Initial Home Dialysis Is Increased for Rural Patients by Accessing Urban Facilities

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Key Points
• Despite having access to fewer facilities that offer home dialysis, rural patients with ESKD are more likely to be on home dialysis.
• There remains a significant mortality gap between urban and rural patients with ESKD, even when accessing home dialysis.

Abstract
Background The 240,000 rural patients with end stage kidney disease in the United States have less access to nephrology care and higher mortality than those in urban settings. The Advancing American Kidney Health initiative aims to increase the use of home renal replacement therapy. Little is known about how rural patients access home dialysis and the availability and quality of rural dialysis facilities.

Methods Incident dialysis patients in 2017 and their facilities were identified in the United States Renal Data System. Facility quality and service availability were analyzed with descriptive statistics. We assessed the availability of home dialysis methods, depending on rural versus urban counties, and then we used multivariate logistic regression to identify the likelihood of rural patients with home dialysis as their initial modality and the likelihood of rural patients changing to home dialysis within 90 days. Finally, we assessed mortality after dialysis initiation on the basis of patient home location.

Results Of the 97,930 dialysis initiates, 15,310 (16%) were rural. Rural dialysis facilities were less likely to offer home dialysis (51% versus 54%, P<0.001). Although a greater proportion of rural patients (9% versus 8%, P<0.001) were on home dialysis, this was achieved by traveling to urban facilities to obtain home dialysis (OR=2.74, P<0.001). After adjusting for patient and facility factors, rural patients had a higher risk of mortality (HR=1.06, P=0.004).

Conclusions Despite having fewer facilities that offer home dialysis, rural patients were more often on home dialysis methods because they traveled to urban facilities, representing an access gap. Even if rural patients accessed home dialysis at urban facilities, rural patients still suffered worse mortality. Future dialysis policy should address this access gap to improve care and overall mortality for rural patients.

Introduction
The 2019 federal Advancing American Kidney Health (AAKH) initiative set the goal of 80% of incident ESKD patients receiving home RRT or undergoing kidney transplantation by 2025 (1). Although delayed in implementation, this remains an important lens for ESKD policy evaluation. Attaining these goals is ambitious and faces a significant obstacle: of the 131,636 incident ESKD patients in 2018, only 14,334 (11%) started on peritoneal dialysis, 443 (0.3%) started on home hemodialysis, and 3854 (3%) underwent kidney transplantation (2). Achieving these goals therefore requires improving the quality of care of the ESKD population (3) by addressing pervasive health care disparities and inequities that limit access to these treatment modalities (4–6).

The role of these disparities in a rural ESKD population is understudied (7). In general, rural patients have less access to primary care (8) and specialist (9) physicians, and they have a higher population mortality due to lower overall socioeconomic status, health care provider shortages, and lower rates of health insurance (10). Compared with their urban counterparts, the 240,000 rural patients with ESKD in the

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United States have less access to predialysis nephrology care, suffer higher mortality on dialysis, and are less likely to receive or be evaluated for kidney transplantation (11). Although rural patients with ESKD are more often on home RRT, the supply of peritoneal dialysis providers in rural areas has only modestly increased over the past decade (12), thereby impairing the expansion of access to home RRT (13–15).

Due to these disparities, patients with ESKD may benefit less from AAKH initiatives and from dialysis policy changes more generally. The role and quality of rural dialysis facilities, and which facilities patients have access to, is not well understood. To understand better the available dialysis facilities, their characteristics, and the likelihood of starting on home RRT, we undertook this study to assess the relationship of patient rurality, dialysis facility location, home dialysis use, and patient mortality for the initiating dialysis cohort in 2017.

**Materials and Methods**

**Data Sources**

The data reported here have been supplied by the United States Renal Data System (USRDS). The interpretation and reporting of these data are the responsibility of the authors and in no way should be seen as an official policy or interpretation of the US government. Dialysis facility characteristics were obtained from Medicare Dialysis Facility Compare (16). The data that support the findings of this study are available from the corresponding author upon reasonable request, and the manuscript complies with STROBE guidelines for cohort studies.

**Study Cohort**

The study cohort consisted of all adult (≥18 years of age) patients beginning chronic dialysis for the first time in the United States in 2017 with follow-up through the end of 2018. We then matched Dialysis Facility Compare data from 2017 to the USRDS cohort to enhance the description of the cohort, dialysis facility characteristics, and quality measures.

**Variable Definitions**

Rurality was defined for both patients and dialysis centers on the basis of the county in which they were located. Using the Urban Influence Code (https://www.ers.usda.gov/data-products/urban-influence-codes/documentation.aspx), counties were categorized as urban (categories 1 and 2) or rural (categories 3–12). This also matches the federal Office of Management and Budget definition of counties being either metropolitan or nonmetropolitan/rural. Dialysis facility size was divided into small (≤10 stations), medium (11–30 stations), and large (≥31 stations). We also grouped dialysis facilities by the type of ownership: large chains (Fresenius and DaVita facilities), small chains (all others in a chain), and independent facilities.

**Outcomes and Statistical Analyses**

Categorical variables are described using frequencies and percentages. Continuous measures are described using median and interquartile range (IQR). Pearson chi-squared test and Kruskal–Wallis test were performed to determine the unadjusted associations as appropriate. An α level of 0.05 was used as the criterion for statistical significance. No adjustments were made for multiple comparisons.

The three primary outcomes, with rurality as main covariate of interest, were (1) the likelihood of home dialysis as the initial dialysis modality, (2) the likelihood of switching dialysis modality in the first 90 days, and (3) all-cause mortality after dialysis initiation. Covariates in the models were chosen for their clinical and policy significance. Results are presented as fully adjusted models with patient- and facility-level covariates. Logistic regression was used for initial dialysis modality, switching within 90 days, and for being on home dialysis at facilities that offer home dialysis. The survival analysis was conducted for patient mortality after dialysis initiation using Cox proportional hazard models. Patients who were alive until the last day of follow-up or the end of 2018 were censored.

All statistical analyses and data linkages were performed using SAS v9.4 (SAS Institute, Cary, NC). Map was made with QGIS v3.12 (QGIS Development Team, Open Source Geospatial Foundation Project; http://qgis.osgeo.org).

**Results**

**Patient and Dialysis Facility Characteristics Vary by Urban and Rural Location**

A total of 97,930 patients initiated dialysis in 2017, among whom 15,310 (16%) were from rural counties and 82,620 (84%) were from urban counties. The rural and urban populations had several clinically relevant differences (Table 1). Rural patients were more often White (70% versus 50%, P<0.001) and obese (47% versus 41%, P<0.001). Although only 949 (1%) of urban patients used a rural dialysis facility, 3293 (22%) of rural patients used an urban dialysis facility (P<0.001). Finally, a greater proportion of rural patients had home dialysis as their initial modality (9% versus 8%, P<0.001).

Dialysis facilities also varied considerably between urban and rural locations (Table 2). Of the 5884 facilities, 1050 (18%) were in rural counties. Rural facilities were more likely to be small or medium-sized (97% versus 93%) facilities (P<0.001). They were less likely to offer peritoneal dialysis (51% versus 54%, P=0.04; map in Figure 1), and among those facilities that offered it, there was a lower median percentage of rural patients on home dialysis compared with their urban counterparts (12.8% versus 13.4%, P=0.03). Although rural dialysis facilities were less likely to be for-profit (86% versus 91%, P<0.001), there was no association with rurality and chain ownership (P=0.97).

Dialysis facility quality metrics were associated with geographic setting (Table 2). Rural facilities were more likely to have a high Dialysis Facility Compare star rating (41% versus 24% with 5 stars, P<0.001). Rural facilities also had a lower median hospitalization rate (155.1 versus 184.5 per 100 patient-years, P<0.001), a lower median readmission rate (25% versus 27% of hospital discharges, P<0.001), and a higher median fistula rate (65% versus 64%, P<0.001). Although rural facilities had fewer median nurses per facility (3 versus 4, P<0.001), they had a higher median nurse/patient ratio (0.08 versus 0.06, P<0.001). Similarly, they had fewer social workers (median 1 versus 1; there were two or
more social workers at 5% of rural versus 17% of urban facilities, \( P<0.001 \), and a higher median social worker/patient ratio (0.024 versus 0.021, \( P<0.001 \)).

### Rural Patients Are More Likely to Have Home Dialysis as Initial Dialysis Modality

In the fully adjusted model with patient covariates only, rural patients were 16% more likely to initially begin home dialysis than urban patients were (odds ratio [OR] = 1.16; 95% confidence interval [CI], 1.09 to 1.23; \( P<0.001 \); Table 3). Men (OR = 0.95, 95% CI, 0.91 to 0.997; \( P=0.04 \)) and older patients (OR = 0.90; 95% CI, 0.88 to 0.92; per 10 years, \( P<0.001 \)) were less likely to begin on home dialysis. Black patients (OR = 0.65; 95% CI, 0.61 to 0.69; \( P<0.001 \)), Hispanic patients (OR = 0.69; 95% CI, 0.64 to 0.75; \( P<0.001 \)), and those of other race and ethnicity (OR = 0.87; 95% CI, 0.79 to 0.95; \( P=0.003 \)) were less likely to be on home dialysis compared with White patients.

Because patients often start on hemodialysis urgently, we then investigated the association between patient factors and the likelihood of switching dialysis modality within 90 days. A total of 4019 (5%) switched to home dialysis modalities within 90 days of dialysis initiation. From facilities that offered home dialysis, rural patient geography was associated with switching dialysis modality

| Table 1. Characteristics of patients beginning dialysis in 2017 |
|---------------------------------|-----------------|-----------------|-----------------|
| Covariate                        | Total (\( N=97,930 \); 100%) | Urban (\( N=82,620 \); 84%) | Rural (\( N=15,310 \); 16%) | \( P \) Value |
|---------------------------------|-----------------|-----------------|-----------------|
| Men, n (%)                      | 56,457 (58)     | 47,747 (58)     | 8710 (57)       | 0.04* |
| Age, yr, median (IQR)           | 66 (55–75)      | 66 (55–75)      | 66 (56–74)      | 0.81b |
| Race, n (%)                     |                 |                 |                 | <0.001a |
| White                            | 52,007 (53)     | 41,291 (50)     | 10,716 (70)     |       |
| Black                            | 25,662 (26)     | 22,793 (28)     | 2869 (19)       |       |
| Hispanic                         | 13,863 (14)     | 12,918 (16)     | 945 (6)         |       |
| Other                            | 6395 (7)        | 5615 (7)        | 780 (5)         |       |
| Missing                          | 3 (0)           | 3 (0)           |                 |       |
| Primary disease, n (%)           |                 |                 |                 | <0.001a |
| Cystic kidney                    | 1617 (2)        | 1313 (2)        | 304 (2)         |       |
| Diabetes                         | 48,916 (50)     | 40,996 (50)     | 7920 (52)       |       |
| Glomerulonephritis               | 6168 (6)        | 5184 (6)        | 984 (6)         |       |
| Hypertension                     | 29,742 (30)     | 25,566 (31)     | 4176 (27)       |       |
| Urologic                         | 1344 (1)        | 1094 (1)        | 250 (2)         |       |
| Other                            | 10,143 (10)     | 8467 (10)       | 1676 (11)       |       |
| BMI, kg/m², n (%)                |                 |                 |                 | <0.001a |
| Underweight (<18.5)              | 2853 (3)        | 2478 (3)        | 375 (2)         |       |
| Normal weight (18.5–25)          | 26,372 (27)     | 22,789 (28)     | 3583 (23)       |       |
| Overweight (25–30)               | 27,101 (28)     | 22,955 (28)     | 4146 (27)       |       |
| Obese (≥ 30)                     | 41,252 (42)     | 34,110 (41)     | 7142 (47)       |       |
| Missing                          | 352 (0.4)       | 288 (0.3)       | 64 (0.4)        |       |
| Employment status, n (%)         |                 |                 |                 | <0.001a |
| Employed                         | 10,323 (11)     | 9100 (11)       | 1223 (8)        |       |
| Retired                          | 59,532 (61)     | 49,596 (60)     | 9956 (65)       |       |
| Unemployed                        | 28,075 (29)     | 23,924 (29)     | 4151 (27)       |       |
| Facility type, n (%)             |                 |                 |                 | <0.001a |
| Rural                            | 12,941 (13)     | 924 (1)         | 12,017 (79)     |       |
| Urban                            | 84,989 (87)     | 81,696 (99)     | 3293 (22)       |       |
| Comorbidities, n (%)             |                 |                 |                 |       |
| Amputation                        | 3593 (4)        | 2935 (4)        | 658 (4)         | <0.001a |
| Atherosclerotic heart disease    | 13,135 (13)     | 10,688 (13)     | 2447 (16)       | <0.001a |
| Cancer                           | 7055 (7)        | 5895 (7)        | 1160 (8)        | 0.05* |
| Congestive heart failure         | 29,487 (30)     | 24,512 (30)     | 4975 (33)       | <0.001a |
| Chronic obstructive pulmonary disease | 9840 (10) | 7707 (9)    | 2133 (14)       | <0.001a |
| Diabetes with insulin            | 43,206 (44)     | 35,984 (44)     | 7222 (47)       | <0.001a |
| Diabetes without insulin         | 7093 (7)        | 5933 (7)        | 1160 (8)        | 0.08a |
| Hypertension                     | 86,476 (88)     | 72,999 (88)     | 13,477 (88)     | 0.23a |
| Peripheral vascular disease      | 9427 (10)       | 7600 (9)        | 1827 (12)       | <0.001a |
| Informed of transplantation, n (%) | 85,833 (88) | 72,866 (87.8) | 13,267 (87)     | <0.001a |
| Initial dialysis modality, n (%) |                 |                 |                 |       |
| In-center                        | 89,764 (92)     | 75,864 (92)     | 13,900 (91)     |       |
| Home hemodialysis                 | 348 (0.4)       | 311 (0.4)       | 37 (0.2)        |       |
| Peritoneal dialysis               | 7814 (8)        | 6442 (8)        | 1372 (9)        |       |

Percentages may not total 100 due to rounding. IQR, interquartile range; BMI, body mass index.
*Chi-squared test.
*Wilcoxon two-sample test.
within 90 days (OR=1.16; 95% CI, 1.05 to 1.29; P=0.005; Table 3). As with the initial dialysis modality, Black patients (OR=0.64; 95% CI, 0.58 to 0.72; P<0.001), Hispanic patients (OR=0.61; 95% CI, 0.53 to 0.70; P<0.001), and those of other race and ethnicity (OR=0.80; 95% CI, 0.72 to 0.89; P=0.001) were less likely to switch dialysis modalities.

We then performed two sensitivity analyses. First, we examined the relationships with the likelihood of switching modality after 90 days (Table 3). These were generally the same direction and magnitude as those who started on home dialysis; that is, typically younger patients of higher socioeconomic status with fewer comorbidities. Second, we also examined the stable dialysis modality at 90 days so that successful early home dialysis starts would be included (Supplemental Table 1). These results, despite coming from a slightly different patient population, were largely consistent with those who started on home dialysis, underscoring the importance of starting at home.

Next, we investigated the relationship between patient and facility location; that is, how were rural patients more likely to be on dialysis if rural facilities were less likely to offer it? To test this, we limited the cohort to patients who initially started dialysis at facilities that offered home dialysis (Supplemental Table 2). In the fully adjusted model for initial dialysis modality, rural patients had higher mortality (adjusted hazard ratio [aHR]=1.05, 95% CI, 1.01 to 1.10; P=0.001) and urban patients at a rural facility (OR=2.74; 95% CI, 2.46 to 3.05; P<0.001) and urban patients at a rural facility (OR=1.36; 95% CI, 1.05 to 1.77; P=0.02) were more likely to be on home dialysis.

### Rural Patients Have Worse Survival on Dialysis

We then investigated patient mortality after the initiation of dialysis. In the first model, rural patients had higher mortality (adjusted hazard ratio [aHR]=1.05, 95% CI, 1.01 to 1.10; P=0.001).
After demonstrating worse overall survival for patients from rural areas, we then accounted for the geographic locations of both patient and dialysis facility to establish if rural patients who go to an urban facility also gain the same survival advantage (Table 4). Unfortunately, this did not prove to be true for rural patients no matter where they underwent dialysis: rural patients who visited an urban facility still had worse overall survival (aHR = 1.10, 95% CI, 1.02 to 1.19; \( P = 0.02 \)) compared with urban patients who remained at urban facilities, and rural patients who dialyzed at a rural facility also had worse overall survival (aHR = 1.05; 95% CI, 1.003 to 1.09; \( P = 0.04 \)). Urban patients who visited rural facilities had similar survival to the urban patients who remained at urban facilities (aHR = 1.12; 95% CI, 0.98 to 1.28; \( P = 0.11 \)). To establish if rural patients at urban facilities fared worse than urban patients at rural facilities, we ran the model with urban patient at rural facilities as the reference group: the aHR was 0.99 (95% CI, 0.85 to 1.15; \( P = 0.84 \)), making an association difficult to establish, given the relatively few urban patients who were at rural facilities.

Patients whose initial dialysis modality was at home were at significantly lower risk of death (aHR = 0.61; 95% CI, 0.56 to 0.65; \( P < 0.001 \)). Mortality was not different for patients on either home hemodialysis or peritoneal dialysis (aHR = 1.06; 95% CI, 0.85 to 1.32; \( P = 0.59 \); data not shown in table), so the categories were maintained as home dialysis versus in-center hemodialysis. Mortality was lower among Black patients (aHR = 0.74; 95% CI, 0.72 to 0.77; \( P < 0.001 \)), Hispanic patients (aHR = 0.66; 95% CI, 0.63 to 0.70; \( P < 0.001 \)), and those of another race and ethnicity (aHR = 0.58; 95% CI, 0.54 to 0.63; \( P < 0.001 \)). Compared with patients at small facilities, medium-sized facilities were associated with lower mortality (aHR = 0.91; 95% CI, 0.86 to 0.96; \( P < 0.001 \)), but large facilities were not (aHR = 0.93; 95% CI, 0.86 to 1.002; \( P = 0.06 \)). Finally, higher Dialysis Facility Compare star ratings were also associated with lower mortality (for five stars versus one star: aHR = 0.58; 95% CI, 0.53 to 0.63; \( P < 0.001 \)).

Discussion
In this study, we examined the relative contributions of both patient and dialysis facility rurality in the treatment of ESKD. Although rural patients had a 13% higher utilization of home dialysis as initial modality, there were 5% fewer facilities that offer peritoneal dialysis in rural counties. The increased utilization of home dialysis by rural patients is driven by starting at urban facilities where they could access peritoneal dialysis, where they were 2.74 times more likely to be on home dialysis. The fact that patients who already suffer from geographic disparities need to travel outside of their communities to fulfill the goals of AAKH is worth considering for future policy and incentives.
We then investigated what factors were associated with switching dialysis modality within 90 days of initiation. Many patients start on hemodialysis abruptly (“crash onto dialysis”) and later have the chance to convert to more permanent access, either via peritoneal dialysis or using a permanent fistula. The patients most likely to switch were younger, employed, and White. Because these patients are under the care of the dialysis center rather than their pre-ESKD nephrologists, this both emphasizes and measures the role the dialysis centers have in assisting patients to change modality before the incentives attached to AAKH. Future policy and reimbursement incentives could also encourage a broader consideration of home dialysis starting on home dialysis, which could be designed to correct some of the issues experienced by rural patients in the United States and to hold rural dialysis facilities to be held accountable for. Unfortunately, rural patients visiting an urban facility did not consistently have the same survival benefit that urban patients have. This makes the problem significantly more complex because it would not be expected that simply increasing the number of rural dialysis facilities would improve outcomes.

We expect that urban patients have. This indicates that urban patients have. This suggests that the dialysis centers have a role in facilitating modalities that are appropriate for rural patients.

### Table 3. Patient covariates associated with home dialysis as initial dialysis modality and with switching to home dialysis

| Covariate                           | Home Dialysis as Initial Modality | Switch to Home Dialysis within 90 days |
|-------------------------------------|-----------------------------------|----------------------------------------|
|                                     | Odds Ratio (95% CI) | P Value | Odds Ratio (95% CI) | P Value |
| Rural geography (urban)             | 1.16 (1.09 to 1.23) | <0.001  | 1.16 (1.05 to 1.29) | 0.005   |
| Men                                 | 0.95 (0.91 to 0.97) | 0.04    | 1.11 (1.02 to 1.20) | 0.02    |
| Age (per 10 years)                  | 0.90 (0.88 to 0.92) | <0.001  | 0.85 (0.82 to 0.87) | <0.001  |
| **Race (White)**                    |                      |         |                       |         |
| Black                               | 0.65 (0.61 to 0.69) | <0.001  | 0.64 (0.58 to 0.72) | <0.001  |
| Hispanic                            | 0.69 (0.64 to 0.75) | <0.001  | 0.61 (0.53 to 0.70) | <0.001  |
| Other                               | 0.87 (0.79 to 0.95) | 0.003   | 0.66 (0.55 to 0.80) | <0.001  |
| **Primary disease (cystic kidney)** |                      |         |                       |         |
| Diabetes                            | 0.59 (0.51 to 0.68) | <0.001  | 0.74 (0.57 to 0.97) | 0.03    |
| Glomerulonephritis                  | 0.79 (0.68 to 0.91) | 0.001   | 1.02 (0.77 to 1.35) | 0.87    |
| Hypertension                        | 0.55 (0.48 to 0.63) | <0.001  | 0.80 (0.61 to 1.04) | 0.09    |
| Other urologic                      | 0.32 (0.24 to 0.42) | <0.001  | 0.54 (0.35 to 0.84) | 0.006   |
| Other                               | 0.35 (0.30 to 0.41) | <0.001  | 0.71 (0.54 to 0.95) | 0.02    |
| **BMI (18.5–25 kg/m²)**            |                      |         |                       |         |
| Underweight (<18.5)                 | 0.83 (0.70 to 0.98) | 0.03    | 0.96 (0.74 to 1.24) | 0.73    |
| Overweight (25–30)                  | 1.22 (1.15 to 1.30) | <0.001  | 1.03 (0.92 to 1.16) | 0.56    |
| Obese (≥30)                         | 1.13 (1.06 to 1.20) | <0.001  | 0.99 (0.89 to 1.10) | 0.84    |
| **Employment (unemployed)**         |                      |         |                       |         |
| Employed                            | 2.89 (2.70 to 3.10) | <0.001  | 2.43 (2.15 to 2.74) | <0.001  |
| Retired                             | 1.25 (1.17 to 1.33) | <0.001  | 1.15 (1.03 to 1.28) | 0.02    |
| **Comorbidities**                   |                      |         |                       |         |
| Amputation                          | 0.69 (0.59 to 0.81) | <0.001  | 0.87 (0.69 to 1.10) | 0.24    |
| Atherosclerotic heart disease       | 0.94 (0.87 to 1.02) | 0.14    | 0.85 (0.74 to 0.98) | 0.02    |
| Cancer                              | 0.91 (0.82 to 1.01) | 0.08    | 0.82 (0.69 to 0.97) | 0.02    |
| Congestive heart failure            | 0.55 (0.52 to 0.59) | <0.001  | 0.86 (0.78 to 0.95) | 0.002   |
| Chronic obstructive pulmonary disease| 0.53 (0.47 to 0.59) | <0.001  | 0.91 (0.79 to 1.05) | 0.20    |
| Diabetes with insulin               | 0.89 (0.83 to 0.95) | <0.001  | 0.97 (0.87 to 1.09) | 0.62    |
| Diabetes on oral medications        | 1.04 (0.96 to 1.13) | 0.34    | 0.94 (0.81 to 1.09) | 0.43    |
| Diabetes without insulin            | 0.98 (0.89 to 1.08) | 0.65    | 0.94 (0.79 to 1.11) | 0.46    |
| Hypertension                        | 1.11 (1.03 to 1.20) | 0.01    | 0.95 (0.84 to 1.08) | 0.42    |
| Peripheral vascular disease         | 0.78 (0.71 to 0.87) | <0.001  | 0.98 (0.84 to 1.14) | 0.75    |

All odds ratios from the final fully adjusted models.
of home dialysis—providing units would improve mortality. Perhaps different resource allocation and priority, especially toward caring for such an ill population, is the best way to improve the overall mortality of these patients.

The economic incentives attached to AAKH to increase the utilization of home dialysis will likely increase the availability of home dialysis at different facilities; whether this will happen somewhat randomly or be focused on

| Covariate                                      | Hazard Ratio (95% Confidence Interval) | P Value |
|------------------------------------------------|----------------------------------------|---------|
| Patient-level                                  |                                        |         |
| Geography (urban patient visits urban facility) |                                        |         |
| Rural patient visits rural facility            | 1.05 (1.00 to 1.09)                    | 0.04    |
| Rural patient visits urban facility            | 1.10 (1.02 to 1.19)                    | 0.02    |
| Urban patient visits rural facility            | 1.12 (0.98 to 1.28)                    | 0.11    |
| Men                                            | 1.00 (0.97 to 1.03)                    | 0.85    |
| Age (per 10 years)                             | 1.39 (1.37 to 1.41)                    | <0.001  |
| Race (White)                                   |                                        |         |
| Black                                          | 0.74 (0.72 to 0.77)                    | <0.001  |
| Hispanic                                       | 0.66 (0.63 to 0.70)                    | <0.001  |
| Other                                          | 0.58 (0.54 to 0.63)                    | <0.001  |
| Primary disease (cystic kidney disease)        |                                        |         |
| Diabetes                                       | 1.92 (1.60 to 2.30)                    | <0.001  |
| Glomerulonephritis                             | 1.75 (1.45 to 2.12)                    | <0.001  |
| Hypertension                                   | 1.99 (1.66 to 2.39)                    | <0.001  |
| Other urologic                                 | 2.01 (1.62 to 2.49)                    | <0.001  |
| Other                                          | 3.19 (2.66 to 3.83)                    | <0.001  |
| BMI (18.5–25 kg/m²)                            |                                        |         |
| Underweight (<18.5)                            | 1.31 (1.22 to 1.40)                    | <0.001  |
| Overweight (25–30)                             | 0.83 (0.80 to 0.86)                    | <0.001  |
| Obese (≥30)                                    | 0.81 (0.78 to 0.84)                    | <0.001  |
| Employment (unemployed)                        |                                        |         |
| Employed                                       | 0.53 (0.49 to 0.58)                    | <0.001  |
| Retired                                        | 1.04 (1.00 to 1.08)                    | 0.03    |
| Initial modality (in-center dialysis)          |                                        |         |
| Home dialysis                                  | 0.61 (0.56 to 0.65)                    | <0.001  |
| Comorbidities                                  |                                        |         |
| Amputation                                     | 1.42 (1.33 to 1.53)                    | <0.001  |
| Atherosclerotic heart disease                  | 1.06 (1.02 to 1.10)                    | 0.005   |
| Cancer                                         | 1.22 (1.17 to 1.28)                    | <0.001  |
| Congestive heart failure                       | 1.44 (1.39 to 1.48)                    | <0.001  |
| Chronic obstructive pulmonary disease          | 1.28 (1.23 to 1.33)                    | <0.001  |
| Diabetes with insulin                          | 1.12 (1.08 to 1.16)                    | <0.001  |
| Diabetes on oral medications                   | 0.93 (0.88 to 0.97)                    | 0.002   |
| Diabetes without insulin                       | 0.92 (0.87 to 0.98)                    | 0.006   |
| Hypertension                                   | 0.79 (0.76 to 0.82)                    | <0.001  |
| Peripheral vascular disease                    | 1.16 (1.11 to 1.21)                    | <0.001  |
| Facility-level                                  |                                        |         |
| Facility size (≤10 stations)                   |                                        |         |
| Medium (11–30 stations)                        | 0.91 (0.86 to 0.96)                    | <0.001  |
| Large (>30 stations)                           | 0.93 (0.86 to 1.002)                   | 0.06    |
| For-profit (nonprofit)                         | 1.05 (1.00 to 1.11)                    | 0.08    |
| Dialysis chain (independent)                   |                                        |         |
| Large chain                                    | 0.95 (0.91 to 0.99)                    | 0.03    |
| Small/regional chain                           | 0.95 (0.90 to 1.00)                    | 0.07    |
| Five Star rating (1 star)                      |                                        |         |
| 2 stars                                        | 0.76 (0.69 to 0.83)                    | <0.001  |
| 3 stars                                        | 0.68 (0.63 to 0.73)                    | <0.001  |
| 4 stars                                        | 0.65 (0.60 to 0.71)                    | <0.001  |
| 5 stars                                        | 0.58 (0.53 to 0.63)                    | <0.001  |
| Offers home hemodialysis training              | 0.97 (0.94 to 1.00)                    | 0.08    |
| Total patients at beginning of year (per 10 patients) | 1.00 (0.99 to 1.00)                   | 0.11    |
| Percentage of patients on home dialysis        | 1.00 (1.00 to 1.00)                    | 0.45    |
| Nurse/patient ratio (per 10 nurses)            | 1.00 (0.98 to 1.02)                    | 0.75    |
| Social worker/patient ratio (per 10 social workers) | 1.00 (0.99 to 1.00)                 | 0.55    |
specific geographic areas is unknown. It is tempting to speculate on the broader economic effects of this increase in home dialysis use, especially if more rural facilities offered home dialysis methods. In that hypothetical case, travel would likely decrease and patient experience and quality of care would likely improve, but fully estimating these effects is outside of the scope of the current study, given the uncertain future course. Additionally, incentivizing small rural facilities could have the unintended consequence of reducing individual facility expertise, which may expose patients to higher risks of technique failure (22).

Our analysis is limited by its retrospective nature, which cannot establish causal relationships. There is not a reliable way to account for why patients end up at a particular dialysis facility or why they change modalities, but there is evidence from this study, others in literature, and those in access to transplantation that the dialysis facility itself played a significant role in care and outcomes for these patients (23–26). Additionally, the role of distance (27,28) and the social determinants of health (17,21,29) could not be fully accounted for with the data available in the USRD5, and certainly represent areas of future study. In conclusion, rural patients on dialysis face barriers in accessing home dialysis, and they do so by accessing urban dialysis facilities. Despite the challenges imposed by distance, these patients generally overcome it by getting to a facility in an urban county that offers home dialysis methods. Further policy would benefit from increasing access to home dialysis for rural patients, and to consider candidates for home dialysis more broadly.

Disclosures

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Author Contributions

J.T. Adler, J.R. Rodrigue, and S.S. Waikar conceptualized the study; J.T. Adler curated the data and was responsible for funding acquisition, project administration, resources, and software; J.T. Adler, S.A. Husain, and L. Xiang were responsible for the investigation and methodology; J.T. Adler and S.A. Husain were responsible for visualization and wrote the original draft of the manuscript; and all authors were responsible for the formal analysis and for reviewing and editing the manuscript.

Data Sharing Statement

Data cannot be shared. This is secondary analysis of a publicly available dataset, but the data use agreement would prohibit direct sharing of the data.

Supplemental Material

This article contains the following supplemental material online at http://kidney360.asnjournals.org/lookup/suppl/doi:10.34067/KID.0006932021/-/DCSupplemental.

Supplemental Table 1. Patient covariates associated with stable home dialysis after 90 days.

Supplemental Table 2. Covariates associated with home dialysis as initial modality.

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