Data Article

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

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A R T I C L E   I N F O

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.

https://doi.org/10.1016/j.dib.2021.106779

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.

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 'arcos' 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 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) https://data.hrsa.gov/topics/health-workforce/ahrf Centers for Disease Control & Prevention's Wide-ranging Online Data for Epidemiologic Research https://wonder.cdc.gov/ National Conference of State Legislatures https://www.ncsl.org/research/health/scope-of-practice-overview.aspx

Data accessibility	Repository name: Mendeley Data
	Data identification number: https://data.mendeley.com/datasets/dwfgxrh7tn
	Instructions for accessing these data: Raw data, processed data, and R scripts are
	publicly-available for direct download.
Related research article	[5] Implications of county-level variation in U.S. opioid distribution, Drug and Alcohol
	Dependence 219: e108501. https://doi.org/10.1016/j.drugalcdep.2020.108501

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;
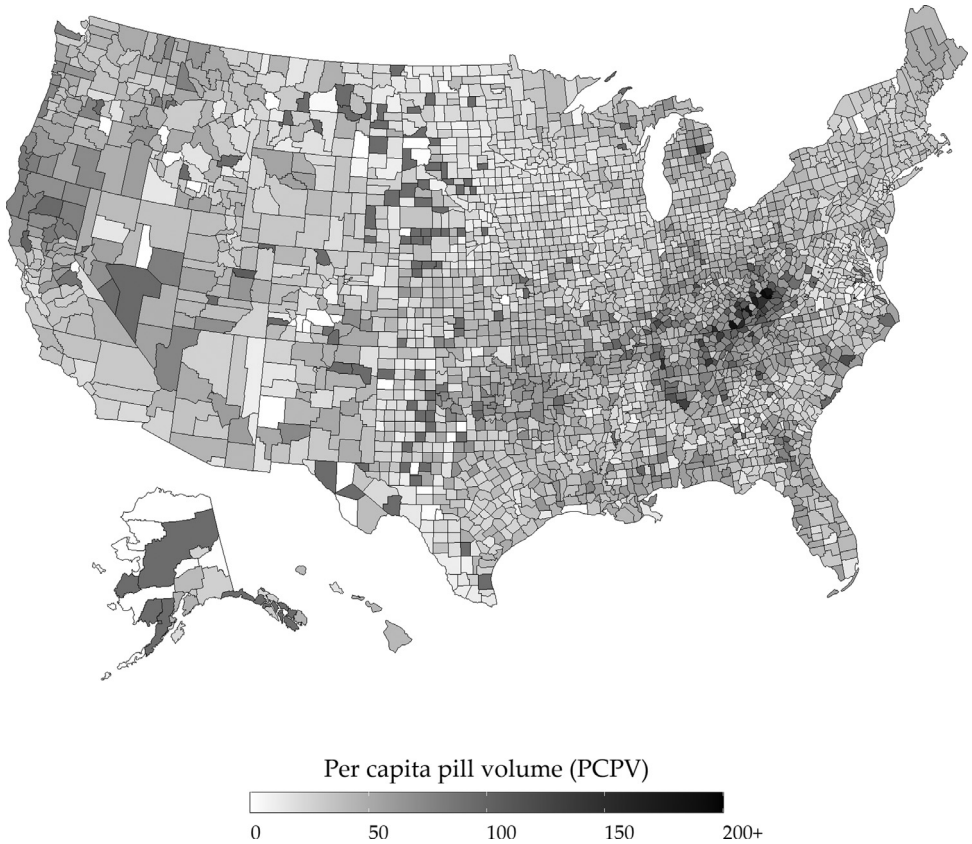
Fig. 1. Mean annual distribution of oxycodone and hydrocodone by county, 2016-2013.

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
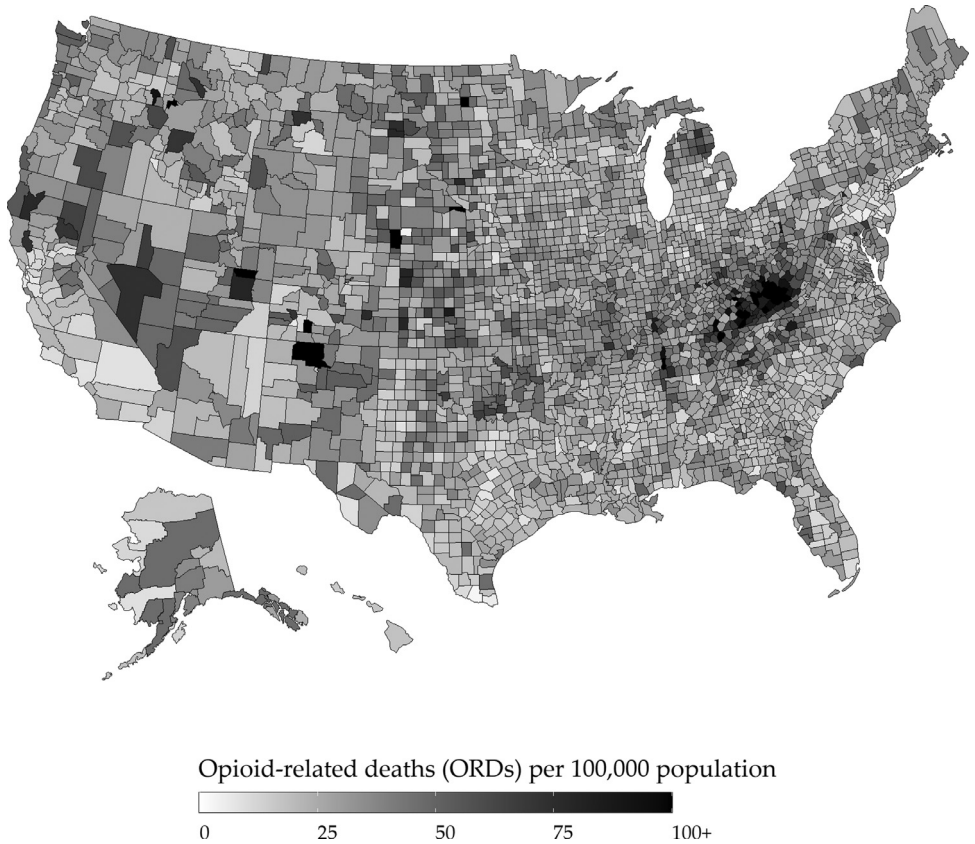
Opioid-related deaths (ORDs) per 100,000 population

0   25   50   75   100+

Fig. 2. Mean annual opioid-related deaths by county, 2006–2013.

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 (F13191), 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 psychodysleptics [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 abberviation	–
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+	–

Table 1 (*continued*)

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 inpatient days, 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	–

Table 1 (*continued*).

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

Table 1 (*continued*)

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_35T44_PC	AHRF	Medical specialists aged 35 to 44 per 100,000 residents	F04917 / F11984 * 100000
SPEC_45T54_PC	AHRF	Medical specialists aged 45 to 54 per 100,000 residents	F04918 / F11984 * 100000
SPEC_55T64_PC	AHRF	Medical specialists aged 55 to 64 per 100,000 residents	F04919 / F11984 * 100000
SPEC_65T74_PC	AHRF	Medical specialists aged 65 to 74 per 100,000 residents	F12034 / F11984 * 100000
SPEC_75PLUS_PC	AHRF	Medical specialists aged 75+ per 100,000 residents	F12035 / F11984 * 100000
SPEC_PC	AHRF	Specialists per 100,000 residents	(F04916 + F04917 + F04918 + F04919 + F12034 + F12035) / F11984 * 100000
DENTISTS_LT35_PC	AHRF	Dentists aged <35 per 100,000 residents	F10498 / F11984 * 100000
DENTISTS_35T44_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	F13176 / 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/ AHRF	Crude opiod-related death rate, imputed	–
ORD_CDR_NOIMP	WONDER/ AHRF	Crude opiod-related death rate, non-imputed	–
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

Table 1 (*continued*)

Variable	Source	Definition	Notes
CANCER_DEATHS_ NOIMP	WONDER	# of cancer-related deaths, non-imputed	–
CANCER_CDR	WONDER/ AHRF	Crude cancer-related death rate, imputed	–
CANCER_CDR_NOIMP	WONDER	Crude cancer-related death rate, non-imputed	–
SHIP_COUNT	ARCOS	Total number of opioid shipments	–
DOSAGE_UNIT	ARCOS	Total number of opioid pills distributed	–
PCPV	ARCOS/ AHRF	Per capita opioid pill volume	DOSAGE_UNIT / F11984
PILL_QUART	ARCOS	Per capita opioid pill volume, quartiles	Quartiles of PCPV
EXP_EARLY	KFF	Early state Medicaid expansion status	1 if county-month is located in a state after the effective date of Medicaid expansion, 0 otherwise
NP_RX	NCSL	Nurse practitioner prescribing authority	1 if the state allows nurse practitioners to prescribe opioids, 0 otherwise
PDMP_REQ_CHECK	NCSL	Presription drug monitoring programs (PDMP)	1 if providers are required to check the state's PDMP before prescribing opioids, 0 otherwise

Notes: Percentages of calculated variables may not sum to 100 due to imputation. Data source abbreviations**:** AHRF=Health Resources & Services Administration's Area Health Resources File, ARCOS=U.S. Drug Enforcement Administration's Automation of Reports and Consolidated Orders System, KFF=Kaiser Family Foundation, NCSL=National Conference of State Legislatures, WONDER=Centers for Disease Control and Prevention Wide-ranging Online Data for Epidemiologic Research.

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

Acknowledgments

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