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Geographic Variation in Opioid Prescribing in the U.S.

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Abstract

Estimates of geographic variation among states and counties in the prevalence of opioid prescribing are developed using data from a large (135M) representative national sample of opioid prescriptions dispensed during 2008 by 37,000 retail pharmacies. Statistical analyses are used to estimate the extent to which county variation is explained by characteristics of resident populations, their healthcare utilization, proxy measures of morbidity, availability of healthcare resources, and prescription monitoring laws. Geographic variation in prevalence of prescribed opioids is large, greater than variation observed for other healthcare services. Counties having the highest prescribing rates for opioids were disproportionately located in Appalachia and in Southern and Western states. The number of available physicians was by far the strongest predictor of amounts prescribed, but only one-third of county variation is explained by the combination of all measured factors. Wide variation in prescribing opioids reflects weak consensus regarding the appropriate use of opioids for treating pain, especially chronic non-cancer pain. Patients' demands for treatment have increased, more potent opioids have become available, an epidemic of abuse has emerged, and calls for increased government regulation are growing. Greater guidance, education and training in opioid prescribing are needed for clinicians to support appropriate prescribing practices.

Perspective—Wide geographic variation that does not reflect differences in the prevalence of injuries, surgeries, or conditions requiring analgesics raises questions about opioid prescribing practices. Low prescription rates may indicate under-treatment, while high rates may indicate overprescribing and insufficient attention to risks of misuse.

Keywords

opioids; prescribing; prevalence; geographic variation

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Disclosures

Prescription LRx Data, 2008 was obtained by Abt Associates under license from IMS Health Incorporated; all rights reserved. County location of prescribers' offices obtained from Physician Professional Data, 2008, American Medical Association; all rights reserved. None of the authors has any institutional or personal conflict of interest. Authors had full access to all of the data in the study and are responsible for the integrity of the data and the accuracy of the analyses. The statements, findings, conclusions, views, and opinions contained and expressed herein are not necessarily those of Abt Associates Inc., the National Institutes of Health, the National Institute on Drug Abuse, or IMS Health Incorporated or any of its affiliated or subsidiary entities.

Introduction

Despite concerns about geographic variation in health care spending and utilization,^{9, 16, 17, 46, 47, 51} little attention has been given to the extent and reasons for geographic differences in prescribing opioid pain relievers in the U.S. Most attention to opioids in recent years has focused on the growing epidemic of their abuse, with some studies of geographic variation in non-medical use.^{7, 27, 29, 31, 32} The extant studies suggest that geographic differences in prescribing are large. One study of opioid prescribing by primary care physicians during 1992–2001 reported that physicians in the Northeast and Midwest were significantly less likely to prescribe opioids than those working in the South and West,²⁶ which is consistent with findings of other studies of using opioids for back pain.^{23, 43} An analysis of claims during 2000 from a small number of private insurance firms for twelve oral opioid analgesics found a ten-fold difference among states in numbers of claims per 1,000 outpatients.^{10, 11} Another study of fee-for-service (FFS) Medicaid claims for adult outpatients in 49 states during 1996–2002 found widespread geographic variation in standardized daily doses per 1,000 beneficiaries.⁵⁰ Variation among states increased during that period from a six-fold difference in 1996 to a twenty-three fold difference in 2002.¹⁰ These estimates suggest variation in opioid prescribing is much wider than for all classes of medications combined, at least among FFS Medicaid recipients.^{50, 51} Generalizing from these few studies is risky because they use small samples of privately insured or Medicaid patients and describe only state-level differences.

Research Objectives

Our study seeks to answer two principal questions: How much does the prevalence of opioid prescribing vary among states and counties? How much of the observed variation among counties in prevalence of prescribing is attributable to differences in resident populations' socioeconomic characteristics, their healthcare utilization, the local availability of prescribers, and state policies regarding prescription monitoring?

Methods

Pharmacy records for 135 million opioid prescriptions were obtained under license from IMS Health Incorporated. These records comprise all prescriptions dispensed during 2008 by approximately 37,000 (about three-quarters of) retail pharmacies in the U.S. The sample includes all dosages and all forms of the eight opioids most frequently prescribed for analgesia: codeine, fentanyl, hydrocodone, hydromorphone, methadone, oxycodone, oxymorphone, tramadol, and propoxyphene (which was removed from the market in 2010). All but tramadol are scheduled controlled substances. We assume that methadone dispensed by retail pharmacies is prescribed primarily for analgesia rather than for addiction treatment. These prescriptions were written by 907,782 unique de-identified prescribers, approximately all the active providers in the U.S. authorized to prescribe controlled substances, and include prescriptions paid in cash or by public or private third party payers.

Abt Associates' Institutional Review Board reviewed and approved this research. Patients' consent was not required because study was limited to secondary analyses of de-identified prescription records.

These 135 million records constitute a large sample (66%) of all opioid prescriptions for these eight opioids dispensed to patients by all retail pharmacies during 2008. Retail pharmacies account for about 90% of all opioids dispensed; the remainder are dispensed primarily in hospitals.⁴⁰ To estimate the total number of prescriptions and amounts of each opioid dispensed by retail pharmacies in the U.S. that year, each prescription in this dataset is assigned a sample weight computed by IMS Health for each postal zone, defined by the

first three digits of ZIP codes (“ZIP3”). These weights are derived using information obtained from drug manufacturers, distributors, and prescription benefit managers about sales to *all* retail pharmacies in each ZIP3 area, including those not reporting to IMS Health. Applying these weights to each prescription record in the dataset produces an estimate of all prescriptions written during 2008 by prescribers in each ZIP3 area and dispensed by any retail pharmacy in the U.S. Sampling errors in these estimates are exceedingly small because these data comprise such a large proportion of all opioid prescriptions written in 2008.

These estimates are then aggregated according to the county of *physicians’* primary business location (patients’ addresses were not available). Prevalence rates of prescribing in each county are expressed as milligrams prescribed and dispensed per 1,000 residents, calculated using U.S. Bureau of Census population data. Because rates vary according to patients’ age and gender (higher for females), prescribing rates are standardized for patients’ age and gender to eliminate any effects of differences among states or counties in the age and gender distributions of residents. Weights of all eight opioids dispensed are converted to morphine equivalents to provide a single summary measure.⁴² Variation in estimated amounts prescribed per 1,000 standardized county residents is expressed as the ratio of 25th to 75th quartiles and by the coefficient of variation (COV), calculated as standard deviation divided by the mean.

Information about socioeconomic characteristics of the resident populations in all U.S. counties, their healthcare service utilization, and the supply of prescribing physicians was extracted from the Area Resource File.³⁹ Socioeconomic characteristics of resident populations—indicators of poverty, household income inequality (measured by Gini coefficient), education, and race/ethnicity (as measured by U.S. Bureau of Census)—are examined because these have been shown to be correlated with access to care, hospitalization, overdose deaths, and other health outcomes.^{4, 24, 43} Direct measures of morbidity in the resident population were not available, but we include measures of healthcare utilization (surgeries, inpatient days, emergency department visits) that are correlated with morbidity, although imperfectly. All characteristics are measured either as percentages (e.g., percent of college graduates) or as rates per 1,000 county residents. When measures are not available for 2008, we use data for the closest year. One state-level characteristic, the existence of a prescription drug monitoring program during 2008, is included (pharmacies in 63.5% of all counties were required to report scheduled prescriptions to a state agency). All county-and state-level attributes are considered ecological characteristics and not characteristics of patients who obtained opioid prescriptions from these prescribers during 2008. We do not assume that all patients lived in the same counties where prescribers practice, although most do.

Ordinary least squares regression is used to estimate the extent to which resident population attributes are correlated with amounts of opioids prescribed and dispensed, in morphine equivalent mg per 1,000 residents.

Results

An estimated 205 million prescriptions were written for these eight opioids nationwide in 2008. Of these, hydrocodone prescriptions accounted for 53%, oxycodone prescriptions 21%, followed by tramadol, propoxyphene and codeine (10%, 9%, and 7%, respectively). An estimated 77% of these were paid by third party insurers, 8% by Medicaid, and 15% were paid in cash.

Counties varied widely in the amounts of opioids (measured by weight rather than number of prescriptions) dispensed during 2008 (Figure 1). Table 1 shows the range of this variation

in estimated average number of mg dispensed per county resident, for each of the specific opioids, standardized by age and gender, and for all opioids combined, measured in morphine equivalent mg. By weight, the most commonly dispensed drug during this period is propoxyphene. The average estimated amount dispensed per county is 353 mg per resident, but the top quarter of counties used at least three or four times as much of the four most commonly prescribed opioids as the lowest quarter, and seven to ten times as much oxycodone, methadone, and oxymorphone. The wide variation in oxycodone prescribing and dispensing is perhaps the most significant, given that this drug is almost half (46%) of the total amount of opioids dispensed, measured in morphine equivalents. (Twenty-nine percent of all morphine equivalent amounts dispensed that year were hydrocodones, 14% propoxyphenes, and all other opioids constituted very small percentages of the total.) For all combined, the ratio of the 75th to 25th percentiles is almost 4:1. COVs range from 1.06 for codeine to 4.21 for fentanyl, and 1.05 for all opioids combined, measured in morphine equivalents. Counties with the highest prescribing rates are disproportionately found in Appalachia and in southern and western states. Those with the lowest rates are generally located in midwestern states and in Alaska. Considerable variation among counties exists within regions, with high prevalence counties adjacent to counties with low prevalence.

State-level comparisons provide another way of viewing regional variation in morphine equivalent amounts, although this obscures considerable within-state variation. Table 2 lists states from highest to lowest rates per resident, and compares each state's rate to the average rate for all states. Nevada has the highest rate, with 1,150 milligrams per resident, 603 milligrams more than the average for residents in all states. Florida and Appalachian states are also above the all-states average.

Regression analysis was conducted to identify the correlates of prescribing prevalence at the county level. Measured characteristics of counties and their populations are shown in Table 3, as well as their distribution among all counties in the U.S. Table 4 shows the results of the regression analysis. In general, amounts of opioids prescribed and dispensed in a county are positively correlated with size of the resident population and the proportion of the population that is white non-Hispanic or African American, poor, uninsured, and living in urban areas. Weak correlations among amounts prescribed and indicators of morbidity and healthcare service utilization rates are not statistically significant.

The availability of active physicians in a county is by far the strongest correlate of opioid amounts prescribed. This is consistent with other studies' findings that the availability of medical services accounts for most of the explained geographic variation.⁴⁶ The proportion of surgeons to all active physicians is positively correlated, (reflecting surgeons' common use of opioids for post-operative pain) as is the proportion of pediatricians. The proportion of psychiatrists to all physicians is negatively correlated with amounts of opioids prescribed, perhaps because they are less likely than others to treat pain.

Neither the existence of state prescription drug monitoring program nor household income inequality (measured by Gini Index) were correlated with opioid prescribing, contrary to findings of a study of prescribing opioids for acute lower back pain among workers compensation claimants.⁴³

Discussion

None of the characteristics examined in our study explain most of the variation among counties in prevalence of prescribed opioids. Taken together, those included in the model explain only a third of the observed variation (model $r^2=0.33$). This is consistent with findings of other studies. For example, Zhang, Baicker and Newhouse find that variation in

total spending by Medicaid patients for all drugs (not just opioids) is not driven by patient characteristics, individual health status, or insurance coverage.⁵¹ Caudill-Slosberg, Schwartz and Woloshin report that analgesic prescriptions increased between 1980 and 2000 but office visits in the U.S. for musculoskeletal pain did not.² The primary drivers of variation in opioid prescribing must therefore be found elsewhere. In their report on state differences in prescribing, Zerzan hypothesizes that variation may stem from differences in prescriber habits, state policies regarding pain management (including utilization management procedures), policies for curbing drug diversion and abuse, preferred drug lists, and regionally specific marketing by pharmaceutical manufacturers.⁵⁰ However, given the substantial variation seen within states and the lack of correlation with the existence of state prescription drug monitoring programs, it is unlikely that differences in state policies or insurers' utilization management procedures account for much (if any) of the variation.

Several shortcomings of our data may affect our ability to account more fully for observed variation among counties. (1) The sample excludes some large mass merchandisers, which may contribute non-sampling errors because non-reporting pharmacies may have significantly different characteristics and dispensing patterns. We believe that this exclusion affects the estimates by no more than a few percent, however. (2) The data exclude clinics from which doctors dispense medications directly to patients. Pain clinics have become the focus of law enforcement efforts to battle opioid diversion. Florida has a large proportion of the nation's dispensing doctors,¹⁷ and their exclusion of such prescriptions from our data may result in underestimating opioids dispensed there and perhaps elsewhere as well. (3) More generally, we do not include information about physicians other than their declared specialty. We do not know if they practice alone or in groups, or the extent to which managed care constraints affect their prescribing. (4) Direct measures of morbidity in the resident populations were not available. (5) Our analysis examines characteristics of resident populations in counties where prescribers practice, and not where patients live, as we lack information about patients' residence. An undetermined number of patients obtained prescriptions from prescribers outside the county in which they lived. In a significant number of counties, there were no opioid prescribers during 2008 in our dataset; patients living in those counties may have traveled outside their county of residence to obtain prescriptions. (6) We do not include information about physician's prescribing rates. The existence of high-rate prescribers in certain counties --who may draw disproportionate numbers of patients from other counties--may explain some of the residual variation not accounted for in the model.

Our finding of large residual variation is consistent with the majority of studies of geographic variation in medical practices, which report that between one-half to three-fourths of variation remains unaccounted for.⁹ How much variation is "too much" is also unsettled because at least some variation due to chance is to be expected.¹³ What may be special about opioid prescribing, however, is that the range of variation we find is wider than ranges reported for other types of medications and medical practices. We find COVs range from 1.06 for codeine to 4.21 for fentanyl, and 1.05 for all opioids combined. In contrast, among elderly Medicare beneficiaries nationwide during 2007, the COV for drug spending per beneficiary at the hospital referral region level was 0.08.⁵² The COV for total state level health care spending per capita in the U.S. during 2004 was 0.123 and 0.11 for Medicare spending per beneficiary.^{9, 17} The surgical procedure found to vary the most among the 306 hospital referral regions in the U.S.—lumbar fusion for Medicare enrollees—had a COV of 0.5.⁴⁴

The existence of wide variation in practitioners' prescribing practices is not surprising, given the recent shifts in the normative environment surrounding the use of prescription opioids. For most of the 20th Century, the norms that guided professional conduct supported a

conservative approach to pain management. The Harrison Act of 1914, subsequent regulations, and prosecutions of physicians created a general reluctance to use narcotics to treat pain, especially neuropathic and chronic non-cancer pain.^{21, 38} Fear of investigation by authorities for excessive prescribing was commonplace among physicians.⁴⁵ In many states, medical boards voiced recommendations and statements that discouraged using opioids for pain management, and state laws in some jurisdictions added additional restrictions.²¹ When opioids were used for pain relief, the most commonly prescribed were weaker ones—codeine and meperidine.²⁷ Pain management was rarely taught in medical schools, and surveys of physicians' knowledge of pain management principles found significant deficits.^{22,48}

In the 1990s, the normative environment began to change. In 1998, the Federation of State Medical Boards promulgated model guidelines that authorized flexibility in pain management, including more expansive use of opioids,¹⁴ which was reinforced by policy statements in 2004,¹⁵ although some observers noted that medical boards in several states were slow to revise their policies.²¹ To promote more expansive treatment of pain in hospitals, the Joint Commission on the Accreditation of Healthcare Organizations proposed in 2001 that pain be considered the “fifth vital sign.”³⁷ Some argued that the under-treatment of pain constituted a “prominent public health concern.”¹⁸ These developments reinforced a growing consensus that opioid therapy is appropriate not only for acute pain, cancer pain, and palliative care, but also for some patients with chronic non-cancer, and that potent opioids are appropriate. Chronic pain was being redefined as a disease deserving of treatment.^{1, 19}

By 2008, the period studied here, the norms that had guided professional medical practice for decades had changed but had not been replaced by a new consensus. The analgesic effectiveness of short-term opioid treatment for severe pain has been well established and widely accepted, but the evidence base for long-term opioid treatment remains fragmentary to this day. Scientific studies have demonstrated that various chronic pain conditions, including neuropathic pain conditions, are opioid responsive, but the extent to which analgesic efficacy is maintained over the long term remains an open question. The evidence basis is also weak for making clinical decisions about other benefits of long term treatment, such as quality of life and functional improvements; the risks of misuse and iatrogenic addiction; optimal approaches to initiating, titrating, escalating, monitoring and terminating opioid therapy; the utility of opioid rotation; and the utility of informed consent and opioid management plans, among other matters. A review commissioned by the American Pain Society and the American Academy of Pain Medicine concluded in 2009 that “clinical decisions regarding the use of opioids for chronic non-cancer pain need to be made based on weak evidence.”⁵ Various professional medical bodies have sought to revise and clarify guidelines for prescribing them for this purpose.^{6, 30, 49} Moreover, a tide of abuse of these potent opioids has arisen, with increasing overdose, accident and death rates, spurring a new public health crisis.¹² Despite studies finding no evidence that increasing medical use of opioids is correlated with increases in health consequences of abuse,²⁰ more recent research does find a direct association between rates of therapeutic use and of abuse.⁷

The extent to which these changes in professional practice norms contribute to wide geographic variation in opioid prescribing is difficult to determine with precision. Because no earlier published studies of county variation exist, we are unable to assess the extent to which regional variation changed as opioid prescribing became more prevalent and as practice norms became unsettled. It is likely, however, that the variation was significantly wider in 2008 than it was a decade earlier. One study of state-level variation in prescribing to Medicaid recipients reported that variation in opioid prescribing increased from 1996 through 2002.⁵⁰ The introduction of extended release oxycodone in 1996 and subsequent

efforts to market it no doubt contributed to greater variability in prescribing practice. Between 1997 and 2006, amounts of oxycodone dispensed from retail pharmacies in the U.S. increased by 678%, while the U.S. population increased only 11%.⁴⁰ To market its extended release oxycodone, the pharmaceutical manufacturer mined prescription data to identify physicians who prescribed opioids with greater than average frequency (especially primary care physicians) and focused its sales efforts on them and the regions where they lived.⁴¹ Sales of this one drug alone increased from \$48 million in 1996 to \$1.1 billion in 2000. Our data show that by 2008, geographic variation in prescribing was greater for oxycodone than for the other most frequently prescribed opioids (Table 1).

But the aggressive marketing of extended release oxycodone cannot explain the overall increase in opioid prescribing and the widespread variation in practice. Sales of other opioids increased dramatically as well during this period: the amounts of methadone, fentanyl and hydrocodone dispensed from retail pharmacies in the U.S. grew by 1,053%, 591%, and 336%, respectively.⁴⁰ In 2008, variation among counties in prevalence of prescribing these drugs was not as wide as for oxycodone but was still substantial (Table 1).

In summary, residual geographic variation in opioid prescribing may be explained by a number of dynamics, which are not exclusive of one another. One is that the collapse of an earlier consensus about using opioids for pain management resulted in individual prescribers setting their own practice pattern that reflects their own personal attitudes, values, knowledge, and other interests. Another is that practice variation may stem from different local medical subcultures—i.e., shared attitudes about what constitutes appropriate practice, which may be reinforced by policies and attitudes of licensing boards and other local regulators. Regional differences in how medical practice is organized and in the prevalence of managed care may explain some of the residual geographic variation, as there is evidence that patients with private HMO insurance are less likely to get opioids from their primary care providers in office visits.²⁶ Patients' demands for care that result in prescribing opioids—because of differences in injuries or other reasons we are unable to measure or that are not correlated with measured characteristics—may also vary regionally. Finally, geographic variation may reflect different rates of diverting opioids for non-medical use. Surveys find increasing numbers of U.S. residents reporting non-medical use of prescription drugs, including opioids,³⁴ which has large economic, social, and health costs,^{3, 8, 27, 28, 35, 36} and studies have found correlations between amounts prescribed and various indicators of misuse, such as fatal opioid overdoses.²⁹ Most opioids are prescribed and dispensed for legitimate medical reasons,⁷ so county differences in diversion rates probably contribute little to the observed variation in opioid prescribing.

More systematic attention to geographic variation in opioid prescribing is needed because the wide range of variation and the amount of variation that is not explained raise questions about the appropriateness and effectiveness of practice. The growing epidemic of opioid diversion and abuse has spurred consideration of a variety of legal and administrative controls,²⁵ including even taking certain often-abused drugs off state formularies.³³ Such drastic interventions are unlikely to be implemented, as they will make these drugs unavailable for legitimate medical use. Better understanding of effective opioid use and of prescribing practices would inform design of regulations so that they strike the right balance between the benefits and risks of opioids.

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Figure 1.

Variation among counties in mean milligrams of opioids (in morphine equivalents) dispensed by retail pharmacies, per county resident, 2008

Note: Variation is measured as difference between mean amount in milligrams in all counties and amounts prescribed and dispensed in each single county. Milligrams per resident are standardized by age and gender.

Sources: Prescription data LRx Data, 2008, obtained under license from IMS Health Incorporated. All rights reserved. County location of prescribers' offices obtained from Physician Professional Data, 2008, American Medical Association. All rights reserved. See table 3 below for sources of data on population characteristics.

Table 1

Variation among counties in average milligrams of opioids dispensed per resident, 2008, standardized by age and gender

	Percentile					COV	Ratio 75% to 25%
	25%	50%	75%	Mean			
Propoxyphene	116	250	451	353	1.5	3.9	
Tramadol	111	213	357	280	1.29	3.2	
Hydrocodone	43	95	190	146	1.27	4.4	
Codeine	39	86	152	114	1.06	3.9	
Oxycodone	19	60	134	103	1.36	7.1	
Oxymorphone	0.3	1.1	2.8	2.3	1.87	10.8	
Methadone	0.1	0.3	0.8	0.9	2.69	8.0	
Fentanyl	0.000	0.001	0.006	0.009	4.21	--	
All opioids combined (morphine equivalents)	148	323	564	426	1.05	3.8	

Sources: Computed from LRx Data, 2008 obtained under license from IMS Health, Incorporated. All rights reserved.

Table 2

Estimated mean milligrams of opioids (in morphine equivalents) dispensed per resident, by state, 2008

State	Mean mg per resident	Relative to all- states mean		State	Mean mg per resident	Relative to all- states mean	
		mg	Percent			mg	Percent
NV	1150	+603	210%	TX	512	-35	94%
DE	973	+426	178%	PA	500	-46	92%
FL	969	+423	177%	NJ	497	-50	91%
KY	893	+346	163%	CT	491	-55	90%
TN	849	+302	155%	RI	477	-70	87%
AR	834	+288	153%	MD	469	-78	86%
WV	821	+274	150%	WI	461	-85	84%
UT	796	+249	146%	VA	429	-117	79%
AL	749	+203	137%	KS	425	-121	78%
SC	729	+182	133%	CO	420	-126	77%
LA	711	+164	130%	WY	417	-130	76%
MS	694	+148	127%	NE	410	-137	75%
OK	672	+126	123%	ME	408	-139	75%
NC	644	+98	118%	NH	404	-142	74%
AZ	642	+95	117%	MA	381	-165	70%
OH	630	+83	115%	CA	372	-175	68%
IN	629	+82	115%	NY	352	-194	64%
GA	619	+72	113%	IA	334	-212	61%
OR	562	+16	103%	MN	327	-220	60%
MT	558	+12	102%	VT	319	-228	58%
MO	551	+5	101%	IL	311	-235	57%
ID	551	+4	101%	SD	310	-237	57%
WA	543	-4	99%	ND	310	-237	57%
MI	531	-15	97%	HI	305	-242	56%
NM	514	-32	94%	AK	262	-284	48%
				DC	157	-390	29%

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Sources: Computed using LRx Data, 2008, obtained under license from IMS Health Incorporated. All rights reserved. Location of prescribers' offices obtained from Physician Professional Data, 2008, American Medical Association. All rights reserved. State population data from Bureau of Census, extract, 2008.

Table 3

Distribution of Selected Characteristics, all U.S. Counties

	Mean	25 th Percentile	Median	75 th Percentile
Resident Population Characteristics				
County population size (1,000s) <i>(a)</i>	91	12	26	61
Percent of county classified as urban <i>(a)</i>	0.41	0.14	0.41	0.64
County is zero percent urban <i>(a)</i>	0.22	0.00	0.00	0.00
Percent college graduates <i>(a)</i>	0.23	0.17	0.22	0.27
Percent completed high school but not college <i>(a)</i>	0.55	0.51	0.55	0.60
Percent education variable not reported <i>(a)</i>	0.19	0.00	0.00	0.00
Percent white non-Hispanic <i>(a)</i>	0.81	0.71	0.89	0.96
Percent African American <i>(a)</i>	0.09	0.0	0.02	0.11
Percent Hispanic ethnicity <i>(a)</i>	0.06	0.01	0.02	0.05
Persons in poverty per 1,000 <i>(b)</i>	126	81	114	157
Household income inequality (Gini coefficient) <i>(f)</i>	.431	.406	.429	.454
Percent <65 yrs old without insurance in 2005 <i>(e)</i>	0.18	0.13	0.17	0.21
Percent Medicaid eligible <65 years old, in 2004 <i>(e)</i>	0.21	0.14	0.19	0.26
Health Care Utilization & Rx Monitoring				
Surgeries/year, per 1,000 <i>(c)</i>	74	9	58	102
In-patient days/year in short-term hosp. per 1,000 <i>(c)</i>	677	133	357	757
Emergency department visits/year per 1,000 <i>(c)</i>	395	192	364	524
Prescription drug monitoring program in state, 2008 <i>(g)</i>	0.63	0.00	1.00	1.00
Availability of Prescribers <i>(d)</i>				
Active MDs per 1,000 residents	0.08	0.00	0.05	0.12
Surgeons as percent of all MDs	0.06	0.00	0.03	0.09
Psychiatrists as percent of all MDs	0.05	0.00	0.00	0.06
Pediatricians as percent of all MDs	0.26	0.00	0.15	0.37
Emergency MDs as percent of all MDs	0.81	0.35	0.59	0.99

Sources: All from U.S. Department of Health and Human Services, *Area Resource File (ARF) Access System 2008*. Original sources:

(a) Bureau of Census, extract, 2008,

(b) Computed as the average number of two separate measures--food stamp recipients per 1,000 from Bureau of Census, County Level Food Stamp/SNAP Recipient File, for year 2006 and persons in poverty per 1,000 from Bureau of Census, Small Area Income Poverty Estimates, for year 2007,

(c) American Hospital Association, Hospital Facilities Database, for year 2006,

(d) AMA Physician Master File, for year 2007,

(e) Bureau of Census, Small Area Health Insurance Estimates,

(f) U.S. Census Bureau, American Community Survey, Available at <http://www-958.ibm.com/software/data/cognos/manyeyes/datasets/gini-coefficient-by-county-2000-20/versions/1>. Accessed May 24, 2012,

^(g) Alliance of States with Prescription Monitoring Programs, at <http://www.pmpalliance.org/>.

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Table 4

Estimated Association of County-Level Attributes and Amounts of Prescription Opioids (Morphine Equivalents) Prescribed During 2008

	Coefficient	SD
Resident Population Characteristics		
County population size	0.162 ***	0.026
Percent of county classified as urban	0.095 *	0.043
County is zero percent urban	0.530	0.277
Percent college graduates	-0.248	0.216
Percent completed HS, but not college	-0.192 *	0.096
Education variable not reported	-0.023	0.058
Percent white non-Hispanic	0.844 ***	0.072
Percent African American	0.046 ***	0.010
Percent Hispanic	-0.015	0.020
Persons in poverty per 1,000 residents	0.336 ***	0.083
Household income inequality (Gini coefficient)	0.100	0.689
Percent <65 yrs old without insurance	0.220 **	0.079
Percent Medicaid eligible <65 yrs old	0.102	0.077
Health Care Utilization & Rx Monitoring		
Surgeries per 1,000 residents	0.023	0.014
In-patient days in short-term hospitals per 1,000 residents	0.020	0.022
Emergency department visits per 1,000, short-term hospitals	0.038	0.029
Prescription drug monitoring program in state, 2008	0.067	0.039
Availability of Prescribers		
Active MDs per 1,000 residents	0.347 ***	0.035
Surgeons as percent of all MDs	0.083 **	0.027
Psychiatrists as percent of all MDs	-0.060 *	0.024
Pediatricians as percent of all MDs	0.054 *	0.027
Emergency MDs as percent of all MDs	-0.001	0.020
<u>Constant</u>	<u>-0.191</u>	1.165
r ²	0.329	

Notes.

*
p < .05,

**
p < .01,

p < .001.

Educational attainment in 674 counties was imputed to equal mean values for counties with non-missing data.

Sources: See sources for Table 3.