 (23.4%)	
<b>First MOUD prescription</b>	<b>575</b>					
Group 2 initiators	109	19%	108.8 (56.9)	<b>&lt;.001</b>	14 (12.8%)	<b>0.01</b>
Group 1 initiators	466	81%	131.2 (48.3)		111 (23.8%)	

MOUD= Medication for OUD . SUD= Substance Use Disorder, SDI= Social Deprivation Index. T test/Chi-square tests were used to test the differences in MOUD days/ Continuity among groups. Bolded numbers mean significant level at p< .05

**Table 2.**

Mixed-effect regression model results

Factors	Number of MOUD days		Continuity of MOUD care for 180 days
	Model 1 aRR (95% CI)	Model 2 aRR (95% CI)	aOR (95% CI)
<b>Age,y</b>			
18-34	Reference	Reference	Reference
35-49	1.007 (0.990, 1.024)	1.001 (0.985, 1.018)	1.113 (0.697, 1.778)
50	<b>1.054 (1.030, 1.078)***</b>	<b>1.065 (1.041, 1.090)***</b>	1.262 (0.677, 2.352)
<b>Sex</b>			
Male	Reference	Reference	Reference
Female	<b>1.074 (1.058, 1.091)***</b>	<b>1.076 (1.060, 1.093)***</b>	1.395 (0.92, 2.115)
<b>Race</b>			
Non-White	Reference	Reference	Reference
White	<b>1.085 (1.052, 1.119)***</b>	<b>1.077 (1.044, 1.111)***</b>	1.658 (0.655, 4.197)
<b>Other SUD diagnoses</b>			
No	Reference	Reference	Reference
Yes	<b>1.073 (1.051, 1.096)***</b>	<b>1.072 (1.049, 1.095)***</b>	1.328 (0.75, 2.348)
<b>Chronic pain diagnoses</b>			
No	Reference	Reference	Reference
Yes	<b>1.033 (1.015, 1.051)***</b>	<b>1.034 (1.016, 1.052)***</b>	1.354 (0.85, 2.157)
<b>Any mental disorder disorders</b>			
No	Reference	Reference	Reference
Yes	<b>1.025 (1.008, 1.042)**</b>	<b>1.027 (1.010, 1.044)**</b>	0.743 (0.471, 1.171)
<b>Insurance</b>			
Not Medicaid	Reference	Reference	Reference
Medicaid	1.009 (0.992, 1.026)	<b>1.019 (1.002, 1.036)*</b>	1.172 (0.74, 1.854)
<b>SDI score</b>	<b>0.982 (0.978, 0.986)***</b>	<b>0.977 (0.968, 0.986)***</b>	1.006 (0.994, 1.019)
<b>Driving time from home to clinic</b>			
t <= 60 min	Reference	Reference	Reference
t >60 min	<b>0.95 (0.932, 0.969)***</b>	<b>0.893 (0.851, 0.937)***</b>	0.775 (0.456, 1.319)
<b>Telehealth utilization</b>			
No	Reference	Reference	Reference



Factors	Number of MOUD days		Continuity of MOUD care for 180 days
	Model 1 aRR (95% CI)	Model 2 aRR (95% CI)	aOR (95% CI)
Yes	1.233 (1.211, 1.255)***	1.505 (1.444, 1.568)***	1.458 (0.894, 2.377)
<b>First MOUD prescription</b>			
Group 2 initiators	Reference	Reference	Reference
Group 1 initiators	1.138 (1.115, 1.162)***	1.262 (1.184, 1.345)***	2.187 (1.163, 4.113)*
Group 1 initiators* Telehealth utilization	NA	0.787 (0.753, 0.822)***	NA
Group 1 initiators* Driving time (>60min)	NA	1.074 (1.021, 1.131)**	NA
Group 1 initiators* SDI	NA	1.008 (0.998, 1.019)	NA
<b>Clinic characteristic</b>			
Number of buprenorphine prescribers	0.966 (0.896, 1.042)	0.964 (0.892, 1.041)	0.984 (0.952, 1.017)
High need area scores	1.010 (0.987, 1.034)	1.01 (0.986, 1.035)	1.005 (0.991, 1.02)

MOUD= Medication for OUD. SUD= Substance Use Disorder. SDI= Social Deprivation Index. aRR= adjusted Relative Risk. aOR= adjusted Odds Ratio. CI= Confidence Interval.

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p<.001,

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p<.01,

\*  
p<.05