Published in final edited form as:

Subst Abuse. 2020 ; 41(2): 259–268. doi:10.1080/08897077.2019.1635959.

Adoption of the 275-Patient Buprenorphine Treatment Waiver for Treating Opioid Use Disorder: A State-Level Longitudinal Analysis

Hannah K. Knudsen, PhD^{a,*}, Lewei (Allison) Lin, MD^b, Michelle R. Lofwall, MD^a

^aDepartment of Behavioral Science and Center on Drug and Alcohol Research, University of Kentucky, Lexington, KY

^bDepartment of Psychiatry, University of Michigan and Center for Clinical Management Research (CCMR), VA Ann Arbor Healthcare System, Ann Arbor, MI

Abstract

Background: Increasing access to buprenorphine treatment is a critical tool for addressing the opioid epidemic in the United States. In 2016, a federal policy change allowed physicians who meet specific requirements to treat up to 275 concurrent buprenorphine patients. This study examines state-level measures of buprenorphine treatment supply over 21 months since this policy change and estimates associations between the supply of 275-patient waivers and state characteristics.

Methods: Monthly state-level measures of the number of physicians holding the 275-patient waiver per 100,000 residents were constructed from September 2016 to May 2018 using the Drug Enforcement Agency's Controlled Substance Act database. State characteristics were obtained from publicly available sources. Mixed effects regression models were estimated to examine change over time.

Results: During the 21-month period, the number of physicians waived to treat 275 patients increased from 153 to 4,009 physicians. The mean supply of 275-patient physicians per 100,000 state residents significantly increased from 0.07 (SD=0.21) in September 2016 to 1.43 (SD=1.08) per 100,000 residents in May 2018 ($t=-9.84$, $df=50$, $p<.001$). The final mixed effects regression model indicated that Census division and the pre-existing supply of 100-patient waived physicians were correlated with the rate of growth in 275-patient waivers over the study period.

*Corresponding Author. Hannah K. Knudsen, Department of Behavioral Science and Center on Drug and Alcohol Research, University of Kentucky, 845 Angliana Avenue, Room 204, Lexington, KY, 40508. Phone: 1-859-323-3947. Fax: 1-859-257-5232. hannah.knudsen@uky.edu.

Author Contributions

Hannah Knudsen conceived the research question, reviewed the literature, and analyzed the data. Lewei Lin and Michelle Lofwall contributed to the literature review and elaborated upon the discussion. All authors revised the manuscript and reviewed the final draft of the manuscript prior to submission.

Financial Disclosure

Hannah Knudsen has no financial disclosures.

Lewei (Allison) Lin has no financial disclosures.

Michelle Lofwall has received contract funding for research from Braeburn Pharmaceuticals (which is developing a buprenorphine product), has consulted for Braeburn, CVS Caremark and Indivior (which manufactures a buprenorphine product), and has received honoraria from PCM Scientific, which was the recipient of unrestricted educational grant funds from Reckitt Benckiser (now Indivior), that supported developing and presenting educational talks on opioid use disorder.

Conclusions: Although uptake of the 275-patient waiver has exceeded initial projections, growth is uneven across the United States. Unequal patterns of growth pose a challenge to efforts to increase treatment availability as a means of addressing the opioid epidemic.

Keywords

buprenorphine; opioid use disorder treatment; DATA 2000

INTRODUCTION

The United States has experienced a dramatic increase in the prevalence of opioid use disorder and the incidence of fatal and non-fatal opioid overdoses.¹⁻⁵ The National Survey on Drug Use and Health estimates 2.4 million people have OUD, although others believe this is an underestimate, with the number actually closer to 5 million people.^{6,7} Untreated OUD is associated with negative health consequences,^{8,9} impaired family functioning,¹⁰ and criminal activity,^{11,12} with annual costs between \$78 - \$95 billion.^{13,14}

Buprenorphine and methadone are agonist medications that effectively treat OUD and reduce mortality.¹⁵⁻¹⁸ Relatively few individuals receive these treatments. Only about one-quarter of individuals with OUD report receiving any type of treatment in the preceding year,¹⁹ and for individuals who enter specialty OUD treatment, only one-third of treatment admissions include pharmacotherapy.²⁰ Increasing supply and access to OUD treatment is a major focus of efforts to address the rising prevalence of OUD.²¹

The number of individuals with OUD exceeds the national capacity for delivering methadone and buprenorphine in the US.²² About 1,100 licensed opioid treatment programs (OTPs) dispense methadone in the United States, a number that has only slightly increased since the early 2000s.²² Methadone for OUD can only be dispensed in OTPs. In contrast, under the Drug Addiction Treatment Act (DATA) of 2000, buprenorphine can be prescribed in office-based settings, provided that physicians obtain a waiver after submitting information on training or board certification to the Substance Abuse and Mental Health Administration (SAMHSA).²³ The waiver system under DATA 2000 places limitations on the number of concurrent buprenorphine patients, with up to 30 patients allowed in the first year and 100 in future years if physicians submit a second notification to SAMHSA. In 2016, about one-third of waived physicians held the 100-patient waiver.²⁴ Previous research has documented ongoing growth in the numbers of physicians holding the buprenorphine waiver²⁵⁻²⁹ and increased Medicaid spending on buprenorphine treatment over time.^{30,31}

To increase treatment capacity, a new tier was added to the waiver system in August 2016 that allows physicians to treat up to 275 concurrent patients.³² Physicians must have held the 100-patient waiver for at least a year, submit a third notification of intent to prescribe to SAMHSA, and meet a requirement of either holding credentials in addiction medicine or psychiatry (e.g., certification from the American Society of Addiction Medicine (ASAM), American Board of Psychiatry and Neurology (ABPN), American Osteopathic Academy of Addiction Medicine (AOAAM), or the American Board of Addiction Medicine (ABAM) in an addiction specialty) or delivering buprenorphine in a qualified practice setting that meets

specific criteria. To be considered a qualified practice setting, the treatment setting must: 1) provide coverage for medical emergencies when the practice is closed, 2) provide access to case management services through direct provision or referral, 3) use health information technology, 4) participate in the state's prescription drug monitoring program, and 5) accept third-party payments for at least some services. In addition, practitioners must certify that they adhere to specific standards, such as adhering to national evidence-based practice guidelines and implementing a diversion control plan³³. Every three years, physicians must re-apply to maintain their 275-patient waiver. The Department of Health and Human Services initially projected that about 2,000 physicians were likely to seek the 275-patient waiver over the next 5 years,³² but data on uptake has yet to be published. Data suggests that many physicians are currently prescribing at levels considerably below their waiver limits,³⁴⁻³⁶ originally suggesting that many physicians may not need to seek this higher tier waiver.

There is also a need to consider whether uptake of the 275-patient waiver is uneven across states. Previous research has documented geographic disparities in uptake of other types of buprenorphine waivers.^{37,38} States in the Northeast have significantly more waived physicians³⁹ and greater rates of growth in waived physicians than states in the South, Midwest, and West.²⁸ Economic factors, such as the Medicaid expansion under the Affordable Care Act, may shape uptake when measured at the state-level. States that have expanded Medicaid have experienced greater reductions in the size of their uninsured populations,^{40,41} particularly for individuals with OUD⁴² who are now more likely to access treatment after the implementation of the ACA.⁴³ Growth in buprenorphine utilization within Medicaid has been greater in expansion states.³⁰

Unmet treatment need may encourage physicians to seek this higher tier of waiver. States with higher rates of prescription opioid mortality, a measure of unmet treatment need, have experienced greater growth in waived physician supply.²⁴ The number of people needing treatment but who have not received treatment (i.e., the size of the treatment gap) may also prompt more physicians to seek the 275-patient waiver. A state's supply of OTPs may be associated with uptake of the 275-patient waiver. Previous research found a positive correlation between a population-adjusted measure of OTPs and state-level supply of buprenorphine waived physicians (i.e., number of waived physicians per 100,000 residents).³⁹ Given that the 100-patient waiver is a prerequisite, the pre-existing supply of 100-patient waived physicians is likely to be correlated with uptake of the 275-patient waiver.

Although the intent of the 275-patient waiver is to expand treatment capacity and ultimately access, the impact of this policy change has not been examined. It is unclear how many providers have adopted the 275-patient waiver and whether uptake is associated with other state-level factors. Therefore, the present study has two aims. First, it examines state-level measures of buprenorphine treatment supply over a 21-month period since the policy change that added the 275-patient waiver. Second, it estimates associations between the 275-patient waived physician supply (275-WPS) and several state-level characteristics, including region, the Medicaid expansion, unmet treatment need, pre-existing supply of 100-patient waivers, and the supply of OTPs. These characteristics were selected because they have been correlated with state-level measures of waived physician supply in previous research.

METHODS

Data and Measures

This observational longitudinal study of the supply of buprenorphine-waivered physicians combined data purchased from the National Technical Information Service (NTIS) with publicly available data on state characteristics. All US states and the District of Columbia (n=51) were included in the analyses. Information about whether physicians hold the waiver to prescribe buprenorphine is recorded in the Drug Enforcement Agency's the Controlled Substances Act (CSA) Active Registrants database. For this study, we purchased a monthly subscription from NTIS and counted the number of waived civilian physicians from September 2016, when the first 275-patient waived physicians appeared in the database, to May 2018. Each monthly state-level measure of 275-patient buprenorphine waived physician supply (275-WPS) represents the number of civilian physicians holding the 275-patient waiver per 100,000 state residents; state population was drawn from annual US Census data.⁴⁴ Measures of 30-patient waived physician supply (30-WPS) and 100-patient waived physician supply (100-WPS) were also calculated. Because all measures were constructed from secondary data obtained at the state-level and no human subjects were recruited for this analysis, informed consent was not obtained. However, the University of Kentucky Institutional Review Board approved the study procedures as part of a larger project that involved a national survey of physicians.

Seven independent variables were examined because of their associations in prior analyses of waived physician supply before the implementation of the 275-patient waiver. States were categorized according to the US Census Bureau's definitions divisions which consist of New England (reference; n=6), Middle Atlantic (n=3), East North Central (n=5), West North Central (n=7), South Atlantic (n=9), East South Central (n=4), West South Central (n=4), Mountain (n=8), and Pacific (n=5).⁴⁵ Information on each state's decision regarding the Medicaid expansion as of September 2016 was obtained from the Henry J. Kaiser Foundation's website,⁴⁶ with states coded as 1 for having adopted the expansion and 0 for not adopting the expansion. The size of the uninsured non-elderly population in 2016 was calculated using data published by the Henry J Kaiser Foundation from their analysis of the US Census's American Community Survey⁴⁷ and each state's population.⁴⁴ States were grouped in tertiles (n=17 per tertile) of low (<5,959), medium (5,959-8,594), and high levels (>8,594) of uninsured persons per 100,000 residents.

Two measures of state-level treatment need, opioid overdose mortality and unmet illicit drug treatment need, were examined. Opioid overdose mortality was measured using data from the Henry J. Kaiser Family Foundation's analysis of the Centers for Disease Control WONDER database;⁴⁸ states were then divided into 3 tertiles (n=17 per tertile) based on their rates of age-adjusted opioid-related overdose mortality per 100,000 residents in 2016. Tertiles were used because, while prior analyses have shown differences using median splits, tertiles provide a more nuanced measure of these characteristics. Low tertile states had opioid-related overdose mortality rates of less than 8.8 per 100,000 residents, medium tertile states ranged from 8.8 and 16.0 deaths per 100,000 residents, and high tertile states had opioid overdose mortality rates that exceeded 16.0 per 100,000 residents. The second

measure drew upon information published by the Henry J. Kaiser Foundation using data from the 2015-2016 National Survey of Drug Use and Health (NSDUH) regarding the number of residents aged 18 and older who were in need of treatment for illicit drug use in the past year but did not receive it in 2016 per 100,000 residents.⁴⁹ States were then grouped into three tertiles of low need (<1,700 adults per 100,000 population with unmet drug treatment needs), medium (1,700-1,929 adults per 100,000 population with unmet drug treatment needs), and high need (>1,929 adults per 100,000 population with unmet drug treatment needs).

Finally, two treatment availability measures were examined. A measure of the supply of licensed opioid treatment programs in 2016 was calculated using state-level counts from SAMHSA's treatment locator and state population. Tertiles of low (<0.201 OTPs per 100,000 residents), medium (0.201-0.427 OTPs per 100,000 residents), and high OTP supply (>0.428 OTPs per 100,000 residents) were constructed. Counts of each state's physicians holding the 100-patient waiver were extracted in August 2016 (i.e., the month before the 275-patient waiver was implemented) from the DEA's CSA database and adjusted for state population. Tertiles of low (<2.130 physicians with the 100-patient waiver per 100,000 residents), medium (2.130-3.977 physicians with the 100-patient waiver per 100,000 residents) and high (>3.977 physicians with the 100-patient waiver per 100,000 residents) 100-patient waived physician supply (100-WPS) were constructed.

Statistical Analysis

Descriptive statistics were calculated for the measures of waived physician supply with paired *t*-tests to compare supply in September 2016 and May 2018. Growth in 275-WPS during this period was estimated using mixed effects regression, which estimates within-state change, associations between state-level characteristics and the intercept (i.e., the value at the baseline of September 2016), and interactions between time and state characteristics to test group differences in growth.⁵⁰ Each state characteristic was examined separately, and then those significant at $p < .05$ (two-tailed test) were included in a multivariate model. All models were estimated using the "mixed" command in *Stata 15.1* (StataCorp, College Station, TX). After estimating the final model, the commands "margins" and "marginsplot" were implemented to graph the growth rates for variables that were statistically significant ($p < .05$), while adjusting for the other variables in the model.⁵¹

RESULTS

In September 2016, the first month in which any physicians holding the 275-patient waiver appeared in the DEA CSA database, 153 physicians had received this higher limit waiver. By May 2018, this number had increased to 4,009 physicians (Figure 1), which constituted 10.1% of all waivers. After adjusting for state population, the mean for 275-WPS was 0.07 per 100,000 residents (SD=0.21; median=0.02, interquartile range, IQR=0.00-0.05) in September 2016, which significantly increased to 1.42 per 100,000 residents in May 2018 (SD=1.08; median=1.04, IQR=0.65-1.97; $t=-9.81$, $df=50$, $p<0.001$). This same period saw significant increases in the total waived physician supply from 10.77 (SD=7.17; median=8.14, IQR=5.49-14.28) to 13.73 (SD=8.91; median=10.19, IQR=8.09-18.19; $t=$

–9.89, $df=50$, $p<0.001$) and 30-WPS from 7.07 (SD=5.01; median=5.25, IQR=3.91–9.02) to 9.26 (SD=6.34; median=6.76, IQR=5.28–12.26; $t=-9.01$, $df=50$, $p<0.001$). However, 100-WPS significantly decreased, from 3.62 per 100,000 residents (SD=2.46; median=2.81, IQR=1.81–4.95) to 3.04 per 100,000 residents (SD=2.12; median=2.31, IQR=1.73–3.90, $t=-6.24$, $df=50$, $p<0.001$). Much of the change in 100-WPS occurred in the initial months after the 275-patient waiver became available (Figure 1). Table 1 presents 275-WPS by state in May 2018. West Virginia had the highest 275-WPS, and South Dakota had the lowest 275-WPS.

An initial model of 275-WPS with month as the only variable revealed significant growth over time ($b=.046$, 95% confidence interval, CI=0.037, 0.055, $p<0.001$). Next, each state characteristic was examined separately. First, there was significantly slower growth in 275-WPS in six divisions (East North Central $b=-0.052$, 95% CI=–0.077, –0.027, $p<0.001$; West North Central $b=-0.076$, 95% CI=–0.099, –0.053, $p<0.001$; South Atlantic $b=-0.043$, 95% CI=–0.065, –0.022, $p<0.001$; West South Central $b=-0.061$, 95% CI=–0.088, –0.034, $p<0.001$; Mountain $b=-0.065$, 95% CI=–0.088, –0.042, $p<0.001$; and Pacific $b=-0.065$, 95% CI=–0.090, –0.039, $p<0.001$) when compared to the New England division. Medicaid expansion status was not associated with growth in 275-WPS. To consider whether there was a lagged effect of the Medicaid expansion, the model was re-estimated with a measure regarding expansion as of December 2014, which was neither associated with the intercept nor the rate of growth (results not shown). States with medium ($b=-0.032$, 95% CI=–0.052, –0.012, $p=.002$) and high levels of uninsured residents ($b=-0.027$, 95% CI=–0.047, –0.008, $p=.006$) experienced slower growth in 275-WPS than states with low levels of uninsured residents. Regarding opioid overdose deaths, states in the high tertile ($b=0.055$, 95% CI=0.040, 0.070, $p<0.001$) experienced a greater rate of growth in 275-WPS than states in the low tertile. Rates of 275-WPS growth were significantly greater in states with medium ($b=0.035$, 95% CI=0.016, 0.055, $p<0.001$) and high unmet drug treatment need ($b=0.028$, 95% CI=0.009, 0.048, $p=.005$), relative to states with low unmet treatment need. States with a high supply of OTPs experienced greater growth in 275-WPS ($b=.034$, 95% CI=0.015, 0.054, $p=.001$) than states with a low supply of OTPs. Finally, states in the medium ($b=0.017$, 95% CI=0.006, 0.028, $p=.003$) and high tertiles for 100-WPS ($b=0.067$, 95% CI=0.056, 0.078, $p<0.001$) had significantly greater growth in 275-WPS than states in the low tertile.

State characteristics significant at the bivariate-level were included in a multivariate model, which is presented in Table 2. There continued to be differences in rates of growth in 275-WPS by Census divisions. Specifically, states in the East North Central, West North Central, South Atlantic, Mountain, and Pacific divisions had significant slower growth than states in New England. The measure of opioid overdose mortality was no longer significantly associated with 275-WPS. For the measure of unmet drug treatment need, there was significantly greater growth in 275-WPS for states in the medium tertile versus the low tertile, but the other comparison was not significant. States in the high tertile of 100-WPS experienced greater growth over time (relative to the low tertile), but states in the high tertile for OTP supply actually had slower growth in 275-WPS than states with a low supply of OTPs once other state characteristics were controlled. Figures 2, 3, 4, and 5 visually depicts these differences in growth while adjusting for all other variables in the model.

DISCUSSION

The policy change that added the 275-patient buprenorphine waiver has the potential to increase access to this vitally important treatment, but such gains will only be made if physicians adopt the 275-patient waiver and expand the number of patients who they are treating. The present study speaks to the first issue. Over a 21-month period, there was significant growth in the 275-patient waived physician supply (275-WPS). However, growth in 275-WPS was uneven, with rates of growth correlated with Census divisions, the supply of OTPs, and the pre-existing 100-patient waived physician supply (100-WPS).

Of note, growth in the number of physicians holding the 275-patient waiver has exceeded federal estimates. DHHS estimated 1,150 physicians would seek the 275-patient waiver in the first year of availability and another 200 would request the 275-patient waiver in the second year.³² More than 4,000 physicians received the 275-patient waiver in the first 21 months, which is nearly triple the projection. This higher tier of buprenorphine waiver allows each physician to treat an additional 175 patients, so adoption of the 275-patient waiver by May 2018 had increased the national capacity by more than 700,000 potential treatment slots, if every physician holding the 275-patient waiver was to treat the maximum number of patients.

There was also continued growth in the total number of waived physicians over this period. As of May 2018, the total waived physician supply had increased by nearly 30% over our previously report of 9.9 waived physicians per 100,000 residents in January 2016.²⁴ This ongoing pattern of growth is notable because the literature on innovations typically reveals a pattern of adoption that mimics an S-shaped curve, where there is initially slow growth, accelerated growth, and then a leveling off of the adoption rate.⁵² More than 15 years after buprenorphine's approval by the FDA, there has not been a leveling off in total waivers, and there has been rapid growth in the 275-patient waivers. In part, this continued growth may reflect the ongoing opioid epidemic which has increased the prevalence of OUD and, hence, the need for OUD treatments. Furthermore, there have been ongoing efforts to expand treatment through increased federal funding, particularly during the time period of the current study (e.g., SAMHSA's State Targeted Response to the Opioid Crisis grants to states). There have been greater education and training opportunities aimed at increasing the physician workforce through the expansion of addiction medicine fellowships and board certification in addiction medicine. These factors may help to explain why uptake of the buprenorphine waiver has not followed the traditional S-shaped curve.

The question remains whether physicians will fully utilize this increased capacity, as there are many obstacles to treatment utilization. A substantial number of individuals with OUD do not perceive a need for treatment⁵³ and do not perceive buprenorphine as a preferred treatment option,⁵⁴ while others continue to face other barriers in accessing treatment (e.g., lack of transportation, cost). Furthermore, it remains to be seen whether physicians actually are willing to treat this larger number of patients. Some data suggests that many physicians are prescribing to far fewer patients than their waivers allow.³⁴⁻³⁶ Data on the number of patients being treated by physicians holding the 275-patient waiver as well as the proportion

of patients receiving ongoing treatment (as opposed to short-term detoxification) is urgently needed.

Limitations

This study has a number of limitations. First, its observational design cannot establish causality. Second, our analysis spans a limited period of time, so it is unknown whether the observed pattern of growth will persist or slow over time. Third, growth may be associated with other unmeasured state characteristics, such as the market share of naltrexone and methadone within states for treating OUD as well as growth in the number of non-physicians who obtain buprenorphine waivers to treat up to 30 or 100 patients (e.g., nurse practitioners, physician assistants, certified nurse midwives, nurse anesthetists). Another relevant state-level factor for predicting growth in the 275-patient waiver may be the number of practice settings that meet the criteria of being a “qualified practice setting”; such data are not currently available from public sources. County-level analyses might also yield more nuanced explanations of the factors associated with waiver uptake. Fourth, the state characteristics were measured at a single point in time. Ideally, state-level measures of treatment need would be available in real-time and more frequently than annually. Currently, there is a considerable lag in data availability for measures of unmet treatment need and opioid overdose mortality. Furthermore, the clinical impact of states moving between tertiles of 100-WPS may be limited if physicians are not fully utilizing their treatment capacity. Finally, the study only considers growth in waivers held by physicians. Although other medical professionals cannot hold the 275-waiver, waived nurse practitioners, physician assistants, clinical nurse specialists, certified nurse midwives, and nurse anesthetists can now treat up to 100 patients after holding the 30-patient waiver for at least a year. Future research should examine uptake of the waiver by these professionals, as they have the potential to further expand treatment capacity.

There are numerous areas for future research. In addition to data on actual numbers of patients being treated by physicians holding the 275-waiver, it would be valuable to examine associations between physician characteristics and adoption of this highest tier waiver. Unfortunately, the CSA database does not include information about physician characteristics. Qualitative data would be informative about the reasons that physicians are seeking the 275-waiver and barriers that preclude them using this waiver to its full extent. Furthermore, a comparison of treatment practices of physicians waived to treat 275 patients relative to those with the lower tiers of waivers would be informative, as would be the extent to which treatment practices are associated with treatment duration.

CONCLUSIONS

The ongoing opioid crisis requires a robust public health response, including the expansion of effective treatments for opioid use disorder such as buprenorphine. Although there has been considerable uptake of the 275-patient waiver, growth in this type of waiver has been uneven across the United States. Notably, growth in the 275-patient waiver reflects earlier patterns of unequal uptake associated with the 100-patient waiver. While such growth has the potential to increase access to buprenorphine treatment, it is critical for future research to

measure the impact of waiver growth in terms of the number of individuals with OUD receiving treatment as well as strategies to encourage more physicians to treat more patients with OUD.

Acknowledgments

Funding

This research was supported by the National Institute on Drug Abuse (NIDA Grant R33DA035641) and use of REDCap was supported by the National Center for Advancing Translational Sciences (NIH CTSA UL1TR000117). NIDA and NCATS had no further role in study design; in data collection, analysis, or interpretation; manuscript preparation; or the decision to submit this manuscript. The content of this manuscript is solely the responsibility of the authors and does not represent the official views of NIH, NIDA, or NCATS.

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Figure 1.
Numbers of physicians holding the 100-patient and 275-patient buprenorphine waivers from September 2016 to May 2018

Figure 2.
Predictive Margins of 275-Patient Buprenorphine-Waivered Physician Supply by US Census Division

Figure 3.
Predictive Margins of 275-Patient Buprenorphine-Waivered Physician Supply by Unmet Drug Use Disorder Treatment Need

Figure 4.
Predictive Margins of 275-Patient Buprenorphine-Waivered Physician Supply by OTP Supply

Figure 5.
Predictive Margins of 275-Patient Buprenorphine-Waivered Physician Supply by 100-Patient Waivered Supply

Table 1.

Number of Physicians with the 275-Patient Buprenorphine Waiver per 100,000 Residents by State in May 2018

State	Rate	State	Rate	State	Rate
Alabama	2.36	Kentucky	3.91	North Dakota	1.06
Alaska	0.95	Louisiana	1.96	Ohio	2.62
Arizona	0.71	Maine	3.07	Oklahoma	0.94
Arkansas	0.67	Maryland	1.73	Oregon	0.89
California	0.47	Massachusetts	3.02	Pennsylvania	2.73
Colorado	0.78	Michigan	1.16	Rhode Island	4.06
Connecticut	1.81	Minnesota	0.56	South Carolina	1.09
Delaware	2.39	Mississippi	1.34	South Dakota	0.11
District of Columbia	0.58	Missouri	0.88	Tennessee	2.93
Florida	1.15	Montana	0.57	Texas	0.48
Georgia	0.65	Nebraska	0.31	Utah	1.06
Hawaii	0.28	Nevada	0.67	Vermont	3.53
Idaho	0.58	New Hampshire	2.23	Virginia	0.97
Illinois	0.45	New Jersey	1.48	Washington	1.01
Indiana	1.45	New Mexico	1.29	West Virginia	4.57
Iowa	0.22	New York	1.31	Wisconsin	0.85
Kansas	0.41	North Carolina	1.33	Wyoming	1.04

Table 2.

Mixed Effects Regression Models of State-Level Supply of Physicians Holding the 275-Patient Buprenorphine Waiver

	Unstandardized Coefficient	95% CI	p
Month ^a	0.052	0.029, 0.076	0.000
<i>State characteristics on the growth rate^b</i>			
Month-by-Middle Atlantic state	-0.017	-0.038, 0.004	0.110
Month-by-East North Central state	-0.034	-0.053, -0.014	0.001
Month-by-West North Central state	-0.033	-0.057, -0.010	0.005
Month-by-South Atlantic state	-0.017	-0.033, -0.001	0.036
Month-by-East South Central state	-0.009	-0.032, 0.014	0.446
Month-by-West South Central state	-0.017	-0.041, 0.007	0.176
Month-by-Mountain state	-0.034	-0.054, -0.013	0.001
Month-by-Pacific state	-0.031	-0.050, -0.011	0.002
Month-by-Medium uninsured population	-0.008	-0.018, 0.003	0.167
Month-by-High uninsured population	-0.012	-0.025, 0.001	0.072
Month-by-Medium fatal opioid overdose	0.010	-0.002, 0.021	0.099
Month-by-High fatal opioid overdose	0.014	-0.003, 0.031	0.117
Month-by-Medium unmet DUD treatment need	0.012	0.001, 0.022	0.039
Month-by-High unmet DUD treatment need	0.003	-0.009, 0.014	0.666
Month-by-Medium OTP supply	-0.004	-0.014, 0.007	0.492
Month-by-High OTP supply	-0.022	-0.037, -0.007	0.004
Month-by-Medium 100-patient waiver supply	0.008	-0.005, 0.021	0.246
Month-by-High 100-patient waiver supply	0.046	0.027, 0.065	0.000
<i>State characteristics on the intercept^c</i>			
Census divisions			
New England	Reference		
Middle Atlantic	-0.675	-1.171, -0.179	0.008
East North Central	-0.641	-1.107, -0.174	0.007
West North Central	-0.713	-1.264, -0.162	0.011
South Atlantic	-0.299	-0.677, 0.079	0.121
East South Central	-0.479	-1.024, 0.066	0.085
West South Central	-0.391	-0.961, 0.178	0.178
Mountain	-0.729	-1.205, -0.252	0.003
Pacific	-0.674	-1.139, -0.208	0.005
Uninsured persons per 100,000 residents			
Low tertile	Reference		
Medium tertile	-0.031	-0.286, 0.223	0.810
High tertile	-0.238	-0.551, 0.075	0.137
Fatal overdose rate			
Low tertile	Reference		

	Unstandardized Coefficient	95% CI	p
Medium tertile	0.089	−0.183, 0.361	0.523
High tertile	0.175	−0.234, 0.583	0.403
Unmet DUD treatment need			
Low tertile	Reference		
Medium tertile	0.337	0.077, 0.597	0.011
High tertile	−0.020	−0.289, 0.250	0.887
Supply of opioid treatment programs (OTPs)			
Low tertile	Reference		
Medium tertile	−0.003	−0.247, 0.240	0.978
High tertile	−0.456	−0.810, −0.102	0.012
Supply of 100-patient waived physicians in August 2016			
Low tertile	Reference		
Medium tertile	0.109	−0.201, 0.419	0.492
High tertile	0.634	0.185, 1.083	0.006
Intercept ^c	0.901	0.346, 1.455	0.001
Random-Effects Parameters ^d			
Variance(Month)	0.0001	0.0001, 0.0002	
Variance(_cons)	0.081	0.053, 0.123	
Covariance(month, _cons)	0.003	0.002, 0.004	
Variance(Residual)	0.038	0.035, 0.042	

Notes: Values are multivariable unstandardized coefficients.

^aThe coefficient for month represents the average monthly growth if all independent variables are set at zero.

^bVariables under “*State characteristics on the growth rate*” represent interaction terms between month and each state characteristic.

^cThe intercept represents the average buprenorphine physician supply at baseline (i.e., September 2016), and the coefficients labeled “*State characteristics on the intercept*” represent associations between the state characteristics and the supply at baseline.

^dThe Random Effects Parameters are estimates of the variability between states’ intercepts and slopes (i.e., growth curves).

CI = confidence interval.

DUD=drug use disorder.

OTP=opioid treatment program.