
Chapter 6

Analysis of End-Stage Renal Disease Expenditures

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INTRODUCTION

The End-Stage Renal Disease (ESRD) program reimburses its beneficiaries for dialysis treatments, for physician services, and for hospital care. Analysis of data collected in conjunction with monitoring expenditures of the program, therefore, provides an alternative method by which to estimate the costs of treatment by different dialysis modalities.

Two major distinctions must be kept in mind when the results of this analysis are compared to those projected from cost audits or average ESRD program reimbursement rates presented in chapter 5. First, projected costs assume full compliance with average prescribed dialysis regimens, while *dialysis costs estimated from Medicare Part B expenditures* reflect actual billings and, therefore, any deviations from average regimens or failures in compliance. Part B expenditures include physician services and ancillaries in addition to those of dialysis treatments per se.

Second, the ESRD program, by recording the frequency of hospitalizations, allows estimation of hospital costs. The *total* costs of medical care, therefore, can be calculated as the basis for comparing dialysis modalities and thereby offset any

lower dialysis costs by any higher costs of hospitalization identified. In the case of continuous ambulatory peritoneal dialysis (CAPD), for example, some claim that any savings in the cost of dialysis are negated by added hospitalizations due to frequent bouts of peritonitis.

This analysis examines expenditures by the Medicare ESRD program on behalf of its beneficiaries during 1981 and 1982. The primary objective is to compare the cost of uninterrupted treatment by center hemodialysis (HD), home HD, and CAPD. In addition, any increases in costs incurred by patients who are unable to tolerate one modality of treatment and are changed to another modality, and the costs associated with dying are examined. These incremental "costs of changing" or "costs of dying" are particularly important to the extent that "procedure survival" or patient survival differ among dialysis modalities.

Although many questions have been raised about the reliability of Medicare ESRD reimbursement data, there is no reason to believe a priori that comparisons among dialysis modalities should be biased even though *actual* dollar figures may be suspect.

METHODS OF THE ANALYSIS

ESRD Program Data Files

The ESRD program records the following information on each beneficiary:

- Patient characteristics such as age, sex, race, and primary ESRD diagnosis.
- Time in the program (a 3-month waiting period is required after the diagnosis of ESRD before enrollment occurs).
- Aggregated Medicare payments under Part B for dialysis treatments, supplies and equip-

ment, and physician services. These figures exclude a 20 percent coinsurance and deductibles.

- Admission and discharge dates for hospitalizations related to the treatment or complications of ESRD. This criterion is very broadly interpreted because of the widespread systemic manifestations of renal disease. Days of hospitalization are converted to dollars by using the national average Medicare per diem rate for the year in question.

The data files obtained for this analysis included all persons enrolled in the ESRD program, with the exception of patients who had undergone renal transplantation at any time and patients who first enrolled in the ESRD program during 1981 or 1982. Transplanted patients were excluded because of the special problems that maybe encountered in the dialysis of patients with failed transplants. Newly enrolled patients were excluded because of concern that the startup costs of dialysis might obscure differences in costs of maintenance treatment.

Patient Subgroups for Analysis

The 1981 and 1982 files were merged and 10 subgroups of patients were identified:

Continuous Dialysis on a Single Modality From January 1, 1981 to December 31, 1982 and Survived:

1. Center HD (hospital or independent center)
2. Home HD
3. CAPD

Single Change of Dialysis Modality Between January 1, 1981 and December 31, 1982 and Survived:

4. CAPD to center HD
5. Center HD to CAPD
6. CAPD to home HD
7. Home HD to CAPD

Continuous Dialysis on a Single Modality From January 1, 1981 Until Death Between July 1, 1982 and December 31, 1982:

8. Center HD
9. Home HD
10. CAPD

In all *survivor* subgroups (subgroups 1 to 7), the analysis was limited to data that applied to the 18-month period from April 1, 1981 to October 31, 1982. The first 3 months of 1981 and the last 3 months of 1982 were excluded to eliminate any expenditures for hospitalizations that might have been associated with the startup of therapy or with complications that might have led to a change in therapy or death after December 31, 1982. Another exclusion was *deaths* before July 1, 1982; this was done to ensure a sufficiently

long period of observation prior to death that stable estimates of expenditures prior the terminal costs of dying would be obtained.

Variables examined in each subgroup were:

- age on July 1, 1981;
- sex;
- race;
- time in ESRD Program prior to January 1, 1981;
- aggregate Medicare Part B reimbursements;
- number of hospitalizations; and
- duration of each hospitalization.

Dates of change of dialysis modality depend on information provided in claims submitted by dialysis centers or physicians. Change dates tended to clump around the end of quarters (March 31, June 30, September 30, December 31). The listed date was accepted if it were other than the end of a quarter, but the date of the midpoint of the preceding quarter was arbitrarily assigned for changes reported in claims dated within 3 days of the end of the quarter on the assumption that actual dates of change were randomly distributed.

Dates of hospital admission and discharge were provided only for the first five hospitalizations in any calendar year for any given patient. In those few patients with more than five hospitalizations, the average length of stay of the first five hospitalizations was used as an estimate of the duration of hospitalization on subsequent admissions,

Costs of Hospitalizations

Hospital days per patient-year are converted to dollars as follows:

$$\text{Hospital days in the period of observation} \times \frac{365}{\text{length of period of observation}} \times \frac{\text{Average hospital per diem rate}}{\text{diem rate}} \times 0.68 \times 1.047 \times 1.07$$

The average national hospital per diem rate for Medicare patients was \$348 in 1981 and \$412 in 1982. The factor 0.68 is the proportion of the hospital per diem rate that Medicare reimburses. The factor 1.047 adjusts for hospital administrative and overhead costs not otherwise included in the per diem rate, and the factor 1.07 adjusts for the average coinsurance and deductibles patients pay towards the cost of their Part A Medicare treat-

ment. Adjusted average per diem rates are \$265.11 for 1981 and \$313.86 for 1982.

This formulation assumes that days of hospitalization for patients with ESRD are of average intensity and, hence, average cost. To the extent that ESRD patients may require more days in intensive care units, more ancillary services, or more nursing services than the average patient, this assumption will underestimate the true cost of hospitalizations. Similarly, to the extent that renal dialysis during hospitalizations is billed separately under Medicare Part B, costs of hospitalization will be further underestimated. No reliable information is currently available on either issue.

Costs of Outpatient Dialysis and Physician Services

Medicare Part B reimbursements are assumed to represent 80 percent of all bills for dialysis and physician services rendered in both outpatient and inpatient sites. To estimate total costs, adjustment is made for the 20 percent coinsurance that must be borne by the patient or another payor, but the annual deductible of \$75 is ignored. Part B costs

are assumed to accrue at a uniform rate throughout the year. The cost of outpatient care and physician services per patient-year, therefore are calculated as:

$$\frac{\text{Medicare Part B reimbursements in period of observation}}{\text{length of period of observation}} \times \frac{365}{\text{length of period of observation}} \times 1.25$$

Total Costs of Care

Total costs are presented as the sum of the costs of hospitalizations and Part B costs per patient-year of treatment.

Costs of Changing Dialysis Modality and Costs of Dying

The “cost of changing” and the “cost of dying” are estimated as the difference between the actual total cost and the total cost predicted from the relevant dialysis subgroup(s) that survived on a single dialysis modality (subgroups 1 to 3). For change subgroups, predicted expenditures are weighted by the number of days a patient was on each dialysis modality.

RESULTS

Population Characteristics

The distribution of the ESRD population among defined subgroups for the 1981 and 1982 files separately and for the merged file are shown on table 6-1. Patients remaining continuously on one dialysis modality predominate in each file, and include 90.9 percent of patients in the merged file. The number of deaths in the merged file are about half those in the 1981 or 1982 files, because only deaths between July 1, 1982 and December 31, 1982 were included. Fewer than 1 percent of patients experienced multiple changes in dialysis modality. Of note is that among patients who changed dialysis modality, many more change from center HD to CAPD than in the reverse direction. This finding no doubt reflects both the larger population of center HD patients at risk for change and the increasing acceptance of CAPD as a viable alternative. Sample sizes in the merged file are of tolerable size for analysis except for the change group of CAPD to home HD.

Table 6-2 shows the demographic characteristics of patient subgroups for the merged file. Patients who are continuously on CAPD are, on average, slightly younger than those on center HD (49.7 years vs. 53.9 years), while the age of patients on home HD is intermediate (51.0 years). Patients who die are, on average, 6 to 8 years older than their surviving counterparts. A markedly higher proportion of ESRD program participants on continuous center HD are black (37 percent) than those on either home HD (20 percent) or CAPD (16 percent). Modest male predominance is seen among patients on home HD (57 percent) and CAPD (55 percent).

Costs of Dialysis and Physician Services (Part B Costs)

The estimated cost per patient-year of continuous dialysis is \$16,915 for center HD, \$12,024 for home HD and \$7,631 for CAPD (table 6-3). For center HD, this amount is about 60 percent

Table 6-1.—Distribution of the ESRD Population by Clinical Subgroup and Dialysis Modality for 1981 and 1982 Files and for the Merged File

Clinical and dialysis subgroups	1981		1982		Merged file ^a	
Continuous dialysis on a single modality and survived:						
Center HD ^b	25,583		30,075		20,186	
Home HD ^b	1,216		1,463		418	
CAPD ^b	627		1,693		357	
Other ^c	217		293		—	
Subtotals	27,697	81.3%	33,524	83.7%	20,967	90.9%
Single change of dialysis modality and survived:						
CAPD to center HD	113		292		108	
Center HD to CAPD	433		438		388	
CAPD to home HD	36		31		9	
Home HD to CAPD	93		81		49	
Other ^d	413		385		—	
Subtotals	1,088	3.2%	1,227	3.1%	554	2.4%
Continuous dialysis on a single modality but died: *						
Center HD	4,825		4,664		1,499	
Home HD	173		218		21	
CAPD	104		252		29	
Other	179		171		—	
Subtotals	5,281	15.5%	5,305	13.2%	1,549	6.7%
Totals	34,066	100.0%	40,056	100.0%	23,070	100.0%

^aMerged file includes only patients who remained in the specified subgroup from 4/1/81-9/30/82 inclusive or who were on one modality of dialysis after 4/1/81 and died between 7/1/82 and 12/31/82.

^bCenter HD may be at either a hospital or independent dialysis center. Home HD and CAPD are supervised by a hospital or independent center or, rarely, by individual physicians.

^cIncludes intermittent peritoneal dialysis or simultaneous combinations of dialysis modalities.

^dIncludes multiple changes in dialysis modality.

^eFor 1981 and 1982 files, the patient may have died any time in the specified year; for merged file the patient died between 7/1/82 and 12/31/82.

SOURCE: Office of Technology Assessment.

Table 6-2.—Demographic Characteristics of ESRD Program Participants by Clinical Subgroup and Dialysis Modality for the Merged File

Clinical and dialysis subgroups ^a	Number	Mean age (on 7/1/81)	Sex		Race			
			Male	Female	White	Black	Other	Unknown
Continuous dialysis on a single modality and survived:								
Center HD	20,192	53.9	50%	50%	58%	37%	3%	2%
Home HD	418	51.0	57	43	75	20	3	2
CAPD	357	49.7	55	45	79	16	3	2
Single change of dialysis modality and survived:								
CAPD to center HD	108	49.2	54	46	63	32	3	2
Center HD to CAPD	388	49.6	49	51	70	25	3	2
CAPD to home HD	9	46.8	33	67	56	22	11	11
Home HD to CAPD	49	49.3	45	55	86	10	2	2
Continuous dialysis on a single modality but died:								
Center HD	1,499	61.1	54	46	66	29	3	2
Home HD	21	57.0	38	62	76	10	10	4
CAPD	29	56.3	48	52	90	3	7	0

^aCenter HD may be at either a hospital or independent dialysis center. Home HD and CAPD are supervised by a hospital, independent center or, rarely, by individual physicians.

SOURCE: Office of Technology Assessment.

Table 6-3.—Mean Costs of Dialysis and Physician Services by Clinical Subgroup and Dialysis Modality

Clinical and dialysis subgroups ^a	Mean costs per patient-year	
	ESRD reimbursements	Estimated total cost ^b
Continuous dialysis on a single modality and survived:		
Center HD	\$13,532	\$16,915
Home HD	9,619	12,024
CAPD	6,105	7,631
Single change of dialysis modality and survived:		
CAPD to center HD	10,833	13,604
Center HD to CAPD	10,549	13,186
CAPD to home HD	5,331	6,664
Home HD to CAPD	7,626	9,533
Continuous dialysis on a single modality but died:		
Center HD	14,086	17,608
Home HD	11,675	14,594
CAPD	6,058	7,573

^aCenter HD may be at either a hospital or independent dialysis center. Home HD and CAPD are supervised by a hospital, independent center or, rarely, by individual physicians.

^bESRD reimbursements multiplied by 1.25 to adjust for the 20 percent coinsurance charged to the patient under Part B of the Medicare ESRD program.

of yearly costs projected from average ESRD program reimbursement rates for dialysis plus the average cost of physician supervision. For home HD and CAPD, they are about 80 percent and 40 percent, respectively, of those projected from the HCFA cost audit results plus the estimated average cost of physician supervision (table 6-4).

Several explanations are possible to account for these differences. One is that ESRD enrollees who are stable on a single dialysis modality require less frequent dialysis and less physician supervision than the “average” ESRD patient. Although this may be true, it could account for only a small fraction of the discrepancies, because costs in the

subgroups of patients who changed modalities (weighted by the time on each modality) and in the subgroups of patients who died are only slightly higher than in the continuous dialysis subgroups.

A second explanation maybe that a significant proportion of patients have dialysis prescribed less frequently than the assumed three times a week for HD and four times per day for CAPD. Some estimates suggest that this may occur in 20 to 25 percent of patients, and especially in those with some residual renal function.

Third, failures in compliance maybe important. Compliance with treatment regimens for chronic diseases has been well demonstrated to be extremely difficult; that with treatment for ESRD, undoubtable, is no exception.

Fourth, incomplete rendering of bills to the ESRD program may occur either because of dual entitlement to coverage or, in the case of a new technology such as CAPD, because of cost incentives offered by industrial suppliers. Nearly 4,000 patients have dual entitlement to coverage by the Veterans Administration and by the ESRD program. ESRD reimbursements for these individuals, naturally, would be low. Data files do not permit identification and exclusion of these patients.

Finally, some bills submitted by providers may not be recorded in the Part B data system. Even though physicians have been instructed to submit all bills for ESRD patients to this system, they may not always do so.

Whatever their explanations, discrepancies between projected dialysis costs and actual costs de-

Table 6-4.—Comparisons of the Estimated Costs of Dialysis From Different Data Sources by Dialysis Modality

Dialysis type	Cost audits (1980-81)		Average Medicare reimbursement rates (1982)	Medicare ESRD reimbursements under Part B (1981 -82) ^b
	HCFA ^a	GAO ^a		
Center HD ^c :				
Hospital center	\$21,060	—	\$24,804	\$16,915
Independent center	16,848	—	21,528	16,915
Home HD	13,572	16,068	—	12,024
CAPD	17,784	17,160	—	7,631

^aExcludes physician services not billed through the facility.

^bEstimates are for patients who continue on a single form of dialysis for at least 2 years and include physician services.

^cMedicare part B data did not permit differentiation of center HD by whether it was performed in a hospital or independent dialysis center.

SOURCE: Off Ice of Technology Assessment

terminated from the ESRD data system require further evaluation, especially in the case of CAPD.

Rates and Costs of Hospitalization

Patients on any one dialysis modality who survived averaged slightly over one hospitalization per patient-year (table 6-5). Patients who changed dialysis modality or died had nearly double these rates of hospitalization. Somewhat more CAPD patients had at least one hospitalization during

the 18 months of observation than center HD patients (76 vs. 69 percent), and patients on home HD were least likely to have been hospitalized (58 percent).

Hospital days per patient-year among survivors on a single dialysis modality were higher for center HD (11.9 days) than either CAPD (10.6 days) or home HD (8.9 days) (table 6-6). These hospitalization rates are lower than those reported in chapter 4, because they are for patients who are on

Table 6-5.—Mean Frequency of Hospitalizations by Clinical Subgroup and Dialysis Modality

Clinical and dialysis subgroups	All patients		Patients with one or more hospitalization	
	Number	Mean number of hospitalizations per patient-year	Percent of all patients	Mean number of hospitalizations per patient-year
Continuous dialysis on a single modality and survived:				
Center HD	20,192	1.3	690/0	1.9
Home HD	418	1.0	58	1.7
CAPD	357	1.3	76	1.7
Single change of dialysis modality and survived:				
CAPD to center HD	108	2.4	96	2.5
Center HD to CAPD	388	2.3	93	2.5
CAPD to home HD	9	1.3	78	1.7
Home HD to CAPD	49	1.6	84	2.0
Continuous dialysis on a single modality but died:				
Center HD	1,499	2.5	94	2.7
Home HD	21	2.1	81	2.6
CAPD	29	2.4	90	2.7

^aCenter HD may be at either a hospital or independent dialysis center. Home HD and CAPD are supervised by a hospital, independent center or, rarely, by individual physicians.

SOURCE: Office of Technology Assessment.

Table 6-6.—Mean Number of Hospital Days and Estimated Hospital Costs per Patient-Year by Clinical Subgroup and Dialysis Modality

Clinical and dialysis subgroups	All patients		Patients with one or more hospitalization
	Hospital days per patient-year	Annual hospital costs	Hospital days per patient-year
Continuous dialysis on a single modality and survived:			
Center HD	11.9	\$3,342	17.1
Home HD	8.9	2,443	15.3
CAPD	10.6	2,953	14.0
Single change of dialysis modality and survived:			
CAPD to center HD	23.1	6,655	23.9
Center HD to CAPD	17.6	5,151	18.9
CAPD to home HD	9.9	2,806	12.8
Home HD to CAPD	11.4	3,340	13.7
Continuous dialysis on a single modality but died:			
Center HD	31.1	9,205	33.2
Home HD	21.4	6,403	26.5
CAPD	26.0	7,763	29.0

^aCenter HD may be at either a hospital or independent dialysis center. Home HD and CAPD are supervised by a hospital, independent center or, rarely, by individual physicians.

SOURCE: Office of Technology Assessment.

continuous dialysis and exclude hospitalizations related to startup of dialysis or change in modality. Patients changing from CAPD to center HD had more hospital days than those changing from center HD to CAPD or from home HD to CAPD (23.1, 17.6, and 11.4 days, respectively). Patients who remained on a single dialysis modality, but died, were hospitalized between two and three times as many days as their surviving counterparts. Distributions of lengths of hospital stays are shown in table 6-7. The highest proportions of patients with long periods of hospitalization occur in the group changing from CAPD to center HD and in nonsurvivors.

In nonsurvivors, hospitalization rates in the last 3 months of life were three times those experienced earlier in the last year in life, but during the preceding months were more than twice those in stable survivors. This pattern of increasing hospital utilization reflects the crescendo of complications and medical interventions that often precede death.

Annual hospital costs directly reflect lengths of stay because of the assumption that the average Medicare per diem rate applies to each hospital day (table 6-8). Hence, any differences between patient groups in the intensity of care required,

Table 6-7.—Distribution of Lengths of Hospital Stay by Clinical Subgroup and Dialysis Modality

Clinical and dialysis subgroups	Number	Days per patient-year ^b									
		O	1-3	4-6	7-9	10-19	20-29	30-39	40-49	50-59	>60
Continuous dialysis on a single modality and survived:											
Center HD	20,192	31%	14%	12%	7%	17%	80/0	5%	3%	2%	30/0
Home HD	418	42	11	13	5	14	7	3	3	1	2
CAPD	357	24	16	18	9	17	8	4	1	3	1
Single change of dialysis modality and survived:											
CAPD to center HD	108	4	9	9	7	23	19	14	7	5	4
Center HD to CAPD	388	7	11	14	12	23	14	7	6	3	3
CAPD to home HD	9	22	11	11	11	33	11	0	0	0	0
Home HD to CAPD	49	16	12	12	14	25	14	4	0	2	0
Continuous dialysis on a single modality but died:											
Center HD	1,499	6	6	6	6	19	15	12	9	6	15
Home HD	21	19	0	5	10	19	24	14	5	0	5
CAPD	29	10	4	4	7	28	4	17	17	7	4

^aCenter HD may be at either a hospital or independent dialysis center. Home HD and CAPD are supervised by a hospital, independent center or, rarely, by individual physicians.

^bRows may not add to 100 percent because of rounding.

SOURCE: Office of Technology Assessment.

Table 6-8.—Total Costs of Care Per Patient-Year by Clinical Subgroup and Dialysis Modality

Clinical and dialysis subgroups	Costs of dialysis and physician services ^a	costs of hospitalization	Total costs
Continuous dialysis on a single modality and survived:			
Center HD	\$16,915	\$3,342	\$20,257
Home HD	12,024	2,443	14,485
CAPD	7,631	2,953	10,584
Single change of dialysis modality and survived:			
CAPD to center HD	13,604	6,655	20,259
Center HD to CAPD	13,186	5,151	18,337
CAPD to home HD	6,664	2,806	9,470
Home HD to CAPD	9,533	3,340	12,873
Continuous dialysis on a single modality but died:			
Center HD	17,608	9,205	26,813
Home HD	14,594	6,403	20,997
CAPD	7,573	7,763	15,336

^aCenter HD may be at either a hospital or independent dialysis center. Home HD and CAPD are supervised by a hospital, independent center or, rarely, by individual physicians.

^bESRD reimbursements multiplied by 125 to adjust for the 20 percent coinsurance charged to the patient under Part B of the Medicare ESRD Program calculated using adjusted average national Medicare per diem rate.

SOURCE: Office of Technology Assessment.

operating room use, and diagnostic test requirements are not captured. Costs per year for hospital care range from \$2,443 in patients continuously on home HD to \$9,205 in patients on center HD who die; and costs are slightly lower in patients continuously on CAPD than those who remain on center HD (\$2,953 vs. \$3,342 per year).

Total Costs of Care

The total cost of care per patient-year in “continuous survivors” was \$20,257 for center HD, \$14,485 for home HD, and \$10,584 for CAPD (table 6-8). Interpretation of the low figure for CAPD again must be tempered by concern over the reliability of the unexpectedly low Part B reimbursements recorded for this modality. Patients who changed from CAPD to center HD experienced higher costs than for the reverse direction of change (\$20,259 vs. \$18,337) due primarily to differences in the cost of hospitalizations.

Total costs distribute widely. Higher proportions of patients with costs above \$25,000 per patient year are notable for continuous survivors on center HD, changes from CAPD to center HD or the reverse, and for patients who die (table 6-9).

“Cost of Changing” Dialysis Modality

Estimated costs of changing dialysis modality are shown in table 6-10. Predicted costs are those that would have applied if the patient accrued costs at the rates of patients on continuous dial-

ysis by each of the dialysis modalities involved. Change dates were used to time-weight predicted costs. Total change costs range from \$1,621 in patients who change from home HD to CAPD, and to \$4,922 for those who change from CAPD to center HD. By far the largest contribution to the costs of change involving CAPD and center HD arise from additional days of hospitalization. No doubt these days reflect both requirements to treat complications of the previous treatment and those to begin the new treatment. Results in the group who changed from CAPD to home HD are suspect because of the small numbers of patients involved.

“Cost of Dying”

The incremental cost of dying, shown in table 6-11, ranges from \$4,752 in patients on CAPD to \$6,556 in patients on center HD. These costs relate only to death in patients on a single modality of dialysis for 18 months prior to death and exclude those whose terminal events led to either a change in chronic dialysis modality or to transplantation.

Predictors of Hospitalization in Survivors Who Continue on a Single Dialysis Modality

Case-mix differences, as well as dialysis modality, may influence the need for hospitalization. To examine the independent effects of sociodemo-

Table 6.9.—Distribution of Total Costs of Care per Patient-Year by Clinical Subgroup and Dialysis Modality

Clinical and dialysis subgroups	Number	<\$5,000	\$5,000-9,999	\$10,000-14,999	\$15,000-19,999	\$20,000-24,999	\$25,000-29,999	\$30,000-39,999	\$40,000-49,999	>\$50,000
Continuous dialysis on a single modality and survived:										
Center HD	20,192	7%	16%	17%	13%	11%	14%	17%	4%	1%
Home HD	418	12	28	18	17	13	5	5	1	1
CAPD	357	19	36	24	13	6	1	1	0	0
Single change of dialysis modality and survived:										
CAPD to center HD	108	5	11	21	18	12	12	18	3	0
Center HD to CAPD	388	4	15	24	20	14	12	8	3	0
CAPD to home HD	9	0	56	33	11	0	0	0	0	0
Home HD to CAPD	49	16	21	27	16	14	6	0	0	0
Continuous dialysis on a single modality but died:										
Center HD	1,499	1	8	13	14	12	13	23	11	5
Home HD	21	5	19	9	19	24	10	0	14	0
CAPD	29	7	27	10	28	14	7	7	0	0

^aCenter HD may be at either a hospital or independent dialysis center. Home HD and CAPD are supervised by a hospital, independent center or, rarely, by individual physicians

SOURCE: Office of Technology Assessment,

Table 6-10.—Mean Costs Per Patient-Year of a Single Change in the Modality of Dialysis Among Survivors

Dialysis change	Number	Actual	Predicted	Difference
Costs of dialysis and physician services:				
CAPD to center HD	108	\$13,604	\$12,599	\$1,005
Center HD to CAPD	388	13,186	12,463	723
CAPD to home HD	9	6,664	8,733	-2,069
Home HD to CAPD	49	9,533	8,741	792
Hospitalization costs:				
CAPD to center HD	108	\$6,655	\$2,738	\$3,917
Center HD to CAPD	388	5,151	2,681	2,470
CAPD to home HD	9	2,806	2,333	473
Home HD to CAPD	49	3,340	2,511	829
Total costs:				
CAPD to center HD	108	\$20,259	\$15,337	\$4,922
Center HD to CAPD	388	18,337	15,144	3,193
CAPD to home HD	9	9,470	11,066	-1,596
Home HD to CAPD	49	12,873	11,252	1,621

SOURCE: Office of Technology Assessment.

Table 6-11.—Mean Costs of Dying in Patients on a Single Dialysis Modality

Dialysis modality	Total costs per patient-year		
	Died	Survived	Difference
Center HD	\$26,813	\$20,257	\$6,556
Home HD	20,997	14,485	6,512
CAPD	15,336	10,584	4,752

SOURCE: Office of Technology Assessment.

graphic characteristics, lengths of time on chronic dialysis, and dialysis modality on days of hospitalization, a multiple regression analysis was performed using the number of hospital days during 18 months of observation as the dependent

variable (table 6-12). Longer length of time on dialysis and female gender were significantly associated ($p < 0.05$) with more days in the hospital. Older age was less strongly associated ($p < 0.06$), and race was not associated with longer periods of hospitalization. After adjustment for these patient characteristics, home HD patients still experienced fewer hospital days, but no difference in hospital days was seen between patients on CAPD and center HD.

These findings reemphasize the importance of case-mix differences in explaining differences in costs and morbidity among patients on chronic dialysis.

Table 6-12.—Predictors of Days of Hospitalization in Survivors on Continuous Dialysis by a Single Modality^a

Factor	Coefficient	Standard error	F value	Level of significance
Age ^b	0.02103	0.01104	3.63	$p < 0.06$
Sex ^c	0.73479	0.32495	5.11	$p < 0.03$
Race ^d	0.07393	0.33034	0.05	$p < 0.83$ n.s.
Length of time on dialysis ^e	0.00038	0.00013	7.73	$p < 0.01$
Dialysis group ^f			3.23	$p < 0.04$
Home HD	-2.83343	1.16193	5.95	$p < 0.02$
CAPD	-0.97231	1.25590	0.59	$p < 0.44$ n.s.
Center HD	—	—	—	—

^aPatients who continued on a single dialysis modality from 1/1/81 to 12/31/82 and survived; persons with no hospitalizations are entered as zero days. Sample sizes are: Center HD 20,192; home HD 418; CAPD 357.

^bAs of 7/11/81.

^cFemale = 1; male = 0.

^dNon-White = 1; white = 0.

^eLength of time in ESRD program prior to 1/1/81.

^fCompared to center HD as referent.

SOURCE: Office of Technology Assessment.

DISCUSSION

This analysis of Medicare ESRD reimbursement data provides the only available estimates of actual expenditures for chronic renal dialysis which distinguishes between the costs of dialysis itself and those for associated hospitalizations. The focus on three distinct clinical populations—patients who are able to continue for a prolonged period of time on one dialysis modality and survive, those who require a single change in modality, and those who remain on a single modality but die—facilitates cost comparisons by creating relatively homogeneous subgroups. Costs of continuous dialysis, costs associated with changing dialysis modality, and the added costs incurred by ESRD patients who die, therefore, can be estimated.

The costs of dialysis alone estimated from ESRD reimbursement data differ substantially from those projected from cost audits or average ESRD program reimbursement rates (table 6-4). Despite the vagaries of these comparisons the following conclusions seem warranted:

- Hemodialysis in hospital centers is the most expensive form of dialysis treatment.
- Home HD appears less expensive than center HD, although much or all of the difference probably would be nullified if health aides to assist with home dialysis treatments were required or if opportunity costs were assigned to the time family members must spend learning and assisting the patient with home HD.
- The cost of CAPD is uncertain. Estimates from Medicare ESRD program data are markedly lower than those projected from cost audits or from the prices of supplies and equipment. One can only speculate on possible explanations for this discrepancy. Underreporting of dialysis costs in the Medicare data system seems most likely.

Perhaps the most important finding of this study is that patients who are able to remain on CAPD experience no more days of hospitalization than those who continue on center HD (although more than patients on home HD). The higher hospitalization rates for CAPD reported

in the literature, therefore, probably reflect days of hospitalization related to startup of dialysis or early failures.

This result, coupled with the demonstration of the high costs associated with changing dialysis modalities, underscores the importance of carefully selecting those patients most likely to succeed on a given treatment modality. *Public policy decisions on financial incentives for one or another type of dialysis treatment need to take into account the likelihood of changes in treatment modality and the cost of change.*

Finally, this study demonstrates the effects of patient characteristics, such as sex, age, and total length of time on dialysis, on the need for hospitalization. Case-mix differences have important effects on hospitalization rates, and hence, on the costs of ESRD treatment and on survival that are independent of the dialysis modality. To facilitate valid comparisons, future cost studies need to include consideration of differences in population characteristics.

The total costs of care for ESRD patients estimated in this analysis are similar to those by Eggers (12) using 1979 Medicare ESRD data (table 6-13). The slightly lower costs in the 1981-82 data, despite inflation, are probably due to the fact that the figures were obtained in clinically stable patients and exclude the additional costs of dying or changing from one dialysis modality to another.

The limitations of this analysis of Medicare ESRD reimbursement data need to be acknowledged. These limitations relate both to the fact that the patient samples used in the analysis were

Table 6-13.—Estimated Total Costs Per Patient-Year of Care by Modality of Dialysis

Dialysis modality	Medicare (ESRD) data	
	1979 ^a	1981-82
Center HD.	\$23,562	\$20,257
Home HD.	18,629	14,485
CAPD.	—	10,584

^aP. W. Eggers, unpublished paper on the ESRD program, Office Of Research and Demonstration, Health Care Financing Administration, U.S. Department of Health and Human Services, 1983.

SOURCE: Office of Technology Assessment

selected subsets of the ESRD population and to deficiencies of the Medicare ESRD medical information system.

Patients were included in the analysis only if they had remained on one or another dialysis modality for at least 1 year; hence, early procedure failures and patients newly enrolled in the ESRD program were excluded. Similarly excluded were patients who had previously undergone renal transplantations and those with multiple changes in dialysis modality. The rationale was to focus attention on the costs of treatment in groups that were relatively homogeneous in terms of the clinical course of dialysis. The tradeoff is that the results can be generalized only to about two-thirds of ESRD program beneficiaries on chronic dialysis.

Deficiencies of the Medicare ESRD data system include, first, that dates of change in dialysis modality are often inaccurate, and, hence, compromise calculations of the "cost of changing." Second, significant delays are often experienced in receiving or recording bills that are submitted. The effects of this problem were minimized, so

far as hospital costs were concerned, by terminating the period of observation 3 months prior to the end of 1982. Third, Part B reimbursements are reported only in aggregate for the calendar year and do not permit dissection either by their rate of accrual during the year or according to source (dialysis center, physician, commercial supplier). The aberrant result for Part B CAPD costs is particularly troublesome. Fourth, the extent to which the hospital per diem rates used to estimate hospitalization costs also capture dialysis treatments in hospitals could not be ascertained.

Finally, information on patient characteristics is limited. The primary ESRD diagnosis was available for only slightly more than 60 percent of patients, and no information was available on comorbidity. This last deficiency compromised the extent to which case-mix differences could be explored. *Relatively straightforward changes in the Medicare ESRD data collection methods could rectify many of these deficiencies and greatly facilitate future assessments of the ESRD program and chronic renal dialysis in general.*