Contents lists available at ScienceDirect

Drug and Alcohol Dependence

Full length article

Geographic proximity to buprenorphine treatment providers in the U.S.

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ARTICLE INFO

ABSTRACT

Objective: To combat the growing opioid epidemic, people who use drugs need access to medications for opioid use disorder (MOUD) as part of comprehensive treatment. Despite progress, treatment gaps remain. Our objective was to use a geospatial buffering model to estimate treatment access for buprenorphine providers nationally.

Methods: Using buprenorphine provider location data from the Substance Abuse and Mental Health Services Administration (SAMHSA) and population estimates from the U.S. Census, we use geospatial distance buffering analyses to estimate the percent of the population who are within reasonable (10, 30, 50 mile) driving distances from a buprenorphine provider across the contiguous states. Pearson correlation coefficients were used to analyze relationships between variables.

Results: There were 47,000 buprenorphine practitioners across the contiguous states, or 14.3 per every 100,000 persons. Approximately 28 million citizens, or 9.2 % of the population, were outside of a 10-mile distance from the nearest buprenorphine provider and 2.65 million outside of a 30-mile range. There was a positive correlation between state's percentage rurality and percentage outside distance buffers (r = .491, p < .000) and access is lower in areas of higher need Texas had the absolute highest number of people outside the 10-mile distance buffer (3.7 million), although South Dakota had 46 % of its overall population outside that access point.

Conclusions: Wide variability in treatment access to buprenorphine providers exists across all states. Improving geospatial proximity to buprenorphine providers is an important goal, but more work needs to be done to improve treatment access especially in certain states.

1. Introduction

The opioid crisis has reached epidemic proportions with nearly 47,000 opioid-related deaths in 2018 (Wilson et al., 2020). Individuals with opioid use disorder (OUD), especially those in high-risk categories, have increased odds of future overdoses and death (Kolodny et al., 2015). Identifying and engaging people who use drugs (PWUD) into treatment is a strategic priority. Yet, systematic barriers such as limited availability of treatment programs and provider capacity impede access to treatment (Langabeer et al., 2019).

Buprenorphine has been shown to be an effective medication for opioid use disorder (MOUD) (Nielsen et al., 2017). Buprenorphine, a Schedule III medication under the Controlled Substances Act of 1970 is tightly controlled, and the Drug Addiction Treatment Act of 2000 (DATA 2000) requires prescribing providers to either be certified addiction specialists or have obtained an "X" waiver through additional

training (Walsh and Eissenberg, 2003). Subsequent revisions have allowed others advanced non-physician providers, such as nurse practitioners and physician assistants, to also be waivered.

Despite efforts to allow other mid-level providers to prescribe buprenorphine, there continues to be concerns about access to treatment. National estimates suggest that nearly 90 % of all individuals with opioid use disorder who need treatment are not currently receiving treatment (SAMHSA, 2020b). Several studies have analyzed buprenorphine providers and suggest improvement over time (Dick et al., 2015; Rosenblatt et al., 2015), although these studies were conducted using data prior to 2015. In one recent study of changes between 2016 and 2018, Ghertner found that there was a 175 % increase in the number of waivered providers, and a corresponding 211 % increase in potential patient capacity (Ghertner, 2019). Other studies have attempted to estimate the number of patients in treatment for buprenorphine (Olfson et al., 2020), focusing on demand rather than capacity or access. The
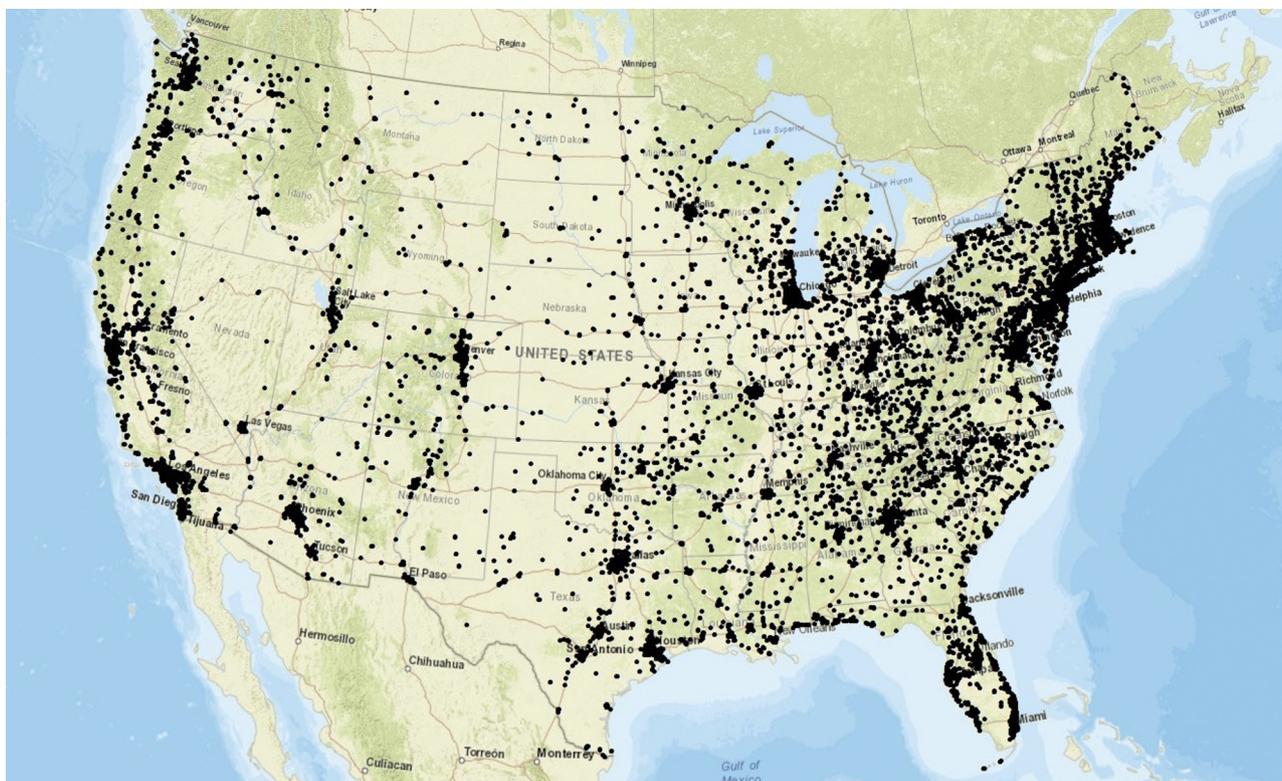
Fig. 1. Buprenorphine Providers Across the United States.

majority of prior studies have focused on descriptive analyses of waivered providers or trends, but few have focused on drive times. One study of methadone providers used drive time analyses and found that median drives were nearly 20 min to nearest methadone providers (Joudrey et al., 2020).

With over 2 million individuals needing access to buprenorphine and other approved medications, and more than 90 % of these not currently in treatment, driving distance and times are an important concept of access. Prior research has shown that driving < 10 miles is generally considered reasonable for most primary care, although patients may be willing to travel further for specialized care (Billi et al., 2007). In one study assessing driving times to methadone treatment, Rosenblum and colleagues (2011) found that only a minority of patients (6%) are willing to travel over 50 miles, and that more than 60 % of all patients travel less than 10 miles. Longer distances serve as a barrier to treatment access and could effectively limit the number of patients seeking treatment for substance use treatment (Yarbrough et al., 2020).

The objective of this study was to analyze the geographical proximity of U.S. persons to buprenorphine treatment programs, or more specifically to estimate the proportion of individuals within reasonable driving distance to the nearest treatment provider. We modeled three different distance buffers (10, 30, and 50-mile radius) around each provider. We estimated the number of citizens both inside and outside these buffer ranges. We further estimated need for treatment in each state to assess state-level differences in treatment capacity and need. This type of analysis is novel in its accuracy using distance radius techniques, rather than simply summarizing based on county or city level boundaries. Our aim was to estimate treatment access proximity nationally and to assess regional variations.

2. Methods

Geospatial and descriptive statistical analyses were used to evaluate the U.S. population's access to buprenorphine providers on both the state and national levels. We relied on the SAMHSA buprenorphine

practitioner locator for detailed address and provider listing of all waivered practitioners (SAMHSA, 2020a). Further, we extracted population data and percent rurality from the U.S. Census Bureau 2019 population estimates, which projects approximately 330 million persons across the country (US Census Bureau, 2020). Census blocks were used as the population unit of analysis because of their granularity and was the lowest unit of measure available. Rurality was operationalized in dichotomous binary terms, based on Census bureau classification of population density for each census block. We also examined prevalence of opioid use disorder through the detailed state estimates provided by the most recent SAMHSA national survey on drug use and health (SAMHSA, 2020b). There was a total of 47,210 providers listed as of March 2020. Addresses were first geo-located into ArcGIS, and data quality validations were used in the geo-processing stage prior to initial analyses. Radial buffers were then calculated around each geo-located provider address to get the geodesic radius surrounding each provider in the geospatial information system. Buprenorphine provider access was analyzed using three different mile buffer distances: 10, 30, and 50-mile buffers. The proportion of the population within these buffer ranges was calculated for the total U.S. population and for each state. Descriptive statistics were calculated for each state and Pearson correlations were used for correlation analyses. All geospatial analyses were conducted using ArcGIS 10.0 (ESRI, Redlands, CA).

3. Results

There were 47,210 buprenorphine providers, or roughly 14.3 providers for every 100,000 persons. This varied between a high of 35 per 100,000 in Massachusetts and Vermont to a low of 5.46 in Texas. Approximately 70 % of all practitioners were medical doctors (MD or DO), 24 % were nurse practitioners, and just 5.7 % were physician assistants (with approximately 16 % of the list not identifying their license type).

Fig. 1 geographically presents the buprenorphine treatment providers. The eastern portion of the U.S. had considerably higher density of

providers than the central region. When we overlay population, a similar pattern emerged with the central and western regions having a greater number of persons outside the 10-mile distance buffer.

Overall, 9.2 % of the U.S. population, or 27.9 million people were estimated to be outside of ten miles from the nearest buprenorphine provider, although this varied widely by states. The state of Texas had the highest absolute number of people outside this distance (3.8 million), followed by Illinois (1.19 million) and Iowa (1.8 million). The highest proportion of population outside reasonable proximity was South Dakota (46 % outside buffer), Iowa and Wyoming (both at 36 %), followed by North Dakota, Montana, and Mississippi (about 33 % of their population was outside this 10-mile range).

There were considerably fewer persons outside the 30-mile radius, with nearly 2.65 million persons living outside this radius from the nearest buprenorphine provider, which decreased to < 1% at the 50-mile radius. On a percentage basis, South Dakota (20 %), Wyoming (16 %) and Alaska (11 %) had the highest relative proportion of individuals outside the 30-mile access. An average of 26 % of the states are considered rural by U.S. Census Bureau standards, ranging from 0% (in the District of Columbia) to a high of 61 % in Vermont and Maine. There was a positive correlation between state's percentage rurality and percent without a buprenorphine provider within 10-miles (r = .491, p < .000) which persisted at the 30-mile buffer (r = .228, p < .05). Fig. 2 presents the spatial variation at 10, 30, and 50-mile distance buffers. Green and grey indicates that most of the population are within the buffer, while colors yellow, orange and red represent increasing number of people outside of that distance buffer.

SAMHSA provides state level estimates of both heroin and opioid use for non-medical purposes (SAMHSA, 2020b), which we used to assess need for treatment and prevalence of the disease by state. Across the country there are a little over 11 million people who have either used heroin, prescription, or other opioids for non-medical purposes, or approximately 240.6 (± 123.9) people for every one buprenorphine provider nationally. This varied widely by state. Massachusetts had the lowest ratio (100.9 people per provider), followed by Maine (112.5), Vermont (113), and Rhode Island (117.2). The states with the greatest need (number of individuals with opioid use disorder and the lowest number of providers) is Iowa (581.1), Texas (573.9), Nebraska (568.9), and Kansas (493.2). The central and western portion of the country

persisted with high ratios between need and providers. Table 1 summarizes all of the state level data for the analyses, including the percentage of the population outside of each distance buffer, the estimated population living with OUD, and ratios for the potential demand for OUD and number of providers per capita.

There is a 9% gap in access at the 10-mile radius, which diminishes as the radius increases. Access is also lower in areas of higher need. The top 10 states with the highest potential number of individuals with OUD has an average of 25.2 % of their population outside of the 10-mile radius, which is nearly 2.5x that of the national average. In addition, there is a strong positive correlation between the number of persons living outside of the 10-mile radius and the potential demand for OUD treatment (P = .562, p < .001).

4. Discussion

In this study we found that over 9% of the U.S. population was outside of a 10-mile radius from the nearest buprenorphine treatment provider, or roughly 28 million people. This gap diminished to a much smaller percentage (approximately 1%) at the 30-mile radius, and over 99.9 % of the U.S. population was within a 50-mile radius of the closest provider. Distance from nearest provider is equally as important to the presence of a provider, since the physical environment (transportation) is one of the most important social determinants of health and represents a significant barrier. Longer distances required to travel for OUD treatment could be a barrier limiting access to care, especially in more rural states with fewer number of buprenorphine providers. For many people with OUD, access to reliable transportation is lacking and long distances equate to lower engagement in treatment (Bunting et al., 2018; Saunders et al., 2018).

The lack of access to treatment could result in a reduction in overall health, and potential for greater number of both fatal and non-fatal overdoses, relapses, and other poor health outcomes (Sigmon, 2014). Greater access to treatment, with shorter driving distance, could be associated with lower levels of opioid mortality (Haley et al., 2019). We further found that if all patients presented for treatment who needs treatment, there would be an insufficient number of providers in nearly all states, and the ratio of 240 potential patients per buprenorphine provider far exceeds the 30-patient limit restraining the majority of
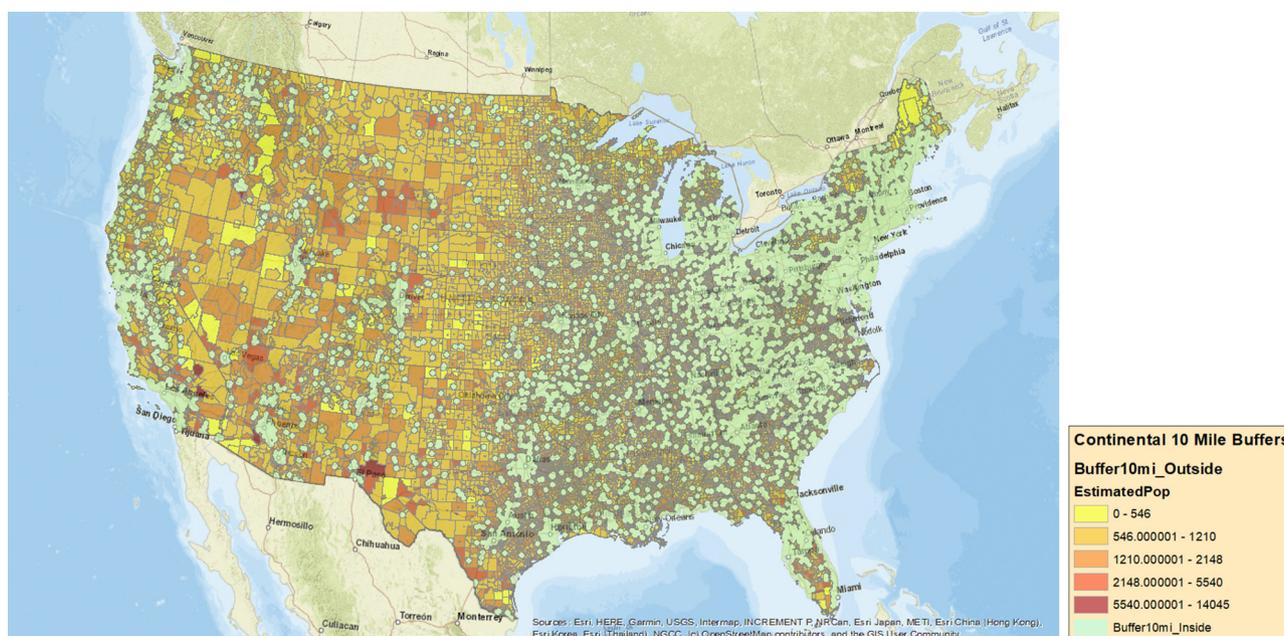

Fig. 2. Spatial Variation at 10, 30, and 50-Mile Distance Buffers. (Three figures belong together for Fig. 2: they are the 10 mile buffer, the thirty mile buffer, and the 50 mile buffer.) Legends for Figures are on separate pages, as they are in high resolution TIFF format.
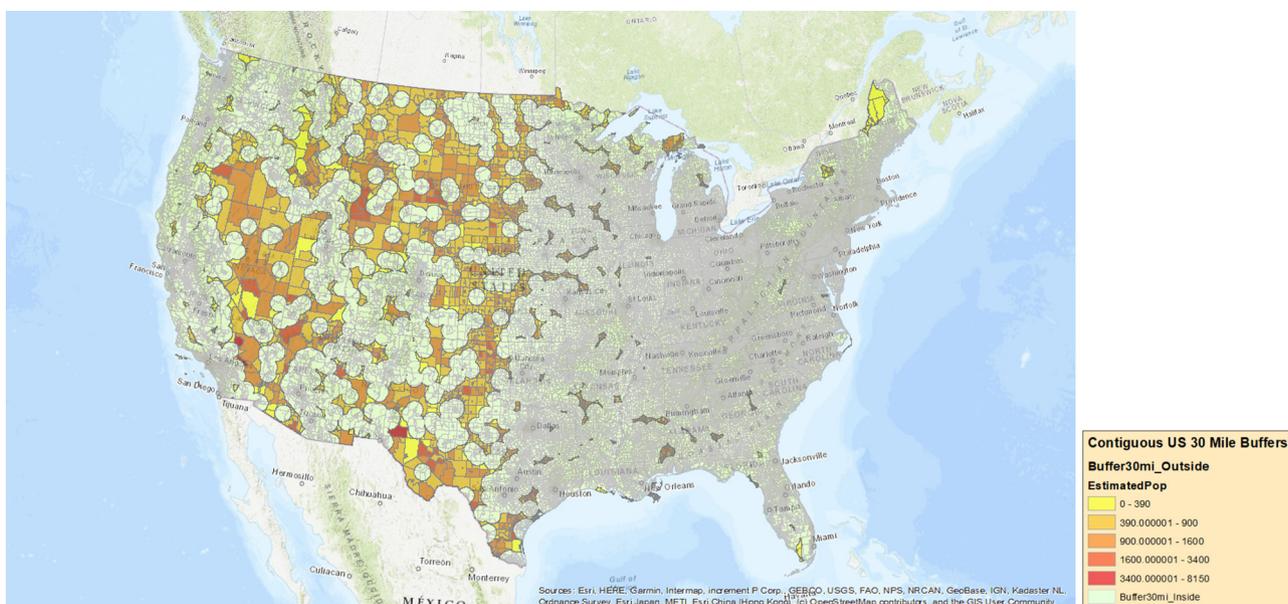
Fig. 2. (*continued*)

most waivered physicians. Wide variation exists and a pattern of geospatial access and provider limitations are present throughout much of the central and Midwestern region. Our results are interesting in that this study uses current data and buffering analyses around providers, rather than simply comparing based on county or city boundary lines. This detailed method improves accuracy as patients seeking treatment are limited by transportation challenges and driving distances, rather than artificial regional boundaries. We also utilized the most recent data from 2020, while most similar studies are at least five or more years old.

The number of buprenorphine certified providers has increased over time. Our study is consistent with prior studies that show improvement in potential access, although significant gaps remain. Rosenblatt and others found that using 2012 data, nearly 30 million Americans were outside of counties that had treatment providers (Rosenblatt et al., 2015). Dick and colleagues found that the percentage of counties with a shortage of waivered physicians decreased from 99 % in 2002 to 47 %

in 2011 and the proportion of the U.S. population living in treatment shortage counties decreased from 49 % to 10 % (Dick et al., 2015). Others have found that from 2008 to 2011, 43 % of counties had no buprenorphine waivered physicians (Stein et al., 2015). Between 2009–2014 office-based visits for buprenorphine increased from 1900,000–4,300,000. Though the number of buprenorphine providers and patients prescribed buprenorphine has increased in recent years, most U.S. adults with opioid use disorder still do not receive treatment (Olfson et al., 2020). Our more recent research shows improvement in access relative to these comparisons.

Another study which examined the relationship between opioid-related overdose deaths and treatment programs found that 19 % of counties across the country had < 1 provider and more than 10 deaths (Langabeer et al., 2019). Other research has shown relatively low number of providers and higher deaths across the Southern, Mid-western, and Western U.S. (Jones et al., 2018).We noted similar geographical patterns in our analyses.
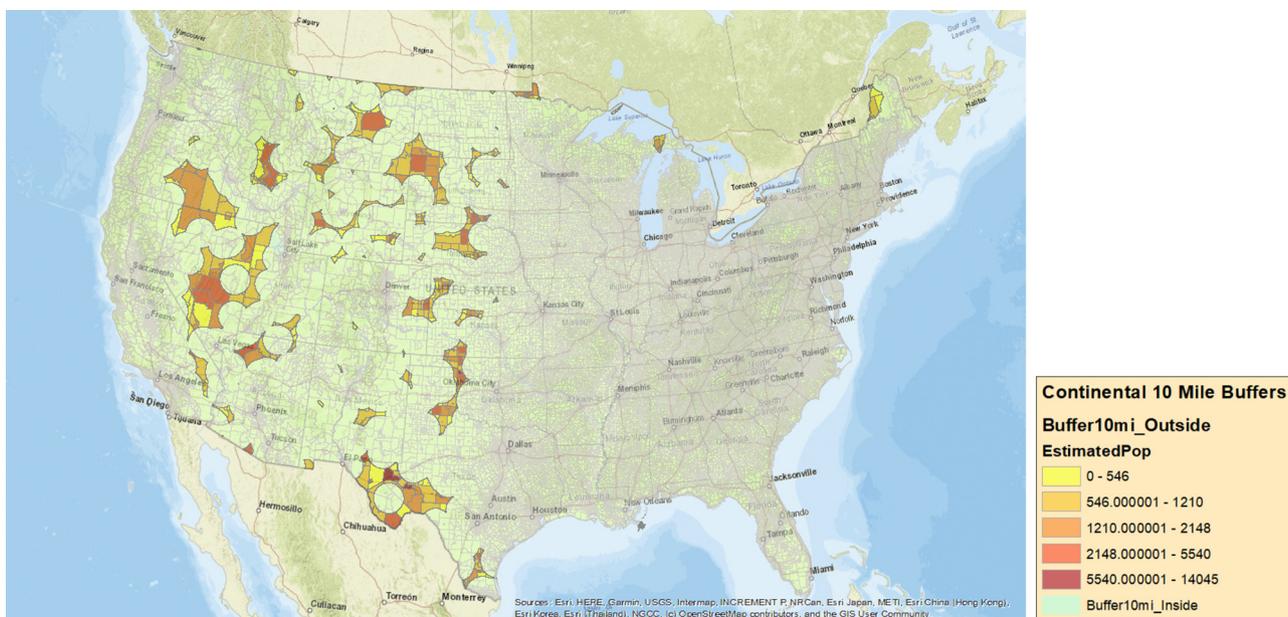

Fig. 2. (*continued*)

Table 1
Summary of State Level Indicators.

State	Bup. Providers*	Est. Pop. (000)	10 mile, % Out	30 mile, % Out	50 mile, % Out	Est. Pop with Opioid Use	Potential OUD per Bup. Provider	Provider per 100,000
Alabama	567	4968	17.7	1.2	0.0	205,000	361.3	11.42
Alaska	241	752	22.5	12.0	9.6	30,000	124.6	32.02
Arizona	1181	7132	6.1	1.2	0.2	256,000	216.9	16.55
Arkansas	263	3067	27.2	1.5	0.0	122,000	463.5	8.58
California	4630	39,807	2.1	0.2	0.0	1,321,000	285.3	11.63
Colorado	999	5712	6.7	1.0	0.2	233,000	233.2	17.49
Connecticut	921	3631	0.1	0.0	0.0	126,000	136.8	25.37
Delaware	209	988	0.0	0.0	0.0	38,000	182.2	21.11
DC	198	689	0.0	0.0	0.0	27,000	136.4	28.74
Florida	2501	20,876	3.1	0.0	0.0	824,000	329.4	11.98
Georgia	804	10,517	10.2	0.2	0.0	331,000	411.6	7.65
Hawaii	156	1460	6.9	0.2	0.0	39,000	250.0	10.69
Idaho	271	1760	20.0	2.9	0.7	68,000	250.9	15.40
Illinois	1333	12,970	9.1	0.3	0.0	362,000	271.7	10.27
Indiana	862	6762	10.8	0.0	0.0	276,000	320.3	12.74
Iowa	198	3219	36.6	2.8	0.0	115,000	581.1	6.15
Kansas	203	2970	26.4	7.2	2.0	100,000	493.2	6.83
Kentucky	1018	4548	11.6	0.0	0.0	174,000	171.0	22.38
Louisiana	570	4825	13.9	0.2	0.0	172,000	301.6	11.82
Maine	445	1376	5.3	0.2	0.1	50,000	112.5	32.30
Maryland	1554	6119	0.8	0.0	0.0	200,000	128.7	25.39
Mass.	2428	6925	0.1	0.0	0.0	245,000	100.9	35.07
Michigan	1244	10,057	8.2	0.5	0.0	352,000	283.0	12.37
Minnesota	584	5658	19.7	1.8	0.3	192,000	328.8	10.32
Mississippi	244	3052	31.1	1.9	0.0	104,000	426.7	7.99
Missouri	625	6224	17.6	1.0	0.0	227,000	363.3	10.04
Montana	170	1069	32.9	10.7	1.6	39,000	229.9	15.87
Nebraska	107	1957	26.2	7.2	1.1	61,000	568.9	5.48
Nevada	364	3026	5.4	1.3	0.6	125,000	343.8	12.02
New Hamp.	361	1374	3.1	0.0	0.0	50,000	138.6	26.25
New Jersey	1488	9113	0.0	0.0	0.0	297,000	199.7	16.32
New Mexico	586	2148	14.7	3.0	0.2	71,000	121.2	27.28
New York	4193	20,070	2.1	0.0	0.0	556,000	132.6	20.89
North C.	1455	10,456	6.3	0.0	0.0	336,000	230.9	13.92
North Dakota	86	797	33.2	10.4	**1.6**	25,000	291.4	10.76
Ohio	2319	11,773	4.6	0.0	0.0	460,000	198.4	19.70
Oklahoma	465	4036	19.1	2.7	0.3	141,000	303.2	11.52
Oregon	810	4185	7.3	0.6	0.2	175,000	216.0	19.36
Pennsylvania	2475	12,993	3.2	0.0	0.0	468,000	189.1	19.05
Rhode Island	341	1068	0.2	0.0	0.0	40,000	117.2	31.96
South Carolina	635	5109	10.0	0.0	0.0	175,000	275.8	12.42
South Dakota	82	890	46.0	20.4	2.9	31,000	378.6	9.20
Tennessee	784	6818	12.5	0.0	0.0	229,000	292.2	11.49
Texas	1582	28,955	12.7	2.0	0.3	908,000	573.9	5.46
Utah	542	3184	6.2	1.0	0.2	101,000	186.3	17.02
Vermont	221	644	5.3	0.0	0.0	25,000	113.0	34.39
Virginia	837	8566	9.6	0.1	0.0	268,000	320.0	9.78
Washington	1824	7452	4.2	0.0	0.0	277,000	151.9	24.48
West Va.	462	1896	16.3	0.3	0.0	67,000	145.0	24.37
Wisconsin	684	5848	15.9	0.6	0.0	226,000	330.3	11.70
National Totals	**47,210**	**330,090**	**9.2**	**1.1**	**0.5**	**11,359,000**	**240.6**	**14.30**

* As of Feb 1, 2020; Bup, buprenorphine; Pop, population, OUD, opioid use disorder.

Factors associated with lower numbers of buprenorphine waivered physicians include rural location, younger age of prescribing physician, and lack of state Medicaid funding (Andrilla et al., 2019; Stein et al., 2015). Factors associated with higher numbers of buprenorphine waivered physicians include widespread distribution of state guidelines and education about the buprenorphine waiver program, increased waivered physician-patient limits, and higher rates of opioid-related deaths (Dick et al., 2015). State policies to promote buprenorphine use through methadone clinics had no impact on the number of buprenorphine waivered physicians (Knudsen, 2015; Stein et al., 2015).

We found a positive and significant relationship between rurality and percent of the population outside a reasonable distance range from providers. More rural areas have fewer numbers of waivered providers (Sigmon, 2014). States should consider implementing policies regarding Medicaid reimbursement and also promoting the buprenorphine waiver program. Federal legislation could appraise the feasibly of

raising the limit on number of patients a certified physician can treat (Stein et al., 2015). The recent use of telemedicine for buprenorphine treatment could help improve access, especially in these more rural areas (Huskamp et al., 2018).

Although our results indicate that distance-based access to buprenorphine providers appears to cover the majority of the population, especially at the higher distance radius, a concern is whether the inclusion of all waivered providers overstates potential capacity. It is important to consider that the SAMHSA federal database listing may somewhat overstate total capacity, as providers may not accept new (or any) buprenorphine patients, take federal or state-funded insurance programs, or have capacity in their clinics for additional patients. One study conducted by Flavin and colleagues found that only 39 % of all providers listed in the SAMHSA treatment directory actually provided buprenorphine to treat substance use disorder, and of these, only 75 % accepted health insurance (Flavin et al., 2020). Although this source

has limitations, this directory provides the most complete listing of providers available and is managed by the federal agency responsible for treatment oversight. It has also been used in multiple prior studies, and does not seem to systematically over-estimate the number of providers (Haffajee et al., 2019; Andrilla et al., 2019; Jones et al., 2018).

Another important consideration is the number of providers per capita. States such as Texas, Nebraska, and Iowa have less than 6 providers for every 100,000 persons compared to the national 14.3 average. In states where there is a relative low density of providers, there is a positive association with greater proportion of the population outside of the 10-mile radius. Additional work is necessary to improve state and regional substance use program policies to encourage greater number of waivered providers who will practice addiction medicine. There is still significant room for expanding the sheer density of providers, as well as the geospatial distribution across all states.

The analyses presented here help to shed more light on the geographical proximity to buprenorphine treatment for opioid use disorder. However, this study is not without limitations. The first is our primary data source, the SAMHSA buprenorphine treatment locator, which as discussed has inherent limitations on the accuracy and completeness of the provider listings, yet we not feel that there is a systematic over-estimation which would alter the results in this study. Another limitation is the descriptive nature of this study, where our objective is to present the geospatial access and not to conduct detailed statistical analyses underlying these variations.

5. Conclusions

Wide variability in reasonable, distance-based access to buprenorphine treatment providers exists across all states. Over 9.2 %, or 28 million Americans, are outside of a reasonable 10-mile distance, which diminishes greatly at the 30-mile radius. Areas of high need are related to lower levels of access. Improving geospatial proximity to buprenorphine providers is an important goal, but more work needs to be done to improve treatment access especially in certain states.

Role of funding source

Contributors

JL developed the study concept and methodology, performed analysis, and wrote the original draft of the manuscript. ALS assisted with the methodology, writing the original manuscript, and study oversight. AC contributed to data collection and analysis. GT contributed to data collection and analysis. TC-L contributed to study oversight, writing the original draft, and substantial revisions.

All authors have read and approved the final manuscript.

Declaration of Competing Interest

No conflict declared.

Acknowledgements

Appendix A. Supplementary data

Supplementary material related to this article can be found, in the online version, at doi:https://doi.org/10.1016/j.drugalcdep.2020.108131.

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