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Comparison between buprenorphine provider availability and opioid deaths among US counties

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ABSTRACT

Background: Buprenorphine is an effective medication for the treatment of opioid addiction, but current barriers to buprenorphine access limit treatment availability for many patients. We identify and characterize regions within the United States (US) with poor buprenorphine access relative to the observed burden of overdose deaths.

Methods: This cross sectional study includes US county-level data on the number of available buprenorphine providers (Substance Abuse and Mental Health Services Administration Buprenorphine Treatment Practitioner Locator) and the number of opioid-related overdose deaths between 2013 and 2015 (Centers for Disease Control and Prevention WONDER Database). Counties with fewer than 10 deaths during this time period were excluded to maintain patient privacy. Population-adjusted county death rates and provider availability were compared to identify locations with high disease burdens and limited buprenorphine access. The presence of significant clustering across the dataset was evaluated using Global Moran's I and zones of significant spatial clusters and anomalies were identified using Local Indicator of Spatial Autocorrelation.

Results: County data were available for 846 counties from 49 states and the District of Columbia, comprising 83% of the US population. The median number of opioid overdose deaths per county was 20.0 deaths per 100,000 residents (interquartile range 13.4–29.9, range 2.9 to 108.8). The number of buprenorphine providers per 100,000 county residents ranged from 0 to 45, with a median of 5.9 (interquartile range 3.2 to 9.5). Global Moran's I analysis yielded significant clustering in the distribution of both providers and deaths, with notable significant clusters of higher than average providers and deaths in the Northeast, and scattered mismatched regions of lower-than-average providers and higher-than-average deaths across the Southern, Midwestern, and Western US. Graphical analysis of buprenorphine provider availability and overdose burden reveals limited treatment access relative to overdose deaths throughout much of the Midwestern and Southern US.

Conclusions: Substantial county-level imbalances between the availability of buprenorphine providers and the burden of opioid overdose deaths are present within the US.

1. Introduction

Rates of opioid abuse and opioid-related overdose deaths have increased dramatically across the United States (US) over the last two decades, including an increase in deaths due to illicit opioids of over 200% since 2010 (Dowell, Noonan, & Houry, 2017; Rudd, Aleshire, Zibbell, & Gladden, 2016). Medication assisted treatment is currently the most effective intervention for reducing morbidity and mortality associated with opioid use disorder (Amato et al., 2005; Mattick, Breen, Kimber, & Davoli, 2014). Medication treatment options for patients with opioid use disorder include opioid maintenance therapy (OMT) with full opioid-receptor agonists (methadone) or with partial opioid receptor agonists (e.g. buprenorphine), both of which have been shown to be safe and effective for treating opioid use disorder and limiting illicit opioid use (Hser et al., 2014; Hser et al., 2016). Compared with patients treated using other modalities, those on OMT have increased

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treatment retention rates, decreased high risk behaviors, decreased incidence of HIV and hepatitis C, and reduced mortality from overdose (Amato et al., 2005; Gowing, Farrell, Bornemann, Sullivan, & Ali, 2008; Mattick et al., 2014). While methadone is associated with a higher treatment retention rate, buprenorphine has several advantages including decreased patient travel- and time-related treatment burdens, decreased stigma, and fewer regulatory barriers for prescribers. While the number of healthcare providers with Drug Enforcement Agency (DEA) license waivers permitting the prescription of buprenorphine continues to increase (Dick et al., 2015), access to this treatment option remains limited for much of the US, and buprenorphine is underutilized among patients with opioid use disorders (Knudsen, Havens, Lofwall, Studts, & Walsh, 2017; Parran et al., 2017; Stein et al., 2015; Tsui, Burt, Thiede, & Glick, 2017).

In considering policies aimed at addressing these access discrepancies, it is critical to characterize the areas with the greatest need for improved access to options for OMT. We aimed to characterize county-level differences in access to buprenorphine prescribers across the US, and to describe the relationship between buprenorphine availability and rates of death due to opioid overdose.

2. Methods

We obtained a list of all practitioners in the US as of July 2017 with a DEA license waiver granting the ability to prescribe buprenorphine from the Substance Abuse and Mental Health Services Administration (SAMHSA). This database included practitioner names and the addresses of practice locations with zip codes. Entries with duplicate first names, last names, and zip codes were removed, and we tallied the number of providers with a practice location within each zip code. When a practitioner with the same first and last names had entries in more than one zip code, we considered the provider to have a practice location in each listed zip code. This was done to limit the risk of failing to count a provider because he or she shared a name with another healthcare provider in the database. Additionally, when providers have more than one practice location, they likely serve as an available resource to residents with proximity to each of these locations.

We obtained mortality data from the CDC WONDER database, which includes county-level mortality data from 1979 through 2015. Deaths recorded from 2013 to 2015 among ages 15 and older were included if they were classified within ICD-10 Categories X42 (Accidental poisoning by and exposure to narcotics and psychodysleptics), X62 (Intentional self-poisoning by and exposure to narcotics and psychodysleptics), or Y12 (Poisoning by and exposure to narcotics and psychodysleptics). Deaths were recorded on a per-county basis; due to confidentiality requirements, data were suppressed from counties with fewer than 10 deaths during the study period. Many counties include multiple zip codes. In some cases, portions of an individual zip code exist within more than one county. When this occurred, we tallied healthcare providers within a shared zip code according to the county that contained the highest proportion of that zip code's area. For example, a provider with an office in a zip code which was 90% within County A and 10% within County B, was counted within County A for the purposes of our study.

County-level characteristics including 2015 median household income, and rural-urban continuum codes were obtained from the United States Department of Agriculture (USDA) Employment, Unemployment, and Median Household Income dataset (Davis & Carr, 2017). The USDA classifies each US county with a rural-urban continuum code which reflects the county's population and proximity to a metropolitan area. County population and race data were obtained from the United States Census Bureau using 2015 estimates. We linked CDC Wonder data to the county-level data using county-specific Federal Information Processing Standard Publication (FIPS) codes.

2.1. Outcomes

The primary study outcome was the number of buprenorphine providers per 100,000 individuals in each included county. We compare the availability of buprenorphine providers between counties stratified according to urban/rural status, median household income, state, and racial makeup. We also compare counties based on population-adjusted drug overdose death rates, and report the county-level relationship between the availability of buprenorphine providers and drug overdose death rates.

2.2. Statistical analyses

We use descriptive statistics to present county overdose death rates per 100,000 individuals. The bivariate correlation between the number of buprenorphine providers per 100,000 county residents and the number of overdose deaths per 100,000 residents was assessed using Spearman's correlation. We constructed a linear regression model to assess the relationship between buprenorphine providers per 100,000 residents and death rate due to overdoses per 100,000 residents while controlling for the metropolitan status of the county, median county income, the proportion of black county residents and the proportion of Hispanic county residents. There was no evidence of significant collinearity within this model.

We also displayed county-level rates of buprenorphine providers per 100,000 residents and opioid overdose deaths per 100,000 residents, delineated by quartiles, on a map of the US in order to facilitate the identification of regions with relatively high rates of overdose deaths and poor availability of buprenorphine providers. Statistical analyses were performed using PASW version 18.0 (IBM, Armonk, NY). P values < 0.05 were considered statistically significant.

The presence of statistically significant spatial clustering across each dataset was evaluated using a Global Moran's I test with an inverse distance squared neighbor definition (Moran, 1950). Clustering was further evaluated using the Local Indicator of Spatial Autocorrelation (LISA) analysis (Anselin, 1995), yielding identified counties that demonstrated significant spatial clusters of higher-than-average or lower-than-average values for either variable, as well as the presence of outliers that significantly differed from the surrounding region. All spatial analysis operations were implemented in ArcGIS 10.5.1 software (ESRI 2017).

3. Results

Data from the 2013–2015 study period were available for 846 counties from 49 states (not including North Dakota) and the District of Columbia, encompassing 83% of the U.S. population. During the three-year study period there were 51,688 recorded deaths in the included counties due to opioid overdose. Rates of overdose death per 100,000 residents ranged from 2.9 to 108.8. The median number of opioid overdose deaths per county was 20.0 deaths per 100,000 residents (IQR 13.4–29.9) (Table 1).

The number of buprenorphine providers ranged from 0 to 601 per county, with a median of 9 (IQR 3–23). The number of buprenorphine providers per 100,000 county residents ranged from 0 to 45, with a median of 5.9 (IQR 3.2 to 9.5). Fifty-seven (7%) of the included counties had no buprenorphine provider available, and 223 (26%) had three or fewer. The availability of buprenorphine providers and the rate of opioid deaths was only weakly correlated (correlation coefficient 0.18, $p < 0.001$) (Fig. 1).

We used multiple linear regression to predict the availability of buprenorphine providers within the included counties based on the observed county opioid death rate, while controlling for other county characteristics. An increasing county opioid death rate and classification as a metropolitan area were the only factors significantly associated with increased availability of buprenorphine providers, though