



Receipt of medications for opioid use disorder among rural and urban veterans health administration patients

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HIGHLIGHTS

- Among 66,842 VA patients diagnosed with opioid use disorder, 27.4 % were in rural settings.
- Rural patients had a lower likelihood of accessing any form of medication for opioid use disorder.
- Rural patients had a lower likelihood of receiving methadone and naltrexone.
- Rural patients had a higher likelihood of receiving buprenorphine.

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ABSTRACT

Aim: We examined differences in medications for opioid use disorder (MOUD) receipt between rural and urban veteran patients following initiatives within the US Department of Veterans Affairs (VA) to expand access to MOUD.

Methods: Data for this retrospective cohort study were obtained from the VA Corporate Data Warehouse, which contains national electronic health record data for all VA patients. The analytic sample included all patients diagnosed with OUD from 10/1/2018–9/30/20. Rurality was identified by the Rural Urban Commuting Area (RUCA) code of patients' home address. Associations between rurality and MOUD receipt, as well as type of MOUD received, were examined using logistic regression.

Results: Among 66,842 patients with OUD, 27.4 % were rural residents. Compared to urban patients, rural patients were slightly younger (50.1 vs. 52.5 years), more often white (87.7 % vs. 70.3 %) and less often received MOUD (42.6 % vs 45.5 %). Multivariable models confirmed that rural patients had a lower likelihood of accessing any form of MOUD (aOR = 0.84, 95 % CI: 0.81–0.87) relative to urban VA patients. Medication-specific analyses identified a lower likelihood of receiving methadone (aOR = 0.36, 95 % CI: 0.33–0.39) and naltrexone (aOR = 0.89, 95 % CI: 0.80–0.99) among rural patients, but higher likelihood of receiving buprenorphine (aOR = 1.05, 95 % CI: 1.01–1.09).

Conclusion: Rural VA patients have a lower likelihood of receiving methadone and naltrexone for OUD treatment relative to urban patients, but greater likelihood of receiving buprenorphine. Continued work is needed to ensure that rural Veterans have equitable access to the most appropriate medication for their health care needs.

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1. Introduction

Opioids were involved in more than 75 % of all US drug overdose deaths in 2022 ([Drug Overdose Death Rates, 2023](#)). Effective medications for opioid use disorder (OUD) exist but are underutilized. Gold standard medication treatment for OUD (MOUD) includes buprenorphine, a partial agonist medication, methadone, an agonist medication, and extended-release naltrexone, an antagonist medication ([National Academies of Sciences, 2019](#)). In the United States (US) in 2022, an estimated 3.7 % (9367,000) of adults needed treatment for OUD, yet only 25.1 % received medication to treat OUD ([Dowell et al., 2024](#)), indicating that there are still considerable gaps in access to this evidence-based treatment.

Availability of MOUD also varies by medication; a 2022 study of accountable care organizations (ACOs) with Medicare and Medicaid contracts found that 51 % offered buprenorphine, 41 % offered extended-release naltrexone, and 27 % offered methadone ([Newton et al., 2024](#)). Further, a 2024 study of community outpatient mental health treatment facilities found that 84 % offered buprenorphine, 70 % offered extended-release naltrexone, and 14 % offered methadone ([Cantor et al., 2024](#)). The prevalence of each medication is also indicative of prescriber availability. Buprenorphine can be prescribed in any office-based medical setting (e.g., primary care, psychiatry), whereas methadone can only be dispensed in opioid treatment programs (OTPs), of which there were over 2000 in the US in 2022 ([Medications for the Treatment of Opioid Use Disorder, 2024](#)). Efforts to increase access to MOUD have become even more important given the mortality risks posed by the rise of fentanyl in the US drug supply ([Ciccarone, 2021](#)).

US military veterans have also been affected by the opioid epidemic, with an estimated 0.71 % of VA patients meeting the diagnostic criteria for OUD ([Opioid Use Disorder Fact Sheet, 2022](#)). Veterans are a uniquely vulnerable population, with higher risks of mental health diagnosis, substance use disorders (SUD), post-traumatic stress disorder (PTSD), and suicide compared to the civilian population ([Betancourt et al., 2021](#); [Ernstmeier and Christman, 2022](#)). Veterans who engage with the US Department of Veterans Affairs (VA) Health Care Systems are more likely to be Black, have lower household income, and screen positive for lifetime mental health conditions ([Meffert et al., 2019](#)). Among veterans diagnosed with OUD who receive care within the VA, more than 40 % receive a medication to treat OUD ([Gordon et al., 2023](#)). Prior research has indicated that male gender, white race, and younger age are associated with greater receipt of MOUD ([Jones et al., 2023](#); [Finlay et al., 2021, 2016](#); [Wyse et al., 2019](#)). In addition, medical complexity as indicated by the presence of non-OUD substance use disorders and comorbid mental health disorders decrease MOUD utilization ([Ford et al., 2021](#); [Xu et al., 2022 and 2023](#)).

Rural VA patients, who comprise 23 % of all VA patients, historically have had poorer access to MOUD ([Cowper et al., 2017](#); [Rubin, 2020](#); [Teeters et al., 2017](#)). In 2012, veterans with a rural residence had 27 % lower adjusted odds of receiving MOUD, a gap that had declined to 19 % lower odds by 2017 ([Finlay et al., 2021, 2016](#)). Documented barriers rural patients face to accessing MOUD include a dearth of credentialed prescribers and few OTPs licensed to dispense methadone in rural areas ([Ghertner et al., 2019](#); [Jones et al., 2018](#); [Joudrey et al., 2021](#); [Lister et al., 2020](#); [Wyse et al., 2018](#)). More generally, a lack of specialized medical providers in rural areas often creates barriers to treatment receipt resulting from prohibitively long travel distances required to access specialty care ([Amiri et al., 2018](#); [Buzza et al., 2011](#); [Cyr et al., 2019](#); [Joudrey et al., 2019](#)). Additional barriers include stigma among both patients and providers regarding OUD as well as medications to treat OUD that result in a reluctance to prescribe the medications on the part of providers and use the medications on the part of patients ([Showers et al., 2021](#)).

In research examining differences in MOUD access in rural versus urban VA facilities, Wyse and colleagues (2023) examined average differences in the proportion of patients receiving MOUD between VA

Health Care Systems classified as rural ($n = 15$) from those classified as urban ($n = 114$) and found that a similar proportion of patients were treated with MOUD in rural and urban systems in all study years. Finlay and colleagues (2016; 2021) examined receipt of MOUD generally, not medication specific, among VA patients and justice involved veterans. Finlay found in both studies that rural veteran were less likely to receive MOUD than their urban counterparts ([Finlay et al., 2016 and 2021](#)).

In recent years, the VA has implemented national programs to reduce opioid-related adverse outcomes and increase the accessibility of MOUD, with a particular focus on buprenorphine. Efforts include the Stepped Care for Opioid Use Disorder Train the Trainer Initiative (SCOUTT), evidence-based educational outreach and technical assistance to clinicians provided by clinical pharmacists (academic detailing), and greatly expanded use of buprenorphine-prescribing and management via telehealth ([Frost et al., 2022](#); [Gordon et al., 2020](#); [Hawkins et al., 2021](#); [Wyse et al., 2024a](#); [Wyse et al., 2018](#); [Wyse et al., 2024b](#)). Additionally, outside of the VA, policy changes have reduced barriers to receiving buprenorphine, for instance, no longer requiring providers to obtain an “x- waiver” to prescribe ([SAMHSA Applauds Expansion of Access to Medication for Opioid Use Disorder \(MOUD\), 2023](#)). Other harm reduction programs implemented by the VA include the overdose education and naloxone distribution program (OEND) and syringe service programs. OEND was created to increase access to and educate veterans on the use of naloxone ([Pauly et al., 2018](#)). Syringe service programs distribute syringes, fentanyl test strips, wound care kits, and safe sex kits ([Rife-Pennington et al., 2023](#)). These efforts may have further diminished disparities between rural and urban VA patients in access to MOUD generally, and buprenorphine specifically, since last evaluated in 2017 ([Finlay et al., 2021](#)).

This study examined differences in overall and medication specific MOUD receipt between rural versus urban VA patients, which addresses limitations of prior work that focused on differences between rural and urban facilities ([Wyse et al., 2023](#)) and work that examined MOUD generally, rather than specific medication type ([Finlay et al., 2016, 2021](#)). We hypothesized that Veterans in rural areas would be less likely to receive MOUD as they are further from health care providers and other SUD resources than those in urban locations.

2. Methods

2.1. Study design and data source

This is a retrospective cohort study using VA administrative data. This study was approved by the Institutional Review Board of the VA Portland Health Care System. Data for this study were obtained from the VA Corporate Data Warehouse (CDW), which contains national patient-level data for all patients receiving care within the VA. Eligible participants included Veterans with at least two documented clinical encounters in inpatient or outpatient settings with a diagnosis of OUD, identified using International Classification of Diseases – 10th Revision – Clinical Modification (ICD-10-CM) diagnosis codes (see Appendix III). Prior research utilizing VA administrative data has used two or more OUD diagnoses to enhance accuracy ([Lagisetty et al., 2021](#)) given some inaccuracy in OUD diagnoses when utilizing a single OUD diagnosis ([Howell et al., 2021](#); [Scherrer et al., 2023](#)). The index OUD diagnosis was defined as the first OUD diagnosis within the two-year study period, 10/1/2018–9/30/20. Demographic variables were defined at the time of the index OUD diagnosis, when applicable. Patients were followed for one-year post-index diagnosis to collect information on MOUD utilization within the cohort.

The timeframe of this study overlaps with the beginning of the COVID-19 pandemic. Research has shown that policy changes enacted during COVID-19 allowed patients who were already engaged in MOUD treatment to continue ([Stein et al., 2023](#)). However, new patients were less likely to initiate MOUD care ([Stein et al., 2023](#)). Thus, there may have been a lower rate of new treatment engagement over the study

period than would be the case in a different period.

2.1.1. Analytic sample

The initial dataset included all veterans receiving care within the VA who met the OUD diagnosis inclusion criterion during the study period ($n = 69,999$). Veterans were excluded if they died within the year following the index date ($n = 2770$). Participants were also excluded if they were missing information on the independent variable of interest, rurality ($n = 56$). After applying the exclusion criteria for this cohort, the final analytic sample was $n = 66,842$, Appendix I.

2.2. Measures

Rurality was defined by Rural-Urban Commuting Area (RUCA) code of patients' home address and categorized as urban, rural, and highly rural, consistent with VHA's definition. See Appendix II. Due to the small number of highly rural Veterans, we combined Veterans living in highly rural regions with those residing in rural settings into a single category of rural/highly rural, RUCA codes 2.0–10.3. Differences in descriptive statistics between rural and urban populations were examined for statistical significance, see Table 1. The dependent variable of interest for this analysis was receipt of any form of MOUD (buprenorphine, methadone, or extended-release naltrexone) in the year following the participants' index OUD diagnosis, coded as yes vs. no. "Any MOUD" was defined as a prescription for buprenorphine, clinical visit to an OTP, or injection of extended-release naltrexone. For the "Any MOUD" variable, yes meant an individual received one or any combination of the previously listed MOUD, as to not count individuals twice who received different MOUD types during the study period. We excluded buprenorphine formulations indicated for the treatment of chronic pain. Within the VA system, methadone dispensation is not recorded in pharmacy data and must be approximated by observing visits to an OTP via stop code 523 (Oliva et al., 2012); thus, 523 stop code visits to VA facilities with OTPs was used as a proxy measure for receiving methadone. Prior research suggests that an estimated 95 % of patients visiting VA OTPs receive methadone, rather than buprenorphine (Oliva et al., 2012).

2.2.1. Covariates

Age at index date, sex assigned at birth, and race were extracted from the CDW for each patient in the cohort. In addition, we identified individual non-OUD SUD and individual psychiatric diagnoses associated with a clinical encounter in the year prior to the index date. Non-OUD SUD diagnoses included cannabis, cocaine, stimulants, inhalants, and tobacco. Mental health diagnoses included depressive, anxiety, PTSD, personality, schizophrenia, and bipolar disorders. All diagnoses were coded as yes for presence of a diagnosis in the year prior to the index date or no for the absence of the diagnosis.

2.3. Analysis

Descriptive statistics characterized demographic characteristics and MOUD receipt for the full sample and stratified by rural-urban status. Chi-squared cross tabulations were run to analyze the differences in characteristics between rural and urban populations. Associations between veterans' rurality and receipt of any MOUD were first estimated using bivariable logistic regression. Multivariable models subsequently assessed the stability of the association after controlling for demographic variables (age, sex, race), SUD diagnoses, and psychiatric diagnoses. The same analyses were conducted for individual MOUD: buprenorphine, methadone, and extended-release naltrexone. All models adjusted for standard errors of the estimate. Odds ratios (ORs) and adjusted odds ratios (aORs) with accompanying 95 % confidence intervals (CIs) are reported for all models.

Models were assessed for multicollinearity and goodness of fit using the variance inflation factor (VIF) and Akaike information criterion (AIC). The VIFs for each adjusted model revealed no collinearity. AIC

was run for each unadjusted and adjusted model. AICs for the adjusted models indicated a better fit, as evidenced by the decreased AIC in the adjusted models, compared to the unadjusted models.

R version 4.3.0 was used to conduct all analyses. This study was approved by the Institutional Review Board of the VA Portland Health Care System.

3. Results

3.1. Participants

Rural-residing veterans comprised 27.4 % of the study sample. Veterans in rural areas were slightly younger, on average, than urban veterans (50.1 years vs. 52.5 years), more likely to be of white race (87.7 % vs. 70.3 %), and less likely to be of Black race (5.7 % vs. 23.0 %) (Table 1).

Although rural patients had equal prevalence of previous mental health diagnosis overall (68.7 % vs 68.9 %), rural patients had a lower prevalence of mood, personality, and schizophrenia/bipolar disorder diagnoses, and a higher prevalence of PTSD diagnosis (40.0 % vs 36.9 %). Patients in rural settings were less likely to be diagnosed with a non-OUD SUD (63.8 % vs. 69.3 %), with lower prevalence of alcohol, cannabis, cocaine, and tobacco use disorders, but higher prevalence of stimulant use disorder (19.7 % vs 18.8) (Table 1).

3.2. MOUD receipt among veterans, by rurality

Among VA patients with OUD living in rural areas, 42.6 % received any form of MOUD over the study period. Of those who received MOUD over the study period, 90.2 % were prescribed buprenorphine, 11.5 % received methadone, and 6.0 % received extended-release naltrexone. Among patients with OUD living in urban areas, 45.5 % were prescribed any MOUD over the study period. Of urban patients who received MOUD over the study period 74.9 % were prescribed buprenorphine,

Table 1

Characteristics of veterans diagnosed with OUD from 10/1/2018–9/30/20, by Rural/Urban Residence ($n = 66,842$).

	Rural ($n = 18,348$)		Urban ($n = 48,494$)		P-Value
Sex, n (%)					
Male	16,948	(92.4)	44,598	(92.0)	0.08
Female	1400	(7.6)	3896	(8.0)	0.08
Age, mean years (SD)	50.1	(14.5)	52.5	(14.2)	< 0.01 *
Race, n (%)					
White	16,091	(87.7)	34,099	(70.3)	< 0.01 *
Black	1050	(5.7)	11,130	(23.0)	< 0.01 *
Native American/ Alaska Native	241	(1.3)	380	(0.8)	< 0.01 *
Native Hawaiian/ Pacific Islander	102	(0.6)	318	(0.7)	0.14
Asian	44	(0.2)	206	(0.4)	< 0.01 *
Race Unknown	820	(4.5)	2361	(4.9)	0.03 *
Mental Health Diagnosis, n (%)	12,604	(68.7)	33,417	(68.9)	0.60
Mood Disorder	8124	(44.1)	22,176	(45.5)	< 0.01 *
Anxiety	350	(1.9)	923	(1.9)	0.99
PTSD	7354	(40.0)	18,012	(36.9)	< 0.01 *
Personality Disorder	1687	(9.2)	4822	(9.9)	< 0.01 *
Schizophrenia/Bipolar Disorder	3062	(16.6)	9122	(18.7)	< 0.01 *
Non-OUD Substance Use Disorder Diagnosis, n (%)	11,699	(63.8)	33,586	(69.3)	< 0.01 *
Alcohol	7129	(38.7)	21,503	(44.1)	< 0.01 *
Cannabis	4586	(24.9)	12,737	(26.1)	< 0.01 *
Cocaine	2815	(15.3)	13,086	(26.8)	< 0.01 *
Stimulants	3626	(19.7)	9178	(18.8)	< 0.01 *
Inhalants	38	(0.2)	119	(0.2)	0.47
Tobacco	5955	(32.4)	16,976	(34.8)	< 0.01 *

* = Significant p value of < 0.05

31.8 % received methadone, and 6.4 % received extended-release naltrexone. Distribution of MOUD by rurality is displayed in Table 2.

In adjusted models, rural veterans had a lower likelihood of receiving any form of MOUD (buprenorphine, methadone, or naltrexone) relative to veterans living in urban areas (aOR= 0.79; 95 % CI: 0.73–0.85). However, results differed by medication type. Veterans residing in rural areas had a greater likelihood of accessing buprenorphine than those in urban areas (aOR= 1.11; 95 % CI: 1.03–1.20), but a lower likelihood of receiving methadone (OR= 0.26; 95 % CI: 0.22–0.30) compared to those in urban areas. Rurality was unassociated with receipt of extended-release naltrexone (aOR= 0.81; 95 % CI: 0.48–1.38).

4. Discussion

4.1. Summary of findings

Veterans in the sample received MOUD at a rate of 42.6 % and 45.5 % for rural and urban locations, respectively. Of those with past year OUD diagnosis in the general patient population, only 22.3 % received MOUD (Jones et al., 2023). The notably higher rate of MOUD received by VA patients relative to the general population may reflect the potential effectiveness of VA policies to expand access to MOUD (Wyse et al., 2018), as well as the potential benefits of an integrated healthcare system (Blanco et al., 2020).

Consistent with prior research, this study revealed a disparity between rural and urban VA patients in likelihood of receiving MOUD overall (Finlay et al., 2021), although the prevalence of MOUD receipt for both urban and rural VA patients has increased over time. In the current study 42.6 % of rural and 45.5 % of urban patients received MOUD, compared to 37 % of rural patients and 43 % of urban VA patients in the 2017 fiscal year (Finlay et al., 2021). This study's medication-specific analyses provide additional context around the rural-urban medication gap, revealing that the disparity in patient access to MOUD is largely explained by a significantly lower rate of methadone utilization among rural patients (4.9 % vs 14.5 %). In contrast, we found that buprenorphine was utilized more frequently by rural patients relative to their urban counterparts (38.4 % vs 34.1 %).

These findings are consistent with prior research. Wyse and colleagues (2023) found a higher prevalence of buprenorphine receipt in rural VA facilities compared to urban facilities (45.0 % vs 39.6 %) and a lower rate of methadone utilization (6.0 % vs 12.7 %). Higher receipt of buprenorphine among rural patients could be a result of recent VA initiatives to improve MOUD access in rural areas as well as federal policy changes, for instance, providers are no longer required to obtain an x-

waiver to prescribe (SAMHSA Applauds Expansion of Access to Medication for Opioid Use Disorder (MOUD), 2023). Methadone receipt is likely lower among rural patients due to the lack of OTP facilities located in rural areas. Previous studies have identified policy barriers to accessing methadone, including the restriction of dispensation to federally certified OTPs, which are often located in large, urban areas, and burdensome requirements placed upon patients receiving methadone (Haffajee et al., 2018, Wyse et al., 2023).

Although access to MOUD for rural patients has improved, these findings make clear that continued efforts are needed to close the rural-urban gap in MOUD utilization. One strategy to improve access for rural patients is to increase buprenorphine prescribing within primary care, which is often more accessible to rural patients. Prior research has identified strategies utilized by rural VA sites that had improved primary care access to buprenorphine over time. Successful strategies included targeted hiring, often of a clinical pharmacist, a champion to encourage buy-in and support team-based care, and clinical redesign—all of which were facilitated by active support from leadership. (Wyse et al., 2024a). The recent addition of Sublocade, a form of extended-release buprenorphine, to the VA formulary may also help address the rural-urban gap in access. Sublocade remains active in the body for up to 30 days, thereby potentially alleviating the perceived need for frequent in-person clinic visits to assess medication adherence in the early stages of treatment. Telehealth flexibilities initiated during the COVID-19 public health emergency, which, among other changes, allowed patients to initiate buprenorphine without an in-person clinical visit, may also prove beneficial for rural patients. However, the full impact of these policy changes may not be realized in the absence of structural interventions to address limited broadband access in rural areas and/or technological training and supports for rural patients (Leung et al., 2023; O'Shea et al., 2024).

Additional efforts are also warranted to increase rural patient access to methadone specifically. Such efforts may be increasingly important given the rising role of fentanyl in the opioid crisis (Ciccarone, 2021), as some research suggests that patients may experience challenges initiating buprenorphine in the context of fentanyl use (Varshneya et al., 2022). The VA is currently undertaking a pilot program to provide methadone via mobile methadone units, a program that could serve rural communities experiencing high need for treatment (National Drug Control Strategy, 2022). If the pilot is successful, such an approach could be expanded, and potentially increase methadone accessibility. Recent policy changes, which now allow eligible patients to receive up to 28 days of methadone “take-homes” far earlier in the treatment process than was previously the case, may also allow rural patients greater

Table 2

Receipt of MOUD among VA Patients Diagnosed with OUD from 10/1/2018–9/30/20, by Urban/Rural Residence (n = 66,842).

	Rural n = 18,348		Urban (ref.) n = 48,494		Unadjusted Models OR (95 % CI)		Adjusted Models* aOR (95 % CI)	
Any MOUD, n (%)								
No	10,537	(57.4)	26,432	(54.5)	1.00 (ref.)	NA	1.00	NA
Yes	7811	(42.6)	22,062	(45.5)	0.89	(0.86–0.92)	0.84	(0.81–0.87)
Buprenorphine, n (%)								
No	11,301	(61.6)	31,964	(65.9)	1.00 (ref.)	NA	1.00	NA
Yes	7047	(38.4)	16,530	(34.1)	1.21	(1.16–1.25)	1.05	(1.01–1.09)
Methadone, n (%)								
No	17,452	(95.1)	41,479	(85.5)	1.00 (ref.)	NA	1.00	NA
Yes	896	(4.9)	7015	(14.5)	0.30	(0.28–0.33)	0.36	(0.33–0.39)
Extended-release Naltrexone, n (%)								
No	17,879	(97.4)	47,075	(97.1)	1.00 (ref.)	NA	1.00	NA
Yes	469	(2.6)	1419	(2.9)	0.87	(0.78–0.97)	0.89	(0.80–0.99)

*Multivariable models adjusted for Race, Age, Sex, individual mental health diagnosis (Mood disorder, Anxiety, PTSD, Personality disorder, Schizophrenia/Bipolar disorder), and individual non-OUD SUD diagnosis (alcohol, cannabis, cocaine, stimulants, inhalants, tobacco).

*Values may add up to greater than 100 % as some participants received more than one type of MOUD during the study period.

opportunities to utilize methadone (Englander et al., 2024).

However, given the persistent rural-urban disparity in patients' ability to access methadone, additional policy changes should be considered. The Modernizing Opioid Treatment Access (M-OTAA) bill, currently under congressional review, is one such opportunity. This bill would allow board certified addiction specialists to prescribe methadone in office-based settings and allow community pharmacies to dispense methadone, rather than limiting methadone dispensation exclusively to OTPs (Incze et al., 2024). Although this change is unlikely to have sweeping effects, given the underrepresentation of board-certified addiction specialists in rural settings, it would be an important step forward, particularly in rural states with few or no OTPs currently (Amiri et al., 2021).

4.2. Strengths and limitations

Strengths of this study include a focus on rural veterans, differentiation between forms of MOUD received (buprenorphine, methadone, extended-release naltrexone), and the use of recent data from the largest integrated health care system in the US. There are also limitations. First, this study analyzed data for patients enrolled in the VA Health Care System; findings may not generalize to patients in other health care systems or veterans who are not engaged with the VA. Second, the timeframe of this study overlapped with the COVID-19 pandemic, which may have affected results in complex ways. Previous research indicates that, while the pandemic did not affect receipt of MOUD among patients already engaged in treatment, it did affect new initiation, with patients less likely to begin treatment during this period. Thus, our results may represent an underestimate of MOUD receipt compared to later time periods. However, this is less of a concern for this analysis because there is no evidence of differences across rural and urban patients in new initiations of MOUD during COVID-19 (Stein et al., 2023). Third, results may not apply to those in the general population with OUD. Rates of mental health diagnoses were higher in this study sample, over 68 %, compared to previous research estimates of 59.8 % (Bakos-Block et al., 2020). Additionally, co-occurring non-OUD SUD was greater in this study sample, 66.7%, compared to the estimated prevalence among the civilian population, ranging from 26.5%- 57.3% (Hassan et al., 2019; Xu et al., 2022). This suggests that veterans with OUD may have greater clinical complexity than civilians with OUD. Fourth, our study outcome identified medication receipt; we did not address differences in patients' retention in MOUD treatment over time. Fifth, within the VA system, methadone dispensed within an OTP is not recorded in pharmacy data and can only be captured through visits to an OTP using stop code 523 (Wyse et al., 2022). However, prior research suggests that a small number (approximately 5 %) of patients utilizing VA OTPs receive buprenorphine (Oliva et al., 2012). Thus, our results likely only slightly overrepresent methadone versus buprenorphine utilization by VA patients. Lastly, though the decision to require two OUD diagnoses is

consistent with findings from prior research, this may have underestimated the true rate of OUD diagnosis in the population (Howell et al., 2021).

4.3. Conclusion

This study helps to broaden understanding of OUD treatment availability for rural and urban patients in the VA health care system. Study findings reveal that rural patients have a lower likelihood of receiving methadone for OUD treatment but are more likely to receive buprenorphine. Continued work is needed to ensure that rural Veterans have equitable access to the most appropriate medication for their health care needs.

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CRediT authorship contribution statement

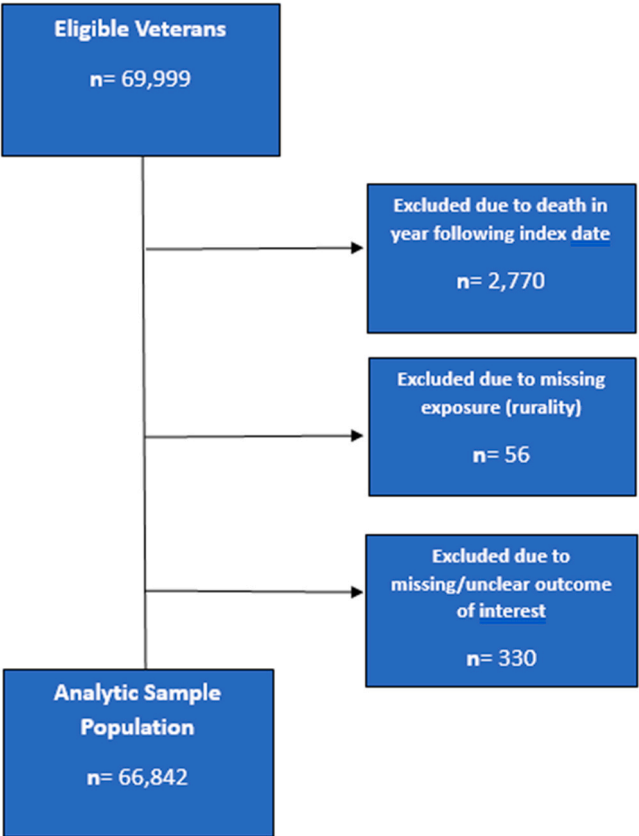
Jessica J Wyse: Writing – review & editing, Visualization, Supervision, Resources, Methodology, Funding acquisition, Conceptualization. **Travis I Lovejoy:** Writing – review & editing, Visualization, Supervision, Methodology, Investigation, Conceptualization. **Todd Korthuis:** Writing – review & editing, Investigation, Conceptualization. **Benjamin Morasco:** Writing – review & editing, Investigation, Conceptualization. **Adam J. Gordon:** Writing – review & editing, Investigation, Conceptualization. **Robert Handley:** Writing – review & editing, Data curation. **Kathleen F Carlson:** Writing – review & editing, Supervision, Methodology, Formal analysis, Conceptualization. **Olivia Reynolds:** Writing – original draft, Visualization, Methodology, Formal analysis.

Declaration of Competing Interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: Olivia Reynolds reports administrative support and statistical analysis were provided by US Department of Veterans Affairs. 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.

Appendix A

I: Inclusion and Exclusion Criteria for Analytic Sample Population



II. Rural-Urban Commuting Area (RUCA) Codes

Area	RUCA Code
Urban	1.0, 1.1
Rural	2.0–9.0, 10.1–10.3
Highly Rural	10.0

III: ICD-10 Codes

Study Variable	Diagnostic Type	ICD-10 Code
Mental Health Diagnosis	Anxiety	F06.4
		F10.10
	PTSD	F40.00- F40.298
		F43.10- F43.12
		F20.0- F20.9
		F21- F24
	Schizophrenia, Bipolar Disorder	F25.0- F25.9
		F28
		F29
		F30.1-F30.9
	Mood (Depression)	F31.0- F31.9
		F32.0- F32.9
		F32.A
		F33.0- F33.9
	Personality Disorder	F34.0- F34.1
F60.0- F60.9		
F68.10- F68.13		
F69		
Non-ODD SUD	Alcohol Use Disorder	F10.10- F10.99
	Cannabis Use Disorder	F12.10- F12.99
	Cocaine Use Disorder	F14.10- F14.99
	Stimulant Use Disorder	F15.10- F15.99

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Study Variable	Diagnostic Type	ICD-10 Code
	Tabacco Use Disorder	F17.20- F17.299
	Inhalant Use Disorder	F18.10- F18.99

V. Receipt of Any MOUD among VA Patients Diagnosed with OUD from 10/1/2018–9/30/20, by Urban/Rural Residence

Unadjusted Model			
Variable	OR (95 % CI)		p-value
(Intercept)	0.83	(0.82–0.85)	< 0.01
Rurality			
Urban (ref.)	1.00	NA	NA
Rural	0.88	(0.86–0.92)	< 0.01
Adjusted Model			
Variable	OR (95 % CI)		p-value
(Intercept)	2.49	(2.32 – 2.68)	< 0.01
Rurality			
Urban (ref.)	1.00	NA	NA
Rural	0.84	(0.81 – 0.87)	< 0.01
Age	0.98	(0.98 – 0.98)	< 0.01
Sex			
Male (ref.)	1.00	NA	NA
Female	0.82	(0.77 – 0.87)	< 0.01
Race			
White (ref.)	1.00	NA	NA
Black	0.95	(0.91 – 0.99)	0.02
Asian	0.82	(0.63 – 1.06)	0.13
Native American/Native Alaskan	0.94	(0.80 – 1.10)	0.45
Native Hawaiian/Pacific Islander	0.92	(0.75 – 1.12)	0.38
Unknown	0.92	(0.85 – 0.99)	0.02
Mental Health Diagnosis, n (%)			
Mood Disorder	0.97	(0.94 – 1.01)	0.13
Anxiety	1.07	(0.96 – 1.20)	0.22
PTSD	1.03	(0.99 – 1.06)	0.15
Personality Disorder	0.81	(0.77 – 0.86)	< 0.01
Schizophrenia/Bipolar Disorder	0.76	(0.73 – 0.80)	< 0.01
Non-ODD Substance Use Disorder Diagnosis, n (%)			
Alcohol	0.74	(0.71 – 0.77)	< 0.01
Cannabis	0.80	(0.77 – 0.83)	< 0.01
Cocaine	1.18	(1.13 – 1.23)	< 0.01
Stimulants	0.94	(0.90 – 0.98)	0.05
Inhalants	0.85	(0.61 – 1.17)	0.32
Tobacco	1.81	(1.75 – 1.87)	<

0.01 *Multivariable models adjusted for Race, Age, Sex, individual mental health diagnosis (Mood disorder, Anxiety, PTSD, Personality disorder, Schizophrenia/Bipolar disorder), and individual non-ODD SUD diagnosis (alcohol, cannabis, cocaine, stimulants, inhalants, tobacco).

V. Receipt of Buprenorphine among VA Patients Diagnosed with OUD from 10/1/2018–9/30/20, by Urban/Rural Residence

Unadjusted Model			
Variable	OR (95 % CI)		p-value
(Intercept)	0.52	(0.51–0.53)	< 0.01
Rurality			
Urban (ref.)	1.00	NA	NA
Rural	1.21	(1.16–1.25)	< 0.01
Adjusted Model			
Variable	OR (95 % CI)		p-value
(Intercept)	2.09	(1.94 – 2.25)	< 0.01
Rurality			
Urban (ref.)	1.00	NA	NA
Rural	1.05	(1.01 – 1.09)	< 0.01
Age	0.98	(0.98 – 0.98)	< 0.01
Sex			
Male (ref.)	1.00	NA	NA
Female	0.90	(0.85 – 0.96)	< 0.01
Race			
White (ref.)	1.00	NA	NA
Black	0.61	(0.58 – 0.64)	< 0.01
Asian	0.82	(0.63 – 1.07)	0.15
Native American/Native Alaskan	0.90	(0.76 – 1.07)	0.24
Native Hawaiian/Pacific Islander	0.86	(0.70 – 1.06)	0.17

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Unadjusted Model			
Variable	OR (95 % CI)		p-value
Unknown	0.89	(0.83 – 0.96)	< 0.01
Mental Health Diagnosis, n (%)			
Mood Disorder	1.00	(0.97 – 1.04)	0.79
Anxiety	1.09	(0.97 – 1.23)	0.14
PTSD	1.02	(0.99 – 1.06)	0.21
Personality Disorder	0.83	(0.78 – 0.88)	< 0.01
Schizophrenia/Bipolar Disorder	0.79	(0.75 – 0.83)	< 0.01
Non-ODD Substance Use Disorder Diagnosis, n (%)			
Alcohol	0.73	(0.70 – 0.76)	< 0.01
Cannabis	0.82	(0.79 – 0.86)	< 0.01
Cocaine	1.05	(1.01 – 1.10)	0.02
Stimulants	0.96	(0.92 – 1.00)	0.08
Inhalants	0.54	(0.37 – 0.78)	< 0.01
Tobacco	1.59	(1.54 – 1.65)	< 0.01

*Multivariable models adjusted for Race, Age, Sex, individual mental health diagnosis (Mood disorder, Anxiety, PTSD, Personality disorder, Schizophrenia/Bipolar disorder), and individual non-ODD SUD diagnosis (alcohol, cannabis, cocaine, stimulants, inhalants, tobacco).

VI. Receipt of Methadone among VA Patients Diagnosed with OUD from 10/1/2018–9/30/20, by Urban/Rural Residence

Unadjusted Model			
Variable	OR (95 % CI)		p-value
(Intercept)	0.17	(0.16–0.17)	0.00
Rurality			
Urban (ref.)	1.00	NA	NA
Rural	0.30	(0.28–0.33)	< 0.01
Adjusted Model			
Variable	OR (95 % CI)		p-value
(Intercept)	0.13	(0.12 – 0.15)	< 0.01
Rurality			
Urban (ref.)	1.00	NA	NA
Rural	0.36	(0.33 – 0.39)	< 0.01
Age	1.00	(1.00 – 1.00)	0.01
Sex			
Male (ref.)	1.00	NA	NA
Female	0.70	(0.63 – 0.78)	< 0.01
Race			
White (ref.)	1.00	NA	NA
Black	2.03	(1.92 – 2.16)	< 0.01
Asian	1.05	(0.68 – 1.55)	0.83
Native American/Native Alaskan	0.81	(0.58 – 1.10)	0.19
Native Hawaiian/Pacific Islander	1.25	(0.92 – 1.67)	0.14
Unknown	0.97	(0.85 – 1.09)	0.59
Mental Health Diagnosis, n (%)			
Mood Disorder	0.86	(0.82 – 0.91)	< 0.01
Anxiety	0.93	(0.76 – 1.12)	0.43
PTSD	0.95	(0.91 – 1.01)	0.09
Personality Disorder	0.84	(0.77 – 0.92)	< 0.01
Schizophrenia/Bipolar Disorder	0.76	(0.71 – 0.82)	< 0.01
Non-ODD Substance Use Disorder Diagnosis, n (%)			
Alcohol	0.70	(0.67 – 0.74)	< 0.01
Cannabis	0.79	(0.75 – 0.85)	< 0.01
Cocaine	1.38	(1.29 – 1.46)	< 0.01
Stimulants	0.89	(0.83 – 0.95)	< 0.01
Inhalants	1.55	(0.95 – 2.42)	0.07
Tobacco	1.70	(1.61 – 1.79)	< 0.01

*Multivariable models adjusted for Race, Age, Sex, individual mental health diagnosis (Mood disorder, Anxiety, PTSD, Personality disorder, Schizophrenia/Bipolar disorder), and individual non-ODD SUD diagnosis (alcohol, cannabis, cocaine, stimulants, inhalants, tobacco).

VII. Receipt of Extended-Release Naltrexone among VA Patients Diagnosed with OUD from 10/1/2018–9/30/20, by Urban/Rural Residence

Unadjusted Model			
Variable	OR (95 % CI)		p-value
(Intercept)	0.03	(0.03–0.03)	< 0.01
Rurality			
Urban (ref.)	1.00	NA	NA
Rural	0.87	(0.78–0.97)	0.01
Adjusted Model			
Variable	OR (95 % CI)		p-value
(Intercept)	0.03	(0.02 – 0.03)	< 0.01
Rurality			
Urban (ref.)	1.00	NA	NA
Rural	0.89	(0.80 – 0.99)	0.04
Age	0.97	(0.97 – 0.97)	< 0.01
Sex			
Male (ref.)	1.00	NA	NA
Female	0.89	(0.74 – 1.05)	0.18
Race			
White (ref.)	1.00	NA	NA
Black	0.73	(0.63 – 0.85)	< 0.01
Asian	0.87	(0.41 – 1.64)	0.70
Native American/Native Alaskan	1.32	(0.86 – 1.94)	0.19
Native Hawaiian/Pacific Islander	1.00	(0.51 – 1.75)	0.99
Unknown	0.97	(0.77 – 1.21)	0.80
Mental Health Diagnosis, n (%)			
Mood Disorder	1.48	(1.34 – 1.63)	< 0.01
Anxiety	0.97	(0.71 – 1.30)	0.86
PTSD	1.18	(1.07 – 1.30)	< 0.01
Personality Disorder	1.18	(1.04 – 1.34)	0.01
Schizophrenia/Bipolar Disorder	1.20	(1.07 – 1.33)	< 0.01
Non-ODU Substance Use Disorder Diagnosis, n (%)			
Alcohol	3.96	(3.50 – 4.50)	< 0.01
Cannabis	1.10	(0.99 – 1.21)	0.07
Cocaine	1.77	(1.59 – 1.96)	< 0.01
Stimulants	1.21	(1.09 – 1.34)	< 0.01
Inhalants	0.83	(0.40 – 1.52)	0.57
Tobacco	1.49	(1.36 – 1.65)	<

0.01 *Multivariable models adjusted for Race, Age, Sex, individual mental health diagnosis (Mood disorder, Anxiety, PTSD, Personality disorder, Schizophrenia/Bipolar disorder), and individual non-ODU SUD diagnosis (alcohol, cannabis, cocaine, stimulants, inhalants, tobacco).

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