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BACKGROUND

Over the past two decades, the United States has experienced a dramatic increase in the number of drug-related overdose deaths, driven in large part by the opioid epidemic. In 2017 alone, more than 70,000 people died from a drug overdose, and 67.8% of these deaths were opioid-related.[1] Over the course of the epidemic, changes in prescribing patterns have reduced access to prescription opioids, but overdose deaths involving heroin and synthetic opioids such as illicitly manufactured fentanyl have increased.[2] Most recently, deaths involving synthetic opioids have spiked, increasing 71% per year from 2013 to 2017.[3]

Although urban areas have higher rates of overall illicit drug use,[4] rates of opioid misuse are more comparable across the rural-urban spectrum.[5] In 2018, rates of opioid misuse were 3.5% in large metropolitan statistical areas (MSAs), 4.1% in small MSAs, and 3.8% in non-MSAs.[1] Despite the similar prevalence of opioid misuse across MSAs, there is evidence to suggest that use of opioids may be more lethal for those living in rural areas. A recent analysis examining county-level factors associated with opioid-related deaths found rurality to be a significant determinant of opioid-related mortality.[6] Observing drug overdose trends from 1999 to 2015, Mack and colleagues found that while overdose death rates were initially higher in metropolitan areas, this difference disappeared in 2004, and by 2015 rates were higher in nonmetropolitan areas.[4]

One impact of the higher rates of opioid misuse and related overdoses has been an increased strain on emergency departments (EDs). In 2016, the rate of opioid poisoning-related ED visits was 62 per 100,000 population.[1] An analysis of ED data from 52 jurisdictions in 45 states found that rates of ED visits for suspected opioid-involved overdoses varied widely by state and region, but overall trends showed an increase of 5.6% each quarter from 2016-2017.[7] These trends reflect the wider impact of the opioid crisis on hospital services. From 1993 to 2016, hospital discharges for opioid use disorder (OUD) quadrupled, from 38.3 to 154.5 per 100,000.[8]

Although analyses of opioid overdoses by rural-urban status have found that rates are generally higher in urban than rural EDs, rates have increased for all regions.[1, 7, 9, 10] These studies, however, have been limited in geographic or temporal scale, resulting in an incomplete understanding of national ED visits for opioid poisoning by metropolitan status over time. Even if rates are lower in rural areas, increasing overdose rates may prove especially challenging for rural EDs already experiencing growing demand for their services. From 2005 to 2016, overall ED visit rates at rural hospitals rose more than

Key Findings

- Opioid-related visits (ORVs) to rural and urban emergency departments (EDs), as a proportion of total visits, increased between 2006 and 2013.
- Rural ORV rates were lower than urban rates in both periods, but the difference narrowed because of somewhat higher rural increases.
- Rural ORVs were more likely than those in urban areas to be by patients aged 65 and older and to involve concurrent use of benzodiazepines.
- One fifth of ORVs by rural residents occurred in urban EDs and rural EDs were more likely to transfer patients to another hospital.
- More research is needed to understand the impact of rural residents' treatment in other facilities on short- and long-term outcomes for patients who experience an ORV.

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50%, from 36.5 to 64.5 visits per 100 people, while urban EDs only saw a slight increase over the same time period.[11]

It is especially important to assess opioid poisoning visit rate increases in rural EDs, given the resource constraints that they face. Relative to urban facilities, rural EDs typically have lower staffing levels,[12] fewer emergency medicine physicians and on-call specialists,[12] fewer training opportunities,[12] and more limited access to advanced medical technologies.[13] Thus, when faced with climbing rates, rural EDs may have difficulties addressing the acute needs of opioid overdose patients while serving other members of their patient populations at the same time; as a result, they may need to create new protocols to cope with disruptions in workflow. Although physical management of acute opiate overdose may be relatively straightforward (airway maintenance, reversal agents, withdrawal support),[14] there is growing recognition that an opioid overdose may present a unique opportunity for future overdose preventions including naloxone prescribing or initiation of treatment.[15] Yet, because rural hospitals may have more limited clinical capabilities than urban hospitals,[16] and because rural communities typically have fewer providers of substance use disorder (SUD) treatment,[17, 18] rural EDs may confront special obstacles in arranging appropriate, psychosocial and post-emergency care for patients who present with opioid poisoning.

EDs are a critical rural health resource and may play an important frontline role in addressing the opioid epidemic. However, we lack information on whether opioid poisonings place a disproportionate burden on rural EDs or whether rural EDs have the capacity to address patients experiencing an overdose. The purpose of this study was to gain insight about rural ED visits for acute opioid poisoning and how they compare with urban ED visits. We explored how rural and urban rates of opioid-related visits changed between 2006 and 2013, and how they compared to each other in each year. We also analyzed what proportion of rural residents sought care for opioid poisoning at urban EDs, particularly compared to other diagnoses and between the two time periods. Finally, we examined whether these opioid-related visits to rural EDs had different outcomes such as transfer or death than urban visits.

METHODS

This study used the 2006 and 2013 Nationwide Emergency Department Sample (NEDS), a data set created as part of the Agency for Healthcare Research and Quality's Healthcare Cost and Utilization Project. At the time we initiated this study, the 2013 dataset was the most recent year available. We examined rural and urban opioid-related visits to ED, including rate change over time, and the outcomes of these ED visits (treatment and release, inpatient admission, transfer, and death). By opioid-related visits (ORVs), we specifically mean visits to a rural or urban ED with a diagnosis of acute poisoning by a prescription or illicit opioid. The study addressed the following research questions:

1. Did opioid-related ED use differ across rural and urban EDs in 2013? How did rural opioid-related visit rates change from 2006 to 2013 (in absolute rates and relative to urban)?
2. In each year, what proportion of rural patients received opioid-related care in rural versus urban EDs?
3. Did rates of various outcomes (e.g., admissions, transfers, and death) differ across rural and urban EDs in 2013? How did rates of rural outcome change from 2006 to 2013, including relative to urban?

Data: The NEDS contains data from a sample of ED visits in the U.S. that are weighted to enable nationally representative estimates about EDs and ED visits. The EDs that contribute data to the NEDS approximate a 20%, stratified sample of all U.S. hospital-based EDs. It contains information on injury-related ED visits including: type and severity of injury; whether the injury resulted in death; post-ED disposition (e.g., whether the patient was treated and released, admitted, or transferred to another facility); and patient characteristics.

Dependent Variables: To measure opioid-related ED use, we used ICD-9-CM diagnosis and injury codes to identify opioid-related ED visits each year. (Examples of relevant codes include: 965.01 for poisoning by heroin; 965.09 for poisoning by other opiates and related narcotics; E850.1 for accidental poisoning by methadone; and 305.52 for nondependent opioid abuse, episodic use). All ED visits were categorized as opioid-related or not opioid-related. To assess outcomes following opioid-related visits, we classified each as resulting in release from the ED, inpatient admission, transfer to a non-hospital health care provider, or death.

Independent Variables: The two independent variables in the study were ED location (urban or rural) and time period (2006 versus 2013). To indicate the rurality of the county in which an ED is located, the NEDS uses an aggregated version of the Urban Influence Codes (UICs) devised by the United States Department of Agriculture's Economic

Research Service. While the NEDS divides counties into metropolitan, micropolitan, and non-core, we combined micropolitan and non-core into a single rural variable to increase our rural sample size.

Covariates: Our covariates included patient characteristics: age, gender, median household income in the patient's ZIP code, type of opiate ingested, and presence of co-morbidities. We also included census region where the hospital is located as a covariate (Northeast, South, Midwest and West).

Analysis: In bivariate analyses, we used chi-square tests to compare opioid-related ED use and outcomes of ORVs by rurality of ED location and across time periods. We also used chi-square to test rural-urban differences in patient residence by ED location within each time period. To further understand rural-urban differences in transfer rates for ORVs, we used logistic regression to examine the odds that a rural hospital would transfer a patient to another facility, controlling for the covariates listed above. We used SUDAAN (Release 11.0.1, Research Triangle Park, NC: 2012) for all analyses to account for stratification and weighting in the NEDS data. Unless otherwise noted, all differences discussed in this brief were statistically significant with p-values at or below 0.05.

FINDINGS

Prevalence of Opioid-Related Visits

The proportion of visits that were related to the use of any opioid was higher in urban than rural EDs in both 2006 and 2013. These differences decreased slightly between the two time periods, largely because rural ORV rates grew faster than urban rates (Table 1). In 2006, 64 out of every 100,000 visits to a rural ED was related to opioid poisoning, compared to 92 per 100,000 in urban. By 2013, rural ORV rates had increased 39 percent, to 89 per 100,000 visits. Urban rates grew to 124 per 100,000 visits, an increase of about 35 percent.

Most of the rural-urban difference in ORV rates appears to be driven by higher urban versus rural rates of poisoning by heroin or an unspecified opioid. Rural-urban differences in methadone-related visits were minimal in each year use (10 versus 8 per 100,000 in 2006 and 7 versus 6 per 100,000 in 2013). There was no statistically significant rural-urban difference in either year for ED visits that were related to non-methadone prescription drugs, although both rural and urban EDs saw an increase in the rate of visits related to prescription opioids other than methadone. Urban EDs were somewhat more likely than rural to see

Table 1. Opioid-Related Emergency Department (ED) Visits, by Year and Rural or Urban Hospital Location

	2006		2013	
	Urban ED	**Rural ED**	**Urban ED**	**Rural ED**
	Weighted N = 97,267,531 visits	Weighted N = 22,766,219 visits	Weighted N = 110,136,173 visits	Weighted N = 24,011,421 visits
	Opioid-related visits per 100,000 visits			
Any opioid[4,iv, d, ****]	92	64	124	89
Heroin[4,iv, b,****]	26	3	42	11
Methadone[1, i, d, **]	10	8	7	6
Non-methadone prescription opioid[ns, ns, a, *]	38	38	41	44
Unspecified opioid[1,ii,d, ****]	17	14	31	26
Multiple opioids[ns, ns, d, ****]	2	1	3	3

SOURCE: Nationwide Emergency Department Sample, 2006 and 2013

Chi square test of difference by ED location (rural vs. urban) in 2006 significant at: [1]p < 0.05, [2]p < 0.01, [3]p < 0.001, [4]p < 0.0001.

Chi square test of difference by ED location (rural vs. urban) in 2013 significant at: [i]p < 0.05, [ii]p < 0.01, [iii]p < 0.001, [iv]p < 0.0001.

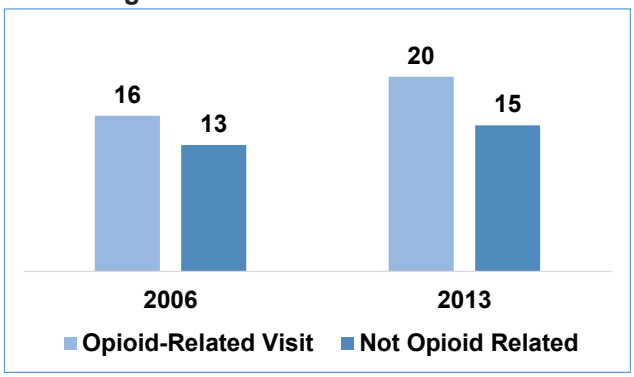
Chi square test of difference by year (2006 vs. 2013) among rural EDs significant at: [a]p < 0.05, [b]p < 0.01, [c]p < 0.001, [d]p < 0.0001.

Chi square test of difference by year (2006 vs. 2013) among rural EDs significant at: *p < 0.05, **p < 0.01, ***p < 0.001, ****p < 0.0001.

cases of unspecified opioid poison (17 versus 14 per 100,000 in 2006 rising to 31 versus 26 per 100,000 in 2013). During 2013, the rate of heroin-related urban ED visits was 42 per 100,000 total visits versus 11 in rural EDs. However, it is important to note that between 2006 and 2013, the rate of heroin-related visits to rural EDs nearly quadrupled, rising from 3 per 100,000 to 11 per 100,000.

Given the substantially lower proportion of ED visits related to opioids in rural EDs, we next sought to understand whether some segment of rural residents who experience an ORV actually end up at urban EDs. As demonstrated in Figure 1, in 2006, about one out of six ORVs by a rural resident took place in an urban ED (16 percent). This compared to only 13 percent of ED visits for all other types of diagnoses combined (p. <.05). This proportion

Figure 1. Percentage of Rural Residents' ED Visits Made to an Urban ED for Opioid Poisoning Versus All Other Diagnoses



Differences between ORVs and non-ORVs significant in each year at p <.05

rose to 20 percent of ORVs in 2013, meaning that one out of every five ED visits for opioid poisoning experienced by a rural resident in that year occurred within an urban ED. However, only 15 percent of rural residents who received ED treatment for a non-opioid-related diagnosis did so in an urban ED. Among urban residents, about 1 percent of all ORVs were to a rural ED in both 2006 and 2013 (data not shown).

Patient Characteristics and Comorbidities among Opioid-Related Visits

The characteristics of patients who presented for an ORV to rural EDs differed somewhat from those going to urban EDs in both 2006 and 2013 (Table 2). For example, visits by children (under age 18), older adults (age 65+), and female patients comprised a higher proportion of ORVs to rural EDs compared with urban EDs. Not surprisingly given the economic characteristics of rural places, rural ORVs were more likely than urban ORVs to be made by individuals from lower income communities (defined by median incomes below the U.S. median). Potentially reflecting these income and age differences, ORVs to rural EDs were more likely to be paid for by Medicare or Medicaid than were ORVs to urban EDs in 2006. By 2013, the percentage of rural ORVs covered by Medicaid had declined while Medicare as a payer increased. In 2013, nearly one-third (32 percent) of all rural ORVs were covered by Medicare, compared with 27 percent of urban ORVs.

To assess whether there were differences in the underlying or acute patient health status of rural versus urban ED visits for opioid poisoning, we analyzed comorbid condition diagnoses appearing in each ORV record. Between 2006 and 2013, the proportion of ORVs accompanied by a chronic pulmonary condition increased, particularly in rural EDs. Similarly, rates of concurrent respiratory failure among ORVs increased between 2006 and 2013, nearly doubling for rural ORVs. About 30 percent of rural and urban ORVs were associated with comorbid mood or psychotic disorders in both years. Compared with urban ORVs, a somewhat higher proportion of rural ORVs included a concurrent diagnosis of benzodiazepine intoxication (13 versus 10 percent in 2013).

Opioid-Related Visit Outcomes

Among individuals presenting at rural and urban EDs for ORVs, close to half are treated and released, while more than 40 percent end up admitted to that hospital (Table 3). There was no statistically significant difference in these outcomes for rural versus urban hospitals in either year, or change among urban hospitals across years. However, in both years the rate of ORVs that resulted in a transfer to another hospital was four to five times higher for rural EDs compared with urban EDs (8 percent versus two percent in 2013). A very small number of ORVs (less than 1 percent) resulted in death in the ED across geographic locations and study years and the rural rates did not differ from urban in either year.

To understand whether the rural-urban differences in hospital transfers for an ORV may be explained by differences in the patient characteristics of visits, we conducted a pair of adjusted and unadjusted logistic regressions for 2013. The first model estimated the simple odds that a rural versus urban ORV would end in a hospital transfer versus admission to the same hospital as the ED. The second model estimated the rural odds of a hospital transfer, controlling for patient age, sex, comorbidities, median income in their neighborhood, and the hospital's region of the

Table 2. Patient Characteristics and Comorbidities among Opioid-Related Emergency Department (ED) Visits, by Year and Rural or Urban Hospital Location

	2006		2013	
	Urban ED	Rural ED	Urban ED	Rural ED
	(N = 89,612 ORVs)	(N = 14,622 ORVs)	(N = 137,312 ORVs)	(N = 22,341 ORVs)
	Percent of Visits by Patient Characteristic			
Characteristic				
Age[4, d,****]				
0-17	4.3	7.1	3.3	4.6
18-34	35.9	28.9	39.6	29.8
35-64	52.7	52.8	47.7	51.6
65+	7.1	11.2	9.5	13.9
Female[4,iv, n.s., n.s.]	45.4	53.7	45.8	54.6
Median Household Income in Patient's ZIP Code below US Median[4,iv, n.s, n.s.]	52.3	84.0	54.1	83.8
Primary Payment Source [4, iv,d,*]				
Medicaid	22.1	27.1	24.7	25.2
Medicare	19.0	26.5	23.1	31.7
Private	22.8	21.3	20.8	18.7
Self-pay	28.7	21.5	25.0	20.1
No charge	3.2	0.3	1.9	0.5
Other	4.2	3.7	4.6	3.8
Comorbid Diagnosis at Admission				
Chronic pulmonary condition[ns,i,d,****]	11.2	11.2	14.4	16.3
Mood or psychotic disorder[ns,ns,ns,**]	29.1	28.6	32.0	31.6
Alcohol-related disorders[ns, ii, a,ns]	11.9	11.0	13.2	11.2
Cancers[ns,ns,ns,*]	3.2	3.1	3.6	4.2
Neurological disorders[ns,ns, b, ns]	6.1	6.0	7.2	6.9
Alcohol intoxication[ns, ns, b, *]	4.3	4.6	3.5	3.1
Benzodiazepine intoxication[1,iv,ns, ns]	9.9	11.9	9.7	12.9
Respiratory failure[4,ns,d, iv]	10.3	6.4	13.4	12.0

SOURCE: Nationwide Emergency Department Sample, 2006 and 2013

Chi square test of difference by ED location (rural vs. urban) in 2006 significant at: [1]p < 0.05, [2]p < 0.01, [3]p < 0.001, [4]p < 0.0001.

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Chi square test of difference by year (2006 vs. 2013) among rural EDs significant at: [a]p < 0.05, [b]p < 0.01, [c]p < 0.001, [d]p < 0.0001.

Chi square test of difference by year (2006 vs. 2013) among rural EDs significant at: *p < 0.05, ** p < 0.01, ***p < 0.001, ****p < 0.0001.

Table 3. Outcomes of Opioid-Related Emergency Department (ED) Visits, by Year and Rural or Urban Hospital Location

	2006		2013	
	Urban ED	Rural ED	Urban ED	Rural ED
	(Weighted N = 89,612 ORVs)	(Weighted N = 14,622 ORVs)	(Weighted N = 137,321 ORVs)	(Weighted N = 21,341 ORVs)
	Column %	Column %	Column %	Column %
Outcome of ED Visit				
Treated and released[ns, i, ns,ns]	48.9	44.1	52.0	48.1
Admitted to same hospital[ns,ns,ns,ns]	46.1	47.3	45.7	43.2
Transferred to another hospital[4,iv, a,ns]	1.3	6.6	1.8	8.1
Died in ED[ns,ns,a,ns]	0.1	0.3	0.2	0.2
Not admitted, destination unknown[ns, ns, d,ns]	3.6	1.8	0.3	0.4

SOURCE: Nationwide Emergency Department Sample, 2006 and 2013
Chi square test of difference by ED location (rural vs. urban) in 2006 significant at: [1]p < 0.05, [2]p < 0.01, [3]p < 0.001, [4]p < 0.0001.
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Chi square test of difference by year (2006 vs. 2013) among rural EDs significant at: [a]p < 0.05, [b]p < 0.01, [c]p < 0.001, [d]p < 0.0001.
Chi square test of difference by year (2006 vs. 2013) among rural EDs significant at: *p < 0.05, **p < 0.01, ***p < 0.001, ****p < 0.0001.

country. In other words, even if rural and urban patients shared the same characteristics, what would be the ratio of rural transfers to urban transfers? Compared to urban EDs, patients arriving at rural EDs for an ORV had 4.8 times higher unadjusted odds of being transferred to a different hospital. When we controlled for the patient characteristics described above, the odds of a rural ORV visit ending in a transfer increased slightly to 5.3 times that of urban. This suggests that when key risk factors for poor ORV outcomes are held constant, rural EDs are even more likely than urban EDs to transfer a patient.

DISCUSSION AND POLICY IMPLICATIONS

Our findings indicate that ORVs made up an increasing proportion of all rural and urban ED visits in 2013 compared with 2006 and the rate of increase was higher in rural. This reflects other data showing historically lower rural rates of death from overdose by drugs of all kinds, yet a more rapid increase among rural populations has led to overdose death rates that were slightly higher in rural areas in 2015 (17 versus 16 per 100,000).[4] Although the rural-urban difference in ORVs narrowed by 2013, the rate of ORVs among all ED visits was lower in rural compared with urban hospitals in both years.

Given that rural-urban rates of opioid use are roughly comparable,[5] the relatively lower volume of ORVs in rural EDs suggests that a segment of rural residents who experience opioid poisoning may be voluntarily, or involuntarily, not seeking care in their local hospitals. Our analysis confirmed that 20 percent of rural residents who experienced an ORV did so at an urban ED in 2013, compared with only 15 percent of all other ED visit types. It is unclear whether this difference is driven by friends and family bringing rural individuals to urban EDs, perhaps in response to stigma or other concerns, or whether first responders are making these decisions. Prior research indicates that the emergency medical services (EMS) protocols may divert severe trauma or other emergencies directly to urban EDs, particularly if the rural hospital has limited trauma or intensive care services.[19] It is possible that rural hospitals may doubt their capacity to handle opioid overdoses and may be peremptorily routing patients to larger, more urban facilities.

This potential concern about rural hospital capacity appears to be supported by rural hospitals' decisions to transfer ORV admissions to other hospitals at substantially higher rates than urban hospitals. When controlling for the characteristics and health status of patients, the odds of a transfer were five times that for rural versus urban hospitals. Unfortunately, the NEDs does not provide detail about the hospitals to which individuals are transferred, which is a limitation of our study. The NEDs also does not allow us to distinguish between types of rural hospitals and Critical Access Hospitals may face unique pressures to transfer based on Medicare policy that limits CAH stays to 96 hours.

In addition to concerns about rural hospital capacity, our analysis of patient characteristics found some important differences between the patients who appear for ORVs in rural versus urban EDs. In particular, a greater proportion of ORVs in rural EDs were patients aged 65 and older. This may be driven by rural-urban differences in prescribing patterns for opioid medications. For example, prior research indicates that in 2015-16, rural older adults (65+) were more frequently prescribed opioids than were their urban counterparts.[20] It is unclear from our study whether these older adults in rural EDs were experiencing OUDs, or whether they were taking opioids generally as prescribed but experienced an overdose because of lower health literacy or other confusion about appropriate dosing. This suggests that we need more research into the opioid use patterns of older adults, particularly for those living in rural areas, to better understand the education needs of rural providers and patients and the SUD treatment needs of rural older adults.

More research is needed to determine whether the potential diversion to urban EDs and the transfer of patients to other facilities has a positive or negative impact on patients' short- and long-term outcomes. For example, many EDs have begun offering medication-assisted treatment (MAT) for opioid use disorders to individuals experiencing an overdose while they are in the ED, as evidence suggests this may be an optimal time to engage individuals in treatment.[21] Whether and how rural residents' treatment in urban EDs or transfer to other facilities affects the initiation and maintenance of treatment will be an important question to address for the future.

Finally, given the age of the data used for these analyses, it will be important to update this study in the near future. More recent data from the NEDS show a generally increasing trend in opioid-related ED visits from 2013-2017;[22] increasing prevalence of overdoses involving synthetic opioids during this time period[3] may also have important consequences for EDs in both rural and urban places.

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Kansas Hospital Association
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Michigan Health & Hospital Association
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Missouri Hospital Industry Data Institute
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