Dialysis-related mortality in the United States

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■ **BACKGROUND** In the United States, the gross mortality rate for patients undergoing dialysis in 1992 was 23.6% per year, higher than in any other industrialized country. This mortality rate has been rising slightly for the last 10 years. Wide variations in mortality rates exist among states and among dialysis centers, and smaller dialysis centers have higher mortality rates than larger ones.

■ **PURPOSE** To review the possible reasons for the high mortality rate associated with dialysis in the United States.

■ **SUMMARY** Differences in patient populations do not explain the variations in mortality rates. The incidence of new patients and the prevalence of older patients and patients with diabetes are higher in the United States than in other countries and are continuing to rise. However, these numbers are rising in other countries as well without a concomitant increase in their mortality rates. Black patients make up a disproportionate number of US dialysis patients, but they are less likely to die than white patients. US patients spend less time per week in dialysis than their European counterparts and use smaller dialyzers, resulting in lower clearance of solutes.

■ **CONCLUSION** Approximately two thirds of US patients receive inadequate dialysis. Nephrologists must examine their practices and their outcomes to improve the quality of care they give.

■ INDEX TERMS: HEMODIALYSIS; MORTALITY
■ CLEVE CLIN J MED 1994; 61:393–397

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Adapted from a lecture given at the Cleveland Clinic Foundation.

SOMETHING is wrong with hemodialysis in the United States. Our gross mortality rate for patients undergoing dialysis is 23.6% per year, the highest of any industrialized country that keeps and reports such data. This mortality rate has been rising for the last 10 years. Further, there is a wide range of mortality rates among states and among dialysis facilities.[1]

Various theories have been proposed to account for these statistics, but the one that best explains them is that most patients in the United States receive inadequate dialysis, most likely the result of physicians prescribing dialysis empirically or intuitively.

This brief overview of how the adequacy of dialysis is defined or quantified in the United States vs European and other countries points out the need for US physicians to apply objective measures to their practice of prescribing dialysis.

HOW DIALYSIS STATISTICS ARE REPORTED

Incidence is the number of new patients undergoing dialysis; the US incidence rate was 180 per million population per year in 1991, the highest in the world (*Table 1*). *Prevalence* is the number of patients undergoing dialysis on a selected date, usu-

TABLE 1
DIALYSIS AROUND THE WORLD, 1991

Country	Incidence, per million population	Prevalence, per million population	Gross mortality rate, %
Australia	55	180	15.2
New Zealand	59	160	15.8
Canada	95	254	19.4
Japan	168	933	9.8
United States	180	488	23.6
EDTA*	60–100	—	10.0

*European Dialysis and Transplant Association (Germany, France, Italy, United Kingdom, Austria)

ally December 31; the US prevalence rate is high at 488 per million per year, but less than half as high as in Japan, where few renal transplantations are performed. Gross *mortality* is the number of patients who die in a given year as a percentage of the mid-year census. Finally, the *standardized mortality rate* is adjusted for age, race, and prevalence of diabetes; by definition, the standardized mortality rate for the United States Renal Data System (USRDS) is 1.0.[2]

Granted, different registries have different reporting practices, making it difficult to compare data meaningfully. For example, the European Dialysis and Transplant Association (EDTA) registry, which was once the world's standard, is a voluntary system, and only about 70% of their patients are included. Canada has good data but a low incidence rate, as do Australia and New Zealand. The USRDS is highly accurate, and reporting is tied to payment, so nearly all patients are included. However, it misses the first 3 months of treatment because Medicare payment does not begin until then. Japan has an accurate registry, but as mentioned previously, it is skewed by a low transplantation rate.

The incidence, prevalence, average age of patients, and the percentage of patients who have diabetes mellitus have been rising around the world. Only in the United States, however, has the gross mortality rate been rising. In 1985, when the US gross mortality rate was approximately 21%, the gross mortality rates by state ranged from 12% to 30%. In 1989, the gross mortality rates ranged from 18% to 30%, and in 1992, from 18% to 29%.[1] The mortality rate seems to be higher in small dialysis facilities than in large facilities. However, there is still wide variation, even among the big facilities (*Table 2*).

EXCUSES FOR OUR HIGH MORTALITY RATE

Confronted with these statistics, many nephrologists reply that their patient population is older than the national average and includes more black patients and patients with diabetes. The standardized mortality rate was devised to control for these variables; therefore, these excuses do not bear scrutiny.

'We accept too many patients'

The United States does have the highest incidence rate. However, Japan's incidence rate is nearly as high, and their mortality rate is much lower (*Table 1*). In addition, the incidence rate in the EDTA has been rising in recent years, but their mortality rate has not.

'We have more minority patients'

The incidence rate for African-American patients is more than three times as high as for white patients, and they have a prevalence rate that is an incredible seven times higher (*Table 3*). Nevertheless, African-American patients undergoing dialysis are less likely to die than white patients. Therefore, and more disturbing, the US mortality rate would be even higher without the African-American patients.

TABLE 2
MORTALITY RATES BY SIZE OF DIALYSIS FACILITY IN ONE STATE

Number of patients	Percent of facilities	Gross mortality rate, %	Range	Standardized mortality rate*	Range
0–25	12	29.5	14–48	0.89	0–2.1
26–50	28	21.3	0–48	0.77	0–1.52
51–75	16	20.4	8–33	0.79	0.38–1.2
76–100	16	23.1	13–35	0.75	0.42–1.32
101–150	16	19.8	8–33	0.79	0.54–1.38
> 150	11	16.2	9–31	0.69	0.36–1.12

*The standardized mortality rate for the entire United States is 1.0 ; for this state it is 0.77

'Our patients are noncompliant'

Approximately 20% of US patients miss one or more treatments per week or leave their dialysis sessions early against medical advice. Some physicians would allege that US patients are less compliant than European or Japanese patients, and that African-American patients are less compliant than whites. Undoubtedly, some patients do get into trouble because of noncompliance, but probably not as many as once thought. Further, African-Americans have a lower mortality rate than whites.

TABLE 3
DIALYSIS AND RACE IN THE UNITED STATES, 1992*

Race	Incidence, per million population	Prevalence, per million population	Gross mortality rate, %
Caucasian	140	381	26.0
African-American	458	2001	18.5

*Data from the United States Renal Data System, reference 1

'Our patients are older'

The average age of US dialysis patients has been rising since the program began to keep statistics in 1973. Although the average age of our patients is similar to that in other countries, we have more patients over age 65 (*Table 4*). Almost all of the growth in the US dialysis population (approximately 10% per year) is in patients over age 65. Nevertheless, the average age of patients has been rising in other countries as well, without a concomitant rise in their mortality rates.

TABLE 4
AGE OF PATIENTS UNDERGOING DIALYSIS

Country	Mean age, years	Percent older than age 65
United States	58	41.5
Canada	57	39.5
Japan	58	35.8
Australia	56	25

'Our patients are sicker'

The percentage of new dialysis patients who have diabetes has also been rising, although part of this rise may be due to improved reporting. Approximately 33% of US patients beginning dialysis in 1991 had diabetes; by the year 2000, it is estimated that over 50% will be so affected. Patients with diabetes do not live as long as patients without diabetes; therefore, the prevalence of patients with diabetes lags behind the incidence (24% vs 33%). We have a higher percentage of patients with diabetes than most other countries: Japan has 11%, Australia 13%, and Canada 24%. New Zealand has a larger prevalence of patients with diabetes than the United States, as does Finland (*Table 5*).

TABLE 5
DIABETIC PATIENTS UNDERGOING DIALYSIS, 1991

Country	New patients with diabetes, %	Total patients with diabetes, %
United States	33	24
Japan	11	10.6
Canada	24	20.1
Australia	13	—
New Zealand	34	—

'We reuse our dialyzers'

Seventy percent of dialysis facilities in the United States reuse dialyzers, accounting for 80% of US patients. The average dialyzer that is reused is reused eight or nine times. In Japan, reuse is forbidden by law. Data on reuse are not available for Australia, New Zealand, and the EDTA, but their reuse rates are relatively low. In Canada 12.5% of dialyzers are reused. This issue demands further study. A decade ago, Deane[3] studied dialyzer reuse and found it to be safe. Held et al[4] have examined data from the USRDS and found no significant difference in mortality rates between facilities that reuse and facilities that do not. Shaldon,[5] who has condemned the reuse of dialyzers, concedes that reuse might be acceptable if there were careful studies done now that we have changed how we dialyze.

'Patients who withdraw are counted separately from patients who die'

Most patients who withdraw from dialysis die within a few days, yet they are counted separately from deaths. Of the approximately 160 000 US dialysis patients, 2% to 3% withdrew from treatment in 1992. The USRDS and the Health Care Financing Administration (HCFA) eventually check the Medicare listing to ascertain which patients have

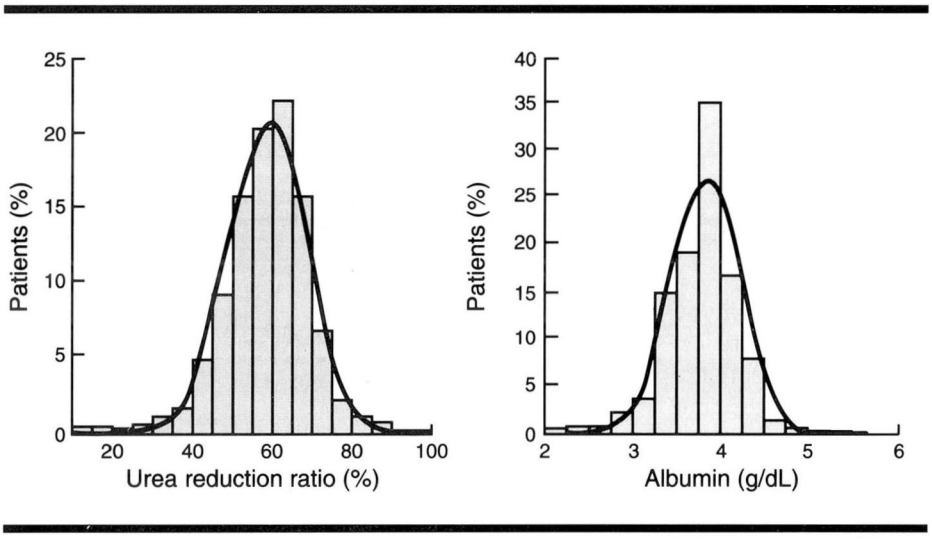

FIGURE. Frequency distribution of the average urea reduction ratios and serum albumin concentrations in 13 473 patients with end-stage renal disease treated with hemodialysis. From Owen et al, reference 8.

died. If the patients who died after withdrawing from dialysis were added to the patients who died while undergoing dialysis, the gross mortality rate would be even higher. However, differences in reporting patients who are withdrawn from dialysis could conceivably account for some of the difference in mortality rates among states.

'We deliver inadequate dialysis'

Most US physicians prescribe dialysis empirically, but the search continues for the ideal measure of the adequacy of dialysis. The clearance of urea over a given time period divided by the volume of distribution of urea (Kt/V) is difficult to calculate. However, the Kt/V can be easily estimated from the urea reduction ratio, which is the difference between the blood urea nitrogen concentrations before and after a dialysis session, divided by the blood urea nitrogen concentration before the session.[6,7] The serum albumin concentration is a more powerful predictor of death than the urea reduction ratio,[8] as low serum albumin concentrations probably indicate malnutrition secondary to inadequate dialysis. As a reference, a Kt/V of 1.2 or greater is desirable, as is a urea reduction ratio of 65% or greater and a serum albumin concentration of 4.0 g/dL or greater. These three standards give evidence of adequate dialysis.

By whatever measure is used, most US patients do not receive adequate dialysis. In a study of 2200 patients, Held et al[9,10] found that 43% of patients were receiving a Kt/V of 1.0 or less. In another study of 13 473 patients, Owen et al[8] found that 55% had a urea reduction ratio of less than 60%, and 60% had a serum albumin concentration less than 4.0 g/L (*Figure*). In contrast, in a study of 10 units in Dallas, the average Kt/V was 1.46, and in France, it is approximately 1.7.[11] Not coincidentally, the French have the lowest gross mortality rate yet published.

One can increase the amount of solute cleared by three means: increase the treatment time, use a bigger dialyzer, or increase the rate of blood flow through the dialyzer. Patients in the EDTA spend an average of 23.5% more time in dialysis than patients in the United States, and the dialyzers used in the EDTA have at least 20% more surface area.[10] US patients spend approximately 9 hours per week (3 hours, three times per week) in dialysis; German patients spend approximately 12 hours.[10] Data are not available regarding the blood flow rates used in the EDTA, but if we assume that they are the same as in the United States, total urea clearance per week would be at least 29% higher in Europe than in the United States.[10]

Chronic ambulatory peritoneal dialysis (CAPD) presents a similar picture. As many as 17% of US dialysis patients undergo CAPD; some countries have more CAPD patients, some have fewer. Many of these patients do well for a year or two, but as their residual renal function declines, CAPD at the average US level of four exchanges per day is no longer adequate for them.

ECONOMICS

Dialysis occupies a unique niche in American medicine. In 1972, when dialysis facilities were scarce and hospital ethics committees had to make uncomfortable decisions regarding who should live and who should die, Congress decided Medicare would pay for this life-saving technology for anyone

who needed it. Since then, the number of people who need it has been rising far beyond anyone's estimations.

The HCFA has responded by controlling the price. The reimbursement rate in the United States is lower than in most industrialized countries. At the present rate of currency exchange (100 yen to the dollar), physicians in Japan receive payment approximately four times higher than in the United States. Furthermore, they are paid on an incentive basis. US facilities are paid, on the average, approximately $126 per patient per treatment. Nephrologists receive approximately $175 per month for the care of the patient, including overseeing dialysis treatment.

Nevertheless, most nephrologists make their living from dialysis. In fact, a new dialysis facility opens every 3 days in the United States. Anybody who owns a dialysis facility is going to find a way to continue to dialyze, no matter what the rate of reimbursement is. But we may be doing it at the expense of our patients.

Up to now, the HCFA has not monitored the quality of treatment. This is going to change. Under any new health care system that is likely to emerge, dialysis facilities as well as all other forms of care are going to be measured by quality as well as cost. As the standard mortality rate is one of the few things that can be measured, it behooves us to use it to examine how well we are doing.

EDUCATING NEPHROLOGISTS

When nephrologists believe that patients undergoing dialysis cannot do well and have a short life expectancy, this belief becomes a self-fulfilling prophecy. As far as we can tell, approximately one third of nephrologists appear to have gotten the message and have increased dialysis to a target Kt/V level of 1.2.[4,8] Unfortunately, two thirds have not.

Many US nephrologists may have been undertrained in their fellowships regarding dialysis. In perhaps a majority of fellowship programs, no one on the staff is a dialysis expert and is able to teach the basic course. Most nephrologists in the United States see patients in the clinic, the hospital, and the dialysis facility, whereas in Europe the physician in charge of the dialysis facility usually does only dialysis. Nephrologists have also been misled by industry, whose job it is to sell dialyzers, not teach, and who would have us believe that new equipment paid for by shorter dialysis really works.

SUMMARY

Patients undergoing dialysis in the United States are older and sicker than those in other countries, but the average age and percent of patients with diabetes has been rising world-wide, and only in the United States has the gross mortality rate been rising. We are left with the ugly fact that most US patients probably receive inadequate dialysis.

Nephrologists need to examine what they are doing, and what their outcomes are. Those who prescribe the level of dialysis by intuition need to start using objective measures of the adequacy of dialysis such as Kt/V, the urea reduction ratio, and the serum albumin concentration. In these cost-conscious times, outcomes of treatment such as how many patients live and how many die are going to become even more important. In retrospect, they should have been important all along.

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