2.
Treatment Approaches

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Hemodialysis is one of the three major treatment approaches for end-stage renal disease (ESRD). The others are peritoneal dialysis and transplantation. Each treatment involves a somewhat different array of equipment and supplies. This section briefly describes each approach and discusses the associated equipment. Table 1 shows the number of ESRD patients enrolled in the Medicare program who utilized each treatment modality during 1983.

Table 1.—Estimated Number of End-Stage Renal Disease (ESRD) Patients in the United States by Type of Treatment, 1983

Estimated number of ESRD patients in the United States	95,687[a]
Estimated number of Medicare and nonMedicare ESRD patients receiving treatment as of Dec. 31, 1983: Hemodialysis	61,722
Intermittent peritoneal dialysis	1,572
Continuous ambulatory peritoneal dialysis	8.688
Kidney transplants	6,112
	78,094[a]

[a]The difference between the estimated number of ESRD patients in the United States (95,687) and the estimated number of patients receiving treatments (78,094) may be attributable to the fact that patients who received transplants from 1980 to 1982 were still considered to be ESRD beneficiaries in the Medicare program in 1983

SOURCES P W Eggers Office of Research, Health Care Financing Administration. Baltimore, MD personal communication, February 1984 and U S Department of Health and Human Services, Health Care Financing Administration, ESRD Data Branch 'End Stage Renal Disease Program Quarterly Statistical Summary, " Baltimore MD June 15, 1984

DESCRIPTION OF ALTERNATIVES

A healthy kidney performs a variety of functions within the body. It filters the blood, removing the waste products built up from dietary intake and physical activity; it regulates fluid and chemical balance in the body; and it facilitates hormone secretion, assisting in the regulation of blood pressure and the prevention of anemia. In a patient suffering from ESRD, the kidney has ceased to adequately perform these life-sustaining functions.

Treatments for ESRD seek to compensate in various ways for the renal failure (52). Conceptually, the most direct correction is transplantation. A health kidney from a donor, living or recently deceased, is transplanted into the patient. If the transplant is successful, the new kidney will take on the normal kidney functions and the patient, barring other complications, can lead a nearly normal life.

Unfortunately, although transplantation appears an attractive solution in principle, its practical implementation is often quite difficult. Finding an appropriately matched donor kidney is not easy since the body has a strong innate tendency to reject the foreign organ. In addition, immunosuppressive therapy, which has many deleterious side effects, is necessary to prevent kidney rejection. Although graft retention rates have apparently been improving, success is hardly assured (48,49,89). During graft rejection, patients are likely to suffer other complications and must either return to dialysis or undergo another transplantation.

At present, because of these difficulties, renal transplantation remains a treatment for less than 7 percent of U.S. ESRD patients annually (6,112 patients in 1983) (102). The future is unclear. Some observers feel transplantation may work for only a small percentage of the patient population; others believe that the new immunosuppressive drugs, such as cyclosporine, hold promise for more successful transplants in the future. The lat-

ter group see an inadequate supply of donor organs as the major stumbling block to transplantation (81).

Dialysis, the major alternative to transplantation, offers an artificial mechanism for performing kidney functions. In hemodialysis, blood is pumped from the patient's body, subjected to a process of dialysis, and then returned to the body in a continuous extracorporeal blood loop. Dialysis occurs as the blood is passed through a hemodialyzer, or artificial kidney. In the hemodialyzer (or, simply, dialyzer) the blood flows next to but separate from another fluid, a dialysate. The blood and the dialysate are separated from each other by a semipermeable membrane. The patient's blood, because of the renal failure, contains accumulated waste products and abnormal levels of electrolytes. The dialysate, on the other hand, is free of waste products and contains desirable concentrations of physiological chemicals. Via diffusion and osmosis, waste products and other molecules pass through the semipermeable membrane so the blood can again take on its appropriate properties. Furthermore, by regulating pressure on either side of the membrane, buildup of excess body fluids can be effectively removed through the blood to the dialysate.

Patients on hemodialysis typically are dialyzed three times per week, for sessions ranging from about 3% to **5** hours each. These patients can be dialyzed at home or in hospital-based or freestanding dialysis facilities or centers. Hemodialysis was the treatment chosen by about 89 percent of the patients with ESRD in 1982 (25).

Another form of dialysis, peritoneal dialysis, has been increasing in popularity in recent years. The two forms of dialysis differ in the nature of the semipermeable membrane separating the blood and the dialysate. This difference leads to different methods of dialysis therapy. In peritoneal dialysis, the peritoneum, the membrane surrounding the abdominal organs and lining the abdominal cavity, is utilized in vivo; thus, dialysis occurs within the patient's body rather than via an extracorporeal blood loop. A permanent catheter is inserted into the abdomen, and the dialysate fluid is introduced through the catheter into the peritoneal cavity. The fluid is allowed to remain for varying periods of time, during which dialysis occurs across the semipermeable peritoneal membrane, Later the dialysate fluid is drained out through the catheter and discarded.

The various kinds of peritoneal dialysis reflect variations in the timing of this process. In intermittent peritoneal dialysis (IPD) an automatic machine performs intermittent treatment three to four times per week. Typically, the patient is dialyzed for about 12 hours per treatment, during which the dialysate is automatically exchanged from the peritoneal cavity every hour. Continuous cycling peritoneal dialysis (CCPD) is a variation of IPD involving the use of a machine to warm and cycle the dialysate in and out of the peritoneal cavity automatically about every 4 hours overnight as the patient sleeps. Normally, some fluid is left in the abdomen during the day. Continuous ambulatory peritoneal dialysis (CAPD) involves a continuous, manual exchange of dialysate, roughly every 4 to **6** hours. CAPD offers the advantage of freeing the patient from dependency on a machine. It was chosen by about 10 percent of the ESRD population in 1982 and is, thus, the most popular form of peritoneal dialysis (25).

The relative clinical effectiveness of the modalities remains a subject of study. For various medical or psychological reasons some patients may do better on certain modalities, but there are no controlled, long-term, clinical trials on which to make an overall judgment. Hemodialysis in a dialysis center remains the general historical standard for care. In this regard, a recent analysis done for the Office of Technology Assessment (OTA) concludes that "CAPD appears to be an acceptable alternative to hemodialysis for, at least, selected persons with end-stage renal disease" (86). The authors note that short-term survival rates for the two modalities appear similar, but CAPD patients may be slightly more likely to be hospitalized than either home or in-center hemodialysis patients. This hospitalization is usually because of peritonitis, which many patients on CAPD develop (76).

PATTERNS OF CHOICE AMONG MODALITIES

Choice of modality and treatment setting (home or in-center) depends on a variety of factors reflecting not only the patient's medical condition but also the patient's and physician's personal preferences. The decision to undergo dialysis at home is complicated by concerns about the availability of an assistant to help in dialysis and the cost and disruption the machinery can cause. Also, a patient being dialyzed at home must psychologically balance the responsibilities and the rewards associated with self-care.

The set of choices to be made has varied somewhat over time. With regard to setting, table 2 notes that in 1982 home dialysis was the choice of about **18** percent of dialysis patients. Prior to the enactment of the Federal Government's ESRD program in **1972,** the percentage at home was as high as 40 percent; it declined sharply after the program was established but seems to be gradually creeping up. Of course, these percentage changes are based on a patient population whose size and characteristics have also changed.

The percentage of dialysis patients at home varies considerably among States. Some have more than half of their patients at home (e. g., Washington) while others have less than 10 percent (e. g., Illinois). The nature of the facility with which patients deal influences the choice. Hospitals send a greater proportion of patients home than do free-standing facilities (20).

Table 2.— **Percent of Dialysis Patients Treated at Home by Year**

Year	Percent at home
1972	40
1973	33
1975	16
1976	14
1977	12
1978	12
1979	13
1980	14
1981	16
1982	18

SOURCES Sanford C Bernstein & Co Inc *The Kidney Dialysis Industry* (New York February 1981) C Davis Administrator Health Care Financing Administration testimony at hearing Proposed *Prospective Reimbursement Rates for the End. Stage Renal Disease Program,* before the Subcommittee on Health of the Committee on Finance U S Senate, Mar 15 1982 (Washington DC U S Government Printing Office 1982) Kidder Peabody & Co *Baxter Travenol Laboratories Inc CAPD* Update, Company Follow up New York Aug 16, 1982 and P W Eggers Office of Research, Health Care Financing Administration Baltimore MD personal communication, February 1984

The percent of patients being dialyzed at home also varies among countries. The U.S. rate *is very* similar to the overall European rate of roughly 17 percent **(50).** However, there are variations among countries. Great Britain, for example, sends more than half of its patients home, whereas other countries (e. g., The Netherlands and Spain) tend to send less than 10 percent home (1). Such differences may reflect differences among nations in the institutional setting for medical care.

Among approaches, CAPD's share of U.S. patients represents a growth in popularity over the past few years (86), which many market analysts predict will continue (46,79). Similar growth has been evidenced in other countries, although as of the end of 1981, only 6 percent of the European dialysis patients were being treated with this approach (50). As with home dialysis in general, there is considerable intercountry variation. In Canada, about 30 percent of the patients are on CAPD, but in Spain and West Germany, the figure is below **5** percent **(46,50).**

CAPD is a home-based modality, and thus its use is linked closely with the decision to dialyze at home. Most new patients choosing home dialysis are choosing CAPD, and roughly 68 percent of home patients were on CAPD in **1983 (14,66).** At the same time, however, "procedure survival" on CAPD, i.e., the percent of patients remaining on the treatment for a given period, is somewhat low. Recent U.S. figures show rates of **62** percent after 1 year and **56** percent after **18** months **(66).** The experience in Europe shows even lower procedure survival rates **(50).** Stason and Barnes note that while there is a lack of systematic comparative data on hemodialysis, the CAPD figures do give cause for concern about the modality's long-term viability (86).

COSTS OF TREATMENT MODALITIES

From an economic perspective the choices made could have important effects on costs. Various studies suggest that there are important differences in costs among modalities, but the estimates offered do not always agree (14,15,31,55,79,86). Table 3 presents estimates from various sources. On balance, in-center hemodialysis is the most costly modality. Within this category, hospitals incur greater costs than independent centers. Home hemodialysis appears less costly than CAPD, except in the Stason and Barnes **(86)** estimates from Medicare data.

There are various problems with such estimates. For one thing, data are limited in breadth of coverage and depth of detail. Moreover, the choice of modality does vary with age, race, and sex (86). These and other factors create case-mix differences that affect the cost estimates. Cost estimates are also hard to arrive at because assessing certain of the costs is difficult. For example, the costs of home hemodialysis are probably understated because the economic cost of unpaid aides who assist in dialysis is usually not adequately accounted for. Some estimates for CAPD have tried to account for costs of hospitalization (such as would be associated with peritonitis), but other costs are more difficult to incorporate into the estimates. For example, the costs of failure on CAPD, as measured by costs of the resulting change in modality, are higher than for center hemodialysis (86).

On balance, evidence of the cost differences between hemodialysis in hospitals and free-standing facilities is strong. However, a recent assessment for OTA concludes that evidence of other cost differences remains rather uncertain and worthy of further study (86).

Table 3.—Estimated Costs of Dialysis per Patient-Year by Modality (dollars)

	Cost audits (1 980-81)		Medicare data		Market study
Modality	HCFA	GAO	1979	1981-82	1981
Center hemodialysis:					
Hospital center	21,060	—	23,562	20,257	28,800
Independent center	16,848	—)			24,100
Home hemodialysis	13,572	16,068	18,629	14,485	14,850
Continuous ambulatory peritoneal dialysis	17,784	17,160		10,584	18.300

KEY: HCFA— Health Care Financing Administration, U S. Department of Health and Human Services, GAO—General Accounting Office

SOURCES Cost audit data are presented In W B Stason and B.A. Barnes, "Effectiveness and Costs of Continuous Ambulatory Peritoneal Dialysis (CAPD) in Comparison With Home and Center Hemodialysis, " contract report prepared for the Off Ice of Technology Assessment, U S. Congress, Washington, DC, in press, estimates from Medicare data for 1979 are from P W. Eggers, End-Stage Renal Disease Program, 1983, unpublished, and for 1981-82 are from Stason and Barnes; market study data are from Sanford C Bernstein & Co., Inc., *The Kidney Dialysis Industry (New* York February 1981)