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Pre-ESKD Nephrology Care and Employment at the Start of Dialysis

Ahmed A. Awan[1], Bo Zhao[1], Samaya J. Anumudu[1], Wolfgang C. Winkelmayer[1], Vivian Ho[2,3] and Kevin F. Erickson[1,2,3]

[1]Selzman Institute for Kidney Health and Section of Nephrology, Baylor College of Medicine, Houston, Texas, USA; [2]Center for Innovations in Quality, Effectiveness, and Safety, Baylor College of Medicine, Houston Texas, USA; and [3]Baker Institute for Public Policy, Rice University, Houston, Texas, USA

Introduction: Employment is associated with an improved sense of well-being and quality of life in patients with kidney disease. Earlier nephrology referral and longer duration of pre–end-stage kidney disease (ESKD) nephrology care are associated with improved health outcomes in patients with advanced kidney disease who initiate dialysis. It is unknown if pre-ESKD nephrology care helps patients stay employed leading up to dialysis initiation.

Methods: We used the US ESKD registry to identify adults aged 18–54 years who initiated dialysis between 2007 and 2014. Analyses were restricted to patients who reported being employed 6 months prior to ESKD. We used multivariable regression models with estimated average marginal effects to examine the independent association between ≥6 months of pre-ESKD nephrology care and employment at dialysis initiation. To reduce bias, we conducted an instrumental variable (IV) analysis based on geographic variation in pre-ESKD care.

Results: Of 75,700 patients included in study cohort, 49% reported receiving pre-ESKD nephrology care for ≥6 months, and 62% were employed at dialysis initiation. Although geographic variation in pre-ESKD nephrology care was strongly associated with the likelihood that working-aged patients in our analytic cohort received pre-ESKD care, the receipt of pre-ESKD nephrology care was not significantly associated with employment at dialysis initiation; estimated probability: 5%; 95% confidence interval (CI) –6% to 14%.

Conclusions: Pre-ESKD nephrology care 6 months prior to initiation of dialysis is not associated with the likelihood of remaining employed at the initiation of dialysis. Although nephrology care has potential to help patients remain employed, this benefit is not manifested in current practice.

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Early nephrology referral and longer duration of pre-ESKD nephrology care are associated with improved health outcomes in patients with advanced kidney disease initiating kidney replacement therapy. Patients with access to regular pre-ESKD nephrology care have better health (relatively higher hemoglobin and albumin levels), are better prepared for ESKD (optimal vascular access for initiating dialysis), and have reduced mortality, especially within the first year of ESKD.[1–5] Pre-ESKD nephrology care can also provide patients the opportunity to make informed decisions about kidney replacement therapy and assist them in enrollment for kidney transplantation. Despite these benefits, 36% of incident ESKD patients reported receiving little or no pre-ESKD nephrology care in 2015,[6] suggesting that increased access to pre-ESKD care could lead to significant improvements in patient health.

Qualitative studies indicate that maintaining a high quality of life is important to patients with ESKD.[7–9] Although often overlooked as a determinant of a person's well-being, employment can contribute to higher quality of life through economic benefits as well as an improved sense of well-being.[10] Return-to-work programs may benefit physical health, [11] and employment is inversely related to mortality.[12,13] Maintaining employment, especially full-time employment, can also help individuals keep their employer-provided health insurance, thus reducing public health expenditures. However, a patient's ability to work may be negatively

Correspondence: Ahmed A. Awan, Baylor College of Medicine, 7200 Cambridge Street, Suite 8B, MS: BCM902, Houston, Texas 77030, USA. E-mail: ahmed.awan@bcm.edu

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impacted during the initiation of dialysis, owing to declining health, time constraints, and fatigue associated with treatments.[14,15] One-third of patients employed 6 months prior to initiation of dialysis were unable to maintain their employment by the start of dialysis.[16]

Close attention to pre-dialysis nephrology care may help patients remain employed as they transition to dialysis. Longer duration of pre-ESKD nephrology care is an important predictor of selecting home-dialysis modalities,[1] and patients receiving home dialysis are more likely to be employed.[17] Preconceived expectations about whether it is possible to work after developing ESKD are important determinants of employment after the onset of ESKD,[18] and pre-dialysis counseling and education by nephrologists may help patients remain employed through physical and psychological preparations for the life-changing event of dialysis initiation.[19]

In this study, we examined the association between pre-ESKD nephrology care and the likelihood of remaining employed at the initiation of dialysis. We hypothesized that employed patients who received regular pre-ESKD nephrology care would be more likely to remain employed when they start dialysis.

METHODS

Data Sources and Study Population

Using the US Renal Data System (USRDS), we identified all working-age adults (18–54 years) who initiated dialysis in the US between January 1, 2007 and December 31, 2014. The USRDS is a national registry capturing nearly all patients with ESKD. The age range of 18 to 54 years is used to monitor employment at dialysis facilities in the ESKD Networks' annual reports. We began following patients in 2007 because this was the first full year when information about pre-ESKD nephrology care was regularly reported in a mandatory government form, the Centers for Medicare & Medicaid Services (CMS) Medical Evidence Report (form CMS-2728). This report is completed by nephrologists and case managers for all patients with newly diagnosed ESKD, regardless of their insurance status or treatment modality. The form is filled out within 45 days of the onset of ESKD, and it includes information about employment status 6 months prior to and at the onset of ESKD. We restricted our study population to patients who were reported to have been employed 6 months prior to initiating dialysis, and included patients who started in-center hemodialysis, as well as patients using home-based kidney replacement therapies. Kutner *et al*. recently studied and

Table 1. Characteristics of patients employed at the onset of dialysis between 2007 and 2014

Covariates and outcome	>6 mo of pre-ESKD nephrology care (n = 36,940)	<6 mo or no pre-ESKD nephrology care (n = 38,760)	Absolute standardized difference
Employment at ESKD onset			
Full-time	57.2	43.7	0.27
Part-time	9.6	8.9	0.02
Student	2.5	2.8	0.01
Any employment (primary study outcome)	69.3	55.4	0.29
Dialysis modality			
In-center hemodialysis	74.1	89.2	0.399
Home dialysis	25.9	10.8	0.399
Calendar year			
2007	13.7	13.3	0.011
2008	13.5	13.6	0.003
2009	13.0	14.0	0.030
2010	11.9	13.2	0.038
2011	11.2	13.4	0.068
2012	12.0	11.4	0.018
2013	12.1	10.6	0.046
2014	12.7	10.4	0.070
Patient demographic, health, and socioeconomic characteristics			
Age group, yr[a]			
18–28	8.6	12.1	0.117
29–38	18.2	21.1	0.074
39–48	38.3	36.7	0.033
49–54	35.0	30.1	0.105
Female	38.2	33.0	0.110
Race			
White	58.4	55.6	0.057
Black	33.5	37.3	0.079
Other	8.1	7.1	0.036
Hispanic ethnicity	14.0	18.2	0.115
Medicare disability	6.6	5.4	0.052
Smoker	5.9	7.9	0.079
Drug or alcohol abuse	1.1	3.7	0.167
Immobility	0.6	1.5	0.093
Institutionalized	0.4	1.2	0.087
Comorbidities at onset of ESKD[b]			
Diabetes	43.0	35.9	0.145
Coronary heart disease	5.9	4.9	0.045
Cancer	2.2	2.8	0.043
Heart failure	10.6	13.0	0.076
Lung disease	1.7	1.8	0.013
Cerebrovascular disease	2.5	2.6	0.007
Peripheral vascular disease	3.9	3.6	0.014
Hemoglobin, g/dl	9.94 (1.85)	9.48 (2.03)	0.238
Serum albumin, g/dl	3.40 (0.75)	3.13 (0.78)	0.352
Body mass index, kg/m^2	30.90 (8.25)	29.91 (8.23)	0.119
eGFR, ml/min per 1.73 m^2	8.58 (4.63)	8.19 (6.28)	0.071

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Table 1 (Continued) Characteristics of patients employed at the onset of dialysis between 2007 and 2014

Covariates and outcome	>6 mo of pre-ESKD nephrology care (n = 36,940)	<6 mo or no pre-ESKD nephrology care (n = 38,760)	Absolute standardized difference
Geographic characteristics			
County-level unemployment rate (%)	7.49 (2.65)	7.80 (2.78)	0.117
County-level median household Income			
1st (bottom) 1/5	16.2	18.1	0.049
2nd 1/5	19.1	18.6	0.012
3rd 1/5	20.9	20.4	0.011
4th 1/5	18.8	20.3	0.038
5th (top) 1/5	25.0	22.6	0.057
Population density of patient zip code			
Metropolitan	85.6	85.3	0.007
Micropolitan	8.1	8.5	0.014
Small town	3.9	4.0	0.005
Rural	2.3	2.1	0.014

eGFR, estimated glomerular filtration rate; ESKD, end-stage kidney disease; ESRD, end-stage renal disease.
[a]Age categories were derived by selecting sequential 10-year intervals within the definition of working age (18–54 yr) used by ESRD Network monitoring of dialysis facilities.
[b]Comorbidities were not included in primary regression model. Other race includes Asian, Native American, and Pacific Islander. Missing comorbidities were hemoglobin: n = 7449; serum albumin: n = 18,516; body mass index: n = 632; and eGFR: n = 3. Secondary models included these comorbidities following multiple imputation.
Includes 75,700 patients initiating dialysis between January 1, 2007 and December 31, 2014. Values are % or mean (SD), unless otherwise indicated.

found good registry validity of the patients' self-reported employment status.[20]

We obtained information about patients' demographics and comorbidities from form CMS-2728 and Medicare enrollment files. We used patient zip codes and counties of residence to obtain information about population density,[21] local poverty rates,[22] and county-level unemployment rates.[23]

This study was approved by an institutional review board at Baylor College of Medicine and governed by a data-use agreement with the National Institute of Diabetes and Digestive and Kidney Diseases.

Outcome, Exposure, and Covariates

The study outcome was employment at the start of dialysis. We did not differentiate between part-time and full-time employment and considered students to be employed. The study exposure was whether or not a patient reported receiving ≥6 months of pre-ESKD nephrology care as documented on the CMS-2728 report. In sensitivity analyses, we examined ≥12 months of pre-ESKD nephrology care as an alternative exposure.

In all analyses, we adjusted for patient demographic, socioeconomic, and geographic information (listed in Table 1) as well as the calendar year of dialysis initiation. Because state disability and unemployment insurance policies vary, we included dummy variables for each state. As comorbidities may develop (or be identified or prevented) as a consequence of pre-ESKD care, we did not include comorbidities in our primary analyses. However, we included them as additional covariates in sensitivity analyses.

Patients with employer-provided health insurance may lose health insurance soon after they stop working. We had information about only health insurance available at the onset of ESKD and not about health insurance 6 months prior to the onset of ESKD. Because the type of health insurance patients have at the onset of ESKD could be a *consequence*—rather than a cause—of discontinuing work, we did not include health insurance as a covariate in our primary analysis. However, we examined the potential role that health insurance may have in explaining our study findings by including it as an additional covariate in a secondary analysis. In contrast to the loss of health insurance (which can occur soon after discontinuing work), the application process for federal disability typically takes longer. We therefore included Medicare disability as a covariate in our primary analysis, even though information about Medicare disability was also ascertained at the onset of dialysis.

Study Design and Statistical Analysis

When describing baseline characteristics, we used absolute standardized differences (ASD) to assess for meaningful differences between the 2 comparison groups, using 10% (0.1) ASD as significant.[24]

We used multivariable regression models (modified Poisson) to estimate the independent association between pre-ESKD nephrology care and employment at the time of dialysis initiation, while controlling for observed covariates. Each patient contributed one entry to the dataset at the time of dialysis initiation. Within this regression framework, the estimated coefficients approximate the log relative risk of employment associated with a 1-unit change in each covariate. We then used results from multivariable logistic regression models (and the delta method) to obtain estimated marginal effects of pre-ESKD nephrology care on the absolute probability of remaining employed.

Instrumental Variable Analysis

A common source of bias in observational analyses occurs if unobserved factors are associated with both the exposure and outcome of interest but are not along the causal pathway between the exposure and outcome. In this study, this bias would involve unobserved patient characteristics that are associated with both pre-ESKD nephrology care and employment at dialysis initiation. The restriction of our study cohort to patients who were employed 6 months prior to the

onset of dialysis partly addresses this form of bias by selecting comparison groups that are similar in important ways. In particular, all patients were healthy enough to be able to work 6 months prior to the onset of ESKD.

In order to further address this form of potential bias, we conducted an instrumental variable (IV) analysis, a quasi-experimental approach used to reduce bias in observational studies. An ideal IV is associated with the exposure of interest (in our case pre-ESKD nephrology care) and is associated with the outcome (employment) only through its association with the exposure. We used geographic variation in the delivery of pre-ESKD nephrology care as an IV. The prominent role of geographic variation on physician practice patterns and in predicting care delivery to individual patients motivated our use of this IV.[25–27]

To measure geographic variation in pre-ESKD care practice patterns, we calculated the proportion of patients >54 years old in each county who reported receiving any pre-ESKD nephrology care prior to ESKD. We chose patients >54 years old because these patients were not included in our primary cohort. To account for potential changes over time in regional practice patterns, we obtained this proportion twice for each county, once between 2007 and 2009, and once between 2010 and 2014. In each time interval (i.e., 2007–2009 and 2010–2014), we assigned patients in our primary analytic cohort to the proportion corresponding to the county where they lived at the onset of dialysis.

We conducted the IV analysis with a 2-stage residual inclusion model.[28,29] Because both the exposure and outcome are binary variables, we used logistic regression for both stages. We estimated the average marginal effect of pre-ESKD nephrology care on the probability of remaining employed, using bootstrapped standard errors. The IV analysis controlled for all demographic, socioeconomic, and geographic information listed in Table 1, as well as the calendar year of dialysis initiation.

We conducted several analyses to assess the validity of our IV. First, we examined the association between the IV and the study exposure (>6 months of pre-ESKD nephrology care). Next, we stratified patients by quintile of the IV and compared characteristics of patients in the lowest versus highest quintile of the IV, using a 10% standardized difference between the 2 groups as a marker of heterogeneity.[24] Finally, we used a multinomial logistic regression model to examine the independent associations between each patient and geographic characteristic and the relative risk ratio that a patient would be assigned to a given IV quintile. We used the lowest quintile (i.e., lowest area-level pre-ESKD care) as the reference and characteristic's association with the remaining 4 quintiles of the IV by testing the null hypothesis that there was no independent association between a given characteristic and IV quintile. We used a P value of 0.05 as a marker of heterogeneity in this multinomial model.

RESULTS

Population Characteristics

The study cohort included 75,700 adults initiating dialysis between 2007 and 2014 who were employed 6 months prior to the onset of ESKD; 36,940 patients (49%) reported receiving pre-ESKD nephrology care for more than 6 months, and 38,760 patients (51%) received either less than 6 months or no pre-ESKD nephrology care (Figure 1). A total of 47,072 (62%) patients reported maintaining employment at the onset of dialysis. Among patients with more than 6 months of pre-ESKD nephrology care, 69% reported maintaining employment at the onset of dialysis. Among patients with no (or <6 months) or pre-ESKD nephrology care, 55% reported maintaining employment at the onset of dialysis (P value < 0.001 for difference in proportions).

Patients who received >6 months of pre-ESKD nephrology care were older, had a higher prevalence of diabetes, and were more likely to be female. However, they had higher serum hemoglobin concentrations at the initiation of dialysis (mean, 9.9 g/dl) compared to those with little or no pre-ESKD nephrology care (mean, 9.5 g/dl), as well as a higher serum albumin concentration (3.4 g/dl vs. 3.1 g/dl, respectively). Slightly more than 25% of patients who received >6 months of pre-ESKD nephrology care initiated dialysis with a home modality, compared to only 11% of patients with little or no pre-ESKD care. Patients with >6 months of pre-ESKD nephrology care lived in counties with lower unemployment rates and were less likely to be of Hispanic ethnicity and to have drug or alcohol abuse issues (Table 1).

Differences in observed characteristics were smaller across levels of the IV (i.e., geographic variation in pre-ESKD nephrology care among older patients in a county). In unadjusted comparisons of patient and geographic characteristics among those initiating dialysis in the lowest versus the highest quintile of the IV, patients living in areas with the lowest rates of pre-ESKD nephrology care delivery were more likely to be Black, to be of Hispanic ethnicity, and to live in areas with lower income levels. However, there were no meaningful differences in patient health across quintile of pre-ESKD care (Table 2). In a multinomial regression model examining the independent association between each characteristic and IV quintile, differences in observed characteristics across IV strata

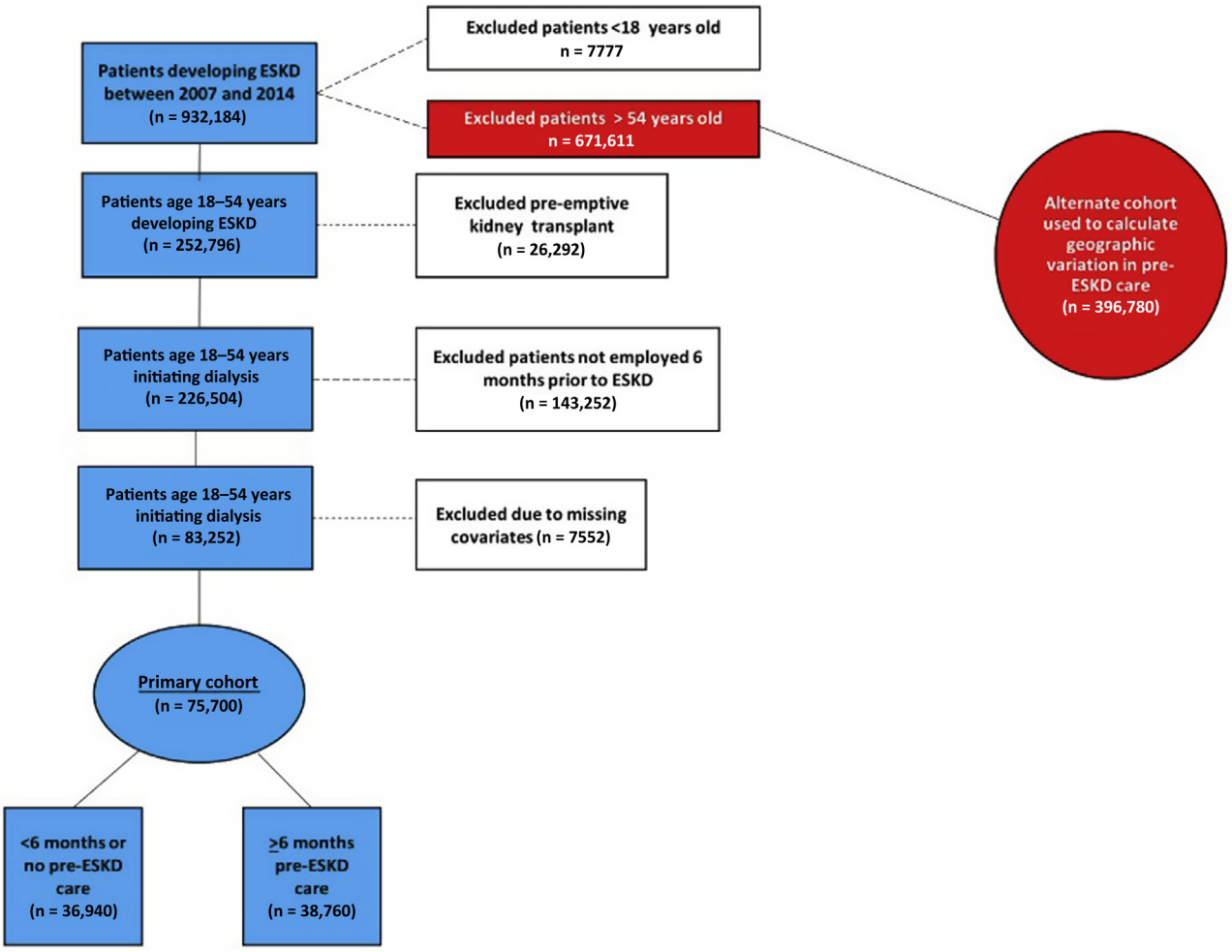

Figure 1. Cohort selection diagram. Exclusions due to missing covariates include 7501 patients with unknown or missing pre-dialysis nephrology care, 48 patients with missing data on population density, and 3 patients with missing sex. ESKD, end-stage kidney disease.

were similar, with several exceptions (Supplementary Table S1). Although household incomes were associated with the IV in both unadjusted and adjusted analyses, the direction of this association was not consistent across income levels.

Further Assessment of the Validity of the Instrumental Variable

The proportion of older patients in a county—not in the analytic study cohort—who received pre-ESKD nephrology care varied geographically and was associated with the likelihood that a patient in our cohort received >6 months of pre-ESKD care. In the lowest quintile of counties by pre-ESKD care, the mean proportion of patients in our analytic cohort who received >6 months of pre-ESKD care was 43%. In the highest quintile of counties by pre-ESKD care, the mean proportion of patients in the analytic cohort who received >6 months of pre-ESKD care was 58%. The F-statistic was 706 from a 1st-stage regression model in which pre-ESKD care was modeled as a function of the IV, suggesting that our IV was strongly correlated with pre-ESKD.[30]

Regression Results

An examination of the association between pre-ESKD care and employment at the individual patient level (prior to the IV analysis) indicated that reported receipt of >6 months of pre-ESKD nephrology care was independently associated with a 22% relative increase in the risk of remaining employed at dialysis initiation (95% CI, 20%–23%). This corresponds to an increase of 12% in the absolute probability of remaining employed (95% CI, 11%–13%; Supplementary Tables S2–S4).

Although geographic variation in the delivery of pre-ESKD nephrology care was highly predictive of the likelihood that individual patients in the analytic cohort received >6 months of pre-ESKD nephrology care, the magnitude of association between pre-ESKD care and employment was substantially smaller in the IV analysis, and was no longer statistically significant; pre-ESKD nephrology care predicted a 5% increase in the absolute probability of remaining employed (95% CI, −6% to 14%; Figure 2; Supplementary Tables S3 and S4). These findings were virtually unchanged in

Table 2. Comparison of patient characteristics across quintile of the instrumental variable (pre-ESKD nephrology care among older patients in a county)

Covariates	Quintile of IV					Std diff 1st vs. 5th quintile
	1st (lowest)	2nd	3rd	4th	5th (highest)	
Regional intensity of pre-ESKD nephrology care	50.94 (9.15)	63.20 (4.37)	71.85 (3.17)	78.50 (3.41)	87.79 (4.84)	
Dialysis modality						
In-center hemodialysis	83.3	83.1	82.0	79.6	80.0	0.08
Home dialysis	16.7	16.9	18.0	20.4	20.0	0.08
Calendar year						
2007	10.1	14.2	13.3	13.5	15.7	0.17
2008	10.6	14.1	13.5	13.9	14.1	0.11
2009	10.2	14.5	12.9	13.8	15.3	0.16
2010	9.9	13.2	12.2	12.8	13.6	0.12
2011	16.0	11.8	12.6	11.6	10.7	0.16
2012	14.4	10.8	12.3	11.4	10.4	0.12
2013	14.3	10.5	11.3	11.8	10.0	0.13
2014	14.5	10.9	11.7	11.3	10.1	0.13
Patient demographics and comorbidities						
Age group, yr						
18–28	10.4	10.3	10.5	10.3	10.5	0
29–38	19.2	19.8	19.6	20.0	19.0	0
39–48	36.8	37.7	37.5	37.0	38.6	0.04
49–54	33.6	32.2	32.3	32.8	31.9	0.04
Female	35.3	35.3	36.0	35.4	35.9	0.01
Race						
White	56.5	53.7	58.4	59.1	61.9	0.11
Black	37.3	39.7	34.9	30.7	28.9	0.18
Other	6.2	6.6	6.8	10.2	9.2	0.11
Hispanic ethnicity	19.2	19.2	16.4	12.0	8.2	0.32
Medicare disability	7.0	5.9	6.2	5.4	6.2	0.03
Smoker	6.6	6.3	6.7	7.6	9.0	0.09
Drug or alcohol abuse	2.4	2.4	2.4	2.4	2.6	0.02
Immobility	1.1	1.1	1.1	1.1	0.8	0.03
Institutionalized	0.9	0.8	0.9	0.8	0.8	0.01
Comorbidities at onset of ESKD[a]						
Diabetes	41.5	38.9	39.2	39.3	39.9	0.03
Coronary heart disease	5.8	4.9	5.3	5.5	6.4	0.02
Cancer	2.5	2.4	2.5	2.7	2.8	0.02
Heart failure	12.7	12.0	11.5	11.5	11.9	0.02
Lung disease	2.2	1.6	1.7	1.7	2.0	0.02
Cerebrovascular disease	2.8	2.6	2.4	2.6	2.8	0
Peripheral vascular disease	4.4	3.5	3.6	3.8	4.3	0.01
Hemoglobin, g/dl	9.60 (1.98)	9.66 (1.97)	9.70 (1.97)	9.78 (1.93)	9.83 (1.96)	0.12
Serum albumin, g/dl	3.23 (0.80)	3.26 (0.78)	3.26 (0.77)	3.28 (0.78)	3.27 (0.78)	0.05
BMI, kg/m^2	30.57 (8.30)	30.29 (8.23)	30.42 (8.20)	30.39 (8.30)	30.62 (8.38)	0.01
eGFR, ml/min per 1.73 m^2	8.56 (6.16)	8.28 (5.51)	8.39 (5.49)	8.48 (5.57)	8.20 (4.82)	0.06
Geographic and socioeconomic characteristics						
County-level unemployment rate (%)	8.10 (2.75)	8.04 (2.87)	7.57 (2.64)	7.12 (2.46)	7.10 (2.63)	0.37
County-level median household Income						
1st (bottom) 1/5	28.7	17.4	16.5	10.8	22.5	0.14
2nd 1/5	29.9	16.1	18.4	17.9	22.2	0.18
3rd 1/5	22.3	18.2	25.3	18.4	18.3	0.1
4th 1/5	14.1	28.5	13.7	16.7	14.7	0.02
5th (top) 1/5	5.0	19.8	26.0	36.1	22.4	0.52

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Table 2 (Continued) Comparison of patient characteristics across quintile of the instrumental variable (pre-ESKD nephrology care among older patients in a county)

Covariates	Quintile of IV					Std diff 1st vs. 5th quintile
	1st (lowest)	2nd	3rd	4th	5th (highest)	
Population density of patient zip code						
Metropolitan	72.9	90.5	87.8	85.3	70.7	0.05
Micropolitan	13.1	5.8	7.5	9.1	15.5	0.07
Small town	8.8	2.6	3.1	3.7	8.4	0.01
Rural	5.2	1.2	1.6	1.9	5.4	0.01

Std diff, standardized difference; BMI, body mass index; eGFR, estimated glomerular filtration rate; ESKD, end-stage kidney disease; IV, instrumental variable.
Values are % or mean (SD), unless otherwise indicated.
[a]Comorbidities were not included in the primary Poisson and IV analyses.
Includes patients employed at the initiation of dialysis, who started dialysis between January 1, 2007 and December 31, 2014. N = 75,578; 122 patients were excluded because they could not be linked to a county-level visit frequency. IV is the proportion of older patients not in our analytic cohort who received any pre-ESKD kidney care.

a sensitivity analysis in which we used >12 months of pre-ESKD care as the exposure of interest. The absolute probability of remaining employed remained 5% higher among patients with >12 months of pre-ESKD care (95% CI, −9% to 20%).

Additional Individual-Level Analyses

We conducted additional modified Poisson regression analyses to examine potential confounders that might account for the discrepant results between individual-level and IV regression models. In an analysis in which we included comorbidities documented at the time of dialysis initiation (Table 1), and used multiple imputation to address missing comorbidities, >6 months of pre-ESKD care was associated with an 18% increase in the relative risk of remaining employed (95% CI, 16%–20%; Supplementary Table S5). The association between >6 months of pre-ESKD nephrology care and remaining employed decreased further (relative risk, 1.16; 95% CI, 1.14–1.19) in an analysis in which we accounted for both comorbidities and the initial dialysis modality. In an analysis in which we included the presence of employer-provided health insurance at the onset of dialysis as an additional model covariate, pre-ESKD nephrology care was associated with a 15% increase in the relative risk of remaining employed (95% CI, 14%–16%; Supplementary Table S6). These magnitudes of the observed association between pre-ESKD nephrology care and employment at the individual patient level (relative risk, 15%–18%) were less pronounced than the 22% relative increase observed in the primary individual-level analysis. Hence, additional confounders may explain part of the discrepant findings between the individual-level and IV analyses.

DISCUSSION

In this study of patients initiating dialysis in the US between 2007 and 2014 who were employed 6 months prior to dialysis initiation, we found that patients who received pre-ESKD nephrology care experienced a 5%

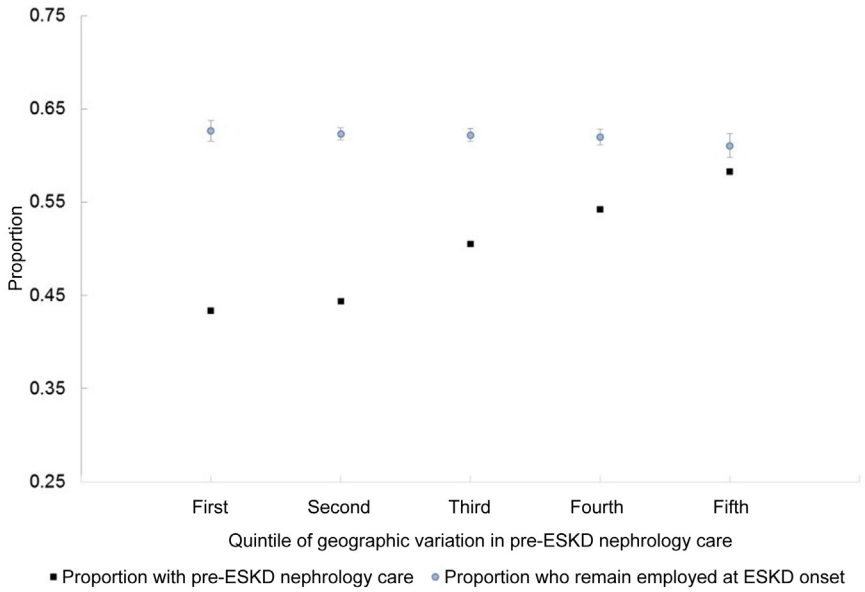

Figure 2. Geographic and individual-level associations between pre–end-stage kidney disease (ESKD) nephrology care and employment.

increase in the absolute probability of remaining employed at initiation, after accounting for potential observed and unobserved confounders. However, compared to patients who did not receive pre-ESKD nephrology care, this increase was not statistically significant.

The absence of an employment-related benefit from pre-ESKD nephrology care when examined in the setting of geographic variation in an IV analysis is consistent with a growing body of literature suggesting that the benefits of pre-ESKD care are limited. For example, recent studies have raised important questions about the association between pre-ESKD nephrology care and mortality,[31] and postulated that benefits from early referral to nephrologists may be limited in the setting of infrequent physician visits.[32]

The finding that benefits from pre-ESKD nephrology care may be limited highlights an opportunity to improve how nephrologists deliver care to patients who have advanced chronic kidney disease. While trying to manage myriad of active medical issues in patients with advanced kidney disease, ranging from anemia to metabolic bone disease, issues related to employment may not be adequately addressed in the nephrology office. Yet, 21% of unemployed patients receiving dialysis indicated that they wanted to return to work,[18] and a sizable portion of unemployed patients surveyed reported that dialysis interfered with their work schedule.[33] A multidisciplinary pre-dialysis education program designed to provide realistic expectations about employment with ESKD, and to assist the home, work, and healthcare environments in supporting patients' employment goals, may help patients remain employed.[19] One study reported that patients' beliefs about the ability to work while on dialysis can become a self-fulfilling prophecy,[18] while positive reinforcement can help patients maintain employment.[19]

Despite the absence of observed employment-related benefits from pre-ESKD nephrology care in our primary IV regression analysis, pre-ESKD nephrology care was associated with a 12% increase in the absolute probability of remaining employed in an analysis at the individual patient level. This discrepancy could be, in part, due to selection bias (or residual confounding) when examining pre-ESKD care and employment at the individual patient level. For example, as we did not have information about the type of health insurance that patients had at the start of our study, we were unable to control for this potential confounder in our primary individual-level analysis. However, patients with employer-provided insurance may have greater access to pre-ESKD care and may be more likely to remain employed in order to retain the insurance coverage for themselves and their families. Our additional examination of insurance coverage at the initiation of dialysis supports this concern. When we included the presence of employer-provided insurance at the onset of dialysis as an additional covariate, we observed a less pronounced (15%) association between pre-ESKD nephrology care and the risk of remaining employed.

This study has several limitations. Because it was based on a large administrative and observational dataset, its findings could be influenced by data irregularities, [34] including recall bias about pre-ESKD nephrology care, and documentation of certain comorbidities.[35] We did not have claims on individual healthcare encounters and associated diagnoses and procedures that would have permitted more detailed ascertainment of healthcare utilization and comorbid conditions. Because we did not study employment after initiation of dialysis, we may have missed the full impact of pre-ESKD care on employment status months after the initiation of dialysis, which is a particularly vulnerable period. Results may have been affected by survival bias, as some of the patients who did not receive pre-ESKD nephrology care may have died before dialysis could be initiated. Although reported employment at the onset of ESKD has been previously validated, reported employment 6 months prior to the onset of ESKD has not been similarly validated. The IV analysis may have had limited power to detect small benefits from pre-ESKD nephrology care.

In conclusion, we found that pre-ESKD nephrology care 6 months prior to initiation of dialysis was not significantly associated with the likelihood of remaining employed at the initiation of dialysis. Although nephrology care may have potential to help some patients remain employed, this benefit does not appear to be manifested in current practice. These findings underscore the need to identify effective methods to help patients remain employed when they transition to dialysis.

DISCLOSURE

All the authors declared no competing interests.

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SUPPLEMENTARY MATERIAL

Supplementary File (PDF)

Table S1. Multinomial model examining independent associations between patient characteristics and quintile of the instrumental variable (area-level pre-ESKD care).

Table S2. Primary multivariable regression results (does not include patient comorbidities): outcome is relative risk (RR) of employment.

Table S3. Logistic regression results from instrumental variable analysis (does not include patient comorbidities): outcome is odds of employment.

Table S4. Estimated effects of pre-ESKD care on the absolute probability of remaining employed at dialysis initiation in primary (standard regression) model and instrumental variable models.

Table S5. Individual-level regression including patient comorbidities: outcome is relative risk (RR) of employment.

Table S6. Individual-level regression, adjusting for employer-based group health insurance at the onset of dialysis: outcome is relative risk (RR) of employment.

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