Increasing the Use of Arteriovenous Fistula in Hemodialysis: Economic Benefits and Economic Barriers

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The Fistula First Initiative set a goal of 66% arteriovenous (AV) fistula-based access among US hemodialysis patients. This study modeled the impact of achieving the target AV fistula placement rate on Medicare expenditures and on dialysis patient survival and also reviewed economic disincentives for providers that will inhibit achieving this target. The model projects lifetime costs and survival in the US 2003 incident hemodialysis population. Annual treatment costs were estimated from previous analyses of Medicare expenditures by access modality. Patient survival by mode of access was derived from the Dialysis Morbidity and Mortality Study (DMMS). These parameters were applied to a cohort of patients who meet the 66% AV fistula target and an identical cohort with the current vascular access case mix. Comparison of outcomes yields estimates of differential total expenditures and total patient life-years. If prevalence AV fistula-based access in the 2003 incident hemodialysis cohort were 66% rather than the observed 35%, then the Center for Medicare and Medicaid Services would save $840 million in access-attributed expenditures over the expected lifetime of these patients. However, population survival would increase by 35,000 additional life-years, increasing total lifetime expenditures by a net of $1.4 billion. Relative to the current mix of access modality, the shift to 66% AV fistula would be achieved at a net incremental cost of $40,000 per year of life gained. Economic barriers to reaching this goal include financial disincentives to providing adequate predialysis care, performing AV fistula surgical procedures, and monitoring vascular access flow. Achievement of the 66% AV fistula target is cost-effective. Financial incentives in the form of higher reimbursement to encourage wider use of AV fistula placement also could be cost-effective.

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Stable vascular access is vital for the long-term health of people who undergo long-term hemodialysis. Among the three leading modalities—arteriovenous (AV) fistula, polytetrafluoroethylene (PTFE) graft, and catheter—the AV fistula is widely recognized as superior because of greater reliability (1), fewer infections (2), fewer events that require hospitalization (3,4), and reduced mortality (5,6). However, despite their disadvantages, PTFE graft and catheterization remain the primary vascular access modalities in the US ESRD population, with only 35% of new dialysis patients in 2003 using an AV fistula (7). Although use of AV fistulas has increased steadily since 1999, rates of fistula creation are far lower than the 80 to 90% that is seen in Europe and Japan (8,9).

The National Kidney Foundation established the Dialysis Outcomes Quality Initiative (K/DOQI) in 1997 with guidelines that included a goal of 50% fistula-based access among US incident patients (10,11). The Center for Medicare and Medicaid Services (CMS) also adopted this as a goal for the ESRD program in 2004 (12). In 2005, the CMS together with a consortium of stakeholder organizations that are known as the Fistula First Initiative increased that goal to 66% fistula-based access in prevalent patients as part of a "Breakthrough Initiative" for quality improvement (13). In this study, we project the impact of achieving the target 66% AV fistula placement rate on Medicare ESRD expenditures and on the survival of people who undergo long-term renal dialysis. We also discuss economic barriers to reaching the target.

Materials and Methods

We constructed a mathematical model to project Medicare expenditures and expected survival of beneficiaries who undergo hemodialysis as a function of vascular access modality. The time horizon is the expected lifetime for a group of patients who become eligible for the Medicare ESRD program during a 1-yr period (2003). Figure 1 depicts the structure of the model, which was implemented in Microsoft Excel (Microsoft Corp., Redmond, WA).

Model inputs establish demographic characteristics of the incident cohort and the proportion of patients who undergo each mode of vascular access. Next, annual treatment costs are estimated on the basis of published reports of Medicare expenditures by access modality (14).

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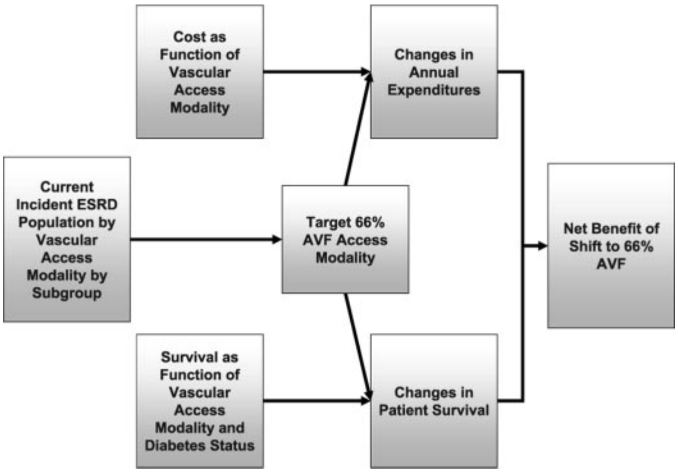

Figure 1. Model summary.

Patient survival by mode of access is derived from the Dialysis Morbidity and Mortality Study (DMMS) (5). These parameters are applied to an incident cohort of patients who meet the 66% AV fistula target and an identical cohort with the current vascular access case mix. Comparison of outcomes in the two cohorts yields estimates of differential total expenditures and total patient life-years. Using these results, we calculate cost-effectiveness and net benefit of meeting the CMS target. Sources of data and modeling assumptions for each of these steps are documented in the balance of this section.

Characteristics of the Incident Cohort

The number of people in the cohort and their demographic characteristics are based on the 2003 incident hemodialysis population as reported by the US Renal Data System (USRDS) (15). The USRDS collects data on all patients in the CMS ESRD program through surveys of dialysis facilities and analysis of Medicare enrollment and claims payment files.

The year 2003 is the latest for which we have reliable data on vascular access modality by patient type from the ESRD Critical Performance Measures (CPM) program (7). CPM is a national quality improvement effort that is conducted by CMS and its 18 ESRD networks and tracks annual progress in achieving CMS goals for dialysis outcomes. A random sample of approximately 9000 patients who are on hemodialysis at year's end is part of the data collection effort. One CPM measure is the vascular access modality as observed in each patient's last dialysis session during the fourth quarter. For the 1500 patients who are incident in the first 8 mo of the year, this measure was designed to determine a patient's permanent access modality, as opposed to temporary use of a long-term catheter while a fistula or a PTFE graft matured.

To project characteristics of a hemodialysis population that would achieve 66% use of fistula, we needed to specify the distribution of the remaining 34% of patients between graft or permanent catheter. We assumed that the share of permanent catheter relative to graft would remain at the 2003 level.

Treatment Costs by Access Modality

Medicare expenditures by method of vascular access for dialysis patients who were incident in 1997 were reported by Eggers and Milam (14). Using multivariate regression, they estimated incremental costs that were attributable to vascular access on 1997 and 1998 expenditures while controlling for age, gender, race, and primary cause of ESRD. As a proxy for severity, Eggers and Milam also included a variable that indicated whether a patient died during the period. Costs were annualized for the observation time of the patient and censored at the point of death or transplantation. Because the dependent variable was total medical expenditure, this approach captures the combined cost impact of differing rates of graft failure, infections, and other complications, as well as direct cost of placement.

Table 1 displays the total Medicare ESRD expenditures in 1997 and 1998 and costs by access modality as predicted by the multivariate model. Relative to AV fistula, PTFE graft placement was associated with $4500 in additional annual Medicare expenditure, whereas catheter placement accounted for $9000 per year (1997 dollars). Costs were substantially lower in the second year for each mode of access. Subsequent extension of the analysis to include 1999 revealed the same level of expense in the third year (16).

To estimate lifetime savings that are attributable to AV fistula placement, we allocated the 2-yr average cost increments that were esti-

Table 1. Annual per capita Medicare expenditures for first and second year by vascular access modality among patients with vascular access first placed in 1997

Vascular Access Modality	Total[a] ($)		Annual Incremental Cost *versus* Fistula Averaged over 2 yr and Multivariate Adjusted[a] ($)	Incremental Cost *versus* Fistula Adjusted and Allocated by Year[b] ($)	
	Year 1	Year 2		Year 1	Year 2+
1997 and 1998 Medicare expenditures					
fistula	68,002	49,689	–	–	–
graft	75,611	54,555	4500	5250	3667
catheter	86,927	57,178	9000	10,629	7423
Escalated for medical price inflation to 2003[c]					
fistula	86,363	63,105	–	–	–
graft	96,026	69,285	5715	6668	4657
catheter	110,397	72,616	11,430	13,499	9427

[a]Eggers and Milam (14).
[b]Author allocation of Eggers and Milam (14) results.
[c]27% rise in medical component of urban Consumer Price Index (17).

mated by Eggers and Milam in proportion to first- and second-year total expense. We assume that the cost differential in the second year holds for subsequent years. All cost estimates were adjusted to base year 2003 using the medical component of the Consumer Price Index (17).

Survival by Access Modality

The USRDS reports the survival of hemodialysis patients until death, transplantation, or switch to peritoneal dialysis. Expected time on hemodialysis in the model was calculated on the basis of tables that give mortality at half-year intervals over a 5-yr period for patients who were incident during 1993 to 1997 and at a single 10-yr time point for patients who were incident during 1992 (15). Separate survival functions were developed for patients with and without diabetes.

To estimate the effect of vascular access on mortality, we used the analysis of the DMMS sample of 5507 patients in 1993 by Dhingra *et al.* (5). In a 2-yr observation period, patients with diabetes were found to have approximately half again as high an adjusted risk for death for PTFE graft (relative risk [RR] 1.4; 95% confidence interval [CI] 1.1 to 1.8) and catheter (RR 1.5; 95% CI 1.2 to 2.0) as for AV fistula. For patients without diabetes, PTFE graft RR was not statistically significant, but catheter was (RR 1.7; 95% CI 1.4 to 2.1). Results from other studies on mortality by access modality did not differentiate by diabetes status but reported similar ranges for the overall dialysis population that we summarize in Table 2 (6,18–21). All of the studies are observational and strove to adjust for selection bias with multivariate models that incorporated age, gender, comorbidities, previous time on dialysis, and other risk factors.

Table 3 summarizes the findings of Dhingra *et al.* on the relation of vascular access and mortality, the USRDS figures, and our derived estimates of expected time on dialysis by vascular access modality and diabetes status. The USRDS survival curves as well as other analyses of Dialysis Outcomes and Practice Patterns Study (DOPPS) data (21) reflect a constant death rate; therefore, the expected survival time for a particular category is inversely proportional to its RR. We assumed that the resulting differences in estimated years of life for patients with a fistula relative to other modalities would vary depending on diabetes status but were otherwise independent of age, gender, and race in the subanalyses of these populations. For example, our model projects that survival in a patient with diabetes and a catheter would be shortened by 1.8 yr relative to a similar patient with a fistula.

Cost-Effectiveness and Net Health Benefit

Applying these modality-specific costs and mortality estimates to a cohort that meets the 66% AV fistula target and comparing this with the 2003 cohort yields estimates of differences in lifetime costs and survival. With these data, we calculated a cost-effectiveness ratio as incremental cost per year of life gained. Both costs and benefits were discounted by 3% per year. We also calculated the net health benefit, which is defined as the difference between the incremental cost of an intervention and societal willingness to pay per year of incremental survival (22). Finally, we explore a hypothetical scenario whereby Medicare reimbursement rates for performing the AV fistula surgical procedures are increased above current levels.

Sensitivity Analysis

The differences in lifetime costs and survival are broken out by demographic group so that one can judge the sensitivity of the total estimate to the share of AV fistula that is achieved for each group. We illustrate the sensitivity of net health benefits to the estimates of vascular access cost savings, improved survival, and the societal value of an additional life-year. The sensitivity of results to the relative share of catheter and graft when AV fistula use is a goal also is explored.

Results

In 2003, the CPM project found that 35% of patients who were incident to hemodialysis during that year had fistula as their permanent mode of access, with PTFE graft and catheter use at 26 and 39%, respectively. Table 4 described access modality in 2003 by demographic subgroup as well as our projection for each modality if the 66% fistula target were achieved. On the basis of the 2003 proportion of use, we estimate that PTFE graft would fall to 14% with catheter usage at 20%.

How this shift to the new modality mix could have an impact on lifetime expenditures and survival of the 93,000 patients who had ESRD and were incident in 2003 is illustrated in Table

Table 2. Published estimates of hazard for death for PTFE graft and catheter relative to fistula[a]

Author, Data, Design[b], Sample Size	HR Relative to Fistula (95% CI)	
	Graft	Catheter
Polkinghorne *et al.* (18), New Zealand, longitudinal, $n = 3912$	1.55 (1.15 to 2.07)	2.31 (1.60 to 3.32)
Astor *et al.* (6), CHOICE, longitudinal, $n = 616$	1.2 (0.8 to 1.8)	1.5 (1.0 to 2.2)
Pastan *et al.* (19), southeast US, cross-sectional, $n = 7497$	NA	1.4 (1.1 to 1.9)
Xue *et al.* (20), Medicare elderly claims, longitudinal, $n = 66{,}595$	1.16 (1.08 to 1.24)	1.70 (1.59 to 1.80)
Port *et al.* (21), DOPPS, longitudinal, $n = 17{,}245$ risk from catheter use in facility >28% compared to <7%	NA	1.23
Dhingra *et al.* (5), DMMS, longitudinal, $n = 5507$		
with diabetes	1.4 (1.1 to 1.8)	1.5 (1.2 to 2.0)
without diabetes	1.1(0.9 to 1.3)	1.7(1.4 to 2.1)

[a]CHOICE, Choices for Healthy Outcomes in Caring for ESRD; DMMS, Dialysis Morbidity and Mortality Study; DOPPS, Dialysis Outcomes and Practice Patterns Study; HR, hazard ratio; NA, not applicable; PTFE, polytetrafluoroethylene.
[b]All were observational studies with multivariate adjustments for other risk factors.

Table 3. Estimation of expected years on dialysis by vascular access and diabetes status[a]

Parameter	Mode of Access			
	All	Fistula	Graft	Catheter
HR relative to fistula patients[b]				
with diabetes	NA	1.0	1.4	1.5
without diabetes	NA	1.0	1.0	1.7
HR relative to all patients[c]				
with diabetes	1.0	0.8	1.1	1.1
without diabetes	1.0	0.9	0.9	1.5
Expected years on hemodialysis, applying HR to USRDS reported mean survival[d]				
with diabetes	4.1	5.5	3.9	3.6
without diabetes	5.2	5.8	5.8	3.4
Increment in mean survival relative to fistula (yr)				
with diabetes		0.0	−1.6	−1.8
without diabetes		0.0	0.0	−2.4

[a]USRDS, US Renal Data System.
[b]Dhingra *et al.* (5). Because the difference between graft and fistula in patients without diabetes was not found to be statistically significant, 1.0 was assumed.
[c]Author calculation based on modality mix in Dhingra sample.
[d]USRDS (15) Tables 4.12, I0.15 for all modes of access, and author calculations assuming constant hazard rate for specific modes.

Table 4. Vascular access modality case mix, current and CMS target[a]

Demographic Group	% by Vascular Access					
	2003 Incident Cohort[b]			CMS Target		
	Fistula	Graft	Catheter	Fistula	Graft[c]	Catheter[c]
All	35	26	39	66	14	20
Age (yr)						
0 to 44	48	17	35	66	11	23
45 to 54	39	23	38	66	13	21
55 to 64	34	25	41	66	13	21
65 to 74	33	31	36	66	16	18
75+	27	27	46	66	13	21
Gender						
male	43	20	37	66	12	22
female	24	33	43	66	15	19
Race						
white	37	24	39	66	13	21
black	28	31	41	66	15	19
other/unknown	33	24	43	66	12	22
Cause of ESRD						
diabetes	34	27	39	66	14	20
hypertension	35	28	37	66	15	19
glomerulonephritis	54	21	25	66	16	18
other	31	20	49	66	10	24

[a]CMS, Center for Medicare and Medicaid Services.
[b]CMS (7).
[c]Allocated in same proportion as 2003.

5. Applying our estimates of vascular access costs and survival, we calculate that Medicare would save $9030 in access-attributed expenditures per patient lifetime, or $840 million for the entire cohort. This savings represents 3% of patient lifetime costs. Increased use of AV fistula would prolong survival of the average patient by an estimated 0.38 yr. Medicare also would incur new expenditures for continued treatment during this additional period of survival, an issue that we discuss later.

The savings in vascular access costs and life-years by age category, race, gender, and cause of renal failure also are shown in Table 5 and demonstrate the sensitivity of the estimate to the share of AV fistula achieved for each group. For example, if fistula use in those who are older than 74 yr remains at roughly their 2003 level of 27%, then we would forgo $292 million and 12,200 life-years—one third of the projected savings.

The current fistula utilization rate among women was approximately half that of men (24 *versus* 43%) in 2003, and achieving the target for women is critical to achieving two thirds of the prospective savings. The potential saving among black patients also is disproportionate to their share of the population; their 2003 fistula utilization was below that of white and other patients (28 *versus* 37%).

Cost-Effectiveness and Net Health Benefit

Although the model projects $840 million in reduced expenditure for vascular access and related morbidities, the long-term impact on Medicare over the 4.4 yr average lifetime of the patient cohort is not necessarily cost-saving. Patients with ESRD and an AV fistula live longer on average than those with PTFE graft or catheter, and Medicare continues to pay for their treatment during this time. Each additional year of survival with an AV fistula will cost Medicare approximately $63,000 on average (Table 1). Our model projects that the shift to 66% AV fistula would provide an additional 35,000 yr of survival for the 2003 incident cohort, resulting in $2.25 billion in additional Medicare expenditures. When offset by the $840 million savings in vascular access–attributed costs, Medicare's net additional expenditure is $1.4 billion over the cohort's lifetime. Relative to the current mix of access modality, the shift to 66% fistula would be achieved at a cost-effectiveness ratio of $40,000 per year of life gained.

Another approach to assessing the value of a shift in access modality is to calculate net health benefit as the value of life-years gained from a societal perspective less the expenditure to achieve these additional years of survival. If society values a year of life gained at $50,000, a benchmark that is common in current economic analyses (23), then the net benefit is $400 million ($1.8 billion in societal value of life offset by 1.4 billion in expenditures). In Figure 2, we show the net health benefit of achieving the CMS target in the 2003 cohort for which societal willingness to pay ranges from 0 to $100,000 per year of life gained. With a value of 0 per life-year gained, net health benefit is a negative $1.4 billion, equivalent to incremental ESRD ex-

Table 5. Vascular access cost savings and additional life-years attributable to increasing fistula share to 66%

Demographic Group	US Hemodialysis Incident Population 2003[a]			Vascular Access Cost Savings for Current Life-Years, Discounted		Additional Life-Years, Discounted	
	n	% of Total	% with Diabetes	Per Person	Total (Millions)	Per Person	Total[b]
All	93,276	100	45	$ 9030	$843	0.38	35,400
Age (yr)							
0 to 44	11,939	13	29	$ 5430	$ 65	0.23	2800
45 to 54	13,716	15	49	$ 7930	$109	0.35	4700
55 to 64	19,471	21	58	$ 9340	$182	0.41	8000
65 to 74	22,920	25	52	$ 9320	$214	0.39	8900
75+	25,230	27	34	$11,570	$292	0.48	12,200
Gender							
male	50,546	54	42	$ 6840	$346	0.29	14,800
female	42,730	46	48	$12,040	$515	0.50	21,400
Race							
white	59,457	64	45	$ 8520	$506	0.36	21,500
black	27,617	30	43	$10,950	$302	0.45	12,400
other/unknown	6202	7	53	$ 9740	$ 60	0.42	2600
Cause of ESRD							
diabetes	41,940	45	100	$ 8970	$376	0.45	19,000
hypertension	26,553	28	0	$ 9190	$244	0.33	8700
glomerulonephritis	7023	8	0	$ 3530	$ 25	0.12	800
other	17,760	19	0	$10,780	$191	0.46	8200

[a]USRDS (15).
[b]Life-year estimates by subgroup do not sum exactly to estimate for all because of rounding errors.

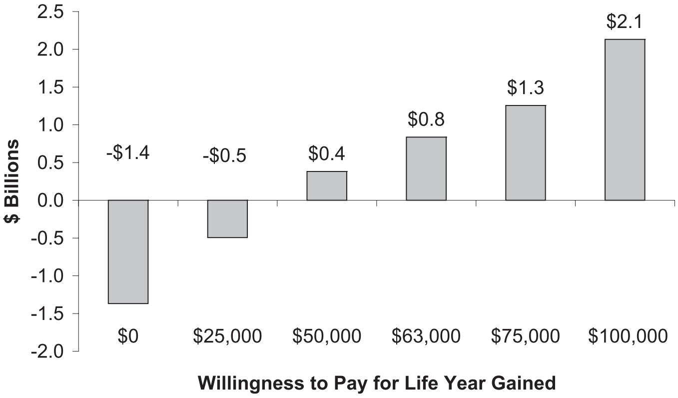

Figure 2. Lifetime net health benefits by value of additional life-year.

penditures. If society is willing to pay $100,000 per life-year gained, then the net benefit is $2.1 billion. Note that if a life-year is valued at the same $63,000 per year that Medicare now is paying to extend life with dialysis treatment, then the net benefit is the $840 million savings in vascular access–attributed costs.

Figure 3 displays a sensitivity analysis that examines the effect on net health benefit of differing assumptions for cost savings and survival attributable to increased use of AV fistula, with $75,000 as the value of an additional year of life. For example, if annual cost savings and incremental survival are half of the base case levels ($4500/yr and 0.19 yr, respectively), then net benefits also are halved ($0.63 billion instead of $1.26 billion). The figure illustrates that even if there is no improvement in survival, there is a positive net benefit equal to the amount of vascular access savings actually realized.

We also examined the impact of a change in the relative shares of catheter and graft with achievement of the 66% fistula target. The base case analysis assumed that the relative shares would not change, resulting in a 20% share for catheter and 14% share for graft. If the catheter share were only 10%, then the shift to 66% fistula would increase average survival by 0.50 yr (instead of 0.38), with a resulting net health benefit of $1.5 billion (valuing an additional life year as $75,000). If the catheter share reached 30%, then average survival would increase by 0.27 yr for a net health benefit of $1.0 billion.

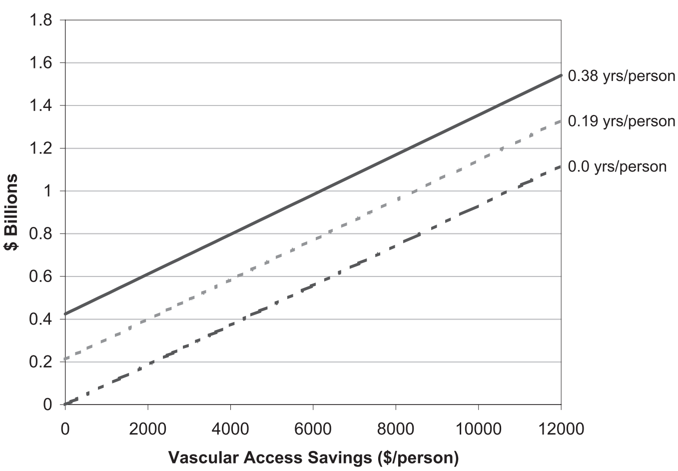

Figure 3. Net health benefits (additional life-year valued at $75,000) *versus* vascular access and life-year savings.

Discussion

DOPPS data demonstrate that 80% of prevalent European patients have an AV fistula (24). The CMS goal of 66% AV fistula seems modest in comparison. A high rate of diabetes as a comorbidity (45 *versus* 22% of European patients) often is cited as a key factor in the US preference for PTFE grafts rather than fistulas. Rates of peripheral vascular disease and angina pectoris also are higher. These factors complicate the establishment of an AV fistula. However, even when accounting for comorbidity, Pisoni *et al.* (24) estimated that 79% of prevalent dialysis patients still could receive an AV fistula if European practice patterns were adopted by US clinicians. Europeans place AV fistulas significantly more often than do US physicians, even in the presence of comorbidities.

Although a suboptimal rate of AV fistula placement in the United States is due at least partly to clinical characteristics of the hemodialysis population, it also is a result of structural factors such as inadequate pre-ESRD care, gaps in clinician knowledge and training, and underuse of technology. To address such factors, the CMS and a consortium of ESRD stakeholders are cooperating in the "Fistula First" initiative that began in April 2004 (25). A consortium of clinicians and quality-of-care experts developed practice improvement recommendations while the CMS monitors performance by regional ESRD network. However, barriers to AV fistula construction, such as historical practice, culture, and resistance to change, are exacerbated by economic incentives that favor current reliance on catheter and graft. We summarize these issues in Table 6.

Using Benefits to Overcome Barriers

With estimated net health benefit ranging from $0.4 billion to $2.1 billion, funds could be allocated to motivate increased AV fistula use while still realizing a net benefit to society. In fact, the Pay for Performance Panel of the Fistula First Initiative recently made this recommendation to the CMS. The panel suggested that, as a high-impact, well-studied program that is experienced with quality improvement, ESRD is a good early candidate for Pay for Performance (26). The CMS agreed, making fistula creation one of 36 draft measures for the Physician Voluntary Reporting Program launched in 2006 (27). The program is an interim step to test reporting methods that will lead to financial incentives for quality improvement. The panel also recommended adjusting reimbursement levels for surgeons and interventional physicians as well as establishing new incentives for early referral of patients with late-stage chronic kidney disease, conversion of prevalent catheter and graft patients to fistula, monitoring of vascular access, and patient education. Also suggested were incentives for patients who sometimes are reluctant to agree to fistula for cosmetic reasons. Copayments for fistula-related procedures could be suspended, or reimbursement could be provided for travel to a facility

Table 6. Barriers to achieving KDOQI AV fistula targets[a]

Problem	Issue
Inadequate pre-ESRD care	A nephrologist often sees ESRD patients for the first time immediately before initiating long-term dialysis (29). In these cases, a PTFE graft often is constructed to avoid the 4- to 6-mo maturation time required for an AV fistula. Central venous catheter is the first mode of access for 61% of US ESRD patients compared with 15% for AV fistulas (30). The Medicare ESRD program currently lacks a formal coverage and reimbursement approach to promote pre-ESRD medical management and preventive services among people who are not already Medicare beneficiaries (31).
Relatively few surgeons perform the AV fistula procedure	There is a scarcity of surgeons in the United States with proficiency in constructing AV fistulas, resulting in shortage of capacity to establish this mode of access.
Reimbursement for the AV fistula procedure is relatively low	Construction of an AV fistula is more technically challenging than other access modalities and reimbursement is lower. Medicare-allowable payment for the placement of PTFE graft in 2005 was 25% greater than reimbursement for AV fistula ($610 for CPT 36821).
Diagnostic imaging is not used adequately to construct AV fistula	KDOQI guidelines call for preoperative imaging to assess appropriateness of AV fistula and facilitate construction. Preoperative imaging involves use of Doppler ultrasound or low-concentration contrast that allows for venous mapping. Use of preoperative imaging carries the potential to increase rates of AV fistula construction as surgeons are able to gain a better understanding of the patient's vasculature before surgery (32).
Surveillance of established AV fistula is spotty, leading to higher than necessary rates of failure	Payment for surveillance is bundled as a component of the composite reimbursement for hemodialysis. Only one manufacturer (Fresenius Medical Care) makes vascular access flow monitoring available as part of routine hemodialysis therapy. For the majority of patients, flow surveillance will be performed only if the cost is absorbed by the provider.

[a]AV, arteriovenous; KDOQI, Kidney Disease Outcomes Quality Initiative.

where a fistula can be placed as the current shortage of surgeons who are skilled in the procedure may dictate.

We explored the impact of an increase in Medicare reimbursement for the AV fistula procedure on projected savings in access-attributed expenditures with results as shown in Figure 4. If the vascular access modality case mix achieves the CMS target of 66% AV fistula and payment for the AV fistula procedure remains at the current level ($610), then Medicare's projected access savings are approximately $840 million (column 1). The next three columns show the impact on Medicare expenditures if payment for the AV fistula procedure were increased by 50, 100, or 200%. As shown in the last column, Medicare could triple the AV fistula payment rate—boosting payment from $610 to $1830 or spending an equivalent amount on other incentives—while still achieving vascular access savings of $765 million over the lifetime of the cohort. A 200% increase in reimbursement would have only a small impact on the incremental cost-effectiveness ratio ($42,000 *versus* $40,000 per life-year).

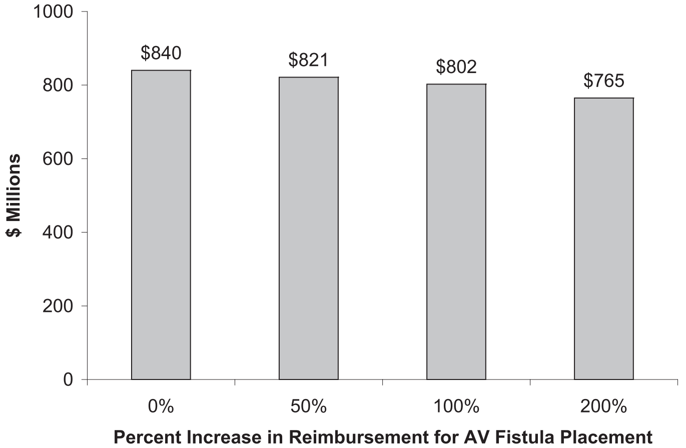

Figure 4. Impact of change in Medicare reimbursement for arteriovenous (AV) fistula placement on vascular access–attributed savings: Lifetime savings of 2003 incident cohort.

Limitations

Costs that are associated with vascular access modality are based on the observational analysis by Eggers and Milam (14), who caution that even with the multivariate adjustments of their model, bias toward selection of more severe patients for catheter or PTFE graft placement may result in overestimation of expense relative to fistula. Our estimate of reduced mortality in fistula also is subject to selection bias, because only observational studies are available. In other words, there may be diminishing returns in moving from the easiest patients (presumably those who now are receiving a fistula) to more difficult patients to implant fistulas. These marginal patients will take more interventions to maintain patency, reducing the potential savings. Mitigating this factor is that much of the benefit of fistula is reduced complications from infections, and both cost- and life-saving benefits would continue to hold in more severe patients. Furthermore, the 66% goal for US fistula prevalence still is well below the 79% prevalence that is seen in Europe and Japan in similar patients (24), so the goal leaves room for the more difficult patients to be assigned catheter or graft.

Port *et al* (21). projected the life-years that might be gained in the 2004 through 2008 hemodialysis population if dialysis patients achieved standards for six areas of care: Dialysis dosage, phosphate control, anemia management, partial correction of serum albumin, reduced interdialytic weight gain, and reduced use of permanent catheter (from 28 to 7%). Their estimate of 144,000 additional life-years can be compared with our estimate of 35,000 additional life-years for improving vascular access for the 2003 incident cohort.

Our approach to modeling the impact of increasing the AV fistula rate can be described as counterfactual. In effect, we show how costs and survival in the 2003 dialysis cohort might be different assuming achievement of the target 66% rate. We do not attempt to model the growth in CMS expenditures if the 66% fistula rate were achieved over a period of time. It is entirely possible that rising ESRD expenditures would lead to unforeseen changes in Medicare policy that would invalidate our projections.

Conclusion

Achieving the CMS target of at least 66% AV fistula use among long-term renal dialysis patients will produce clinical benefits for patients and savings in vascular access costs for Medicare. In the long term, Medicare ESRD expenditures may increase somewhat as a result of decreased mortality with AV fistula relative to PTFE graft or catheter access modalities. However, from a societal perspective, these gains in survival will be achieved at a cost that is well within the range that commonly is considered to represent good value for money. For example, the incremental cost of $40,000 to achieve the 66% fistula target is well below the current Medicare expenditure of $63,000 per year for a patient who is on dialysis.

Reaching the CMS target is not a simple matter. The relatively low rate of AV fistula use in the United States, compared with other developed nations, is attributable to a multiplicity of factors. There is ample evidence that physicians respond to financial incentives and that payment rates can influence quality of care (28). Our results indicate that the CMS could increase economic incentives substantially for AV fistula procedures while still generating a long-term net benefit to society.

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Disclosures

None.

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