

# Dialysis Availability in Rural America



At the Heart of Health Policy

# Dialysis Availability in Rural America

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January 2013



**Rural Health Research  
& Policy Centers**

Funded by the Federal Office of Rural Health Policy

[www.ruralhealthresearch.org](http://www.ruralhealthresearch.org)

Funding Acknowledgment:

This report was prepared under Grant Award U1CRH03711  
With the Federal Office of Rural Health Policy, Health Resources and Services Administration

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## Executive Summary

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### Executive Summary

End stage renal disease (ESRD), a potential consequence of diabetes, hypertension and other chronic conditions, leaves the individual in need of a kidney transplant or kidney dialysis to survive. Depending on their clinical condition and service availability, patients may receive hemodialysis, generally performed in a clinic, or peritoneal dialysis, which can be performed at home. We used the Medicare Dialysis Compare files, which contain information about dialysis facilities in 2008, and the Standard Analysis File of the US Renal Data System, which contains information about ESRD patients in 2008, to explore the availability of services in rural America. Our research questions were:

- What is the current distribution of dialysis facilities, by characteristics and capacity, across levels of rurality?
- How does the distribution of facilities compare to estimated need, defined as patients with ESRD?
- How do dialysis facility performance measures compare across levels of rurality?

#### Key Findings:

*The prevalence of dialysis use did not differ across urban versus rural counties.*

- We found the prevalence of dialysis use to be similar across rural and urban counties, with an overall median of 3.9 persons per 1,000 residents in 2008. The top three disorders leading to ESRD were also similar across geography (diabetes, hypertension, and glomerulonephritis).

*Rural residents travel further for dialysis services*

- While most residents of urban and micropolitan rural counties were likely to have a facility within their county, more than half of residents in small adjacent or remote rural counties must travel out-of-county for care. While only 23.5% of urban and 20.6% of micropolitan residents lacked an in-county facility, 63.9% of residents of small adjacent rural counties and 77.3% of those in remote rural counties must travel to an out-of-county facility.
- Rural ESRD patients were estimated to travel farther for care than urban residents, measuring from the ZIP Code of residence to the ZIP Code of the nearest facility. Rural residents lived a median of 33.3 driving miles from the closest facility, versus 13.7 miles for urban patients. Distances were longest for remote rural residents, who traveled an estimated 39.8 road miles to care.
- Travel burden was greatest among rural patients of “other” race, who traveled an estimated 46.0 road miles to the nearest facility. In small adjacent rural counties, dialysis patients of “other” race traveled an estimated 56.5 road miles for care.

*Fewer expanded services were offered in rural areas*

- The proportion of facilities offering peritoneal dialysis, home hemodialysis training, and

## Executive Summary

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after-hours (evening) services was lower in rural than in urban communities, affecting both choice of dialysis modality and the ability of rural ESRD patients and their families to maintain normal employment schedules:

- Peritoneal dialysis: Available in 48.1% of urban counties, but only 36.3% of rural counties
- Home hemodialysis training: Available in 24.0% of urban counties, but only 16.7% of rural counties
- After-hours services: Available in 21.4% of urban, but only 8.5% of facilities in rural counties

### *The characteristics of rural and urban dialysis facilities differed*

- The relative penetration of for-profit facilities was lower in rural counties. For-profit institutions accounted for 84.5% of all urban facilities, versus 75.9% of rural dialysis facilities.
- Chain membership was lower in rural counties. Among urban facilities, 82.0% were part of a chain, versus 77.5% among rural facilities.
- Rural dialysis facilities were smaller than facilities in urban counties and reported fewer patients per station. Urban facilities have a median of 18 stations each serving 12.6 patients, while rural facilities have a median of 13 stations each serving 9.7 patients.

### *Dialysis quality outcomes were similar across rural and urban ESRD facilities*

- Despite differences between rural and urban facilities, quality differences as measured by hemoglobin, blood urea, and survival were small and did not show a clear advantage for facilities in either area.

### Policy Implications

In 2011, the Centers for Medicare and Medicaid Services (CMS) switched to a per-treatment, prospective payment system for funding dialysis services, adjusted for patient characteristics and for both local wage index and low-volume providers. The Medicare Payment Advisory Commission (MedPAC) has suggested that an adjustment based on volume alone is too broad, thus distance to the nearest provider should also be used to qualify facilities for the low-volume adjustment. The appropriate distance thresholds, and any ameliorating factors, remain open policy questions. As policy makers assess the issue, it will be important to ensure that changes do not add to the already substantial travel burden experienced by rural dialysis patients.

### Directions for Future Investigation.

Future investigations should address the economic and demographic characteristics associated with for-profit service, to ascertain the implications of economic change for future service availability. Additionally, the varying availability of dialysis services across geography causes certain populations to travel farther for care. While an examination across all rural dialysis facilities reveals no marked differences in patient outcomes for rural versus urban patients, it is possible that some subpopulations may be adversely affected by travel burden.

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## Table of Contents

<b>Table of Contents</b>	
Executive Summary.....	i
Index of Tables and Figures.....	iv
Introduction .....	1
End Stage Renal Disease.....	1
Relevance to Policy .....	2
Gaps in Knowledge .....	3
About the data used in this report.....	3
I. Distribution of Dialysis Facilities .....	4
Dialysis Patients and Stations .....	4
Distance to Nearest Facility.....	5
II. Dialysis Facility Characteristics and Services .....	8
III. Dialysis Facility Performance Measures.....	10
Hemoglobin .....	10
Urea Reduction.....	11
Survival.....	11
IV. Selected Clinical Characteristics of Rural and Urban Dialysis Patients .....	13
Primary Diagnosis .....	13
Primary Treatment Modality.....	13
Summary of Key Findings.....	15
Rural residents travel further for dialysis services .....	15
Fewer services are offered in rural areas.....	15
The profile of rural and urban dialysis facilities differs .....	16
Dialysis quality outcomes are similar across rural and urban ESRD facilities .....	16
Policy Implications.....	17
Directions for future investigation .....	17
Technical Notes.....	19
References.....	22

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## Index of Tables and Figures

### Index of Tables and Figures

#### List of Tables

Table 1: Access to Dialysis Care, by Rurality (mean and median) .....	5
Table 2: Median Centroid and Driving Distances to Nearest Facility, by Rurality and Race .....	7
Table 3: Characteristics of Dialysis Facilities, by Rurality (in percents), 2008 .....	9
Table 4: Dialysis Facility Performance Measures: Ability to Report and Outcomes, by Rurality (in percents), 2008 .....	12
Table 5: Primary Diagnosis among Patients receiving Dialysis, by Rurality (in percents).....	13
Table 6: Treatment Modality for Patients utilizing Dialysis, by Rurality (in percents) .....	14

#### List of Figures

Figure 1. Dialysis Patients per 1,000 residents, 2008, by rurality.....	4
Figure 2. Percent Patients without a dialysis facility in county, 2008, by rurality .....	4
Figure 3. Estimated driving miles to the nearest dialysis facility, ESRD patients, by rurality, 2008.....	6
Figure 4. Percent of dialysis facilities offering home hemodialysis training and after- hours services, by level of rurality, 2008 .....	8
Figure 5: Proportion with Selected Hemoglobin Levels, by Rurality (percent) .....	10

### Introduction

#### *End Stage Renal Disease*

Chronic kidney disease, a common consequence of hypertension and diabetes, affects an estimated 3.8% - 4.5% of American adults, based on previously published nationally representative studies.<sup>1</sup> Estimates based on laboratory values in the 2003 – 2006 National Health and Nutrition Examination Survey (NHANES) population suggest that the actual prevalence may be as high as 15%. Kidney disease can progress to kidney failure, referred to as end stage renal disease (ESRD). Without treatment, ESRD is rapidly fatal. Like its principal predecessor conditions, hypertension and diabetes, ESRD is more prevalent among minorities and low income populations.<sup>2-4</sup> ESRD is three times more prevalent among African American than white individuals (rates of 4,123 versus 1,295 per million population).<sup>5</sup> Half a million persons in the U.S. were estimated to suffer from ESRD in 2007 (522,283 individuals), including about 158,000 living persons who had received a kidney transplant.<sup>5</sup>

Kidney transplantation is generally the best treatment for ESRD, but long waiting lists and difficulty finding suitable donor matches limit this option. The majority of ESRD patients receive dialysis, either as an interim treatment while waiting for a kidney transplant or as their principal therapy. The purpose of dialysis is to achieve blood pressure regulation and balance of essential blood and body chemicals.<sup>6</sup> Dialysis care is available to patients in two primary forms, depending on their clinical condition: hemodialysis and peritoneal dialysis. When a patient undergoes hemodialysis, blood is filtered externally (outside the body) for the removal of waste products and extra fluid then returned to the body. Because this form of dialysis requires licensed healthcare providers such as nurses to re-circulate blood externally from the body for purification, hemodialysis is usually received in a clinic setting. The majority of dialysis patients (91.6%) are treated with hemodialysis in a clinic setting, with a small proportion using home hemodialysis (1.1%). Peritoneal dialysis, which provides more independence since it can be conducted outside of a clinic, is used by about seven percent of patients.<sup>6</sup> In peritoneal dialysis, a catheter is inserted in the abdomen allowing for the flow of dialysis solution. The solution interacts with abdominal cavity walls (peritoneum) thus extracting waste and extra fluids.<sup>7</sup> Peritoneal dialysis is accomplished in two forms: continuous ambulatory peritoneal dialysis (CAPD) and continuous cycler-assisted peritoneal dialysis (CCPD). In the case of the former, the patient is able to move about while dialysis is continuously conducted using minimal



equipment and gravity to facilitate dialysis. CCPD, however, requires the patient, usually at home and while asleep, to connect to a machine called a cycler that dialyzes the patient.<sup>7</sup>

Numerous clinical indicators are used in assessing the quality of dialysis care, with hemoglobin levels and urea reduction being among the most commonly used. The National Kidney Disease Outcomes Quality Initiative has set standards for these measures.<sup>8</sup> The Dialysis Compare service provided by the Center for Medicare and Medicaid Services also collects information about patient survival, adjusted for patient disease characteristics.

### *Relevance to Policy*

ESRD is the only disease-based eligibility category for Medicare, a category established in the 1972 amendments to the Social Security Act. At that time, only 7,000 patients qualified for dialysis, versus an estimated 368,000 at present.<sup>9</sup> Medicare costs have increased from \$6 billion in 1991 to \$24 billion in 2007, constituting 5.8% of the Medicare budget in 2007, with continued increases expected with an aging population.<sup>5</sup> As a result of growth in the dialysis population, Medicare has a significant financial interest in how this condition is treated and how payment is organized.

In 1983, Medicare implemented a partial prospective payment system for dialysis services, working from Medicare Cost Reports for the 1977-1979 period.<sup>10</sup> The composite rate for typical services and drugs has not been substantially changed, except for adjustments for inflation, since that time. However, advances in medical treatment have led to additional services that can improve outcomes for ESRD patients, such as epoetin alpha (EPO) to stimulate erythropoiesis, the production of red blood cells. As of 2005, about 60% of Medicare expenditures for ESRD were billed through the composite rate, with the other 40% paying for separately billable items, such as EPO.

Medicare is currently in the process of revising its payment for ESRD treatment, moving toward a prospective payment approach that includes more items previously billable separately.<sup>10</sup> Payment mechanisms can influence the quality of care provided to individuals with ESRD. Recent research found that ESRD patients experience decreases in hemoglobin levels while hospitalized, which may stem in part from disincentives for the in-hospital use of expensive erythropoiesis stimulating drugs under the prospective payment system.<sup>11</sup> Baseline information on ESRD treatment availability is needed to track the effects of payment reform for dialysis treatment, if any, on rural facility availability and quality of care.

### *Gaps in Knowledge*

We build on previous research by exploring the characteristics and capacities of dialysis clinics, as well as their quality performance measures, by rurality. We assessed patients' hemoglobin levels, urea reduction, and survival as quality indicators. Our specific research questions were:

- What is the current distribution of dialysis facilities, by characteristics and capacity, across levels of rurality?
- How does the distribution of facilities compare to estimated need, defined as patients with ESRD?
- How do dialysis facility performance measures compare across levels of rurality?

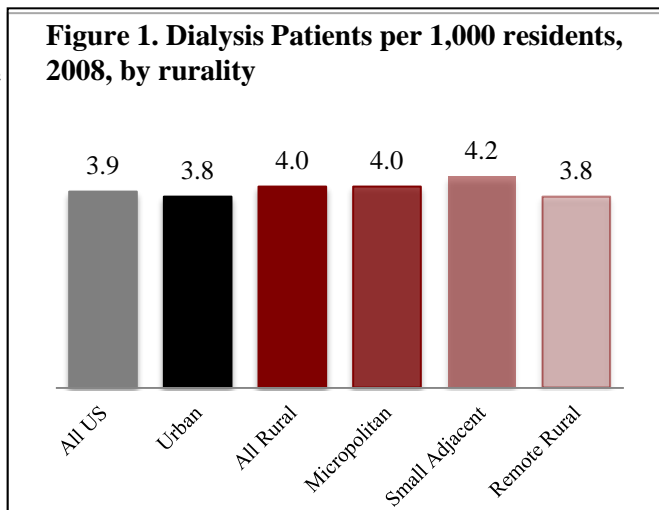
### *About the data used in this report*

Our analysis used 2008 data from two sources: the Medicare Dialysis Compare files and the Standard Analysis File of the US Renal Data System. The Medicare Dialysis Compare data contains information regarding the facilities providing dialysis services as well as performance measures reported by these facilities. The Standard Analytic File of the US Renal Data System contains basic descriptive information for all ESRD patients. Details are provided in the Technical Notes at the end of the report.

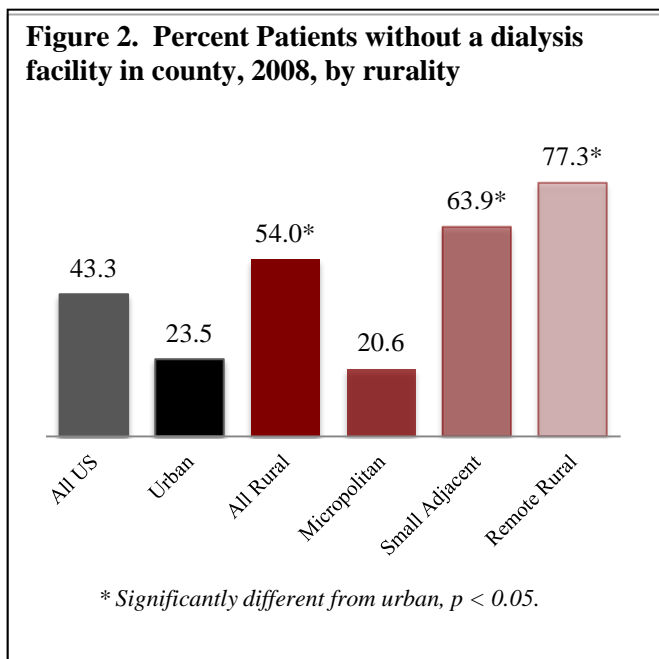
**I. Distribution of Dialysis Facilities**

*Dialysis Patients and Stations*

Across the US, a median of 3.9 persons per 1,000 residents used dialysis services in 2008, with no significant differences across levels of rurality. (Figure 1, at right, and Table 1, next page). However, services are not equally available for all patients. Across the US, about 43% of patients lived in counties without a dialysis facility in 2008 (Figure 2). While most residents of micropolitan rural counties, like most residents of urban counties, were likely to have a facility within their county, more than half of residents in small adjacent or remote rural counties must travel out-of-county for care (details, Table 1).



Rural counties average fewer stations per facility than urban counties (median of 13.0 versus 18.0 stations), yet rural counties had fewer in-county patients per station than urban counties (rural median 9.7, urban median 12.6). Patient/station ratios are likely to underestimate the number of patients served, because these ratios are calculated using only county residents. More than half of rural dialysis patients do not have an in-county facility (54.0%; Figure 2). The proportion of patients without an in-county facility increases to 77.3% in remote rural counties. These patients must travel for care and may rely on adjacent rural counties, increasing patient load beyond that created by in-county patients alone.



## Distribution of Dialysis Facilities

**Table 1: Access to Dialysis Care, by Rurality (median and mean)**

Access Factors	Rurality					
	All	Urban	All Rural	Micro-politan Rural	Small Adjacent Rural	Remote Rural
Median (Mean) number of patients per 1,000 population, by county	3.9 (6.8)	3.8 (4.6)	4.0 (7.9)	4.0 (14.9)	4.2 (4.6)	3.8 (4.2)
Median (Mean) number of Dialysis Stations per facility, by county	15.0 (14.0)	18.0 (18.6)	13.0* (14.4)	14.0* (15.5)	12.0* (13.0)	12.0* (11.9)
Median (Mean) number of patients per station, by county of residence	11.2 (12.6)	12.6 (14.4)	9.7* (11.0)	11.5* (12.3)	8.9* (9.4)	7.0* (8.7)
Percent of ESRD patients without a facility in their county	43.3	23.5	54.0*	20.6	63.9*	77.3*
Data: 2008 Facility data from Medicare Dialysis. Patient data for population per county estimate from the Standard Analysis File of the US Renal Data System; data for 2008. * Significantly different from urban, $p < 0.05$ .						

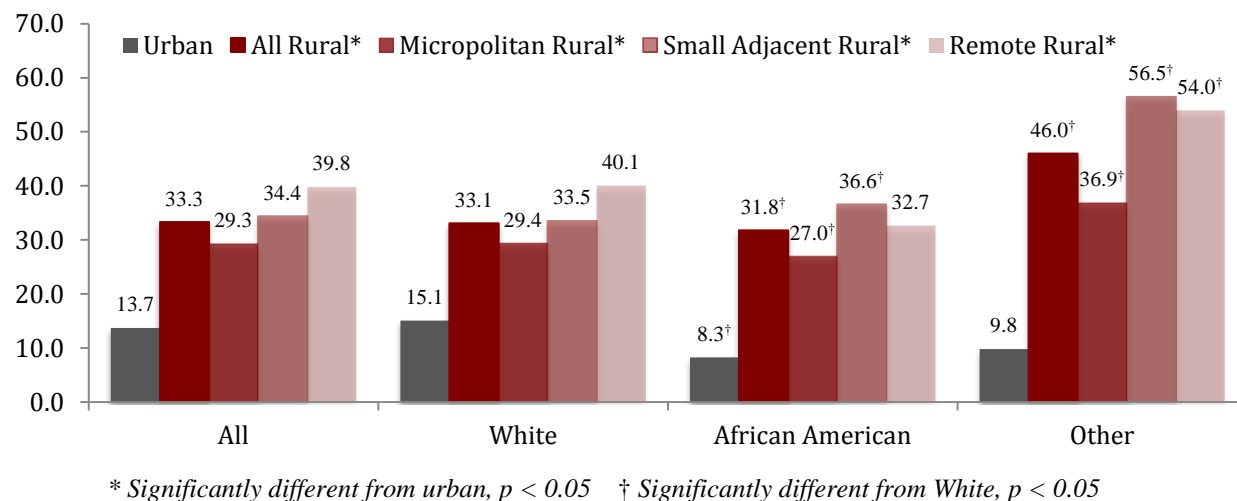
### *Distance to Nearest Facility*

Because more than half of rural counties did not have a dialysis facility in 2008, many rural patients had to travel for care. To assess the travel burden on rural and urban dialysis patients, we calculated the distance, in miles, from the home ZIP Code of an ESRD patient receiving dialysis to the ZIP Code of the nearest dialysis facility. These are estimates of *minimum* travel distance, as the data set did not specify where patients are treated. Patients may choose to bypass the closest facility and thus travel farther. We calculated driving distance in miles between the patient's ZIP Code and the nearest dialysis facility, measuring from the centroid of the resident's ZIP Code (the geographic center of the ZIP Code) to the centroid of the closest facility's ZIP Code. These estimates are displayed in Table 2 (end of section).

Rural dialysis patients lived farther from the nearest dialysis facility. Rural residents lived an estimated median distance of 33.3 miles from the nearest facility, versus 13.7 miles among urban patients. Distances were longest for remote rural residents, who travel an estimated 39.8 road miles to care (Table 2).

## Distribution of Dialysis Facilities

**Figure 3. Estimated driving miles to the nearest dialysis facility, ESRD patients, by rurality, 2008**



Examination of travel patterns by race suggests a travel advantage for African American patients compared to white patients, but possible disadvantage for rural patients of “other” race. Urban African American residents had a shorter estimated road distance than did urban white patients (8.3 miles versus 15.1 miles). Rural African Americans also had a shorter median road distance to the nearest facility than whites (31.8 versus 33.1 miles); a similar pattern was found for African American patients living in micropolitan and remote rural counties (Table 2). Patients of “other” race, however, generally had greater driving distances to the nearest facility. Across all rural patients, persons of “other” race travel an estimated 46.0 road miles to the nearest facility, versus 33.1 miles for white patients. Distances increase for residents of remote rural counties. In these locations, persons of “other” race travel an estimated 54.0 road miles for care, versus 40.1 miles, respectively for white patients. Details are provided in Table 2. [Note: ethnicity was not in the data; Hispanic persons with ESRD may be present across all race groups.]

## Distribution of Dialysis Facilities

**Table 2: Median Driving Distances to Nearest Facility, by Rurality and Race**

Distance to Facilities by Race	Rurality Levels					
	All	Urban	All Rural	Micropolitan Rural	Small Adjacent Rural	Remote Rural
<b>All</b>						
Driving (miles)	22.3	13.7	33.3*	29.3*	34.4*	39.8*
<b>White</b>						
Driving (miles)	23.4	15.1	33.1*	29.4*	33.5*	40.1*
<b>African American</b>						
Driving (miles)	14.1†	8.3†	31.8*†	27.0*†	36.6*†	32.7*
<b>Other</b>						
Driving (miles)	27.2†	9.8	46.0*†	36.9*†	56.5*†	54.0*†
Data source: Facility data from Medicare Dialysis Compare; data for 2008. Patient data for population per county estimate from the Standard Analysis File of the US Renal Data System; data for 2008. Ethnicity variables are unavailable in the data. Hispanic persons may be present in any race category. * Significantly different from urban, $p < 0.05$ † Significantly different from White, $p < 0.05$						

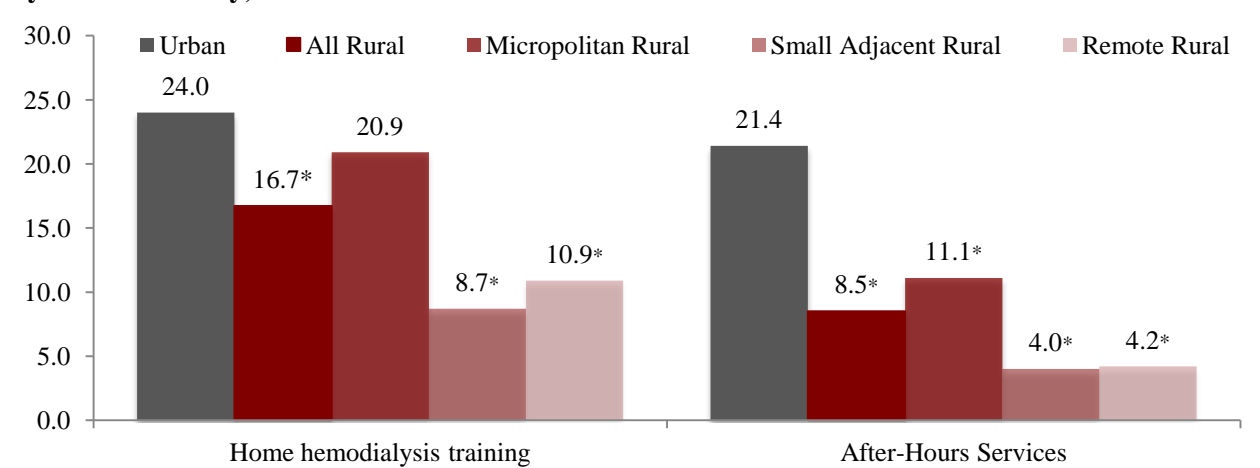
**II. Dialysis Facility Characteristics and Services**

Overall, 82.6% of dialysis facilities in the U.S. were for-profit organizations, with a similar percentage (81.0%) associated with a chain (Table 3). Rural facilities were less likely to be for-profit (rural, 75.9%; urban, 84.5%). There was no clear trend associated with increasing rurality, although the proportion of for-profit facilities was lowest in remote rural counties (68.5%). Similarly, chain membership was more common among urban (82.0%) than among rural dialysis facilities (77.5%), but there was no consistent pattern across rurality.

Nearly all dialysis facilities offer hemodialysis (96.5%). Rural facilities were more likely to report hemodialysis than were urban facilities (rural, 99.0%; urban, 95.8%). An alternative form of dialysis, peritoneal dialysis, was less widespread. Only 45.5% of dialysis facilities nationwide offered peritoneal dialysis, with greater availability in urban facilities (48.1%) than in rural facilities (36.3%). Availability of peritoneal dialysis was lowest among facilities located in small, adjacent rural counties (23.6%; Table 3).

Both home dialysis and after-hours dialysis can increase the ability of an ESRD patient to retain independence, through reduced travel time for care and increased ability to remain employed. Availability of training for home dialysis was reported by 24.0% of urban facilities; availability decreased with rurality (Figure 4 and Table 3). Similarly, 21.4% of urban facilities offered evening services, declining to 4.2% of facilities in remote rural counties.

**Figure 4. Percent of dialysis facilities offering home hemodialysis training and after-hours services, by level of rurality, 2008**



\* Rural significantly different from urban,  $p < 0.05$  or less.

## Dialysis Facility Characteristics and Services

**Table 3: Characteristics of Dialysis Facilities, by level of Rurality, 2008, in percents**

Facility Characteristics	Rurality Levels					
	All	Urban	All Rural	Micro-politan Rural	Small Adjacent Rural	Remote Rural
<b>Ownership type</b>						
For Profit	82.6	84.5	75.9*	76.6*	78.6*	68.5*
Not-For-Profit	17.4	15.5	24.1	23.4	21.4	31.5
<b>Associated with a chain</b>						
Yes	81.0	82.0	77.5*	77.9*	80.1	71.5*
No	19.0	18.0	22.5	22.1	19.9	28.5
<b>In-center hemodialysis</b>						
Yes	96.5	95.8	99.0*	98.8*	99.3*	99.4*
No	3.5	4.2	1.0	1.2	0.7	0.6
<b>In-center peritoneal dialysis</b>						
Yes	45.5	48.1	36.3*	43.3*	23.6*	26.1*
No	54.5	51.9	63.7	56.7	76.5	73.9
<b>Home hemodialysis training</b>						
Yes	22.4	24.0	16.7*	20.9	8.7*	10.9*
No	77.6	76.0	83.3	79.1	91.3	89.1
<b>After-Hours Services</b>						
Yes	18.6	21.4	8.5*	11.1*	4.0*	4.2*
No	81.4	78.6	91.5	88.9	96.0	95.8
Data source: Medicare Dialysis Compare; data for 2008.						
* Rural significantly different from urban, $p < 0.05$ or less.						



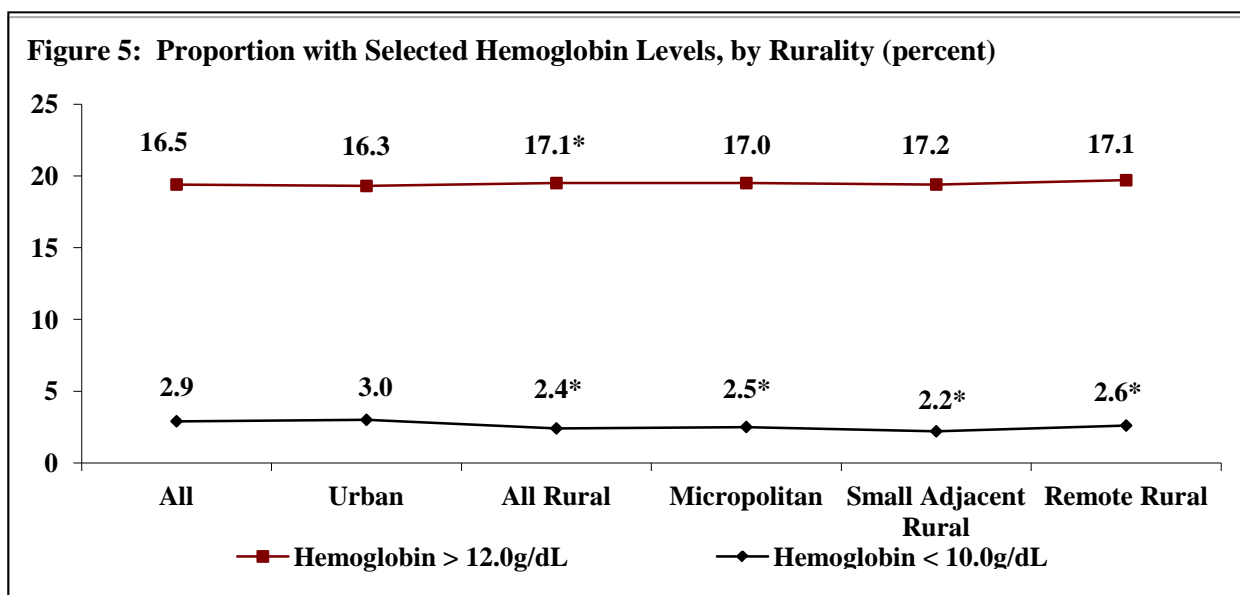
III. Dialysis Facility Performance Measures

*Hemoglobin*

The National Kidney Disease Outcomes Quality Initiative recommends that hemoglobin levels for ESRD patients be maintained between 11.0 – 12.0 g/dL. While there is disagreement among researchers on the clinical implications of hemoglobin values higher than the recommended range, there is agreement that levels below 11.0 g/dL are associated with increased mortality.<sup>14</sup>

Standard hemoglobin measures reported through Medicare Compare were “less than 10.0 g/dL” and “greater than 12.0 g/dL.” In 2008, 87.5% of urban facilities and 89.9% of rural facilities reported hemoglobin outcomes (Table 4). Facilities located in remote rural counties were less likely to report than those in other areas (81.8%).

The average proportion of patients with hemoglobin less than 10.0g/dL was 2.9%. Rural facilities did better on this measure than urban facilities, with lower proportions of patients at this hemoglobin level at all levels of rurality. However, rural facilities overall reported a higher proportion of patients with hemoglobin greater than 12 g/dL; 17.1% of patients versus 16.3% at urban facilities (Figure 5 below).



### *Urea Reduction*

Blood urea nitrogen is an indicator of metabolism byproducts. The relative volume of urea is measured before and after each dialysis session. For a typical patient receiving dialysis three times per week, the difference between the two measures (urea reduction) should be 65% or more of the initial urea value.

Nationally, 86.1% of dialysis facilities report urea reduction levels, with facilities in micropolitan rural areas (91.2%) and small adjacent rural counties (88.1%) being more likely to report than urban facilities (85.2%). Reporting was lowest for facilities in remote rural counties (82.4%).

Among reporting facilities, nearly all patients (96.2%) were reported to have a urea reduction greater than or equal to 65%, with very little geographic variation. While statistically significant, differences between rural and urban facilities were minor (Table 4).

### *Survival*

Information about dialysis patients is collected through CMS data systems and relative survival rates are calculated for CMS by the Kidney Epidemiology and Cost Center at the University of Michigan. Survival rates compare each facility's anticipated survival rate, based on the age, race, sex, body size, and comorbidities of its patients, to the expected survival rate of such patients. Survival rate outcomes fall in one of three categories: better than expected, expected, or worse than expected. Survival rate information was available for 90.2% of all, with information more likely to be available for facilities in micropolitan rural counties than facilities in urban counties (micropolitan, 93.3%; urban, 89.8%).

Overall, patient survival rates at 80.5% of facilities were categorized as better than expected, followed by worse than expected (10.4%) and as expected (9.0%). While facilities located in urban, micropolitan and small adjacent counties did not differ from one another, facilities located in remote rural counties were more likely to report "better than expected" survival (85.5%), and correspondingly less likely to report "worse than expected" survival (5.5%).

## Dialysis Facility Performance Measures

**Table 4: Dialysis Facility Performance Measures: Ability to Report and Outcomes, by Rurality, in percents, 2008**

Performance Measures	Rurality Levels					
	All (n=5380)	Urban (n=4197)	All Rural (n=1183)	Micro- politan Rural (n=742)	Small Adjacent Rural (n=276)	Remote Rural (n=165)
<b>Hemoglobin</b>						
Facilities reporting (% ,n)*	88.1	87.5	89.9*	91.8*	89.8	81.8*
Outcomes:						
% Medicare patients with hemoglobin < 10.0 g/dL (mean)	2.9	3.0	2.4*	2.5*	2.2*	2.6*
% Medicare patients with hemoglobin > 12.0 g/dL (mean)	16.5	16.3	17.1*	17.0	17.2	17.1
<b>Blood Urea Reduction</b>						
Facilities reporting (% , n)*	86.1	85.2	89.3*	91.2*	88.1*	82.4*
Outcome:						
% patients with URR >= 65% (mean)	96.2	96.1	96.5*	96.6*	96.5*	96.2
<b>Survival</b>						
Facilities reporting (% ,n)*	90.2	89.8	91.6	93.3*	89.1	87.9
Outcomes:						
Better	80.5	80.2	81.6	80.6	82.1	85.5*
Expected	9.0	8.9	9.6	10.3	8.1	9.0*
Worse	10.4	10.9	8.8	9.1	9.8	5.5*
Data: Medicare Dialysis Compare data for 2008.						
* Significantly different from urban, $p < 0.05$						

**IV. Selected Clinical Characteristics of Rural and Urban Dialysis Patients**

***Primary Diagnosis***

Overall, differences between rural and urban dialysis patients were slight. The three leading diagnoses leading to kidney failure, diabetes, hypertension and glomerulonephritis, occurred in the same order in each population. Diabetes was slightly more common in rural patients (rural 36.6%, urban 34.4%), with a corresponding decline in the other diagnoses. Details are provided in Table 5.

**Table 5: Primary Diagnosis among Patients receiving Dialysis, Rurality, in percents**

Primary Diagnoses	Rurality Levels					
	All	Urban	All Rural	Micro-politan Rural	Small Adjacent Rural	Remote Rural
Diabetes	34.8	34.4	36.6*	36.3*	36.8*	37.2*
Hypertension	24.3	24.7	22.5*	22.7*	22.9*	20.9*
Glomerulonephritis	17.2	17.4	16.3*	16.5*	16.1*	15.8*
Other	23.7	23.5	24.7*	24.5*	24.2*	26.1*

Data source: Standard Analysis File of the US Renal Data System; data for 2008.  
 \* Significantly different from urban,  $p < 0.05$

***Primary Treatment Modality***

Of all persons experiencing ESRD, 48.6% were receiving dialysis in 2008, while 7.2% had received a transplant, 1.1% had recovered, 29.3% had died, and 13.5% had been lost to follow-up. The treatment profiles of rural and urban patients were similar. Details are provided in Table 6 (next page). While reported use of peritoneal dialysis did not differ significantly across rurality, the availability of these services is lower in rural counties (see Table 3, page 9).

**Table 6: Treatment Modality for Patients utilizing Dialysis, by Level of Rurality (in percents)**

	All	Urban	All Rural	Micro-politan Rural	Small Adjacent Rural	Remote Rural
Receiving Dialysis	48.6	48.6	48.8	48.8	49.1	48.9
Center	38.9	39.3	37.4	37.9	37.2	35.7
Self	0.1	0.1	0.04	0.04	0.1	0.03
Home Hemodialysis	1.5	1.5	1.7	1.6	1.8	2.1
Continuous ambulatory peritoneal dialysis	5.2	4.9	6.3	6.0	6.6	7.4
Continuous cycling peritoneal dialysis	2.9	2.8	3.4	3.3	3.4	3.7
Not receiving dialysis						
Transplant	7.2	7.2	6.9	7.0	6.8	7.0
Recovered	1.1	1.1	1.2	1.2	1.2	1.2
Lost to Follow-up	13.5	13.6	13.3	13.3	13.2	13.3
Other	0.3	0.3	0.3	0.3	n/a	n/a
Death	29.3	29.3	29.5	29.5	29.5	29.2
Data: n/a indicates sample size too small for stable estimates						
* Significantly different from urban, $p < 0.05$						

### Summary of Key Findings

#### *Rural residents travel further for dialysis services*

Across the US, a median of 3.9 persons per 1,000 residents needed dialysis services in 2008, with no significant differences across levels of rurality. However, the availability of care within one's county of residence differed markedly between rural and urban settings. While most residents of micropolitan rural counties, like most residents of urban counties, were likely to have a facility within their county, more than half of residents in small adjacent or remote rural counties had to travel out-of-county for care. Only 23.5% of urban residents lacked an in-county facility; similarly, only 20.6% of residents in micropolitan counties lacked a facility. Nearly two-thirds (63.9%) of residents of small adjacent rural counties, and 77.3% of those in remote rural counties, required travel to an out-of-county facility.

Related to the absence of in-county dialysis facilities, rural ESRD patients were estimated to travel farther for care than urban residents, although their time spent in travel could not be measured. Research has linked increased travel time<sup>12</sup> and distance<sup>13</sup> to decreased quality of life and increased mortality among these patients. Rural residents lived a median of 33.3 driving miles from the closest facility, versus 13.7 miles for urban patients. Distances were longest for remote rural residents, who travel an estimated 39.8 road miles to care.

Travel distances varied with race of the patient (ethnicity data were not available). Urban African American ESRD patients had a shorter median estimated road distance to travel to care than did white patients (8.3 miles versus 15.1 miles among white patients). Rural African American patients also had a shorter median road distance to the nearest facility than white patients (31.8 versus 33.1 miles among white patients). Travel burden was greatest among rural patients of "other" race, who traveled an estimated 46.0 road miles to the nearest facility. In remote rural locations, persons of "other" race travel an estimated 54.0 road miles for care.

#### *Fewer services are offered in rural areas*

The proportion of facilities offering peritoneal dialysis, home hemodialysis training, and after hours (evening) services is lower in rural than in urban communities. This gap may affect both choice of dialysis modality and the ability to maintain a normal employment schedule among rural ESRD patients and their families.

### *The profile of rural and urban dialysis facilities differs*

While more than two thirds of all dialysis centers operate on a for-profit basis, the relative penetration of for-profit facilities is lower in rural counties. Similarly, while more than two thirds of all facilities are affiliated with a dialysis chain, there are more independent facilities in rural counties. Lack of chain and for-profit presence in rural communities has mixed implications. Previous research found lower quality outcomes among for-profit facilities, suggesting that the lower representation of for-profit facilities has advantages for rural patients. However, this research excluded patients who did not live within 30 miles of the treating facility, and thus may not be relevant for rural populations and facilities.<sup>14</sup> With fewer for-profit operators and fewer chain members, rural communities served by local non-profit institutions may be less subject to external market pressures. This may reduce the likelihood of closures initiated by factors outside the community, such as centralized corporate decisions. On the other hand, facilities that are not linked with other institutions, either through ownership or chain membership, may not have access to centralized resources for management, purchasing or quality improvement.

Rural dialysis facilities had fewer dialysis stations than facilities in urban counties and reported fewer patients per station. It was not possible to assess how well the distribution of facilities aligned with need for care, as we did not have information linking patients to facilities. However, subgroups of rural patients travel considerable distances for care, with potential adverse effects on health.

### *Dialysis quality outcomes are similar across rural and urban ESRD facilities*

Despite differences between rural and urban facilities, quality differences as measured by hemoglobin, blood urea, and survival were similar. While some outcomes were statistically different, the differences were generally small. For example, rural facilities performed slightly better than urban on preventing low hemoglobin levels (rural, 2.4% of patients below the recommended level of 10 g/dL; urban, 3.0% of patients). On the other hand, they performed slightly worse at avoiding excess hemoglobin: 17.1% of rural patients, versus 16.3% of urban patients, exceeded 12 g/dL. Given these small and opposite effects, it would be difficult to conclude that either urban or rural facilities exhibit better performance.

### *Policy Implications*

In 2011, CMS switched to a per-treatment, prospective payment system for funding dialysis services. While facilities could opt to phase in their participation in the new system over four years, most (87%) elected to switch immediately. The prospective payment rate is adjusted for patient characteristics, and for both local hospital wage index and low-volume providers. A low volume facility is one that delivers fewer than 4,000 dialysis treatments per year.<sup>15</sup> The principal policy issue relevant to rural providers is whether the low-volume adjustment, intended to ensure that rural facilities are not adversely affected by the new payment structure, is actually too broad. An analysis by the Medicare Payment Advisory Commission (MedPAC) found that 57% of low-volume facilities were located in urban counties, at a median distance of 2.1 miles from another facility.<sup>16</sup> The report suggested that distance to the nearest provider, as well as volume, be considered when allowing facilities to use the low-volume adjuster, but no specific recommendations were made.

The research reported here does not directly address the question of appropriate distance between low-volume providers, as it examined patient travel distance rather than distance between facilities. Rural residents as a whole are estimated to drive a median of 33.3 miles for services, given the 2008 distribution of dialysis facilities. The appropriate distance thresholds, and any ameliorating factors, remain open policy questions. As policy makers assess the issue, it will be important to ensure that the metrics chosen operate equitably across populations and do not add to the already substantial travel burden experienced by rural dialysis patients.

### *Directions for future investigation*

While both peritoneal dialysis and home hemodialysis were less available in rural counties, the proportion of patients reported to be using these modes did not differ across levels of rurality. Additional research is needed to understand this statistical anomaly. There may be a subset of rural counties in which these modes are highly used, raising the number of rural patients while not raising the number of counties in which services are offered. Alternatively, patients who wish these services may choose to travel further.



## Summary of Key Findings

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In addition, facility location and patient outcomes warrant further research. At present, for-profit facilities, as well as dialysis services in general, are less common in rural than in urban counties. The economic and demographic characteristics that are associated with for-profit service availability merit further investigation. It is possible that a certain level of infrastructure must be present before for-profit chains will consider locating in a rural community. On the other hand, if the Affordable Care Act succeeds in expanding access to care in rural communities, health services infrastructure may be retained, and even improved or expanded.

Finally, the varying availability of dialysis services across geography requires certain populations to travel farther for care. While a broad examination across all rural dialysis facilities reveals no marked differences in patient outcomes for rural versus urban patients, outcomes within the populations racially classified as “other” is warranted, based on their markedly high travel times. Future research should explore whether outcomes among subgroups, such as American Indian / Alaska Native populations, suggest the need for improved access to local dialysis care.

### Technical Notes

The analysis utilized two data sources, the 2009 Medicare Dialysis Compare files and the 2009 Standard Analysis File of the U.S. Renal Data System, each of which provides data for the preceding year (2008). The Medicare Dialysis Compare data contains information regarding the facilities providing dialysis services as well as performance measures reported by these facilities. The Standard Analytic File (SAF) of the U.S. Renal Data System (USRDS) contains basic descriptive information for all ESRD patients.

The Medicare Dialysis Compare data contains 43 distinct data fields; data are current as of 2008. The analysis used the following reporting items:

- Home hemodialysis training (y/n)
- Patients w/ hemoglobin information (number)
- % Medicare patients with hemoglobin < 10.0 g/dL
- % Medicare patients with hemoglobin > 12.0 g/dL
- Patients w/ urea reduction (URR) information (number)
- % patients with URR  $\geq$  65%
- Whether survival data are available for facility
- Survival category for facility (1= better than expected, 2 = expected, 3 = worse than expected)

*Capacity* within rural areas was measured by the total number of stations, patients served per station, and whether or not a late shift is offered. Paralleling O'Hare and associates,<sup>6</sup> we characterized facilities by the level of rurality of their location. We also used the facility data to sum the number of stations available in each county, enabling the identification of counties that have no dialysis capacity at all. *Facility characteristics* that might influence response to changing financial incentives include profit status and chain membership. *Service availability* was measured using the availability of peritoneal dialysis and home dialysis training, in addition to in-center hemodialysis. *Quality measures* utilized included the proportion of patients with poor or very poor hemoglobin status (hemoglobin <12 g/dL and <10 g/dL, respectively), the proportion of patients with appropriate urea reduction, and the survival category of the facility (not available for all facilities).

Estimates for each independent variable of interest were calculated across levels of rurality. Differences across levels of rurality were tested using analysis of variance and Tukey's post-hoc test to control for multiple comparisons. All analyses were conducted at the  $\alpha = 0.05$  level.

We used several items from the USRDS SAF to determine the association between patient need and dialysis availability. The data derived from the USRDS SAF included:

- County of residence,
- ZIP Code of residence,
- Age (estimated using age at first service [INC\_AGE] and year of first service [INCYEAR], adding the difference between first service year and 2007),
- Sex (SEX),
- Race (RACE),
- Primary disease causing ESRD (PDIS) and
- Treatment modality (RXGROUP).

No ethnicity variable was available in the USRDS SAF dataset. Race was defined using the following categories:

SAF Race Codes	Coding for current report
Black	Black
White	White
American Indian/Alaskan Native	Other
Asian	
Pacific Islander	
MidEast	
Indian SubCo	
Other/Multi-racial.	
Unknown	

Thus, persons of Hispanic ethnicity are integrated across race categories, a significant weakness of the dataset.

We used patient population information during the available year as an estimate of the typical patient population in each county. Patient information, aggregated at the county level, was merged with the Medicare Compare facility information to assess availability in relationship to need. First, we calculated the ratio of dialysis stations to dialysis patients within each county. We next calculated the proportion of patients requiring dialysis to the population of the county, given as a ratio of patients per 1,000 residents. Finally, we estimated the percentage of patients living in a county without a facility. We then estimated these values by levels of rurality. We then divided the counties into quartiles according to their patient to resident ratio. We then calculated the number of stations per county and the ratio of patients per station by these quartiles. Differences across levels of rurality or quartile were tested using analysis of variance and Tukey’s post-hoc test to control for multiple comparisons. All analyses were conducted at the  $\alpha = 0.05$  level.

For the driving distance estimates, we subset to those patients who lived in a ZIP Code without a facility. The driving distance was calculated using SAS and Google Maps.<sup>17</sup> The method first used FILENAME statements to request Google Maps to generate driving directions between two ZIP Codes. We then used a two-step data procedure to input the Google Maps output into a SAS data file. Macros were then created and utilized to aggregate the driving distances between ZIP Codes from this output. Median distances were estimated for all patients, then subset by rurality and race. Differences across levels of rurality and race were tested using analysis of variance and Tukey’s post-hoc test to control for multiple comparisons. All analyses were conducted at the  $\alpha = 0.05$  level.

*Rurality Definition*

The population of interest for this analysis is rural residents as defined by the 2003 Urban Influence Codes (UIC). Rural residence was classified at the county level using the 2003 UICs for the U.S. Department of Agriculture’s Economic Research Service.<sup>18</sup> These UICs divide the

## Technical Notes

3,141 counties county equivalents and the independent cities in the United States into 12 groups based on population and commuting data from the 2000 Census of the Population in the case of metropolitan counties and adjacency to metro area in the case of nonmetropolitan counties. Metro/non-metro definition is based on the official metro status announced by the Office of Management and Budget on June 1, 2003. UICs of 1 and 2 levels of rurality were classified as “Urban” while all other UICs were classified as rural. Analysis across levels of rurality used three groups: “micropolitan rural” (UICs 3 5 and 8) “small adjacent rural” (UICs 4 6 and 7) and “remote rural” (UICs 9 10 11 and 12)

Rural Grouping	UIC	Number of Counties	Definitions
Urban	1	413	In large metro area of 1+ million residents
	2	676	In small metro area of less than 1 million residents
Micropolitan Rural	3	92	Micropolitan area (urban cluster of 10000 population or more) adjacent to large metro area
	5	301	Micropolitan area adjacent to small metro area
	8	282	Micropolitan area not adjacent to a metro area
Small adjacent rural	4	123	Noncore adjacent to large metro area
	6	358	Noncore adjacent to small metro area and contains a town of at least 2500 residents
	7	185	Noncore adjacent to small metro area and no town of at least 2500 residents
Remote rural	9	201	Noncore adjacent to micro area and contains a town of at least 2500 residents
	10	198	Noncore adjacent to micro area and no town of at least 2500 residents
	11	138	Noncore not adjacent to metro or micro area and contains a town of at least 2500 resident
	12	174	Noncore not adjacent to metro or micro area and no a town of at least 2500 residents

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