

Predialysis Nephrology Care Among Older Veterans Using Department of Veterans Affairs or Medicare-Covered Services

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End-stage renal disease (ESRD) requiring dialysis is associated with high morbidity, mortality, hospitalizations, and health-care costs.^{1,2} To be appropriately prepared for dialysis, it is suggested that patients with advanced chronic kidney disease (CKD) receive care from a nephrologist before dialysis initiation (predialysis period). Absent, infrequent, or late predialysis nephrology care is associated with higher morbidity and mortality after dialysis initiation.¹⁻¹⁶ Unfortunately, recent studies^{1,3,5-11,14-17} indicated that 25% to 50% of incident dialysis patients in the United States were referred to a nephrologist only at an advanced stage of CKD or not at all. Existing literature points to patient factors (eg, nonwhite race/ethnicity, comorbid conditions, absent health insurance, unemployment) and provider uncertainty regarding guidelines as possible reasons for lack of appropriate predialysis nephrology care.^{1,5-7,9-11,14-17} However, little is known about the influence of healthcare system–related factors on patterns of predialysis nephrology care.³

To obtain timely and affordable treatment for chronic complex conditions such as CKD, older patients often seek care from medical providers across multiple venues of care.^{18,19} Almost all older veterans (≥65 years) eligible for the Department of Veterans Affairs (VA) healthcare system are also enrolled in Medicare, and more than 80% use Medicare-covered outpatient services alone or in combination with VA services.^{18,20,21} Although use of multiple healthcare systems may lead to fragmented and redundant care, judicious use of multiple systems may afford better management of complex illnesses.^{18,19,22-25} The objective of this study was to examine the effect of exclusive and dual use of VA and Medicare healthcare systems on the receipt, timeliness, and intensity of outpatient predialysis nephrology care among older veterans beginning chronic dialysis.

METHODS

Study Design and Sample

We conducted a retrospective cohort study of patterns of nephrology care during the 12 months preceding dialysis initiation for veterans who initiated chronic dialysis and were eligible for both VA and Medicare coverage. The

setting was outpatient healthcare facilities within the VA or under Medicare across the United States.

To identify the study cohort, we used the crosswalk file made

Objective: To examine the effect of exclusive and dual use of Department of Veterans Affairs (VA) and Medicare healthcare systems on outpatient predialysis nephrology care.

Study Design: Retrospective cohort study.

Methods: Receipt, timeliness, and intensity of predialysis nephrology care were evaluated among 8033 veterans who initiated dialysis in 2000 and 2001 and were eligible for both VA and Medicare coverage in the 12 months preceding dialysis initiation. Propensity scores were incorporated into analyses to minimize potential selection bias from nonrandom veteran allocation to healthcare systems.

Results: Among the cohort, 17.4% were users of VA services only (VA-only users), 38.5% were users of Medicare-covered services only (Medicare-only users), and 44.1% were users of both VA and Medicare-covered services (dual users). Sixty-six percent of VA-only and dual users and 58.1% of Medicare-only users received predialysis nephrology care. Compared with Medicare-only users, dual users were more likely (risk ratio [RR], 1.12; 95% confidence interval [CI], 1.07-1.17) and VA-only users were as likely (RR, 0.98; 95% CI, 0.88-1.08) to have received predialysis nephrology care. Compared with Medicare-only use, VA-only use (RR, 0.63; 95% CI, 0.50-0.81) and dual use (RR, 0.78; 95% CI, 0.70-0.88) were associated with a lower likelihood of late nephrology care (<3 months before dialysis initiation).

Conclusions: More than one-third of older veterans initiating dialysis do not receive nephrology care beforehand. Dual use of VA and Medicare-covered services was associated with greater receipt and favorable timeliness of predialysis nephrology care, while use of only Medicare-covered services was associated with late predialysis nephrology care. Further studies to identify reasons for system-level variations in access to predialysis nephrology care may assist in identifying opportunities for improvement.

(*Am J Manag Care.* 2010;16(2):e57-e66)

For author information and disclosures, see end of text.

In this article

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Published as a Web Exclusive
www.ajmc.com

Take-Away Points

More than one-third of older veterans have absent, infrequent, or late nephrology care before initiating dialysis. Dual use of Department of Veterans Affairs (VA) and Medicare-covered services was associated with more favorable patterns of predialysis nephrology care, while Medicare-only use was associated with less favorable patterns of care.

- This study emphasizes the critical need to improve access to nephrology care within VA and Medicare-covered services.
- Healthcare system–related factors strongly influence predialysis nephrology care; therefore, attention should focus on cultivating an effective healthcare infrastructure for individuals with chronic illness.
- Future work is needed to identify reasons for system-level variations in access to predialysis nephrology care.

Variables

Patient Characteristics. We obtained data on veteran characteristics from administrative files, the Medicare denominator file, and the USRDS patient and medical evidence files.^{27,29,30} The estimated glomerular filtration rate (eGFR) was calculated approximately 1 year before dialysis initiation using creatinine values from the VA Decision Support System Laboratory Results file³¹ using the simplified Modification of

Diet in Renal Disease formula.³² Comorbidities were determined from diagnostic and procedure codes in the inpatient and outpatient VA administrative files and Medicare claims data.³³ The VA priority level was defined as *high* for veterans with a service-connected condition or whose income was less than a VA-established annual threshold (VA priority groups 1-6), as *low* for veterans whose income was greater than the annual income threshold, and as *missing* for veterans for whom no designation was available.³⁴ To account for the socioeconomic status, we used the county unemployment rate from the Area Resource File³⁵ and zip code–based median household income and education information from the 2000 US Census Bureau data.³⁶ To account for access to care, we obtained county-level healthcare characteristics from the Area Resource File, including short-term hospital and physician density.³⁵ In addition to including veteran US Census Bureau region,³⁶ the urban or rural nature of a zip code was obtained from the VA Planning System Support Group.³⁷

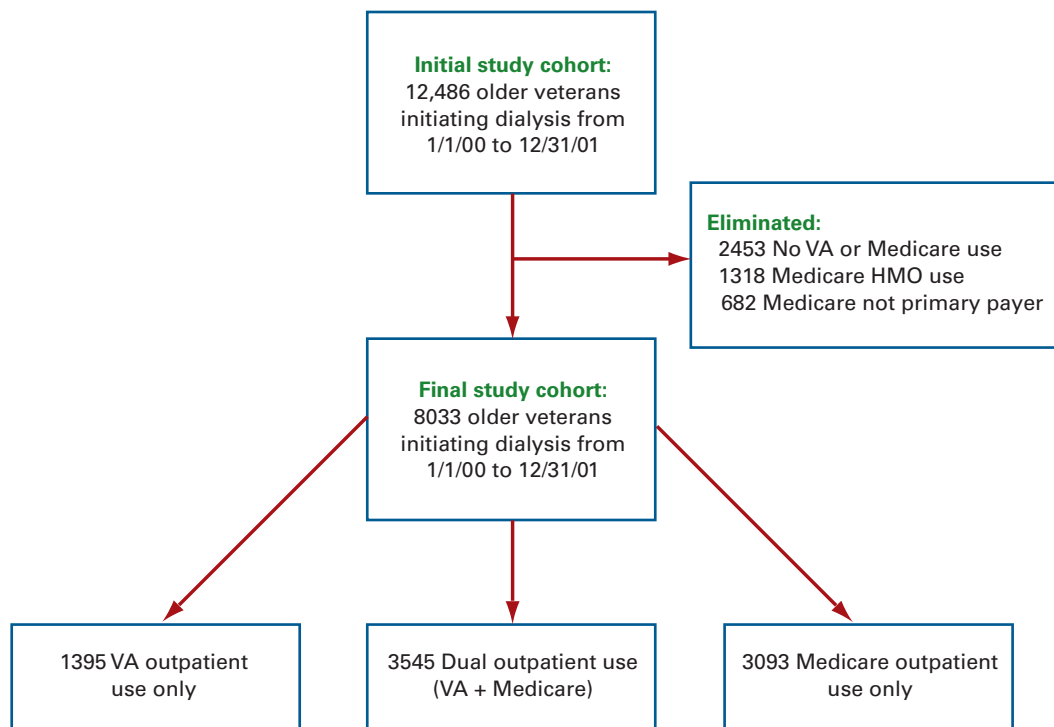
available to the VA Information Resource Center²⁶ from the United States Renal Data System (USRDS),²⁷ which identifies veterans eligible for VA services who have been registered as patients with ESRD. Veterans eligible for VA services were individuals who used VA healthcare services, were enrolled in the Veterans Health Administration, or received pension or compensation from the VA. Initiation of dialysis was identified using the USRDS national ESRD registry.²⁷ We limited the cohort to veterans initiating chronic dialysis between January 1, 2000, and December 31, 2001. Herein, we refer to renal replacement therapy (RRT) as dialysis, as 99.6% of the study cohort's RRT was chronic dialysis (0.4% underwent kidney transplantation). We defined the 12 months preceding dialysis initiation as the *predialysis period*.

To ensure that veterans were also eligible for Medicare-covered services throughout the predialysis period, we restricted our sample to veterans who were aged at least 66 years at dialysis initiation. To ensure adequate capture of healthcare utilization information, we excluded veterans who were enrolled in Medicare but did not have Medicare as their primary payer during this period, were enrolled in Medicare health maintenance organizations (HMOs), or had no healthcare use within the VA or Medicare during the predialysis period (Figure).¹¹

We further classified veterans by the healthcare systems in which they received outpatient healthcare services during the predialysis period as follows: (1) users of VA outpatient care services only (VA-only users), (2) users of both VA and Medicare-covered outpatient care services (dual users), and (3) users of Medicare-covered outpatient care services only (Medicare-only users). Adapting a previously developed algorithm,²⁸ healthcare system determination was made from VA or Medicare encounters in the following 4 types of outpatient care: primary care, specialty care, auxiliary clinic care, and psychiatric care. Any single VA or Medicare encounter for any of these 4 groups was considered evidence of healthcare use in that particular system.

Nephrology Care. We identified episodes of outpatient nephrology care during the 12-month predialysis period using VA outpatient administrative data and Medicare carrier files. *Nephrology care* was defined as the presence of any of the following during the predialysis period: nephrology clinic visit (VA), outpatient hypertension clinic visit with a nephrology provider (VA), and nephrology provider visit (Medicare). Because visits coded as level 1 in Medicare do not require interaction with a nephrology practitioner, these were excluded. Timeliness of nephrology care was characterized as the interval between the index nephrology visit and initiation of dialysis. *Late nephrology care* was defined as receipt of the index nephrology visit less than 3 months before dialysis initiation. *Early nephrology care* was defined as receipt of the index nephrology visit at least 9 months before dialysis initiation.^{3,4,8,17} Intensity of nephrology care was described as the number of nephrology visits by a patient during the predialysis period. *Low intensity of nephrology care* was defined as 3 visits or fewer during the predialysis period, while *high intensity of nephrology care* was defined as more than 6 visits

■ **Figure.** Assembly of Analytic Cohort



HMO indicates health maintenance organization; VA, Department of Veterans Affairs.

during this period.^{4,7} Patients with no nephrology visits were not included in these specific analyses.

Statistical Analysis

We compared the characteristics of veterans in each group (VA-only users, dual users, and Medicare-only users) and the patterns of nephrology care using χ^2 test, analysis of variance, and Kruskal-Wallis test as appropriate. We used generalized linear models (GLMs) with robust variance estimates to examine the adjusted association of healthcare system use with the probability of receipt of predialysis nephrology care in the overall cohort, timeliness of nephrology care, and intensity of nephrology care among those who received predialysis nephrology care.^{38,39} In the GLM framework, a distribution function describes the expected distribution of the outcome data, and a link function describes the scale on which the variables in the model are related to the outcome.⁴⁰ Using a Poisson distribution with a log-link function, we were able to calculate risk ratios (RRs) for these associations.

To adjust for the nonrandom selection of veterans into healthcare use groups, multivariable analyses incorporated a propensity score, which describes the probability that a veteran receives care in a particular setting based on his or her observed characteristics. To create propensity scores, a gener-

alized ordered logistic model was used to estimate 3 predicted probabilities for each patient (ie, VA-only user, dual user, or Medicare-only user), incorporating all available patient characteristics. The predicted probability of the group the veteran was actually in was then used to weigh each patient's observations in the multivariable analysis.⁴¹

Subgroup analyses of dual users were conducted in a similar manner by further classifying their preponderance of use of VA outpatient and Medicare-covered care.¹⁸ We used the proportion of the total number of outpatient care visits to a Medicare provider to compute patients' Medicare or VA reliance as follows: mostly Medicare users (>75% of outpatient care in Medicare), true dual users (25%-75% of outpatient care in Medicare), or mostly VA users (<25% of outpatient care in Medicare).

All analyses were performed using commercially available statistical software packages. These included SAS (version 9.1, SAS Institute, Cary, NC) and Stata (version 9.03, StataCorp LP, College Station, TX).

RESULTS

Participants

The final analytic cohort comprised 8033 veterans, after excluding 4453 veterans (2453 who did not receive outpa-

Table 1. Patient Characteristics Among Older Veterans Initiating Dialysis From 2000 to 2002

Characteristic	Overall (N = 8033)	VA-Only Users (n = 1395)	Dual Users (n = 3545)	Medicare-Only Users (n = 3093)	P
Age at dialysis initiation, y, No. (%)					<.001
66-74	3104 (38.6)	720 (51.6)	1323 (37.3)	1061 (34.3)	
>74	4929 (61.4)	675 (48.4)	2222 (62.7)	2032 (65.7)	
Male sex, No. (%)	7831 (97.5)	1378 (98.8)	3486 (98.3)	2967 (95.9)	<.001
Race, No. (%)					<.001
White	6521 (81.2)	856 (61.4)	3018 (85.1)	2647 (85.6)	
Black	1314 (16.4)	492 (35.3)	457 (12.9)	365 (11.8)	
Other	198 (2.5)	47 (3.4)	70 (2.0)	81 (2.6)	
Hispanic, No. (%)	470 (5.9)	117 (8.4)	191 (5.4)	162 (5.2)	<.001
Body mass index, mean (SD)^a	25.7 (5.3)	25.6 (5.4)	26.2 (5.3)	25.3 (5.2)	<.001
End-stage renal disease cause, No. (%)					<.001
Diabetes mellitus	3180 (39.6)	613 (43.9)	1443 (40.7)	1124 (36.3)	
Hypertension	2793 (34.8)	451 (32.3)	1230 (34.7)	1112 (36.0)	
Glomerulonephritis	501 (6.2)	68 (4.9)	225 (6.3)	208 (6.7)	
Other	1077 (13.4)	169 (12.1)	448 (12.6)	460 (14.9)	
Unknown or missing	482 (6.0)	94 (6.7)	199 (5.6)	189 (6.1)	
Comorbidities, No. (%)					
Diabetes mellitus	4417 (55.0)	830 (59.5)	2034 (57.4)	1553 (50.2)	<.001
Hypertension	7220 (89.9)	1257 (90.1)	3236 (91.2)	2727 (88.2)	<.001
Peripheral vascular disease	2041 (25.4)	321 (23.0)	944 (26.6)	776 (25.1)	<.05
Coronary artery disease	1862 (23.2)	275 (19.7)	896 (25.3)	691 (22.3)	<.001
Congestive heart failure	4546 (56.6)	684 (49.0)	2074 (58.5)	1788 (57.8)	<.001
Stroke	1228 (15.3)	203 (14.6)	570 (16.1)	455 (14.7)	NS
Chronic obstructive pulmonary disease	2633 (32.8)	439 (31.5)	1192 (33.6)	1002 (32.4)	NS
Additional insurance coverage, No. (%)					<.001
None	2753 (34.3)	985 (70.6)	1081 (30.5)	687 (22.2)	
Medicaid	850 (10.6)	161 (11.5)	315 (8.9)	374 (12.1)	
Private	4430 (55.1)	249 (17.8)	2149 (60.6)	2032 (65.7)	
VA priority level, No. (%)					<.001
High	5298 (66.0)	1316 (94.3)	2635 (74.3)	1347 (43.5)	
Low	1656 (20.6)	56 (4.0)	805 (22.7)	795 (25.7)	
Missing	1079 (13)	23 (1.6)	105 (3.0)	951 (30.7)	
College graduate, median (IQR), %	17.2 (12.1-26.0)	15.4 (10.5-24.9)	16.8 (12.1-25.3)	18.1 (12.6-27.8)	<.001
Median (IQR) household income, \$1000	36.7 (30.6-46.2)	34.6 (27.4-42.7)	36.3 (30.8-45.5)	38.0 (31.7-49.0)	<.001
Unemployment, median (IQR), %	4.0 (3.1-5.7)	4.0 (3.2-5.7)	4.1 (3.2-5.7)	4.0 (3.1-5.5)	<.05
Physician density, per 1000, median (IQR)	1.8 (1.1-2.7)	2.2 (1.2-3.3)	1.7 (0.9-2.5)	1.8 (1.1-2.6)	<.001
Hospital density, per 1 million, median (IQR)	14.0 (9.4-25.8)	13.1 (9.2-21.2)	14.7 (9.7-28.4)	13.7 (9.4-24.8)	<.001
Type of zip code, No. (%)					<.001
Urban	6530 (81.3)	1174 (84.2)	2821 (79.6)	2535 (82.0)	
Rural	1503 (18.7)	221 (15.8)	724 (20.4)	558 (18.0)	
Region, No. (%)					<.001
Northeast	1581 (19.7)	217 (15.8)	694 (19.6)	670 (21.7)	
Midwest	2106 (26.2)	339 (24.3)	984 (27.8)	783 (25.3)	
South	3128 (38.9)	553 (39.6)	1375 (38.8)	1200 (38.8)	
West	1081 (13.5)	238 (17.1)	435 (12.3)	408 (13.2)	
Territory	137 (1.7)	48 (3.4)	57 (1.6)	32 (1.0)	

IQR indicates interquartile range; VA, Department of Veterans Affairs.
^aCalculated as weight in kilograms divided by height in meters squared.

Predialysis Nephrology Care Among Older Veterans

Table 2. Receipt, Timeliness, and Intensity of Predialysis Nephrology Care Among Older Veterans Initiating Dialysis From 2000 to 2002

Variable	No. (%)				P
	Overall (N = 8033)	VA-Only Users (n = 1395)	Dual Users (n = 3545)	Medicare-Only Users (n = 3093)	
Receipt of predialysis nephrology care among the cohort					<.001
Yes	5059 (63.0)	925 (66.3)	2337 (65.9)	1797 (58.1)	
No	2974 (37.0)	470 (33.7)	1208 (34.1)	1296 (41.9)	
Among those receiving predialysis nephrology care	(N = 5059)	(n = 925)	(n = 2337)	(n = 1797)	
Timeliness, months before dialysis					<.001
Late, <3	1305 (25.8)	150 (16.2)	575 (24.6)	580 (32.3)	
Intermediate, 3 to <9	1509 (29.8)	263 (28.4)	702 (30.0)	544 (30.3)	
Early, ≥9	2245 (44.4)	512 (55.4)	1060 (45.4)	673 (37.5)	
Intensity, visits before dialysis					<.001
Low, ≤3	1908 (37.7)	342 (37.0)	818 (35.0)	748 (41.6)	
Intermediate, 4-6	1330 (26.3)	293 (31.7)	612 (26.2)	425 (23.7)	
High, >6	1821 (36.0)	290 (31.4)	907 (38.8)	624 (34.7)	

tient care from the VA or Medicare during the predialysis period, 1318 who were enrolled in Medicare managed care plans, and 682 who did not have Medicare as their primary payer (Figure). Slightly more than 17% of veterans were categorized as VA-only users (n = 1395), 44.1% as dual users (n = 3545), and 38.5% as Medicare-only users (n = 3093).

Descriptive Data

More than 80% of the cohort were older non-Hispanic white veterans from all regions of the United States (Table 1). Considerable heterogeneity existed among the 3 user groups in terms of race/ethnicity, additional insurance coverage, VA priority level, education, and median household income, whereas the groups were similar in regard to other characteristics. Although eGFR values were unavailable for most dual users and Medicare-only users, more than 75% of VA-only users had an eGFR of less than 30 mL/min/m² approximately 1 year before dialysis initiation.

Main Analysis

Receipt, Timeliness, and Intensity of Predialysis Nephrology Care. The median (interquartile range) total numbers of primary and specialty care visits during the predialysis period were 16 (9-25) visits for VA-only users, 23 (15-33) visits for dual users, and 17 (9-28) visits for Medicare-only users. The proportion of older veterans having any nephrology care visits during the predialysis period ranged from 58.1%

for Medicare-only users to 65.9% for dual users and 66.3% for VA-only users (Table 2) (P <.001). Among veterans receiving predialysis nephrology care, Medicare-only users had the highest proportion (32.3%) receiving late nephrology care compared with dual users (24.6%) and VA-only users (16.2%) (P <.001). Furthermore, the proportion of VA-only users (55.4%) obtaining early nephrology care was significantly greater compared with dual users (45.4%) and Medicare-only users (37.5%) (P <.001). In terms of intensity, smaller percentages of dual users (35.0%) and VA-only users (37.0%) compared with Medicare-only users (41.6%) had a low intensity of nephrology care during the predialysis period (P <.001). Likewise, dual users had the largest percentage of high-intensity nephrology care (38.8%) relative to VA-only users (31.4%) and Medicare-only users (34.7%).

Independent Association of Factors With Predialysis Nephrology Care. Dual use was independently associated with a 12% greater likelihood (RR, 1.12; 95% confidence interval [CI], 1.07-1.17) of receiving predialysis nephrology care, with an 11% greater likelihood (RR, 1.11; 95% CI, 1.01-1.22) of receiving such care in high intensity, and with a 22% lower likelihood (RR, 0.78; 95% CI, 0.70-0.88) of receiving such care late relative to Medicare-only use (P <.001) (Table 3). The VA-only users were as likely as the Medicare-only users to have received nephrology care (RR, 0.98; 95% CI, 0.88-1.08) and to have received such care in high intensity (RR, 0.88; 95% CI, 0.72-1.07) but were far

■ **Table 3.** Factors Associated With Receipt, Timeliness, and Intensity of Predialysis Nephrology Care Among Older Veterans Initiating Dialysis From 2000 to 2002

Factor	Adjusted Risk Ratio (95% Confidence Interval)		
	Receipt of Predialysis Nephrology Care (N = 8033)	High-Intensity Predialysis Nephrology Care (n = 5059)	Late Predialysis Nephrology Care (n = 5059)
Outpatient care			
VA-only users	0.98 (0.88-1.08)	0.88 (0.72-1.07)	0.63 (0.50-0.81)
Dual users	1.12 (1.07-1.17)	1.11 (1.01-1.22)	0.78 (0.70-0.88)
Medicare-only users	1 [Reference]	1 [Reference]	1 [Reference]
Age at dialysis initiation, y			
66-74	1 [Reference]	1 [Reference]	1 [Reference]
>74	0.93 (0.87-1.00)	1.03 (0.92-1.15)	0.82 (0.69-0.97)
Female sex	0.82 (0.68-1.00)	0.97 (0.69-1.36)	0.92 (0.62-1.35)
Race			
White	1 [Reference]	1 [Reference]	1 [Reference]
Black	1.07 (0.99-1.17)	0.90 (0.76-1.06)	0.97 (0.76-1.25)
Other	1.02 (0.90-1.16)	0.61 (0.42-0.87)	0.99 (0.71-1.38)
Hispanic	1.06 (0.93-1.20)	1.01 (0.81-1.27)	0.86 (0.64-1.14)
Body mass index	1.00 (0.99-1.01)	1.01 (0.99-1.02)	0.99 (0.97-1.00)
Comorbidities			
Diabetes mellitus	1.02 (0.94-1.10)	1.17 (1.04-1.32)	0.99 (0.84-1.15)
Hypertension	1.89 (1.67-2.15)	1.61 (1.28-2.02)	0.62 (0.53-0.73)
Peripheral vascular disease	0.95 (0.87-1.04)	0.87 (0.77-1.00)	1.21 (0.99-1.47)
Coronary artery disease	0.98 (0.89-1.08)	0.93 (0.79-1.10)	0.80 (0.63-1.00)
Congestive heart failure	0.96 (0.90-1.03)	0.79 (0.71-0.88)	1.05 (0.89-1.24)
Stroke	0.97 (0.90-1.04)	0.97 (0.84-1.11)	0.88 (0.73-1.06)
Chronic obstructive pulmonary disease	0.88 (0.82-0.95)	1.04 (0.90-1.20)	1.04 (0.88-1.23)
Additional insurance coverage			
None	1.06 (0.99-1.15)	0.87 (0.77-0.98)	1.19 (1.02-1.39)
Medicaid	1.00 (0.87-1.15)	0.73 (0.58-0.93)	1.15 (0.86-1.53)
Private	1 [Reference]	1 [Reference]	1 [Reference]
VA priority level			
High	1 [Reference]	1 [Reference]	1 [Reference]
Low	0.97 (0.90-1.05)	1.13 (0.99-1.28)	1.02 (0.86-1.22)
Missing	0.95 (0.78-1.14)	0.72 (0.50-1.04)	1.45 (1.03-2.03)
College graduate	1.32 (0.96-1.82)	2.00 (1.13-3.54)	1.61 (0.50-5.23)
Median household income	1.00 (0.99-1.00)	1.00 (1.00-1.01)	1.00 (0.99-1.01)
Unemployment	0.99 (0.98-1.01)	0.99 (0.96-1.01)	1.01 (0.98-1.05)
Physician density	1.00 (0.99-1.02)	1.00 (0.97-1.04)	0.99 (0.94-1.04)
Hospital density	1.00 (0.99-1.00)	1.00 (0.99-1.00)	1.00 (1.00-1.01)
Type of zip code			
Urban	1 [Reference]	1 [Reference]	1 [Reference]
Rural	0.93 (0.82-1.04)	1.04 (0.89-1.21)	1.00 (0.84-1.21)
Region			
Northeast	0.95 (0.87-1.04)	1.06 (0.91-1.23)	0.97 (0.80-1.18)
Midwest	0.91 (0.83-1.00)	0.84 (0.72-0.97)	1.08 (0.87-1.34)
South	1 [Reference]	1 [Reference]	1 [Reference]
West	0.88 (0.81-0.96)	0.81 (0.70-0.95)	0.90 (0.74-1.10)
Territory	0.90 (0.72-1.13)	0.60 (0.36-1.01)	1.24 (0.74-2.07)

VA indicates Department of Veterans Affairs.

less likely to have received such care late (RR, 0.63; 95% CI, 0.50-0.81) ($P < .001$).

Subgroup Analysis of Preponderance of Dual Use

In a subgroup analysis of dual users, 49.4% were found to be mostly Medicare users, 29.3% were true dual users, and 21.3% were mostly VA users. Receipt of predialysis nephrology care was significantly different among mostly VA users (71.7%), mostly Medicare users (64.8%), and true dual users (63.6%) ($P < .001$). However, no independent associations were found between the type of dual use and the receipt of predialysis nephrology care in adjusted analyses ($P > .05$).

DISCUSSION

A significant number of older veterans who initiate chronic dialysis are not receiving adequate predialysis nephrology care, regardless of their type of healthcare system. Consistent with prior studies^{6,11} among older Medicare recipients, more than one-third of older veterans in our study did not receive any nephrology care before dialysis initiation. Even when these veterans received nephrology care, almost one-third received such care infrequently and late in the course of their CKD. These observations are also in keeping with those reported in prior literature in which rates of late referral ranged from 22% to 50% depending on the particular definition used.³⁻¹⁷ Fewer studies^{4,6,11} focused on intensity of nephrology care, but they found that up to 50% of older individuals with incident ESRD receive fewer than 5 visits with a nephrologist before beginning dialysis. Collectively, our findings highlight the delivery of predialysis nephrology care as an important target for quality improvement within the VA and under Medicare.

A single study³ to date examined the relationship between healthcare system-related factors and receipt of predialysis nephrology care, finding that HMO participants were almost 5 times more likely to be referred late for predialysis nephrology care compared with non-HMO participants. However, that study was limited by its small sample size and by a single urban site of care. The differences reported in our study between Medicare-only users and VA-only users are modest by comparison. The uniformly low rates of nephrology referral among older veterans across 2 different healthcare systems observed in this study indicate that there may be some common barriers to predialysis nephrology care. Low rates of referral probably reflect pervasive challenges in identifying those older patients who are most likely to progress to ESRD requiring dialysis and in educating primary care providers (PCPs) about recommended CKD care practices. Because the ratio of patients with CKD to practicing nephrologists continues to increase, PCPs will likely remain the main providers man-

aging CKD, its complications, and relevant comorbid conditions, especially among patients with early CKD.^{42,43} Further targeted educational tools for PCPs, improved coordination of care between nephrologists and PCPs, enhancement of resources for PCPs to evaluate complex chronically ill patients, and modification of incentives for subspecialty referral should be considered.⁴³⁻⁴⁷ Future research efforts to support PCP referral decisions, to develop methods for identifying patients who will benefit most from nephrology care, and to study novel ways of healthcare delivery (eg, multidisciplinary care clinics) for patients at greatest risk of ESRD may be helpful in improving rates of nephrology referral across systems.^{42,43,47}

However, the healthcare system seemed to be a strong determinant of timeliness of predialysis nephrology care. Compared with Medicare-only use, VA-only use was independently associated with a 47% lesser likelihood of late nephrology care. Several differences between the VA and Medicare systems likely explain this observation. First, the VA's healthcare restructuring in 1995 led to quality improvement in chronic disease management through the use of information technology (eg, the electronic health record), integration of services, and measurement and reporting of performance.⁴⁸⁻⁵¹ In contrast to Medicare, PCPs and nephrologists use the same integrated electronic health record, which may facilitate exchange of information and care coordination. Second, within its clinical information system, the VA has Web-based clinical practice guidelines for its providers that detail screening and referral for CKD.⁵¹ Suboptimal understanding of CKD by providers and poor communication among multiple providers and patients, which are cited as frequent causes of untimely nephrology referrals, are likely attenuated in this setting.^{1,7,10,17} Third, perverse financial incentives to curtail access to nephrology care are less likely to exist within the VA, where primary healthcare provider compensation is unaffected by subspecialty referral, in contrast to Medicare's fee-for-service environment. The PCPs may be reluctant to refer patients for subspecialty care because of concerns about loss of clinical responsibility and financial income.^{1,3,10,15} Fourth, copayments for nephrology visits by veterans with high priority scores are free within the VA, while such care necessitates out-of-pocket costs under Medicare. This lesser financial barrier may also contribute to the more timely receipt of predialysis nephrology care within the VA. In several quality process measures for patients with diabetes (eg, annual eye examinations), the VA has been found to outperform Medicare.⁴⁸ The failure of the VA to surpass Medicare in patient receipt of nephrology care may be related to the absence of a specific VA quality improvement initiative for CKD and the unavailability of subspecialty nephrology care at some VA outpatient facilities.

These findings extend prior work evaluating multiple healthcare system use among veterans by focusing on subspecialty medical care for complex chronic illness. While a recent study⁵² found similar rates of recommended ambulatory care services among exclusive VA users and dual users of VA and non-VA services, dual use of the VA and Medicare in our study was strongly and consistently associated with the most favorable patterns of predialysis nephrology care. The superiority of dual use is surprising given prior concerns that use of multiple systems would increase fragmentation of care delivery and diminish continuity of care.¹⁹ Insufficient continuity of care for individuals with chronic complex illnesses has been suggested as a reason for worse disease recognition and for higher rates of missed patient appointments, which would negatively affect receipt of nephrology care for CKD.²³⁻²⁵ On the other hand, it has been argued that dual use might be beneficial by allowing individuals to choose and obtain the spectrum of services that they need in the most efficient and flexible means possible.^{18,22} The latter scenario seems to hold true in this study. In addition to more frequent nephrology care, dual users had significantly more visits with other specialty care physicians and PCPs, which may afford more opportunities for CKD recognition and contribute to the higher levels of referral to a nephrologist. Furthermore, although we accounted for many differences in patient characteristics and found some socioeconomic factors (eg, Medicaid coverage and education) associated with predialysis nephrology care, it is difficult to account for the role of more qualitative factors such as health literacy, social support, and lifestyle factors.⁸ These unmeasured patient-related factors may also account for the superior acquisition of subspecialty nephrology care among dual users compared with single-system users.⁵²

There are limitations to this study. First, selection bias could affect our findings because veterans were allocated to healthcare system groups in a nonrandom manner and some characteristics differed between these groups. However, a robust number of important covariates and a propensity score method were used in our analyses to minimize this concern.⁴⁰ Second, the generalizability of these findings beyond older veterans, a largely vulnerable male group with a distinct healthcare culture, is uncertain. Third, the data for this analysis are several years old, and nephrology referral patterns may have changed. A more contemporary evaluation is impossible because of ongoing prohibitions linking VA and Medicare data for research. Educational CKD campaigns have evolved nationally, and automated eGFR reporting has become more common in the past few years, which seems to increase nephrology referrals in settings outside of the United States.⁵³⁻⁵⁵ However, neither the guidelines for nephrology referral of patients with severe CKD nor the rates of predialysis nephrol-

ogy care in recent American investigations have changed.¹⁶ It would also be unlikely for automated eGFR reporting to have a differential effect on delivery of nephrology care in the VA compared with Medicare. Nonetheless, the absence of current data limits our ability to examine the effect of automated eGFR reporting on current nephrology referral patterns. Fourth, predialysis nephrology care could be undercaptured in veterans with additional private insurance. However, because all veterans in this cohort were eligible for VA- and Medicare-covered services, where Medicare was their primary payer, ascertainment bias is unlikely. Fifth, individuals with an accelerated decline in kidney function or irreversible acute kidney injury (AKI), where a reasonable opportunity for predialysis nephrology care is not possible, may be present in our study cohort; however, irreversible AKI has been found to be the cause of late nephrology care in only 10% of cases,³ and most study subjects with available serum creatinine measurements met guideline criteria for nephrology referral 1 year before dialysis initiation.⁵⁶ Sixth, because all patients in this study initiated dialysis, we cannot comment on the predialysis nephrology care of patients with CKD who did not reach ESRD because of death or less severe kidney disease.

More than one-third of older veterans initiating dialysis have absent, infrequent, or late predialysis nephrology care, regardless of where they receive most of their care. These findings highlight the critical importance of efforts to improve access to nephrology care under Medicare and within the VA. Results of this study suggest that features of the healthcare system, including integrated clinical information systems, care coordination, and incentive structure, may influence predialysis nephrology care. Identifying what these factors are and how patients make choices when dual care is available may also lead to improvement in nephrology referral.

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Funding Source: The authors received funding support for this research project from the Department of Veterans Affairs, Veterans Health Administration, Health Services Research and Development Service (VA HSR&D IIR 02-244 and IIR 20-016 to KTS, MMB, and DMH; VA HSR&D Research Career Scientist Award to DMH; and VA HSR&D Career Development Award to MJF); from the National Kidney Foundation of Illinois (to MJF); and from the National Institutes of Health (NIH K23AG28980 to AMO). The views expressed in this article are those of the authors and do not necessarily represent the views of the Department of Veterans Affairs or Health Services Research and Development Service.

Author Disclosure: Dr O'Hare reports receiving grants from the Centers for Disease Control and Prevention and the National Institutes of Health. She also reports receiving lecture fees and attending meetings on behalf of the Japanese Society for Foot Care, American Society of Nephrology, and the

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American Geriatric Society. The other authors (MJF, KTS, JSK, MMB, ZH, DMH) report no relationship or financial interest with any entity that would pose a conflict of interest with the subject matter of this article.

Authorship Information: Concept and design (KTS, JSK, AMO, DMH); acquisition of data (KTS, ZH, DMH); analysis and interpretation of data (MJF, KTS, JSK, MMB, ZH, DMH); drafting of the manuscript (MJF, JSK, AMO, MMB, ZH, DMH); critical revision of the manuscript for important intellectual content (MJF, KTS, JSK, AMO, MMB, DMH); statistical analysis (MJF, KTS, ZH, DMH); obtaining funding (KTS, DMH); administrative, technical, or logistic support (KTS, MMB, DMH); and supervision (DMH).

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