

Geographic variation and neighborhood factors are associated with low rates of pre-end-stage renal disease nephrology care

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Geographic variation of pre-end-stage renal disease (pre-ESRD) nephrology care has not been studied across the United States. Here we sought to identify geographic differences in pre-ESRD care, assess for county-level geographic and sociodemographic risk factors, and correlate with patient outcomes using facility-level mortality. Patients from 5387 dialysis facilities across the United States from 2007 to 2010 were included from the Dialysis Facility Report. Marginal generalized estimating equations were used for modeling with geographic cluster analysis to detect clusters of facilities with low rates of pre-ESRD care. On average, 67% of patients received pre-ESRD care in the United States but with significant variability across regions ranging from 3 to 99%. Five geographic clusters of facilities with low rates of pre-ESRD care were the metropolitan areas of San Francisco, Los Angeles, Chicago, Miami, and Baltimore, along with Southern states along the Mississippi River. Dialysis facilities with the lowest rates of pre-ESRD care were more likely to be located in urban counties with high African-American populations and low educational attainment. A 10% higher proportion of patients receiving pre-ESRD care was associated with 1.3% lower patient mortality as reflected by facility-level mortality. Thus, geographic and sociodemographic factors can be used to design quality improvement initiatives to increase access to nephrology care nationwide and improve patient outcomes.

Kidney International advance online publication, 22 April 2015;
doi:10.1038/ki.2015.118

KEYWORDS: access to healthcare; dialysis facility; end-stage renal disease; geography; mortality; outcomes

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Received 20 November 2014; revised 13 February 2015; accepted 26 February 2015

Access to nephrology care prior to end-stage renal disease (ESRD) is associated with improved clinical outcomes for chronic kidney disease (CKD) patients. CKD patients who are treated by a nephrologist prior to ESRD onset have lower rates of adverse outcomes, improved quality of life,^{1–13} and increased access to kidney transplantation.^{14–16} Timely nephrologist care is also cost-efficient.^{17,18} Conversely, delays in access to nephrology care are associated with a more rapid progression of kidney disease and increased mortality after dialysis start. The United States (US) and international practice guidelines recommend that all patients with CKD Stage 4 and 5 should be under the care of a nephrologist;^{19,20} however, 25–50% of patients undergoing maintenance dialysis in the US have not received any pre-ESRD nephrology care.²¹

Patient, physician, and health system factors have a significant influence on the receipt of pre-ESRD nephrology care.²² Much of the previous literature in kidney disease outcomes has focused on patient- and provider-specific variables. However, recent trends in health systems-based research have sought to identify geographic and sociodemographic factors, which may contribute to variable rates of pre-ESRD nephrology care at a regional level.^{23,24} A study by McClellan *et al.*²⁵ in the Southeastern US showed substantial variation in the proportion of CKD patients receiving pre-ESRD nephrology care with a range of 14.8–85.0%. Prior studies examining geographic variations in pre-ESRD were limited to isolated ESRD networks; as such, little is known about how this relationship varies among dialysis facilities across the entire US and how access to pre-ESRD nephrology care may influence dialysis facility mortality.

The purpose of this study was to identify geographic differences in the proportion of late-stage CKD patients who received pre-ESRD nephrology care prior to dialysis across the US. We also sought to assess the association between pre-ESRD nephrology care and county-level geographic risk

Table 1 | Dialysis facility characteristics of US dialysis facilities 2007–2010 by pre-ESRD nephrology care quintile (N= 5387)

	Lowest quintile	Second quintile	Third quintile	Fourth quintile	Highest quintile	P-value
<i>Pre-ESRD nephrology care</i>						
Pre-ESRD nephrology care, Any duration (%)	65.5	66.2	67.4	72.0	78.8	0.51
Pre-ESRD nephrology care, Greater than 6 months (%)	20.9	34.3	45.6	56.0	67.9	0.23
Pre-ESRD nephrology care, Greater than 12 months (%)	3.2	12.3	22.3	33.9	50.2	0.02*
<i>Facility-level patient characteristics</i>						
Age (years)	62.9	63.2	62.8	63.1	63.3	0.33
<i>Sex (%)</i>						
Male	55.2	55.9	55.8	56.3	56.7	0.52
Female	44.8	44.1	44.2	43.7	43.3	0.35
<i>Race (%)</i>						
White	60.0	65.5	65.8	69.3	71.2	0.03*
African American	34.0	29.5	29.4	25.5	23.0	0.001*
Other	6.0	5.0	4.8	5.2	5.8	0.22
<i>Insurance status (%)</i>						
Employer group only	13.7	15.2	15.8	16.8	19.2	0.01*
Medicaid only	21.0	22.8	22.9	21.8	19.9	0.59
Medicare only	14.3	11.8	11.8	10.3	8.8	0.46
Medicare and Medicaid only	15.0	13.0	12.3	11.7	10.6	0.80
Medicare and other only	17.7	21.0	22.3	25.7	29.2	0.66
Unknown only	9.8	8.5	7.3	7.1	6.6	0.11
No insurance	8.5	7.7	7.6	6.6	5.7	0.01*
<i>Dialysis facility characteristics</i>						
Standardized mortality ratio	1.09	1.04	1.03	0.99	0.97	0.02*
<i>Facility for-profit status (%)</i>						
For-profit	88.4	89.7	84.9	81.3	75.9	0.13
Non-profit	11.6	10.3	15.1	28.7	24.1	0.79
Patients per facility (N)	109.9	107.5	104.2	109.4	110.5	0.91
Staff per facility (N)	14.6	14.3	14.4	15.1	15.5	0.24
AV fistula utilization (%)	10.1	12.2	13.9	16.7	20.0	0.001*
ESA utilization (%)	14.0	20.1	23.8	30.1	36.6	0.03*
<i>County-level characteristics</i>						
<i>County classification (N, %)</i>						
Urban	2676 (64.5)	2196 (52.6)	2028 (48.5)	1964 (46.5)	1867 (44.2)	0.01*
Suburban	776 (18.7)	1119 (26.8)	1133 (27.1)	1404 (33.2)	1635 (38.7)	0.001*
Rural	696 (16.8)	857 (20.5)	1019 (24.4)	856 (20.3)	726 (17.7)	0.001*
African American (%)	18.0	16.3	16.1	14.2	13.8	0.02*
In poverty (%)	14.7	14.8	14.5	13.6	13.4	
Education: high school diploma (%)	77.5	78.3	78.7	80.3	81.1	0.001*

Abbreviations: AV, arteriovenous; ESA, erythropoiesis-stimulating agent; ESRD, end-stage renal disease.

*P-value < 0.05.

factors at a national scale, as well as the association of pre-ESRD nephrology care with facility-specific patient mortality.

RESULTS

Variations of pre-ESRD nephrology care across facilities

A total of 5387 dialysis facilities were included in the analysis (Table 1). Across the country, 67.4% of patients received pre-ESRD nephrology care for any duration, with a range of 3.2–99.4% and interquartile range of 58.3–71.8% nationally. Nearly half (45.5%) of the patients received care for more than 6 months (range: 1.1–98.0%), and 22.3% received care for more than 12 months (range: 0.5–92.9%). There were large discrepancies in patient access and outcomes across the

highest and lowest quintiles of pre-ESRD nephrology care. The mean pre-ESRD nephrology care of any duration varied from 78.8% in the highest-quintile facilities to 65.5% in the lowest-quintile facilities. These discrepancies were further accentuated for care greater than 12 months, with 50.2% in the highest-quintile facilities versus 3.2% in the lowest-quintile facilities.

Treatment centers in the lowest quintile of pre-ESRD nephrology care were more likely to be financially for-profit (88.39 vs. 75.87%), and showed lower proportions of arteriovenous (AV) fistula utilization (10.1 vs. 20.0%, $P < 0.05$) and erythropoiesis-stimulating agent (ESA) use (14.0 vs. 36.6%, $P < 0.05$) prior to dialysis. Patient-specific

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