Chapter VI

Patient Survival

There are three major sections of this chapter. First, we report on trends in patient survival over the years. Second, we describe changes in the way that standard death rates are calculated and tabulated for ESRD patients. Third, we report projected remaining years of life for ESRD patients.

First, the trend in patient survival among incident ESRD patients continues to show improvement or to maintain the improvements seen in recent years. The 1993 ADR (USRDS, 1993) first showed the trend in mortality for the entire decade of the 1980s. We can report this year that the improvements in survival among incident patients seen in 1989 and 1990 were sustained in 1991.

Second, this edition of the ADR reports mortality rates in a new format that is more useful for the calculation of standardized mortality ratios (SMRs). SMRs are used to standardize observed mortality in specific patient subgroups relative to the national death rates (Wolfe). Tables of mortality rates are included in this data report for dialysis patients including both prevalent (patients already being treated) and incident patients (patients starting ESRD therapy) and including previously transplanted patients. Previous USRDS tabulations of death rates for dialysis patients were limited to prevalent never transplanted patients in order to allow study of a more homogeneous well-defined study group. However, feedback from the renal community has indicated that tabulations for the more diverse patient mix reported this year would be more useful because it more closely approximates the patient mix undergoing treatment. The USRDS encourages such feedback on ways in which the data can be more usefully disseminated and will make every attempt to be responsive to the needs of the renal community.

The new mortality rates were used to compute adjusted mortality rates for prevalent patients. Complementing the improvements seen in mortality for recent incident cohorts, it appears that the mortality among prevalent patients has improved in 1990 and 1991.

Third, we compare projected remaining lifetimes for ESRD patients and the general U.S. population by race, sex, and age groups.

Methods: Survival Trends

We calculated a survival curve for the incident groups of patients starting ESRD therapy in each calendar year and report the fraction of patients still alive one and two years after first therapy. Usually, all patients whose first day of

ESRD therapy occurs in a specific year are called an "incident" cohort of patients for that year. Since the Medicare system does not achieve complete reporting of patient data before day 90, we defined the incident cohort to consist of those patients whose 91st day of therapy occurred during each specific year.

Specifically, we calculated directly adjusted (Breslow) Kaplan-Meier (KM) survival curves (Kaplan) starting 91 days after first treatment for each such incident cohort. The resulting adjusted survival proportions reported here are weighted averages of Kaplan-Meier estimates across patient subgroups defined by age, race, sex, and diagnostic categories of each incident cohort of patients. The weights correspond to the proportion of ESRD patients in each subgroup in the **reference population**, which is the 1991 incident cohort, as described in Chapter XV.

The adjustment method was used to account for the fact that the age, race, sex, and diagnosis characteristics of the incident cohorts of ESRD patients have changed through the years. Unadjusted survival proportions are likely to differ across cohorts merely because of such changes in patient characteristics.

The adjustment process yields estimates of the survival patterns that would have arisen for the cohorts, had they all had the same age, race, sex, and diagnosis composition as the reference population. Since the adjusted survival curves are all adjusted to the same reference population, any remaining differences between them must be due to factors other than age, race, sex, and diagnosis. Thus, direct comparison of adjusted survival proportions across various years yields more useful interpretations than would comparison of unadjusted survival proportions.

Although the estimated surviving proportions reported in this chapter are comparable across years, they are not comparable to results from other USRDS Annual Data Reports (ADRs) because the definition of the reference population differs for each ADR. The reference population for this ADR is the most recent cohort currently available for analysis. Since the current ESRD reference population is older and has a higher prevalence of diabetes, the survival for this reference population is worse than for the reference populations in previous ADRs.

It can be difficult to observe trends at aggregations below the national level because the small number of patients seen by individual physicians or facilities results in too much statistical variation in the data. The combined data from the USRDS allow aggregation so that general patterns can be seen despite the variations present in the outcomes for individual patients or facilities.

The focus here on national trends should not divert attention from important patterns occurring in specific groups of patients. Our understanding of the causes of mortality is often best served by attention to clinical detail. However, the overall patterns reported here will be of interest to the general renal community since they serve as a benchmark for evaluating patient outcomes.

Adjusted One-Year Patient Survival
By Treatment Modality and Year of Incidence, 1982-91

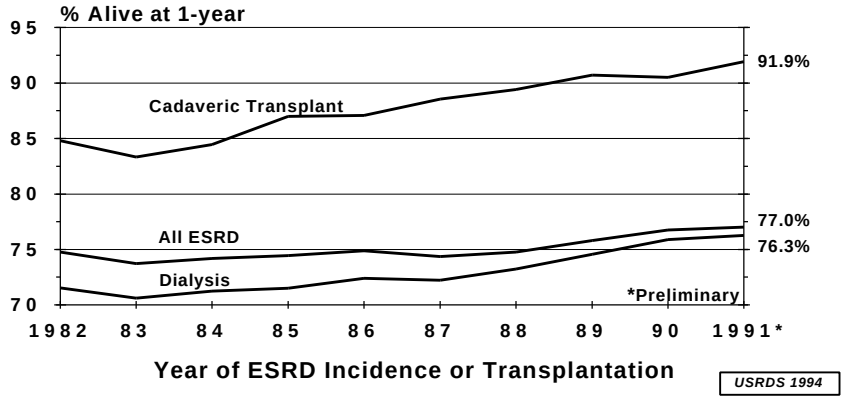

Figure VI-1

Kaplan-Meier one-year ESRD patient survival by modality and year of incidence or transplantation. Starting at day 91 following onset of ESRD for dialysis patients (censored at first transplant) and at day of transplant for transplanted patients. Adjusted for the rage, race, sex, and primary diagnosis characteristics of the 1991 incident cohort. Patients in Puerto Rico and U.S. Territories are included in estimates. Medicare patients only. Source: Reference Tables E.54, E.62, E.66.

Results: Survival Trends

The adjusted proportion of patients surviving for one year is shown in Figure VI-1 for all ESRD patients, independent of changes in treatment. Results are also shown for dialysis patients with follow-up measured since Medicare enrollment and censored at transplantation, and for first cadaveric transplant recipients

Adjusted Two-Year Patient Survival
By Treatment Modality and Year of Incidence, 1981-90

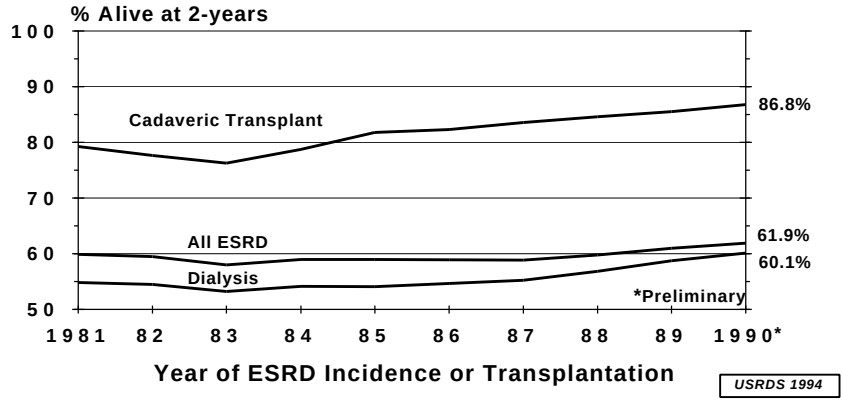

Figure VI-2

Kaplan-Meier two-year ESRD patient survival by modality and year of incidence or transplantation. Starting at day 91 following onset of ESRD for dialysis patients (censored at first transplant) and at day of transplant for transplanted patients. Adjusted for the age, race, sex, and primary diagnosis characteristics of the 1991 incident cohort. Patients in Puerto Rico and U.S. Territories are included in estimates. Medicare patients only. Source: Reference Tables E.55, E.63, E.67.

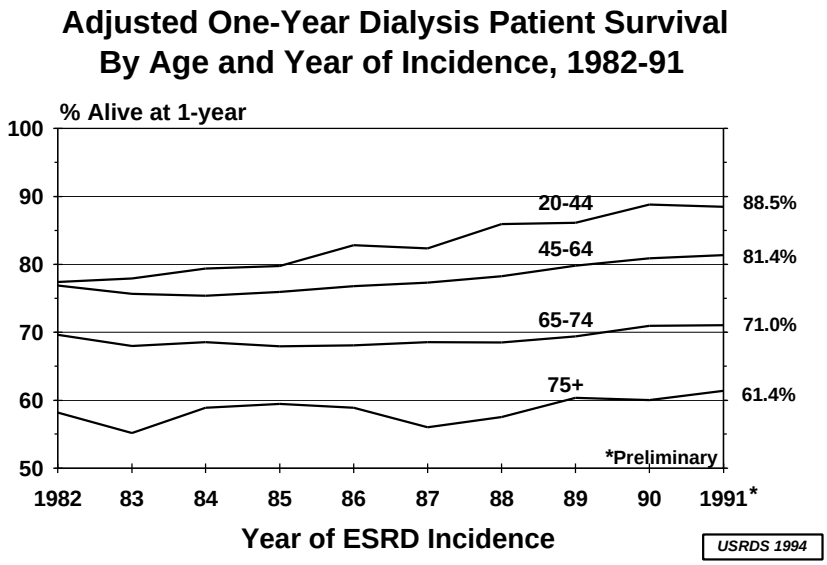

Figure VI-3

Kaplan-Meier one-year dialysis patient survival by age at onset of ESRD and year of incidence.. Starting at day 91 following the onset of ESRD and censored at first transplant. Adjusted for the race, sex and primary diagnosis characteristics of the 1991 incident cohort. Patients in Puerto Rico and U.S. Territories are included in estimates. Medicare patients only. Source: Reference Table E.62

categorized by year of transplant with follow-up measured from the time of first transplantation.

One-year survival is at least as high for the 1991 cohort as it is for the 1990 incident cohort of ESRD patients. This continues the general trend that has been seen for all cohorts since 1983. The higher survival seen before 1983 is likely due to a change in the way that data were reported to the PMMIS data files and may not be directly comparable to the survival after 1983. There has been an improvement in overall survival compared to the previous year for these groups of ESRD patients for every year since 1983 except for 1987.

During this decade, there has been a trend towards treating older patients and more patients with diabetes. The adjusted rates reported here account for these changes and show what would be expected had the patient mix been consistent over the years. However, there may be other changes in the patient characteristics during the decade; which are not accounted for by the adjustments for age, race, sex, and diagnosis; which explain the trends seen here. The current USRDS data cannot adjust for such comorbidity measures for the overall ESRD population because these measures are not recorded for all patients.

Although the reasons for the decreased mortality for dialyzed and transplanted patients are likely to be very different, the result is that recent ESRD patients on both major types of renal replacement therapy continue to enjoy reduced mortality rates relative to that experienced by patients in earlier years. Although survival for patients who received a cadaveric transplant is consistently better than for dialytic

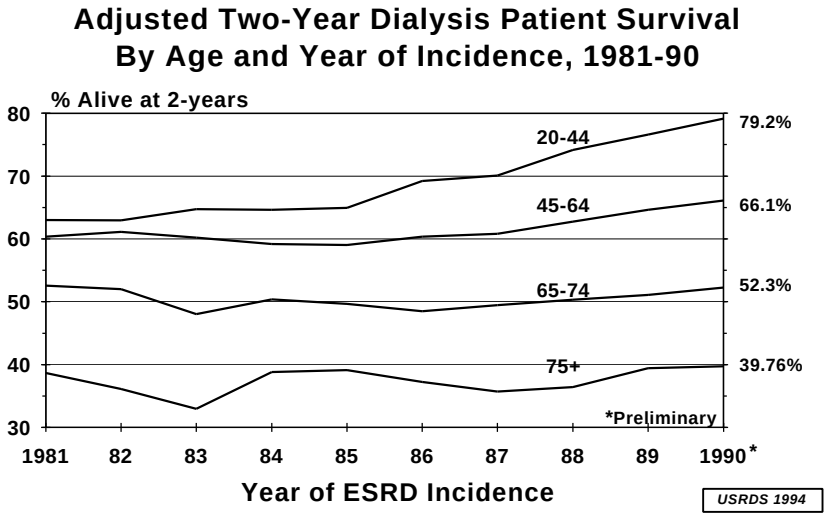

Figure VI-4

Kaplan-Meier two-year dialysis patient survival by age at onset of ESRD and year of incidence. Starting at day 91 following the onset of ESRD and censored at first transplant. Adjusted for the race, sex and primary diagnosis characteristics of the 1991 incident cohort. Patients in Puerto Rico and U.S. Territories are included in estimates. Medicare patients only. Source: Reference Table E.63.

modalities, part of this difference is likely due to differences in the characteristics of transplanted and dialyzed patients. Detailed comparisons of mortality for hemodialysis and peritoneal dialysis patients have been the subject of USRDS special studies (Held) and are not summarized here.

More detailed results are reported for transplant patients in Chapter VIII. The remainder of this chapter will be limited to mortality results for dialysis patients, with follow-up stopped (censored) on the day of first transplant.

The adjusted one-year survival percentage for dialysis patients has increased from 71 percent for the 1983 cohort to 76 percent for the 1991 cohort. Figure VI-2 shows that there has also been a general improvement in two-year survival among dialysis patients since 1983.

Due to limited patient numbers in highly specific patient subgroups, the data cannot reliably tell us just how consistent the quantitative reduction in mortality has been across various subgroups of ESRD patients. Thus, we do not report the changes in mortality in complete detail. The results reported above show the average trend for all dialysis patients with Medicare coverage.

The remainder of this chapter reports the mortality changes for several broad subgroups of patients defined by age, race, sex, and diagnosis. Generally, there has been an improvement in first-year survival for nearly all patient groups. Both one and two year survival percentages are reported. Careful examination of the one and two-year survival probabilities presented below indicate that improvements in one-year survival are generally sustained at two years. This indicates that the

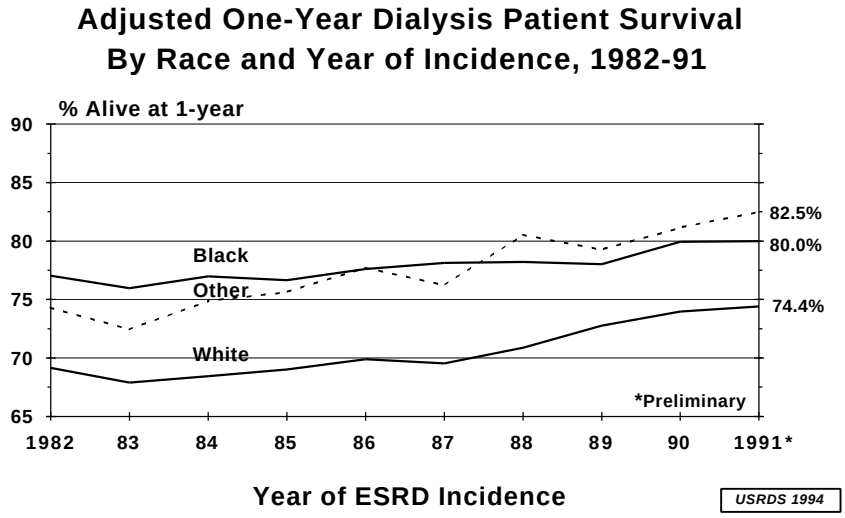

Figure VI-5

Kaplan-Meier one-year dialysis patient survival by race and year of incidence. Starting at day 91 following the onset of ESRD and censored at first transplant. Adjusted for the age, sex and primary diagnosis characteristics of the 1991 incident cohort. Patients in Puerto Rico and U.S. Territories are included in estimates. Medicare patients only. Source: Reference Table E.62.

improvements at one year do not represent mere postponement of early death to the next year, but might instead represent longer term improvements for some patients.

Age

Figure VI-3 shows the one-year surviving percentages by year of first ESRD therapy and age group adjusted for race, diagnosis, and sex. There is a clear improvement in survival for every adult age group over age 45 for the 1991 cohort relative to earlier cohorts. In the youngest non-pediatric age group (20-44) the one-year surviving percentage remained nearly constant compared to the 1990 cohort.

The most consistent and greatest improvement in survival for dialysis patients has been seen in the younger adult age ranges. The one-year surviving percentage has increased from 77.9 percent in 1983 to 88.5 percent in 1991 for the 20 to 44 year old age group while it has improved from 55.2 percent to 61.4 percent for the over 75 year old patients in the same time interval. The two year survival figure shows the same trends by age group (Figure VI-4).

Race

Figure VI-5 shows the one-year survival for dialysis patients by year of first ESRD therapy and race, adjusted for age, diagnosis, and sex. There has been a consistent improvement in survival probabilities for white ESRD dialysis patients since 1983, except in 1987. There has also generally been an improving trend for black patients since 1983, although the year-to-year trend has not been as consistent as it has been for white patients.

Adjusted Two-Year Dialysis Patient Survival By Race and Year of Incidence, 1981-90

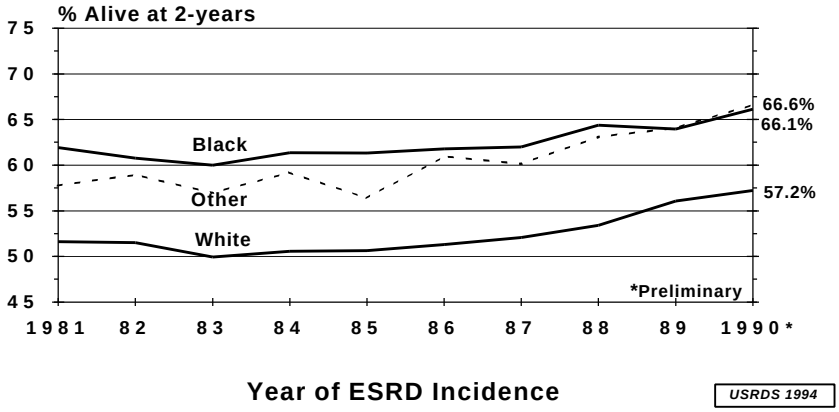

Figure VI-6

Kaplan-Meier two-year dialysis patient survival by race and year of incidence. Starting at day 91 following the onset of ESRD and censored at first transplant. Adjusted for the age, sex and primary diagnosis characteristics of the 1991 incident cohort. Patients in Puerto Rico and U.S. Territories included in estimates. Medicare patients only. Source: Reference Table E.63.

There has also been a substantial improvement in survival for patients of other races since 1983, although, again, the year-to-year trend has not been as consistent as it has been for white patients. In recent years, dialysis patients of other races had higher one-year survival probabilities than did black patients, while white patients consistently had the lowest one-year survival probabilities. These comparisons are adjusted for age,

Adjusted One-Year Dialysis Patient Survival By Diagnosis and Year of Incidence, 1982-91

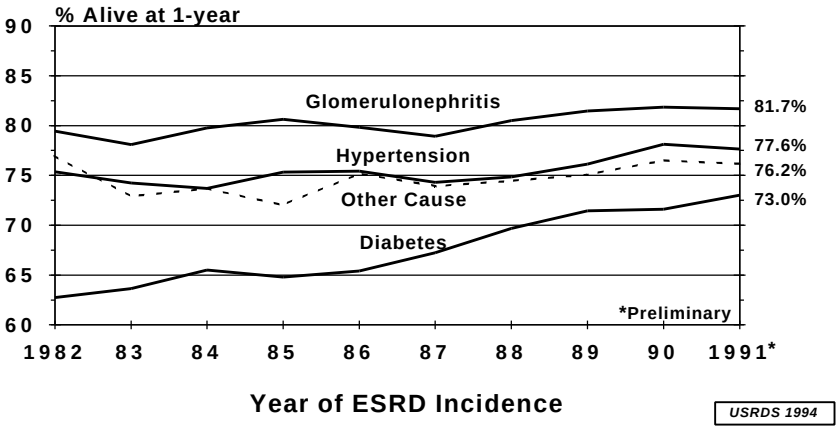

Figure VI-7

Kaplan-Meier one-year dialysis patient survival by primary diagnosis and year of incidence. Starting at day 91 following the onset of ESRD and censored at first transplant. Adjusted for the age, sex and race characteristics of the 1991 incident cohort. Patients in Puerto Rico and U.S. Territories are included in estimates. Medicare patients only. Source: Reference Table E.62.

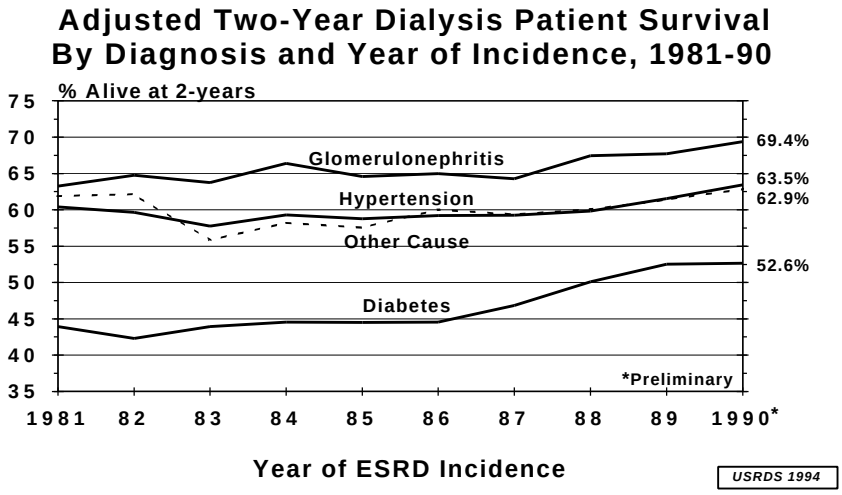

Figure VI-8

Kaplan-Meier two-year dialysis patient survival by primary diagnosis and year of incidence, 1981-1990. Starting at day 91 following the onset of ESRD and censored at first transplant. Adjusted for the age, sex and race characteristics of the 1991 incident cohort. Patients in Puerto Rico and U.S. Territories are included in estimates. Medicare patients only. Source: Reference Table E.63.

diagnosis, and sex, and are valid overall, but may not hold for every age-diagnosis-sex subgroup.

Figure VI-6 shows similar trends for two-year survival. For the 1990 cohort, the difference between black and white patient two-year survival remains at close to the same 10 percentage points that is was in 1983.

Cause of ESRD

Figure VI-7 shows the one-year survival for dialysis patients by year of

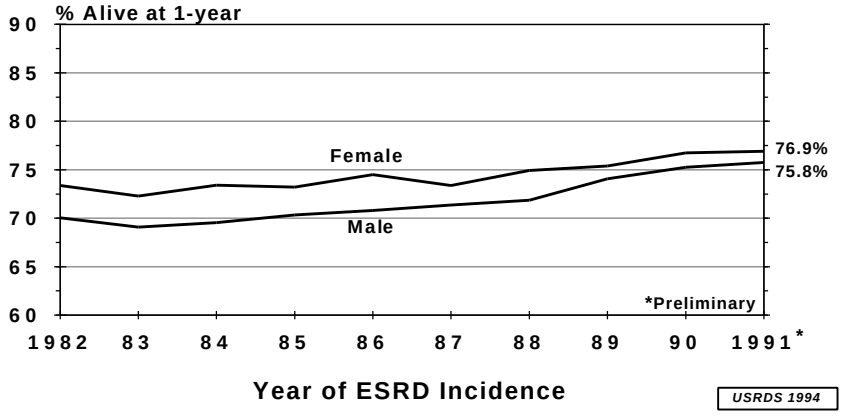

Figure VI-9

Kaplan-Meier one-year dialysis patient survival by sex and year of incidence. Starting at day 91 following the onset of ESRD and censored at first transplant. Adjusted for the age, race, and primary diagnosis characteristics of the 1991 incident cohort. Patients in Puerto Rico and U.S. Territories are included in estimates. Medicare patients only. Source: Reference Table E.62.

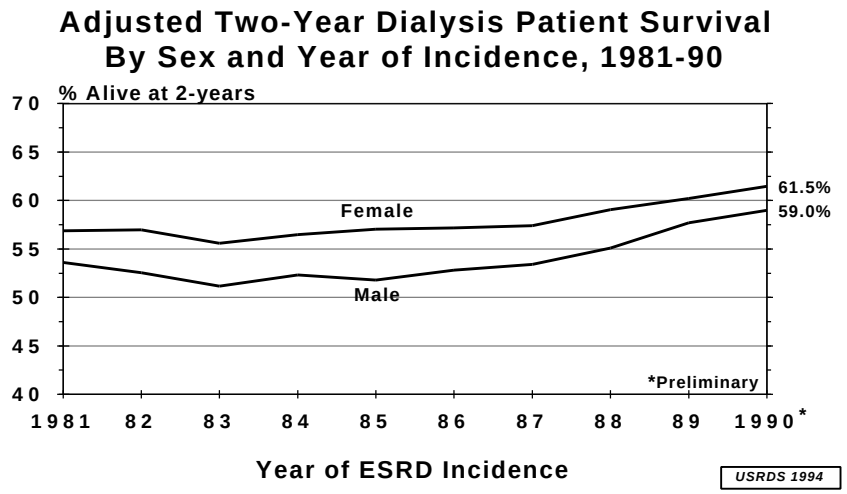

Figure VI-10

Kaplan-Meier two-year dialysis patient survival by sex and year of incidence. Starting at day 91 following the onset of ESRD and censored at first transplant. Adjusted for the age, race, and primary diagnosis characteristics of the 1991 incident cohort. Patients in Puerto Rico and U.S. Territories are included in estimates. Medicare patients only. Source: Reference Table E.63.

first ESRD therapy and major primary cause of ESRD: diabetes, hypertension, glomerulonephritis, and other causes, adjusted for age, race, and sex. There was an improvement in survival for each cohort between 1982 and 1991 for each of four major diagnostic categories.

In 1991, the one year survival probability remained nearly the same as for 1990 except for the diabetes group, which saw improved survival. The surviving fraction has increased most dramatically and consistently for diabetic patients, increasing from 62.7 percent in 1982 to 73.0 percent in 1991. Patients with glomerulonephritis tend to have the highest levels of one-year survival, 81.7 percent in 1991, while patients with diabetes have the lowest survival throughout the 1980s. Two year survival shows a similar pattern except the diabetic group did not change between the 1989 and 1990 cohort.

Sex

Figures VI-9 and VI-10 show the one-year and two-year average survival for dialysis patients by year of first ESRD therapy and sex, adjusted for age, race, and primary cause of ESRD. There has generally been an improvement in survival for each cohort since 1983 for both males and females; more consistently for male patients. Females have had better one-year adjusted survival than males for each cohort during the 1980s, typically by about three percentage points. Since the 1988 cohort, the one-year survival difference by gender appears to be diminishing.

Summary: Survival Trends

The dramatic improvements in survival seen for the 1989 and 1990 incident cohorts are consistent across several classifications of patients and appear to have been largely sustained in the 1991 cohort. These trends are adjusted for age, race, sex, and diagnosis

Adjusted Dialysis Patient Survival at One, Two and Five Years By Primary Diagnosis, 1987 Incident Cohort

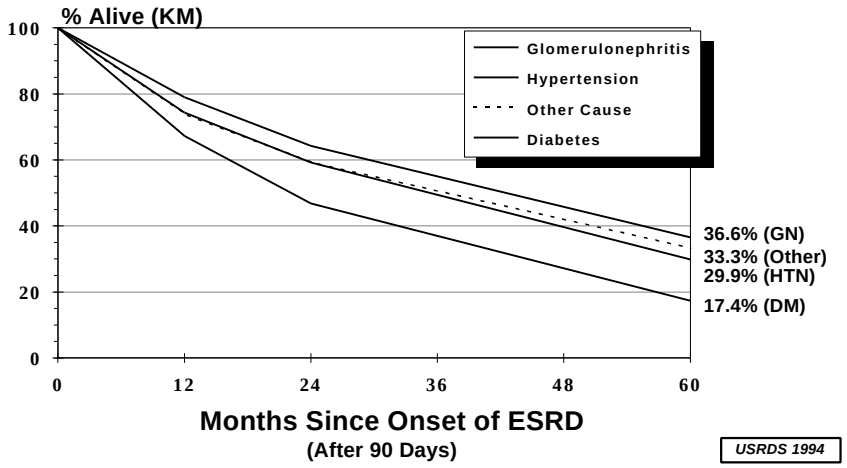

Figure VI-11

Kaplan-Meier dialysis patient survival estimates by primary cause of renal failure. Starting at day 91 following the onset of ESRD and censored at first transplant. Incident cohort is 1987. Adjusted for the age, race, and sex characteristics of the 1991 incident cohort. Patients in Puerto Rico and U.S. Territories are included in estimates. Medicare patients only. Five year survival estimates are considered preliminary. Source: Reference Tables E.62, E.63, and E.64

and thus are not due to changes in the patient mix of new ESRD patients with respect to these characteristics. It is possible that other patient characteristics, not measured in these USRDS data, have changed during this time because of changes in patient referral patterns and that these changes are responsible for the improved survival (McClellan, 1991; McClellan 1992; USRDS, 1992; Andersen; Collins; Held).

It is also possible that changes in dialysis therapy are responsible for improved survival (Hakim; Owens; Parker). Residual renal function may play an important role during the first one to two years of ESRD therapy, so that earlier initiation of chronic dialysis could partly explain the patterns seen here.

Survival Proportions for the 1987 Cohort

Adjusted survival proportions at one, two, and five years are graphed in Figures VI-11 through VI-14 for various subgroups of dialysis patients with first ESRD therapy in 1987. These figures show that the differences in mortality by age, race, sex, and diagnosis that appear at one year are generally sustained at later years, as well.

Methods: Death Rates

There are two major changes in the way that we calculated death rates in this year's ADR. First, both prevalent and incident patients are now included in the calculations. Second, patients with previously failed transplants are now included in the dialysis groups. These changes are described in more detail below.

Adjusted Dialysis Patient Survival at One, Two and Five Years By Race, 1987 Incident Cohort

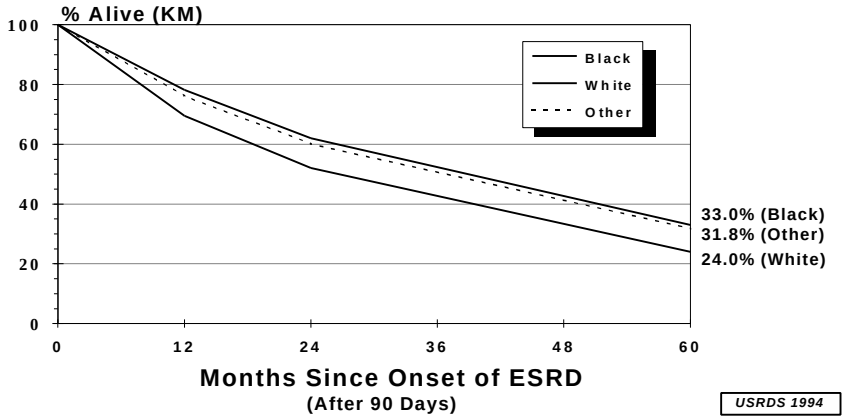

Figure VI-12

Kaplan-Meier dialysis patient survival estimates by patient race. Starting at day 91 following the onset of ESRD and censored at first transplant. Incident cohort is 1987. Adjusted for the age, race, and sex characteristics of the 1991 incident cohort. Patients in Puerto Rico and U.S. Territories are included in estimates. Medicare patients only. Five year survival estimates are considered preliminary. Source: Reference Tables E.62, E.63, and E.64

Previously, the mortality tables were based on the survival experience of patients who satisfied two conditions: they were being treated (were prevalent) at the start of each year and their treatment had started at least 90 days prior to the start of the year. The new criterion includes all of the patients who satisfy the rule above but also includes new patients who start treatment during the year (incident patients), starting on their 91st day of treatment. This change

Adjusted Dialysis Patient Survival at One, Two and Five Years By Age, 1987 Incident Cohort

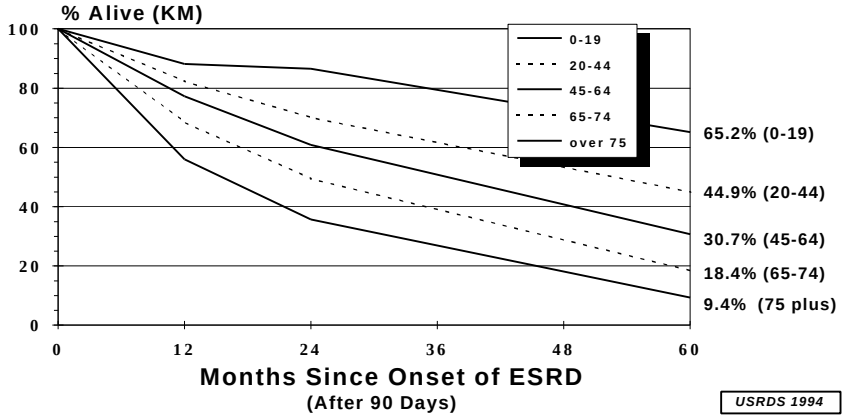

Figure VI-13

Kaplan-Meier dialysis patient survival estimates by patient age. Starting at day 91 following the onset of ESRD and censored at first transplant. Incident cohort is 1987. Adjusted for the age, race, and sex characteristics of the 1991 incident cohort. Patients in Puerto Rico and U.S. Territories are included in estimates. Medicare patients only. Five year survival estimates are considered preliminary. Source: Reference Tables E.62, E.63, and E.64

Adjusted Dialysis Patient Survival at One, Two and Five Years By Sex, 1987 Incident Cohort

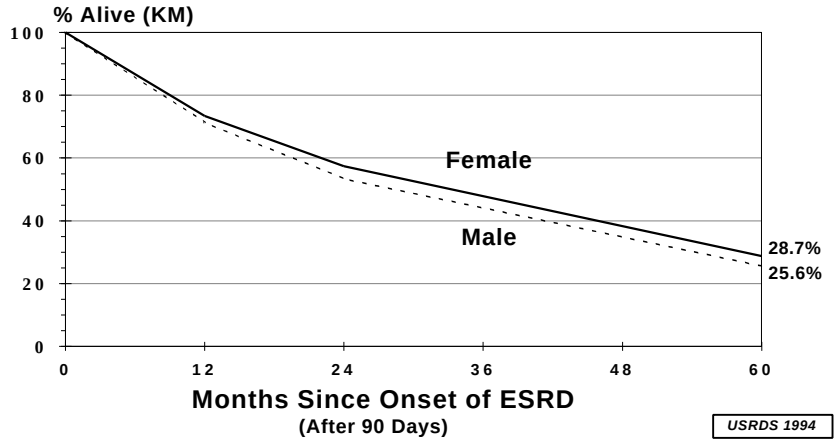

Figure VI-14

Kaplan-Meier dialysis patient survival estimates by patient sex. Starting at day 91 following the onset of ESRD and censored at first transplant. Incident cohort is 1987. Adjusted for age, race, and sex. Patients in Puerto Rico and U.S. Territories are included in estimates. Medicare patients only. Five year survival estimates are considered preliminary. Source: Table E.62, E.63, and E.64

makes the calculations more inclusive and more representative of the patient mix actually being treated in the United States.

The new tabulations for dialysis patient mortality are given for all dialysis, hemodialysis, and peritoneal dialysis patient groups. Previously, mortality rate tables were based upon the mortality experience of dialysis patients who had never received a transplant. The new tabulations include all prevalent dialysis patients, regardless of their prior transplant experience. The "all dialysis" tabulations are based only on the inclusion rules in the paragraph above, with the added stipulation that the patient be receiving dialysis therapy at the start of the year for prevalent patients, or on day 91 of therapy for incident patients. The hemodialysis and peritoneal dialysis tabulations are based on the further stipulation that the patient must have been on the specific dialytic modality for at least 60 days.

The objective of these two changes in the definition of the patients to be included in the mortality calculations is to be more inclusive of patient survival experience. The impact of including incident patients was generally to increase mortality rates, because mortality tends to be higher during the first several months of therapy than during subsequent months. The impact of including previously transplanted patients was generally to lower mortality rates because previously transplanted patients tend to have lower mortality rates than do never transplanted patients. The net results of the two changes is that the mortality rates have not changed greatly from previous tabulations.

We calculated death rates as the number of deaths in a patient group divided by the number of patient-years at risk for the group (Breslow). The patient group for a specific year includes both "incident" (defined in the Survival Trends section of this chapter) and

Adjusted Mortality Rates for All Prevalent Dialysis Patients, 1986-91

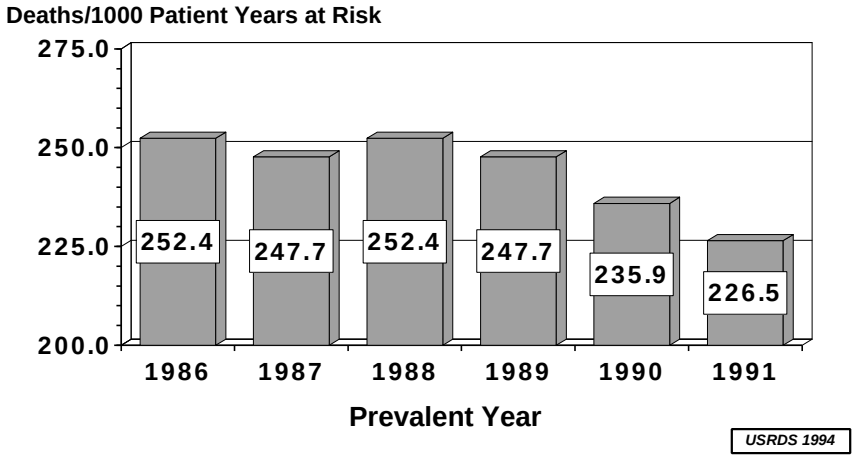

Figure VI-15

Mortality rate (deaths/1000 patient years at risk) for all prevalent dialysis patients whose first treatment was after 1-183. Patients prevalent at the beginning of each year, 1986-91. Rates are adjusted for age, race (black, white), sex, and diagnosis (diabetic, non-diabetic). Patients in Puerto Rico and U.S. Territories included in estimates. Medicare patients only. Source: special analyses.

"prevalent" patients. Patients who were receiving treatment (for at least 90 days) on January 1 of each year are called "prevalent" patients for that year.

The death rate calculated from follow-up of the group of patients that includes both those who were prevalent at the start of a year and those who were incident during the year is called a "period-specific" rate (Breslow). Annual period-specific death rates per 1000 patient years have been calculated for several patient subgroups based on annual period-prevalent patients between 1988 and 1991. Details of the methods for calculating these death rates are given in Chapter XV.

Results: Death Rates

Figure VI-15 shows adjusted death rates per 1,000 patient years by year (1986-91) for prevalent dialysis patients with adjustment for age, race, sex, and diabetes. Only those patients who started therapy after January 1, 1983, are included in these calculations. This is because of the exceptional results seen in Figure VI-4 for age 65 and older incident patients from earlier years. The rates shown were calculated by multiplying the SMR (Wolfe) for each prevalent cohort by the overall crude mortality rate for dialysis patients of 235.9 deaths per 1000 patient years (Table D.2). The adjusted death rates for prevalent patients fell by 8.6 percent from 247.7 in 1989 to 226.5 in 1991, which is the same direction as the improvement in one-year survival for incident cohorts in these two years.

Detailed tabulations of annual death rates are reported in the Reference Tables by a cross-classification of age, race, and diagnosis. These death rates are based on all period-prevalent ESRD patients treated during 1989 through

Expected Remaining Lifetimes for All ESRD Patients (1991) and U.S. Population (1991) by Age, Race, Sex, and Diagnosis

	U.S. Population, 1991[1]				ESRD, 1991			
Age	**White F**	**White M**	**Other F**	**Other M**	**White F**	**White M**	**Black F**	**Black M**
0-14	-	-	-	-	15.9	16.8	10.9	16.4
15-19	-	-	-	-	14.0	14.3	13.0	12.0
20-24	60.3	54.0	56.8	49.0	11.3	11.2	11.4	10.3
25-29	55.4	49.3	52.0	44.6	9.7	9.3	10.1	8.6
30-34	50.6	44.7	47.3	40.3	8.2	7.8	9.8	7.8
35-39	45.8	40.1	42.6	36.0	7.6	6.9	8.8	7.5
40-44	41.0	35.6	38.1	31.9	6.9	6.0	8.1	6.8
45-49	36.2	31.1	33.6	27.8	6.2	5.3	7.2	6.0
50-54	31.6	26.7	29.2	23.9	5.8	4.5	6.2	5.2
55-59	27.2	22.5	25.1	20.3	4.9	3.8	5.4	4.3
60-64	23.0	18.7	21.3	17.0	4.2	3.3	4.6	3.6
65-69	19.1	15.2	17.8	14.0	3.5	2.9	3.8	3.0
70-74	15.4	12.1	14.5	11.4	3.1	2.4	3.4	2.5
75-79	12.0	9.4	11.5	9.1	2.6	2.1	2.7	2.2
80-84	9.0	7.1	8.8	7.0	2.2	1.8	2.3	1.9
85+	6.4	5.2	6.4	5.3	2.0	1.5	1.9	1.9

[1]Source: The Universal Almanac 1994

Table VI-1

1991. They can be used to calculate expected mortality for many study groups of ESRD patients using the methodology described by Wolfe, 1992.

Given recent improvements in survival, the tables will likely need to be updated in the future. However, the methodology based on the tables will not become outdated with continued updating of these tables. In addition, the USRDS is exploring methods that will allow adjustment of mortality rates for a variety of important patient characteristics and comorbidities, in addition to the age, race, sex, and diagnosis characteristics that are accounted for in the current tables.

Methods: Remaining Years of Life

Average remaining years of life have been calculated by age, race, and sex groups using actuarial methods (Gross). Actuarial calculations show the average survival experience that would result over the lifetime of a hypothetical population if it were subject to current age-specific death rates. Current death rates were applied to a hypothetical population for each age-race-sex group in order to estimate the average remaining years of life that would result if the population were subject to those death rates.

Results: Remaining Years of Life

Despite the improvements in survival in recent years, overall mortality in the ESRD population is high relative to the general population, although not much higher than with several other severe diseases (Figure III-8). Shown in Table VI-1 are projections of the expected remaining years of life for prevalent

ESRD patients by current age, based on death rates observed between 1989 and 1991 for dialyzed ESRD patients. The values in Table VI-1 represent averages, and the lifetimes of individual patients will often be substantially longer or shorter than these values.

The average young dialyzed ESRD patient can look forward to over one decade of life if treated for ESRD. Through age 50, the average remaining life is greater than five years for both black and white ESRD patients. Although the remaining lifetimes are shorter for the elderly ESRD population, the general population also faces higher mortality with aging. The projected expected remaining years of life for prevalent dialyzed patients with ESRD is approximately one-fourth to one-sixth that for the general population through age 50, while the ratio is often closer to one-third for older patients.

These projections are based on an actuarial calculation and assume that death rates observed for each age range of patients prevalent in a given calendar period (which was 1989-1991 in the calculation for ESRD patients) will hold in the future when younger patients reach that same age range. In fact, we do not know the death rates that current ESRD patients will face in the future, so the values shown in Table VI-1 should only be used to make approximate projections and comparisons.

References

Anderson JE Kraus J Sturgeon D. Incidence, prevalence, and outcomes of end-stage renal disease patients placed in nursing homes. Am J Kid Dis 1993; 21: 619-627.

Breslow NE, Day NE. *Statistical methods in cancer research (Volume II)*, IARC, Lyon, 1987.

Collins AJ Hanson G Umen A Kjellstrand C Keshaviah P. Changing risk factor demographics in end-stage renal disease patients entering hemodialysis and the impact on long-term mortality. Am J Kid Dis 1990; 15: 422-432.

Gross AJ, Clark VA (1975) Survival Distributions: Reliability Applications in the Biomedical Sciences. Wiley, Page 47.

Hakim RM, Breyer J, Ismail N, Schulman, G. Effects of Dose of Dialysis on Morbidity and Mortality. Am J Kid Dis 1994, 23 :661-669.

Held PJ, Port FK, Turenne MN, Gaylin DS, Hamburger RJ, Wolfe RA. Continuous ambulatory peritoneal dialysis and hemodialysis: a comparison of patient mortality with adjustment for comorbid conditions. Kidney Int, in press, 1994.

Kaplan EL, Meier P. Nonparametric estimation from incomplete observations. J. Am. Stat. Assoc. 1972; 53:457-481.

McClellan WM Anson C Birkeli K Tuttle E Functional status and quality of life: predictors of early mortality among patients entering treatment for end stage renal disease. J Clin Epidemiol 1991; 44:83-9

McClellan WM, Flanders WD, Gutman RA. Variable mortality rates among dialysis treatment centers. Annals of Internal Medicine 1992; 117:332-6

Owens WF, Lew NL, Yan Liu SM, Lowrie EG, Lazarus JM. The urea reduction ratio and serum albumin concentration as predictors of mortality in patients undergoing hemodialysis. N Engl J Med 1993; 329: 1101-1106.

Parker TF, Husni L, Huang W, Lew N, Lowrie EG. Survival of Hemodialysis Patients in the United States is Improved With a Greater Quantity of Dialysis. Am J Kid Dis 1994, 23 :670-680.

United States Renal Data System: Comorbid conditions and correlations with mortality risk among 3,399 incident hemodialysis

patients. Am J Kidney Dis 1992; 20 (Suppl 2):32-8

United States Renal Data System, USRDS 1993 Annual Data Report, The National Institutes of Health, National Institute of Diabetes and Digestive and Kidney Diseases, Bethesda, MD, August 1991.

Wolfe RA, Gaylin DS, Port FK, Held PJ, Wood CL. Using USRDS generated mortality tables to compare local ESRD mortality rates to national rates. Kidney Int 1992; 42:991-996.