Arteriovenous Fistulas among Incident Hemodialysis Patients in Department of Defense and Veterans Affairs Facilities

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ABSTRACT

A higher proportion of patients initiate hemodialysis (HD) with an arteriovenous fistula (AVF) in countries with universal health care systems compared with the United States. Because federally sponsored national health care organizations in the United States, such as the Department of Veterans Affairs (DVA) and the Department of Defense (DoD), are similar to a universal health care model, we studied AVF use within these organizations. We used the US Renal Data System database to perform a cross-sectional analysis of patients who initiated HD between 2005 and 2006. Patients who received predialysis nephrology care had 10-fold greater odds of initiating dialysis with an AVF (adjusted odds ratio [aOR] 10.3; 95% confidence interval [CI] 9.6 to 11.1). DVA/DoD insurance also independently associated with initiating HD with an AVF (aOR 1.4; 95% CI 1.2 to 1.5). Fewer patients initiated HD at a DoD facility, but these patients were also approximately twice as likely to use an AVF (aOR 2.3; 95% CI 1.2 to 4.6). In conclusion, patients in DVA/DoD systems are significantly more likely to use an AVF at initiation of HD than patients with other insurance types, including Medicare. Further study of these federal systems may identify practices that could improve processes of care across health care systems to increase the number of patients who initiate HD with an AVF.

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In the United States, currently >20 million individuals have chronic kidney disease (CKD), including >350,000 dialysis patients, whose number is expected to surpass half a million by 2020,[1] and vascular access accounts for a significant proportion of overall Medicare dialysis costs.[2] The arteriovenous fistula (AVF) is still considered the best access for hemodialysis (HD) because of low complication rate, superior access survival, and decreased mortality when compared with either arteriovenous grafts or central venous dialysis catheters.[3–7] Because AVF requires fewer angiographic procedures and revisions, use of an AVF can also reduce the cost of vascular access–related care up to fivefold,[8,9] and multiple sources suggest that use of an AVF is cost-effective when compared with other vascular accesses.[10,11]

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Ideally, the AVF is placed and ready to use at the initiation of HD, but this process is highly dependent on predialysis nephrology care.[12,13] In the United States, this complex process generally requires early nephrology referral, selection of HD as preferred dialysis modality, estimation of time to HD, surgical referral, vascular imaging, preoperative evaluation, operative procedure, frequent follow-up visits to assess AVF maturation, and sometimes repeat surgical procedures. Understandably, the best AVF outcomes are observed when a multidisciplinary case management approach is used.[14–16] In addition to care coordination, this process requires adequate predialysis insurance coverage. Although Medicare covers costs after the initiation of HD, care before that is dependent on the patient's insurance type.

Historically, AVF rates have varied significantly by country. The Dialysis Outcomes and Practice Patterns Study (DOPPS) assessed patient outcomes at 145 US HD units and 101 HD units in five European countries. In 2002, Pisoni *et al.*[17] reported vast differences in the use of AVFs in both prevalent (80% Europe *versus* 24% United States) and incident HD patients (66% Europe *versus* 15% United States) even after adjusting for patient characteristics. In a more recent DOPPS, Ethier *et al.*[18] found that from 1996 through 2007, use of AVFs in prevalent HD patients increased from 24 to 47% in the United States, presumably related to the Fistula First National Vascular Access Improvement Initiative; however, use of AVFs in incident HD patients remained unchanged at 16% in the United States compared with higher rates in the other countries studied (26% in Canada, 26 to 72% in Europe, 50% in Australia/New Zealand, and 69% in Japan) and remains well below the goal of 50% (13.7% in 2008) set by the Fistula First Initiative.[19]

Interestingly, the countries in which the majority of patients initiate HD with an AVF have universal health care systems, which could influence the increased AVF rate *via* universal coverage of predialysis care. This prompted us to evaluate the use of AVF as initial HD access in federally sponsored national health care organizations such as the Departments of Veterans Affairs (DVA) and Department of Defense (DoD), which provide a similar model of universal health care in the United States.

RESULTS

A total of 129,525 patients who had available Centers for Medicare and Medicaid Services (CMS) Form 2728 data initiated HD during this study period. Of these, 17,110 (13.2%) initiated HD with an AVF. Of those who did not initiate HD with an AVF, 21,874 (16.9%) had a maturing AVF in place. Among different recorded insurers, proportions of patients who started with an AVF were as follows: DVA/DoD, 27.2%; employer group, 18.5%; other insurance, 16.7%; Medicare, 15.6%; Medicaid, 13.0%; and none, 8.2%. Patients who initiated HD in the DVA/DoD system were more likely to have initiated with an AVF (unadjusted odds ratio [OR] 1.82; 95% confidence interval [CI] 1.67 to 1.98; $P < 0.001$) and less likely to have initiated HD with a catheter (73.1 *versus* 80.6%; unadjusted OR 0.65; 95% CI 0.60 to 0.71; $P < 0.001$) compared with patients who initiated HD at non-DVA/DoD centers.

We found that patients in DVA/DoD systems had differing demographic variables compared with other insurance types (Table 1). Factors associated with AVF use at HD initiation are shown in Table 2. Patients who initiated HD with an AVF were more likely to have insurance through Medicare, DVA/DoD, employer group, or other, unspecified insurance and less likely to have Medicaid or no insurance (Table 2). In the final adjusted model, predialysis nephrology care was the greatest independent correlate of initiating HD with AVF (adjusted OR [aOR] 10.3; 95% CI 9.6 to 11.0; $P < 0.001$); however, independent of this, DVA/DoD insurance was also associated with initiating HD with an AVF (aOR 1.4; 95% CI 1.2 to 1.5; $P < 0.001$). Other factors associated with AVF are shown in Table 3.

In a sensitivity analysis that examined only patients who were aged ≥66 years, Medicare coverage was not significantly associated with AVF (aOR 1.05; 95% CI 0.96 to 1.16; $P = 0.273$); however, DVA/DoD insurance was still independently associated with AVF use on initiation of HD in this model (aOR 1.35; 95% CI 1.17 to 1.57; $P < 0.001$). We also assessed the affect of dual insurance coverage on this outcome by adding four interaction terms (DVA/DoD combined with Medicare, Medicaid, employer group, or other) to the final model, and none of the interactions was significant.

In the primary analysis, DVA/DoD status was analyzed as a composite variable of insurance coverage on the basis of the type of facility in which they initiated HD and type of insurance identified on the Medical Evidence Form. In a sensitivity analysis, we obtained similar results of AVF initiation by looking specifically at patients who initiated HD at a federal facility (aOR 1.3; 95% CI 1.1 to 1.4; $P < 0.001$) or who were identified as having DVA insurance on the CMS Form 2728 (aOR 1.4; 95% CI 1.2 to 1.6; $P < 0.001$). Compared with DVA, there were fewer patients in the DoD category. When looking specifically at patients who initiated HD at a DoD facility, the aOR of primary AVF use at initiation was 2.3 (95% CI 1.2 to 4.6; $P = 0.017$).

DISCUSSION

Although Medicare provides universal coverage to all patients after the start of HD regardless of age, predialysis care is not universally covered and is dependent on existing insurance plans before Medicare eligibility. Our null hypothesis was that there will be no difference in the access used at HD initiation between patients with and without DVA/DoD insurance benefits as a model of universal health care among DVA/DoD beneficiaries.

Despite the presence of adverse factors, such as older age and higher prevalence of medical comorbid conditions, sub-

Table 1. Baseline characteristics of patients who initiated HD in 2005 through 2006 in the USRDS database by insurance status

Characteristic	DVA/DoD (*n* = 3202)	Non-DVA/DoD (*n* = 126,323)	*P*
Demographics			
age (years; mean ± SD)	64.5 ± 12.6	63.3 ± 15.5	<0.001
male gender (*n* [%])	2891 (90.3)	69,133 (54.7)	<0.001
race (*n* [%])			
black	1128 (35.2)	36,608 (29.0)	<0.001
Asian	29 (0.9)	3756 (3.0)	<0.001
Hispanic	292 (9.1)	16,797 (13.3)	<0.001
white	1959 (61.2)	83,024 (65.7)	<0.001
BMI (mean ± SD)	27.9 ± 6.6	28.4 ± 7.7	<0.001
Comorbid conditions (*n* [%])			
coronary artery disease	833 (26.0)	28,587 (22.6)	<0.001
hypertension	2757 (86.1)	105,058 (83.2)	<0.001
diabetes	1838 (57.4)	65,233 (51.6)	<0.001
congestive heart failure	937 (29.3)	44,185 (35.0)	<0.001
peripheral vascular disease	780 (24.4)	28,201 (22.3)	0.007
COPD	336 (10.5)	11,535 (9.1)	0.009
cancer	313 (9.8)	9568 (7.6)	<0.001
tobacco use	316 (9.9)	7796 (6.2)	<0.001
nonambulatory	240 (7.5)	9115 (7.2)	0.536
ESRD cause (*n* [%])			
diabetes	1543 (48.2)	56,188 (44.5)	<0.001
hypertension	702 (21.9)	31,745 (25.1)	<0.001
glomerulonephritis	221 (6.9)	8537 (6.8)	0.752
PKD	53 (1.7)	2351 (1.9)	0.424
ARF nonrecovery	95 (3.0)	3379 (2.7)	0.319
other	588 (18.4)	24,123 (19.1)	0.306
Predialysis nephrology care (11.2% missing; *n* [%])	2218 (74.5)	72,350 (64.6)	<0.001
Access at HD initiation (*n* [%])			
catheter	2341 (73.1)	101,796 (80.6)	<0.001
AVG	114 (3.6)	6078 (4.8)	0.001
AVF	684 (21.4)	16,426 (13.0)	<0.001
maturing AVF	509 (20.2)	21,365 (19.4)	0.334
Employment status (*n* [%])			
unemployed	450 (14.1)	26,584 (21.0)	<0.001
employed	244 (7.6)	12,549 (9.9)	<0.001
retired	1260 (39.4)	50,707 (40.1)	0.371
disabled	1160 (36.2)	26,169 (20.7)	<0.001
medical leave	47 (1.5)	4128 (3.3)	<0.001

Data are based on CMS Form 2728 (Medical Evidence). AVG, arteriovenous graft; ARF, acute renal failure; BMI, body mass index; COPD, chronic obstructive pulmonary disease; PKD, polycystic kidney disease.

stantially more patients in the DVA/DoD system initiated HD *via* an AVF. As expected, nephrology care in the year before HD was the greatest independent correlate of AVF at HD initiation on multivariate analysis; however, even after adjustment for this, DVA/DoD insurance was still significantly associated with AVF on multivariate analysis. Potential reasons for this association include greater access to subspecialty care, use of electronic health records, case management services, colocation with surgeons, and defined referral algorithms. Since 2001, the DVA and DoD have had integrated clinical practice guidelines for the management of CKD and pre-ESRD, which are made available to primary care physicians in their respective systems. The guidelines are in place to assist primary care physicians in the early recognition and management of CKD, including preservation of forearm veins to maximize the possibility of future AVF placement.[20] The current guidelines are available on the internet.[21]

Similar patterns were noted in the Translating Research Into Action in Diabetes (TRIAD) study, which was reported in 2004. That study demonstrated improved quality of diabetes care in the DVA system compared with eight commercial managed care organizations. Potential reasons for their findings included the implementation of several simultaneous national-level strategies such as an integrated electronic medical record, unified nationwide guidelines, service integration, alignment of payment incentives, and effective performance monitoring.[22] In contrast, a recent publication showed that DVA patients were less likely to be placed on the waiting list or

Table 2. Baseline characteristics of patients who initiated HD in 2005 through 2006 in the USRDS database by initial vascular access

Variable	AVF (n = 17,110)	Non-AVF (n = 112,387)	P
Age (mean ± SD)	63.2 ± 14.6	63.4 ± 15.6	0.129
Age groups (n [%])			<0.001
≤24.9	138 (0.8)	1573 (1.4)	
25.0 to 34.9	584 (3.4)	4435 (3.9)	
35.0 to 44.9	1324 (7.7)	8972 (8.0)	
45.0 to 54.9	2699 (15.8)	17,145 (15.3)	
55.0 to 64.9	4034 (23.6)	24,200 (21.5)	
65.0 to 74.9	4235 (24.8)	26,011 (23.1)	
≥75.0	4096 (23.9)	30,051 (26.7)	
Male gender (n [%])	11,244 (65.7)	60,764 (54.1)	<0.001
Race (n [%])			
black	4353 (25.4)	33,381 (29.7)	<0.001
Asian	641 (3.7)	3141 (2.8)	<0.001
Hispanic	1990 (11.6)	15,096 (13.4)	<0.001
white	11,718 (68.5)	73,242 (65.2)	<0.001
BMI (mean ± SD)	28.5 ± 7.2	28.4 ± 7.7	0.006
BMI groups (n [%])			<0.001
≤18.49	525 (3.1)	4922 (4.4)	
18.50 to 24.99	5450 (32.3)	37,536 (33.9)	
25.00 to 30.00	5086 (30.2)	31,121 (28.1)	
≥30.01	5803 (34.4)	37,075 (33.5)	
Comorbid conditions (n [%])			
diabetes	8653 (50.6)	58,411 (52.0)	0.001
hypertension	14,928 (87.2)	92,867 (82.6)	<0.001
coronary artery disease	3884 (22.7)	25,535 (22.7)	0.960
congestive heart failure	4620 (27.0)	40,502 (36.0)	<0.001
peripheral vascular disease	3498 (20.4)	25,483 (22.7)	<0.001
COPD	1274 (7.4)	10,595 (9.4)	<0.001
cancer	1126 (6.6)	8755 (7.8)	<0.001
tobacco use	1068 (6.2)	7044 (6.3)	0.918
nonambulatory	519 (3.0)	8836 (7.9)	<0.001
ESRD cause (n [%])			
diabetes	7740 (45.2)	49,985 (44.5)	0.063
hypertension	4315 (25.2)	28,130 (25.0)	0.596
glomerulonephritis	1624 (9.5)	7128 (6.3)	<0.001
PKD	788 (4.6)	1613 (1.4)	<0.001
ARF nonrecovery	50 (0.3)	3424 (3.0)	<0.001
other	2593 (15.2)	22,107 (19.7)	<0.001
Predialysis nephrology care (11.2% missing; n [%])	15,459 (94.6)	59,086 (59.9)	<0.001
Insurance (n [%])			
Medicare	10,143 (59.3)	64,963 (57.8)	<0.001
Medicaid	3940 (23.0)	30,343 (27.0)	<0.001
DVA/DoD	684 (4.0)	2518 (2.2)	<0.001
employer group	5206 (30.4)	28,112 (25.0)	<0.001
other	4299 (25.1)	25,701 (22.9)	<0.001
none	732 (4.3)	8894 (7.9)	<0.001
Employment status (n [%])			
unemployed	2808 (16.4)	24,221 (21.6)	<0.001
employed	2357 (13.8)	10,425 (9.3)	<0.001
retired	7068 (41.3)	44,895 (39.9)	0.001
disabled	3843 (22.5)	23,482 (20.9)	<0.001
medical leave	344 (2.0)	3830 (3.4)	<0.001

Data are based on CMS Form 2728 (Medical Evidence). ARF, acute renal failure; BMI, body mass index; COPD, chronic obstructive pulmonary disease; PKD, polycystic kidney disease.

Table 3. Multivariate logistic regression analysis of factors associated with use of AVF at first HD session

Variable	aOR	95% CI	*P*
Male gender	1.66	1.60 to 1.72	<0.001
Race			
black	0.88	0.84 to 0.91	<0.001
Asian	1.26	1.15 to 1.40	<0.001
Hispanic	0.92	0.87 to 0.98	0.007
Comorbid condition			
congestive heart failure	0.69	0.66 to 0.71	<0.001
hypertension	1.19	1.13 to 1.26	<0.001
peripheral vascular disease	0.94	0.90 to 0.99	0.028
COPD	0.87	0.82 to 0.93	<0.001
cancer	0.83	0.78 to 0.89	<0.001
diabetes	0.86	0.83 to 0.90	<0.001
nonambulatory	0.51	0.46 to 0.56	<0.001
Age (years)			<0.001
≤24.9 (reference)	1.00		
25.0 to 34.9	1.41	1.14 to 1.74	0.001
35.0 to 44.9	1.55	1.27 to 1.89	<0.001
45.0 to 54.9	1.64	1.35 to 10.99	<0.001
55.0 to 64.9	1.73	1.42 to 2.09	<0.001
65.0 to 74.9	1.60	1.32 to 1.95	<0.001
≥75.0	1.35	1.11 to 1.64	0.003
Cause of ESRD			
glomerulonephritis	1.15	1.08 to 1.23	<0.001
PKD	2.03	1.84 to 2.24	<0.001
ARF nonrecovery	0.18	0.14 to 0.25	<0.001
other	0.81	0.76 to 0.85	<0.001
BMI			<0.001
≤18.49 (reference)	1.00		
18.50 to 24.99	1.18	1.07 to 1.32	0.001
25.00 to 30.00	1.26	1.13 to 1.39	<0.001
≥30.01	1.25	1.13 to 1.39	<0.001
Predialysis nephrology care	10.25	9.55 to 10.99	<0.001
Insurance			
DVA/DoD	1.36	1.24 to 1.50	<0.001
Medicare	1.08	1.03 to 1.14	0.002
employer group	1.05	1.00 to 1.10	0.034
other	1.10	1.05 to 1.15	<0.001
none	0.76	0.69 to 0.83	<0.001
Employment status			
unemployed	0.88	0.83 to 0.93	<0.001
disabled	0.94	0.89 to 0.99	0.018
medical leave	0.52	0.46 to 0.59	<0.001

Variables excluded from final model by forward stepwise logistic regression were white race, tobacco use, diabetes as a cause of ESRD, Medicaid insurance, and employed or retired employment status. ARF, acute renal failure; COPD, chronic obstructive pulmonary disease; PKD, polycystic kidney disease.

receive a kidney transplant compared with patients with private insurance. This disparity was thought to be related to an inefficient referral/approval system, geographic barriers (only four VA transplant centers), or decreased access to living donors.[23]

In theory, health care coverage including predialysis nephrology care is universally available in the United States through Medicare once patients reach the age of eligibility. In a sensitivity analysis that examined only patients who were aged ≥66 years at HD initiation (*i.e.*, 1 year of Medicare eligibility before HD initiation), Medicare coverage was not significantly associated with AVF (aOR 1.05; 95% CI 0.96 to 1.16; $P = 0.273$; however, DVA/DoD insurance was still independently associated with AVF use on initiation of HD in this model (aOR 1.35; 95% CI 1.17 to 1.57; $P < 0.001$). This finding suggests that the simple presence of insurance coverage is not the only factor required for placement of an AVF before HD initiation. As described herein, the DVA/DoD systems may have a higher rate of AVF secondary to other factors, such as integrated clinical practice guidelines, greater access to subspecialty care, or improved care coordination.

In the primary analysis, DVA/DoD status was analyzed as a composite variable of insurance coverage on the basis of the type of facility in which they initiated HD and type of insurance identified on the Medical Evidence Form. In a sensitivity analysis, we obtained similar results of AVF initiation by looking specifically at patients who initiated HD at a federal facility (aOR 1.3; 95% CI 1.1 to 1.4; $P < 0.001$) or who were identified as having DVA insurance on the CMS Form 2728 (aOR 1.4; 95% CI 1.2 to 1.6; $P < 0.001$).

Compared with DVA, there were fewer patients in the DoD category. When looking specifically at patients who initiated HD at a DoD facility, aOR of primary AVF use at initiation was 2.3 (95% CI 1.2 to 4.6; $P = 0.017$). The population of these two federal insurers studied likely differed with an older male population expected in patients who received care through the DVA. Higher rates of AVF in the DoD likely reflect a younger population with fewer comorbid medical conditions. Although we attempted to adjust for these factors, there may be other residual confounders that would explain the difference in AVF likelihood between these two federally insured populations.

Other significant findings in our study were more AVF initiations in older and obese subgroups. This is in contrast to a report from the DOPPS[18] and the US Renal Data System (USRDS) Dialysis Mortality and Morbidity Study (DMMS) Wave 2, both of which showed a lower likelihood of AVF in patients of older age and higher body mass index.[13] The USRDS DMMS Wave 2 was composed of a national random sample of patients who had ESRD and initiated HD in 1996, so this may reflect the changing demographics of our ESRD population and/or the policy change to be more aggressive with

AVF attempts, even those previously thought to be poor candidates for AVF; however, it is important to note that ORs for AVF initiations seemed to peak at groups of age 55.0 to 64.9 and body mass index of 25.0 to 30.0 (Table 3). Other associations found in our study confirmed previous studies.

Limitations specific to the USRDS database have been described previously.[24] This study relies primarily on data reported to Medicare *via* CMS Form 2728. Specific concerns in this study are incorrectly classifying initial access at dialysis or incorrectly identifying insurance status. The latter is thought to be minimized by identifying DVA/DoD facilities on the basis of their Medicare facility identification number, which is unique to the facility and reported to the ESRD Network. This method would also address a similar limitation that patients insured by DVA may not necessarily initiate HD at a DVA facility.

The other major concern for this study is underreporting. Because the DVA and the DoD do not rely on Medicare payment for services rendered, there may be less incentive to complete the required documentation. This may be less of a factor in the DoD population, in which all patients are required to apply for Medicare coverage in case the wartime operational tempo requires the diversion of beneficiary health care to civilian facilities.

Another important limitation is that DVA care is not "universal" in the strict sense. Although access to care may be equal among those who qualify as veterans, payment for the care varies on the basis of income and percentage of service connection. Also, although patients may have been identified as having Medicare coverage on CMS Form 2728, we cannot assess whether this Medicare coverage was primary (80%) or secondary (20%); however, we did perform a sensitivity analysis of patients who were older than age 66 at the initiation of HD and would theoretically be eligible for primary Medicare coverage. For patients who were covered primarily by Medicare, we could also not account for differences in secondary insurance coverage. We did evaluate for the effect of dual coverage with DVA/DoD insurance in combination with other insurance types and found no significant associations with AVF use at initiation with either insurance combination.

In conclusion, we found that significantly more patients in the DVA/DoD system initiated HD *via* AVF compared with patients with other forms of insurance. Although AVF use is more frequent in DVA/DoD patients, the proportion of patients who initiated HD with AVF is far from ideal and well below the goal of 50% set by the Fistula First Initiative. For further evaluation of these differences observed in the DVA/DoD, dedicated studies are needed to identify best practices that could potentially be used across health care systems to increase the number of patients who initiate HD with AVF.

CONCISE METHODS

This study used the USRDS database, which incorporates extensive baseline and follow-up demographic and clinical data on all patients who use the Medicare ESRD program in the United States. The variables included in the USRDS standard analysis files (SAFs), as well as methods and validation studies, are published and listed at the USRDS website, under "Researcher's Guide to the USRDS Database." For this study, we created an inception cohort using data from the 2005 version of the Centers for Medicare and Medicaid Services (CMS) Form 2728 (Medical Evidence Form). Variables in this dataset can be found at http://www.usrds.org/2008/rg/C_Data_File_Descriptions.pdf. We used the dataset to perform a cross-sectional analysis of patients who were initiated on HD from 2005 through 2006. We created an inception cohort using data from the 2005 version of the CMS Form 2728 (Medical Evidence Form).

The primary outcome was the use of AVF at HD initiation. This information was obtained from CMS Form 2728 (Question 18d: What access was used on first outpatient dialysis?). Patient characteristics were derived from CMS Form 2728, and assessed variables are summarized in Table 1. The 2005 version of CMS Form 2728 includes information on medical coverage at the start of HD (Medicaid, Medicare, employer group coverage, DVA, other, none), which was used to categorize DVA beneficiaries. In addition, long-term HD facilities have unique Medicare facility identification numbers, which were also used to define DVA/DoD beneficiaries. Medicare Advantage was included with the Medicare variable. Dual combinations of insurance coverage (DoD/DVA and Medicare, Medicaid, employer group, or other) were evaluated in the final model using interaction terms. Predialysis nephrology care was defined using the variable from CMS Form 2728.

All analyses were performed using SPSS 17.0 (SPSS, Chicago, IL). Files were merged and converted to SPSS files using DBMS/Copy (Conceptual Software, Houston, TX). Univariate analysis of factors associated with HD initiation *via* AVF was performed with χ^2 testing for categorical variables (Fisher exact test used for violations of Cochran assumptions) and *t* test for continuous variables (Mann-Whitney test used for non-normally distributed variables), respectively. Statistical significance for univariate comparisons was defined as $P < 0.05$. Multiple logistic regression analysis (forward stepwise) was performed to assess factors independently associated with HD initiation *via* AVF. Variables with $P < 0.10$ tested in univariate analysis for a relationship were entered into multivariate analysis as covariates because of the possibility of negative confounding. Variables thought to have a known clinical association with outcomes were also introduced into multivariate models even at univariate $P > 0.10$, in accordance with established principles of model development. Model fit was assessed using the c-statistic and Hosmer-Lemeshow diagnostics.

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DISCLOSURES

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