Chapter V

Patient Mortality and Survival

Key Words:
ESRD mortality
ESRD survival
Dialysis outcomes
Expected remaining lifetimes
Standardized mortality ratios
Dialysis-unrelated deaths
Long-term survival
U.S. death rates

This chapter focuses on patient survival among treated ESRD patients. Transplanted patients are included in some of the results, but the primary focus is on dialyzed patients. The analyses are based primarily on mortality data for 1985-1996, with some data from as early as 1981.

Until 1994, the USRDS data were largely limited to Medicare insured patients, while after 1994, both incident Medicare and non-Medicare patients are included in the database. This change might cause results based on pre-1994 data to differ from results based on post-1994 data. Patients from Puerto Rico and the U.S. Territories are included in results that are based on the HCFA Annual Facility Survey, but are not included in results based on the USRDS database.

An incident cohort consists of patients who started ESRD therapy in a particular year. For the incident patient results, patients are categorized by the calendar year of first treatment for ESRD in all analyses. In selected analyses they are also categorized by the number of years of treatment. Observed differences in mortality among incident cohorts could be due to factors such as changes in enrollment criteria for ESRD treatment or changes in treatment patterns over time.

A prevalent cohort includes all patients being treated in a particular year, both new and continuing patients, without distinguishing among the patients by the number of years of prior treatment. Sudden changes in mortality among prevalent cohorts would primarily reflect factors such as innovations in treatment that tend to affect all patients being treated in a given year. More gradual changes in mortality could reflect changes in enrollment criteria or slowly-changing treatment patterns.

This chapter has seven major sections:

1. *Adjusted first-year death rates among incident patients* for the years 1985-1995. Trends in mortality during the first year of ESRD therapy are shown for several patient subgroups. Adjusted mortality rates during the first year of ESRD therapy have decreased for nearly all successive cohorts of incident patients between 1985 and 1995.

2. *Long-term survival from first ESRD treatment*. The 5-year survival rates are 88.5 percent and 47.0 percent among 15-19-year-olds and 50-54-year-olds, respectively, in the 1991 incident cohort of ESRD patients, and the 10-year survival rates are 78.9 and 22.5 percent for the same two age groups, respectively, for the 1986 ESRD incident cohort. One-, 2-, and 5-year survival rates are also compared for the various incident cohorts of dialysis patients. Long term survival (through 5 years) is better for the 1991 cohort than for the 1986 cohort, although most of the gains are seen in the early years of therapy.

3. *Adjusted death rates for prevalent patients* over the years 1989-1996. Mortality among prevalent patients decreased between 1989 and 1994, and has remained nearly constant since 1994.

4. *Mortality by year since diagnosis in incident cohorts 1989-1996*. Standardized mortality ratios (SMRs) are used to compare mortality in annual incident cohorts over successive years of observation.

5. *Standardized mortality ratios by state*. SMRs were calculated by state for dialysis patients prevalent between 1994 and 1996.

6. *Projected remaining years of life* for the United States population, ESRD patients, and dialysis patients by patient age (regardless of duration of ESRD), race, and sex. The expected remaining years of life for the entire U.S. population are between 2.0 and 5.3 times those for corresponding ESRD patient groups, while the ratios are between 2.5 and 5.9 for U.S. population compared to dialysis patient groups.

7. Methods for calculating *national death rates*. Several major changes in the analysis methods for calculating the death rates for prevalent patients in Reference Tables D.2 and D.3 were introduced in last year's report, and apply to this year's analysis as well. In summary, deaths not plausibly related to dialysis were excluded, and a regression model was used to stabilize the year-to-year variation in the rates. In this chapter, these changes impact only Table V-4 and Figures V-8 and V-9.

Adjusted First-year Death Rates Among Incident Patients

Methods

The death rates for patients during their first year of therapy are reported in this section. 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, and calculated death rates in 1-year increments from day 90. The analytical methods are briefly described below; further details are given in the Analytical Methods chapter.

The probability of surviving 1 year was estimated using the Kaplan-Meier (KM) method (Kaplan) for each patient subgroup defined by age, race, sex, and cause of ESRD categories for each incident cohort of patients from 1985 to 1995. Weighted averages of the subgroup 1-year survival probabilities were then calculated, yielding directly adjusted (Breslow) KM survival probabilities. The weights correspond to the proportion of ESRD patients in each subgroup in the designated reference population, which is the 1994 incident cohort, as described in Chapter XIII.

From these estimated adjusted survival proportions, we then calculated the average first-year death rate using a standard actuarial relationship given in equation 5.1 below.

(5.1) death rate = - ln(fraction alive at year 1)

The death rate per 100 patients is calculated as the death rate times 100.

The adjustment process yields estimates of the death rates that would have arisen for the cohorts, had they all had the same age, race, sex, and cause of ESRD composition as the reference population (all patients incident in 1994). Since the adjusted survival curves are all adjusted to the same reference population, any remaining differences between them is due to factors other than age, race, sex, and cause of ESRD.

As shown above, there has been a trend during the past decade that incident patients are becoming older and more likely to be diabetic (Young; Reference Tables, Section A). The adjusted rates reported here account for these changes, and show what would be expected had the patient mix by age, race, sex, and diabetes been unchanged over the years. However, changes in other patient characteristics during the past decade may not be accounted for by these adjustments, and may explain the trends seen here. For example, the USRDS data cannot be adjusted for specific disease comorbidity in the overall ESRD population because these measures are not recorded for all patients. However, the adjustment for age and diabetes accounts for the average levels of comorbidity associated with aging and diabetes.

Although the death rates reported in this chapter are comparable across the years specifically reported in this Annual Data Report (ADR), they are not comparable to results from other USRDS ADRs because the definition of the reference population differs for each ADR. **The reference population for this chapter is the 1994 incident cohort.** Differences in the reference population in different years may arise because of changes in the population composition or changes in the methods used to identify the ESRD population, as detailed in Chapter I. In addition, these results will differ from unadjusted death rates presented elsewhere in this ADR. Readers who are interested in the unadjusted

Changing Profile of Incident ESRD Patients by Year of Incidence

Year of Incidence	Average Age	Percent Diabetic	Unadjusted Death Rate*	Adjusted** Death Rate*
1988	57.5	31.2	26	30
1989	58.3	32.8	26	28
1990	58.7	34.4	25	27
1991	59.2	36.1	26	27
1992	59.6	36.6	25	26
1993	60.0	36.4	25	25
1994	59.8	38.2	24	25
1995	59.6	40.6	23	24

* deaths per 100 patient years at risk in the first year of ESRD therapy
** adjusted for age, race, sex, and diabetes as the primary cause of ESRD
Source: Reference Tables A.1, A.14, E.14, and E.22 USRDS 1998

Table V-1

outcomes for a particular year, rather than in comparisons across years, should refer to the tables of unadjusted survival probabilities in Section E of the Reference Tables.

The small number of patients seen by individual physicians or facilities makes it difficult for health care providers to observe trends because of statistical variation. The combined data from the USRDS allow general patterns to be seen despite variations in the outcomes for individual patients or facilities. The trends shown here represent the aggregate national experience for the U.S. ESRD population as reported to the USRDS. Improvements in technology and practice patterns are initiated at different times from facility to facility, so changes at the facility level may not correspond to the national trends shown here.

The death rates during the first year for each incident cohort are presented. Death rates during the second year for those surviving the first year were very similar (1995 ADR) and are not presented here.

Results

Table V-1 shows the importance of accounting for the mix of patient characteristics when evaluating mortality results. For successive cohorts of incident patients between 1988 and 1995, Table V-1 gives the average age in column 2 and the percent of patients with diabetes as the cause of ESRD in columns 3. The average age and percent diabetic have increased in almost every year. If there were no other changes, we would expect crude death rates to increase for these successive cohorts, due to the 2.1 year increase in average age and the increase in percent diabetic patients from 31.2 to 40.6. However, column 4 shows that the crude death rates during the first year of therapy for these incident cohorts did not increase, but instead declined by 12 percent during this same time period. This raises the question: By how much would the crude death rates have decreased if the average age and percent diabetic had not increased? This question is addressed by the adjusted mortality rates, which are shown in the last column. The adjusted mortality rates are adjusted for race and sex, as well as for age and diabetes. The adjusted rates can be interpreted as the death rates that would have arisen if the patients in each successive year had the same age-race-sex-diabetes characteristics as did the 1994 incident cohort. The 20 percent reduction in the **adjusted** rates during this time period is larger than the 12 percent reduction in the **unadjusted** death rates and can be interpreted as the reduction that would have occurred if the patient characteristics had not changed over the years.

The adjusted death rates during the first year of ESRD are shown in Figure V-1 for both dialysis and all ESRD patients. In addition, Figure V-1 presents adjusted death rates for the first year following transplantation for those receiving either cadaveric or living related transplants. The mortality data for dialysis patients are censored at transplantation for

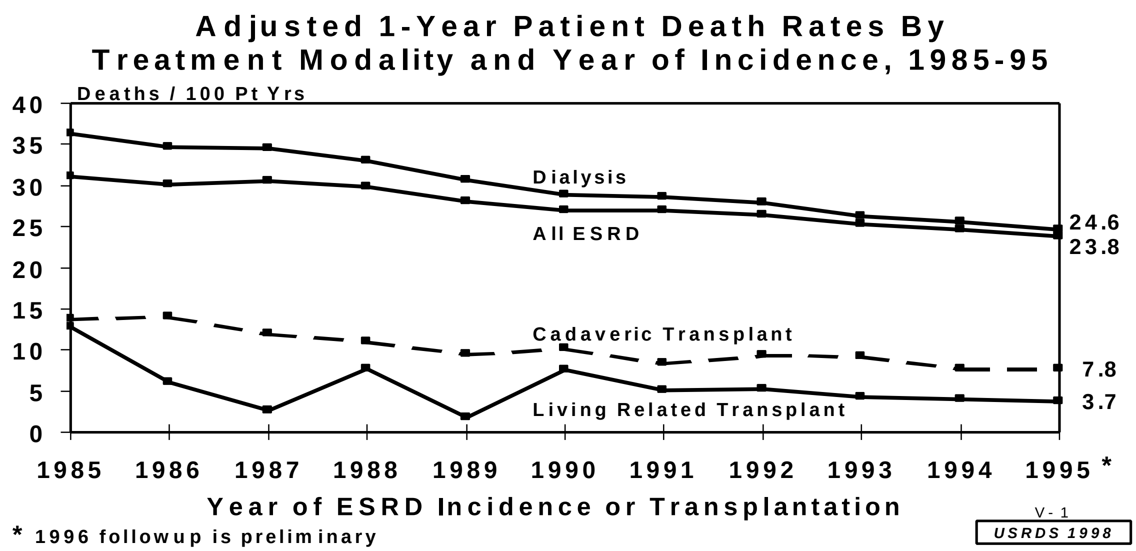

Figure V-1

Death rates based on adjusted Kaplan-Meier estimates, by modality and year of ESRD incidence or of transplantation. Calculation of death rates starts at day 91 following onset of ESRD for dialysis patients and continues through 1 year plus 90 days (censored at first transplant), and at day of transplant for transplanted patients. For each category (dialysis, All ESRD, Cad Tx, LR Tx), death rates are adjusted by age, race, sex, and primary cause of ESRD (diabetes, hypertension, glomerulonephritis, other) to the distribution of the corresponding category of the 1994 incident cohort. Source: Reference Tables E.22, E.54, E.70, and E.86 (with equation 5.1)

those patients transplanted within 1 year of ESRD enrollment.

Adjusted death rates for all ESRD patients in the first year of therapy were 3.6 percent lower in the 1995 cohort than they were in the 1994 incident cohort. This general trend of declining death rates during the first year following ESRD diagnosis has been seen for most incident cohorts since 1985 (except for the 1987 cohort). The adjusted first-year death rates for all dialysis patients have decreased from 36.3 per 100 patient years at risk for the 1985 cohort to 24.6 per 100 patient years at risk for the 1995 cohort.

Figure V-1 shows that the cohort of patients receiving cadaveric transplants during 1995 experienced similar 1-year death rates compared to the 1994 cohort. Survival for patients who received living related transplants has been improving since 1990, and continued to improve between 1994 and 1995 (death rates of 3.9 and 3.7, respectively).

The adjusted first-year mortality shown in Figure V-1 for cadaveric or living related transplant recipients, measured from the day of transplant, is lower than for patients starting treatment on dialysis. Part of the large reduction in mortality seen among transplanted patients, relative to all dialysis patients, can be explained by the fact that transplant patients are drawn from dialysis patients on a transplantion wait list, who have substantially lower mortality than do dialysis patients who are not wait-listed. Because of these differences, survival of transplanted patients is more appropriately compared to the survival of wait-listed dialysis patients rather than all dialysis patients. In addition, part of the reduction in mortality seen among transplanted patients is likely to be related to the benefit of transplantation itself. The remainder of this section will be limited to mortality results for dialysis patients, with followup for mortality stopped (censored) on the day of first transplantation. More detailed results are reported for transplant patients in Chapter VII**.**

Age: Figure V-2 shows the first-year death rates for dialysis patients by age group and year of first ESRD therapy. These death rates for all but the youngest age group (0-19 years) are adjusted for race, sex, and cause of ESRD. The death rates for the 0-19-year age group are adjusted only for the age characteristics of the 1994 incident cohort (in 5-year subgroups) due to small sample sizes. There is some improvement in survival for the 1995 cohort relative to earlier cohorts for all age groups.

Death rates for pediatric patients (0-19 years) have decreased from 20.1 per 100 patient years at risk in 1985 to 3.6 per 100 patient years at risk in 1995. More detailed results for pediatric patients are reported in Chapter VIII.

The most consistent and greatest improvement in survival for dialysis patients has been seen in the younger adult age ranges (20-44 years). First-year death rates for this age group decreased from 27.8 per 100 patient years at risk in 1985 to 10.2 per 100 patient years at risk in 1995. In the 45-64-year age group, the first-year death rate decreased from 29.4 to 17.2 per 100 patient years at risk; and in the 65-74-year age group, the death rate decreased from 40.4 to 30.3 per 100 patient years at risk in the same time interval, 1985-1995.

Race: Figure V-3 shows first-year death rates for dialysis patients by year of first ESRD therapy and race, adjusted for age, cause of ESRD, and sex. There has been a consistent improvement in first-year mortality rates for White ESRD dialysis patients since 1985, except in 1987. There has also been an improving trend for Black patients since 1985, although the magnitude of the year-to-year improvement has not been as great as it has been for White patients.

There has also been a substantial improvement in survival for patients of other races since 1985, although the year-to-year trend has not been as consistent as it has been for White or Black patients, in part because of random fluctuations due to small counts of patients. In recent years, dialysis patients of other races had lower first-year death rates than did Black patients, while White patients consistently had the highest first-year mortality rates. The difference between Black and White patient 1-year death rates has decreased from 12.3 to 4.6 per 100 patient years at risk between the 1985 and 1995 incident cohorts. These comparisons are adjusted for age, sex, and cause of ESRD, and are valid on average, but may not be true for each individual age-sex-cause subgroup.

Cause of ESRD: Figure V-4 shows the 1-year death rates for dialysis patients by primary cause of ESRD and year of first ESRD therapy, adjusted for age, race, and sex. The primary causes of ESRD presented here are diabetes, hypertension, glomerulonephritis, and "other". Mortality during the

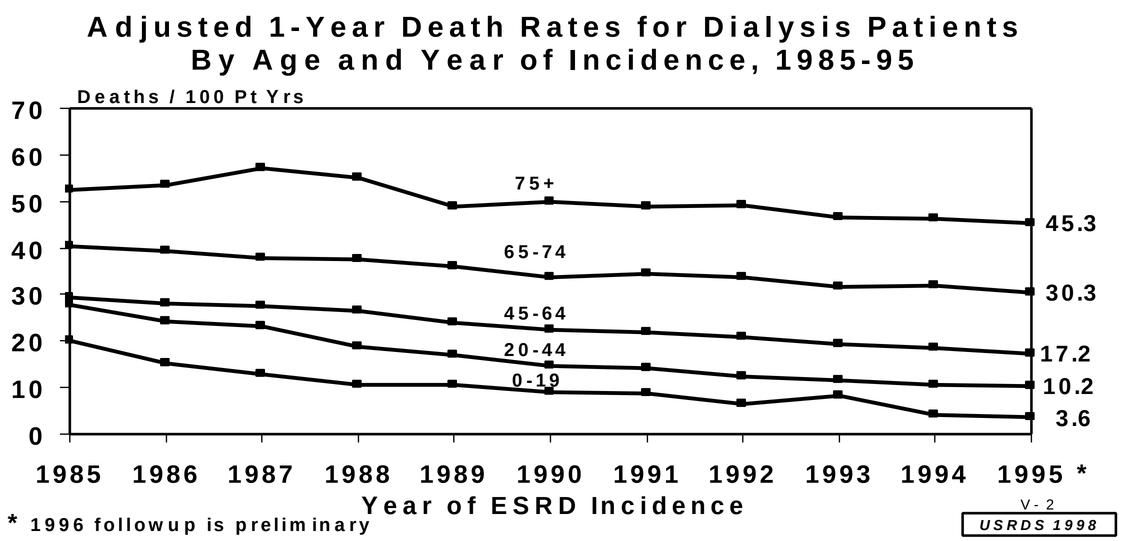

Figure V-2

Death rates for dialysis patients based on adjusted Kaplan-Meier estimates, by age at onset of ESRD and year of incidence. Calculation of death rates starts at day 91 following onset of ESRD and continues through 1 year plus 90 days (censored at first transplant). For those 20 years and older, death rates are adjusted by race, sex, and primary cause of ESRD (8 categories; see reference table) to the distribution of the corresponding category of the 1994 incident cohort. Death rates for the 0-19 age group are adjusted only for age to the distribution of the 1994 incident cohort. Source: Reference Tables E.46, E.54, and A.1 (with equation 5.1)

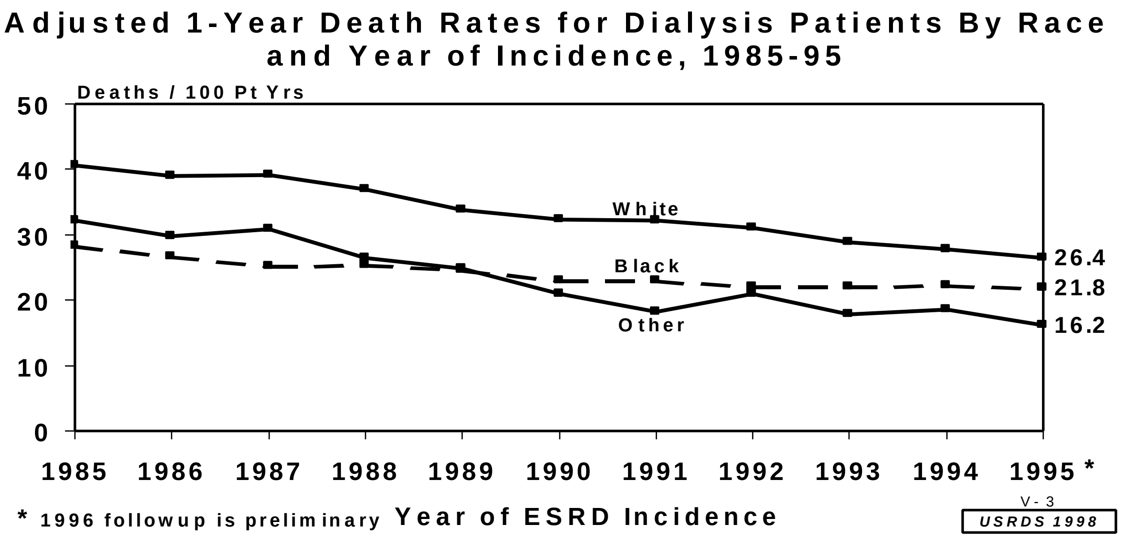

Figure V-3

Death rates for dialysis patients based on adjusted Kaplan-Meier estimates by race and year of incidence. Calculation of death rates starts at day 91 following the onset of ESRD and continues through 1 year plus 90 days (censored at first transplant). Death rates are adjusted by age, sex, and primary cause of ESRD (diabetes, hypertension, glomerulonephritis, other) to the distribution of the corresponding category of the 1994 incident cohort. Source: Reference Table E.54 (with equation 5.1)

first year was lower in 1995 than in 1994 for all four categories of patients.

There has been an overall improvement in survival for each incident cohort from 1985 to 1995 for each of the four major causes of ESRD. First-year

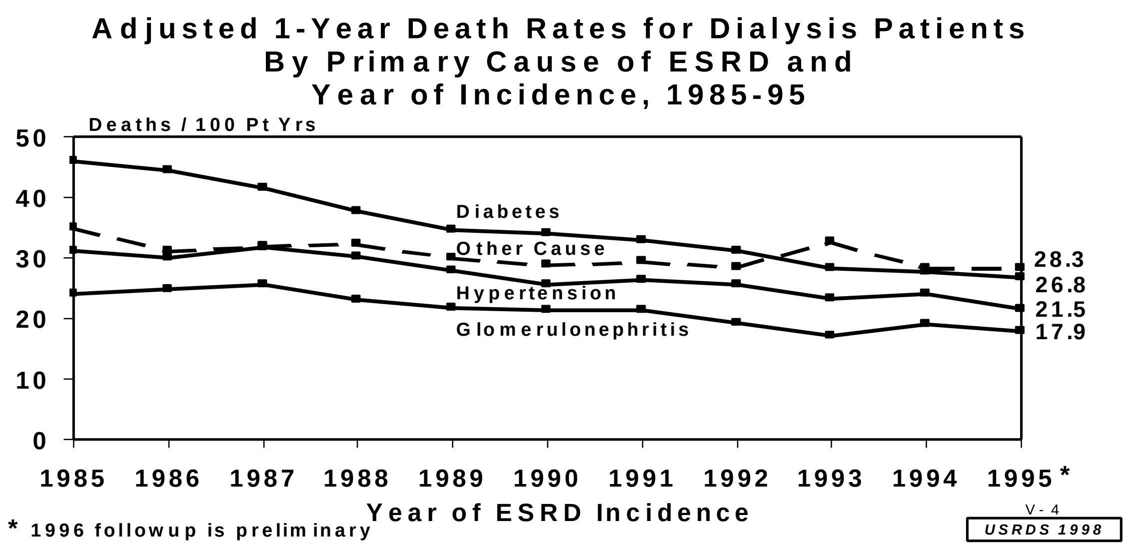

Figure V-4

Death rates for dialysis patients based on adjusted Kaplan-Meier estimates by primary cause of ESRD and year of incidence. Calculation of death rates starts at day 91 following the onset of ESRD and continues through 1 year plus 90 days (censored at first transplant). Death rates are adjusted by age, race, and sex to the distribution of the corresponding category of the 1994 incident cohort. Source: Reference Table E.54 (with equation 5.1)

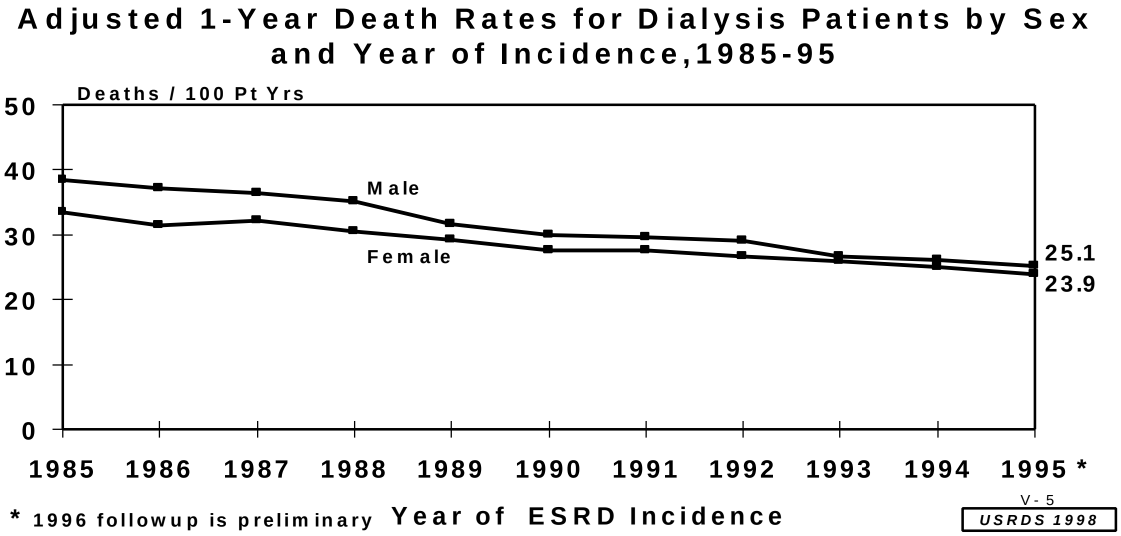

Figure V-5

Death rates for dialysis patients based on adjusted Kaplan-Meier estimates by sex and year of incidence. Calculation of death rates starts at day 91 following the onset of ESRD and continues through 1 year plus 90 days (censored at first transplant). Death rates are adjusted by age, race, and primary cause of ESRD to the distribution of the corresponding category of the 1994 cohort. Source: Reference Table E.54. (with equation 5.1)

mortality decreased most dramatically and consistently for diabetic patients, from 46.0 per 100 patient years in 1985 to 26.8 per 100 patient years in 1995. Patients with glomerulonephritis have had the lowest first-year death rates during the entire 10-year time period. Through 1992, patients with diabetes had the highest first-year death rates. In 1993 through 1995, patients with other causes of ESRD had the highest first-year death rate. Some changes in the categorization of causes of ESRD starting in 1995, as described in Chapter II of the 1997 ADR, could be responsible for some of these changes in relative mortality rates. For example, ESRD attributed to renal artery occlusion had been classified as Other, but is now included in the hypertension category. More details related to cause of ESRD are reported in Chapter VI.

Gender: Figure V-5 shows the 1-year death rates for dialysis patients by sex and year of first ESRD therapy, adjusted for age, race, and primary cause of ESRD.

There has generally been an improvement in survival for both males and females in each cohort since 1985. Until 1993, females had lower adjusted mortality at 1 year than males for each incident cohort. From 1985 through 1988 the difference was about 5 deaths per 100 patient years. This difference decreased to about 2 deaths per 100 patient years for the period 1989 through 1992. In the 1993, 1994, and 1995 cohorts the death rates have been similar for males and females (25.1 and 23.9 per 100 patient years, respectively, in the 1995 cohort).

Summary

There has been a progressive improvement in first-year survival for each successive year's incident cohort since 1985. This improvement has been consistent across several classifications of patients and appears to have been largely sustained in the 1995 cohort. These findings were adjusted for age, race, sex, and primary cause of ESRD and thus are not likely to be 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 period, and that these changes are responsible for the improved survival (McClellan, 1991; McClellan 1992; USRDS, 1992; Andersen; Collins; Held, 1994).

A possible explanation for the decline in mortality is that changes in dialysis therapy may be responsible for improved survival (Hakim; Owen; Parker; Held, 1996; USRDS, 1997). During this time period the renal provider community has given increasing attention to the dose of dialysis that is delivered to hemodialysis patients (USRDS, 1997, Chapter III). In addition, there have been changes in dialysis equipment, including a shift from cellulosic to synthetic hemodialysis membranes and improved connection devices for peritoneal dialysis. The use of rhEPO has also continued to increase during this time period (USRDS, 1997). As improvements in delivered care continue to spread through the community of renal providers, we may see continued improvements in survival across the nation.

Long Term Survival from First ESRD Treatment

Methods

Adjusted survival probabilities were calculated as weighted averages of subgroup Kaplan-Meier (KM) estimates, as described in the previous Methods section of this chapter. We report the probabilities of surviving at 1, 2, and 5 years after day 90 of ESRD for several incident cohorts of dialysis patients. These results are adjusted for age, race, sex, and cause of ESRD so that they can be compared across years.

In addition, for age groups 15-19 and 50-54 we calculated unadjusted KM estimates for patients starting ESRD therapy in 1986 and 1991 and followed through 1995. We report 5- and 10-year survival probabilities for these groups. These curves include data for all ESRD patients, both dialysis and transplant. Since these results are not adjusted, the curves for the two cohorts reflect the actual experience and differences between the two cohorts, and should not be compared as though they are similar with regard to age, race, sex, and diabetes.

Results

The percent of dialysis patients surviving 1, 2, and 5 years after ESRD diagnosis by year of first ESRD therapy and adjusted for age, race, sex, and cause of ESRD is shown in Figure V-6. Five-year survival is shown for the 1981 through 1991 incident cohorts, 2-year survival for the 1984 through 1994 incident cohorts, and 1-year survival for the 1985 through 1995 incident cohorts. There has been a consistent improvement in 1-, 2-, and 5-year survival since 1985. Five-year survival declined from 1981 to 1983, and has slowly improved since then. This decline may be due to a change in the way that the data were reported to HCFA starting in 1983. Thus the survival percentages before 1983 may not be directly comparable to those after 1983.

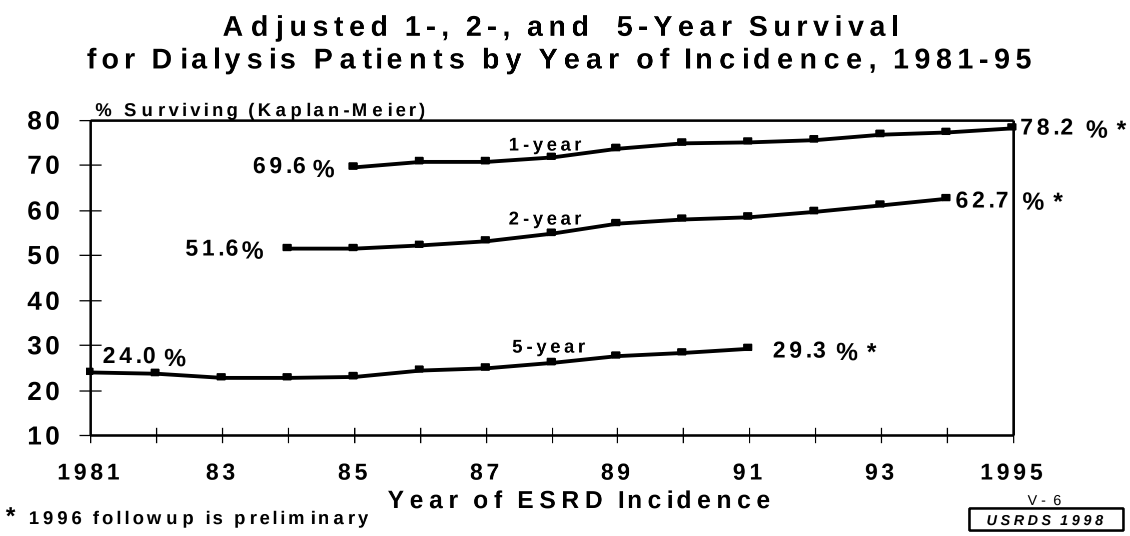

Figure V-6

Adjusted Kaplan-Meier 1-, 2-, and 5-year survival estimates for dialysis patients by year of incidence. Calculation of death rates starts at day 91 following the onset of ESRD. Death rates are adjusted by age, race, sex, and primary cause of ESRD (diabetes, hypertension, glomerulonephritis, other) to the distribution of the corresponding category of the 1994 incident cohort. Source: Reference Tables E.54, E.56, and E.58

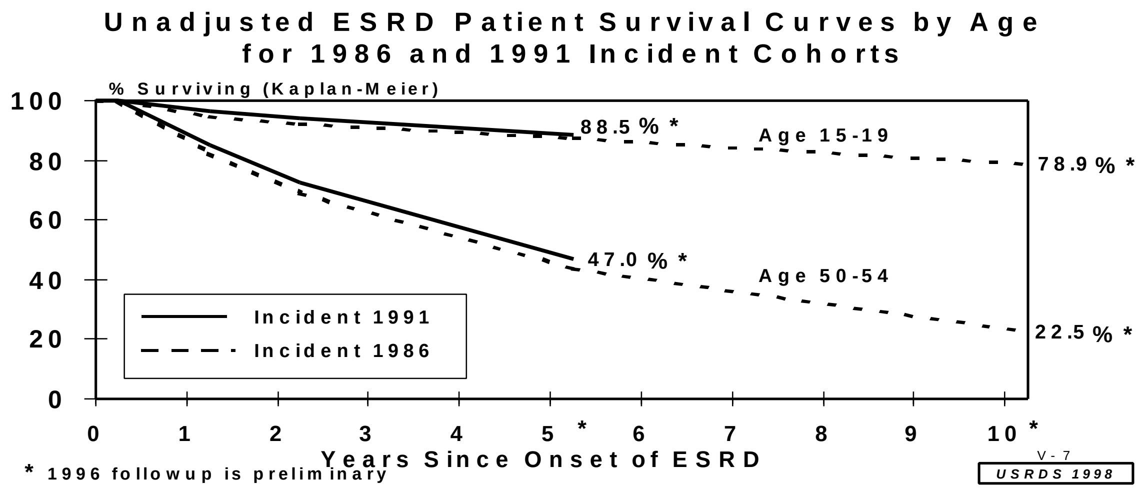

Figure V-7

Unadjusted Kaplan-Meier survival estimates for ESRD patients (1985 and 1990 cohorts) for two age groups. Calculation of death rates starts at day 91 following the onset of ESRD. Differences would be larger if the survival estimates were adjusted. Source: Reference Tables E.14, E.16, E.18, and E.20

Figure V-7 shows the 5- and 10-year survival curves for the 1986 and 1991 incident cohorts of all ESRD patients. Only the 15-19 and 50-54-year age strata are presented. The 1991 cohort has better survival than the 1986 cohort throughout the first 5 years of ESRD therapy. Most (78.9 percent) of the 15-19-year-old patients survived for more than 10 years and a large fraction (22.5 percent) of the 50-54-year-old patients survived for 10 years in the 1986 incident cohort. Based on the higher 5-year survival

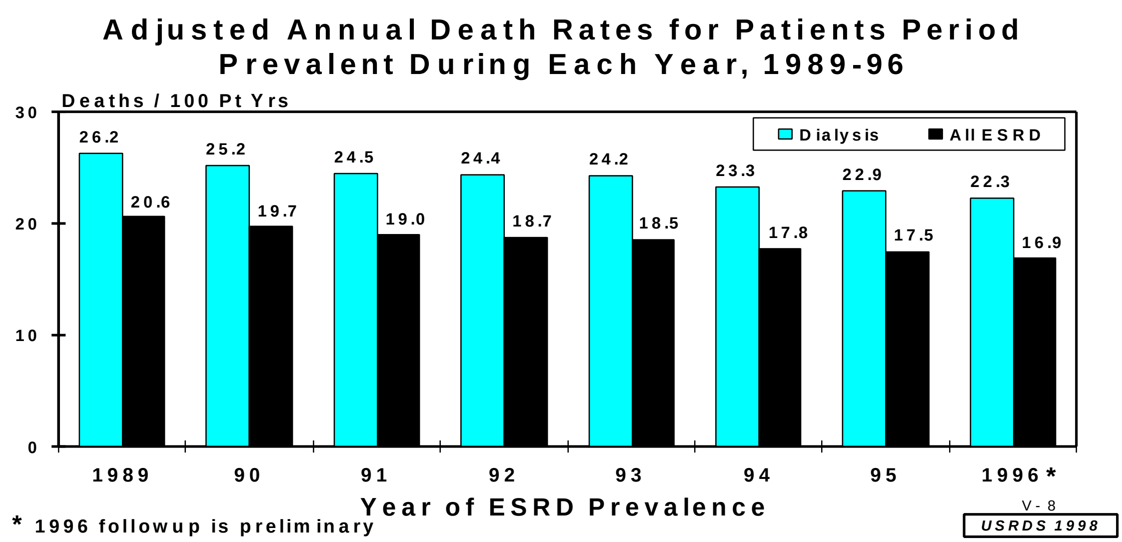

Figure V-8

Adjusted annual death rates (deaths/100 patient years at risk) for all dialysis patients and for all ESRD patients prevalent at any time during each year. The calculation for each year includes point prevalent patients at the beginning of that year as well as patients incident during the same year (1985-97). Death rates are adjusted by age, race (Black, White, Asian, Native American), sex, and primary cause of ESRD (diabetic, other) to the 1995 prevalent dialysis or ESRD population. Patients with missing or unknown race, or missing primary diagnosis are excluded. (Dialysis unrelated deaths are included.) Source: Special Analysis in the 1991 cohort we expect that more will also live to 10 years.

Adjusted Death Rates for Prevalent Patients

Methods

Adjusted death rates were calculated for prevalent patients treated during 1989-1996. A Poisson regression model was used to calculate the mortality rate for each year, relative to 1996, adjusted for age, race, sex, and diabetes as a cause of ESRD. This model is similar to the model described in the Chapter XIII, Analytical Methods. The adjusted mortality rates were calculated by multiplying the crude 1996 mortality rate by the relative rate for each year. Deaths from all causes were included in these calculations.

Crude death percents are also given for all dialysis patients treated between 1990 and 1996. Results are compared for the HCFA Annual Facility Survey (AFS) and the USRDS database.

Results

Figure V-8 shows that the adjusted death rates for all prevalent ESRD patients fell by 18 percent from 1989 to 1996. The lower death rates for all ESRD patients compared to dialysis patients is due to the effect of including healthier transplant patients in the "all ESRD" group. Since the trend to accept older and more diabetic patients for renal replacement therapy continued during this period, it seems unlikely that the level of unmeasured comorbidity fell. We are not aware of other changes in the criteria for starting renal replacement therapy (such as a pattern of starting therapy earlier in the progression of ESRD) that would lead to a reduction in death rates. However, there were many changes in treatment patterns during this time interval that might have led to improved mortality.

Table V-2 reports crude (unadjusted) death counts and crude death percents for successive cohorts of prevalent dialysis patients from 1990 to 1996 from two different data sources. These crude rates do not adjust for the increasing age and frequency of diabetes as a cause of ESRD in the successive cohorts of prevalent ESRD patients. Consequently, the crude death rates do not show clearly the reduction in death rates that has occurred among prevalent patients since 1989, as is shown in the adjusted rates of Figure V-8. The first set of columns gives results from the HCFA Annual Facility Survey (AFS), which includes both Medicare and non-Medicare patients, and is reported in facility-level summaries. The second set of

Crude Death Percent for All Dialysis Patients, 1990-96

Survey	HCFA Annual Facility Survey[2]			USRDS Patient Data Base[3]		
Year[1]	Patients	Deaths	% Dead	Patients	Deaths	% Dead
1990	124,394	28,741	23.1	119,201	24,997	21.0
1991	137,786	31,663	23.0	131,520	27,631	21.0
1992	151,998	35,985	23.7	144,916	31,060	21.4
1993	166,291	39,554	23.8	157,940	34,046	21.6
1994	180,884	42,115	23.3	172,016	36,311	21.1
1995	195,008	45,394	23.3	188,259	39,409	20.9
1996[4]	208,498	48,715	23.4	202,597	41,909	20.7

[1] Calendar year

[2] Facility reported deaths excluding transplant only facilities and those with missing data. (includes Medicare and non-Medicare dialysis patients)

[3] USRDS data excludes most non-Medicare patients whose therapy started before 1995. In addition, calculation of death rates starts at day 91 following onset of ESRD, so patients who die within the first 90 days are excluded.

[4] 1996 USRDS patients database data preliminary

Source: Special Analysis

USRDS 1998

Table V-2

SMRs for All Dialysis Patients by Year of First Treatment (incidence) and by Year of Treatment (prevalence)

Year of Incidence	1989 SMR	1990 SMR	1991 SMR	1992 SMR	1993 SMR	1994 SMR	1995 SMR	1996 SMR
	Year of Treatment							
<1989	1.19	1.16	1.18	1.17	1.21	1.17	1.22	1.18
1989	1.23	1.10	1.05	1.15	1.15	1.21	1.21	1.29
1990	.	1.19	1.06	1.06	1.20	1.15	1.20	1.23
1991	.	.	1.19	1.06	1.07	1.10	1.17	1.14
1992	.	.	.	1.17	1.04	1.03	1.12	1.16
1993	.	.	.	.	1.07	0.97	0.98	1.06
1994	.	.	.	.	.	1.07	0.93	0.94
1995	.	.	.	.	.	.	1.01	0.91
1996	.	.	.	.	.	.	.	1.00

SMRs are standardized to 1996 national dialysis patient death rates by age,race, sex, and diabetes as the primary cause of ESRD, and excluding dialysis unrelated deaths.
For each incident cohort, the SMRs during the first year of treatment are shaded, and SMRs during the second year of treatment are outlined.
Source: Special Analysis

USRDS 1998

Table V-3

columns gives results from the USRDS database, which currently includes both Medicare and non-Medicare patients, and is reported as patient-level data. However, non-Medicare patients whose therapy started before 1995 are largely excluded from the USRDS database. In addition, the USRDS database excludes the first 90 days of ESRD therapy, and starts patient followup on day 91 after first ESRD treatment because of data reporting patterns associated with Medicare coverage. The exclusion of non-Medicare patients incident prior to 1995 and the exclusion of deaths during the first 90 days could largely explain the smaller total numbers of patients in the USRDS database compared with the AFS. The smaller percent deaths in the USRDS data are probably due to the exclusion of deaths in the first 90 days, where the death rate is known to be higher than in the remainder of the first year. (Compare Reference Tables Section E unadjusted 1-year survival rates for patient age groups over 65 starting at day 91 versus day 1.)

Mortality by Year Since Diagnosis in Incident Cohorts

Methods

Standardized mortality ratios (SMRs) were calculated to compare the mortality by year since diagnosis for successive incident cohorts of ESRD patients. These SMR values measure mortality rates for a subgroup of patients relative to a set of reference rates, with adjustment for age, race, sex, and diabetes as a cause of ESRD. The mortality rates for the 1996 prevalent cohort (Reference Tables D.2) have been selected as the reference, and the mortality for other groups is reported relative to them. Higher SMR values represent higher mortality. An SMR of 1.05 (0.95) represents adjusted mortality that is 5 percent higher (lower) than the reference rates, on average. Patients are censored at first transplantation.

Results

Table V-3 shows the SMRs for all patients categorized by both the year of first therapy (incidence) and year of treatment (prevalence). A similar table was most recently reported in the 1996 USRDS ADR. The first row of the table combines all prevalent patients in each year who were diagnosed (incident) prior to 1989.

The relative mortality during successive years for a single incident cohort can be seen by moving to the right in a single row of the table. Typically, mortality is high during the first year, then lower during the second and third years, and then rises after the third year. The drop in mortality rates after the first year is likely due to losses among those patients who are at immediate high risk of death when they start ESRD therapy, with only the healthier patients surviving to the second and third year of therapy. The gradual increase after the third year may be partly due to removal of transplant recipients and deserves further study.

The SMRs for successive incident cohorts during their first year of therapy are shown by the shaded entries on the lower diagonal of the table. The upper left shaded SMR is for patients incident in 1989 during their first year of therapy, while the lower right hand SMR is for the 1996 incident cohort during its first year of therapy. Moving down the shaded diagonal in Table V-3, a general decline in SMR values can be seen. This pattern is consistent with the decline in first-year mortality rates reported earlier in this chapter.

The SMRs for successive incident cohorts during their second year of therapy, shown by the entries on the second lowest diagonal of the table (see outlined cells in Table V-3), also show a general decline between 1990 and 1996. Similarly, the higher successive diagonals in the table report SMR values for the third and fourth years of therapy, which show less consistent trends over the years, with both increases and decreases between successive years.

Prevalent cohorts of patients are given in successive columns of Table V-3. Detailed

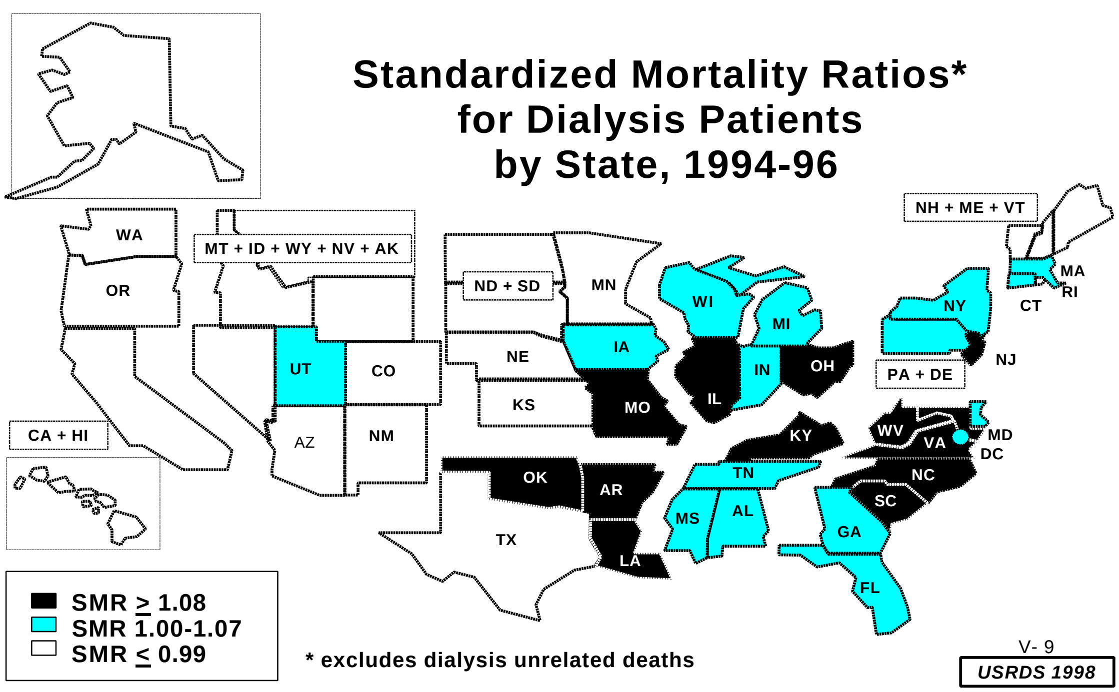

Figure V-9

Standardized Mortality Ratios for dialysis patients by state, 1994-96. Small states are grouped together as indicated in the reference table. Death rates are adjusted by age, race (Black, White, Asian, Native American), sex, and diagnosis (diabetic, other) to the 1996 prevalent dialysis population. Patients with missing or unknown race, or missing primary diagnosis are excluded. Dialysis unrelated deaths are excluded. Source: Reference Table D.3 tabulations of annual death rates for prevalent patients are reported in Section D of the Reference Tables by a cross-classification of age, race, and diabetes. These death rates are based on all period-prevalent ESRD patients treated during 1994 through 1996 and correspond to the summary death rates for the last 3 columns from Table V-3. They can be used to calculate expected mortality for many study groups of ESRD patients using the methodology described by Wolfe, 1992.

Standardized Mortality Ratios by State

Standardized mortality ratios (SMRs) were calculated to compare the death rates for all prevalent dialysis patients in a state to the death rates for virtually all U.S. dialysis patients in the USRDS database for the years 1994 through 1996. The SMR accounts for the age, race, sex, and diabetes status of the prevalent dialysis patients in a state. The observed death rate in a state is compared to the rate that would be expected based on national death rates for patients with similar characteristics. The mortality rates for the 1996 prevalent cohort (Reference Tables D.2) have been selected as the reference, and the mortality for 1994-96 for each state is reported relative to them.

The resulting SMRs are graphically presented in Figure V-9. Although it appears that the eastern half of the United States has generally higher standardized mortality than the western half, further investigation would be required to better explain any observed patterns.

Projected Remaining Years of Life

Methods

The average remaining years of life was calculated using actuarial methods (Gross) for the entire U.S. population, the ESRD population (including transplant patients), and the dialysis population for each of several age-race-sex subgroups. The actuarial method calculates the life expectancy that would result in a population subject to the corresponding age-race-sex-specific death rates. The 1996 prevalent patient death rates for Black and White males and females of various ages (Reference Table D.2) were used in this calculation. These death rates exclude deaths due to AIDS, accidents ("accidents unrelated to treatment" on the ESRD Death Notification), and illegal drugs ("drug overdose (street drugs)" on the Death Notification), so the lifetimes reported here correspond to hypothetical populations in which these causes of death do not occur. The expected remaining lifetimes for the total U.S. population, shown for comparison do include these causes of deaths.

Results

Table V-4 shows the expected remaining years of life for the U.S. population, the ESRD population, and the dialysis population. The results are shown by age group, race and sex subgroups. The values in Table V-4 are average remaining lifetimes, and the lifetimes of individual patients will vary considerably from these averages.

The expected lifetimes of the ESRD population exceed that projected for the dialysis population by 2 to 12 years through age 29. This is because the ESRD population includes the healthier transplanted patients that are excluded from the dialysis group; this effect is stronger for the younger age groups that have higher rates of transplantation. Over age 65, the expected remaining lifetime for all ESRD is about the same as that for dialysis, since transplants are much less frequent in these older age groups.

In the U.S. population, the life expectancy among females is higher than for males at each age, and in both the Black and White populations. In the ESRD population, the male and female lifetimes are more similar, although at most ages male lifetimes exceed those of females, especially at younger ages. In the Black dialysis population, the difference between male and female lifetimes tends to be smaller than in the all ESRD Black population. In the White dialysis population, males have a longer life expectancy than do females through age 39, while females have a longer life expectancy over age 40.

In the U.S. population, the life expectancy among Whites is higher than for Blacks at each age for both the males and females through age 85. In the all ESRD population, lifetimes of Whites exceed those of Blacks through age 35, while the opposite is true over age 35. In the dialysis population, lifetimes of Blacks exceed those of Whites of the same sex at every age.

Black males in the all ESRD population over age 25 have an expected remaining lifetime that is between 33 and 40 percent that of the age matched U.S. Black males. Black females with ESRD over age 25 fare worse, with an expected remaining lifetime between 26 and 34 percent that of age-

Expected Remaining Lifetimes for U.S. Population (1990), All ESRD Patients[1] (1996) and Dialysis Patients (1996) by Age, Race and Sex

	U.S. Population, 1990[2]				ESRD population, 1996[4]				Dialysis population[3,4], 1996			
	Black		White		Black		White		Black		White	
Age	M	F	M	F	M	F	M	F	M	F	M	F
0-14	61.5	67.0	71.1	78.0	29.0	27.6	33.1	32.1	20.3	19.7	18.8	18.8
15-19	51.3	57.4	58.5	65.0	22.7	21.5	24.5	23.5	19.3	18.4	16.4	15.2
20-24	46.8	52.9	53.8	60.1	19.5	18.5	21.3	20.3	16.8	15.9	14.0	13.0
25-29	42.5	48.7	49.2	55.3	16.8	16.5	17.8	17.5	14.5	14.1	11.3	11.0
30-34	38.2	44.6	44.6	50.4	14.6	14.5	15.0	14.9	12.7	12.5	9.4	9.3
35-39	34.1	40.6	40.0	45.6	12.8	12.8	12.6	12.6	11.3	11.4	8.0	7.9
40-44	30.1	36.8	35.4	40.8	11.1	10.9	10.5	10.6	10.0	9.8	6.9	7.1
45-49	26.2	32.4	30.9	36.1	9.4	9.3	8.7	8.7	8.6	8.5	6.1	6.3
50-54	22.5	28.2	26.5	31.5	7.9	7.7	7.1	6.9	7.3	7.1	5.2	5.2
55-59	19.1	24.3	22.4	27.0	6.7	6.6	5.6	5.6	6.3	6.3	4.4	4.5
60-64	16.0	20.6	18.6	22.8	5.5	5.5	4.4	4.5	5.2	5.3	3.7	3.9
65-69	13.3	17.2	15.2	18.9	4.4	4.5	3.5	3.6	4.2	4.4	3.1	3.3
70-74	10.8	14.2	12.0	15.2	3.6	3.7	2.9	3.0	3.5	3.7	2.7	2.9
75-79	8.8	11.3	9.3	11.8	2.9	3.0	2.4	2.5	2.9	3.0	2.4	2.5
80-84	6.9	8.7	7.0	8.8	2.5	2.5	2.1	2.1	2.5	2.5	2.1	2.1
85+	5.4	6.5	5.1	6.1	2.1	2.0	1.7	1.7	2.1	2.0	1.7	1.7

[1]Includes patients treated with either dialysis or transplantation.

[2] Vital Statistics of the US, Vol 2,1990: Mortality, Part A, Table I-9.

[3] Mortality followup is censored at transplant.

[4]Death rates used for these calculations exclude dialysis unrelated deaths.

Source: Reference Table D.2 and Special Analysis

USRDS 1998

Table V-4

matched U.S. Black females. Relative lifetimes of White ESRD patients are even shorter, ranging between 23 and 36 percent for males and between 19 and 32 percent among females over age 25, compared to the U.S. population.

Overall, the expected lifetimes of dialysis patients are between 17 and 39 percent those of the age-sex-race matched U.S. population, while lifetimes of all ESRD patients are between 19 and 47 percent of the corresponding U.S population. Black dialysis patients in general have greater expected remaining lifetimes for all ages when compared to Whites. Finally, the inclusion of healthier transplanted patients in the all ESRD calculations yields longer lifetimes compared to the dialysis only calculations, especially in the younger age groups that have higher rates of transplantation. Over age 70, the expected remaining lifetime for all ESRD is about the same as that for dialysis only, since transplants are much less frequent in these older age groups.

Methods for Calculating National Death Rates

Several major changes were made to the methods for calculating national death rates for prevalent patients reported in Tables D.2 and D.3, starting with the 1997 ADR. In this chapter, these changes impact only Table V-4 and Figures V-8 and V-9.

1. Specific dialysis-unrelated deaths (DU deaths) were excluded from the calculations (deaths due to AIDS, acidents unrelated to treatment such as violence, and street drug overdoses).

2. The 1996 death rates for patient subgroups published in this report are estimated using a Poisson regression model. This new method yields more stable and interpretable estimates than did the previously used method of estimating the death rates separately for each subgroup.

These changes are discussed in Chapter XIII, Analytical Methods. Further details were reported in abstracts presented at the 1996 American Society of Nephrology meeting (Turenne, Wolfe 1996).

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