Data Article

County-level data on U.S. opioid distributions, demographics, healthcare supply, and healthcare access

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A B S T R A C T

The dataset summarized in this article is a combination of several of U.S. federal data resources for the years 2006-2013, containing county-level variables for opioid pill volumes, demographics (e.g., age, race, ethnicity, income), insurance coverage, healthcare demand (e.g., inpatient and outpatient service utilization), healthcare infrastructure (e.g., number of hospital beds or hospices), and the supply of various types of healthcare providers (e.g., medical doctors, specialists, dentists, or nurse practitioners). We also include indicators for states which permitted opioid prescribing by nurse practitioners. This dataset was originally created to assist researchers in identifying which factors predict per capita opioid pill volume (PCPV) in a county, whether early state Medicaid expansions increased PCPV, and PCPV’s association with opioid-related mortality. Missing data were imputed using regression analysis and hot deck imputation.
Non-imputed values are also reported. Taken together, our data provide a new level of precision that may be leveraged by scholars, policymakers, or data journalists who are interested in studying the opioid epidemic. Researchers may use this dataset to identify patterns in opioid distribution over time and characteristics of counties or states which were disproportionately impacted by the epidemic. These data may also be joined with other sources to facilitate studies on the relationships between opioid pill volume and a wide variety of health, economic, and social outcomes.

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Specifications Table

| Subject | Public Health and Health Policy |
|---|---|
| Specific subject area | Geographic variations in opioid pill volume and their demographic and public policy correlates |
| Type of data | Tables, Figures, Raw Data Files, R Scripts |
| How data were acquired | Monthly data on opioid pill volumes were obtained from the U.S. Drug Enforcement Administration (DEA)'s Automation of Reports and Consolidated Orders System (ARCOS) pill shipment database, an extract of which was publicly-released by the Washington Post [1]. Annual data files on county-level characteristics were downloaded directly from the Health Resources & Services Administration’s website (Health Resources and Services Administration, 2018). Three-year rolling averages for cancer and opioid-related deaths were extracted from the Centers for Disease Control and Prevention’s Wide-ranging Online Data for Epidemiologic Research (Centers for Disease Control and Prevention, 2006-2014). State-level scope of practice laws for nurse practitioners were identified via a review of policy documents provided by Scope of Practice Policy [8]. Dates of implementation for early state Medicaid expansions were identified by the Kaiser Family Foundation [7]. |
| Data format | Mixed (raw and preprocessed) |
| Parameters for data collection | We collected data for all counties with the exception of Charleston, South Carolina and Leavenworth, Kansas. These were excluded due to the presence of Veterans Affairs distribution pharmacies that serve the region but are counted in the ARCOS as retail pharmacies. Their inclusion would dramatically bias the pill counts for these counties upwards. |
| Description of data collection | With the exception of opioid pill volumes, raw data were accessed directly from agency websites. Opioid pill volumes were downloaded from the Washington Post’s application programming interface (API) using the ‘arco’ package for R statistical software (Rich et al., 2020). R statistical software was used to merge the disparate data sources into a single analytic file. |
| Data source location | Washington Post's ARCOS data extract [4], [5] https://www.washingtonpost.com/national/2019/07/18/how-download-use-dea-pain-pills-database/ Health Resources & Services Administration’s Area Health Resources Files (AHRF) [6] https://data.hrsa.gov/topics/health-workforce/ahrf Centers for Disease Control & Prevention’s Wide-ranging Online Data for Epidemiologic Research [7] https://wonder.cdc.gov/ National Conference of State Legislatures [8] https://www.ncsl.org/research/health/scope-of-practice-overview.aspx |

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Value of the Data

- The Automation of Reports and Consolidated Orders System (ARCOS) pill shipment database provides an unprecedented opportunity to evaluate the association between opioid pill distribution and ORDs over time.
- These county-level data describe large geographic variations in per capita opioid pill volume, and how these variations are associated with local demographics (e.g., gender, race/ethnicity, and come), healthcare access (e.g., insurance coverage), and the local supply of various healthcare provider types (e.g., doctors, specialists, nurse practitioners).
- These data offer valuable new evidence to researchers who wish to understand the characteristics of areas that were disproportionately affected by the opioid epidemic.
- The variables for local opioid pill volume may be used by researchers to examine the opioid epidemic’s downstream effects on a wide variety of health, economic, and social outcomes.
- Researchers may use this dataset to estimate the effects of various policies or interventions (e.g., Medicaid expansion, prescription drug monitoring programs) on the volume of opioid pill distributions.

1. Data Description

Data on opioid shipments to retail pharmacies were obtained from the U.S. Drug Enforcement Administration (DEA)’s Automation of Reports and Consolidated Orders System (ARCOS) pill shipment database [4]. ARCOS was created as a result of the 1970 Controlled Substances Act, and is the only non-proprietary source of information describing the legal distributions of Schedule I/II controlled substances and Schedule III narcotics from pharmaceutical manufacturers to retailers (e.g., hospitals or pharmacies). Previously, the DEA has reported annual state and national totals for schedule I/II controlled substances and Schedule III narcotics. County-level data on such pharmaceutical distributions were not publicly available until The Washington Post gained access to ARCOS as the result of a 2019 court order [1], and subsequently made these data available to researchers [10]. Fig. 1 depicts the mean annual per capita pill volume by county for the years 2006–2013. The ARCOS data are contained within our Mendeley Data repository in CSV, R, and Stata formats under the ‘Raw data/ARCOS’ subfolder.

Data on opioid-related deaths and cancer deaths were obtained from the Center for Disease Control (CDC) Wide-ranging Online Data for Epidemiologic Research (WONDER) database [3]. This database provides a comprehensive collection of public-use data including U.S. births, deaths, population estimates, and various other public health-related metrics. Data tabulations were obtained as rolling three-year county-level estimates. Fig. 2 depicts the mean annual opioid-related deaths per 100,000 residents by county for the years 2006–2013. The WONDER data extracts for cancer- and opioid-related mortality are provided in our Mendeley Data repository in CSV format under the ‘Raw Data/WONDER’ subfolder.

Supplemental data for community-level characteristics were drawn from the Health Resources & Services Administration’s (HRSA) Area Health Resource Files (AHRF). The AHRF integrates more than 50 different federal and nongovernmental databases, and contains over 1,000 variables regarding all manner of county characteristics such as annual data on demographics, healthcare workforce and facilities, health spending, and other variables representing social determinants of health [6]. The current and prior years of AHRF data are posted online by HRSA;
prior years were obtained through targeted emails and social media crowd-sourcing. Data for the years 2000 and 2004-present are contained within our Mendeley Data repository in CSV, R, and Stata formats under the ‘Raw data/AHRF’ subfolder.

State specific data on NP scope of practice was obtained from review of the annual Advanced Practice Nurse Practitioner Legislative Update and confirmed through review of state legislation per the Scope of Practice Policy [8]. We considered a state to allow nurse practitioner prescriptive authority if they permitted prescribing of at least Schedule III substances without physician oversight. Prescriptive authority was evaluated as a binary variable. The Scope of Practice Policy is generated by the National Conference of State Legislatures and the Association of State and Territorial Health Officials to educate policymakers on state laws related to practice autonomy for a variety of healthcare professionals, including nurse practitioners and physician assistants. Data on scope of practice law for nurse practitioners are provided in our Mendeley Data repository in CSV format under the ‘Raw Data/NCSL’ subfolder.

2. Experimental Design, Materials and Methods

We extracted ARCOS data on pill counts for every oxycodone and hydrocodone shipment to retail pharmacies in the U.S. between 2006-2013. We focused on these two drugs because they comprise the overwhelming majority of both legal opioid shipments and opioids diverted to the

![Fig. 1. Mean annual distribution of oxycodone and hydrocodone by county, 2016-2013.](image_url)
black market. Opioid pill volumes were then aggregated to the county-month level. The counties of Charleston, South Carolina and Leavenworth, Kansas were excluded from our analysis due to the presence of Veterans Affairs distribution pharmacies that serve the region, but are counted in the ARCOS as retail pharmacies [9].

From each year of AHRF data, we selected the following county-level variables (AHRF variable names are in parenthesis): Federal Informational Processing Standard (FIPS) code (F00002), county and state names (F04437, F12424, F00010), total population (F04530/F11984), percent employed in manufacturing (F14587), inpatient days (F09545), outpatient visits to varying hospital types (F09566, F09567, F09568, F09571), per capita Medicare spending (F11391), all-cause mortality (F12558), male or female medical doctors (F04820/F04821), land area (F09721), population eligible for Medicare (F11396), population dually eligible for Medicare and Medicaid (F14206), nurse practitioners with National Provider Identifier (NPI) records (F14624), per capita income (F09781), veterans (F11396), USDA rural-urban continuum codes (F00020), HRSA Healthcare Professional Shortage Area designation (F09787), unemployment rate (F06795), poverty rate (F13321), uninsurance rate for those under age 65 years (F14741/F15474), proportion aged 25+ years with a four-year college education (F14482), hospices (F13220), total hospital beds (F08921), short-term general hospital beds (F08922), short-term non-general hospital beds (F08923), long-term hospital beds (F08924), and hospital-based nursing home beds (F14045). We included counts for each gender by age group (F06712-F06727, F11640-F11643) and by race/ethnicity (Caucasian F13908/F13909, Black F13910/F13911, Asian F13914/F13915, Hispanic F13920/F13921), percent Black (F04538) and percent Hispanic (F04542). Lastly, we
included counts of medical doctors (F04904-F04907, F12016, F12017, F04820, F04821), specialists by age group (F04916-F04919, F12034, F12035), and dentists by age group (F10498, F11318, F11391, F13176, F10505).

We combined the AHRF for years 2006-2018 to create a county-level panel dataset. The AHRF was not produced in 2010 due to the U.S. Census. As a result, Census data was used to replace missing 2010 AHRF variable values when available; see R scripts in Appendix for details. Linear interpolation was used to convert AHRF data from annual to monthly observations and to fill in missing 2010 values. Hot deck imputation was used to impute a small number of missing values (1.2% of cells) [2].

These were then merged with data on cancer deaths (all neoplasms, ICD-10 codes C00-D48) and opioid-related deaths (ORDs) from WONDER. ORD data were queried for Multiple Cause of Death using the following ICD-10 codes: T40.0 (Opium); T40.1 (Heroin); T40.2 (Other opioids); T40.3 (Methadone); T40.4 (Other synthetic narcotics); T40.6 (Other and unspecified narcotics). We added the following ICD-10 codes for underlying cause of death: X40-X44 (Accidental poisoning), and X60-64 (Intentional self-poisoning), Y10-Y14 (Poisoning) by non-opioid analgesics, antipyretics and antirheumatics; antiepileptic, sedative-hypnotic, antiparkinsonism and psychotropic drugs, not elsewhere classified; narcotics and psychodyseptics [hallucinogens], not elsewhere classified; other drugs acting on the autonomic nervous system; other and unspecified drugs, medicaments and biological substances. We also included ICD-10 code X85 (Assault by drugs, medicaments and biological substances). We used a three-year lookback period for cancer deaths and a three-year outcome period for ORDs since WONDER suppresses data for counties having <10 deaths. For suppressed counties, death counts were imputed using Poisson regressions adjusted for all AHRF variables with a log link and offset by the log of total county population.

Nurse practitioner practice autonomy was evaluated as a binary variable, and defined as either permitting prescriptive authority without physician oversight (1) or not (0). States that permit nurse practitioner prescriptive authority after a period of temporary oversight after licensure were considered to allow autonomous practice.

Lastly, the Affordable Care Act allowed states to receive federal Medicaid matching funds to cover adults with incomes up to 133% of the federal poverty level (FPL), effective April 2010. Historically these federal reimbursements were limited at 100% FPL. Six states took advantage of this provision (California, Connecticut, District of Columbia, Minnesota, New Jersey, and Washington). Data from the Kaiser Family Foundation were used to create a binary indicator taking on a value of one if the county was in a state which expanded Medicaid income eligibility after the expansion's effective date.

For completeness and reproducibility, we have included R scripts to prepare the AHRF data and merge the various datasets within our Mendeley Data repository under the subfolder ‘R scripts.’ We also included both imputed and non-imputed final analytic datasets that were used in our analyses in CSV, R, and Stata formats under the ‘Analytic files’ subfolder [5]. All data preparation and analyses were conducted using R version 4.02 (R Foundation for Statistical Computing, Vienna, Austria) (Table 1).

3. File Inventory

- ARCOS data extract (raw)
- AHRF annual datasets (raw)
- AHRF combined dataset (processed)
- WONDER ORD data (raw)
- WONDER cancer incidence data (raw)
- Nurse practitioner scope of practice matrix (processed)
- Merged, imputed analytic file (processed)
- R script to combine and prepare AHRF annual datasets
- R script to combine ARCOS, AHRF, WONDER, and NP data
### Table 1
Data dictionary.

| Variable | Source   | Definition                                                                 | Notes                                                                 |
|----------|----------|----------------------------------------------------------------------------|----------------------------------------------------------------------|
| YR       | AHRF     | Calendar year                                                              | –                                                                      |
| F00002   | AHRF     | Federal Information Processing System (FIPS) code, a unique 5-digit county identifier | –                                                                      |
| F12424   | AHRF     | State name abbreviation                                                    | –                                                                      |
| F00010   | AHRF     | County name                                                                | –                                                                      |
| F04437   | AHRF     | County name w/ state abbreviation                                          | –                                                                      |
| F13874   | AHRF     | Total area in square miles                                                 |                                                                       |
| F09721   | AHRF     | Total land area in square miles                                            |                                                                       |
| F09787   | AHRF     | Healthcare Professional Shortage Area (Primary Care)                        | 1=whole county, 2=partial county                                     |
| HPSA_WHOLE | AHRF | Healthcare professional shortage area - whole county                        | 1 if F09787=1, 0 otherwise                                           |
| HPSA_PART | AHRF | Healthcare professional shortage area - partial county                      | 1 if F09787=2, 0 otherwise                                           |
| F00020   | AHRF     | USDA Rural-Urban Continuum Code                                             |                                                                       |
| RURAL    | AHRF     | Rural indicator                                                            | 1 if F00020=2, 0 otherwise                                           |
| METRO    | AHRF     | Metropolitan indicator                                                     | 1 if F00020 in (1,2,3), 0 otherwise                                  |
| NONMETRO | AHRF     | Nonmetropolitan indicator                                                   | 1 if F00020 in (4,5,6,7), 0 otherwise                                |
| F14642   | AHRF     | # of nurse practitioners with National Provider Identifiers (NPI)          | –                                                                      |
| F13214   | AHRF     | # of home health agencies                                                  | –                                                                      |
| F13220   | AHRF     | # of hospices                                                              | –                                                                      |
| F11984   | AHRF     | Population estimate                                                       | –                                                                      |
| F04538   | AHRF     | % Black                                                                    | –                                                                      |
| F04542   | AHRF     | % Hispanic                                                                 | –                                                                      |
| F11396   | AHRF     | Veteran population estimate                                                | –                                                                      |
| F13191   | AHRF     | # eligible for Medicare                                                    | –                                                                      |
| F06795   | AHRF     | Unemployment rate for ages 16+                                              | –                                                                      |
| F04820   | AHRF     | # of medical doctors, male                                                 | –                                                                      |
| F04821   | AHRF     | # of medical doctors, female                                               | –                                                                      |
| F04904   | AHRF     | # of medical doctors under age 35                                           | –                                                                      |
| F04905   | AHRF     | # of medical doctors aged 35-44                                             | –                                                                      |
| F04906   | AHRF     | # of medical doctors aged 45-54                                             | –                                                                      |
| F04907   | AHRF     | # of medical doctors aged 55-64                                             | –                                                                      |
| F12016   | AHRF     | # of medical doctors aged 65-74                                             | –                                                                      |
| F12017   | AHRF     | # of medical doctors aged 75+                                               | –                                                                      |
| F04916   | AHRF     | # of medical specialists under age 35                                       | –                                                                      |
| F04917   | AHRF     | # of medical specialists aged 35-44                                         | –                                                                      |
| F04918   | AHRF     | # of medical specialists aged 45-54                                         | –                                                                      |
| F04919   | AHRF     | # of medical specialists aged 55-64                                         | –                                                                      |
| F12034   | AHRF     | # of medical specialists aged 65-74                                         | –                                                                      |
| F12035   | AHRF     | # of medical specialists aged 75+                                           | –                                                                      |

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| Variable | Source | Definition | Notes |
|----------|--------|------------|-------|
| F10498  | AHRF   | # of dentists under age 35 | -     |
| F11318  | AHRF   | # of dentists aged 35-44 | -     |
| F11319  | AHRF   | # of dentists aged 45-54 | -     |
| F13176  | AHRF   | # of dentists aged 55-64 | -     |
| F10505  | AHRF   | # of dentists aged 65+ | -     |
| F08921  | AHRF   | # of hospital beds | -     |
| F08922  | AHRF   | # of short-term general hospital beds | -     |
| F08923  | AHRF   | # of short-term non-general hospital beds | -     |
| F08924  | AHRF   | # of long-term hospital beds | -     |
| F14045  | AHRF   | # of licensed hospital-based nursing home beds | -     |
| F09545  | AHRF   | # of outpatient visits, including homes and hospitals | -     |
| F09566  | AHRF   | # of outpatient visits in short-term general hospitals | -     |
| F09567  | AHRF   | # of outpatient visits in short-term non-general hospitals | -     |
| F09568  | AHRF   | # of outpatient visits in long-term hospitals | -     |
| F09571  | AHRF   | # of outpatient visits in Veterans Affairs hospitals | -     |
| OP_VISITS | AHRF | # of outpatient visits, total | F09566 + F09567 + F09568 + F09571 |
| F15297  | AHRF   | Actual per capita Medicare cost | -     |
| F13906  | AHRF   | Total male population estimate | -     |
| F13907  | AHRF   | Total female population estimate | -     |
| F13908  | AHRF   | Total Caucasian male population estimate | -     |
| F13909  | AHRF   | Total Caucasian female population estimate | -     |
| F13910  | AHRF   | Total Black male population estimate | -     |
| F13911  | AHRF   | Total Black female population estimate | -     |
| F13914  | AHRF   | Total Asian male population estimate | -     |
| F13915  | AHRF   | Total Asian Female population estimate | -     |
| F13920  | AHRF   | Total Hispanic male population estimate | -     |
| F13921  | AHRF   | Total Hispanic female population estimate | -     |
| F15549  | AHRF   | # of Medicare enrollees | -     |
| F12558  | AHRF   | # of deaths, any cause | -     |
| F09781  | AHRF   | Per capita personal income in dollars | -     |
| F13226  | AHRF   | Median household income in dollars | -     |
| F13321  | AHRF   | % in poverty | -     |
| F15474  | AHRF   | % under age 65 without health insurance | -     |
| F14482  | AHRF   | % aged 25+ with 4+ years of college | -     |
| F14587  | AHRF   | % employed in manufacturing | -     |
| F14206  | AHRF   | # dually eligible for Medicare & Medicaid | -     |
| F06712  | AHRF   | # of males aged 20-24 | -     |
| F06713  | AHRF   | # of females aged 20-24 | -     |
| F06714  | AHRF   | # of males aged 25-29 | -     |
| F06715  | AHRF   | # of females aged 25-29 | -     |

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| Variable          | Source  | Definition                                                                 | Notes                                      |
|-------------------|---------|---------------------------------------------------------------------------|-------------------------------------------|
| F06716            | AHRF    | # of males aged 30-34                                                     |                                           |
| F06717            | AHRF    | # of females aged 30-34                                                   |                                           |
| F06718            | AHRF    | # of males aged 35-44                                                     |                                           |
| F06719            | AHRF    | # of females aged 35-44                                                   |                                           |
| F06720            | AHRF    | # of males aged 45-54                                                     |                                           |
| F06721            | AHRF    | # of females aged 45-54                                                   |                                           |
| F06722            | AHRF    | # of males aged 55-59                                                     |                                           |
| F06723            | AHRF    | # of females aged 55-59                                                   |                                           |
| F06724            | AHRF    | # of males aged 60-64                                                     |                                           |
| F06725            | AHRF    | # of females aged 60-64                                                   |                                           |
| F06726            | AHRF    | # of males aged 65-74                                                     |                                           |
| F06727            | AHRF    | # of females aged 65-74                                                   |                                           |
| F11640            | AHRF    | # of males aged 75-84                                                     |                                           |
| F11641            | AHRF    | # of females aged 75-84                                                   |                                           |
| F11642            | AHRF    | # of males aged 85+                                                       |                                           |
| F11643            | AHRF    | # of females aged 85+                                                     |                                           |
| F13483            | AHRF    | Median age                                                                |                                           |
| N_BLACK           | AHRF    | Total Black population                                                    | F13910 + F13911                           |
| N_ASIAN           | AHRF    | Total Asian population                                                    | F13914 + F13915                           |
| N_HISP            | AHRF    | Total Hispanic population                                                 | F13920 + F13921                           |
| OP_PC             | AHRF    | Outpatient visits per capita                                              |                                           |
| IP_PC             | AHRF    | Inpatient days per capita                                                 |                                           |
| PCT_MEN           | AHRF    | % male                                                                    | F13906 / F11984                           |
| PCT_WHITE         | AHRF    | % Caucasian                                                                | (F13908 + F13909) / F11984                |
| PCT_BLACK         | AHRF    | % Black                                                                   | N_BLACK / F11984                          |
| PCT_ASIAN         | AHRF    | % Asian                                                                   | N_ASIAN / F11984                          |
| PCT_OTHER         | AHRF    | % other race                                                               | 100 - PCT_WHITE - PCT_BLACK - PCT_ASIAN   |
| PCT_HISP          | AHRF    | % Hispanic                                                                | N_HISP / F11984                           |
| PCT_MEDICARE      | AHRF    | % eligible for Medicare                                                   | F13191 / F11984                           |
| ARF_CDR           | AHRF    | Crude annual death rate, all cause                                        | F12558 / F11984                           |
| POP_DENSITY       | AHRF    | Population density, in hundreds                                           | F11984 / F09721                           |
| PCT_DUALS         | AHRF    | % dual-eligible for Medicare & Medicaid                                    | F14206 / F11984                           |
| NP_PC             | AHRF    | Nurse practitioners per 100,000 residents                                   | F14642 / F11984 * 100000                  |
| PCT_25T34         | AHRF    | % aged 25 to 34                                                           | (F06714 + F06715 + F06716 + F06717) / F11984 |
| PCT_35T44         | AHRF    | % aged 35 to 44                                                           | (F06718 + F06719) / F11984                |
| PCT_45T54         | AHRF    | % aged 45 to 54                                                           | (F06720 + F06721) / F11984                |
| PCT_55T64         | AHRF    | % aged 55 to 64                                                           | (F06722 + F06723) / F11984                |
| PCT_65T74         | AHRF    | % aged 65 to 74                                                           | (F06726 + F06727) / F11984                |
| PCT_75T84         | AHRF    | % aged 75 to 84                                                           | (F11640 + F11641) / F11984                |
| PCT_85PLUS        | AHRF    | % aged 85+                                                                 | (F11642 + F11643) / F11984                |
| PCT_25T44         | AHRF    | % aged 25 to 44                                                           | PCT_25T34 + PCT_35T44                    |
| PCT_45T64         | AHRF    | % aged 45 to 64                                                           | PCT_45T54 + PCT_55T64                    |
| PCT_65PLUS        | AHRF    | % aged 65+                                                                 | PCT_65T74 + PCT_75T84 + PCT_85PLUS       |
| PCT_VETS          | AHRF    | % of population who are veterans                                          | F11396 / F11984 * 100000                  |
| MD_LT35_PC        | AHRF    | Medical doctors aged <35 per 100,000 residents                             | F04904 / F11984 * 100000                  |
| MD_35T44_PC       | AHRF    | Medical doctors aged 35 to 44 per 100,000 residents                        | F04905 / F11984 * 100000                  |
| MD_45T54_PC       | AHRF    | Medical doctors aged 45 to 54 per 100,000 residents                        | F04906 / F11984 * 100000                  |
| MD_55T64_PC       | AHRF    | Medical doctors aged 55 to 64 per 100,000 residents                        | F04907 / F11984 * 100000                  |
| MD_65T74_PC       | AHRF    | Medical doctors aged 65 to 74 per 100,000 residents                        | F12016 / F11984 * 100000                  |

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| Variable         | Source   | Definition                                                                 | Notes                      |
|------------------|----------|-----------------------------------------------------------------------------|----------------------------|
| MD_75PLUS_PC     | AHRF     | Medical doctors aged 75+ per 100,000 residents                               | F12017 / F11984 * 100000  |
| MD_PC            | AHRF     | Medical doctors per 100,000 residents                                       |
|                  |          | (F04904 + F04905 + F04906 + F04907 + F12016 + F12017) / F11984 * 100000 |
| SPEC_LT35_PC     | AHRF     | Medical specialists aged <35 per 100,000 residents                          | F04916 / F11984 * 100000  |
| SPEC_3ST44_PC    | AHRF     | Medical specialists aged 35 to 44 per 100,000 residents                    |
| SPEC_45T54_PC    | AHRF     | Medical specialists aged 45 to 54 per 100,000 residents                    |
| SPEC_55T64_PC    | AHRF     | Medical specialists aged 55 to 64 per 100,000 residents                    |
| SPEC_65T74_PC    | AHRF     | Medical specialists aged 65 to 74 per 100,000 residents                    |
| SPEC_75PLUS_PC   | AHRF     | Medical specialists aged 75+ per 100,000 residents                          | F12035 / F11984 * 100000  |
| DENTISTS_LT35_PC | AHRF     | Dentists aged <35 per 100,000 residents                                     | F10498 / F11984 * 100000  |
| DENTISTS_3ST44_PC| AHRF     | Dentists aged 35 to 44 per 100,000 residents                               | F11318 / F11984 * 100000  |
| DENTISTS_45T54_PC| AHRF     | Dentists aged 45 to 54 per 100,000 residents                               | F11319 / F11984 * 100000  |
| DENTISTS_55T64_PC| AHRF     | Dentists aged 55 to 64 per 100,000 residents                               | F11316 / F11984 * 100000  |
| DENTISTS_65PLUS_PC| AHRF    | Dentists aged 65+ per 100,000 residents                                     | F10505 / F11984 * 100000  |
| ORD_DEATHS       | WONDER   | # of opioid-related deaths, imputed                                         | Multiple Cause of Death:  |
|                  |          |                                                                             | T40.0+T40.1+T40.2+T40.3+ |
|                  |          |                                                                             | T40.4+T40.6                |
|                  |          |                                                                             | Underlying Cause of Death:|
|                  |          |                                                                             | X40+X41+X42+X43+X44+X60+X61|
|                  |          |                                                                             | +X62+X63+X64+Y10+Y11+Y12+Y13|
|                  |          |                                                                             | +Y14+X85                  |
| ORD_DEATHS_NOIMP | WONDER   | # of opioid-related deaths, non-imputed                                     | –                          |
| ORD_CDR          | WONDER/  | Crude opioid-related death rate, imputed                                   | –                          |
|                  | AHRF     |                                                                             |                            |
| ORD_CDR_NOIMP    | WONDER/  | Crude opioid-related death rate, non-imputed                               | –                          |
|                  | AHRF     |                                                                             |                            |
| CANCER_DEATHS    | WONDER   | # of cancer-related deaths, imputed                                         | Multiple Cause of Death:   |
|                  |          |                                                                             | C00+C01+C02+C03+C04+C05+C06|
|                  |          |                                                                             | +C07+C08+C09+C10+C11+C12+C13|
|                  |          |                                                                             | +C14+C15+C16+C17+C18+C19+C20|
|                  |          |                                                                             | +C21+C22+C23+C24+C25+C26+C27|
|                  |          |                                                                             | +C28+C29+C30+C31+C32+C33+C34|
|                  |          |                                                                             | +C35+C36+C37+C38+C39+C40+C41|
|                  |          |                                                                             | +C42+C43+C44+C45+C46+C47+C48|
|                  |          |                                                                             | +C49+C50+C51+C52+C53+C54+C55|
|                  |          |                                                                             | +C56+C57+C58+C59+C60+C61+C62|
|                  |          |                                                                             | +C63+C64+C65+C66+C67+C68+C69|
|                  |          |                                                                             | +C70+C71+C72+C73+C74+C75+C76|
|                  |          |                                                                             | +C77+C78+C79+C80+C81+C82+C83|
|                  |          |                                                                             | +C84+C85+C86+C87+C88+C89+C90|
|                  |          |                                                                             | +C91+C92+C93+C94+C95+C96+D00|
|                  |          |                                                                             | +D01+D02+D03+D04+D05+D06+D07|
|                  |          |                                                                             | +D08+D09+D10+D11+D12+D13+D14|
|                  |          |                                                                             | +D15+D16+D17+D18+D19+D20+D21|
|                  |          |                                                                             | +D22+D23+D24+D25+D26+D27+D28|
|                  |          |                                                                             | +D29+D30+D31+D32+D33+D34+D35|
|                  |          |                                                                             | +D36+D37+D38+D39+D40+D41+D42|
|                  |          |                                                                             | +D43+D44+D45+D46+D47+D48    |

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Ethics Statement

The Boston University Institutional Review Board determined this study did not qualify as human subjects research because no protected health information was collected, accessed, or distributed.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships which have or could be perceived to have influenced the work reported in this article. Erika Crable’s effort was funded by the Lifespan/Brown Criminal Justice Research Training Program on Substance Use and HIV, funded by the National Institute on Drug Abuse (R25DA037190). Samantha Auty and Timothy Levengood’s effort was funded by a training grant from the National Institute on Drug Abuse (5 T32 DA04189803). The authors declare that they have no known competing financial interests or personal relationships which have or could be perceived to have influenced the work reported in this article.

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