Chapter X

The Economic Cost of ESRD, Vascular Access Procedures, and Medicare Spending for Alternative Modalities of Treatment

Key Words:
Vascular access
Hemodialysis cost
Peritoneal dialysis cost
Cost of ESRD
Spending for ESRD
Transplantation
Medicare claims
Physician and supplier files
Consumer price index

The 1996 Annual Data Report (ADR) of the USRDS included an investigation of the spending for alternative treatment approaches for End-Stage Renal Disease (ESRD) furnished through the Medicare ESRD program. This earlier report included Medicare spending experience for the 1991-93 period. This 1997 report updates this analysis to include 1994 and 1995 data.

A major addition to this 1997 report is an analysis of the spending by Medicare for vascular access for hemodialysis patients. This is one of the most requested items that the USRDS CC receives. Vascular access complications have been cited as the largest single cause of morbidity among hemodialysis patients. As such, better management of vascular access provides the potential for improving patients' quality of life and reducing the cost of care. These analyses will complement a long term research agenda of the USRDS to focus on vascular access.

This chapter is divided into three sections. In the first section, we present estimates of the total monetary cost of direct patient care for patients in the United States with ESRD. In addition, there is a presentation of recent shifts and trends in these estimates of total direct cost of treating ESRD. These total direct cost estimates are derived from paid Medicare claims and other estimates including private resource use for direct patient care.

The second section provides estimates of Medicare spending (payments) per time at risk on an "intent-to-treat" basis for ESRD treatment alternatives stratified by several patient characteristics. The data in this study are derived from the USRDS database which contains information from the Medicare payment records as well as extensive epidemiological patient histories. The objective is to compare and contrast Medicare reimbursements (payments) per time at risk for different modalities of renal replacement therapy. The results provide information that would be useful in the determination of "capitation" payment rates, i.e., rates of spending per patient per time at risk. However, these results, which do not provide simultaneous comparison of survival alternatives and costs and are not estimated with consideration for right censoring, are not appropriate for determination of cost effectiveness of alternative modalities of treatment (Cox).

The third section of the report provides estimates of Medicare spending for vascular access for hemodialysis patients.

Methods

Cost of ESRD and Medicare Spending by Modality

These studies analyze Medicare costs (= reimbursements or spending) for patients treated with hemodialysis, CAPD/CCPD, or a renal transplant. The primary focus is ESRD patients prevalent on January 1, 1991 or incident at any time during 1991, 1992, 1993, 1994, or 1995. Patient age, gender, race, and cause of ESRD were obtained from the USRDS database. Treatment modality was determined using the Modality Sequence file from the USRDS database. (See Chapter XII). A secondary analysis focuses on total spending for 1995.

The total cost of direct medical care resources was estimated by combining the paid claims for Medicare-insured ESRD patients with other cost estimates of resource use. These other estimates included: 1) Medicare payments for ESRD patients not included in the paid claims system, 2) Medicare patient obligations, 3) payments for patients enrolled in Employer Group Health Plans (EGHP) for whom Medicare is the "Secondary Payer" (MSP) for insurance, and 4) payments for ESRD patients residing in the United States who were not insured by Medicare.

Medicare paid claims, used in both the cost of ESRD and the Medicare payments analyses, were obtained from HCFA Standard Analysis Files (SAF; HCFA 1993). These files are constructed for each year of service (determined by the service "to date" listed on the paid claim) and are based on all final paid claims listed in the Common Working File by the end of July of the following year (HCFA 1993). The SAFs are organized by year and include all Medicare patients. This project used the SAFs for the calendar years 1991-95.

In order to identify all Medicare ESRD patients, a "finder file" was constructed that separated claims for ESRD patients from all other Medicare patients. This finder file, constructed from the patient identification numbers (IDs) in HCFA's Program Medical Management, yielded 546,112 patient IDs for the period 1977-95 after screening out deaths occurring before 1/1/91. Changes in patient IDs were tracked using information included in HCFA's Enrollment Database (HCFA 1993). SAF (paid, final) claims were extracted for 391,714 patients in the 1991-95 period.

The SAFs are comprised of 7 files with claims classified as (originating from): 1) inpatient institutional, 2) outpatient institutional, 3) skilled nursing facility, 4) hospice, 5) home health agency, 6) physician and other supplier, and 7) durable medical equipment, which includes dialysis supplies, parenteral nutrition claims, iron supplement claims, and claims for immunosuppressives administration and supplies.

These SAF files, as selected by the finder file, contained claims for 391,714 patients and 1,028,194 patient years at risk during 1991-95. Using these figures, the spending for the 1991-95 period totaled $34.91 billion.

Categories of payment in the reference tables in Section K and in Chapter X are classified as follows: 1) for institutional claims, claims from the Inpatient HCFA SAF are categorized as Non-Transplant Inpatient if they have a DRG other than 302, and as Transplant Inpatient if they have a DRG of 30, 2) claims from the HCFA Outpatient SAF are categorized as Outpatient institutional if they have no dialysis revenue center code and as Hemodialysis - Institutional, Peritoneal Dialysis Institutional, or Other Dialysis - Institutional based on their revenue center code (note that embedded EPO costs cannot be distinguished in these records), 3) the categories Skilled Nursing Facility, Home Health Agency, and Hospice are based on the HCFA SAF from which they derive.

The physician/supplier claims are categorized based on HCPCS codes with the following refinements: if the HCPCS code indicates that the claim is for dialysis and the HCFA Service Code indicates that the claim is for monthly capitation payments the claim is categorized as capitation; if the HCPCS code indicates that the claim is for dialysis supplies (hemodialysis or peritoneal dialysis), the HCFA place of service code is used to separate the dialysis supply claims into home supplies vs. unit supplies; for claims whose HCPCS codes are not ESRD specific (not dialysis, dialysis supplies, EPO, immunosuppressive drugs, not PD catheter related, not transplant, not vascular access, not parenteral nutrition, not ESRD capitation, and not iron supplies or administration), claims are categorized based on HCPCS for the categories transportation, diagnostic laboratory or radiology, and durable medical

equipment, and on the HCFA service code for Other Surgery, Other Medical Treatment, and Other Charges. Note that for many of the physician/supplier categories such as EPO, most of the actual Medicare payments occur embedded in the payments for institutional care, principally dialysis payments in the case of EPO.

For patients incident during any calendar year, only costs occurring on or after the first day of ESRD (as defined in the PMMIS) were included. That is, pre-ESRD Medicare spending and pre-ESRD time at risk were not included in calculating total Medicare spending or time at risk in either the total spending or in the intent-to-treat analysis. Likewise, patients whose ESRD start date occurred during a hospitalization had a linearly pro-rated portion of the costs for that hospitalization allocated to the ESRD period. The exception is transplantation. If the first ESRD service is a kidney transplant then the entire hospital stay is included as a cost even if the first day of ESRD occurs during that hospital stay.

The study start date for a patient in the intent-to-treat analysis (limited to 1991-95) was defined as the latest of the following:

- January 1, 1991.
- The first ESRD service date in the USRDS database for the patient.
- For dialysis patients, the beginning of any one month period in which the Medicare paid amount for outpatient dialysis was $675 or more.

The last constraint was designed to exclude patients who were likely to have a Medicare Secondary Payer status even though the Medicare Enrollment Database did not identify them as such.

Patients with MSP status on or at any time following the study start date (identified from the Medicare Enrollment Database) were excluded from the intent-to-treat analysis. These patients were treated separately and excluded from the primary intent-to-treat model because it is impossible to characterize their total costs of care from payments by Medicare. Dialysis patients with insufficient activity (defined for outpatient dialysis as less than $675/month for three consecutive months) are censored as lost to followup at the end of the 3 month period. This limit of $675/month was the 10^{th} percentile of Medicare dialysis spending (institutional outpatient plus physician and other suppliers) for all patients; it would cover 6 to 7 dialysis treatments.

In the intent-to-treat analysis, patients entered the study only once during the 1991-95 period, with the exception of transplant patients. Dialysis patients who received a transplant during the study period were censored at the transplant date and were then moved into a separate record as a transplant patient. All payments on paid claims for inpatient transplantation were added to the transplant cost record even though the inpatient stay may have begun during a period also covered by the dialysis record. Patients who had a functioning transplant at the start of the study window were kept in that modality until death or end of study, regardless of any modality changes.

In the intent-to-treat analysis, dialysis patients were removed from the analysis at the earliest of: death; 12/31/95; transplant (censored); three months with less than $675 dialysis activity (censored). Patient periods at risk were determined by the "from" and "to" dates on the payment records. Unless noted otherwise, periods at risk for mortality and incurred costs were determined for each year with patients frequently counted in more than 1 year.

HCFA estimates that the SAF files include 98 percent of paid claims in a given year (HCFA 1993, Section E2, page 15). To account for this, the total dollar amount of SAF claims, as reported in Figure X-1, were raised by 2 percent. In order to maintain comparability to the Reference Tables, all other reported statistics are not adjusted for this reported undercount in the SAFs.

Patient financial obligations to Medicare, i.e. the coinsurance and deductible, were estimated as 18 percent of the sum of Medicare payments and patient obligations (see the 1995 ADR, Chapter X). Medicare rules for patient obligations are complicated, but generally include a nominal deductible (approximately $100 per year) along with a 20 percent co-payment for approved outpatient charges (Part B). Inpatient (Part A) services require a deductible which approximates the charge for the first hospital day. Additional charges accrue for "outlier" hospital stays.

Kidney donor acquisition costs are not paid by Medicare through the claims process and therefore are not included in the HCFA SAFs. Medicare pays these charges by inflating the cost of all Medicare inpatient stays (both ESRD and non-ESRD) by an amount equal to the institutional acquisition cost for all Medicare transplants. We estimated the Medicare payments for donor acquisitions as $25,000 per

acquisition for the 8,000 kidney transplants. The latter was the sum of paid claims for Medicare kidney transplants as recorded in the PMMIS files (6/95). Eggers estimated the $25,000 per donor acquisition through detailed examination of the annual Hospital Cost Reports filed with HCFA (Eggers). We assumed an increase of 5 percent per year in total acquisition costs from 1993-95.

Also excluded from the claims process recorded in the HCFA SAFs are charges submitted by Health Maintenance Organizations (HMO) treating ESRD patients. We have estimated these Medicare payments as: [6,000 patients * (the sum of the Part A and Part B Adjusted Average Per Capita Costs (AAPC) per month) * 12]. We used the 1995 AAPCC of $1,438/month (Part A Medicare) and $2,040/month (Part B Medicare) (HCFA, 1995). The 6,000 HMO patient count per year is only approximate.

Medicare makes separate payments to inpatient institutions for malpractice insurance, education, capital, and organ acquisition. Organ acquisition costs were estimated as described above. Estimates for the other three items were based on personal communication from Paul Eggers, Ph.D. at HCFA.

The intent-to-treat analysis for the entire 1991-95 period enlisted patients only once during the period, except for transplant patients as described above. Separate intent-to-treat analyses were performed for each year. Each of these annual analyses also enlisted patients only once during the period, except for transplant patients as described above. Patients who had any period of MSP status, as reported in HCFA's Enrollment Database between 1991 and 1995, were treated separately. Patients without any reported MSP during the 1991-95 period were entered into the "primary" intent-to-treat group. For both the primary intent-to-treat group and the MSP group, Medicare payments and survival times were aggregated separately but for identical periods at risk from 1991 through 1995.

Payments by Employer Group Health Insurance Plans are private (non-Federal) payments for Medicare ESRD patients and are not reported in the SAFs. We estimated these payments as follows: from the HCFA Enrollment Database, we identified the subset of Medicare patients recorded as being insured under a Medicare Secondary Payer for either all or part of the time they were included in the intent-to-treat analysis. Under this analysis, we assessed their Medicare payments per year at risk. We then calculated the difference between the average Medicare payments per year at risk for the MSP patients and the average Medicare payment per year at risk for patients without MSP status, the "primary" intent-to-treat group. This difference was taken to be the average amount paid by EGHPs for MSP patients. This result was then multiplied by the number of patient years at risk in the MSP group in order to derive an estimate of the total EGHP payments for the 1991-1994 period. One fourth of this total was assumed to arise in 1994. (See the 1996 ADR). The 1995 estimate is based on the 1994 estimate inflated by 5 percent.

The estimated expenditure for non-Medicare ESRD patients was 7.5 percent of total Medicare claims arising from all "finder file" patients plus patient obligations. This estimate of 7.5 percent is based on the count of non-Medicare dialysis patients (see Chapter XI) and non-Medicare incident kidney transplants.

Unless noted otherwise, spending accruing in different years has not been adjusted for inflation or discounted. Thus, the dollar amounts reported can be interpreted as approximating 1993/94 U.S. dollars. When 1995 estimates are provided these are 1995 current dollars.

Rates of increase in Medicare spending per patient year at risk were estimated from the primary intent-to-treat analysis by aggregating yearly spending estimates and yearly time at risk. The ratio of these estimates provides an estimate of the spending per patient year. This estimate is unadjusted for changes in patient characteristics, including age, sex, race, and diabetes. These estimates of spending change are compared to rates of change in the consumer price index as reported by the U.S. Department of Labor.

Methods Continued:

Cost of Vascular Access Procedures

This subsection focuses on Medicare vascular access reimbursements for hemodialysis patients during 1994. See the previous section for a general description of the data sources. Several additional methodological issues arise when attempting to use claims files to identify costs associated with particular procedures.

First, we had to identify a set of procedure codes that indicate the creation or revision of a vascular access. The codes we used to identify vascular-

access-related procedures, and definitions of the most frequently occurring codes appear in Tables X-6 and X-7. Since some of these codes are ambiguous, it is possible that some procedures we identified were performed for reasons other than creating or revising a vascular access for hemodialysis. As a sensitivity analysis, we excluded some of the more ambiguous codes. Hereafter, the inclusive set of codes is referred to as the "broad" definition of vascular access procedures, while the more restricted definition is referred to as the "narrow" definition. It is also possible that some vascular access procedures were missed in our analysis because they were not assigned to any code in our list.

Second, institutional inpatient claim payments present a particular problem. The Medicare payment amount is for the entire inpatient episode, not just for the costs directly associated with the vascular access procedure or treatment of vascular access-related morbidity. Thus, we would overestimate inpatient vascular access costs to the extent that claims in which a vascular access procedure code was identified also included genuinely unrelated procedures and services.

In order to account for this, we estimated a regression model of total 1994 inpatient costs for the sample of patients in the DMMS Wave 1. Predictors of total inpatient institutional costs included demographic characteristics, comorbid conditions, the number of identified inpatient vascular access claims and the number of identified physician and supplier procedures indicating an inpatient vascular access procedure (this variable is discussed in the next paragraph). The coefficient on the number of inpatient institutional vascular access claims ($9,578, t=25.8 for broad definition of vascular access codes; $8,014, t=19.0 for narrow definition) indicates how much total inpatient spending increased per identified inpatient vascular access claim after controlling for other predictors of inpatient spending. These coefficients were compared to the average Medicare reimbursements per inpatient vascular access claim ($10,671 for broad definition; $10,504 for narrow definition). Since the regression coefficients are lower than the corresponding average Medicare reimbursements (10.3 percent lower for the broad definition and 23.7 percent lower for the narrow definition), the regression coefficients are consistent with the interpretation that the costs of some unrelated services are being captured by the institutional inpatient claims. Thus, the inpatient costs reported in Tables X-10 and X-11 are scaled down using the regression estimate.

It is possible that the demographic and comorbid factors included in the regression model are not good predictors of inpatient costs unrelated to vascular access procedures and vascular access-related morbidity. If so, the regression coefficient on the number of claims with a vascular access procedure may still be an overestimate of vascular-access-related costs. To test this hypothesis, we added a variable indicating whether or not the patient had an acute myocardial infarction (AMI) during 1994. We hypothesized that AMI would be a costly condition that could lead to (but not result from) a vascular access complication. Hence, some AMI claims may contain a vascular access procedure code, causing us to incorrectly classify the costs of treating the AMI as vascular-access-related. While the AMI indicator variable was a highly significant predictor of inpatient costs, the coefficient on the number of claims with a vascular access code remained essentially unchanged. In addition, the regression model was re-estimated using the natural logarithm of inpatient costs as the dependent variable. Again, there was no appreciable effect on the magnitude of the adjustment.

This process was repeated for the outpatient institutional claims for vascular access. Outpatient payments for the vascular access procedure reported in Tables X-10 and X-11 are scaled down (compared to the unadjusted average reimbursements per outpatient institutional claim) by 3.7 percent for the broad definition and 14.9 percent for the narrow definition. These adjustments were smaller than those for inpatient institutional claims, confirming the intuition that unrelated services appearing in the same claim as a vascular access procedure were more prevalent in the inpatient setting than in the outpatient setting.

Third, it appears that the number of institutional claims for vascular access is understated. For example, there exists a relatively large set of patients for whom we identified one or more inpatient physician and supplier payment but for whom we did not find a vascular access procedure code on any inpatient institutional claim. Of all patients in the regression sample with at least one physician/supplier bill for an inpatient vascular access procedure, only 62 percent had an inpatient institutional claim containing a vascular access code. While some of these physician/supplier claims could simply have had the place of service miscoded, this is likely to also reflect the difficult and imprecise task of identifying reasons for hospitalization from procedures coded on the institutional claim.

Total Medicare Payments for ESRD by Source of Claim, 1991-95

Category of Spending by Source of Claim	1995 Total SAF Payments[a] No Restrictions[b] $Millions	Medicare Spending[c] $/Year at Risk Intent-to-Treat 1991-94	1995
Patient years at risk (YAR)	*N.A.*	*607,635*	*173,286*
Patient intent to treat periods	*N.A.*	*330,714*	*N.A.*
Total Medicare Payments	**$8,831**	**$36,616**	**$40,060**
Total - Institutional	7,066	28,914	32,151
Inpatient	3,318	13,566	14,485
Non-transplant inpatient	3,133	12,679	13,546
Transplant inpatient	186	887	939
Outpatient Institutional	353	1,403	1,615
Skilled Nursing Facility	163	336	684
Home Health Agency	292	734	1,285
Hospice	9	19	28
All Dialysis - Institutional	2,932	12,823	14,053
Hemodialysis - Institutional	2,636	11,558	12,697
Perit Dial - Institutional	291	1,256	1,333
Other Dial- Institutional	5	8	21
Total - Physician/Supplier (Part B)	1,765	7,702	7,908
Total Physician/Supplier Dialysis	238	1,195	969
Total Hemo - Physician/Supplier	118	662	521
Hemodialysis - Physician/Supplier	99	522	431
Hemodialysis - Home Supply	19	13	11
Hemodialysis Unit Supply	0	125	77
Total PD - Physician/Supplier	120	533	448
Perit Dial - Physician/Supplier	17	2	0
PD Home Supply	102	524	448
PD Unit Supply	0	6	0
Non-dialysis - Physician/Supplier	1,528	6,506	6,938
PD Catheter - Physician/Supplier	3	75	76
Capitation - Physician/Supplier	249	1,113	1,167
Vascular Access - Physician/Supplier	121	568	526
EPO - Physician/Supplier[d]	1	5	3
Iron - Physician/Supplier	0	N.A.	0
Transplant - Physician/Supplier	21	38	33
Immunosuppresive - Physician/Supplier	24	66	126
Parenteral Nutrition	23	361	116
Other Surgical - Physician/Supplier	230	884	1,018
Other Medical - Physician/Supplier	242	921	1,054
Transportation - Physician/Supplier	180	760	835
Diag Lab/Rad - Physician/Supplier	280	1,190	1,299
DME - Physician/Supplier	73	223	332
Other Physician/Supplier	79	296	346

[a] 291,506 patients
[b] No Restrictions on Medicare Secondary Payer or $/Month
[c] Excludes Medicare Secondary Payer
[d] EPO supplies only, drug not shown

Source: Reference Tables K.1 and K.7

USRDS 1997

Table X-1

The regression coefficient on the variable for the number of inpatient physician and supplier claims can be used to derive an estimate of the cost of the institutional inpatient claims for vascular access that were not identified by the presence of a vascular access procedure code on the inpatient institutional payment record. Since the dependent variable (total inpatient institutional reimbursements) does not include the inpatient payment of the physician and supplier services, if all inpatient physician/supplier claims are either associated with an identified institutional inpatient claim or with a miscoded place of service, this coefficient should not be significantly different from zero. However, if some of these inpatient physician/supplier bills indicate inpatient vascular access procedures for which we were unable to identify an institutional claim, the coefficient will be positive and significant. Since the actual

coefficient (inpatient) is positive and highly significant ($717, t=8.3 for broad definition; $714, t=7.3 for narrow definition), we used the coefficient times the number of inpatient physician supplier payments as an estimate of inpatient institutional payments that were not identified via the procedure codes on institutional inpatient paid claims. Similar procedures for the outpatient institutional claims estimated a coefficient of $81, t= 7.2 for the broad definition of vascular access; $102, t=6.6 for the narrow definition.

Results

Financial Expenditures for Direct Patient Care of ESRD Patients in the United States, 1991-95

The Medicare SAF paid claims for ESRD patients totaled $5.22 billion in 1991, $6.10 billion in 1992, $6.96 billion in 1993, $7.80 billion in 1994, and $8.83 billion in 1995 for a total of $34.91 billion over the 5-year period. Our primary intent-to-treat analysis (excluding Medicare Secondary Payer patients and other patients with short or unusual periods of eligibility) included 83 percent of the total payments from 1991-95. The secondary intent-to-treat model (MSP patients) included 4 percent of these total dollars. This implies that 13 percent of the total Medicare SAF dollars were in neither the primary intent-to-treat analysis nor the secondary MSP model.

The left column of Table X-1 presents estimates of the total 1995 direct monetary cost of medical care for U.S. ESRD patients aggregated from HCFA paid SAF files. There are no restrictions for MSP or for periods of eligibility of any kind. These costs are the total payments by Medicare for all identified ESRD patients. The costs are subdivided into several categories of institutional payments (institutional source and dialysis) and several categories of physician/supplier payments (dialysis, ESRD related treatment such as vascular access, and other treatments).

The second column in Table X-1 presents estimates of 1991-1994 spending for ESRD patient medical care per year at risk from an intent-to-treat analysis. The costs are again subdivided into institutional categories and physician/supplier categories, as in the first column. The third column

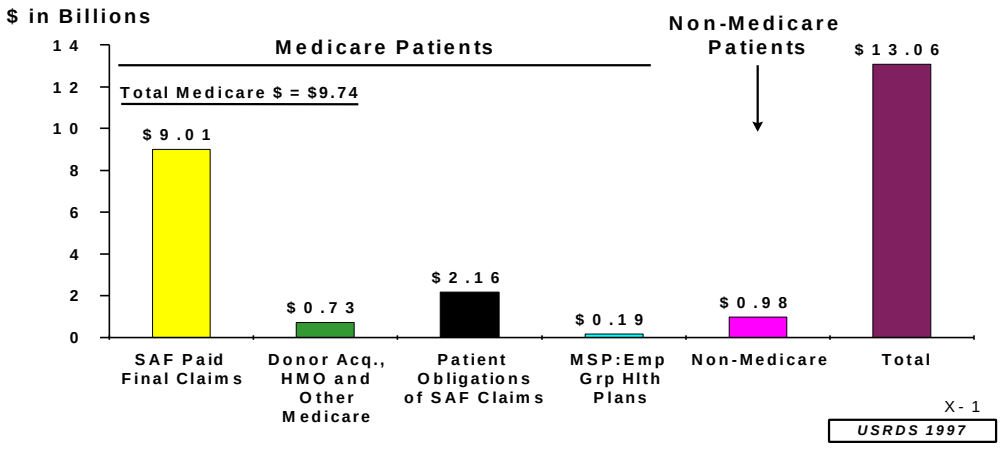

Figure X-1

Estimated total direct monetary cost of treating ESRD in the United States, 1995. Separate estimates of cost are reported according to patient eligibility for Medicare insurance. The estimated cost of treating Medicare ESRD patients includes the following components: total Medicare payments from the HCFA Standard Analysis File (SAF) claims; estimated Medicare payments for organ donor acquisition, patients enrolled in a Health Maintenance Organization (HMO) and other Medicare payments (includes education, capital and malpractice costs); patient obligations of Medicare claims; and payments by private sources for patients who are covered by an employer group health plan and for whom Medicare is a secondary insurance payer (MSP). Source: Reference Table K.1 and special analysis.

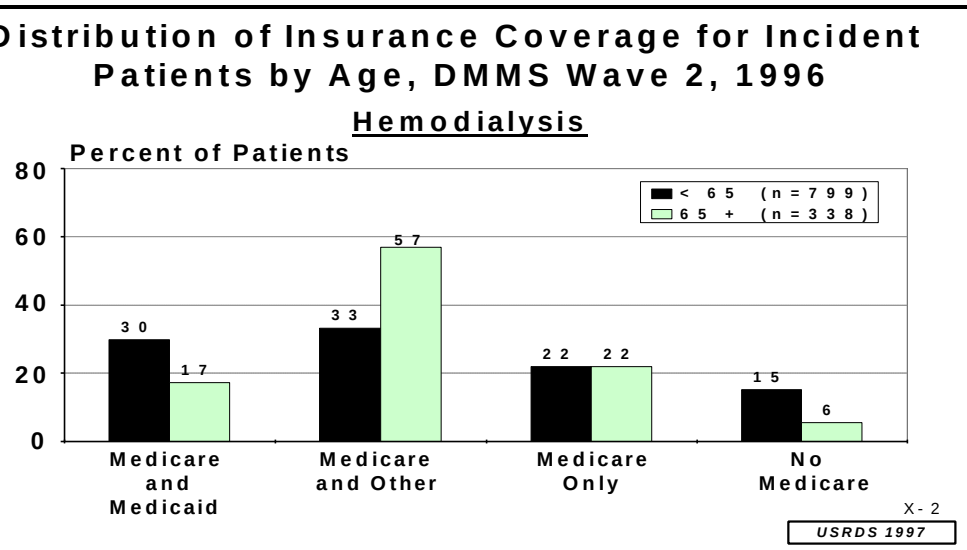

Figure X-2

Distribution of health insurance coverage for incident hemodialysis patients, by age group, 1996. Data are from Wave 2 of the USRDS Dialysis Morbidity and Mortality Study (DMMS) and include both Medicare (includes Medicare pending) and non-Medicare. Source: Special Analysis.

of Table X-1 also presents spending estimates per year at risk, but for the 1995 period alone.

Total estimated direct medical payments for ESRD by public and private sources were $13.06 billion during 1995 (Figure X-1). In the terminology of cost effectiveness, this total would represent the viewpoint of insurers, both public and private. The estimated total Federal spending would be $9.74 billion or 75 percent of the total estimated cost. Other Federal and state funding is provided through Medicaid and likely accounts for at least some of the patient obligations for SAF claims and payments for non-Medicare patients.

As reported in Figure X-1, $9.55 billion ($9.74 billion after a 2 percent adjustment for the late arriving claims) was paid by Medicare in 1995 as reported in the SAF claims records. Patient obligations were estimated to be $2.16 billion (see Figure X-1). There are no precise studies regarding how much of these obligations patients actually pay, but the speculation is that most of these obligations are paid by either insurance or philanthropy.

Employer Group Health Plans were estimated to have paid $190 million in 1995 for the care of Medicare ESRD patients with Medicare as Secondary Insurer. This estimate of total spending for Employer Group Health Plans (EGHP) for ESRD is likely to be a minimum estimate since EGHP are reported to pay "retail prices," which are higher than the Medicare payment rate.

The distribution of health insurance coverage in 1996 is shown for incident hemodialysis patients (Figure X-2) and peritoneal dialysis (Figure X-3) by age group. The data are from Wave 2 of the USRDS Dialysis Morbidity and Mortality Study and include all patients, whether or not they are insured by Medicare.

Rates of Medicare spending increase for ESRD patients per year at risk are shown in Table X-2. From a 3.8 percent change per year in 1992-93, the rate has decreased to a 2.8 percent change from 1994 through 1995.

Spending for ESRD is not the only price increase in the United States. We can choose from two consumer price indices for comparison to the rate of increase of ESRD. The general CPI would be the correct index to choose if one were examining rates of change in the context of what other social and economic purpose these ESRD costs could serve. A point of view which considers only the management of ESRD care on the other hand, would suggest the use of the medical component. Whichever one uses, the rate of increase in real resources spent for the treatment of ESRD is small. This measure of patient years at risk, which is the item of purchase that spending is normalized to, is not adjusted for changes

Distribution of Insurance Coverage for Incident Patients by Age, DMMS Wave 2, 1996

Peritoneal Dialysis

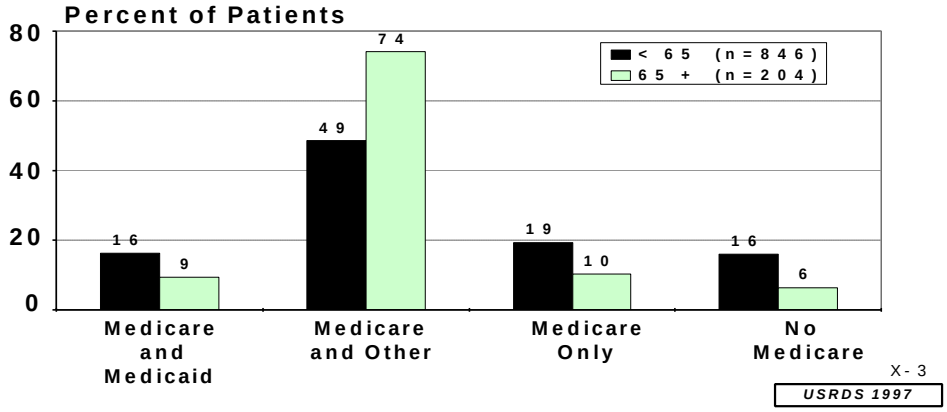

Figure X-3

Distribution of health insurance coverage for incident peritoneal dialysis patients, by age group, 1996. Data are from Wave 2 of the USRDS Dialysis Morbidity and Mortality Study (DMMS) and include both Medicare (includes Medicare pending) and non-Medicare. Source: Special Analysis.

in case mix (age, diabetes etc.). Therefore the changes in spending reported in Table X-2 can be attributed to several sources including increased (decreased) spending due to higher spending per patient or higher (lower) case mix severity, changes not measured in the "patient year at risk".

These data underscore the conclusions of previous Annual Data Reports that the primary driver of the increase in the ESRD program costs is the continuing (albeit recently slowing) increase in the number of patients treated for ESRD.

Changes in Medicare Payment Rates For ESRD and Changes in the Consumer Price Index, 1991-95

Medicare Payments and Consumer Price Index	Change Per Year (%) 1992-93	1993-94	1994-95
Total Medicare ESRD Payment[a] (Per Patient Year at Risk)	3.8	2.1	2.8
Consumer Price Index (CPI)[b]			
General (All Items)	3.0	2.7	2.6
Medical	5.9	5.2	4.4
ESRD minus CPI			
General (All Items)	0.8	-0.6	0.2
Medical	-2.1	-3.1	-1.6

[a] Medicare Spending Rates from Intent-to-Treat, not adjusted for changes in age and comorbidity.
Includes only patients and years at risk with Medicare Payments.
Excludes Medicare Secondary Payer patients.

[b] Source: US Department of Labor, Bureau of Labor Statistics, 1996. http:stats.bls.gov1996.

USRDS 1997

Table X-2

Limitations of this Research

- The estimates for organ procurement and HMO payments by Medicare are particularly soft.
- The estimates of Employer Group Health Plan payments for Medicare ESRD patients are soft, but the overall picture is that MSP may be a smaller issue than common wisdom would suggest.
- There are a number of medical and non-medical costs that are not included in the tally shown in Figure X-1. These excluded costs include: outpatient drugs not paid by Medicare; costs of transportation not paid by Medicare; costs incurred by the Department of Veterans Affairs; and lost labor production in and out of the home. In addition, there are substantial transfer payments involved with ESRD such as Social Security Payments which are not technically a true cost of ESRD, but are nonetheless substantial items on the public policy agenda. While the cost of Medicaid payments for ESRD is included in the tally shown in Figure X-1, the Federal portion of these Medicaid costs is not identified. The Federal expenses for Medicaid insurance would be included in the patient obligations and in the cost of non-Medicare patients.
- There is evidence that not all claims make their way into the HCFA billing records. (Petronis; Sadler; Held). So the estimated spending from HCFA records may have a downward bias.

Medicare Spending for Alternative Modalities of Treatment

Introduction

This study provides an analysis of the Medicare spending (also called payment or reimbursement) for different treatment modalities for patients with chronic renal failure. The analyses were stratified by age, sex, race, and cause of end-stage renal disease. However, no other adjustments for case mix severity were attempted. Since the data are observational (patients were not randomly assigned to treatment modalities), the results are presented with the caveat that there may be selection of patients with particular comorbidities into particular treatment modalities.

A secondary motivation for performing these analyses is the increasing proportion of Medicare's enrollees who are being treated in managed care alternatives to the traditional fee-for-service (FFS) system. In December 1994, 6.3 percent of all Medicare beneficiaries (not restricted to ESRD) were enrolled in at-risk Health Maintenance Organizations, a 22 percent increase compared to 1 year earlier (GAO 1995). Currently, the Health Care Financing Administration sets capitation rates paid to at-risk HMOs on the basis of reimbursements in the FFS system. (This rate is called the AAPCC for Adjusted Annual Per Capita Cost). These rates take ESRD status and the local price level into account, but a wide variety of additional predictors of costs are not explicitly used in the rate-setting process. To the extent that costs of care vary predictably with respect to patient characteristics that are not included in the rate-setting method, the incentives for at-risk HMOs to enroll and care for specific patients can be substantially affected.

Methods and Materials

See the Methods section at the beginning of this chapter.

Results

For each patient, length of followup and Medicare costs during the followup period in the analysis were calculated. The total Medicare payments from the Standard Analysis Files for identified Medicare ESRD patients from January 1, 1991, until December 31, 1995, were $34.91 billion (Reference Table K.1). Eighty seven percent of these total program costs, ($30.36 billion) was incurred by patients who were included in the primary intent-to-treat model (Reference Table K.2). The remaining $4.55 billion was incurred by patients with Medicare Secondary Payer status indicated in the HCFA system ($1.42 billion) and other patients with low spending at some time during the study period ($3.13 billion), including patients who were lost to followup (see Methods) or who had insufficient billing information to establish that the patient had received a transplant or was receiving regular dialysis. The latter two low-spending categories likely include patients for whom there was incomplete billing, patients with short treatment periods that were associated with very low spending, or possibly other patients with MSP sometime during the study period. See the Methods section earlier in this chapter for further details.

Table X-3 illustrates the Medicare payments per patient year at risk by treatment modality. Total spending per year at risk for all treatment modalities combined was $38K. There was considerable variance across modalities, however. While costs for all dialysis patients averaged $46K per year, Medicare payments for transplant patients (not

Medicare Payments ($1000s) Per Patient Year at Risk (YAR) by Age and Diabetic Status, 1991-1995 Intent-to-Treat Analyses[a]

	Modality											
	All ESRD		Dialysis		HD		CAPD/CCPD		Other		TX[b]	
Age Group	PMT	YAR	PMT	YAR	PMT	YAR	PMT	YAR	PMT	YAR	PMT	YAR
All Patients												
All Ages	**$38**	763	**$45**	566	**$46**	476	**$41**	81	**$53**	9	**$16**	197
0-19 years	**22**	15	**41**	4	**41**	2	**40**	2	**45**	<1	**14**	10
20-44	**29**	212	**41**	110	**41**	85	**38**	23	**44**	2	**16**	102
45-64	**37**	268	**44**	194	**45**	162	**41**	29	**48**	3	**17**	73
65-74	**46**	179	**48**	168	**48**	146	**43**	20	**61**	2	**20**	10
75+	**50**	90	**50**	90	**50**	81	**43**	8	**76**	1	**20**	<1
Diabetic												
All Ages	**45**	217	**51**	176	**51**	149	**47**	25	**58**	3	**22**	41
0-19	**34**	<1	**48**	<1	**49**	<1	*	*	*	*	**20**	<1
20-44	**34**	48	**19**	23	**50**	16	**45**	6	**51**	1	**21**	25
45-64	**45**	89	**49**	74	**50**	62	**47**	11	**52**	1	**24**	15
65-74	**51**	61	**52**	60	**52**	53	**48**	6	**65**	1	**30**	1
75+	**54**	19	**55**	19	**55**	17	**47**	1	**82**	<1	*	*
Non-diabetic												
All Ages	**35**	479	**43**	345	**43**	288	**38**	51	**50**	5	**15**	135
0-19	**22**	13	**41**	4	**41**	2	**40**	2	**44**	<1	**14**	9
20-44	**27**	144	**38**	77	**39**	61	**36**	15	**40**	1	**14**	66
45-64	**32**	157	**41**	106	**41**	87	**38**	17	**45**	2	**16**	51
65-74	**43**	103	**45**	95	**46**	82	**40**	13	**58**	1	**20**	8
75+	**48**	63	**48**	63	**49**	56	**42**	5	**74**	1	**20**	<1

[a] Excludes patients with Medicare Secondary Payer status at any time. Dialysis patients are censored at transplatation or end of study.

[b] Tx = Functioning transplant at 1/1/91 and new transplants thereafter; no censoring at graft failure.

PMT=Mean Medicare payment ($1000s) per patient year at risk, 1991-1995

YAR=Years at risk (1000's) for the PMT estimate

* = Insufficient data

USRDS 1997

Table X-3

including payments for organ procurement) were only $16K per year. Hemodialysis payments averaged $46K per year whereas CAPD/CCPD payments combined averaged $41K per year. Patients treated with other or uncertain (less than 60 days on a modality) dialysis were the most costly, averaging $53K per year. None of these figure are adjusted for differences in patient characteristics.

Results for five age groups (0-19, 20-44, 45-64, 65-74, and 75 years and older) are also presented in Table X-3. Annual costs for ESRD treatment rise steadily with age from a low of $22K per person per year for ages 0-19 to a high of $50K per person per year for the 75-and-older age group (127 percent increase between the youngest and oldest age groups). Annual costs within any given modality do not rise as sharply with age as costs averaged across all treatment modalities. For hemodialysis there is an increase of 22 percent, for CAPD/CCPD an increase of 8 percent, for other and uncertain dialysis an increase of 69 percent, and for transplant an increase of 43 percent, between the youngest and oldest age groups. Although costs for transplant patients rise faster with age than costs for hemodialysis and CAPD/CCPD, the absolute increase in costs ($6K) is very similar to that for all dialysis patients ($9K). The higher costs for older patients across all modalities can be attributed to the sharp decline in the ratio of transplanted to dialyzed patients with age.

Costs for diabetic and nondiabetic patients are also illustrated in Table X-4. As expected, diabetic patients are more costly to treat than nondiabetics ($13K difference, $45K vs. $32K for patients aged 45-64). In the 45-64 age group within all treatment modalities except the "other" dialysis group. the differences between diabetics and nondiabetics costs are strikingly similar (ranging from $9K for

hemodialysis and CAPD/CCPD to $8K for transplant).

The finding that the overall difference between diabetics and nondiabetics ($13K) exceeds those found within any major modality arises because diabetics are underrepresented in the lowest cost group (transplant). Gender and race specific spending comparisons for all ESRD, dialysis, and transplant patients are illustrated for diabetic patients in Table X-4.

Several patterns emerge from this table. First, spending for females within the same race category is higher than spending for males in all age groups and all treatment modalities with three exceptions: 1) dialysis for Blacks of age group 75 plus where the spending is equal, 2) transplant for Whites in age groups 20-44 and 45-64 where spending is equal, 3) transplants for Blacks in age group 75 and older where spending is higher for females.

Second, payments for all ESRD is higher for Blacks than Whites within the same gender and age group for patients less than 65 years. In the 65-74 age group, spending for Black female patients per year is less than that for White female patients and that for Black males is equal to that for White males. Differences in cost per year at risk can be attributed to differences in the modality mix across patient cohorts.

Medicare Payments ($1000) Per Patient Year at Risk (YAR), by Age, Race and Sex, 1991-1995 Intent-to-Treat Analyses[a]

Diabetic

Patient Age, Race, Sex	Modality					
	All ESRD		Dialysis[b]		TX[c]	
	PMT	YAR	PMT	YAR	PMT	YAR
All Ages						
Black Female	**$50**	45	**$51**	42	**$31**	2
Black Male	**47**	27	**49**	24	**30**	3
White Female	**46**	66	**52**	52	**21**	13
White Male	**41**	67	**50**	47	**21**	20
Age 0-19 yrs.	*	*	*	*	*	*
Age 20-44 yrs.						
Black Female	**47**	4	**52**	3	**32**	1
Black Male	**44**	5	**49**	4	**30**	1
White Female	**32**	16	**51**	6	**20**	9
White Male	**31**	22	**47**	9	**20**	13
Age 45-64 yrs.						
Black Female	**48**	21	**49**	19	**30**	1
Black Male	**45**	14	**48**	12	**29**	2
White Female	**46**	23	**51**	19	**23**	4
White Male	**42**	25	**50**	18	**23**	7
Age 65-74 yrs.						
Black Female	**51**	15	**52**	15	**31**	<1
Black Male	**50**	6	**51**	6	**32**	<1
White Female	**53**	21	**54**	21	**33**	<1
White Male	**50**	15	**51**	15	**30**	1
Age 75+ yrs.						
Black Female	**55**	4	**55**	4	*	*
Black Male	**55**	2	**55**	2	*	*
White Female	**55**	7	**55**	7	*	*
White Male	**54**	5	**54**	5	*	*

[a] Excludes patients who were Medicare Secondary Payer status at any time

[b] Censored only at transplantation.

[c] Tx = Functioning transplant at 1/1/91 and new transplants thereafter; no censoring at graft failure

PMT=Mean Medicare payment ($1000s) per patient year at risk, 1991-1995

YAR=Years at risk (1000s) for the PMT estimate

* = Insufficient data

USRDS 1997

Table X-4

Third, payments for dialysis are lower or the same for Blacks compared to Whites within the same age group, for the 45-64 and the 65-74 age cohorts, and higher in the 20-44 cohort. Gender and race specific costs for all ESRD, dialysis, and transplant patients are illustrated for nondiabetic patients in Table X-5. First, for all ESRD, spending for Blacks is higher in all age-gender groups except that Black males and White females have the same spending in the 65-74 and the 75+ cohorts.

Second, for transplanted patients spending is higher across all age-gender groups less than 75 for Blacks than for Whites and spending for dialysis is higher in all age-gender groups for Blacks except the 65-74 cohort where spending is equal. Comparing Tables X-4 and X-5 we note that, as expected, spending is higher for diabetics than nondiabetics in all comparable cohorts.

Conclusions and Limitations

The USRDS/HCFA database is certainly rich and powerful. However this database is dynamic and not always complete. Certainly the system is constantly changing especially in the 1994-96 period (See

Medicare Payments ($1000) Per Patient Year at Risk (YAR), by Age, Race and Sex, 1991-1995 Intent-to-Treat Analyses[a]

Non-Diabetic

Patient Age, Race, Sex	Modality					
	All ESRD		Dialysis[b]		TX[c]	
	PMT	YAR	PMT	YAR	PMT	YAR
All Ages						
Black Female	**$41**	77	**$44**	66	**$21**	11
Black Male	**37**	89	**43**	71	**20**	18
White Female	**35**	127	**44**	88	**14**	39
White Male	**32**	166	**42**	107	**13**	59
Age 0-19 yrs.						
Black Female	**34**	1	**45**	1	**23**	1
Black Male	**29**	2	**41**	1	**19**	1
White Female	**22**	4	**40**	1	**15**	3
White Male	**18**	6	**39**	1	**12**	4
Age 20-44 yrs.						
Black Female	**35**	22	**41**	15	**21**	6
Black Male	**34**	34	**39**	25	**20**	9
White Female	**24**	33	**38**	15	**13**	19
White Male	**22**	47	**36**	19	**12**	28
Age 45-64 yrs.						
Black Female	**39**	27	**42**	23	**21**	4
Black Male	**36**	34	**40**	27	**21**	7
White Female	**31**	39	**41**	24	**14**	15
White Male	**28**	49	**39**	27	**14**	22
Age 65-74 yrs.						
Black Female	**46**	17	**46**	17	**23**	<1
Black Male	**44**	13	**45**	12	**26**	1
White Female	**44**	31	**46**	28	**18**	3
White Male	**42**	39	**45**	35	**20**	4
Age 75+ yrs.						
Black Female	**51**	9	**51**	9	*	*
Black Male	**49**	6	**49**	6	*	*
White Female	**49**	20	**50**	20	**16**	<1
White Male	**47**	26	**47**	26	**22**	<1

[a] Excludes patients who were Medicare Secondary Payer status at any time

[b] Censored only at transplantation.

[c] Tx = Functioning transplant at 1/1/91 and new transplants thereafter; no censoring at graft failure

PMT=Mean Medicare payment ($1000s) per patient year at risk, 1991-1995

YAR=Years at risk (1000s) for the PMT estimate

* = Insufficient data

USRDS 1997

Table X-5

Chapter XIII). The estimates of the spending level per year for 1991 in this 1997 report produced somewhat different estimates than we estimated for 1991 in the 1996 report. There have been many changes in the USRDS and other databases in recent years and nearly everything changes in subtle and unmeasured ways, so some caution is warranted in the interpretation of these and all analyses.

The current analyses have used an intent-to-treat model. The primary reason for this was to try to determine a well-defined subpopulation that is known to be insured primarily by Medicare and for whom time at risk could be more precisely estimated. Neither of these objectives is easily achieved. We remain somewhat uncertain about whether and when a patient has MSP status. When this happens the financial indicators may be totally misleading or, in the worst case, only somewhat misleading. It is not easy to find a well defined population for which the spending and time at risk is precisely known.

These spending analyses clearly show that there are substantial differences in the patterns of resource utilization by patient demographics and by modality of treatment. Age, diabetes, and sex are easy to

Definitions of Selected Vascular Access Procedure Codes ICD9 and HCPCS, 1994[a]

Procedure Code (ICD9 or HCPCS)		Definition	Percent of Total VA Procedures Narrow	Broad
ICD9	3927	Arteriovenostomy for renal dialysis	4.6	4.0
	3942	Revision of arteriovenous shunt for renal dialysis	6.2	5.4
	3943	Removal of arteriovenous shunt for renal dialysis	1.0	0.9
	3949	Other revision of vascular procedure	9.6	8.3
HCPCS	01784	Anesthesia for repair of arterio-venous (A-V) fistula, congenital or acquired.	2.1	1.8
	01844	Anesthesia for vascular shunt, or shunt revision, any type (eg, dialysis).	19.0	16.4
	35875	Graft thrombectomy	6.3	5.4
	35876	Thrombectomy of arterial or venous graft; with revision of arterial or venous graft	1.2	1.1
	35903	Excision of infected graft; extremity	1.3	1.1
	36489	Vascular Injection Procedures Intra-arterial Placement of CV catheter for hemodialysis or other, percutaneous, over 2 years old.	12.2	10.5
	36533	Insertion of implantable venous access port, with or without subcutaneous reservoir	3.1	2.7
	36535	Removal of implantable venous access port and/or subcutaneous reservoir	2.4	2.1
	36800	Intravascular Cannula or Shunt Placement Insertion of cannula for hemodialysis, other purpose, vein to vein	6.5	5.6
	36821	Intravascular Cannula or Shunt Placement AV anastomosis,direct, any site, (eg Cimino type).(separate procedure)	1.2	1.0
	36825	Intravascular Cannula or Shunt Placement Creation of AV fistula, autogenous graft.	1.3	1.1
	36830	Intravascular Cannula or Shunt Placement Creation of AV fistula, nonautogenous graft.	8.4	7.3
	36832	Revision of an arteriovenous fistula, with or without thrombectomy, autogenous or non-autogenous graft.	11.8	10.2
Sub Total			98.4	84.9
Other[b]			1.6	15.1
Total			100.0	100.0

[a] Estimates are from Medicare Institutional and Physician/Supplier Claims

[b] Codes of ICD9/HCPCS not shown which bring the totals to 100 percent: 35180, 35900, 35910, 36534, 36810, 36815, 36820, 36834, 36835, 36840, 36845, 37607, M0900

USRDS 1997

Table X-6

measure and verify and should make for reasonable indices on which to base payment for a capitation plan. However, within each of these groups there is still substantial variation, and there is always the possibility that providers and patients may well have information that would permit "gaming " the system (Brown et al, 1993). While such possibilities may suggest that using these demographic indicators may not be sufficient as the guide to setting capitation rates, there is no good reason to not use these indicators as a starting position.

These spending analyses are of course the pattern observed in the fee for service system. When incentives are changed, as under a managed care plan, in all likelihood there will be a very different patterns of spending. It remains to be seen if the costs can be lower and the quality of care as good or better under a managed care plan.

Medicare Spending for Hemodialysis Vascular Access Procedures

Introduction

It has been reported that vascular access complications are the largest single cause of morbidity in the hemodialysis population, accounting for 15-16 percent of hospitalizations (Feldman et al., 1993). In addition, large unexplained variations in geographic practice patterns have been documented along with a dramatic shift away from endogenous arteriovenous fistula towards synthetic grafts as the type of vascular access in newly treated hemodialysis patients. This shift in vascular access has occurred despite clinical evidence that patients with endogenous fistulas experience lower complication rates (Hirth et al., 1996). These findings imply that there may be an opportunity to both improve care and reduce costs by modifying vascular access practice patterns. This makes controlling vascular access decisions a likely target for managed care companies in the upcoming HCFA demonstrations.

Distributions of Selected Vascular Access Procedures by Location of Service, Medicare Hemodialysis Patients, 1994[a,c]

		Inpatient			Outpatient			Total		
ICD9/HCPCS	Code[b]	Count	%	Cum %	Count	%	Cum %	Count	%	Cum %
ICD9	3927	16,407	22	22	7,549	6	6	23,956	12	12
	3942	18,153	25	47	13,879	11	17	32,032	16	29
	3943	4,094	6	53	1,151	1	18	5,245	3	31
	3949	26,771	37	89	22,572	18	37	49,343	25	56
	All Others	7,777	11	100	3,069	2	39	10,846	6	62
HCPCS	01784	0	0	100	86	0	39	86	0	62
	01844	0	0	100	248	0	39	248	0	62
	35875	2	0	100	8,151	7	46	8,153	4	66
	35876	1	0	100	1,784	1	48	1,785	1	67
	35903	0	0	100	407	0	48	407	0	67
	36489	4	0	100	8,874	7	55	8,878	5	72
	36533	0	0	100	2,185	2	57	2,185	1	73
	36535	1	0	100	2,090	2	59	2,091	1	74
	36800	3	0	100	748	1	59	751	0	74
	36821	3	0	100	2,077	2	61	2,080	1	75
	36825	2	0	100	1,965	2	62	1,967	1	76
	36830	0	0	100	4,288	3	66	4,288	2	79
	36832	4	0	100	21,032	17	83	21,036	11	89
	All Others	6	0	100	20,871	17	100	20,877	11	100
Total		73,228	100	100	123,026	100	100	196,254	100	100

[a] Remaining ICD9/HCPCS Codes: 35180, 35900, 35910, 36534, 36810, 36815, 36820, 36834, 36835, 36840, 36845, 37607, M0900

[b] International Classification of Diseases, 9th Revision; HCFA Common Procedure Coding System

[c] Estimates are from Medicare Institutional and Physician/Supplier Claims

USRDS 1997

Table X-7

In this study, we attempt to document the Medicare costs associated with vascular access procedures.

Methods and Materials

See the Methods section at the beginning of this chapter.

Results

Table X-6 defines selected vascular-access-related codes and indicates the percentage of total procedures accounted for by each procedure code. Counts of procedures from the institutional claims files by place of service (inpatient vs. outpatient/other) and total are presented in Table X-7. The small number of procedures performed in dialysis units, skilled nursing facilities, and hospices were classified as outpatient procedures.

To adjust the institutional inpatient and outpatient spending amounts for non-vascular access spending that was implicit but not identified in the entire paid claim, a regression model was estimated to scale the paid amount down. This same regression model was also used to estimate the amount of inpatient and outpatient institutional claims that were "missed" because of the lack of a vascular access code on the institutional paid claim but which were reported by the physician/supplier claims. (See Methods).

The regression model was based on the Wave 1 Dialysis Morbidity and Mortality Study (DMMS) Special Study sample. (See Chapter I and II). Table X-8 reports on the basic characteristics of this regression sample of 4,087 prevalent patients. Some of the details of these regression analyses are reported in Table X-9.

Regression Specification Used to Estimate Medicare Spending for Vascular Access Procedures, DMMS Wave 1 Hemodialysis Patients, 1994

Parameter/Statistics	Definitions / Comments
Sample:	Total DMMS Wave 1 sample was 5450 hemodialysis patients. Excluded from this were non-Medicare patients, patients whose Total Medicare Spending Payment in 1994 was less than $2,000, and Medicare patients who were excluded from the 1991-94 Intent-to-treat model (see text for criteria). Resulting Sample: 4,087 Prevalent Medicare Hemodialysis Patients with 3468 Years at Risk.
Dependent Variables:	(1) Total Institutional Inpatient Medicare Spending and (2) Total Institutional Outpatient Medicare Spending for each patient in 1994.
Estimation Technique:	Multiple Linear Regression
Models Estimated:	Four Models: Broad and Narrow Definitions of Vasular Access Procedures(Covariates) for both Inpatient and Outpatient Spending (Dependent Variables)
Covariate Adjustments:	Age, Sex, Race, Primary Disease and 8 Cormorbid Conditions (LVH, PVD, Pulmonary Edema, CHD, Cardiomaegaly by X-ray, Neoplasm Congestive Heart Failure, Unable to Ambulate Independently).
Vascular Access Covariates:	(1) Count of institutional Inpatient (Outpatient) paid claims with Vascular Access Procedures listed on the claim. (2) Count of Physician/Supplier paid procedures for Inpatient (Outpatient) Vascular Access.
Sensitivity Analysis:	(1) Model without Comorbid Conditions (2) Model with Myocardial Infarction Hospitalization as a covariate.
Estimating Years at Risk (YAR):	"Population" Estimates of YAR were derived from the Standardized Hospitalization Rate (SHR) analysis (see Chapter IX). This analysis requires a Medicare paid dialysis claim before entry into the study. This estimate was restricted to patients classified as hemodialysis on 1/1/94. The result of 119,292 YAR for 1994 is likely to be lower than the full hemodialysis population.

USRDS 1997

Table X-8

Regression Results (Vascular Access Covariates) for Adjusting Medicare Spending for Vascular Access Procedures, DMMS Wave 1 Hemodialysis Patients, 1994

Dependent Variable[a]	Covariates and Statistics	Definition of Vascular Access Procedures: Narrow	Broad
	Inpatient		
	Institutional		
Total Medicare Inpatient Spending for each Patient (mean=$13,246)	Modelled $ (adjusted)	$8,014	$9,578
	p (different from 0$)	(<0.001)	(<0.001)
	Mean # V.A. claims/patient in 1994	0.379	0.427
	Range	0 to 8	0 to 8
	Unadjusted Spending / Patient	$10,504	$10,671
	Adjusted $ / Unadjusted $	0.763	0.897
	Physican/Supplier		
	Modelled $ (adjusted)	$714	$717
	p (different from 0$)	(<0.001)	(<0.001)
	Mean # V.A. proc./patient in 1994	1.656	1.816
	Range	0 to 89	0 to 89
	Unadjusted Spending / Patient	$258	$262
	Adjusted $ / Unadjusted $	2.767	2.737
	Outpatient		
	Institutional		
Total Medicare Outpatient Spending for each Patient (mean=$1,456)	Modelled $ (adjusted)	$815	$944
	p (different from 0$)	(<0.001)	(<0.001)
	Mean # V.A. claims/patient in 1994	0.402	0.506
	Range	0 to 11	0 to 14
	Unadjusted Spending / Patient	$958	$980
	Adjusted $ / Unadjusted $	0.851	0.963
	Physican/Supplier		
	Modelled $ (adjusted)	$102	$81
	p (different from 0$)	(<0.001)	(<0.001)
	Mean # V.A. proc./patient in 1994	0.913	1.106
	Range	0 to 47	0 to 52
	Unadjusted Spending / Patient	$249	$243
	Adjusted $ / Unadjusted $	0.410	0.333

[a] Medicare spending for all procedures and claims not just vascular access.

USRDS 1997

Table X-9

Medicare vascular access procedures spending in 1994 is reported in Table X-10 totaling $743M using the narrowly defined vascular access procedure codes and $939M using the broadly defined codes. These estimates of the lower and upper bounds on spending for vascular access represent between 8.4 and 10.6 percent of total Medicare ESRD spending in 1994 for all modalities and all patients (see Table X-2).

Medicare spending per patient year at risk (Table X-11) was $6,228 under the narrow definition and $7,871 under the broad definition. These rates of spending for vascular access in hemodialysis patients represent between 14 and 17 percent of total spending for hemodialysis patients per year at risk (see Table X-3).

Conclusions and Limitations

Certainly, costs for creating and maintaining vascular accesses for hemodialysis represent a substantial portion of Medicare spending for hemodialysis patients. Both the high overall costs and the large fraction of these costs that accrue in inpatient settings indicate that an opportunity for savings may exist if providers can optimize vascular access care. Steps might include ensuring that the optimal type of access (that least likely to lead to complications) is chosen for each patient, encouraging early referral for vascular access placement to allow more time for accesses to mature prior to cannulation, monitoring vascular accesses for signs of impending failure (it should be noted that our estimates exclude costs associated with such monitoring, and the cost effectiveness of available

Medicare Spending for Identified Vascular Access Procedures by Location of Service and Source of Claim, Medicare Hemodialysis Patients, 1994[a]

Medicare Spending

Location of Service	Source of Claim	Vascular Access			
		Narrow Definition		Broad Definition	
		Total $	$/Procedure	Total $	$/Procedure
Inpatient	Institutional	$430M	$8014[b]	$574M	$9578[b]
	Inpatient institutional from regression[c]	$167M	N.A.	$184M	N.A.
	Physician and Supplier	$60M	$258	$69M	$262
	Total	$657M	N.A.	$827M	N.A.
Outpatient[d]	Institutional	$44M	$815[b]	$65M	$944[b]
	Outpatient institutional from regression[c]	$13M	N.A.	$13M	N.A.
	Physician and Supplier	$29M	$249	$34M	$243
	Total	$86M	N.A.	$112M	N.A.
Total		$743M	N.A.	$939M	N.A.

[a] Restricted to patients with at least one paid Medicare dialysis claim prior to entering the study.
[b] $ per paid claim
[c] Regression based estimate of inpatient institutional vascular access claims not captured by procedure codes. See text.
[d] Includes outpatient, dialysis unit, etc

USRDS 1997

Table X-10

monitoring strategies has not been evaluated), and choosing the most economical setting to perform vascular access procedures.

The costs estimated here are higher than those reported by Feldman et al. (1993). Using 1984-86 data, Feldman estimated that 15-16 percent of ESRD patient hospitalizations were related to vascular access morbidity, at an annual cost to the Medicare program of $150M. There are several likely sources of the differences between Feldman's findings and the current study. First, the number of patients in the Medicare ESRD program, the cost per procedure, and the average case mix severity have all grown in the intervening years. Second, the Feldman study included only inpatient costs for vascular access

Vascular Access Spending by Medicare, by Location and Aggregation Level, Hemodialysis Patients, 1994[a]

Location of Service	Level of Aggregation	Vascular Access Spending	
		Narrow Definition	Broad Definition
Inpatient	Total Absolute	$657M	$827M
	Per Year at Risk	$5,507	$6,933
Outpatient[b]	Total Absolute	$86M	$112M
	Per Year at Risk	$721	$939
Total	Total Absolute	$743M	$939M
	Per Year at Risk	$6,228	$7,871

[a] Restricted to patients with at least one Medicare paid dialysis claim prior to entering the study.
[b] Includes outpatient, dialysis unit, etc

USRDS 1997

Table X-11

complications while the present study included outpatient costs as well as the costs of placing the initial vascular access. We could not reliably determine whether a procedure represented an initial placement, particularly among patients under age 65 who may have had a procedure performed before Medicare became their primary payer. Third, our estimates of inpatient institutional costs, even after the regression-based adjustment, may still capture some costs unrelated to the vascular access procedure. Conversely, the regression adjustment may not capture the costs of treating complications arising from vascular access that do not appear in a vascular-access-related claim. For example, if a vascular access infection necessitates antibiotic therapy but not a vascular access procedure, we would have no way of identifying this cost as being related to vascular access. We have frequently reported here that we are estimating the spending for vascular access procedures, not the spending for vascular access.

Unfortunately, this study also demonstrates the difficulties associated with estimating morbidity costs from payment data. For a condition such as vascular access failure, the variety of codes involved, the ambiguity of the codes, and imprecise coding (particularly for inpatient institutional claims) undoubtedly lead to misclassifications in which some vascular access costs are missed while some non-related costs are treated as vascular access costs. Such misclassifications make it difficult to precisely know how much savings can be expected from improved management of vascular access and complicate attempts to set capitation rates for vascular access (e.g., a managed care organization may wish to place a surgeon at risk for vascular access complications). Nonetheless, it is clear that vascular access costs are substantial and that the management of vascular access warrants increased clinical and economic attention.

References

Brown RS, Bergeron JW, Clement DG, Hill JW, Retchin SM. Does Managed Care Work for Medicare? An Evaluation of the Medicare Risk Program for HMOs, Mathematica Policy Research Inc., Princeton NJ, December 1993.

Cox D. Regression models and life tables. J R Stat Soc. 34:187-201, 1972.

Data Users Reference Guide. U.S. Department of Health and Human Services; Health Care Financing Administration; Bureau of Data Management and Strategy. November 1993.

Eggers PW, Kucken LE. Cost issues in transplantation. Surg Clin North Am 74:1259-1267, 1994.

Eggers P. Personal communication, April 1996, March 1997.

End-Stage Renal Disease Research Report 1992. U.S. Department of Health and Human Services; Health Care Financing Administration; Bureau of Data Management and Strategy. September 1994.

Feldman HI, Held PJ, Hutchinson JT, Stoiber E, Hartigan MF, Berlin JA. Hemodialysis vascular access morbidity in the United States. Kid Int 43:1091-1096.

Health Care Financing Administration; Data and Statistics; http://www.hcfa.gov/stats/erate95. HCFA 1995.

Held PJ, Port FK, Carroll CE, Petronis KR. Race and access to erythropoietin by patients on hemodialysis (letter; reply). JAMA 272:1819, 1994.

Hirth RA, Turenne MN, Woods JD, Young EW, Port FK, Pauly MV, Held PJ. Predictors of type of vascular access in hemodialysis patients. JAMA 276:1303-1308, 1996.

Petronis KP, Carroll CE, Held PJ, Port FK. Effect of race on access to recombinant human erythropoietin in long-term hemodialysis patients. JAMA 271:1760-1763, 1994.

Sadler JH. Race and access to erythropoietin by patients on hemodialysis (letter; comment). JAMA 272:1818-1819, 1994.

U.S. General Accounting Office. Medicare managed care: Growing enrollment adds urgency to fixing HMO payment problem. Washington, D.C., November 1995.

United States Renal Data System; USRDS 1995 Annual Data Report; National Institute of Health; National Institute of Diabetes, Digestive, and Kidney Diseases; Bethesda, MD. June 1995.