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ORIGINAL RESEARCH ARTICLE

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What is the best setting for receiving dialysis vascular access repair and maintenance services?

Audrey M. El-Gamil[1], Al Dobson[1], Nikolay Manolov[1], Joan E. DaVanzo[1], Gerald A. Beathard[2], Terry Foust Litchfield[2], Brook Cowin[2]

[1] Dobson DaVanzo and Associates, LLC, Vienna, VA - USA
[2] Lifeline Vascular Access, a DaVita Healthcare Partner ®, Vernon Hills, IL - USA

ABSTRACT

Introduction: Advances in dialysis vascular access (DVA) management have changed where beneficiaries receive this care. The effectiveness, safety, quality, and economy of different care settings have been questioned. This study compares patient outcomes of receiving DVA services in the freestanding office-based center (FOC) to those of the hospital outpatient department (HOPD). It also examines whether outcomes differ for a centrally managed system of FOCs (CMFOC) compared to all other FOCs (AOFOC).

Methods: Retrospective cohort study of clinically and demographically similar patients within Medicare claims available through United States Renal Data System (USRDS) (2010-2013) who received at least 80% of DVA services in an FOC (n = 80,831) or HOPD (n = 133,965). Separately, FOC population is divided into CMFOC (n = 20,802) and AOFOC (n = 80,267). Propensity matching was used to control for clinical, demographic, and functional characteristics across populations.

Results: FOC patients experienced significantly better outcomes, including lower annual mortality (14.6% vs. 17.2%, p<0.001) and DVA-related infections (0.16 vs. 0.20, p<0.001), fewer hospitalizations (1.65 vs. 1.91, p<0.001), and lower total per-member-per-month (PMPM) payments ($5042 vs. $5361, p<0.001) than HOPD patients. CMFOC patients had lower annual mortality (12.5% vs. 13.8%, p<0.001), PMPM payments (DVA services) ($1486 vs. $1533, p<0.001) and hospitalizations ($1752 vs. $1816, p<0.001) than AOFOC patients.

Conclusions: Where nephrologists send patients for DVA services can impact patient clinical and economic outcomes. This research confirmed that patients who received DVA care in the FOC had better outcomes than those treated in the HOPD. The organizational culture and clinical oversight of the CMFOC may result in more favorable outcomes than receiving care in AOFOC.

Keywords: Dialysis, Dialysis access, ESRD, Freestanding office-based center, Hospital outpatient department, USRDS

Introduction

Over the past two decades, significant changes in dialysis vascular access (DVA) have occurred. There has been a progressive change from primarily arteriovenous grafts (AVGs) to primarily arteriovenous fistulas (AVFs) (1, 2). There has also been an increasing number of endovascular procedures performed for DVA maintenance. The profile of these procedures has changed from approximately equal numbers of angioplasties and thrombectomies performed on AVG to primarily angioplasties performed on AVF (3). Site of service has also changed progressively toward the freestanding outpatient facility (FOC) dedicated to DVA from hospital outpatient departments (HOPD). In the FOC, fluoroscopically guided, endovascular treatments are being performed, utilizing sedation/analgesia in an outpatient environment primarily by interventional nephrologists. Questions arise about their effectiveness, safety, quality, and economy.

In a previous study (4), based on Medicare claims and United States Renal Data System (USRDS) data from 2006 to 2009, a large cohort of cases receiving DVA management care in an FOC was compared using propensity score matching with a cohort of cases managed in an HOPD. This study showed significantly better outcomes for the FOC setting, including fewer vascular access-related infections, fewer septicemia-related hospital admissions, and fewer related and unrelated hospital admissions than those who received care in a HOPD (p<0.001 for each metric). Furthermore, FOC cases had significantly lower mortality and lower per-member-per-month (PMPM) Medicare payments than HOPD cases.

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Corresponding author:
Joan E. DaVanzo
Dobson DaVanzo and Associates, LLC
450 Maple Avenue East, Suite 303
Vienna, VA 22180, USA
joan.davanzo@dobsondavanzo.com

Since the period covered by this report, medical practice as related to DVA has continued to evolve. AVF utilization in prevalent patients has continued to increase under the Centers for Medicare & Medicaid Services' (CMS') Fistula First Breakthrough Initiative designed to improve the AVF rate and reduce catheter use (5). The number of AVF maintenance procedures (3) has also increased. With an increasing percentage of AVF procedures has come an increased level of complexity. According to 2015 Medicare claims data, approximately one-third of these procedures take place in an FOC. In addition, the patient population has changed with a continuing increase in the percentage of elderly patients having a higher penetration of comorbidities (6, 7). There has also been the creation of larger bundles for dialysis services including drugs and other items previously billed in addition to the dialysis treatment and the beginning of the Medicare Meaningful Use incentives and the Physician Quality Reporting System (PQRS) (8).

It is not clear how these changes may have affected the comparison of FOC-based treatment versus that provided in the HOPD. The purpose of this study is to first replicate the previous analysis using more recent data reflecting current practice patterns and to determine if the changing profile of DVA has affected the site-of-service comparison. A secondary purpose is to determine if differences in the quality and economy of DVA services existed within the FOC group.

Methods

Study design and patient selection

This retrospective cohort study was based on Medicare claims and data from the USRDS for 2010-2013. USRDS database contains all health-care utilization and Medicare payment claims for end-stage renal disease (ESRD) patients, as well as select clinical information including ESRD-specific lab values, patient functional status, and comorbidities.

The study sample was drawn from all incident and prevalent ESRD patients with Medicare fee-for-service coverage between 2010 and 2013. A single episode of care that captured all DVA and dialysis-related services, and all related or unrelated hospitalizations during the whole study period was created for each patient. This included services across all settings, including inpatient and outpatient hospitals, skilled nursing facilities, inpatient rehabilitation facilities, home health agencies, long-term care hospitals, physicians, hospices, and durable medical equipment (Tab. I). An episode started with the first DVA-related service during the study period and ended either with patient death or the end of the study period.

Place of service (POS) was determined from CMS designations. Patients who did not receive at least 80% of their DVA maintenance and placement services in either a FOC (POS 11) or a hospital-associated outpatient environment, including HOPD (POS 22), emergency departments (POS 22), emergency departments (POS 23), dialysis centers (POS 65), and state/local public-health clinics (POS 71) were excluded. The study had two phases. In the first phase, the study population was divided into two cohorts: patients who received 80% or more of DVA services in an FOC, and patients who received 80% or more of DVA services in an HOPD.

TABLE I - Dialysis vascular access services included in analysis

Description	CPT codes (unless otherwise noted)
DVA placement services	
Creation of fistula	36821, 36818, 36819, 36820, 36825
Creation of graft	36830
Catheter placement	36558
DVA maintenance services	
Catheter exchange	36581
Catheter repair	36575, 36796
Thrombectomy	36870
Vein cannulation with contrast injection	36005
Ultrasound of vein and artery	93931, 93930, 93970, 93971
Vessel mapping	G0365
Catheter removal	36589
Arteriogram of extremity	75710
Stent placement	37205 & 75960
Arterial/venous angioplasty	35475 & 75962, 35476 & 75978
Cannulation of dialysis access with angiogram	36147
Venous angiogram	75791, 75825, 75827, 75898
Dialysis	
Dialysis	90935-90947, 90999
Hospitalizations	
Septicemia-related	MS-DRGs 870-872
ESRD-related	MS-DRGs: 316-317; ICD-9s: 585, 586
Unrelated	All other MS-DRGs

CPT = current procedural terminology; DVA = dialysis vascular access; ESRD = end-stage renal disease.

In the second phase of this study, a homogeneous subgroup of centrally managed FOCs (CMFOC) using standardized policies and practices was identified and compared to all other members of the FOC group (AOFOC) using propensity score matching. The attributes of the CMFOC include: (i) central oversight of the quality and utilization of its physicians through a single electronic health system; (ii) comparison of center and physician utilization rates with feedback provided at regular intervals; (iii) one-on-one patient education to identify risk factors for adverse events and ensure patient satisfaction; (iv) central training of clinical staff to reduce process variation in routine clinical scenarios; (v) accreditation to provide consistent quality, safety, and leadership; and (vi) review of complicated cases through a robust peer-review process.

A list of Medicare beneficiaries who received at least one DVA service in the CMFOC between 2010 and 2013 was used. URSDS cross-walked the Medicare beneficiary identifier to the USRDS encrypted patient identifier to allow the study team to identify CMFOC in the USRDS claims.

The study was Health Insurance Portability and Accountability Act compliant. As the study only consisted of medical claims data, without patient identifiers, the study was deemed to be research without human subjects. No formal institutional review board approval was required.

Outcome measurements

Three types of outcomes were compared over the four-year study period. The primary metrics were health indicators such as all-cause mortality rate (annually and across the study period), and the number of 21-day infection episodes due to dialysis vascular device, implant, or graft (ICD-9 996.62) and bloodstream infections due to central venous catheter (ICD-9 999.32). The 21-day metric ensured that infections that required, on average, 21-days to be treated, were not measured as multiple infection events. The second outcome included the average annual rate of DVA-related services provided per patient; rate of septicemia-related, ESRD-related, and unrelated hospitalizations; and dialysis treatments (expressed as a weekly rate). The third outcome was average PMPM Medicare payment including DVA-related care, inpatient hospitalizations, and dialysis treatments.

Statistical analysis

Propensity statistics were used to match cohorts based on a series of variables that directly impact the way in which patients receive DVA care. A propensity score for each patient was calculated to indicate the probability of a patient receiving care in the FOC (for FOC vs. HOPD) or of receiving care in the CMFOC (for CMFOC vs. AOFOC). This statistical method isolated the impact of site of service from other causal factors on all three types of outcomes. Propensity score matching techniques are widely used in observational studies when randomized controlled trials (RCTs) are not available or are unethical or impractical to administer (9). Literature suggests that applying this technique to observational studies is one approach for removing observable selection bias among treatment and comparison groups and can result in findings that mimic RCTs (10-13).

Metrics used in calculating the propensity score included patient demographics, clinical characteristics, and historical DVA-related and unrelated health-care utilization. Patient demographic characteristics included: age, gender, race, geographic region of the patient's residence, dual eligibility for Medicare and Medicaid, and smoking and alcohol or drug dependence. Clinical and functional characteristics included: comorbidities used to calculate CMS Hierarchical Condition Category (HCC) scores, history of kidney transplant, body mass index (BMI), and whether the patient was institutionalized and needs assistance with activities of daily living (ADLs). Historical DVA-related and unrelated health-care utilization included: years since first ESRD service, whether the patient first received placement or maintenance services within the study episode, whether the patient had a confirmed fistula or graft during the episode to ensure that outcomes were not due to a disproportionate use of catheters as the primary access type of a given setting, and whether the patient had a catheter as the sole dialysis access. All matching variables, except the confirmed access type, were defined and identified by USRDS.

Patients were matched using an algorithm that compares their propensity score to guarantee the closest match across groups. Matches were made in intervals of probability less than 0.2 standard deviations of estimates of the logit function that determined their propensity score, an approach consistent with the literature (14). Patients who were not able to be matched were excluded from the analysis.

Results

Between 2010 and 2013, 869,587 ESRD patients were identified in the USRDS database, representing the universe of patients for the study. After removing patients with fewer than 80% of their DVA services in FOC or HOPD, 154,322 FOC patients and 209,111 HOPD patients were considered for propensity score matching. Of the FOC population, 61,695 patients received at least one DVA-related service in the CMFOC, with the remaining population (123,226) representing AOFOC (Fig. 1). The propensity match yielded 80,831 FOC and 133,965 HOPD patients, and 20,802 CMFOC and 80,267 AOFOC patients.

FOC versus HOPD: patient characteristics

Following propensity score matching, patient demographics for FOC and HOPD were very similar (Tab. II). Both had an average age of 63 years, 45% female, 60% white, and 16% dually eligible for Medicare and Medicaid. The populations had the same proportion of incident ESRD patients (12%) as defined by the proportion of patients with an access placement as their first DVA service. There were no meaningful differences in the geographic distribution of patients. Despite matching, FOC patients were more likely to have had a transplant (5.0% vs. 4.3%, $p<0.01$), had lower BMI (29.46 vs. 29.57, $p<0.01$), had lymphatic, head, neck, brain or other major cancer (2.2% vs. 2.0%, $p<0.01$), and were less likely to have had congestive heart failure (31.2% vs. 31.7%, $p<0.01$) than HOPD patients. FOC patients were less likely to need assistance with ADLs (8.9% vs. 9.2%, $p<0.01$).

FOC versus HOPD: health indicators, utilization, and costs

Across all outcome measures, FOC patients had better outcomes than those treated in the HOPD (Tab. III). The annual mortality rate for FOC patients was 15.1% lower (14.6% vs. 17.2%, $p<0.001$) than HOPD patients and the overall mortality across the entire study period was 10.9% lower (37.5% vs. 42.1%, $p<0.001$).

FOC patients received, on average, fewer DVA-related services than HOPD patients. Patients treated in the FOC had fewer placement services, including fistula, graft, catheter, and catheter exchanges than HOPD patients ($p<0.001$). FOC patients received slightly more vessel mapping services (0.06 vs. 0.05, $p<0.001$). They also received significantly fewer dialysis treatments per week (2.91 vs. 2.99, $p<0.001$). This difference may have had greater economic significance (i.e., the overall cost of dialysis treatments) than clinical relevance since both groups essentially received three treatments per week.

FOC patients had fewer related and unrelated hospitalizations per patient per year than patients treated in the

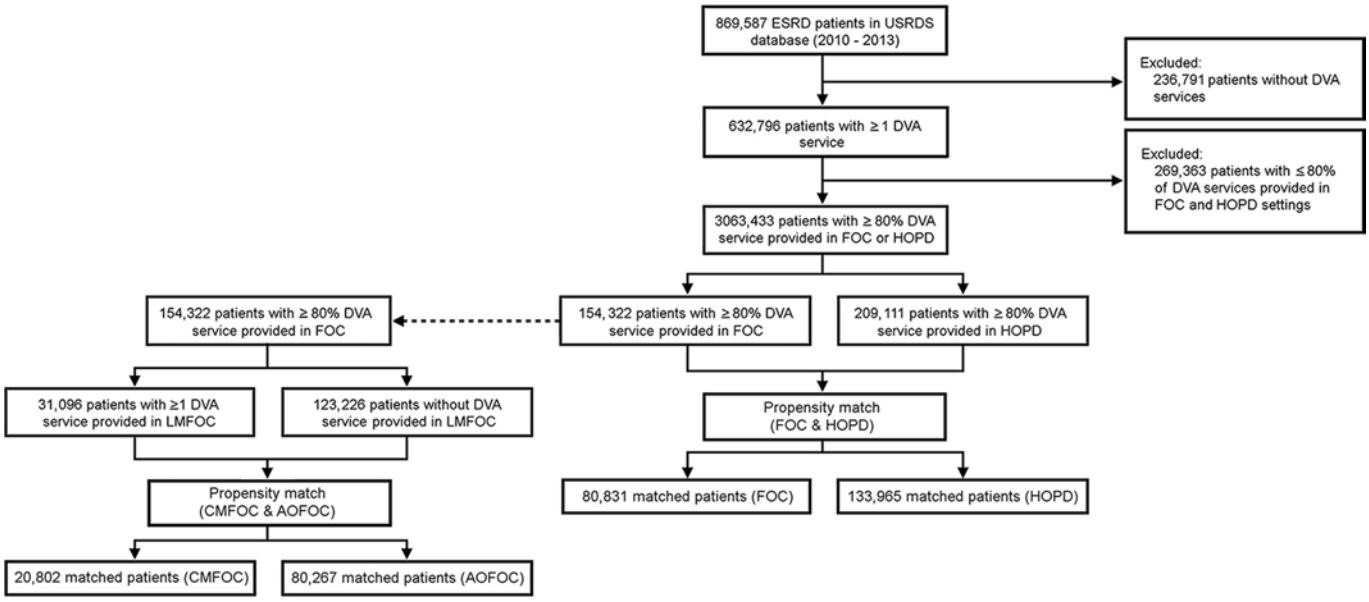

Fig. 1 - Study population. Flow diagram of patient selection.

HOPD. This difference was predominately driven by unrelated hospitalizations (1.56 vs. 1.81, p<0.001). However, FOC patients also had lower rates of septicemia-related hospitalizations (0.08 vs. 0.10, p<0.001).

Because of fewer total hospitalizations and dialysis treatments, matched FOC patients had an average total Medicare PMPM payment (including DVA services, hospitalizations, and dialysis treatments) that was $318 lower than HOPD patients ($5042.70 vs. $5360.97, p<0.001). This difference was primarily due to the differences in hospitalizations ($1958.35 vs. $2250.65, p<0.001) and dialysis ($1588.60 vs. $1613.67, p<0.001), as the cost of DVA services were similar.

CMFOC versus AOFOC: patient characteristics

The FOC population was subdivided and further analyzed to determine if there were significant differences between cases treated in a CMFOC and those treated in AOFOC. Following propensity score matching, CMFOC patients were demographically similar to AOFOC patients. Average age was 62 years, with 43% female, 56% white, and 15% dually eligible for Medicare and Medicaid. CMFOC patients had a higher kidney transplant rate (4.3% vs. 3.9%, p<0.05) and had ESRD for a longer period (3.26 vs. 3.24 years, p<0.01). There was no statistical difference in the rate of DVA placement as the first vascular access service between the two groups, nor in the geographic distribution of patients, their comorbidities, or the functional status (Tab. IV).

CMFOC versus AOFOC: health indicators, utilization, and costs

Compared to patients who received care in AOFOCs, CMFOC patients had comparable hospitalizations, and PMPM spending. However, they had a 9.4% lower annual mortality rate (12.5% vs. 13.8%, p<0.001) and 6.1% lower overall mortality (33.6% vs. 35.8%, p<0.001) (Tab. V). In addition, CMFOC patients were statistically more likely to have an infection (0.16 vs. 0.15, p<0.01).

There were statistically significant differences in the utilization of DVA services between these populations, but the clinical significance of these differences is questionable. CMFOC patients received fewer fistulas (0.09 vs. 0.10, p<0.001), but more catheter exchanges (0.14 vs. 0.09, p<0.001) than AOFOC patients. They also received fewer ultrasounds of veins and arteries (0.33 vs. 0.37, p<0.001) and vessel mapping services (0.06 vs. 0.05, p<0.001), neither of which the authors feel are clinically significant. CMFOC patients received more dialysis treatments per week (2.97 vs. 2.94, p<0.001); however, while this could have an economic impact, it is doubtful that it is of clinical significance.

CMFOC patients had lower PMPM payments for DVA services ($1485.82 vs. $1533.31, p<0.001) and hospitalizations ($1751.92 vs. $1816.47, p<0.001), which was largely due to the cost of unrelated hospitalizations. Higher dialysis treatments per week also resulted in higher dialysis PMPM payments for CMFOC patients ($1676.88 vs. $1574.44, p<0.001).

Discussion

Hemodialysis access has been referred to as the patient's lifeline; however, this access is not without problems. Over the study period, Medicare payments per patient increased disproportionately to the increase in the number of patients being treated (6, 7). A significant portion of this expenditure has been dedicated to the maintenance of dialysis access (treatment of access dysfunction). These services have been, and continue to be, provided in multiple medical settings. Questions arise as to whether there are significant differences in the quality and cost between different settings.

This study examined a large cohort of patients treated in an FOC matched to patients treated in an HOPD. The propensity

TABLE II - Patient characteristics of matched populations for variables included in propensity score matching: FOC versus HOPD

Patient characteristics	FOC (n = 80,831)	HOPD (n = 133,965)	Difference[a]
Age (y)	62.88	62.96	-0.08
Gender (% female)	45.3%	45.4%	-0.1%
Dual eligible	16.0%	16.2%	-0.2%
Geographic region			
New England	3.9%	3.9%	0.0%
Middle Atlantic	14.3%	14.3%	0.0%
East North Central	12.5%	12.6%	-0.1%
West North Central	4.3%	4.5%	-0.2%
South Atlantic	24.7%	24.3%	0.4%*
East South Central	7.3%	7.5%	-0.1%
West South Central	14.5%	14.5%	0.0%
Mountain	5.5%	5.3%	0.2%
Race			
White	60.7%	60.5%	0.2%
Black	33.5%	33.6%	-0.1%
Asian	4.2%	4.2%	-0.1%
Native American	1.3%	1.3%	0.0%
Historical DVA services			
Placement as first vascular access service	12.3%	12.6%	-0.2%
Fistula/graft access type	32.9%	33.4%	-0.5%*
Catheter, no history of fistula/graft	23.9%	24.6%	-0.7%◊
Time since first ESRD service (y)	3.24	3.21	0.03†
History of transplant	5.0%	4.3%	0.7%†
Years since last transplant (y)	9.51	10.02	-0.51†
Comorbidities			
Body mass index	29.46	29.57	-0.10◊
Metastatic cancer and acute leukemia	0.9%	0.9%	0.0%
Lung, upper GI, and other severe cancers	1.0%	1.0%	0.0%
Lymphatic, head and neck, brain, and other major cancers	2.2%	2.0%	0.1%◊
Breast, prostate, colorectal and other cancers and tumors	5.1%	5.1%	0.0%
Diabetes without complication	52.3%	52.4%	-0.1%
Diabetes with renal or peripheral circulatory manifestation	34.4%	34.7%	-0.3%
Diabetes with neurologic or other specified manifestation	14.4%	14.5%	-0.1%
Congestive heart failure	31.2%	31.7%	-0.5%◊
Acute myocardial infarction	2.5%	2.6%	0.0%
Vascular disease	22.7%	23.0%	-0.3%
Chronic obstructive pulmonary disease	14.5%	14.7%	-0.2%
Chronic ulcer of skin, except decubitus	7.3%	7.4%	-0.1%
Specified heart arrhythmias	15.1%	15.2%	-0.1%
Functional status/independence			
Institutionalized	5.8%	5.9%	-0.1%
Institutionalized - assisted living	0.5%	0.5%	0.0%
Institutionalized - nursing home	4.9%	5.1%	-0.1%
Institutionalized - other institution	0.4%	0.4%	0.0%
Needs assistance with daily activities	8.9%	9.2%	-0.3%◊

† Statistically significant at p<0.001.
◊ Statistically significant at p<0.01.
* Statistically significant at p<0.05.
[a] Difference represents the percentage point difference of FOC minus HOPD.
FOC = freestanding office; HOPD = hospital outpatient department; DVA = dialysis vascular access; ESRD = end-stage renal disease; GI = gastrointestinal.

TABLE III - Distribution of outcomes by matched population: FOC versus HOPD

Outcome measures	FOC (n = 80,831)	HOPD (n = 133,965)	Difference[a]
Health indicator			
Mortality during episode	37.5%	42.1%	-4.6%[†]
Mortality per year	14.6%	17.2%	-2.6%[†]
21-day infection episodes per year (count)	0.16	0.20	-0.04[†]
Vascular access related services (count) (per year, unless otherwise noted)			
Fistula	0.11	0.14	-0.03[†]
Graft	0.05	0.06	-0.01[†]
Catheter placement	0.35	0.44	-0.09[†]
Catheter exchange	0.10	0.11	-0.01[†]
Ultrasound of vein and artery	0.41	0.49	-0.09[†]
Vessel mapping	0.06	0.05	0.01[†]
Catheter removal	0.22	0.23	-0.01[†]
Thrombectomy	0.00	0.00	0.00
Dialysis (per week)	2.91	2.99	-0.08[†]
Inpatient admissions per year			
All inpatient admissions	1.65	1.91	-0.26[†]
Vascular-related	0.00	0.00	0.00
Septicemia-related	0.08	0.10	-0.01[†]
Unrelated	1.56	1.81	-0.25[†]
PMPM cost			
Total PMPM	$5042.70	$5360.97	-$318.27[†]
DVA	$1495.75	$1496.65	-$0.90
Inpatient admissions	$1958.35	$2250.65	-$292.30[†]
Vascular related inpatient	$0.05	$0.11	-$0.06
Septicemia-related inpatient	$109.08	$123.44	-$14.36[†]
Unrelated inpatient	$1849.21	$2127.10	-$277.89[†]
Dialysis	$1588.60	$1613.67	-$25.07[†]

[†] Statistically significant at p<0.001.
[a] Difference represents the percentage point difference of FOC minus HOPD.
FOC = freestanding office; HOPD = hospital outpatient department; DVA = dialysis vascular access; PMPM = per-member-per-month.

score model controls for selection bias across different sites of service by matching on observable clinical and demographic characteristics, making the cohorts essentially "twin-like" (Tabs. III, V). There are a few metrics where statistically significant differences were noted. These were not issues that would affect DVA and were not felt by the authors to be clinically significant. Literature indicates that applying this matching technique to an observational study can result in findings that closely correlate with those from an RCT (10-13).

The results from the comparison of FOC-treated to HOPD-treated patients confirmed the findings of our previous report based on 2006 to 2009 data (4). Patients who received DVA care in an FOC had significantly better outcomes, including lower all-cause mortality, fewer infections, and fewer septicemia-related and unrelated hospitalizations than those treated in the HOPD. In addition, patients treated in the FOC had lower average total PMPM payments including DVA services, dialysis, and hospitalizations than patients treated in an HOPD.

Facilities that identify as FOCs represent a heterogeneous group. They vary in size, organization, practice pattern, and staffing. Physicians working in these facilities vary by medical specialty, and degree and type of training in DVA maintenance procedures. The CMFOC group was studied to determine if significant differences existed within the FOC. CMFOC was selected because it represented a homogeneous group characterized by having a uniform system of peer review, an organized program for quality improvement and utilization, a formal accredited training program for clinical staff and operator physicians utilizing a standardized curriculum, and an organized program for DVA education of individual patients and supported dialysis clinics.

Comparison of outcomes for the CMFOC and AOFOC cohorts identified a 9.4% lower annual mortality rate and a 6.1% lower overall mortality in the CMFOC cohort. Other statistically significant differences were felt to not be of clinical significance. CMFOC demonstrated an economic advantage in the DVA-service category and for overall hospitalizations.

TABLE IV - Patient characteristics of matched population for variables included in propensity score matching: CMFOC versus AOFOC

Patient characteristics	CMFOC (n = 20,802)	AOFOC (n = 80,267)	Difference[a]
Age (y)	62.23	62.36	-0.14
Gender (% female)	42.5%	42.8%	-0.2%
Dual eligible	14.7%	14.9%	-0.2%
Geographic region			
New England	0.2%	0.2%	0.0%
Middle Atlantic	10.6%	10.9%	-0.4%
East North Central	12.6%	12.5%	0.1%
West North Central	3.6%	3.5%	0.1%
South Atlantic	27.2%	27.4%	-0.3%
East South Central	7.3%	7.4%	0.0%
West South Central	16.3%	16.2%	0.1%
Mountain	6.4%	6.4%	0.0%
Race			
White	56.5%	56.3%	0.2%
Black	38.1%	38.3%	-0.3%
Asian	4.5%	4.4%	0.1%
Native American	0.7%	0.7%	-0.1%
Historical DVA services			
Placement as first vascular access service	10.4%	10.7%	-0.3%
Fistula/graft access type	27.4%	28.0%	-0.6%
Catheter, no history of fistula/graft	21.7%	22.5%	-0.8%◊
Time since first ESRD service (y)	3.26	3.24	0.02◊
History of transplant	4.3%	3.9%	0.3%*
Years since last transplant (y)	10.26	10.21	0.05
Comorbidities			
Body mass index	29.45	29.41	0.04
Metastatic cancer and acute leukemia	0.7%	0.7%	0.0%
Lung, upper GI, and other severe cancers	0.8%	0.8%	0.0%
Lymphatic, head and neck, brain, and other major cancers	1.8%	1.8%	0.1%
Breast, prostate, colorectal and other cancers and tumors	4.9%	4.8%	0.1%
Diabetes without complication	51.4%	51.5%	-0.1%
Diabetes with renal or peripheral circulatory manifestation	34.3%	35.0%	-0.7%
Diabetes with neurologic or other specified manifestation	13.6%	13.7%	0.0%
Congestive heart failure	28.2%	28.5%	-0.3%
Acute myocardial infarction	2.2%	2.2%	0.0%
Vascular disease	21.5%	21.5%	0.0%
Chronic obstructive pulmonary disease	12.4%	12.5%	-0.1%
Chronic ulcer of skin, except decubitus	6.2%	6.4%	-0.2%
Specified heart arrhythmias	12.8%	12.8%	0.0%
Functional status/independence			
Institutionalized	4.6%	4.8%	-0.1%
Institutionalized - assisted living	0.4%	0.4%	0.0%
Institutionalized - nursing home	3.9%	4.1%	-0.1%
Institutionalized - other institution	0.3%	0.3%	0.0%
Needs assistance with daily activities	7.6%	7.8%	-0.3%

◊ Statistically significant at p<0.01.
* Statistically significant at p<0.05.
[a] Difference represents the percentage point difference of CMFOC minus AOFOC.
CMFOC = centrally managed freestanding office; AOFOC = all other FOCs; DVA = dialysis vascular access; ESRD = end-stage renal disease; GI = gastrointestinal.

TABLE V - Distribution of outcomes by matched population: CMFOC versus AOFOC

Outcome measures	CMFOC (n = 20,802)	AOFOC (n = 80,267)	Difference[a]
Health indicator			
Mortality during episode (%)	33.6%	35.8%	-2.1%[†]
Mortality per year (%)	12.5%	13.8%	-1.3%[†]
21-day infection episodes per year (count)	0.16	0.15	0.01[◊]
Vascular access related services (count) (per year, unless otherwise noted)			
Fistula	0.09	0.10	-0.01[†]
Graft	0.05	0.04	0.00
Catheter placement	0.31	0.31	0.00
Catheter exchange	0.14	0.09	0.05[†]
Ultrasound of vein and artery	0.33	0.37	-0.04[†]
Vessel mapping	0.06	0.05	0.01[†]
Catheter removal	0.20	0.20	0.00
Thrombectomy	0.00	0.00	0.00
Dialysis (per week)	2.97	2.94	0.03[†]
Inpatient admissions per year			
All inpatient admissions	1.53	1.55	-0.01
Vascular-related	0.00	0.00	0.00
Septicemia-related	0.07	0.08	0.00
Unrelated	1.46	1.47	-0.01
PMPM cost			
Total PMPM	$4914.62	$4924.22	-$8.69
DVA	$1485.82	$1533.31	-$47.49[†]
Inpatient admissions	$1751.92	$1816.47	-$64.55[†]
Vascular-related inpatient	$0.03	$0.05	-$0.02
Septicemia-related inpatient	$93.99	$99.51	-$5.52
Unrelated inpatient	$1657.90	$1716.91	-$59.01[◊]
Dialysis	$1676.88	$1574.44	$102.44[†]

[†] Statistically significant at p<0.001.
[◊] Statistically significant at p<0.01.
[a] Difference represents the percentage point difference of CMFOC minus AOFOC.
CMFOC = centrally managed freestanding office; AOFOC = all other FOCs; DVA = dialysis vascular access; PMPM = per-member-per-month.

However, differences in PMPM payments for hospitalizations were primarily due to unrelated conditions. CMFOC patients had higher PMPM payments for dialysis than AOFOC patients, as expected due to receiving significantly more dialysis treatments per week.

An explanation for the superiority of CMFOC's mortality rate is not readily apparent; however, it is characterized by its organization as a homogeneous, centrally managed group of facilities with standardized practices and policies. The culture of medical organizations has been shown to be important in the care of chronic illnesses (15). Organizational cultures that emphasize group affiliation, teamwork, and coordination have been associated with greater implementation of quality improvement practices (16), adoption of group practice guidelines (17), and enhancement of the delivery of patient-centered medical care (18).

A major strength of this study is the large number of patients included. In addition, the methodology allows for rigorous matching of patient cohorts across settings to ensure that comparisons are being made on clinically and demographically similar populations. There are, however, limitations to this approach. First, the study was limited to Medicare claims and USRDS data. The use of medical records would have increased the ability to identify DVA-related outcomes with greater specificity. Second, a reliance on administrative claims over a fixed period precludes examining the patients' health-care utilization prior to the study period. Therefore, prior complications or historical utilization could not be included in the propensity score model. Third, while a characterization of the facilities comprising the CMFOC subgroup was possible, such a characterization was not possible for those facilities in the AOFOC group.

Conclusion

Management of DVA dysfunction is an important part of medical care required by the hemodialysis patient. The site

at which these DVA-services are provided has a direct impact on patient clinical and economic outcomes. Patients receiving care in an FOC have lower all-cause mortality, fewer infections, and fewer septicemia-related and unrelated hospitalizations than those treated in the HOPD. This improved quality of care is also more economically favorable. Within the FOC facilities, a homogeneous subgroup of centrally managed facilities has a lower annual and overall mortality rate when compared to all other FOCs.

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