Medicare Costs Associated With Arteriovenous Fistulas Among US Hemodialysis Patients

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Background: An arteriovenous fistula (AVF) is the recommended vascular access for hemodialysis (HD). Previous studies have not examined the resources and costs associated with creating and maintaining AVFs.

Study Design: Retrospective observational study.

Setting & Participants: Elderly US Medicare patients initiating hemodialysis therapy during 2010 to 2011.

Predictor: AVF primary and secondary patency and nonuse in the first year following AVF creation.

Outcomes: Annualized vascular access costs per patient per year.

Results: Among patients with only a catheter at HD therapy initiation, only 54% of AVFs were successfully used for HD, 10% were used but experienced secondary patency loss within 1 year of creation, and 83% experienced primary patency loss within 1 year of creation. Mean vascular access costs per patient per year in the 2.5 years after AVF creation were $7,871 for AVFs that maintained primary patency in year 1, $13,282 for AVFs that experienced primary patency loss in year 1, $17,808 for AVFs that experienced secondary patency loss in year 1, and $31,630 for AVFs that were not used. Similar patterns were seen among patients with a mature AVF at HD therapy initiation and patients with a catheter and maturing AVF at HD therapy initiation. Overall, in 2013, fee-for-service Medicare paid $2.8 billion for dialysis vascular access–related services, ~12% of all end-stage renal disease payments.

Limitations: Lack of granularity with certain billing codes.

Conclusions: AVF failure in the first year after creation is common and results in substantially higher health care costs. Compared with patients whose AVFs maintained primary patency, vascular access costs were 2 to 3 times higher for patients whose AVFs experienced primary or secondary patency loss and 4 times higher for patients who never used their AVFs. There is a need to improve AVF outcomes and reduce costs after AVF creation.

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Successful treatment of end-stage renal disease (ESRD) with maintenance hemodialysis (HD) is inextricably dependent on reliable access to the bloodstream, typically 3 times a week. The vascular access is the "lifeline" for the HD patient. There are 3 types of vascular access for HD: the arteriovenous fistula (AVF), arteriovenous graft (AVG), and central venous catheter (CVC). In numerous studies, including a meta-analysis of 62 cohort studies with 586,337 participants, patients dialyzing with an AVF have been observed to have less morbidity and mortality.[1] Compared with patients with an AVF, those with a CVC have higher rates of cardiovascular events and all-cause and infection-related mortality.[1] The Centers for Medicare & Medicaid Services (CMS), the principal payer of dialysis services in the United States, has actively promoted use of AVFs with the twin goals of improving health outcomes and lowering costs. Specifically, CMS created the Fistula First Initiative in 2002,[2] initially with a target of AVF use in 40% of prevalent HD patients; subsequently, the goal was increased to 66%. Most recently, the CMS Quality Incentive Program provides a financial incentive for providers to increase AVF use by imposing reimbursement penalties to dialysis units based in part on AVF prevalence. Cumulatively, these vascular access initiatives have been successful, and the proportion of prevalent US HD patients using an AVF has increased from 24%[3] in 1998 to 2000 to 64% in August 2016.[4]

Although AVFs are the preferred form of vascular access, they are limited by high rates of nonuse, patency loss, and abandonment. In an attempt to increase use, many AVFs undergo surgical or endovascular procedures, but these are associated with higher rates of subsequent maintenance procedures and shorter overall AVF survival.[5,6] Permanent AVF failure within the first year after surgical creation is reported to occur in up to 40% of patients[7-10] and can result in prolonged CVC dependence and subsequent morbidity, as well as the need for additional access surgery.

Despite recognition of the complexities associated with AVF creation, few studies have evaluated the costs related to AVF management in a representative US HD population. In this study, we examine the costs to Medicare of vascular access creation, maintenance, and associated complications using national claims data. Our analyses stratify patients into cohorts based on timing of AVF creation relative to HD therapy initiation and evaluate costs over 2.5 years of follow-up based on AVF clinical outcomes.

Methods

Study Design, Data Source, and Patient Population

The observational equivalent of intention-to-treat principle guided the design of this retrospective study to compare

costs associated with different clinical scenarios for AVFs among a cohort of HD patients. We used data from the 2010 to 2013 US Renal Data System (USRDS), which includes demographic and clinical data for patients with ESRD and their institutional providers of dialysis treatment. CMS Medical Evidence Form 2728, a validated and reliable research tool,[11] was used to determine vascular access status at HD therapy initiation. Starting in July 2010, all dialysis units reported vascular access in use for all HD patients on a monthly basis according to the following modifiers: V5 (CVC), V6 (AVG), or V7 (AVF). In addition to the USRDS, 1-year pre-ESRD CMS Medicare claims data were used to identify vascular access procedures conducted in the year before dialysis therapy initiation.

Figure 1 shows the patient cascade using USRDS and CMS Medicare pre-ESRD data to identify 3 study cohorts based on AVF status at the time of first dialysis: cohort 1 initiated HD therapy with a mature AVF, cohort 2 initiated HD therapy with a maturing AVF, and cohort 3 initiated HD therapy with a CVC only and underwent AVF creation within 9 months after dialysis therapy initiation. All incident HD patients who were 66 years and older and initiated dialysis therapy between July 1, 2010, and June 30, 2011, were included for cohorts 1 and 2. Those who initiated dialysis therapy between April 1, 2010, and September 30, 2010, were included for cohort 3 to allow for a 9-month window after dialysis therapy initiation for AVF creation. The study population was limited to patients 66 years and older to enable inclusion of AVF creations that were performed in the prior year.

We used the CMS 2728 form to identify vascular access used at dialysis therapy initiation. An index AVF creation for each patient was identified using *Current Procedural Terminology, 4th Edition* codes 36818, 36819, 36820, and 36821 and *International Classification of Diseases, Ninth Revision* (ICD-9) procedure code 39.27. For cohorts 1 and 2, the most recent AVF creation in the year before dialysis therapy initiation was identified; because codes 36818, 36819, and 36820 can be billed for the second surgery of a 2-stage AVF creation, we used a prior AVF creation as the index procedure if it occurred within the prior 3 months. For cohort 3, only patients who had an AVF creation within 9 months after dialysis therapy initiation were included. This index AVF creation is the start of follow-up for collecting cost data for each patient. Additional patient exclusion criteria related to insurance coverage and other issues are presented in Fig 1. The final study populations were 2,704 for cohort 1, 3,530 for cohort 2, and 3,901 for cohort 3. Table S1 provides the definition and sample size for the 3 AVF patient cohorts based on timing of AVF creation and by primary and secondary patency loss and AVF nonuse.

Because we used encrypted patient information and reported aggregate data, we did not require research ethics committee approval. Informed consent was also waived due to deidentified information.

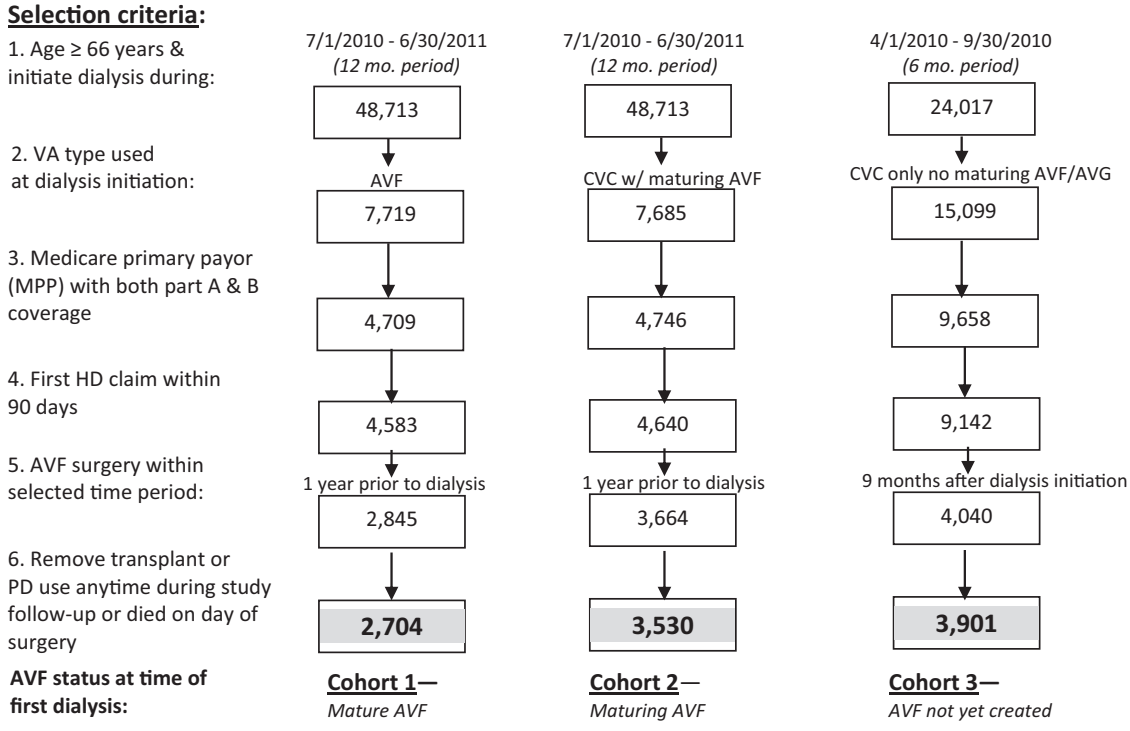

Figure 1. Patient cascade using US Renal Data System and Medicare claims pre–end-stage renal disease data to identify 3 cohorts based on arteriovenous fistula (AVF) status at time of first dialysis. Abbreviations: AVG, arteriovenous graft; CVC, central venous catheter; HD, hemodialysis; PD, peritoneal dialysis; VA, vascular access.