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Variations in Outcomes of Hemodialysis Vascular Access by Race/Ethnicity in the Elderly

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Abstract

Objective—Prevalence of end stage renal disease, modality of treatment and type of hemodialysis vascular access utilized varies widely by race/ethnicity in the United States, but outcomes of hemodialysis vascular access by race/ethnicity are poorly described. The objective of this study is to evaluate variations in outcomes of hemodialysis vascular access in the elderly by race/ethnicity.

Methods—Medicare Outpatient, Inpatient and Carrier files were queried from 2006-2011 for beneficiaries that were age ≥66 and dialysis dependent at time of index fistula/graft creation, qualified for Medicare by age only and were continuously enrolled in Medicare twelve months before and after index fistula/graft creation. Primary outcome measures were early vascular access failure and 12-month failure-free survival, specifically, the variation in the difference between fistula and graft in non-White versus White race/ethnicity groups..

Results—Fistulas comprised a smaller proportion of index procedures performed in Blacks (65.9%, P<.001) and Asians (71.4%, P<.001), compared to Whites (78.0%) with no difference in Hispanics (78.7%, P=.59). Incidence of early failure after graft versus fistula was: Whites, 34.9% versus 43.5% (P<.001), Blacks, 32.9% versus 49.1% (P<.001), Asians, 30.8% versus 40.5% (P=.014) and Hispanics 35.2% versus 43.2% (P=.005). The difference in early failure after fistula versus graft in Blacks was significantly larger than the difference in Whites (P<.001). 12-month failure-free survival after index graft versus fistula was: Whites, 41.9% versus 38.9% (P=.008), Blacks 48.5% versus 37.3% (P<.001), Asians 51.6% versus 45.2% (P=.98) and Hispanics 51.9% versus 42.2% (P<.001). The difference in 12-month failure-free survival after graft versus fistula in Blacks and in Hispanics was larger than the difference in Whites (P<.001 and P=.02, respectively).

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Conclusions—Outcomes of fistulas versus grafts in the elderly vary significantly by race/ethnicity. The decreased risk of early failure after graft versus fistula creation is larger in Blacks compared to Whites. The higher failure-free survival at 12 months after graft versus fistula creation is larger in Blacks compared to Whites and trends toward being larger in Hispanics compared to Whites.

Introduction

The prevalence of end stage renal disease (ESRD) in the United States is higher in all non-White racial groups compared to Whites.[1] In 2013, the prevalence per million among Blacks was higher than any other racial group at 5,584 compared to 2,196 among Asians, 2,133 among Native Americans, 2,970 among Hispanics and 1,499 among Whites.[1] Additionally, among prevalent ESRD patients, the percentage of Blacks that utilize hemodialysis as their treatment modality is the highest, at 76%, compared to 59% of Whites, 70% of Native Americans, 61% of Asians and 69% of Hispanics.[1] Furthermore, the type of vascular access utilized varies significantly by race/ethnicity. Among hemodialysis patients in 2013, 64.3% of Whites were using an arteriovenous fistula for vascular access, compared to 56.9% of Blacks, 67.2% of Asians and 67.5% of Hispanics.[1]

Despite the recognition that these racial/ethnic disparities exist, little work has been done to examine the outcomes of vascular access type by race/ethnicity. Outcomes of hemodialysis vascular access are particularly relevant in the elderly given the 31% per year all-cause mortality in the age 65+ hemodialysis population.[1] National guidelines, initiatives and the recently instituted Center for Medicare and Medicaid Services (CMS) End Stage Renal Disease (ESRD) Quality Incentive Program (QIP) all place increasing emphasis on prioritizing the creation of fistulas over grafts for hemodialysis vascular access.[2,3] However, there is increasing evidence that fistula maturation and patency may be worse in elderly compared to younger ESRD patients.[4,5,6] The combination of elevated one-year mortality rates in elderly ESRD patients and lower fistula maturation/ patency suggests that a significant proportion of elderly hemodialysis patients may not survive to experience the purported long-term benefits that fistulas provide versus grafts, making the short-term results of fistula/graft creation for hemodialysis vascular access an important area of investigation.

The purpose of this study is to determine the variations in 12-month outcomes of fistula versus graft creation among non-White race/ethnicity groups compared to Whites in dialysis dependent patients undergoing first time fistula/graft creation in the Medicare population.

Methods

Medicare Outpatient, Inpatient and Carrier files from 2006 through 2011 were queried for upper extremity vascular access procedures identified by the current procedural terminology (CPT) codes for fistula and graft (Appendix Table 1). Index fistula/graft creation was defined as the first occurrence of the CPT code per beneficiary during the study period. Repeat fistula/graft creation was defined as any new fistula/graft creation, identified by CPT code, performed in the twelve months subsequent to index fistula/graft, regardless of

whether the index procedure was a fistula or a graft. Tunneled hemodialysis catheter placement procedures were identified by CPT code (Appendix Table 1).

Inclusion criteria were age ≥66 and dialysis dependent at time of index fistula/graft creation, qualification for Medicare exclusively by virtue of age, complete demographic and co-morbidity data, continuous enrollment in fee-for-service Medicare for twelve months before and after index fistula/graft creation. By excluding patients who qualified for Medicare by virtue of ESRD and limiting the patient population to those who were enrolled in Medicare for twelve months before index fistula/graft creation, we limit the cohort to patients who were undergoing first time dialysis vascular access creation to the best of our ability. Patients who died within twelve months after index fistula/graft creation were included. Co-morbidities were defined by having ever met the claims criteria of the Chronic Condition Data Warehouse as of the date of index fistula/graft creation.[7]

Dialysis dependence was identified using Berenson-Eggers Type of Service (BETOS) Codes P9A (Dialysis Services Medicare Fee Schedule) and P9B (Dialysis Services Non-Medicare Fee Schedule). BETOS codes are assigned for each Health Care Financing Administration Common Procedure Coding System (HCPCS) procedure code. Each HCPCS code is assigned to a single BETOS code. BETOS code categories are designed to permit objective assignment and be stable over time.[8] Chronic dialysis dependence was defined as at least one occurrence of BETOS 9A or 9B during the 12 months preceding index fistula/graft month or within 30 days after creation of index fistula/graft.[9]

In Medicare claims data, beneficiary race is determined by taking the beneficiary race code that has historically been used by the Social Security Administration (SSA) and applying an algorithm developed by the Research Triangle Institute (RTI). The RTI algorithm incorporates beneficiary language preference, the language that the beneficiary has requested that the SSA use when sending notices, the source of the beneficiary's Medicare enrollment database race/ethnicity code, the state in which the beneficiary resides and the first and last name of the beneficiary. The RTI algorithm has been shown to significantly improve the accuracy of coding for Hispanics and Asians or Pacific Islanders.[10] The race categories designated by Medicare claims data are non-Hispanic White, (hereafter referred to as White), Black, Asian/Pacific Islander (hereafter referred to as Asian), Hispanic, American Indian/Alaska Native and Other. Outcomes were adjusted for using three increasingly comprehensive models. Model 1 co-variates were age and its square, sex, index year, index month, total covered charges from outpatient, inpatient and carrier files in the year preceding index fistula/graft creation date, inpatient setting for the index fistula/graft creation and all co-morbidities available from the Chronic Condition Data Warehouse, (except chronic kidney disease which was used to select the cohort). In Model 2, community contextual factors (obtained by linking residential zip code from Medicare enrollment files to the 2000 Census) were included in addition to all co-variates in Model 1.[11,12] In Model 3, binary indicator variables for hospital referral region (HRR) were included in addition to all co-variates in Model 2. HRRs represent regional health care markets and are included in an effort to control for regional variation in access to health care and practice patterns surrounding ESRD care.[13]

Statistical analysis was conducted using Stata, version 13.1 (StataCorp, College Station, Texas). Two group comparisons for age were assessed by a t-test of equality of means. Two group comparisons for dichotomous outcomes were assessed by chi-squared tests. Prevalence of access procedure type was analyzed by race/ethnicity groups using logistic regression, controlling for the factors described in the various models. Logistic regressions of early failure were performed based on index fistula versus graft, controlling for the factors described in the various models. Adjusted outcomes were calculated based on predictions which varied the access procedure for each patient while holding all other covariates fixed, averaged across the sample.[14] The primary outcome measures of this study were early failure and 12-month failure free survival-specifically, the variations in the difference between fistula and graft of these two outcomes among race/ethnicity groups. Early failure was defined by creation of another fistula/graft and/or tunneled hemodialysis catheter placement in the 12 months following index fistula/graft. Calculations of incidence of early failure include patients who expired during the 12 months following index fistula/graft procedure in the denominator. 12-month failure-free survival was defined by the patient surviving for 12 months after index fistula/graft creation without occurrence of another fistula/graft creation or tunneled catheter placement. Survival analysis was performed.[15]

In order to account for multiple comparisons, a Bonferroni correction can be applied to the P-value for our two primary outcomes, the variation of the difference in fistula and graft for non-White versus White for early failure and 12-month failure free survival. For each primary outcome, there were three hypotheses for equality of Black, Asian/PI and Hispanic, respectively, with Whites. This results in a total of six hypotheses. After applying a Bonferroni correction, the required p-value for statistical significance on each hypothesis is lowered from .05 to .008. As the Bonferroni correction can be a conservative approach, both the corrected and uncorrected significance are presented.

This research was deemed exempt from review by the Institutional Review Board as the study was retrospective, the Medicare data utilized was de-identified and there was no contact with human subjects for this research. Patient informed consent was unnecessary for this study as only de-identified data was used and there was no contact with human subjects.

Results

During the study period, 16,402 index fistula and graft creations met the inclusion criteria. 10,507 (64.1%) procedures were performed in Whites, 3,331 (20.3%) in Blacks, 685 (4.2%) in Asians, 1,570 (9.6%) in Hispanics, 146 (0.89%) in American Indians / Alaska Natives and 163 (0.99%) in Other. The small sample size of American Indians / Alaska Natives and Other would preclude meaningful statistical analysis and the results of both groups are not further presented. Patient demographics, co-morbidities and zip code community contextual factors varied by graft versus fistula and across racial/ethnic groups (Table I, Appendix Table 2). The mean age of patients who underwent graft was slightly older than patients who underwent fistula in all race/ethnicity groups, and a smaller proportion of females underwent fistula. Patients who underwent graft had higher mean total covered billed charges in the twelve months prior to the fistula/graft creation date in all race/ethnicity groups. There was a trend towards a higher incidence of co-morbidities in the graft group compared to the fistula

group across race/ethnicity groups. In most cases across race/ethnicity groups, when there was a difference in zip code community contextual factors between the fistula and graft group, the graft group was more likely to be associated with disadvantaged community contextual factors.

Unadjusted, fistulas accounted for 79.9% of the vascular access procedures performed in Whites. A smaller proportion of procedures performed in Blacks, Asians and Hispanics were fistulas (Table II). The intermediate models did not result in major changes in absolute or relative proportions of fistulas except in Hispanics. (Appendix Table 3) Upon adjusting for the variables in model 2, the difference in proportion of fistulas performed in Hispanics versus Whites became negligible. After further adjusting for hospital referral region (model 3), 78.0% of the index vascular access procedures performed in Whites were fistulas. Compared to Whites, a smaller proportion of the index procedures performed in Blacks and in Asians were fistulas (Table II). There was no difference between the proportion of index fistulas performed in Whites versus Hispanics.

Overall, 4,707 (28.7%) patients expired during the 12 months post index vascular access procedure. The unadjusted 12-month mortality rates were: White 31.3%, Black 25.0%, Asian 23.3% and Hispanic 23.3%. The unadjusted 12-month mortality rate was higher in grafts compared to fistulas for Whites and Blacks, with no difference for Asians or Hispanics (Table III). Upon adjusting for demographics and co-morbidities, the difference in mortality between graft and fistula became no longer significant for Blacks. This pattern persisted with further adjustment for community contextual factors and hospital referral region. In the fully adjusted model, the mortality in grafts was higher than fistulas for Whites (32.4% versus 30.0%, P=.03) (Table III). In Blacks, Asians and Hispanics, the mortality in the there was no difference between the mortality in the grafts and the fistulas. The difference in mortality between grafts and fistulas within Blacks, Asians and Hispanics was not significantly larger or smaller than the difference between procedures for Whites in any of the models (Table III).

In all race/ethnicity groups, the unadjusted incidence of early failure (repeat fistula or graft, or tunneled catheter placement) was lower in patients who underwent graft than fistula (Table IV). The intermediate models did not result in major changes in the absolute or relative incidence of early failure (Appendix Table 4). After adjustment for all covariates (model 3), the incidence of early failure was lower after graft than fistula in all race/ethnicity categories (Table IV). In Whites, the incidence of early failure was 34.9% for graft versus 43.5% for fistula (P<.001), resulting in an incidence of early failure in Whites that was 8.6% lower after graft versus fistula (Table IV). In Blacks, grafts had a 16.2% lower incidence of early failure than fistulas, significantly larger than the 8.6% difference in Whites (P<.001) (Table IV). In Asians and Hispanics, the difference in early failure of graft versus fistula was not significantly larger or smaller compared to Whites.

In Whites, Blacks and Hispanics, the unadjusted 12-month failure-free survival rate was significantly higher for grafts than for fistulas (Table IV). The intermediate models did not result in major changes in the absolute or relative 12-month failure-free survival (Appendix Table 4). In Whites, Blacks and Hispanics, the fully adjusted 12-month failure-free survival

was higher after graft versus fistula (Table IV). In Asians, there was no difference in 12-month failure-free survival for graft versus fistula. In Whites, the 12-month failure-free survival was 41.9% for graft compared to 38.9% for fistula (P=.008) (Table IV). Restated, the 12-month failure-free survival in Whites was 3.0% higher for grafts compared to fistulas. In Blacks, the 12-month failure-free survival was 11.2% higher for grafts compared to fistulas, significantly larger than the 3.0% difference seen in Whites (P<.001) (Table IV). In Hispanics, the 12-month failure-free survival was 9.7% higher for grafts compared to fistulas, which is also larger than the difference seen in Whites (P=.02) (Table IV). However, upon applying the Bonferroni correction, this P-value becomes no longer statistically significant. In Asians, the difference in 12-month failure-free survival of graft versus fistula was not significantly larger or smaller compared to Whites.

Discussion

It is well-documented that the prevalence of ESRD in the United States varies widely by race/ethnicity.[1] While the modality of ESRD treatment varies by race/ethnicity, hemodialysis is still the most prevalent mode of renal replacement therapy utilized by all race/ethnicity groups.[1] It is also well-documented that the prevalence of hemodialysis vascular access type varies widely by race/ethnicity.[1] In the face of such disparities in care, a well-known Institute of Medicine report “Confronting Racial and Ethnic Disparities in Health Care” called for further research to better understand how race and ethnicity are associated with disparities in *outcomes* from care.[16] Despite this, little work has been done to examine the outcomes of hemodialysis vascular access by race/ethnicity.

Among prevalent hemodialysis patients in 2013, 64.3% of Whites were using a fistula for vascular access, compared to 56.9% of Blacks[1] a difference that is reflected in our study where there was a 12% higher fully-adjusted incidence of fistula creation in Whites compared to Blacks. This could suggest that there is something inherently related to being Black that makes a patient less likely to undergo fistula creation compared to a White patient. There is some evidence to indicate that Blacks have smaller diameter upper extremity veins than non-Black patients which may contribute to Blacks having a lower prevalence of fistula creation, a trend that has been reported by numerous studies.[17,18,19] However, the reported data regarding racial/ethnic variations in upper extremity vein diameter is very limited.

Our study also found that Asians had a significantly lower incidence of fistula creation compared to Whites. However, USRDS data demonstrates a slightly higher prevalence of Asians compared to Whites using a fistula for vascular access (67.2% versus 64.3%), although USRDS does not report whether this difference is significant.[1] It is possible that this difference in fistula use and fistula creation is attributed to a higher incidence of fistula creation in younger Asians, a group not included in our study. In addition, we found that there was no difference in the fully adjusted incidence of fistula created between Hispanics and Whites. Interestingly, the unadjusted model demonstrated a significantly lower incidence of fistula creation in Hispanics versus Whites. However, once community contextual factors were adjusted for, this difference was reduced to 1% and became non-

significant, suggesting that the unadjusted difference is related to community characteristics of where the Hispanic patients live, and not to being Hispanic itself.

The overall mortality in our study is consistent with the USRDS reported all-cause mortality of 31% per year in the elderly ESRD population.[1] The unadjusted mortality rate in Whites was higher than all other race/ethnicity groups. This has been demonstrated in numerous previous reports documenting increased mortality risk among White ESRD patients, which cannot be explained by differences in co-morbidities or transplantation rates, or vascular access type.[18,20,21] Within Whites, after full adjustment, grafts were associated with a 2.4% higher mortality than fistulas. Although this difference in mortality is statistically significant, its magnitude is so small that may not be considered clinically significant. Similarly, other authors have demonstrated in a decision and cost-utility analysis that fistula use was associated with a minimal improvement in survival over grafts of only 2.6 months.[22] Whites were the only race/ethnicity group in our study that experienced a lower mortality with fistula compared to graft, further calling into question the purported mortality benefit of fistula over graft.

Within all race/ethnicity groups, the incidence of early failure was significantly lower after index graft versus fistula creation, consistent with the growing body of literature indicating that fistula maturation failure is high in the elderly.[4,5] The fully adjusted difference between graft and fistula for Blacks was nearly twice that of Whites and highly statistically significant. In the unadjusted model, the difference was even larger, becoming smaller with each model, suggesting that variations in demographics, co-morbidities, community contextual factors and hospital referral region account for a portion of this difference in early failure between Blacks and Whites. The remaining difference is unexplained by the factors included in model 3, suggesting that another factor associated with being Black causes the significantly larger difference between graft and fistula early failure compared to Whites.

The rate of early fistula thrombosis and failure to mature in Blacks has been demonstrated to be as high as 45%, consistent with our findings.[23] Additionally, Black race has been shown to be an independent risk factor for hospitalization due to vascular access-related morbidity.[24] Despite Blacks being the highest utilizers of hemodialysis and having nearly twice the prevalence of ESRD compared to any other racial/ethnic group, the underlying causes of these poor vascular access outcomes have not been well studied. A study published in 2002 demonstrated that Lipoprotein (a), a low density lipoprotein associated with increased risk of atherothrombosis, is present in higher in Blacks compared to Whites.[25] Blacks with the highest lipoprotein (a) levels had a higher incidence of requiring vascular access interventions; there was no association among Whites. Further studies do not appear to have been performed.

The optimal outcome for any ESRD patient, after vascular access creation, is to survive without requiring another vascular access creation or tunneled catheter placement, measured in our study by failure-free survival at 12 months. Overall, the 12-month failure-free survival was sobering for all groups with a fully-adjusted high of only 51.9% in Hispanics who underwent grafts. Given the poor life expectancy of elderly ESRD patients, it is even more important that quality of life issues associated with failed vascular access procedures be

taken into consideration when determining the optimal access type for each individual patient.

Among Whites, there was no significant difference in unadjusted failure-free survival between grafts and fistulas, with fistulas even having a slight 1.1% absolute advantage over grafts. Upon adjusting for demographics and co-morbidities, grafts conferred a failure-free survival advantage over fistula, suggesting that the unadjusted equipoise between fistula and graft failure-free survival for Whites is attributed to variations in demographics and co-morbidities. The failure-free survival advantage of grafts increased slightly with each successive model, to only a high of 3%.

Within Hispanics, the fully adjusted failure-free survival was greater after grafts versus fistulas with a difference of nearly 10%, a larger difference compared to Whites which may or may not be statistically significant. Among Asians, the fully adjusted failure-free survival after graft was over 6% higher than fistula; however, this did not achieve statistical significance, possibly due to small sample size. The difference in failure-free survival between fistula and graft was greatest among Blacks. The fully adjusted advantage of grafts over fistulas Blacks was nearly four times that seen in Whites. Again, this suggests that there is a significant variation in outcomes of vascular access in the elderly among race/ethnicity groups and that particularly in Blacks and Hispanics, grafts may confer improved outcomes compared to fistulas.

This study has a number of limitations, the most significant being that it is an observational study. Although we controlled for all readily available confounders measured in claims data, it is possible that worse outcomes in certain minority populations compared to Whites can be attributed to factors other than race/ethnicity. In fact, we believe that future studies should explore these variations in outcomes by race/ethnicity to determine with greater granularity the contributing factors and whether the factors are modifiable. The RTI algorithm utilized by Medicare claims does not recognize Hispanic as an ethnicity and does not allow for the fact that it is possible to be Hispanic as well as White or Black or any other race. While we acknowledge this important distinction, we are limited by the categories that Medicare claims records. Other access-related complications, such as infection and revision, were not included in this study due to the fact that the CPT codes for these complications are not as clear as codes for fistula/graft creation. As a result, the total incidence of encounters related to vascular access is likely to be significantly underestimated. Additionally, we did not measure the number of catheter dependent days, which may vary significantly by fistula versus graft and would be an important outcome to examine in future studies.

Conclusions

Outcomes of grafts versus fistulas in the elderly vary significantly by race/ethnicity and are not accounted for by the demographics, co-morbidities, community contextual factors or hospital referral region studied. The decreased risk of early failure after graft versus fistula creation is larger in Blacks compared to Whites. The higher failure-free survival at 12 months after graft versus fistula creation is larger in Blacks compared to Whites and trends towards being larger in Hispanics compared to Whites. It is imperative that vascular access

guidelines be updated to take into consideration individual patient characteristics, including age, race/ethnicity and life expectancy and that future research focus on identifying potentially modifiable risk factors for these variations in outcomes.

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Appendix Table I

Current Procedural Terminology (CPT) codes and procedure descriptions

CPT code	Procedure description
Fistula	
36818	arteriovenous anastomosis, open; by upper arm cephalic vein transposition
36819	arteriovenous anastomosis, open; by upper arm basilic vein transposition
36820	arteriovenous anastomosis, open; by forearm vein transposition
36821	arteriovenous anastomosis, opendirect, any site
36825	creation of arteriovenous fistula by other than direct arteriovenous anastomosis; autogenous graft
Graft	
36830	creation of arteriovenous fistula by other than direct arteriovenous anastomosis; non autogenous graft
Tunneled Catheter	
36565	Insertion of tunneled centrally inserted central venous access device, requiring 2 catheters via 2 separate venous access sites; without subcutaneous port or pump (eg, Tesio type catheter)
36558	Insertion of tunneled centrally inserted central venous catheter, without subcutaneous port or pump; age 5 years or older

Appendix Table II

Distribution of access procedures by year and month.

	White			Black			Asian			Hispanic		
	Index fistula (%) (n=8,397)	**Index graft (%) (n=2,110)**	**P-value**	**Index fistula (%) (n=2,071)**	**Index graft (%) (n=1,260)**	**P-value**	**Index fistula (%) (n=467)**	**Index graft (%) (n=218)**	**P-value**	**Index fistula (%) (n=1,173)**	**Index graft (%) (n=397)**	**P-value**
Year that index fistula/graft was performed			<0.001			0.001			0.009			0.23
2007	2,130 (25.4)	651 (30.9)		548 (26.5)	382 (30.3)		109 (23.3)	76 (34.9)		280 (23.9)	107 (26.9)	
2008	2,035 (24.2)	523 (24.8)		504 (24.3)	283 (22.5)		104 (22.3)	49 (22.5)		279 (23.8)	102 (25.7)	
2009	2,092 (24.9)	501 (23.7)		470 (22.7)	323 (25.6)		133 (28.5)	52 (23.9)		304 (25.9)	102 (25.7)	
2010	2,140 (25.5)	435 (20.6)		549 (26.5)	272 (21.6)		121 (25.9)	41 (18.8)		310 (26.4)	86 (21.6)	
Month that index fistula/ graft was performed			0.28			0.06			0.49			0.83
January	752 (9)	211 (10)		207 (10)	138 (11)		41 (8.8)	22 (10.1)		105 (9)	41 (10.3)	
February	739 (9)	194 (9.2)		169(8.2)	123 (9.8)		36 (7.7)	21 (9.6)		97 (8.3)	41 (10.3)	
March	737 (8.8)	193 (9.1)		187 (9)	126 (10)		56 (12)	18 (8.3)		123 (10.5)	36 (9.1)	
April	696 (8.3)	197 (9.3)		186 (9)	119 (9.4)		46 (9.9)	18 (8.3)		105 (9)	45 (11.3)	
May	689 (8.2)	182 (8.6)		176 (8.5)	97 (7.7)		37 (7.9)	13 (6)		89 (7.6)	31 (7.8)	
June	763 (9.1)	162 (7.7)		170(8.2)	96 (7.6)		34 (7.3)	25 (11.5)		106 (9)	37 (9.3)	
July	711 (8.5)	166 (7.9)		124 (6)	104 (8.3)		31 (6.6)	21 (9.6)		104 (8.9)	35 (8.8)	
August	715 (8.5)	173 (8.2)		189 (9.1)	118 (9.4)		36 (7.7)	17 (7.8)		91 (7.8)	26 (6.5)	
September	649 (7.7)	174 (8.2)		173 (8.4)	96 (7.6)		41 (8.8)	14 (6.4)		88 (7.5)	28 (7.1)	
October	718 (8.6)	179 (8.5)		173 (8.4)	96 (7.6)		44 (9.4)	17 (7.8)		104 (8.9)	30 (7.6)	
November	639 (7.6)	138 (6.5)		172 (8.3)	79 (6.3)		33 (7.1)	15 (6.9)		80 (6.8)	22 (5.5)	
December	589 (7)	141 (6.7)		145 (7)	68 (5.4)		32 (6.9)	17 (7.8)		81 (6.9)	25 (6.3)	

Appendix Table III

AVF prevalence (Intermediate Models)

	Model 1[a]		Model 2[b]	
	AVF Prevalence[c]	P-value compared to White	AVF Prevalence[c]	P-value compared to White
white	79.5%	ref	78.7%	ref
black	63.5%	<0.001	64.1%	<0.001
asian/PI	68.6%	<0.001	70.5%	<0.001
hispanic	74.8%	<0.001	78.4%	0.80

[a]Adjusted for age and its square, sex, index year, index month, total covered charges from outpatient, inpatient and carrier files in the year preceding index fistula/graft creation date, inpatient setting for the index fistula/graft creation and all co-morbidities available from the Chronic Condition Data Warehouse (except chronic kidney disease)

[b]Adjusted for age and its square, sex, index year, index month, total covered charges from outpatient, inpatient and carrier files in the year preceding index fistula/graft creation date, inpatient setting for the index fistula/graft creation, all co-morbidities available from the Chronic Condition Data Warehouse (except chronic kidney disease) and community contextual factors

[c]Predictive margin for prevalence of fistula created vs graft.

Appendix Table IV

Mortality, Early Failure and 12-month Failure Free Survival (Intermediate Models)

		Model 1				Model 2			
Mortality									
	Access Type	**Rate[1]**	**P-value for fistula vs graft within race/ ethnicity**	**Difference of graft-fistula within race/ ethnicity**	**P-value for difference compared to White[2]**	**Rate[3]**	**P-value for fistula vs graft within race/ ethnicity**	**Difference of graft-fistula within race/ ethnicity**	**P-value for difference compared to White[4]**
White	Fistula	29.9%	0.02	2.5%	ref	30.0%	0.02	2.6%	ref
	Graft	32.4%				32.6%			
Black	Fistula	25.7%	0.21	1.9%	0.85	25.7%	0.28	1.6%	0.71
	Graft	27.6%				27.3%			
Asian/PI	Fistula	22.9%	0.79	0.8%	0.70	22.8%	0.57	1.9%	0.93
	Graft	23.7%				24.7%			
Hispanic	Fistula	24.8%	0.76	−0.7%	0.25	24.1%	0.64	−1.1%	0.19
	Graft	24.1%				23.0%			
Early Failure									
	Access Type	Rate[1]	P-value for fistula vs graft within race/ ethnicity	Difference of fistula-graft within race/ ethnicity	P-value for difference compared to White[4]	Rate[3]	P-value for fistula vs graft within race/ ethnicity	Difference of fistula-graft within race/ ethnicity	P-value for difference compared to White[4]
White	Fistula	42.4%	<0.01	7.6%	ref	43.1%	<0.01	8%	ref
	Graft	34.8%				35.1%			
Black	Fistula	50.5%	<0.01	16.7%	<0.01	49.8%	<0.01	16.7%	<0.01
	Graft	33.8%				33.1%			
Asian/PI	Fistula	41.4%	0.021	9.1%	0.68	40.9%	0.01	9.8%	0.62
	Graft	32.3%				31.1%			
Hispanic	Fistula	44.6%	<0.01	8.3%	0.85	43.1%	<0.01	7.8%	0.95
	Graft	36.3%				35.3%			
12-month Failure Free Survival									

		Model 1				Model 2			
Mortality									
	Access Type	**Rate[1]**	**P-value for fistula vs graft within race/ ethnicity**	**Difference of graft-fistula within race/ ethnicity**	**P-value for difference compared to White[2]**	**Rate[3]**	**P-value for fistula vs graft within race/ ethnicity**	**Difference of graft-fistula within race/ ethnicity**	**P-value for difference compared to White[4]**
	Access Type	Survival[1]	P-value for fistula vs graft within race/ ethnicity	Difference of graft-fistula within race/ ethnicity	P-value for difference compared to White[5]	Survival[3]	P-value for fistula vs graft within race/ ethnicity	Difference of graft-fistula within race/ ethnicity	P-value for difference compared to White[5]
White	Fistula	39.7%	0.03	2.4%	ref	39.1%	<0.01	2.5%	ref
	Graft	42.1%				41.6%			
Black	Fistula	36.4%	<0.01	11.6%	<0.01	37.0%	<0.01	11.5%	<0.01
	Graft	48.0%				48.5%			
Asian/PI	Fistula	44.4%	0.16	5.3%	0.45	44.9%	0.014	5.7%	0.44
	Graft	49.7%				50.6%			
Hispanic	Fistula	40.1%	<0.01	8.8%	0.02	42.3%	<0.01	9.3%	0.02
	Graft	48.9%				51.6%			

[1] Predictive margin adjusted for age and its square, sex, index year, index month, total covered charges from outpatient, inpatient and carrier files in the year preceding index fistula/graft creation date, inpatient setting for the index fistula/graft creation and all co-morbidities available from the Chronic Condition Data Warehouse (except chronic kidney disease)

[2] P-value for difference in incidence of mortality for fistula vs graft within race/ethnicity group compared to difference in incidence of mortality for fistula vs graft within Whites

[3] Predictive margin adjusted for age and its square, sex, index year, index month, total covered charges from outpatient, inpatient and carrier files in the year preceding index fistula/graft creation date, inpatient setting for the index fistula/graft creation, all co-morbidities available from the Chronic Condition Data Warehouse (except chronic kidney disease) and community contextual factors

[4] P-value for difference in incidence of early failure for fistula vs graft within race/ethnicity group compared to difference in incidence of early failure for fistula vs graft within Whites

[5] P-value for difference 12 month failure free survival for fistula vs graft within race/ethnicity group compared to difference 12 month failure free survival for fistula vs graft within White

JVS-D-16-00857
Variations in Outcomes of Hemodialysis Vascular Access by Race/Ethnicity in the Elderly
Race and ethnicity based variations in the elderly on outcomes after hemodialysis access placement are not well known.
Retrospective multi-center study using the United States Medicare Outpatient, Inpatient and Carrier files
The 12 month outcomes in 16,402 patients undergoing placement of av fistula and av graft were inferior in black and hispanic patients compared to white patients.
This study suggests that further investigation is necessary to understand why blacks and hispanics have inferior outcomes compared to whites after av access placement.
1.Strong
B.Medium

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Table 1

Patient Demographics, Co-Morbidities and Zip Code Community Contextual Factors

	White			Black			Asian			Hispanic		
	Index fistula (%) (n=8,397)	**Index graft (%) (n=2,110)**	**P-value**	**Index fistula (%) (n=2,071)**	**Index graft (%) (n=1,260)**	**P-value**	**Index fistula (%) (n=467)**	**Index graft (%) (n=218)**	**P-value**	**Index fistula (%) (n=1,173)**	**Index graft (%) (n=397)**	**P-value**
Mean age, years	77.8	78.8	<.001	75.6	76.8	<.001	76.7	79.3	<.001	75.3	76.9	<.001
Female	3,489 (41.6)	1,147 (54.4)	<.001	1,095 (52.9)	836 (66.3)	<.001	225 (48.2)	124 (56.9)	.03	555 (47.3)	249 (62.7)	<.001
Index fistula/graft performed in an inpatient setting	1,560 (18.6)	549 (26)	<.001	441 (21.3)	318 (25.2)	.008	115 (24.6)	60 (27.5)	.42	278 (23.6)	106 (26.7)	.23
Mean total covered billed charges in 12 months prior to index fistula/graft creation date (in thousands of dollars)	184.9	251.6	<.001	190.3	245.8	<.001	208.2	256.1	.03	229.2	287.1	<.001
Year of index procedure	*Appendix Table 2		<.001	*Appendix Table 2		.001	*Appendix Table 2		.009	*Appendix Table 2		.23
Month of index procedure	*Appendix Table 2		.28	*Appendix Table 2		.06	*Appendix Table 2		.49	*Appendix Table 2		.83
Co-morbidities												
Hypertension	8,324 (99.1)	2,089 (99)	.58	2,043 (98.6)	1,249 (99.1)	.21	-	-	-	-	-	-
Diabetes	5,777 (68.8)	1,501 (71)	.04	1,640 (79.2)	1037 (82.3)	.03	389 (83.3)	183 (83.9)	.83	1029 (87.7)	362 (91.2)	.06
Atrial Fibrillation	2,900 (24.5)	835 (39.6)	<.001	363 (17.5)	233 (18.5)	.48	102 (21.8)	52 (23.9)	.56	184 (15.7)	81 (20.4)	.03
Heart Failure	6,606 (78.7)	1,790 (84.8)	<.001	1,616 (78)	1028 (81.6)	.01	345 (73.9)	188 (86.2)	<.001	925 (78.9)	334 (84.1)	.02
Stroke/Transient Ischemic Attack	2,076 (24.7)	640 (30.3)	<.001	538 (26)	444 (35.2)	<.001	104 (22.3)	67 (30.7)	.02	309 (26.3)	119 (30)	.16
Ischemic Heart Disease	6,881 (81.9)	1,785 (84.6)	.004	1,539 (74.3)	1,001 (79.4)	.001	355 (76)	187 (85.8)	.003	909 (77.5)	341 (85.9)	<.001
Acute Myocardial Infarction	1,421 (16.9)	374 (17.1)	.38	212 (10.2)	173 (13.7)	.002	61 (14.3)	31 (14.2)	.68	143 (12.2)	52 (13.1)	.64
Chronic Obstructive Pulmonary Disease	4,003 (47.7)	1,075 (50.9)	.007	732 (35.3)	505 (40)	.006	154 (33)	95 (43.6)	.007	394 (33.6)	187 (47)	<.001

	White			Black			Asian			Hispanic		
	Index fistula (%) (n=8,397)	**Index graft (%) (n=2,110)**	**P-value**	**Index fistula (%) (n=2,071)**	**Index graft (%) (n=1,260)**	**P-value**	**Index fistula (%) (n=467)**	**Index graft (%) (n=218)**	**P-value**	**Index fistula (%) (n=1,173)**	**Index graft (%) (n=397)**	**P-value**
Hyperlipdemia	7,385 (87.9)	1,815 (86)	.02	1,655 (79.9)	1,015 (80.6)	.65	402 (86)	197 (90.4)	.12	1,003 (85.5)	346 (87.2)	.42
Anemia	8,211 (97.8)	2,082 (98.7)	.01	NA[a]	NA[a]	-	NA[a]	NA[a]	-	NA[a]	NA[a]	-
Endometrial cancer	83 (0.99)	26 (1.2)	.32	15 (0.72)	12 (0.95)	.48	NA[a]	NA[a]	-	NA[a]	NA[a]	-
Prostate cancer	789 (9.4)	169 (8)	.05	222 (10.7)	109 (8.7)	.05	23 (4.9)	16 (7.3)	.2	51 (4.3)	25 (6.3)	.12
Lung cancer	170 (2)	36 (1.7)	.35	26 (1.3)	20 (1.6)	.43	NA[a]	NA[a]	-	NA[a]	NA[a]	-
Breast cancer	305 (3.6)	114 (5.4)	<.001	80 (3.9)	86 (6.8)	<.001	NA[a]	NA[a]	-	NA[a]	NA[a]	-
Colorectal cancer	410 (4.9)	139 (6.6)	.002	83 (4)	65 (5.2)	.12	16 (3.4)	13 (6)	.13	31 (2.6)	16 (4)	.16
Alzheimer's Disease	332 (4)	117 (5.5)	.001	117 (5.6)	116 (9.2)	<.001	23 (4.9)	13 (6)	.57	66 (5.6)	41 (10.3)	.001
Dementia	1,234 (14.7)	448 (21.2)	<.001	396 (19.1)	366 (29)	<.001	79 (16.9)	51 (23.4)	.04	208 (17.7)	110 (27.7)	<.001
Cataract	5,971 (71.1)	1,513 (71.7)	.59	1,193 (57.6)	759 (60)	.14	297 (63.6)	154 (70.6)	.07	725 (61.8)	284 (71.5)	<.001
Glaucoma	1,817 (21.6)	477 (22.6)	.34	646 (31.2)	426 (33.8)	.12	131 (28.1)	67 (30.7)	.47	305 (26)	140 (35.3)	<.001
Hip/Pelvic Fracture	432 (5.1)	180 (8.5)	<.001	54 (2.6)	71 (5.6)	<.001	14 (3)	14 (6.4)	.04	46 (3.9)	21 (5.3)	.24
Depression	2,495 (29.7)	762 (36.1)	<.001	459 (22)	352 (27.9)	<.001	86 (18.4)	55 (25.2)	.04	333 (28.4)	153 (38.5)	<.001
Osteoporosis	1,199 (14.3)	393 (18.6)	<.001	156 (7.5)	129 (10.2)	.007	84 (18)	64 (29.4)	.001	187 (15.9)	95 (23.9)	<.001
Rheumatoid Arthritis/Osteoarthritis	4,452 (53)	1,191 (56.4)	.005	1,031 (49.8)	687 (54.5)	.008	216 (46.3)	115 (52.8)	.11	537 (45.8)	210 (52.9)	.01
Asthma	1,210 (14.4)	333 (15.8)	.11	300 (14.5)	225 (17.9)	.01	79 (16.9)	34 (15.6)	.67	145 (12.4)	68 (17.1)	.02
Acquired hypothyroidism	2,164 (25.8)	665 (31.5)	<.001	296 (14.3)	239 (19)	<.001	72 (15.4)	42 (19.3)	.21	250 (21.3)	112 (28.2)	.005
Benign prostatic hyperplasia	2,521 (30)	489 (23.2)	<.001	417 (20.1)	187 (14.8)	<.001	111 (23.8)	49 (22.5)	.71	271 (23.1)	67 (16.9)	.009
Patient Zip Code Community Contextual Factors												

	White			Black			Asian			Hispanic		
	Index fistula (%) (n=8,397)	**Index graft (%) (n=2,110)**	**P-value**	**Index fistula (%) (n=2,071)**	**Index graft (%) (n=1,260)**	**P-value**	**Index fistula (%) (n=467)**	**Index graft (%) (n=218)**	**P-value**	**Index fistula (%) (n=1,173)**	**Index graft (%) (n=397)**	**P-value**
Urban	6,033 (71.8)	1,568 (74.3)	.004	1,718 (83)	1,057 (83.9)	.39	446 (95.5)	211 (96.6)	.32	1,061 (90.5)	364 (91.7)	.32
Single	3,425 (40.8)	871 (41.3)	.007	1,051 (50.8)	652 (51.7)	.01	210 (45.3)	100 (45.9)	.16	522 (44.5)	179 (45)	.29
Less than high school education	1,516 (18.1)	389 (18.4)	.11	541 (26.1)	331 (26.2)	.76	100 (21.5)	52 (23.9)	.04	390 (33.2)	150 (37.7)	<.001
Employed	5,017 (59.8)	1,257 (59.6)	.42	1,133 (54.7)	689 (54.6)	.85	277 (59.4)	126 (57.8)	.03	637 (54.3)	206 (52)	<.001
Poor	872 (10.4)	223 (10.6)	.24	387 (18.7)	244 (19.4)	.07	61 (13.1)	30 (13.7)	.43	225 (19.2)	87 (21.8)	<.001
Sensory disability among elderly	1,190 (14.2)	300 (14.2)	.61	303 (14.6)	184 (14.7)	.92	66 (14.1)	31 (14.3)	.45	183 (15.6)	62 (15.6)	.93
Non-institutionalized elderly with physical disability	2,370 (28.2)	605 (28.6)	.03	684 (33)	418 (33.2)	.44	133 (28.5)	60 (27.7)	.09	371 (31.7)	127 (32.1)	.25
Mental Disability	864 (10.3)	221 (10.5)	.10	274 (13.3)	170 (13.5)	.12	59 (12.6)	29 (13.3)	.07	157 (13.4)	56 (14.2)	.004
Self-Care Disability	770 (9.2)	198 (9.4)	.03	256 (12.4)	156 (12.4)	.68	48 (10.2)	22 (10.2)	.93	135 (11.5)	49 (12.4)	<.001
Difficulty going outside the home disability	1,646 (19.6)	422 (20)	.004	509 (24.6)	313 (24.9)	.16	105 (22.5)	49 (22.5)	.94	282 (24)	102 (25.6)	<.001
Social security income (in thousands of dollars)	11.6	11.6	.72	10.3	10.2	.24	11.1	11.0	.14	10.3	10.0	<.001
Elderly in an institution	387 (4.6)	98 (4.6)	.81	89 (4.3)	59 (4.7)	.03	18 (3.8)	8 (3.8)	.98	42 (3.6)	13 (3.2)	.08
Median Household income (in thousands of dollars)	45.0	45.4	.40	36.3	36.0	.42	49.8	49.6	.94	38.2	36.1	.01

[a]These values are not reported as either the group with the co-morbidity or the group without the co-morbidity represents less than 12 individuals and Medicare restricts the reporting of data such instance

Table 2

Fistula prevalence (Unadjusted and Fully Adjusted)

	Unadjusted		Fully Adjusted (Model 3)[a]	
	Fistula Prevalence	**P-value compared to White**	**Fistula Prevalence[b]**	**P-value compared to White**
White	79.9%	ref	78.0%	ref
Black	62.4%	<.001	65.9%	<.001
Asian/PI	67.7%	<.001	71.4%	<.001
Hispanic	74.3%	<.001	78.7%	.59

[a]Adjusted for age and its square, sex, index year, index month, total covered charges from outpatient, inpatient and carrier files in the year preceding index fistula/graft creation date, inpatient setting for the index fistula/graft creation, all co-morbidities available from the Chronic Condition Data Warehouse (except chronic kidney disease), community contextual factors and hospital referral region.

[b]Predictive margin for prevalence of fistula created vs graft.

Table 3

Mortality (Unadjusted and Fully Adjusted)

		Unadjusted				Fully Adjusted (Model 3)			
12-Month Mortality									
	Access Type	**Rate**	**P-value for fistula vs graft within race/ ethnicity**	**Difference of graft-fistula within race/ ethnicity**	**P-value for difference compared to White[1]**	**Rate[2]**	**P-value for fistula vs graft within race/ ethnicity**	**Difference of graft-fistula within race/ ethnicity**	**P-value for difference compared to White[1]**
White	Fistula	29.7%	<.001	7.6%	ref	30.0%	.03	2.4%	ref
	Graft	37.3%				32.4%			
Black	Fistula	22.8%	<.001	5.8%	0.70	25.8%	.28	1.7%	.77
	Graft	28.6%				27.5%			
Asian/PI	Fistula	21.3%	.09	5.8%	0.89	22.7%	.73	1.2%	.79
	Graft	27.1%				23.9%			
Hispanic	Fistula	22.4%	.14	3.5%	0.26	23.7%	.77	−0.6%	.28
	Graft	25.9%				23.1%			

[1] P-value for difference in incidence of mortality for fistula vs graft within race/ethnicity group compared to difference in incidence of mortality for fistula vs graft within Whites

[2] Predictive margin adjusted for age and its square, sex, index year, index month, total covered charges from outpatient, inpatient and carrier files in the year preceding index fistula/graft creation date, inpatient setting for the index fistula/graft creation and all co-morbidities available from the Chronic Condition Data Warehouse (except chronic kidney disease), community contextual factors and hospital referral region.

Table 4

Early Failure and 12-month Failure Free Survival (Unadjusted and Fully Adjusted)

		Unadjusted				Fully Adjusted (Model 3)			
Early Failure									
	Access Type	**Rate**	**P-value for fistula vs graft within race/ ethnicity**	**Difference of fistula-graft within race/ ethnicity**	**P-value for difference compared to White[1]**	**Rate[2]**	**P-value for fistula vs graft within race/ ethnicity**	**Difference of fistula-graft within race/ ethnicity**	**P-value for difference compared to White[3]**
White	Fistula	41.7%	<.001	6.6%	ref	43.5%	<.001	8.6%	ref
	Graft	35.1%				34.9%			
Black	Fistula	51.3%	<.001	16%	<.001	49.1%	<.001	16.2%	<.001
	Graft	35.3%				32.9%			
Asian/PI	Fistula	41.3%	.02	9%	.55	40.5%	.014	9.7%	0.74
	Graft	32.3%				30.8%			
Hispanic	Fistula	44.9%	.01	6.9%	.98	43.2%	.005	8.0%	0.82
	Graft	38.0%				35.2%			
12-month Failure-Free Survival									
	Access Type	Survival	P-value for fistula vs graft within race/ ethnicity	Difference of graft-fistula within race/ ethnicity	P-value for difference compared to White[3]	12-month Failure-Free Survival[2]	P-value for fistula vs graft within race/ ethnicity	Difference of graft-fistula within race/ ethnicity	P-value for difference compared to White[3]
White	Fistula	40.3%	.33	−1.1%	ref	38.9%	.008	3.0%	ref
	Graft	39.2%				41.9%			
Black	Fistula	37.4%	<.001	9%	<.001	37.3%	<.001	11.2%	<.001
	Graft	46.4%				48.5%			
Asian/PI	Fistula	45.5%	.55	2.3%	.41	45.2%	.98	6.4%	.38
	Graft	47.8%				51.6%			
Hispanic	Fistula	41.2%	.05	5.4%	.03	42.2%	<.001	9.7%	.02[4]
	Graft	46.6%				51.9%			

[1] P-value for difference in incidence of early failure for fistula vs graft within race/ethnicity group compared to difference in incidence of early failure for fistula vs graft within Whites

[2]Predictive margin adjusted for age and its square, sex, index year, index month, total covered charges from outpatient, inpatient and carrier files in the year preceding index fistula/graft creation date, inpatient setting for the index fistula/graft creation and all co-morbidities available from the Chronic Condition Data Warehouse (except chronic kidney disease), community contextual factors and hospital referral region.

[3]P-value for difference 12 month failure free survival for fistula vs graft within race/ethnicity group compared to difference 12 month failure free survival for fistula vs graft within White

[4]After applying the Bonferroni correction, this value becomes no longer statistically significant.