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ESRD Facility Characteristics by Rurality and Risk of Closure

Key Findings

- Rural dialysis facilities treat a low volume of patients and run on lower profit margins and as a result are at greater risk for closure.
- Based on clinical quality measures such as hemoglobin levels, AV fistula use, and urea reduction ratios, rural dialysis facilities perform similarly to or better than their urban counterparts.
- Despite providing high-quality care, rural dialysis facilities are more likely to operate on negative profit margins, be designated as low volume, and not offer as many amenities, such as in-home dialysis or late shifts.

Background

End-stage renal disease (ESRD) indicates permanent and irreversible kidney failure. Incidence rates of ESRD have been shown to be higher in rural versus urban counties [1]. ESRD requires regular dialysis or kidney transplantation to maintain life [2]; the majority of patients eventually require long-term dialysis. In 2015, over 465,000 persons in the U.S. required dialysis for ESRD [3], with spending accounting for 7.1% of overall expenditures in the fee-for-service Medicare program [4]. Most patients receive dialysis in medical facilities (vs. home). Facility-based dialysis requires more travel time and has been associated with compliance problems [5]. In contrast, home hemodialysis has been shown to improve the patient's quality of life and blood pressure [6].

In 2011, the Centers for Medicare and Medicaid Services (CMS) implemented an expanded prospective payment system (PPS) for dialysis facilities [7]. Prior to this change, a narrow payment bundle was used, with a base rate of $130 per treatment, whereas drugs, laboratory services, and physician fees were paid in a fee-for-service (FFS) model [8]. Some suggest this FFS arrangement promotes the prescription of expensive, unnecessary medications [8]. Further adjustments were made in 2014, which effectively reduced payments by 9.5% between 2014 and 2018 [9].

Additional payment adjustments support low-volume and rural facilities[10]. To qualify for a low-volume payment adjustment, dialysis facilities must apply to a designated Medicare contractor, who is responsible for verifying eligibility (i.e., facilities must have provided fewer than 4,000 total dialysis treatments and must have not opened, closed, or changed ownership in the previous three years to be designated low-volume)[11]. Because rural ESRD facilities are smaller in size, are less likely to be chain-affiliated or for-profit [12], treat a lower volume of patients, and have lower profit margins (-5.1% vs. 1.3% in urban areas) [13], these payment adjustments are necessary to maintain current operations and avoid closure. Facility closure results in patients traveling greater distances and investing more time in seeking dialysis care [14, 15]. Increased travel distance and travel time are associated with delayed care, reduced access to care, lower treatment adherence and time spans, poorer outcomes, and higher all-cause hospitalization and mortality rates [16-20].

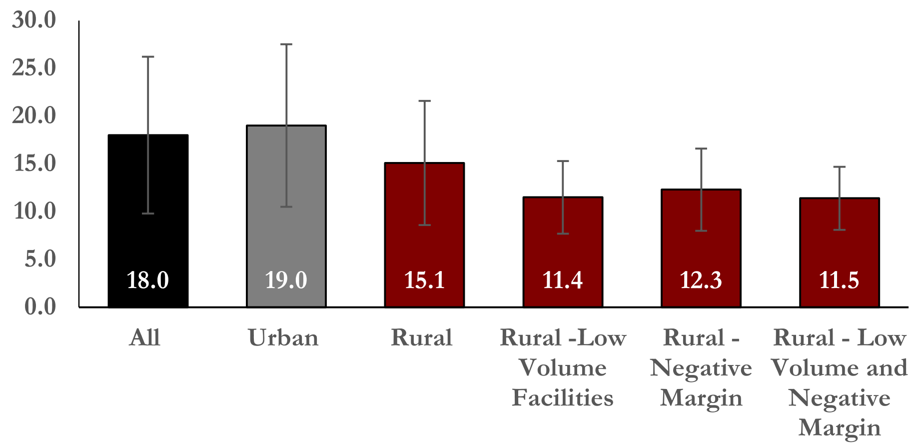
The purpose of this study was to profile rural ESRD facilities, focusing specifically on those at greatest risk for closure based on low-volume designation and/or negative Medicare profit margins. Specifically, we examined the characteristics of these facilities, the quality of care they provide, and the distance patients in rural areas would have to travel if these facilities were to close.

Facility characteristics

We identified 5,733 unique freestanding renal dialysis facilities for 2014 (See Table 1). The majority of facilities operated as for-profit or was affiliated with a chain (91.2%). Although all facilities offered in-center hemodialysis (100%), fewer offered peritoneal dialysis (59.0%) or home hemodialysis (28.5%). About 18% of all facilities offered late dialysis shifts (shifts starting after 5 pm). Facilities operated an average of 18 dialysis stations.

Geographically, 4,298 facilities (75.0%) were classified as urban, and 1,435 facilities (25.0%) were rural. Of the facilities located in rural ZIP Codes, 58.2% were in areas designated as micropolitan, 33.4% were in small towns, and 8.4% were in rural areas. Fewer rural facilities reported for-profit status or chain affiliation (89.8%) compared to their urban counterparts (91.7%). Similarly, fewer rural facilities offered alternatives to in-center hemodialysis, including peritoneal dialysis (rural, 55.3%; urban, 60.2%) and home hemodialysis (rural, 23.3%; urban, 30.2%). Rural facilities were also less likely to offer late shifts (rural, 6.8%; urban, 21.2%) and reported fewer dialysis stations (mean (SD): rural, 15.1 (±6.5); urban, 19.0 (±8.5); See Figure 1).

Figure 1: Mean Stations per Facility, by Rurality and At-Risk Status (mean, SD)



Low-Volume and Fiscally Vulnerable Facilities

About 9.1% of facilities operated under low patient volumes nationwide. Rural areas had significantly more facilities reporting low patient volumes (14.2%) than urban areas (7.4%; See Table 1). A higher proportion of facilities that were both low-volume and negative-margin (considering Medicare payments and expenses only) were non-profit (14.1%) compared to facilities in other risk categories (low volume, 10.3%; negative profit margin, 9.6%). Conversely, a lower proportion of facilities that were both low-volume and negative-margin were chain-affiliated (85.9% vs. 89.7% for low volume; 90.4% for negative margin). Low-volume facilities were less likely to offer late shifts or in-home hemodialysis.

Table 1: Characteristics of Dialysis Treatment Facilities, by Rurality and Risk Status

Facility Characteristics	All	Urban	Rural	Rural, Low Volume	Rural, Negative Margin	Rural, Low Volume + Negative Margin
	n=5,733 (100%)	n=4,298 (75.0%)	n=1,435 (25.0%)	n=204 (14.2%)	n=353 (24.6%)	n=64 (4.5%)
Low-volume designation, %	9.1	7.4	14.2 *	100	18.1	100
Negative profit margin, %	20.8	19.5	24.6*	31.4	100	100
Chain affiliation, %	91.2	91.7	89.8	89.7	90.4	85.9
Treatment options						
In-center hemodialysis, %	100	100	100	46.1	63.2	67.2
In-center peritoneal dialysis, %	59.0	60.2	55.3 *	46..1†	63.2‡	67.2
In-home dialysis, %	28.5	30.2	23.3 *	14.2†	27.5	32.8
Offers late shift, %	17.6	21.2	6.8 *	2.9	7.7	7.8
Medicare profit margin[a], mean (SD)	10.4 (21.8)	11.1 (21.9)	8.2 (21.0)	5.9 (23.0)	-20.0 ‡ (22.5)	-20.7 § (21.1)

Data source: Facility data from Medicare Dialysis Facility Compare and Cost Files, 2014
*Significantly different from urban at α = 0.01
a Facilities after removing those with outliers (≥99% or ≤1% of the distribution) for profit margin, n=5619.
†Significantly different from rural not low-volume facilities at α = 0.01
‡ Significantly different from rural not negative margin facilities at α = 0.01
§Significantly different from rural not low-volume and/or not negative margin facilities at α = 0.01

After removing outliers (i.e., those ≥99% or ≤1% of the distribution), facilities had an average Medicare profit margin of 10.4% (±21.8%). Nearly 21% of facilities operated under negative profit margins (urban, 19.5%; rural, 24.6%). Among rural facilities, the average profit margin was 8.2% (±21.0%). Rural low-volume facilities had an average profit margin of 5.9% (±23.0%), and among rural facilities with a negative margin, the average profit margin was -20.0% (±22.5%). For those rural facilities that are both low-volume and negative-margin, the average profit margin was -20.71% (±21.1%). Facilities in all types of rural areas were more likely to report negative profit margins (micro: 23%, small town: 25%, rural: 31%) than low-volume designation (micro: 11%, small town: 19%, rural: 17%).

Facility-Reported Clinical Measures, by Rurality and At-Risk Status

ESRD facilities use several measures to assess a patient's progress and health. A summary of these measures, as well as expected values and indicators of poor outcomes, is shown in the Appendix. Comparative results are reported here.

Hemoglobin (Hgb) levels

Overall, the average proportion of patients with Hgb <10 g/dl (i.e., indicative of anemia) was 12.8%; this was significantly higher in urban facilities than rural facilities (urban, 13.1%; rural, 11.8%; See Table 2). Less than 0.5% of patients averaged Hgb greater than 12 g/dl (i.e., risk of adverse cardiac event), with rural facilities performing slightly better than their urban counterparts (rural, 0.2%; urban, 0.3%).

Further analysis compared the proportion of patients with Hgb <10 g/dl and Hgb >12 g/dl in each rural facility risk category (See Table 2). The average proportions of Hgb <10 g/dl were 15.2%, 12.8%, and 18.0% among rural low volume, rural negative margin, and rural low volume and negative margin facilities, respectively. This suggests that patients in rural facilities with low volume and those with both low volume negative margin may experience poorer outcomes. The average proportion of patients with Hgb greater than 12 g/dl did not differ across types of rural facilities.

Urea Reduction Ratio (URR) ≥65%

The average proportion of patients that achieved the URR target of ≥65% was very high (98.8%), with rural facilities having a slightly higher average (99.0%) than urban facilities (98.8%). The average proportion of patients that achieved target levels for clearance of urea (Kt/V), a related URR measure, was 88.8%, with rural facilities having a slightly higher average (89.5%). Within rural facilities, attainment of URR and Kt/V targets did not differ substantially based on low-volume and/or negative-margin status.

Vascular Access

The average proportion of patients that underwent dialyses using a fistula created to link an artery and a vein was 63.2%; this was slightly higher among rural facilities than urban facilities (64.0% vs. 63.0%, respectively). The average proportion of patients with an inserted catheter was lower among rural compared to urban facilities (rural, 10.0%; urban, 10.6%). Slight variations in fistula and catheter use across rural facilities were not significant.

Table 2: Patient Quality Indicators of Dialysis Treatment Facilities, by Rurality and Risk Status

	All	Urban	Rural	Rural, Low Volume	Rural, Negative Margin	Rural, Low Volume + Negative Margin
Patient Quality Indicators, %						
<10 mg Hgb level	12.8	13.1	11.8*	15.2†	12.8	18.0‡
>12 mg Hgb level	0.3	0.3	0.2*	0.2	0.3	0.2
URR ≥65%	98.8	98.8	99.0*	99.2	99.1	99.6
Kt/V ≥1.2	88.8	88.5	89.5*	88.3	89.1	89.1
AV fistula in place	63.2	63.0	64.0*	63.7	65.1	64.0
Catheter in use for ≥90 days	10.5	10.6	10.0*	10.8	10.1	10.2

Data Source: Facility data from Medicare Dialysis Facility Compare and Cost Files, 2014
* Significantly different from urban at $\alpha = 0.01$
†Significantly different from rural not low-volume facilities at $\alpha = 0.01$
‡ Significantly different from rural not negative-margin facilities at $\alpha = 0.01$

Survival, hospitalization, and transfusion ratios

Overall, facilities reported an average 'expected' survival for patients of 77.8%, 'better than expected' survival for patients of 6.7%, and 'less than expected' survival for patients of 8.2% (See Table 3). The average 'expected' survival rate was higher for rural facilities (81.5%) than urban facilities (76.6%) but was lower for 'better than expected' (urban, 7.1%: rural, 5.5%) and 'less than expected' (urban, 8.4 %; rural, 7.7%) survival.

Rural facilities with negative margins were least likely to report 'less than expected' survival (2.8%), compared with 7.8% for rural low-volume facilities and 6.3% for rural facilities at risk of closure (See Table 3). Interestingly, 'better than expected' patient survival was reported most among rural facilities at risk of closure (7.8%). The high percentage of rural facilities with 'not available' data for survival, transfusion, and/or hospitalization rates should be noted, and thus interpretation of the results should be performed with caution.

Table 3: Facility Quality Indicators of Dialysis Treatment Facilities, by Rurality and At-Risk Status

	All facilities	Urban facilities	Rural facilities	Rural, Low Volume	Rural, Negative Margin	Rural, Low Volume + Negative Margin
Standardized mortality ratio, mean (SD)	1.03 (0.3)	1.03 (0.3)	1.04 (0.3) *	1.08 (0.3)	1.03 (0.3)	1.02 (0.4)
Patient survival						
Less than expected, %	8.2	8.4	7.7*	7.8†	2.8‡	6.3
As expected, %	77.8	76.6	81.5	87.8	75.9	85.9
Better than expected, %	6.7	7.1	5.5	3.4	3.4	7.8
Not available, %	7.3	7.9	5.3	1.0	17.9	0
Standardized transfusion ratio, mean (SD)	1.01 (0.5)	1.00 (0.5)	1.04 (0.6)	1.08 (0.7)	1.04 (0.6)	1.04 (0.7)
Patient Transfusion						
Less than expected, %	5.7	5.5	6.2	3.4†	4.0‡	1.6§
As expected/better than expected, %	82.6	83.1	81.6	69.1	63.5	54.7
Not available, %	11.7	11.5	12.3	27.5	32.6	43.8
Standardized hospitalization ratio, mean (SD)	1.00 (0.3)	1.04 (0.3)	0.89 (0.3) *	0.91(0.4)	0.92 (0.3)	0.94 (0.4)
Patient hospitalization						
Less than expected, %	4.7	5.4	2.5*	3.4	3.1‡	3.1
As expected/better than expected, %	89.3	88.1	93.1	95.1	81.6	93.8
Not available, %	6.0	6.6	4.4	1.5	15.3	3.1

Data Source: Facility data from Medicare Dialysis Facility Compare and Cost Files, 2014
*Significantly different from urban at α = 0.01
†Significantly different from rural not low-volume facilities at α = 0.01
‡ Significantly different from rural not negative-margin facilities at α = 0.01
§Significantly different from not low-volume and/or not negative-margin facilities at α = 0.01

Travel Impact on Rural Patients Seeking ESRD Services

To assess the potential impact of rural facility closure, we calculated the driving distance in miles between each patient's current ESRD facility and 1) the next-closest ESRD facility, 2) the next-closest 'not low-volume' ESRD facility, and 3) the next-closest 'not at-risk' ESRD facility. The results are stratified by the urban vs. rural status of the current ESRD facility.

Rural patients would face markedly increased travel burden in cases of ESRD facility closure: an additional average travel distance of 22.4 (± 31.0) miles to the next-closest facility in rural areas compared to 3.9 (± 6.4) miles in urban areas (See Table 4). If all low-volume facilities ceased to offer services, rural patients would have to travel 25.3 (±32.6) miles to their next-closest facility compared to 4.2 (±6.8) miles for their urban counterparts.

We further analyzed the distances patients would have to travel if they sought care from an alternate venue not at risk of closure. Rural patients would travel farther to reach a facility not at risk: 35.4 (± 99.3) miles vs. 9.4 (±7.3) miles for urban patients. Our study also included the travel impacts of facility closure for patients who are currently seeking care from at-risk facilities. Persons seeking care from these highly vulnerable facilities would have to travel twice as far to reach their next-closest provider if their current facility closed (42.0 miles ± 113.4) than their rural neighbors who seek care from a facility not at risk (20.6 miles ±17.5). Assuming ***all*** at-risk facilities ceased to offer services, persons currently seeking care from an at-risk rural facility would have to travel >120 miles to get to the next-closest facility that is not at risk.

Table 4: Driving Distance between ESRD Patients' Current Dialysis Facility and the Next-Closest Facility, by Risk of Closure

	n	Distance to next-closest facility, average miles (SD)	Distance to next-closest not low-volume facility, average miles (SD)	Distance to next-closest facility, not at risk for closure, average miles (SD)
Urban facilities				
All	4,002	3.9 (6.4)	4.2 (6.8)	9.4 (7.3)
Not at risk	3,151	3.8 (6.6)	3.9 (6.7)	4.6 (8.8)
Low volume	259	5.3 (7.5)	7.1 (8.0)	7.9 (9.4)
At risk for closure*	97	4.3 (5.6)	7.9 (10.4)	11.5 (15.9)
Rural facilities				
All	1,330	22.4 (31.0)	25.3 (32.6)	35.4 (99.3)
Not at risk	898	20.6 (17.5)	21.9 (18.4)	24.9 (19.3)
Low volume	127	24.7 (18.8)	36.4 (22.3)	39.3 (23.2)
At risk for closure	54	42.0 (113.4)	59.5 (114.3)	120.4 (358.2)

Data Source: Facility data from Medicare Dialysis Facility Compare and United States Renal Data System (USRDS) Files, 2014
* At risk for closure indicates that a facility is designated as low volume and had a negative Medicare profit margin, 2014
SD = standard deviation

Discussion and Conclusions

We found a higher prevalence of facilities designated as low-volume and facilities with negative profit margins in rural areas. Research suggests that facilities with average profit margins of 3-4% will find it difficult to remain open in a bundled payment environment [6, [21]. Rural facilities, especially those with low-volume designation and/or negative profit margins, are likely to become more vulnerable. CMS predicts an overall reduction of 0.5% in rural dialysis provider payment in 2018 [21]. Facilities that are designated low-volume and already have negative profit margins will be adversely affected by these changes; such facilities are disproportionately located in rural communities (i.e., dose-response relationship with profit margin and level of rurality).

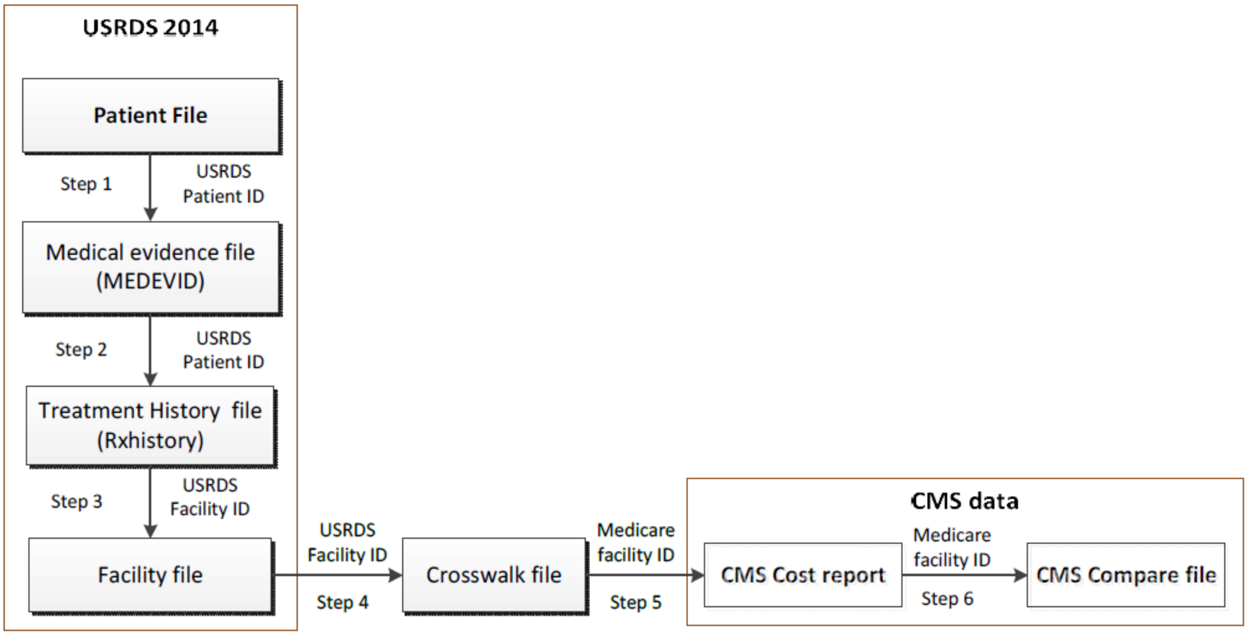
Our study also found that rural ESRD facilities (particularly those at risk for closure) offered fewer services (i.e., fewer dialysis stations, fewer late shifts). Despite functioning at a lower scale, these facilities performed similarly to or, in some cases, better than their urban counterparts in terms of quality. A significantly higher proportion of patients in rural facilities achieved clinical targets, including Hgb management, AV fistula, Kt/V ≥1.5, and URR ≥65%.

Given the high frequency of treatment for ESRD patients, high compliance rates and home dialysis options can save time and money [22, 23]. Home dialysis also increases the chances of the patient remaining employed, independent, and able to socialize with family and friends [24, 25]. Further, frailty associated with ESRD makes the home dialysis option more imperative [26]. However, we found low uptake of home hemodialysis among the population studied. Further, the rates were lower among rural facilities and even more so in rural low-volume facilities. These findings are consistent with past research demonstrating inverse associations between home hemodialysis and a higher patient-dialysis station ratio, rurality, and a higher proportion of blacks in the ZIP Code [27]. The large upfront cost of training patients to perform home dialysis is not trivial [22]. Because Medicare does not pay for the costs of the necessary dialysis equipment and home health aides to assist with home dialysis, lower rates of self-dialysis are expected [28].

The literature indicates travel distance as a major barrier to accessing health care among rural patients [15]. Generally, rural patients are less likely to seek health care when they need it [29]. Rural patients are also more likely to face dialysis access barriers because of longer travel distances and transport issues[15]. Our study found that rural patients will be adversely affected by potential closures of at-risk rural facilities, although travel distances will vary by the type of facility a patient chooses as an alternative venue for care. Should their at-risk facility close, rural patients would have to travel an average of >100 miles to seek care from a facility that is not at risk. It is imperative that CMS recognize and address the potential impacts of bundled payments on facilities in rural areas running on low volumes and/or negative Medicare profit margins. The possible closure and consolidation of such facilities will increase the travel distances faced by rural patients and will likely lead to lower compliance rates and, ultimately, higher mortality.

Technical Appendix

We used the 2014 United States Renal Disease Data Files (Standard Analytic Files), 2014 Medicare Dialysis Facility Compare File, and Centers for Medicare and Medicaid Services (CMS) 2014 Renal Facility Cost Reports, respectively, for individual and facility-level information. A flow chart describing the data merging process is shown below.



Definitions

Facility ZIP codes were used to classify facilities as located in areas considered metropolitan, micropolitan, small adjacent rural or remote rural. Rural-Urban Commuting Areas (RUCA) codes, which categorize ZIP Code Tabulation Areas (ZCTAs) based on their population density and workplace commuting patterns, were used to define rurality. ZCTAs were categorized as metropolitan (codes 1-3), micropolitan (codes 4-6), small adjacent rural (codes 7-9) and remote rural (code 10). Some analyses are categorized as urban (1-2) versus rural (3-12).

Clinical measures

Measure	In range	Poor Outcome Indicator(s) & Rationale	Citations
Hemoglobin (Hgb)	10-12 g/dl	< 10 g/dl – low hemoglobin levels indicate anemia >12 g/dl – high hemoglobin levels increase the risk of a cardiac event	[30, 31]
Urea Reduction Ratio (URR)	>65%	≤65% – measures reduction of urea in blood	[32]
Kt/V of > 1.2	> 1.2	≤1.2 – measures rate of reduction of urea in blood	[32]
Arteriovenous fistula (AVF) versus catheter	AVF is a preferred vascular access treatment	Catheter use is more likely to cause blood stream or localized infection, compared with AVF	[33]

Analytic approach

Statistical analyses were performed in SAS Version 9.3, and distances were calculated using the ESRI Network Analyst Extension in ArcGIS Version 10.2. We calculated proportions for categorical and means (± SD) for continuous variables. The bivariate associations between the facility rurality (urban vs. rural) and risk groups – 'low volume vs. not low volume', 'negative profit margin vs. not negative profit margin' and 'low volume and negative profit margin vs. others rural (not low volume and/or not negative margin facilities), were run using chi-square test for categorical and t-test for continuous variables at $\alpha = 0.01$ (See Tables 1-3). To reduce the likelihood of including facilities with cost report data entry errors, we removed facilities with profit margins in the tails of the distribution (i.e., 99% and 1% cutpoints) from all central tendency analyses related to profit margins in Table 1. These facilities remained in subsequent analyses and tables, as such extreme values are unlikely to change the categorization of a facility from negative to positive profit margin (or vice versa). Similar approaches to removing possible outliers from central tendency statistics for Medicare profit margin have been employed by the US Governmental Accountability Office.[34]

Distance calculations

ArcGIS 10.3 was used to calculate road network distances between the origin-destination points. Network distances were based on the distance between the facility address and patient ZIP code centroid.

Profit margin calculations

The cost data were extracted from the Independent Renal Dialysis Facility Cost Report. The reports are updated quarterly, using the CMS form 265-2011. The Medicare cost reports include data on facility volume and cost and payment data. The worksheet D in the form contains the data on Medicare costs, payments and number of treatments. In the worksheet, the line 11 of column 5 sums up the total cost incurred for a facility. Similarly, the line 11 of column 8 compiles the total payments. We used the cost and payment data to calculate Medicare profit margins using the formula used in the United States Government Accountability Office report on cost of independent renal facilities [34]. Outliers in the upper and lower distribution of the profit margin (i.e., 1% and 99% cutpoints) were removed to eliminate possible bias due to data entry errors, as previously stated.

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