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County Fact Sheets: Treatment Gaps in Opioid-Agonist Medication-Assisted Therapy and Estimates of How Many Additional Prescribers Are Needed

Methodological Appendix

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July 2021

Summary of Methods

Recent efforts in several states have explored options to expand access to medication treatment for people with opioid use disorder (OUD), with a focus on expanding access to buprenorphine and methadone treatment (GAO 2016; Schuckit 2016). Together, these highly effective therapies are referred to as opioid-agonist medication-assisted treatment (OA-MAT). These efforts have been hampered by a lack of local data describing local OUD treatment needs and local OUD treatment capacity. This research aims to help fill this information gap and to inform state and local efforts to increase access to OUD treatment, with a focus on expanding buprenorphine treatment.

This appendix presents the methodology we used to produce county-level estimates of OUD and treatment needs in six states and Washington, DC, for a project funded by Bloomberg Philanthropies. The main objective was to estimate the number of additional buprenorphine-waivered prescribers needed per county to achieve capacity to offer all people with OUD treatment with buprenorphine or methadone. This analysis is subject to several assumptions and limitations, described below.

To estimate the demand for treatment, we calculated county rates of OUD by averaging two estimates based on different methodological approaches. For the first, we started with substate estimates of past-year pain reliever use disorder (PUD) and heroin use (HUD) for people ages 12 and older from the combined 2016–18 National Survey on Drug Use and Health (NSDUH) substate data. We adjusted these estimates for recent trends and estimated the share of people with HUD who have HUD only and not PUD. We estimated substate OUD rates as the sum of individuals estimated to have any PUD and HUD only. We then used regression models to predict county-level rates as a function of explanatory variables that have an empirical relationship with OUD (Alzeer, Jones, and Bair 2017; Paulozzi et al. 2011). We tested various models that produced similar results. For the second estimate, we multiplied the estimated NSDUH-based estimates by a scalar representing the relationship between an NSDUH-based OUD rate, known to be biased downward, and an OUD rate for Massachusetts based on a capture-recapture analysis of seven administrative databases linked at the person level (Barocas et al. 2018). We used the 2015 OUD rates from the Massachusetts study, the most recent data available. We averaged these two estimates to compute county OUD rates. We applied county-level population estimates from the Centers for Disease Control and Prevention (CDC) to create county-level counts, which we adjusted to match the NSDUH substate counts.

To estimate buprenorphine treatment capacity, we drew on information about buprenorphine episode primary prescribers and such prescribers' mean annual buprenorphine patient caseloads, obtained from the OPTIC website,[1] derived from IQVIA data containing retail pharmacy prescription claims from approximately 92 percent of US retail pharmacies. We also used information from the Drug Enforcement Administration (DEA) Controlled Substances Act Registrants Database, which includes all prescribers with a waiver to prescribe buprenorphine (DATA-waiver). We mapped prescriber addresses to counts using a zip-code-to-county crosswalk from the US Department of Housing and Urban Development's Office of Policy Development and Research.

We calculated a lower bound of county buprenorphine treatment capacity from the estimated number of patients with an active buprenorphine treatment episode in the past year plus the number of methadone patients in opioid treatment programs (OTPs). We computed an upper-bound estimate based on a projected increase if buprenorphine prescribers doubled their number of patients and OTPs operated at full capacity, assuming they currently operate at 80 percent capacity. To compute the treatment gap (i.e., the number of people with OUD who do not have access to buprenorphine or methadone treatment in their county), we assumed that all people with OUD are likely to seek treatment. We calculated the treatment gap by subtracting the low and high estimated range of the treatment capacity in each county from the estimated number with OUD. We computed the estimated

number of additional 30-waivered buprenorphine prescribers (i.e., prescribers with a 30-patient waiver limit) needed per county to achieve capacity to fill the lower- and upper-bound estimates of the treatment gap, assuming new prescribers treat the estimated state average of patients per 30-waivered prescriber for the lower bound and twice that for the upper bound. We present strategies to meet demand for treatment, showing a range using lower and upper estimates of the treatment gap and the treatment capacity. In cases where the number of needed new prescribers would be more than double the number of current buprenorphine prescribers, we present an alternative, more feasible strategy of doubling the number of active prescribers or adding 10 new prescribers, whichever is higher. In these cases, we present the share of the treatment gap that would be filled.

Data Sources and Key Variables

Our estimates are based on several data sources.

2019 county population estimates are from the Bridged-Race population estimates published by the CDC.[2] 2020 DC ward population estimates for people 12 and older are from DC Health Matters age data for DC wards.[3] We estimated 2019 DC ward populations by multiplying 2020 DC ward populations by a factor representing DC population growth from 2019 to 2020 from the Bridged-Race population estimates.

We used 2016–18 past-year PUD and HUD estimates for people 12 and older for substate areas.[4] These estimates were produced by the Substance Abuse and Mental Health Services Administration (SAMHSA), combining 2016–18 data from the NSDUH, which provides estimates of the use of alcohol, tobacco, and drugs by the US civilian, noninstitutionalized population ages 12 and older. We also used estimates of the share of people with HUD only and state rates of PUD and HUD from the 2019 NSDUH detailed tables.[5]

We use county drug overdose death data from all drugs and from opioids from the CDC WONDER multiple cause of death data.[6] We identify drug overdose deaths using the following underlying cause-of-death codes from the tenth revision of the International Classification of Diseases: X40–X44 (unintentional), X60–X64 (suicide), X85 (homicide), and Y10–Y14 (undetermined). We identify opioid overdose deaths using the additional multiple-cause-of-death codes: opium (T40.0), heroin (T40.1), natural opioid analgesics (T40.2), methadone (T40.3), synthetic opioid analgesics other than methadone (T40.4), or other and unspecified narcotics (T40.6). Both definitions follow the CDC's definition of drug and opioid overdose deaths.[7] Because small counts are suppressed, we used overdose death counts from 2016 to 2019 combined.

We used county-level counts of opioids prescribed per capita in morphine milligram equivalents from 2015 and HIV prevalence rates from 2018.[8] Both are published by amfAR (the Foundation for AIDS Research) on the Opioid and Health Indicators Database.

As a measure of buprenorphine treatment prescribers, we used the Controlled Substances Act Registrants Database, purchased from the National Technical Information Service. The DEA database contains information on all registered prescribers across all types (Doctor of Medicine and Doctor of Osteopathic Medicine, Nurse Practitioner, Physician Assistant), including prescriber name and address, whether the prescriber has obtained a DATA-waiver, authorized patient limit (30, 100, or 275 patients), and DATA-waiver expiration date. We used data from February 2018 and January 2020. We mapped prescriber addresses to counties using a zip-code-to-county crosswalk from the US Department of Housing and Urban Development's Office of Policy Development and Research.[9]

Information on the number of buprenorphine prescribers, treatment episodes, and mean patient census in 2018 was derived from IQVIA Real World Data–Longitudinal Prescriptions data and was analyzed and published by the RAND Corporation (IVQIA, n.d.).[10] These data capture an estimated 90 percent of all prescriptions filled at retail pharmacies in all 50 states and the District of Columbia and contain information on the prescription, patient demographics, and prescriber location. As in prior research, we used counts of the primary prescribers of patient episodes, where each patient episode was assigned to only the primary prescriber, which accounted for approximately 95 percent of all buprenorphine prescribers (Stein, Jones, et al. 2021). Episodes in which the patient filled buprenorphine prescriptions from two or more prescribers were attributed to the prescriber who wrote the majority of buprenorphine days of supply during the episode. Episodes started with the date of the first observed fill of a prescription for a buprenorphine formulation with an Food and Drug Administration–approved indication for OUD treatment, after a 90-day period with no day's supply from a previously filled buprenorphine prescription. The episode ended with the last-day supply of buprenorphine for the last-filled buprenorphine prescription, with no more than a 30-day gap in the patient having a supply of buprenorphine. For example, if an individual filled a prescription with a 10-day supply on September 1, the episode would be considered as having ended on September 10 if there were no opioid prescriptions filled in the 30 days after September 10.

We used statewide counts of the number of patients receiving methadone at OTPs from the 2019 National Survey of Substance Abuse Treatment Services,[11] which is an annual census of all substance use treatment facilities in the United States and its territories, conducted for SAMHSA by Mathematica Policy Research. We used counts of the number of OTPs by county from SAMHSA's Opioid Treatment Program Directory.[12] We mapped OTP addresses to counties using the zip-code-to-county crosswalk

published by the US Department of Housing and Urban Development's Office of Policy Development and Research.[13]

To estimate driving time from county centroids to the nearest buprenorphine prescriber and OTP, we used 2016 county population–weighted centroids from the Missouri Census Data Center.[14] We used DC block centroids from Open Data DC to estimate DC ward centroids.[15]

Methods

PREVALENCE OF OUD, BY COUNTY

To estimate treatment need, we calculated estimated rates of past-year opioid abuse or dependence by county by averaging two estimates. For the first estimate, we started with estimates of past-year PUD and HUD for people 12 and older for substate areas from the combined 2016–18 NSDUH substate data. We adjusted these estimates up to 2019 by multiplying each substate rate by a factor equal to the change in PUD and HUD, respectively, from the combined 2017–18 rate from NSDUH to the 2018–19 rate specific to each state. We estimated the number of people with PUD and HUD, respectively, by multiplying each substate rate by the 2019 substate population. Using estimates from the 2019 NSDUH detailed tables, we estimated the share of people who have HUD only (but not PUD) to be 58.4 percent of people with any HUD. To estimate this share, we used the estimated total number of people with HUD, PUD, and any OUD (HUD, PUD, or both) to calculate the number who have both HUD and PUD, HUD only, and PUD only. We then calculated the share of people who have HUD only, out of those with any HUD, to be 58.4 percent. We estimated the number of people with any OUD in each substate as those with any PUD plus those with HUD only. This method allows for the rate of HUD to vary by substate, though we assume the share of people with HUD only, out of those with any HUD, is constant throughout substates. OUD is defined as self-report of heroin use or pain reliver abuse or dependence consistent with Diagnostic and Statistical Manual of Mental Disorders IV criteria.

Using these estimated substate OUD rates, we used ordinary least squares regression models to predict county-level OUD rates as a function of explanatory variables that have an empirical relationship with OUD. We used existing research to select independent variables (Alzeer, Jones, and Bair 2017; Paulozzi et al. 2011), presumed to capture variation in counties' underlying OUD rates, as independent variables in the model. We tested various models, which produced similar results and strong performance for predicting OUD rates. We chose the following parsimonious model: opioid overdose death rates from 2016 to 2019 and a state dummy variable (R-squared = 0.7427). We used this model to predict county-level OUD rates. We applied 2019 county-level population estimates to

these rates to create county-level counts, which we aggregated to the substate regions and adjusted to match the NSDUH substate counts.

For the second substate estimates, we multiplied the estimated 2019 county OUD estimates derived from NSDUH by a scalar representing the relationship between an NSDUH-based OUD rate, known to be biased downward, and an OUD rate for Massachusetts based on a capture-recapture analysis of seven administrative databases linked at the person level (Barocas et al. 2018). This scalar was computed as the ratio of the estimated OUD rate in Massachusetts in 2015 as computed by Barocas and coauthors (2018) to the estimated 2015 rate from the NSDUH. This scalar is equal to 4.6 percent divided by 0.8 percent, or 5.8. We used the 2015 OUD rates from the Massachusetts study because it is the most recent year of data available. We averaged the two county OUD estimates to compute final county OUD rates.

ESTIMATED NUMBER OF BUPRENORPHINE PRESCRIBERS

We used the number of prescribers responsible for a buprenorphine treatment episode by county in 2018 from IQVIA data. We divided this number by 0.90 to account for IQVIA encompassing 90 percent of pharmaceutical sales (Stein, Smart, et al. 2021; Stein, Jones, et al. 2021). We then multiplied this number by half of the growth rate in DATA-waivered prescribers from 2018 to 2020 using DEA data. We chose to use half of the growth rate in DATA-waivered prescribers since previous literature has found that only half of prescribers with a DEA waiver are likely to write a prescription in the year (Duncan et al. 2020). This results in the estimated number of prescribers responsible for a buprenorphine treatment episode in 2020.

To estimate the number of active buprenorphine prescribers by waiver limit, we used the share of DATA-waivered prescribers by waiver limit (30, 100, or 275 patients) from January 2020 DEA data. Following findings from Duncan and coauthors (2020), we first multiplied the number of waivered prescribers by the share that are active per waiver limit. They find that 38.9 percent of all waivered clinicians with a 30-patient waiver limit (30-waiver) are active, as are 84.1 percent of those with a 100-waiver and 98.0 percent of those with a 275-waiver (Duncan et al. 2020). Using these estimates, we then calculated the share of active waivered prescribers by waiver limit, using the distribution from January 2020 DEA data. We applied this share to IQVIA's estimate of active prescribers in 2020.

ESTIMATED OA-MAT TREATMENT CAPACITY, BY COUNTY

To estimate total OA-MAT treatment capacity, or treatment "slots," we used a lower bound of the number of patients currently in OA-MAT treatment. We calculated buprenorphine capacity from the number of active prescribers and the mean active buprenorphine prescriber patient caseload. Because

IQVIA includes only 90 percent of retail pharmacy sales, we divided the number of patients in each county by 0.90 to adjust for the assumption that we are missing 10 percent of patients (Stein, Smart, et al. 2021; Stein, Jones, et al. 2021). We estimated the number of patients receiving methadone at each OTP by dividing the number of patients receiving methadone in each state from the 2019 National Survey of Substance Abuse Treatment Services by the number of OTPs in the state. We then estimated the total number of methadone patients per county as the estimated number of methadone patients per OTP in that state multiplied by the number of OTPs in that county.

We used an upper-bound projection of whether the number of patients in buprenorphine treatment were to double (i.e., whether prescribers all doubled their number of patients). We used an upper bound of methadone treatment by inflating the estimated number of patients receiving methadone at OTPs by 20 percent, based on the finding that most OTPs operate at approximately 80 percent capacity (Jones et al. 2015).

This process produces an average estimated number of patients per buprenorphine prescriber ranging from 21 in Washington, DC, to 66 in West Virginia (table 1). We used additional data to estimate the average number of patients per buprenorphine prescriber by waiver level (i.e., the average number of patients per prescriber for 30-waivers and for 100- and 275-waivers, combined). To inform these estimates, we used county patient-per-prescriber ratios from IQVIA data showing the 10th, 25th, 50th, 75th, and 90th percentiles and the mean. We estimated the number of patients per prescriber at every percentile by using linear interpolation, assuming the value for the first percentile is equal to 1. Using the share of prescribers with a 30-waiver from the DEA data, we calculated the average patients per prescriber for all percentiles equal to and less than the share of 30-waivers for that county. This results in the estimated patients per prescriber for 30-waivers only by county. We multiplied this number by the number of 30-waivers to calculate the number of patients treated by 30-waivered prescribers. We divided the estimated number of patients treated by 30-waivered prescribers by the number of active 30-waivered prescribers to find the estimated number of patients per prescriber for 30-waivered prescribers. We follow a similar process to estimate the patients per prescriber for 100- and 275-waivers, computing the patients treated by these prescribers as the total patients minus the estimated patients treated by 30-waivered prescribers.

The estimated mean patients per 30-waivered prescriber ranges from 3 in Michigan to 7 in West Virginia, and the range in estimated mean patients for the 100- and 275-waivered prescribers combined also roughly doubled from lowest to highest.

TABLE 1

Mean Patients per Prescriber for Active Buprenorphine-Waivered Prescribers

State	Mean patients per prescriber for prescribers with a treatment episode	Mean patients per prescriber for 30-waivered prescribers	Mean of patients per 100- and 275-waivered prescribers	Estimated active 30-waivers	Estimated active 100-waivers	Estimated active 275-waivers
DC	21	5	57	3,721	1,342	244
ME	27	4	58	8,916	6,088	1,712
MI	31	3	58	23,675	15,963	6,870
NJ	29	5	62	16,806	8,057	4,328
NM	25	4	47	13,160	8,034	2,090
PA	47	5	89	46,864	25,855	17,302
WV	66	7	96	981	824	671

Source: Urban Institute analysis of buprenorphine primary prescriber data derived from IQVIA and Drug Enforcement Administration data.

Notes: We calculated the mean patients per prescriber for 30-waivered prescribers by dividing the estimated number of patients treated by 30-waivered prescribers by the number of 30-waivered prescribers. We calculated the mean patients per prescriber for 100- and 275-waivered prescribers by dividing the estimated number of patients treated by 100- and 275-waivered prescribers by the number of 100- and 275-waivered prescribers. We calculated the number of active prescribers as the total number of prescribers responsible for an episode derived from IQVIA data multiplied by the share of 30-waivered prescribers from Drug Enforcement Administration data.

ESTIMATED BUPRENORPHINE TREATMENT GAP, ASSUMING ALL PEOPLE WITH OUD SEEK OA-MAT

To compute the number of people with OUD who do not have access to treatment in their county, we started with the county-level counts of the number of people with OUD. We assumed that all people with OUD will seek treatment. Recent literature describing treatment in the US suggests that 19.4 percent of people with OUD received opioid-related treatment in the past year (Wu, Zhu, and Swartz 2016).

We computed a lower- and upper-bound treatment gap estimate by subtracting the number of people estimated to have OUD per county by the lower- and upper-bound treatment capacity estimates in each county. The lower-bound treatment gap estimates the number of people with OUD who are not currently receiving treatment. The upper-bound treatment gap estimates the number of people with OUD who would not have access to treatment if current prescribers doubled their number of patients and if OTPs increased to fill all their methadone slots, assuming OTPs are currently operating at 80 percent capacity.

ESTIMATED ADDITIONAL BUPRENORPHINE PRESCRIBERS NEEDED TO FILL THE TREATMENT GAP

We computed the estimated number of additional buprenorphine prescribers needed per county to achieve capacity to treat all people with OUD, following the lower- and upper-bound assumptions. We computed a maximum estimate of the number of new 30-waivered prescribers needed based on the current treatment gap, assuming new prescribers follow the estimated average patients per 30-waivered prescriber per state (table 1). We computed a minimum estimate of the number of new 30-waivered prescribers needed based on the treatment gap projection if current prescribers doubled their number of patients, all methadone slots were filled, and new prescribers treated twice the current average number of patients per 30-waiver per state.

The main recommendations include a cap on the recommendations to ensure the estimates of new providers needed are feasible for counties. These recommendations limit the number of new prescribers recommended to the greater of the number of active prescribers or 10 new prescribers. This ensures that at a maximum, we recommend that a county double its number of prescribers or add 10 new prescribers. In these cases, we also present the share of the treatment gap the new prescribers would fill. In counties with no current prescribers, we recommend a maximum of 10 new prescribers and present the share of the treatment gap that the new prescribers would fill.

We conducted all analyses with Stata 16.

WASHINGTON, DC, ESTIMATES

For the eight wards in Washington, DC, we computed separate OUD estimates based on NSDUH substate estimates by ward. We report the treatment capacity, treatment gap, and new prescribers needed to meet the demand for treatment for DC as a whole because residents are most likely to travel outside their community and to central DC to receive care (DC DOH 2017). We estimated the number of prescribers in each county by applying the share of prescribers in each ward using prescriber addresses in the DEA data to the total number of active prescribers in Washington, DC, from the IQVIA data. We calculated ward centroids by averaging latitudes and longitudes for block centroids by ward and estimated the average driving time from ward centroids to the nearest buprenorphine and methadone treatment.

TRAVEL TIME TO NEAREST TREATMENT

We computed the driving time to the nearest OTPs (where methadone treatment is available) and DEA-registered buprenorphine prescribers using OpenTripPlanner, an open-source software that provides driving and transit route information.[16] We computed the travel time from county population–weighted

centroids to OTPs and buprenorphine prescribers in the 2020 DEA database. We geocoded OTP and buprenorphine prescriber addresses using a geocoding tool developed by the Urban Institute's technology and data science team. We calculated driving time based on traffic patterns from Wednesday, July 15, 2020, with a departure time of 8:00 a.m. We report the estimated driving time to the nearest OTPs and buprenorphine prescribers. We conducted the analysis in R 4.0.4.

Limitations and Considerations

This study has several limitations.

- First, the NSDUH survey data we used to estimate the first set of substate estimate rates of OUD have important limitations. The NSDUH rates are based on self-reported information and are thus subject to recall and social-desirability biases. In addition, the survey excludes some populations likely to have relatively higher rates of OUD, such as people experiencing homelessness and not using shelters and people in institutional settings such as jails. Previous research found NSDUH OUD rates to be substantially lower than OUD rates based on linked administrative datasets (Barocas et al. 2018), and we used this research to develop the final OUD rate estimates used in this analysis to correct for this known bias.
- Second, the substate NSDUH estimates we used to estimate OUD rates are model-based small-area estimates, with limitations described elsewhere (SAMHSA, n.d.).
- Third, the scalar we used to create the second set of substate OUD estimates assumes that the relationship between Barocas and coauthors' (2018) Massachusetts estimates of OUD (based on administrative data, including mortality data) and the Massachusetts NSDUH OUD rates in 2015 is similar to such a computation for our study states in 2019.
- Fourth, the average duration for a buprenorphine treatment episode is likely less than one year; thus, prescribers could use each of their waivered slots to treat multiple patients sequentially over the course of a year, while in this study, we assume this treatment slot is used for one patient.
- Fifth, the treatment gap could be filled under alternative scenarios, such as by shifting some providers who are already waivered to higher patient limits than we used in our projected upper-bound estimate (e.g., from 30-patient to 100-patient waiver limits).
- Sixth, not all people with OUD seek treatment, so the estimated number of providers needed to treat everyone may be higher than would be needed to treat only those who seek treatment.

- Seventh, though we report the driving time to the nearest methadone and buprenorphine treatment, this estimate is likely underestimated because not all buprenorphine-waivered prescribers are active, many practice in locations other than the one under which they are registered in the DEA data, and OTPs may not have availability for new patients. Additionally, we report the driving time from the county centroid to the nearest treatment option, and actual driving time may vary for residents who do not live close to their county's centroid.

Additional limitations relate to the use of estimates derived from the IQVIA data used to estimate the current number of buprenorphine patients and the number of buprenorphine prescribers per county.

- First, the IQVIA Real World Data–Longitudinal Prescriptions data capture an estimated 90 percent of prescriptions filled at retail pharmacies in the United States (Stein, Smart, et al. 2021; Stein, Jones, et al. 2021). As such, we assumed the missing data relate to 10 percent of patients and 10 percent of prescribers, and we divided patient and prescriber counts by 0.9 to adjust our totals upward to account for the missing 10 percent. But the missing data may not be spread evenly across states and counties, and our decision to adjust county estimates of patients and prescribers evenly may produce overestimates in some counties and underestimates in others.
- Second, mean patient census counts for primary prescribers were by the prescriber's county, which may not be the patient's county of residence. Ideally, as in our previous research,[17] we would have presented estimates of the treatment gap based on the patient's county, but these data were not available.
- Third, the prescriber's county may not reflect all the counties in which the prescriber treats patients. But our methodology assigns the entire patient load to a single county for each prescriber, even if they practice in multiple counties.
- Fourth, we used IQVIA Real World Data–Longitudinal Prescriptions data analyzed by researchers in the RAND Corporation's Opioid Policy Tools and Information Center (OPTIC) that followed a previous definition of buprenorphine treatment episode and episode primary prescriber (Stein, Smart, et al. 2021; Stein, Jones, et al. 2021). But patients receiving buprenorphine may fill prescriptions from multiple prescribers during an episode. As a result, this definition of buprenorphine prescribing may not describe the additional buprenorphine-waivered workforce capacity needed to treat patients.

- Fifth, we use linear interpolation to estimate the patients per prescriber for 30-waivers, which assumes a constant rate of increase in patients for prescribers at each percentile, though in reality, this may vary by county. We use a linear model for clarity rather than a cubic spline model, which may more accurately describe prescribing patterns by waiver limit. We assume that the first percentile of prescribers always treats one patient.

Lastly, many people with OUD need access to supportive services, more intensive treatment, treatment for co-occurring mental health conditions, and services to address other substance use problems, and these additional services may not be available in typical outpatient medication treatment settings, such as those described in this study.

Notes

[1] See Bradley D. Stein, Rosie Kerber, and Jill Gurvey, "2017-18 Buprenorphine County Prescriber Counts and Mean Monthly Census and Buprenorphine Treatment Episode Duration for Fifty States and DC," RAND Corporation, accessed July 20, 2021, https://www.rand.org/content/dam/rand/pubs/external_publications/EP60000/EP68582/RAND_EP68582-BUP.zip.

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[3] "2021 Demographics for the District of Columbia: Age," DC Health Matters, accessed March 22, 2021, https://www.dchealthmatters.org/?module=demographicdata&controller=index&action=index&id=130951&sectionId=942.

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[6] "About Multiple Cause of Death, 2018–2019, Single Race," Centers for Disease Control and Prevention, accessed March 22, 2021, https://wonder.cdc.gov/mcd-icd10-expanded.html.

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[9] "HUD USPS Zip Code Crosswalk Files," US Department of Housing and Urban Development, Office of Policy Development and Research, accessed March 22, 2021, https://www.huduser.gov/portal/datasets/usps_crosswalk.html.

[10] Stein, Kerber, and Gurvey, "2017-18 Buprenorphine County Prescriber Counts.

[11] "National Survey of Substance Abuse Treatment Services (N-SSATS), 2019: Data on Substance Abuse Treatment Facilities," US Department of Health and Human Services, Substance Abuse and Mental Health Services

Administration, accessed March 22, 2021, https://www.samhsa.gov/data/sites/default/files/reports/rpt29389/2019_NSSATS/2019_NSSATS.html.

[12] "Opioid Treatment Program Directory," US Department of Health and Human Services, Substance Abuse and Mental Health Services Administration, accessed March 22, 2021, https://dpt2.samhsa.gov/treatment/directory.aspx.

[13] "HUD USPS Zip Code Crosswalk Files," US Department of Housing and Urban Development.

[14] "Geocorr 2018: Geographic Correspondence Engine," Missouri Census Data Center Data Applications, last updated December 4, 2018, https://mcdc.missouri.edu/applications/geocorr2018.html.

[15] "Block Centroids," Open Data DC, last updated June 25, 2019, https://opendata.dc.gov/datasets/block-centroids/geoservice?geometry=-77.538%2C38.810%2C-76.487%2C38.997.

[16] See the website for OpenTripPlanner at https://www.opentripplanner.org/.

[17] See the appendix (linked in the penultimate paragraph) for Lisa Clemans-Cope, Douglas A. Wissoker, Marni Epstein, and Joshua Aarons, "California County Fact Sheets: Treatment Gaps in Opioid-Agonist Medication Assisted Therapy (OA-MAT) and Estimates of How Many Additional Prescribers Are Needed," Urban Institute, last updated November 11, 2019, https://www.urban.org/policy-centers/health-policy-center/projects/california-county-fact-sheets-treatment-gaps-opioid-agonist-medication-assisted-therapy-oa-mat-and-estimates-how-many-additional-prescribers-are-needed.

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Acknowledgments

This research was funded by Bloomberg Philanthropies and NIDA (P50DA046351 (Stein, PI). We are grateful to them and to all our funders, who make it possible for Urban to advance its mission.

The views expressed are those of the authors and should not be attributed to the Urban Institute, its trustees, its funders, or the National Institutes of Health. Funders do not determine research findings or the insights and recommendations of Urban experts. Further information on the Urban Institute's funding principles is available at urban.org/fundingprinciples.

For more information on this project, see https://www.urban.org/policy-centers/health-policy-center/projects/county-fact-sheets-selected-states-treatment-gaps-opioid-agonist-medication-assisted-therapy-and-estimates-how-many-additional-prescribers-are-needed.

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