Opioid Prescribing Rates by Congressional Districts, United States, 2016

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Objectives. To determine the extent to which opioid prescribing rates vary across US congressional districts.

Methods. In an observational cross-sectional framework using secondary data, we constructed 2016 congressional district–level opioid prescribing rate estimates using a population-weighted methodology.

Results. High prescribing rate districts were concentrated in the South, Appalachia, and the rural West. Low-rate districts were concentrated in urban centers.

Conclusions. In the midst of an opioid overdose crisis, we identified congressional districts of particular concern for opioid prescription saturation.

Public Health Implications. The congressional district geography represents a policy-relevant boundary and a politically important level at which to monitor the crisis and determine program funding. Furthermore, in the context of the opioid crisis, knowing how congressional districts rank across the country and in states is useful in the creation of policies targeted to areas in need. (Am J Public Health. Published online ahead of print July 19, 2018: e1–e6. doi:10.2105/AJPH.2018.304532)

On October 26, 2017, the president of the United States officially declared the opioid epidemic a “public health emergency.” According to the Centers for Disease Control and Prevention (CDC), prescription opioid–related overdose deaths have quadrupled between 1999 and 2010.1 This large increase was matched by the quadrupling of the number of opioid prescriptions in the United States during that same period. From 2006 to 2010, opioid prescribing rates increased from 72.4 to 81.2 prescriptions per 100 persons. This rate remained constant from 2010 to 2012 and decreased to 70.6 from 2012 to 2015.1 The link between prescribing rates and overdose deaths appears to be directly related to maximum prescribed daily doses and not to regularly scheduled and as-needed doses.2,3 Thus, in understanding the nature of opioid overdose risk, it is necessary to understand how saturated a particular area is with prescription opioids.

More efficient monitoring and the development of policy that targets opioid-related mortality can be aided by knowing the geographic distribution of the opioid crisis.

Data on US opioid prescribing rates are available at the national, state, and county levels. In recent years, county- and state-level analysis has been the focus of many public health studies.1,4–6 This work has been important for characterizing wide disparities in opioid prescribing rates and overdose mortality rates within states and finding associations with White populations, rural areas, and Medicaid enrollment, among other variables.1 State-level analysis provides an explicit geographic link to state and federal government representation.7 We focused on congressional districts to analyze opioid prescribing rate data in states and capture a population that is represented by elected officials at a level higher than the municipality.

The congressional district in the United States is “a territorial division of a state from which a member of the U.S. House of Representatives is elected.”8 Districts tend to be of similar population size; as of the 2010 Census reapportionment, congressional districts have 710,767 people on average.9 This geography is a policy-relevant boundary and a politically important level at which to monitor the crisis and determine program funding. Using our analysis, policymakers can understand how their districts are faring relative to other districts across the country and within their state using a single measure instead of using several different county measures. In the context of the opioid crisis, knowing how congressional districts rank across the country and within states is useful in the creation of policies targeted to areas in need. Furthermore, previous literature has shown that the administrative level of the county may not be an appropriate primary unit of analysis, especially when developing policy and implementing programs that do not operate at the administrative level of the county.10 Even with the clear connection between geography and political representation, relatively few studies on health indicators perform analysis at this level, with some notable exceptions.11,12

Although previous literature has focused on the county, leaders in Congress are typically more familiar and concerned with constituents in their own districts, which are often composed of many different counties and portions of counties. Thus, there is value in constructing district-level rates that incorporate the spatial relationship between districts and counties. The aggregation of county-level opioid prescribing rates may accurately capture congressional district–level prescribing rates when

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RESULTS

The 2016 mean and median rates for opioid prescriptions per 100 people across all congressional districts were 66.96 and 65.14, respectively, with a range of 23.30 to 166.69 (Table A available as a supplement to the online version of this article at http://www.ajph.org). Districts with the 10 highest rates were overwhelmingly contained in the Southeastern states, whereas districts with the 10 lowest rates were entirely contained in California, New York City, and Virginia (Table 1). Interestingly, the state of Virginia contained both a top and bottom 10 prescribing rate district. However, these extremes within the state may be expected, as the low-rate district contains Arlington County, which is near Washington, DC, whereas the high-rate district covers the far western part of the state along the border with West Virginia.

Of the top 10 rates shown in Table 1, Alabama’s 4th district, Kentucky’s 5th district, Tennessee’s 1st and 3rd districts, and Alabama’s 1st district were outliers with respect to the overall distribution of prescribing rates (Figure A, available as a supplement to the online version of this article at http://www.ajph.org, contains a boxplot). There were no outliers at the lower end of the distribution. The interquartile range was relatively narrow compared with the minimum and maximum values, running from 49.40 to 80.80.

With respect to geographic patterns of prescribing rates across congressional districts (Figure 1), there was a concentration of high prescribing rates throughout the South and along Appalachia. These areas have been highlighted as the most at-risk regions in terms of opioid-related mortality.4 Eastern Arizona, northern California, and Nevada along with the more rural portions of the states of Oregon and Washington had relatively high levels of...
TABLE 1—Top 10 and Bottom 10 Opioid Prescribing Rates by Congressional District: United States, 2016

<table>
<thead>
<tr>
<th>Rank</th>
<th>State</th>
<th>Congressional District</th>
<th>Opioid Prescribing Rate per 100</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Alabama</td>
<td>4</td>
<td>166.69</td>
</tr>
<tr>
<td>2</td>
<td>Kentucky</td>
<td>5</td>
<td>147.00</td>
</tr>
<tr>
<td>3</td>
<td>Tennessee</td>
<td>3</td>
<td>133.00</td>
</tr>
<tr>
<td>4</td>
<td>Tennessee</td>
<td>1</td>
<td>131.95</td>
</tr>
<tr>
<td>5</td>
<td>Alabama</td>
<td>1</td>
<td>131.35</td>
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<tr>
<td>6</td>
<td>Mississippi</td>
<td>4</td>
<td>126.14</td>
</tr>
<tr>
<td>7</td>
<td>Arkansas</td>
<td>1</td>
<td>125.79</td>
</tr>
<tr>
<td>8</td>
<td>Virginia</td>
<td>9</td>
<td>124.49</td>
</tr>
<tr>
<td>9</td>
<td>Tennessee</td>
<td>6</td>
<td>118.79</td>
</tr>
<tr>
<td>10</td>
<td>Oklahoma</td>
<td>1</td>
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<tr>
<td>427</td>
<td>Virginia</td>
<td>8</td>
<td>29.29</td>
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<td>428</td>
<td>California</td>
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<td>27.73</td>
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<td>New York</td>
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<tr>
<td>436</td>
<td>New York</td>
<td>9</td>
<td>23.30</td>
</tr>
</tbody>
</table>

Note: Table G (available as a supplement to the online version of this article at http://www.ajph.org) provides a full ranking of all congressional districts.

Sensitivity Analysis

We tested the accuracy of the population-weighted methodology by constructing congressional district estimates of a related socioeconomic characteristic that is observed at both the county and the congressional district levels. Specifically, we applied the population-weighting methodology to construct congressional district–level estimates and then compared these estimates to actual observed values. We selected White population proportion as the comparable socioeconomic characteristic because of its correlation with opioid prescribing rates. We retrieved White proportion at the county and congressional district levels from the 2011 through 2015 American Community Survey. Summary statistics of the actual proportions versus estimated proportions showed high similarity in the mean and maximum (Table F, available as a supplement to the online version of this article at http://www.ajph.org). However, the estimated proportions displayed a lower SD and larger minimum value, resulting in a slightly lower median value than the true median.

To assess variation in estimation strength that might occur as a result of how completely counties are nested in the congressional districts, we calculated fit statistics on the basis of nesting degree quartiles. Specifically, for each county intersecting with a congressional district, we calculated the county population proportion that is contained in the congressional district on the basis of census block population counts. We equated the degree of nesting for a particular congressional district to the mean of the contained population proportions of all counties intersecting with the district. Perfect nesting (mean = 1), districts that contain only full counties, produced perfect estimates, which we expected. We did not include these districts in the calculation of nesting degree quartiles. We calculated a root mean square error (RMSE) for each nesting degree quartile.
The 25th, 50th, and 75th percentiles for nesting degree were 0.43, 0.75, and 0.93, respectively. Estimation accuracy increased as the degree of nesting increased. The poorest performing estimates came from districts in the first quartile (RMSE = 0.1523). These districts tend to be densely populated urban areas, with many of these districts contained in a much larger single county. The second quartile estimates produced a RMSE of 0.079, which is nearly one half the size of the first.
DISCUSSION

The United States experienced a declining life expectancy for a second straight year in 2016.¹⁸ Increasing age-specific death rates among those aged 15 to 44 years are attributable to increases in unintentional injuries that are largely driven by opioid overdose mortality.¹⁹ In 2016, 42,200 deaths were attributed to opioids,¹⁹ which is staggering by itself but may even be a vast underestimate.²⁰ However, beyond the toll on American lives, the opioid epidemic bears large economic costs. The opioid epidemic was estimated to cost the United States $78.5 billion in 2013, with about a third going to increased healthcare and treatment costs.²¹ With these alarming facts in mind, understanding the opioid epidemic at policy-relevant geographies is important.

To the best of our knowledge, this is the first study to focus on congressional district–level opioid prescribing rates. We have identified the following salient findings. First, at-risk districts were concentrated in the Southeastern states with clear rural versus urban variation. Although these geographical patterns have been previously identified in county-level analysis, our contribution here is in the identification of additional variation between district and state rates and in the creation of congressional district rankings. Second, we identified how our population-weighting technique was affected by the spatial relationship between congressional districts and counties.

Variation in opioid prescribing rates both across and within states has potential policy implications, especially in terms of identifying which level of government should monitor prescribing rates and develop policies. Members of Congress are most concerned about the issues directly affecting their own constituents. By knowing opioid prescribing rates by congressional district, instead of at the state level, which may be very different, representatives may be able to advocate more strongly for federal policy. Additionally, county-level rates provide members of Congress important information on how rates vary within a state at a relatively small geographic scale. However, because of the spatial relationship between a member’s district and intersecting counties, the county rates may provide a poor approximation for the district rate. We took a first step in estimating congressional district–level opioid prescribing rates and in identifying locations of variability, but we did not isolate the contributing components.

Variability between congressional district opioid prescribing rates can be generated in 3 ways. First, rates may depend on socioeconomic composition in a district. Second, variation in rates may be endogenously generated because people may demand more in certain areas for reasons the researcher does not observe. Third, rates may vary as a result of deliberate policy actions or a lack of action, which may influence prescribing rates over time. Disentangling these 3 sources is of priority for future research. With this knowledge, we would increase our ability to learn why certain districts are more successful in achieving more appropriate opioid prescribing rates.

Our analysis was limited in the following ways. On the basis of the sensitivity analysis using White population proportion, our population-weighting methodology proved reasonably robust for most congressional districts. However, for districts that exhibit low levels of nesting with counties, that is, contain only small portions of counties, the estimation was poor. These districts tend to contain dense urban geographies with average socioeconomic characteristics that deviate from the averages for counties with which they intersect. In this setting, population

![Diagram](https://example.com/diagram.png)

**Note.** Q = quartile. We equated the degree of nesting for a particular CD to the mean of the contained population proportions of all counties intersecting with the district. Low nesting degree implies that only small portions of counties (or a single county) are contained in a district. High nesting degree implies that an overall large proportion of intersecting counties are contained in the district. Districts containing perfectly nested counties are not included.

**FIGURE 3**—Congressional District (CD) White Population Proportion Estimate vs Actual by County Nesting Degree: United States, 2016
weighting does not accurately capture the underlying variation. Future research will seek to develop weighting methods that consider socioeconomic variables, such as poverty, race, and population density, that are associated with opioid prescribing rates.\textsuperscript{1,3,4} Specifically, census block socioeconomic variables can potentially be used to adjust the population weighting up or down. The development of this methodology will also address traditional concerns with population-weighting techniques, namely that the source zone (county) data are distributed down to the geographic intermediary (census blocks) in a uniform manner.

There are 3 caveats related to the data we used. First, census block data are available for 2010; however, the opioid prescription rate data are from 2016. Thus, we constructed population weights on the basis of 2010 census block and congressional district population ratios.

Second, opioid prescribing rate data were missing for 180 counties. In these instances, population weights were constructed with respect to the total number of census blocks in a district that contained county-level prescribing rate data. The impact of the missing rate data on the estimation was assumed to be minimal because missing counties contain very small proportions of congressional district total populations. The average district population proportion associated with a missing county was 0.01. The singular congressional district of Alaska was an outlier, where 0.12 of its population was contained in counties with missing opioid prescribing rate data. The estimated congressional district prescribing rate should be interpreted with caution here.

Lastly, the modifiable areal unit problem is a potential issue because 3 different scales were used within our analyses: census block, county, and congressional district. Had we selected a different set of scales, results may have varied. However, we chose to use the finest resolutions possible to preserve the greatest amount of information in the data. Furthermore, we were restricted by the need to find a spatial unit that nests both within counties and congressional districts. This is true only for census blocks.

In summary, our results emphasize the value in analyzing health and clinical outcomes at the congressional district level. In the opioid crisis context, a major driver has been prescription opioid abuse, and it is important to understand the amount of saturation in particular congressional districts to drive both federal and local policy efforts. Our results indicate areas of priority for reducing prescription opioid saturation, particularly in the Southeast.

\textbf{CONTRIBUTORS}

L. A. Rollheiser wrote the initial draft of the article. L. A. Rollheiser and J. Cordes led the data analysis. L. A. Rollheiser and S. V. Subramanian conceptualized and designed the study. J. Cordes and S. V. Subramanian contributed to interpretation of the results and writing. S. V. Subramanian provided overall supervision of the study. All authors approved the final submission of the study.

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\textbf{HUMAN PARTICIPANT PROTECTION}

No protocol approval was necessary as data were obtained from secondary sources.

\textbf{REFERENCES}