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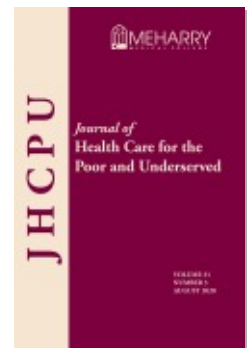
Shortages of Medication-Assisted Treatment for Opioid Use Disorder in Underserved Michigan Counties: Examining the Influence of Urbanicity and Income Level

Jamey J. Lister, Addie Weaver, Jennifer D. Ellis, Todd Molfenter, David M. Ledgerwood, Joseph A. Himle

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Shortages of Medication-Assisted Treatment for Opioid Use Disorder in Underserved Michigan Counties: Examining the Influence of Urbanicity and Income Level

Jamey J. Lister, PhD

Addie Weaver, PhD

Jennifer D. Ellis, MA

Todd Molfenter, PhD

David M. Ledgerwood, PhD

Joseph A. Himle, PhD

Abstract: Overdose-death rates continue to rise, necessitating accessible medication-assisted treatment (MAT). However, national data demonstrate rural shortages. The purpose of the study was to investigate rural/urban comparisons in the Midwest and simultaneously examine the influence of rural and low-income status. We extracted 2018 public data for Michigan's 83 counties on two MAT forms: 1) methadone clinics and 2) waived buprenorphine practitioners. Urbanicity was operationalized using Rural Urban Continuum Codes. Income was categorized with U.S. Census data. Bivariate analyses demonstrated MAT shortages among rural ($ps < .001$) and low-income counties ($ps < .01$). In multivariable analyses, urban counties were 35.6 and 12.2 times more likely than rural counties to have any clinic(s) ($p < .001$) or practitioner(s) ($p < .05$), respectively. High-income counties were 5.9 times more likely than low-income counties to have any practitioner(s) ($p < .01$). These state-level findings identify targeted Michigan counties currently underserved for available MAT. Expanding treatment access to underserved communities using economic approaches is urgently needed.

Key words: Medication-assisted treatment, rural, urban, income, buprenorphine, methadone, clinic, practitioner, Michigan, Midwest.

JAMEY J. LISTER is affiliated with the School of Social Work at Rutgers, The State University of New Jersey and the Department of Psychiatry and Behavioral Neurosciences at the Wayne State University School of Medicine. **ADDIE WEAVER** is affiliated with the University of Michigan School of Social Work. **JENNIFER D. ELLIS** is affiliated with the Wayne State University Department of Psychology. **TODD MOLFENTER** is affiliated with the Department of Industrial and Systems Engineering at the University of Wisconsin-Madison. **DAVID M. LEDGERWOOD** is affiliated with the Department of Psychiatry and Behavioral Neurosciences at the Wayne State University School of Medicine. **JOSEPH A. HIMLE** is affiliated with the University of Michigan School of Social Work and the University of Michigan Department of Psychiatry. Please address all correspondence to Jamey Lister, Rutgers, The State University of New Jersey, School of Social Work, 120 Albany Street, Tower One, New Brunswick, NJ 08901, USA Tel: +1 848 932 8058; email: jlister@ssw.rutgers.edu.

There has been a dramatic increase in overdose-related deaths in the U.S.,¹⁻³ and overdose-death rates in rural areas recently surpassed rates in urban areas.⁴ The state of Michigan, characterized by a mix of rural and urban counties,⁵ saw overdose-related deaths significantly increase in 2015 and 2016, and the state now has the 15th highest death rate nationally.^{1,5} In addition to risks related to rurality and geographic region, overdose-related deaths are more common among individuals living in low-income communities.⁶ These trends for increasing rates of overdose-related deaths in the Midwest and Michigan, and for both rural and low-income community residents represent a significant public health concern. However, despite information about hard-hit regions and communities, we do not have a clear understanding of the ways urbanicity and low-income status simultaneously influence evidenced-based treatment access. Furthermore, the literature is currently lacking any county-level comparisons of medication-assisted treatment (MAT) availability in the Midwestern United States.

Medication-assisted treatment is the evidence-based treatment⁷⁻¹⁰ for people with opioid use disorder (OUD) and the preferred modality of leading substance use disorder organizations.¹¹⁻¹³ Medication-assisted treatment involves opioid agonist (methadone, buprenorphine) and antagonist medications (naltrexone) that help suppress opioid cravings.¹³ Improved MAT outcomes (e.g., longer treatment retention) have been demonstrated when patients receive concurrent psychosocial treatment.¹⁴ Traditionally, patients have sought MAT at specialty clinics that provide methadone treatment and other services (e.g., group treatment, case management), though it has become increasingly common to access buprenorphine treatment in non-specialty (e.g., primary care, family medicine) settings.¹⁵⁻¹⁶

Rural residents face substantial barriers to accessing MAT at specialty and non-specialty settings.¹⁷ Importantly, national data demonstrate rural areas are significantly more likely to experience shortages of MAT compared with urban areas.¹⁸⁻²² Further, provider-level barriers challenge the widespread implementation of MAT, including a lack of specialty-care backup, stigma toward people with OUD as well as OUD patients in MAT, negative attitudes about the efficacy of MAT, and insufficient staffing to provide concurrent psychosocial treatment.²³⁻²⁵ Consumer-level data identify long travel distances as an accessibility barrier among rural residents,²⁶⁻²⁸ and living further from the clinic as a predictor of treatment dropout among low-income patients.²⁹ Additionally, consumers with OUD typically have limited funds to pay for treatment,²⁴ often relying on public health insurance,²⁹⁻³⁰ which hinders the ability for most consumers to access remote-friendly options like telemedicine³¹ that utilize videoconferencing to offset travel burdens in a relatively private, non-stigmatized setting, as those services typically require paying out-of-pocket.

Despite challenges related to rural and low-income county status, existing studies have yet to simultaneously examine their influence as it relates to MAT availability. Moreover, literature examining rural/urban comparisons for available MAT in Midwestern communities is sparse,³² with regionally-focused studies primarily conducted in the Pacific Northwest.^{18,20,33-34} To date, no rural/urban comparisons of MAT availability in the Midwest have been conducted, with examinations in the Middle Atlantic (Northeast Region)³⁰ and East South Central (South Region)²⁶ the closest alternatives. Given the high risk of opioid-related overdose deaths in the Midwest and Michigan¹

and limited rural/urban comparisons in the Midwest,³² it is imperative to understand whether MAT shortages in rural Michigan are similar to shortages in other rural U.S. regions.^{18–22,32} These findings can also provide guidance to the decisions of state-level policymakers when implementing programs to underserved communities through federal opioid crisis funds. Further, this study in a hard-hit state with a balance of county types can help disentangle whether rural and low-income communities^{6,33–34} are both underserved, if the former or latter is relatively more influential, or if there are differential MAT shortage patterns by underserved county type.

The present study examined rural/urban differences and county-level income differences in the availability of two forms of MAT across all Michigan counties. Finally, we conducted separate multivariable logistic regression analyses to identify the comparative influence of rural and low-income county status to both forms of MAT. We hypothesized rural compared with urban, and low-income compared with high-income, counties would be more likely to lack both forms of MAT in bivariate analyses. We predicted that rural county status would demonstrate a stronger association than low-income county status to MAT shortages in multivariable analyses.

Methods

Data sources. We extracted public data on the availability of two forms of MAT in Michigan's 83 counties in 2018: 1) methadone clinics (formally called "opioid treatment programs") and 2) waived* buprenorphine practitioners, using the Substance Abuse and Mental Health Services Administration (SAMHSA) Behavioral Health Treatment Services Locator tool.³⁵ The SAMHSA tool refreshes annually. We also extracted the most recent (2016) county-level sociodemographic characteristic data using the U.S. Census Bureau's QuickFacts tool.³⁶

Measurement. MAT availability. We assessed county-level availability of methadone clinics and buprenorphine practitioners in two ways: 1) dichotomous [any (≥ 1) vs. not available (0)] and 2) continuous (the number of clinics and the number of practitioners, summed separately). We also calculated per capita rates of methadone clinics and waived buprenorphine practitioners per 100,000 Michigan residents, urban Michigan residents, and rural Michigan residents. We use the dichotomous versions of both variables in bivariate and multivariable analyses.

Urbanicity level. Rural Urban Continuum Codes (RUCCs),⁵ a widely used county-level classification scheme developed by the U.S. Department of Agriculture to measure rurality by population size and adjacency to metropolitan areas, were used to assess the urbanicity level of Michigan counties. Rural Urban Continuum Codes have nine categories, ranging from counties in large metropolitan areas (1) to completely rural counties or less than 2,500 urban population, not adjacent to any metropolitan areas (9). Consistent with prior studies,^{22,38} we categorized counties as urban (RUCC = 1–3) and rural (RUCC = 4–9).

County-level income. Household income at the county-level was measured using a

*To earn waivers, practitioners must complete training, register with the Drug Enforcement Administration, and abide by patient cap requirements.³⁷

median split (due to severe skew), with low-income counties identified as those with median household incomes \leq \$43,373 USD*).

County-level sociodemographic characteristics. We assessed the number of residents in the county, (median) age of residents, racial composition, educational attainment, health insurance status, disability status, and poverty status. The number of residents was measured as a sum, while all other county-level sociodemographic characteristics were measured as percentages of total county populations.

Data analyses. We used chi-square, Mann-Whitney (*U*), and *t*-tests to assess rural/urban and county-level income differences in MAT availability and sociodemographic characteristics. We conducted Pearson (*r*) correlation tests between sociodemographic characteristics, with the exception of Kendall's Tau-b tests for skewed characteristics. We conducted separate multivariable logistic regression analyses for each respective form of MAT. Each model included urbanicity level and county-level income. Partial odds ratios and 95% confidence intervals were computed for both predictor variables.

We focused on the influence of urbanicity level and county-level income to MAT shortages and sociodemographic characteristics in bivariate analyses. Multivariable analyses examined the unique influence of urbanicity and county-level income to MAT shortages. We excluded other sociodemographic characteristics in multivariable analyses primarily due to statistical power constraints,⁴⁰ as well as conceptual considerations, i.e., health care access (health insurance gap areas likely to be treatment shortage areas), poverty (redundant with county-level income), disability status (potentially caused by MAT shortages), education (not a differentiator of urbanicity), and race (limited representation of racial minority groups in rural and low-income counties). While county-level age may relate to treatment demand (i.e., treatment more common among young adults), we excluded it since we could not estimate OUD treatment demand in these data.

Preliminary analyses identified redundant findings when utilizing continuous or dichotomous MAT measures as dependent variables. Therefore, we use continuous data only to highlight salient findings in a visual graphic.

Results

Sample characteristics. The state of Michigan was comprised of relatively more rural ($n = 57$, 68.7%) than urban ($n = 26$, 31.3%) counties. In 2016, the median Michigan county had 37,724 residents (range: 2,199–1,747,167), with medians of 25,327 residents in rural counties and 159,024 residents in urban counties. The median county-level household income was \$43,373 (range: \$30,824–\$76,764) with medians of \$40,885 (Interquartile Range = \$4,188) in low-income counties and \$49,300 (Interquartile Range = \$9,587) in high-income counties.

*Our median split maps closely to 200% of the 2018 federal poverty level, a commonly used proxy for low-income status.³⁹

There were 42 methadone clinics and 769* waived buprenorphine practitioners in the state. Of the unique practitioners that provided information about their academic training ($n = 636$), 66.4% were medical doctors, 20.4% were doctors of osteopathy, 8.6% were nurse practitioners, and 4.6% were physician assistants. As all counties that had methadone clinics also had buprenorphine practitioners, we did not analyze counties with any form of MAT (i.e., any buprenorphine was the lowest threshold).

Per capita rates of available methadone clinics were as follows: 0.42 methadone clinics per 100,000 Michigan residents, 0.48 methadone clinics per 100,000 urban Michigan residents, and 0.17 methadone clinics per 100,000 rural Michigan residents. Per capita rates of available waived buprenorphine practitioners were as follows: 7.75 buprenorphine practitioners per 100,000 Michigan residents, 8.50 buprenorphine practitioners per 100,000 urban Michigan residents, and 4.34 buprenorphine practitioners per 100,000 rural Michigan residents.

Bivariate analyses. Table 1 presents descriptive statistics and bivariate analyses for any available MAT and sociodemographic characteristics by urbanicity level. Rural counties were more likely to lack any available methadone clinic(s) ($p < .001$) or buprenorphine practitioner(s) ($p < .001$) compared with urban counties. Rural counties were more likely to have fewer overall residents ($p < .001$), to have an older median age among residents ($p < .001$), to be a low-income county ($p < .001$), to have a greater concentration of non-Hispanic White residents ($p < .001$), and to have more residents living in poverty ($p < .05$), with a disability ($p < .001$), and without health insurance ($p < .001$). There was no significant difference in educational attainment between the rural and urban counties.

Table 2 presents descriptive statistics and bivariate analyses for any available MAT and sociodemographic characteristics by county-level income. Low-income counties were more likely (compared with high-income) to lack any available methadone clinic(s) ($p = .002$) and buprenorphine practitioner(s) ($p < .001$). Low-income counties were more likely to have fewer overall residents ($p < .001$), an older median age among residents ($p < .001$), a greater concentration of non-Hispanic White residents ($p < .001$), fewer residents with a high school degree ($p < .001$), and more residents living in poverty ($p < .001$), with a disability ($p < .001$), and without health insurance ($p < .001$).

Table 3 displays correlations between county-level sociodemographic characteristics. Four characteristics, disability, lack of health insurance, poverty, and education, were all strongly correlated ($p < .001$) with each other. All correlations were positive with the exception of negative correlations ($p < .001$) between education (high school degree or more) and the three other characteristics. Age was positively correlated ($p < .001$) with disability, race (percentage non-Hispanic White) and lack of health care access. Race (percentage non-Hispanic White) was correlated with disability ($p = .002$). All other correlations were non-significant. In general, bivariate analyses demonstrated significant covariance between sociodemographic characteristics.

*There were 700 unique practitioners. Some practitioners were also licensed in additional locations ($n = 69$). We counted each practitioner location as unique since services in each unique area made treatment a possible event in that respective county.

Table 1.

AVAILABILITY OF MEDICATION-ASSISTED TREATMENT AND SOCIODEMOGRAPHIC CHARACTERISTICS BY URBANICITY LEVEL, MICHIGAN COUNTIES 2018

County-level factors	All counties (N = 83)	Rural counties (n = 57)	Urban counties (n = 26)	Test Statistic	p value
<i>Medication-Assisted Treatment Availability (2018)</i>					
Any methadone clinic(s)s, % (n)	20.5 (17)	3.5 (2)	57.7 (15)	$\chi^2 = 32.19$	< .001
Any waived BUP practitioners, % (n)	62.7 (52)	47.4 (27)	96.2 (25)	$\chi^2 = 18.16$	< .001
<i>Sociodemographic Characteristics</i>					
Number of residents in county, Mdn (IQR)	37,724 (76,739)	25,327 (26,882)	159,024 (220,095)	U = 38.00	< .001
Age of residents, M (SD)	44.1 (6.0)	46.1 (6.0)	39.8 (3.4)	t = 6.08	< .001
Race, % of residents Non-Hispanic White, Mdn (IQR)	91.4 (10.4)	93.6 (6.0)	82.4 (17.4)	U = 266.50	< .001
Education, % of residents with a HS degree, M (SD)	89.7 (2.9)	89.3 (3.0)	90.6 (2.6)	t = 1.92	.058
Health care, % of residents without insurance, M (SD)	7.9 (1.5)	8.5 (1.3)	6.8 (1.1)	t = 5.55	< .001
Disability, % of residents with a disability, M (SD)	12.2 (3.0)	13.0 (3.0)	10.3 (2.1)	t = 4.14	< .001
Poverty, % of residents living in poverty, M (SD)	15.1 (3.8)	15.7 (3.3)	13.7 (4.4)	t = 2.31	.024
Low-income county, % (n)	50.6 (42)	68.4 (39)	11.5 (3)	$\chi^2 = 23.11$	< .001

Notes:

Urban counties (RUCC = 1–3) and rural counties (RUCC = 4–9).

Low-income county status dummy-coded using a median split of all Michigan counties.

BUP = buprenorphine.

Due to non-normality, Mdn (median), IQR (interquartile range) statistics, and Mann-Whitney (U) tests used to examine urbanicity differences for the number of residents in the county, and the race of county residents.

Table 2.

AVAILABILITY OF MEDICATION-ASSISTED TREATMENT AND SOCIODEMOGRAPHIC CHARACTERISTICS BY INCOME LEVEL, MICHIGAN COUNTIES 2018

County-level factors	All counties (N = 83)	Low-income counties (n = 42)	High-income counties (n = 41)	Test Statistic	p value
<i>Medication-Assisted Treatment Availability (2018)</i>					
Any methadone clinic(s)s, % (n)	20.5 (17)	7.1 (3)	34.1 (14)	$\chi^2 = 9.29$.002
Any waived BUP practitioners, % (n)	62.7 (52)	38.1 (16)	87.8 (36)	$\chi^2 = 21.91$	< .001
<i>Sociodemographic Characteristics</i>					
Number of residents in county, Mdn (IQR)	37,724 (76,739)	23,491 (22,822)	88,340 (116,729)	U = 207.00	< .001
Age of residents, M (SD)	44.1 (6.0)	46.7 (6.5)	41.5 (4.2)	t = 4.28	< .001
Race, % Non-Hispanic White, Mdn (IQR)	91.4 (10.4)	94.1 (9.2)	90.2 (11.9)	U = 538.00	.003
Education, % of residents with a HS degree, M (SD)	89.7 (2.9)	88.6 (2.8)	90.9 (2.6)	t = 3.96	< .001
Health care, % of residents without insurance, M (SD)	7.9 (1.5)	8.8 (1.2)	7.1 (1.1)	t = 6.46	< .001
Disability, % of residents with a disability, M (SD)	12.2 (3.0)	14.0 (2.9)	10.4 (2.0)	t = 6.78	< .001
Poverty, % of residents living in poverty, M (SD)	15.1 (3.8)	17.2 (2.9)	13.0 (3.3)	t = 6.18	< .001

Notes:

County-level income dummy-coded using a median split of all Michigan counties.

BUP = buprenorphine.

Due to non-normality, Mdn (median), IQR (interquartile range) statistics, and Mann-Whitney (U) tests used to examine county-level income differences for the number of residents in the county, and the race of county residents. Equal variances were not assumed in the disability analysis.

Table 3.

**COUNTY-LEVEL CORRELATIONS AMONG
SOCIODEMOGRAPHIC CHARACTERISTICS IN MICHIGAN**

County-level factors	1	2	3	4	5	6
1. Age of residents	—	.46***	-.19	.45***	.60***	-.05
2. Race, % Non-Hispanic White	.46***	—	-.04	.11	.24**	-.03
3. Education, % residents with HS degree	-.19	-.04	—	-.57***	-.62***	-.55***
4. Health care, % of residents without insurance	.45***	.11	-.57***	—	.55***	.47***
5. Disability, % of residents with a disability	.60***	.24**	-.62***	.55***	—	.53***
6. Poverty, % of residents living in poverty	-.05	-.03	-.55***	.47***	.53***	—

Notes:

Significance levels = * $p < .05$, ** $p < .01$, and *** $p < .001$.

Kendall's Tau-b correlations conducted for all analyses with racial composition due to non-normal distribution of the variable.

Multivariable analyses of any available MAT by urbanicity and county-level income. Table 4 presents full statistics for separate multivariable logistic regression analyses explaining any methadone clinic(s) (Model 1) and any buprenorphine practitioner(s) (Model 2) availability, respectively.

Model 1 correctly classified 84.3% of cases, explained 49.5% of variation (R^2) in methadone clinic(s) availability, and demonstrated an adequate chi-square goodness-of-fit. Urban counties were 35.6 times more likely to have any available methadone clinic(s) compared with rural counties. County-level income was not significantly associated with methadone clinic(s) availability.

Model 2 correctly classified 78.3% of cases, explained 43.1% of variation (R^2) in buprenorphine practitioner(s) availability, and demonstrated an adequate chi-square goodness-of-fit. Urban counties were 12.2 times more likely to have any buprenorphine practitioner(s) compared with rural counties. County-level income also was associated with the availability of buprenorphine practitioner(s), as high-income counties were 5.9 times more likely (than low-income counties) to have any buprenorphine practitioner(s).

Buprenorphine practitioner shortages among underserved Michigan counties. To reflect the above results regarding county-level shortages of buprenorphine practitioners among both rural and low-income Michigan counties, we provide a heat map (Figure 1) displaying the number of buprenorphine practitioners in 2018 for all counties. Data illustrate the number of practitioners in underserved counties (categorized as rural and/or low-income) and high-income, urban counties.

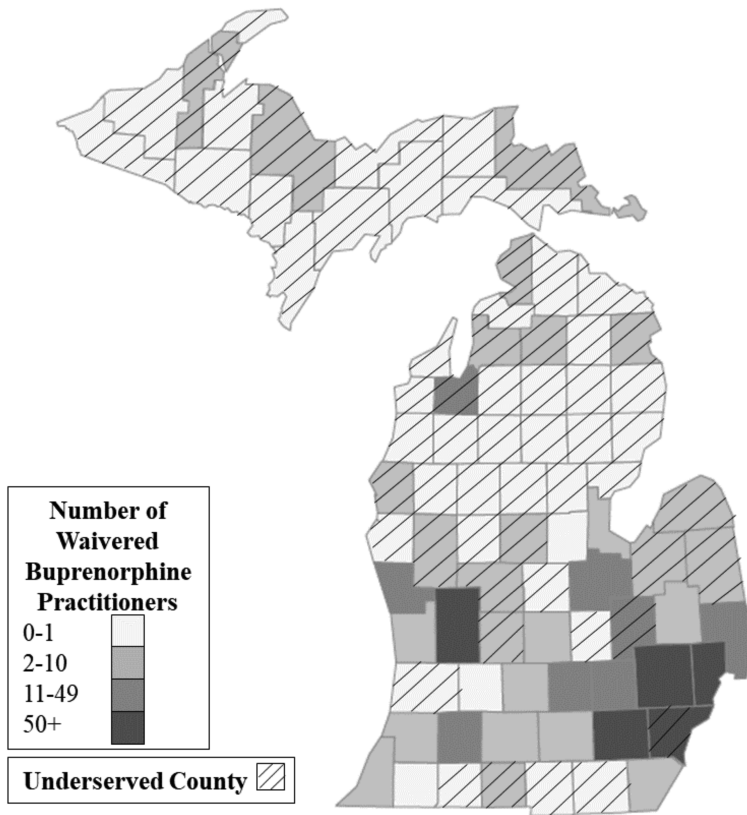


Figure 1. County-level heat map of buprenorphine practitioners, Michigan 2018

Notes:

The number of waived buprenorphine practitioners is displayed above for each of Michigan's 83 counties. An underserved county, denoted by shaded lines, refers to a county designated as rural (RUCC = 4–9) and/or low-income. All non-shaded counties are high-income, urban (RUCC = 1–3) counties. County-level income was dummy-coded using a median split ($\leq \$43,373$ USD). Information uses 2018 data from the Substance Abuse and Mental Health Services Administration (SAMHSA) Behavioral Health Treatment Services Locator tool.

Discussion

Our study highlights treatment shortages for rural and low-income Michigan counties using 2018 public data for available MAT clinics and practitioners. Midwestern states such as Michigan have been overlooked in most rural/urban analyses,^{32,41} despite high and rising rates of overdose-related deaths in the rural U.S., in the Midwest and Michigan, and among low-income communities.^{1,4,6,41} State-level analyses such as this may prove particularly helpful to policymakers as they assess how best to implement and expand MAT through funds targeting the opioid crisis in their jurisdiction. Our regionally-focused approach provides information specific to a high-risk^{1,41} yet understudied region of the country,^{32,41} highlighting treatment shortages and implications specific to underserved Michigan counties. Furthermore, these data provide the first

simultaneous comparison of urbanicity and county-level income in any U.S. jurisdiction. As a result, these findings offer regional value while also providing preliminary evidence that offers value at the national level.

Our findings demonstrate rural and low-income Michigan counties are at increased risk for MAT shortages. Consistent with the literature in other regions of the U.S., rural counties were more likely to lack any available methadone clinics and buprenorphine practitioners compared with urban counties. In line with our hypotheses, low-income counties were more likely than high-income counties to experience MAT shortages, and when included with urbanicity in multivariable analyses, county-level income status was less influential than rural county status. Other U.S. regions should consider the influence that rurality and low-income county status may have in their jurisdiction when identifying target communities in urgent need of treatment expansion.

This study adds to a growing literature demonstrating limited availability of health services in rural America. Similar to MAT shortages, rural settings, compared with urban, lack available mental and behavioral health providers⁴² and relatively few rural hospitals are equipped to provide specialty care.⁴³ In this analysis, rural counties were also more likely to be identified as low-income counties, which suggests rural residents will typically be unable to overcome treatment shortages using personal finances while their community will likely have limited economic means to expand MAT locally. This study suggests that low-income status is common among rural counties and also aggravates treatment shortages in rural areas. However, our results also demonstrate that low-income status uniquely predicted practitioner shortages, highlighting that low-income urban counties are underserved compared with high-income, urban counties.

To address these challenges, we suggest innovative approaches that increase the reach of MAT to rural and low-income counties. First, initiatives that engage practitioners in underserved communities to deliver MAT⁴⁴ in non-specialty settings (family medicine, primary care) may prove more feasible than costly efforts to build methadone clinic capacity. Second, to address practitioner concerns about delivering MAT services,^{23–25,44} we suggest county health departments and clinical directors in underserved counties work together to facilitate, incentivize, and reimburse service delivery using low-cost, technology-assisted psychosocial treatment⁴⁵ that can be provided via mobile, computer-assisted, or videoconferencing platforms. In addition, policymakers are recommended to make services such as remote peer-to-peer consultation⁴⁶ financially sustainable to both the local and remote practitioner to help increase the number of waived practitioners,^{37,46} and ultimately, increase the reach of buprenorphine treatment in underserved counties. Third, we encourage policymakers to address existing regulations that limit the provision of controlled substances,^{47–48} buprenorphine in particular, and work toward expanding public health insurance options that reimburse MAT regardless of medication type or treatment setting.⁴⁹ These efforts hold particular value for low-income and rural communities, where a sizable number of residents rely on publicly funded treatment (e.g., Medicaid).

Our study has a few limitations. First, the SAMHSA Behavioral Health Treatment Locator tool³⁵ did not provide information for waived practitioners listed privately,

or details regarding the number of patients receiving treatment services through each practitioner. In this respect, some existing practitioners are omitted from this analysis, and publicly waived practitioners may be providing services at different capacities. Of note, recent data⁵⁰ assessing buprenorphine capacity in Michigan estimates approximately 11 monthly patients per waived physician, and our per capita rates estimate slightly fewer than eight buprenorphine practitioners per 100,000 state residents. Despite the above limitations, there is no reason to believe these issues would function differently across county types, and therefore are unlikely to undermine our aim to conduct county-level comparisons of MAT availability. Further, comparisons using the SAMHSA tool have been used in prior literature^{51–52} and utilize the treatment provider data most easily accessible to patients and health care providers. We recommend future research replicate our findings using alternative measures of buprenorphine practitioner supply such as the Drug Enforcement Agency (DEA) Drug Addiction Treatment Act (DATA) Waived Physician List. Second, this study was not statistically powered⁴⁰ to simultaneously examine MAT accessibility factors such as travel burden and access (or lack thereof) to health care. Future research should extend these and previous data highlighting travel hardships to MAT as a consumer-level barrier among both rural^{26–28} and low-income communities²⁹ as well as the influence that health insurance type has on access to MAT. Third, these data do not speak to the availability of naltrexone, an additional form of medication treatment for OUD, which may offer a wider, albeit less effective, reach to underserved communities since any medication provider can deliver services due to fewer risks and regulations compared with buprenorphine and methadone.⁵³ Lastly, we do not know whether county-level variations in OUD rates may have influenced demand for MAT services. Michigan-specific information at the city or county-level was only available for drug-overdose death rates.⁵⁴ Future research should assess urbanicity and county-level income differences in OUD rates so subsequent comparisons can account for potentially different levels of treatment demand.

In conclusion, this is the first study to examine simultaneously rural/urban and county-level income differences in the availability of MAT clinics and practitioners, as well the first urbanicity-based MAT comparison in the Midwest. We determined that rural and low-income counties were at higher risk for MAT shortages compared with urban and high-income counties. We encourage policymakers, health departments, and clinical directors to consider these findings as they design and oversee treatment services for OUD in their jurisdiction.

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