

# Diabetes-Related Hospital Mortality in Rural America: A Significant Cause for Concern

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*This policy brief is the third in a series prepared by the Southwest Rural Health Research Center on the topic of diabetes.*

## Purpose

This study examines trends and rates of diabetes-related hospital deaths for persons hospitalized in the U.S., with emphasis on rural versus urban differences. Data from the Healthcare Cost and Utilization Project<sup>1</sup> (HCUP) Nationwide Inpatient Sample (NIS) for the years 2009 – 2014 were utilized to provide more recent estimates of rural versus urban differences in diabetes-related mortality for persons hospitalized.

## Background

Over 30 million adults, or nearly 10% of the adult population, have diabetes and 97% of those with a diagnosis of diabetes suffer from type 2 diabetes<sup>2</sup> (T2DM). It is the seventh leading cause of death in the U.S. with nearly 80,000 diabetes-related deaths in 2015.<sup>2</sup> Studies using older data found that diabetes prevalence is approximately 15% to 17% higher in rural areas than urban areas.<sup>3-5</sup> Previous studies have also shown that rural adults were more likely to report a diabetes-related diagnosis than urban adults (9.6% versus 8.4%).<sup>6,7</sup> Other studies have shown that rural persons with diabetes have higher morbidity from diabetes-related complications than urban persons with diabetes.<sup>6,8,9</sup> These studies use older data however, and new estimates are needed to inform national and state policy makers.

Although some improvement has been observed in the availability of diabetes self-management programs, it is unclear whether any gains have been made over the past decade in reducing overall deaths attributable to or associated with diabetes, especially in rural and underserved areas of the U.S. As such, our study uses more recent data to examine diabetes-related mortality in U.S. hospitals by U.S. census region, observing for rural versus urban differences in diabetes mortality.

The research questions addressed in this policy brief are: (1) Are there rural versus urban differences in diabetes-related hospital deaths observed in the HCUP-NIS for the years 2009 – 2014, and (2) if so, how do these differences vary across census regions?

## Key Findings

- ◆ Between 2009 and 2014, on average, there were 1,456,200 diabetes-related hospitalizations per year and, on average, there were 38,075 diabetes-related hospital deaths.
- ◆ Rural America has a disproportionately high number of diabetes-related hospital deaths compared to urban America. Out of the estimated average of 38,075 diabetes-related hospital deaths per year between 2009 – 2014, 79.3% of deaths occurred in areas classified as urban, and 20.3% occurred in areas classified as rural/noncore.
- ◆ On average, 2.63% of all diabetes-related urban admissions resulted in death, while 2.74% of all rural admissions resulted in death.
- ◆ The odds of mortality for those classified as having diabetes-related hospitalizations were 3.4% higher in noncore areas compared to large central metro areas, regardless of the census region.
- ◆ Diabetes-related deaths were 7.5% higher in the rural South compared to large metro areas within the same census region.
- ◆ In the Midwest, compared to the large metro areas, the odds of diabetes-related deaths were 6.3% higher in large fringe metro areas, 15.8% higher in small metro areas, 14.9% in micropolitan areas, and 17.3% in rural areas.

## Methods

To carry out our analysis of diabetes-related deaths during hospitalization, we acquired 2009-2014 HCUP-NIS data made available by the Agency for Healthcare Research and Quality (AHRQ). The HCUP-NIS is the “largest all-payer inpatient care database in the U.S., containing data on more than seven million hospital stays.”<sup>1</sup> The HCUP-NIS data provides publicly available data allowing analysis at the state and local level and includes six levels of rurality for observation along the rural-urban continuum. Critical for our analysis is the level of rurality as it provides information about diabetes-related mortality during hospitalization. For our analyses, we considered all sampled cases of diabetes (type 1 and type 2), including insulin-dependent, non-insulin dependent, malnutrition-related, and other types of diabetes-related deaths

Rurality is determined using the 2013 National Center for Health Statistics (NCHS) Urban-Rural classification scheme providing six levels of urbanization including large central metropolitan large fringe metropolitan, medium metropolitan, small metropolitan, micropolitan (towns of 5,000 – 49,000 not adjacent to an urban area), and noncore or rural-remote areas. Under this scheme, micropolitan and non-core areas are considered rural, whereas the remaining areas are generally considered urban or suburban.<sup>10,11</sup>

## Statistical Analysis

We calculated the average number of deaths related to diabetes between 2009 and 2014 by census region and rurality. We divided the average deaths by the average population of each geographical area over the same time period. These rates were then multiplied by a 100,000 population. In order to examine the odds of diabetes-related hospital deaths across the urban-rural continuum in the U.S., we conducted a multivariate logistic regression, controlling for year and population estimates. Separate multivariate logistic regressions were also conducted to estimate

the odds of mortality across the urban-rural continuum within each of the four U.S. census regions.

## Results

A total of 8,537,292 persons were admitted between 2009 and 2014 with a diagnosis of either type 1 or type 2 diabetes. Of the estimated average of 38,075 diabetes-related hospital deaths per year between 2009 and 2014, 79.3% were urban, and 20.3% were rural. On average, 2.63% of all diabetes-related urban hospital admissions resulted in death, while 2.73% of all rural diabetes-related hospital admissions resulted in death ( $p < 0.001$ ).

**Table 1** shows the average number of diabetes-related hospital deaths per 100,000 population by rurality within the four census regions across all six years, 2009 – 2014. Within the Northeast region, the average diabetes-related hospital mortality rates were highest in micropolitan areas (17.0 deaths per 100,000 population) compared to other areas. Mortality rates were highest within the rural areas of the South and Midwest regions (21.0 and 15.1 deaths per 100,000 population, respectively) compared to other areas in both regions. The noncore, micropolitan, and small metro areas of the South had the highest average diabetes-related hospital mortality rates (21.0, 20.3, and 14.0 deaths per 100,000 population respectively) compared to corresponding areas in the Northeast, Midwest and West regions.

**Table 1. Average Number of Hospital Deaths Related to Diabetes per 100,000 Population by Rurality and Census Regions, 2009 – 2014**

	<b>Northeast</b> n = 6,667	<b>Midwest</b> n = 8,458	<b>South</b> n = 15,325	<b>West</b> n = 7,624
<b>Large Central Metro</b>	13.9	12.8	11.4	11.2
<b>Large Fringe Metro</b>	10.8	11.1	11.0	11.0
<b>Medium Metro</b>	10.3	11.2	11.5	8.6
<b>Small Metro</b>	10.2	13.0	14.0	9.2
<b>Micropolitan</b>	17.0	14.5	20.3	10.9
<b>Noncore</b>	11.1	15.1	21.0	10.8

*Note: n is the average number of deaths per year in the census region between 2009 and 2014.*

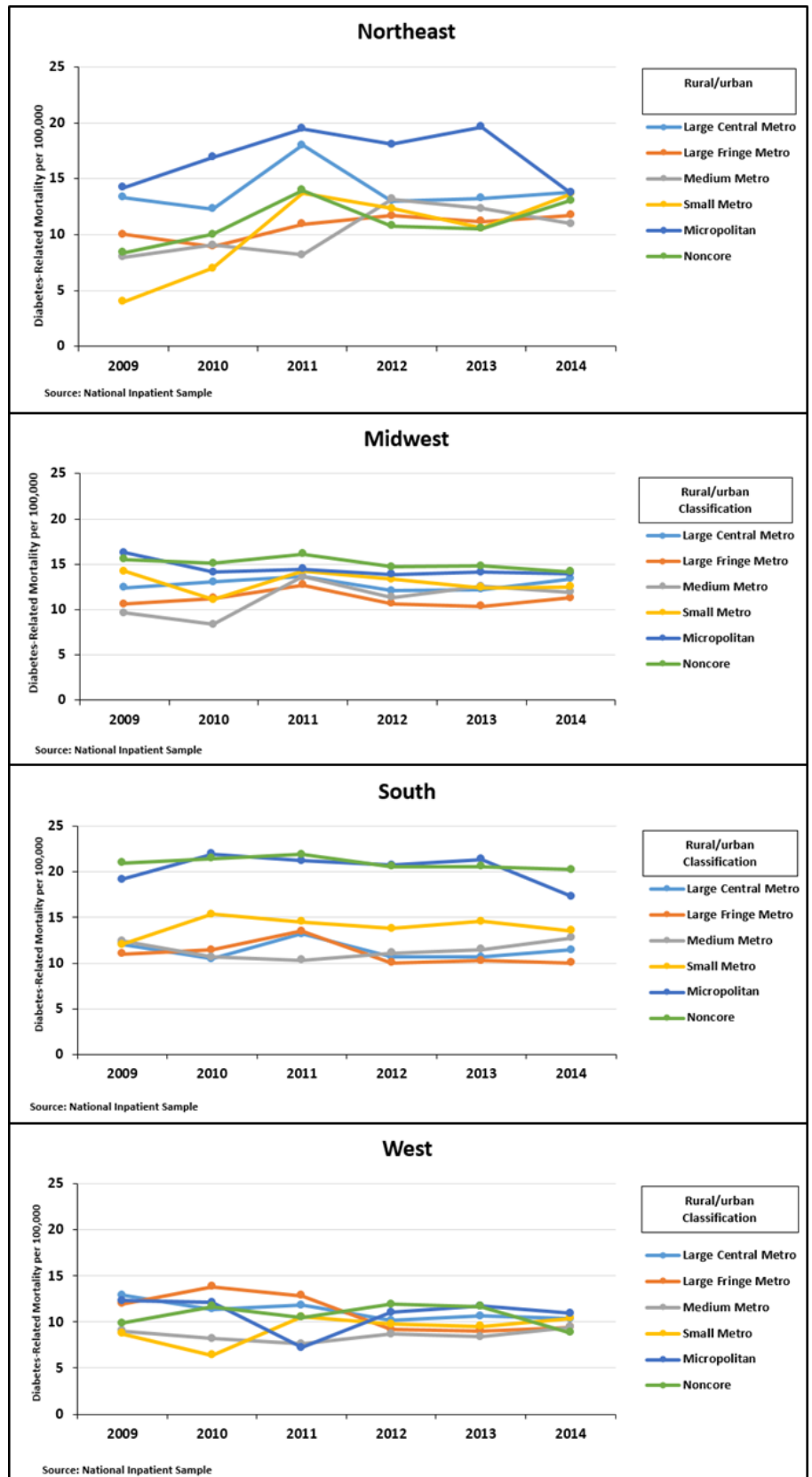
Figure 1 shows diabetes-related hospital death trends by census region and rurality between 2009 and 2014, and further highlights the differences within each census region. In the Northeast, mortality rates were highest across all the years in micropolitan areas, followed by large central metro areas. In the Midwest, the number hospital deaths related to diabetes appear to be clustered across urban and rural areas. Nonetheless, the mortality rates were consistently higher in the micropolitan and noncore areas of that census region.

In the South, the mortality rates were markedly higher in noncore and micropolitan areas across all six years, reflecting a gap between rural areas and metropolitan areas. This gap in the likelihood of diabetes-related hospital deaths is most notable within the South relative to other census regions. In the West, there appears to be no clear trend, with noncore, micropolitan, and metropolitan areas closely clustered.

Table 2 shows the combined odds of hospital diabetes-related deaths across the urban-rural continuum in the U.S. We used large central metropolitan areas as the reference category. The odds of mortality from diabetes-related hospitalizations were 3.4% higher in noncore areas compared to large central metro areas, adjusting for population estimates and year.

Using separate multivariate logistic regressions for each census region, we estimated the odds of hospital diabetes-related deaths with the six urban / rural categories as the independent variable, controlling for year. Table 3 shows the odds of hospital diabetes-related deaths across the urban-rural continuum within each census region.

**Figure 1. Hospital Deaths Related to Diabetes by Census Region and Rurality, 2009 – 2014**



**Table 2: Odds of Hospital Diabetes-Related Deaths across the Urban-Rural Continuum, 2009 – 2014**

	Odds Ratio (95 % C.I)
<b>Large Central Metro</b>	1.0 (Ref)
<b>Large Fringe Metro</b>	0.96 (0.94 – 0.97)*
<b>Medium Metro</b>	0.95 (0.94 – 0.96)*
<b>Small Metro</b>	0.98 (0.97 – 0.99)*
<b>Micropolitan</b>	0.99 (0.98 – 1.01)
<b>Noncore</b>	1.03 (1.01 – 1.05)*

Note: Analysis includes adjustments for population estimates and year. \*P ≤ 0.05

In the Northeast, small metropolitan areas had an 8.7% increase in the odds of hospital diabetes-related deaths compared to large central metropolitan areas. In the Midwest, the odds of diabetes-related hospital deaths increased significantly across the urban-rural continuum compared to large metropolitan areas, with the exception of the medium metropolitan areas. Compared to the large metropolitan areas, the odds of dying were 6.3% higher in large fringe metropolitan areas, 15.8% higher in small metro areas, 14.9% in micropolitan areas, and 17.3% in noncore areas.

In the South, the odds of diabetes-related hospital deaths were 7.5% higher in noncore areas, and 1.8% higher in micropolitan areas compared to large metro areas, though the odds for micropolitan areas in the South did not reach statistical significance. Taken together, our findings demonstrate that between 2009 and 2014, the odds of hospital diabetes-related deaths were significantly higher in rural areas in the Midwest and South census regions.

**Table 3: Odds of Hospital Diabetes-Related Deaths across the Urban-Rural Continuum and Census Regions, 2009 – 2014**

	Northeast	Midwest	South	West
	OR (95 % C.I)	OR (95 % C.I)	OR (95 % C.I)	OR (95 % C.I)
<b>Large Central Metro</b>	1.0 (Ref)	1.0 (Ref)	1.0 (Ref)	1.0 (Ref)
<b>Large Fringe Metro</b>	0.98 (0.96 – 1.01)	1.06 (1.03 – 1.09)*	0.95 (0.93 – 0.97)*	0.99 (0.96 – 1.01)
<b>Medium Metro</b>	0.92 (0.89 – 0.95)*	1.00 (0.97 – 1.03)	0.96 (0.94 – 0.98)*	0.99 (0.97 – 1.01)
<b>Small Metro</b>	1.09 (1.03 – 1.41)*	1.16 (1.12 – 1.19)*	0.98 (0.95 – 1.00)	0.87 (0.84 – 0.90)*
<b>Micropolitan</b>	1.01 (0.97 – 1.05)	1.15 (1.12 – 1.18)*	1.02 (0.99 – 1.04)	0.95 (0.91 – 0.99)*
<b>Noncore</b>	0.95 (0.89 – 1.02)	1.17 (1.14 – 1.21)*	1.07 (1.05 – 1.10)*	0.97 (0.92 – 1.03)

Note: Analysis includes adjustments for year. \*P ≤ 0.05

## Discussion

Two main findings emerged from our analyses. First, our results suggest that despite innovations and more widespread availability of diabetes self-management programs over the years, substantive differences in the odds of diabetes-related hospital mortality between rural and urban areas still persist. Taken together, rural Americans face a higher diabetes-related mortality burden than non-rural Americans. Secondly, the burden is especially pronounced for rural residents in the South and Midwest. This difference in mortality burden may reflect varying factors such as access to primary and endocrinology care, health literacy, trust in the healthcare system, access to wholesome nutrition, and lifestyle choices, among others. Future research should continue to explore the reasons for these discrepancies.

Given the costs associated with inpatient hospitalization, further inquiry is warranted to examine the financial burden of diabetes and diabetes-related mortality in the U.S. The financial burden of the disease is shouldered by individuals, insurance companies, and state and federal governments alike, thus making it a policy-relevant issue. Recent research has indicated that diabetes-related hospital discharges have been amenable to Medicaid expansion, with striking reductions in Medicaid expansion states with high baseline uninsured rates in the first quarter of 2014.<sup>12</sup> Since many states in the South and Midwest have not expanded Medicaid and reforms continue to be discussed concerning health care coverage, future research should explore the potential implications for rural Americans as it relates to diabetes in the presence or absence of health policy reforms.

## Implications

Between 2009 and 2014, the odds of hospital diabetes-related deaths were significantly higher in rural areas in the Midwest and South census regions. This may be due to the fact that their condition is untreated or poorly managed.<sup>14</sup>

Although diabetes is a condition sensitive to ambulatory care, rural healthcare providers may find it more challenging to provide regular care for persons with diabetes or provide self-management education because of both costs and scarcity of diabetes-management education-trained professionals available in rural settings.<sup>14</sup> In the rural areas of the Midwest and South regions of the U.S., where there is limited access to health care services due to shortages of healthcare providers, mortality rates associated with diabetes are demonstrably higher. Our work reveals that innovations are still needed, and informs national and state level efforts to address rural disparities in access to appropriate care for diabetes.

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