Chapter V

Patient Mortality and Survival

There are six major sections of this chapter, which focuses upon patient survival among dialyzed ESRD patients. The sections are:

1. Trends in adjusted death rates among *incident patients* for the years 1982-1992 and on differential mortality during the first and second years of ESRD therapy.
2. Mortality comparisons for *peritoneal dialysis and hemodialysis* based upon patients incident between 1989-91.
3. *Long-term survival* based on five year survival results for the 1988 incident cohort and 10 year survival for the 1983 incident cohort.
4. Standardized mortality rates for *prevalent patients* over the years 1982-1992.
5. The relationship of several *comorbid conditions* with death rates.
6. Projected *remaining years of life* for ESRD patients, by patient age.

Death Rates Among Incident Patients

Methods

The trend in death rates among incident ESRD patients is presented in a new format that allows the assessment of the effect of year of therapy (vintage) on survival. Instead of reporting cumulative first and second year survival probabilities for each incident cohort, we report the corresponding death rates during the first year and, for those surviving the first year, death rates during the second year. Reporting death rates in this manner allows us to look at mortality during the second year for each incident cohort, as opposed to the cumulative first and second year mortality as was presented in previous editions of the ADR.

We calculated adjusted survival curves for the incident groups of patients starting ESRD therapy in each calendar year for the years 1982-1992 and report the corresponding death rates for patients during the first year and second 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 surviving proportions are weighted averages of Kaplan-Meier estimates for patient subgroups defined by age, race, sex, and diagnostic categories, for each incident cohort of patients. The weights correspond to the proportion of ESRD patients in each subgroup in the designated reference population, which is the 1992 incident cohort, as described in Chapter XIV.

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 (and the subsequent death rates) are likely to differ across cohorts merely because of such changes in patient characteristics. Readers who are interested in the outcomes for a particular year, rather than in comparisons across years, should

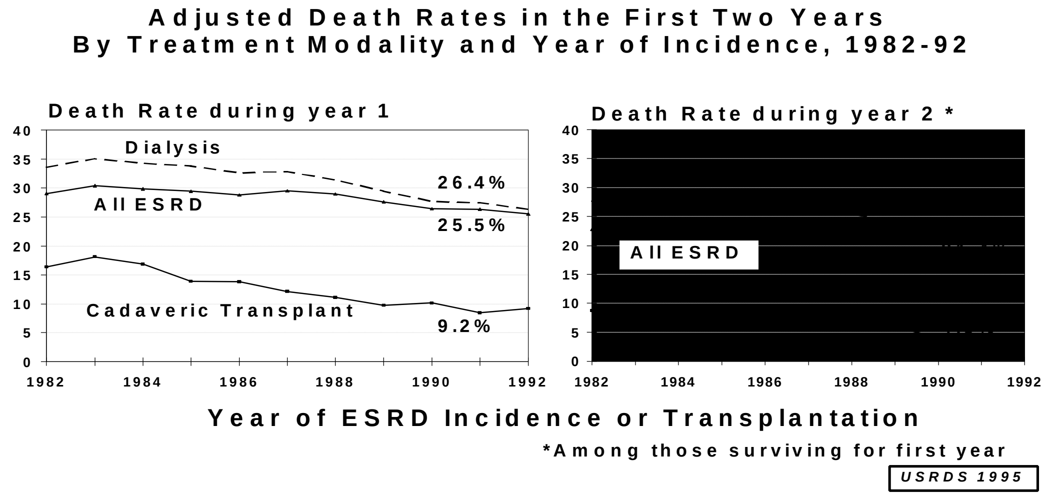

Figure V-1

Death rates based on adjusted Kaplan-Meier estimates 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 age, race, sex and primary diagnosis characteristics of the 1992 incident cohort. Source: Reference Tables E.22, E.46, E.58 for Year 1 and E.23, E.47, E.59 for Year 2.

refer to the tables of unadjusted survival probabilities in Appendix E.

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 is due to factors other than age, race, sex, and diagnosis. Thus, direct comparison of adjusted survival proportions and/or mortality rates across various years yields more useful interpretations than would comparison of unadjusted survival proportions or mortality rates.

We then calculated death rates per 100 patient years from these estimated adjusted surviving proportions using the equation:

death rate = - 100*ln(fraction alive at year 1).

The death rates during the second year are calculated in a similar way among patients who survived the first year.

Although the mortality rates 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 (1992).

The small number of patients seen by individual physicians or facilities results in too much statistical variation in the data causing it to be difficult for health care providers to observe trends. 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 trends shown here represent the aggregate national experience for the U.S. Medicare Population. Improvements in technology are initiated at different times from facility to facility, so changes at the facility level may not correspond to the trends shown here.

Results

The adjusted death rate during the first two years of ESRD is shown in Figure V-1 for all ESRD patients. *As with all the graphics in the chapter, results are for Medicare patients only, with patients in Puerto Rico and the U.S. Territories included.* Results are also shown for dialysis patients with follow-up measured since

Medicare enrollment and censored at transplantation, and for first cadaveric transplant recipients categorized by year of transplant with follow-up measured from the time of first transplantation.

Death rates in the first year of therapy were lower in the 1992 cohort than they were in the 1991 incident cohort of all ESRD patients. This continues the general trend that has been seen for all cohorts since 1983, except for the 1987 cohort. The lower mortality 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 mortality after 1983. There has been an overall decline in mortality since 1983 for all ESRD patients, for dialysis patients and for transplant patients.

During this decade, there has been a trend towards treating older patients and more patients with diabetes (see Figures IV-4 and IV-8). 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 may explain the trends seen here. For example, the current USRDS data cannot adjust for comorbidity for the overall ESRD population because these measures are not recorded for all patients. Later in the chapter we report some relative mortality rates for patients with and without specific comorbidities based on the Case Mix Adequacy special study data set.

The adjusted first-year death rates for dialysis patients have decreased from 35 percent for the 1983 cohort to 26 percent for the 1992 cohort. Figure V-1 also shows that there has also been a general decrease in mortality during the second year among dialysis patients since 1983, from 29 percent to 23 percent. Comparison of both sides of Figure V-1 shows that the difference between first and second year mortality rates has decreased in recent years.

Due to limited patient numbers in highly specified patient subgroups, the data cannot reliably tell us just how consistent the quantitative reduction in mortality has been across various age, race, and sex 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.

Careful examination of the first and second-

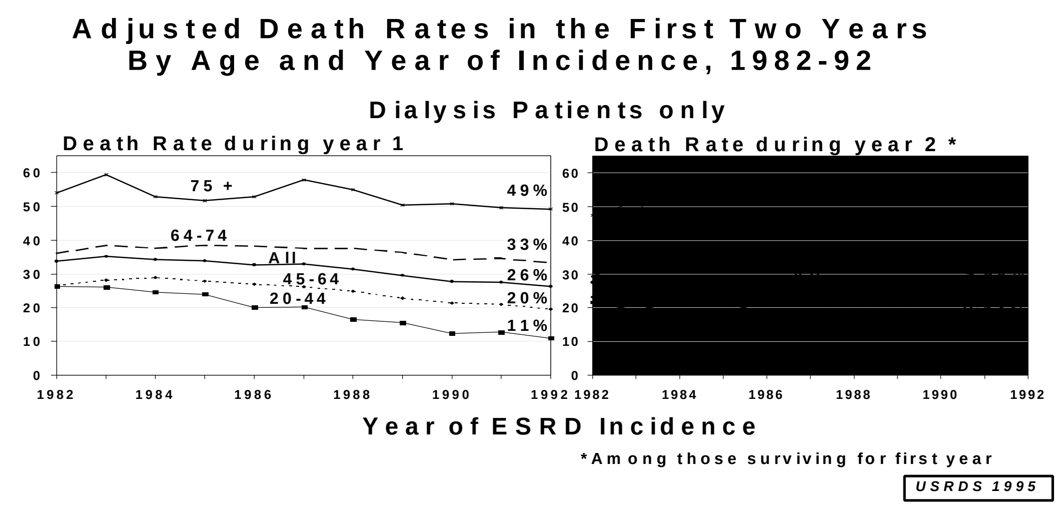

Figure V-2

Death rates based on Kaplan-Meier estimates by age at onset of ESRD and year of incidence. Starting at day 91 and following the onset of ESRD and censored at first transplant. Adjusted for the race, sex and primary diagnosis characteristics of the 1992 incident cohort. Source: Reference Tables: E.46 and E.47.

year mortality rates for dialysis patients indicate that improvements in mortality during the first year are generally maintained during the second year. This indicates that the 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. Also note that mortality rates during the second year are typically lower than mortality rates during the first year. This indicates that vintage has an effect on mortality.

Figure V-1 shows that the cohort of patients receiving transplants during 1992 experienced a slightly worse survival than did the previous year's cohort. More detailed results are reported for transplant patients in Chapter VII. The figure also shows a gradual trend from 1982 to 1991 of improving patient survival for cadaveric transplant recipients during the second year after transplantation.

First year mortality from the day patients received a cadaveric transplant is consistently lower than for dialytic modalities. Part of this difference is likely due to differences in the characteristics and selection of transplanted and dialyzed patients. 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

Age: Figure V-2 shows the first and second year death rates for dialysis patients 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 for the 1992 cohort relative to earlier cohorts. In the oldest age group (75+) the first-year death rate remained nearly constant compared to the 1991 cohort.

The most consistent and greatest improvement in survival for dialysis patients has been seen in the younger adult age ranges. The death rates during the first year have decreased from 26 percent in 1983 to 11 percent in 1992 for the 20 to 44 year old age group while it has decreased from 39 percent to 33 percent for the 65-74 year old patients in the same time interval. The decrease in transplantation rates in the 20-44 year old age group in recent years (see Figure VII-2) may have resulted in a healthier corresponding dialysis population with lower mortality.

The mortality rates during the second year are much lower than first year mortality rates for the over 75 year old patients and for the 65-74 year old patients. We speculate that this may be due

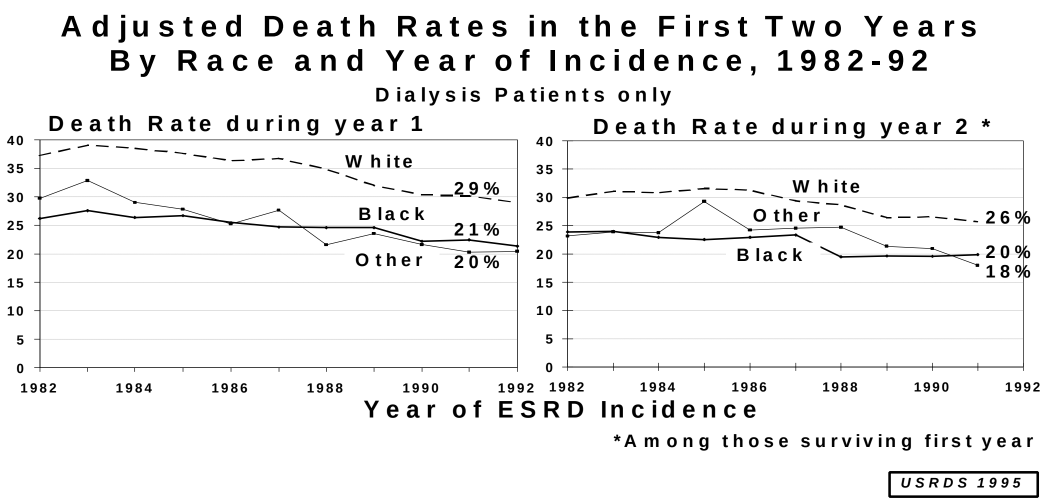

Figure V-3

Death rates based on Kaplan-Meier estimates by race and year of incidence. Starting at day 91 and following the onset of ESRD and censored at first transplant. Adjusted for the age, sex and primary diagnosis characteristics of the 1992 incident cohort. Source: Reference Tables: E.46, E.47.

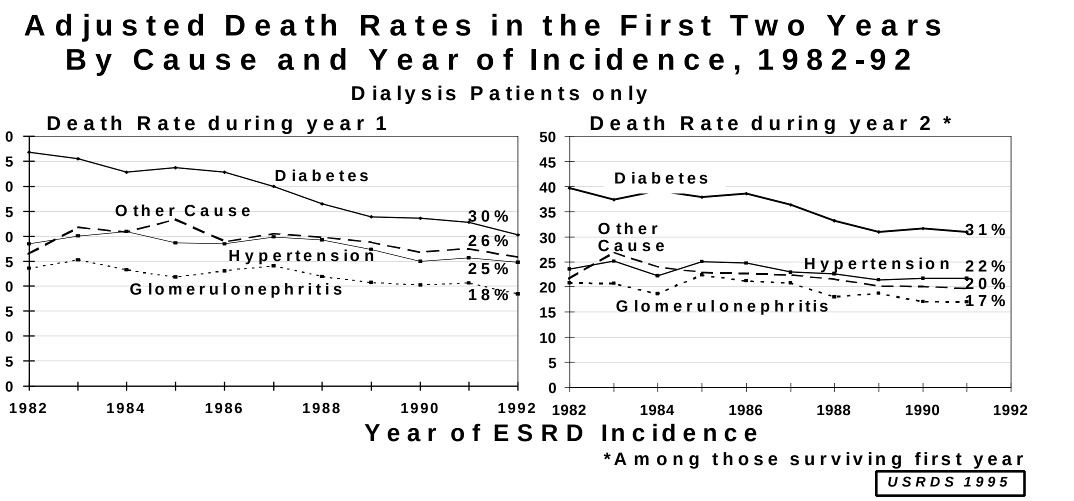

Figure V-4

Death rates based on Kaplan-Meier estimates by primary diagnosis and year of incidence. Starting at day 91 and following the onset of ESRD and censored at first transplant. Adjusted for the age, race, and sex characteristics of the 1992 incident cohort. Source: Reference Tables: E.46, E.47

in part to high withdrawal rates during the first year among the elderly, since it has been shown in prevalent populations that elderly patients generally withdraw at higher rates than younger patients (Nelson, Chapter VI). Alternatively, it could be that the elderly who have more comorbidities at onset of ESRD also have higher death rates in the first year, resulting in a substantial selection of healthier survivors at the start of the second year. In the 20-44 and the 45-64 year old patient groups the difference between the second year mortality and the first year mortality is relatively small. Thus, for age groups less than 65 the mortality within each incident cohort is fairly constant during the first two years, whereas it is not constant for those over age 65.

Race: Figure V-3 shows the mortality during the first two years for dialysis patients by year of first ESRD therapy and race, adjusted for age, diagnosis, and sex. There has been a consistent improvement in first year mortality rates 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.

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 lower first year mortality rates than did black patients, while white patients consistently had the highest first year mortality rates. For the 1992 cohort, the difference between black and white patient one-year death rate remains at close to the same 10 percentage points that is was in 1983. These comparisons are adjusted for age, diagnosis, and sex, and are valid overall, but may not hold for every age-diagnosis-sex subgroup.

Figure V-3 shows that the trends in first and second year mortality were similar to each other among white patients, with mortality during the second year being lower. Black patients also show a similar trend in second year mortality as in first year mortality, although the difference between first and second year mortality is not as large as it is for white patients. Other race patients have no consistent pattern of first versus second year mortality, although this could be a result of the smaller population of patients of other race.

Cause of ESRD: Figure V-4 shows the first-year mortality rates for dialysis patients by year of 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 1992 for each of four major diagnostic categories.

In 1992, the mortality during the first year is lower than that for 1991 for each diagnostic category. Over the years, the first year mortality decreased most dramatically and consistently for diabetic patients, from 46 percent in 1982 to 30 percent in 1992. Patients with glomerulonephritis tend to have the lowest levels of first-year mortality, 18 percent in 1992, while patients with diabetes have the highest first year mortality throughout the years shown.

Gender: Figures V-5 shows the first year mortality rates for dialysis patients by year of first ESRD therapy and sex, after adjustment 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. Females have had lower one-year adjusted mortality than males for each incident cohort, typically by about five percentage points in the early 1980s. Since the 1988 cohort, the difference in the one-year survival by gender appears to be diminishing. The second year mortality trend was very similar and is not shown here.

Summary

The dramatic improvements in survival seen for the 1990 and 1991 incident cohorts are consistent across several classifications of patients and appear to have been largely sustained in the 1992 cohort. These findings are adjusted for age, race, sex, and ESRD diagnosis 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, 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 unlikely that the level of unmeasured comorbidity has decreased during the same time that incidence rates have been increasing. Therefore, the decline in death rates is most likely due to improvements in therapeutic methods.

It is also possible that changes in dialysis therapy may be responsible for improved survival (Hakim; Owens; Parker). During this time period, 1988-92, the renal provider community has given increasing attention to the

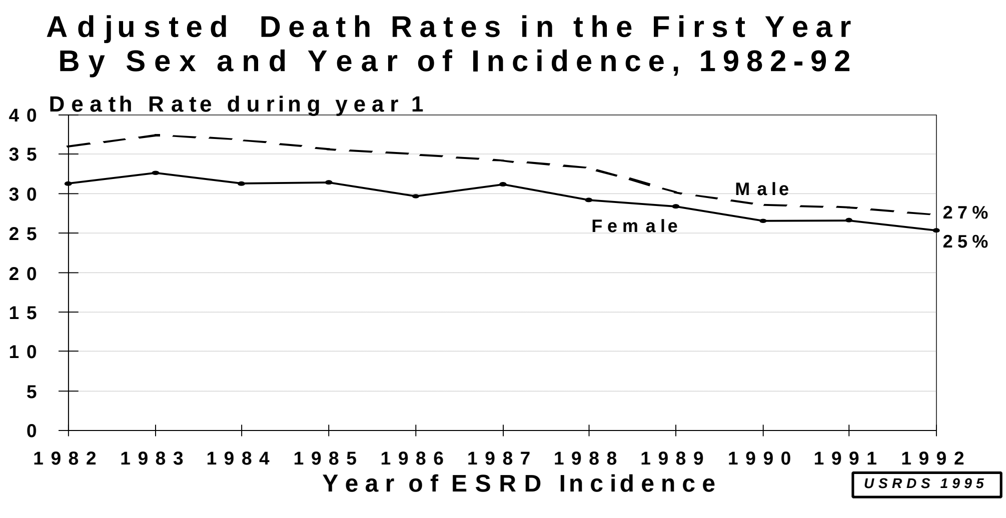

Figure V-5

First year death rates based on adjusted Kaplan-Meier estimates by sex and year of incidence. Starting at day 91 following onset of ESRD and censored at first transplant. Adjusted for the age, race, and primary diagnosis characteristics of the 1992 incident cohort. *Source:Reference Table E.46*

Death Rates in Year 1 and Year 2* by Age, Race, Modality at Day 90 among Non-Diabetic Dialysis Patients 1989-93

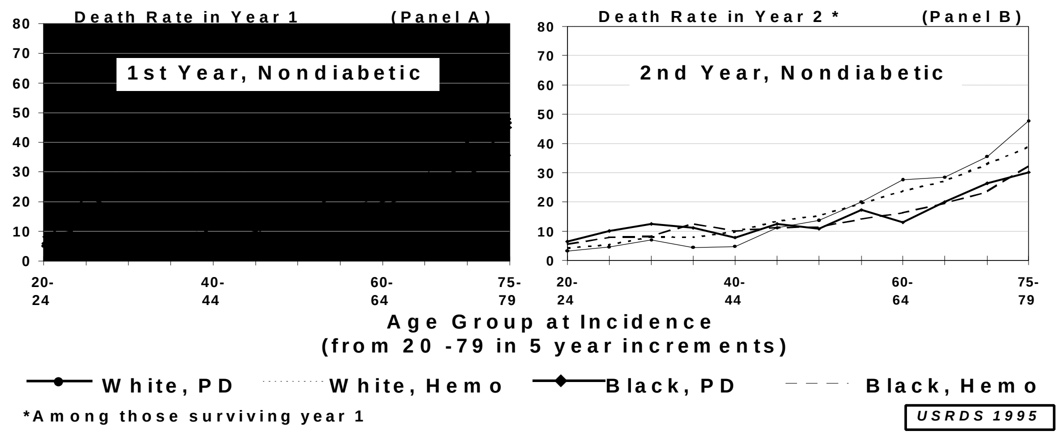

Figure V-6

First and second year death rates based on Kaplan-Meier estimates for diabetics by age, race, and dialytic modality. Starting at day 91 following onset of ESRD and censored at first transplant. Incident cohorts of 1/1/89- 6/30/91, followed through June 1993. Source: Special Analyses

amount of dialysis (Kt/V) that is delivered to hemodialysis patients. In addition, there have been improvements in dialysis equipment, including connection devices for peritoneal dialysis patients and the membranes used for hemodialysis. As improvements in delivered care continue to spread through the community of renal providers, we hope that there will be further reductions in average mortality across the nation.

Levels of residual renal function during the early years of ESRD therapy are unknown and could have changed if changes occurred in the time at which ESRD therapy was typically initiated. However, the higher first year death rate and the trends for the second year suggest that the improved survival cannot be easily explained by the possibility of earlier initiation of dialysis in recent years.

Mortality Comparisons for Peritoneal dialysis and Hemodialysis

Methods

In the past the only classification of death rates for incident patients was by *separate* classifications of age, race and diagnosis of ESRD. This edition of the ADR also includes death rates for *cross*-classifications of these patients characteristics and dialytic modality for the incident cohorts of 1989-1991 followed through June 1993. First and second year death rates were calculated for peritoneal dialysis and hemodialysis, by age, race and age. Death rates were calculated based on the Kaplan-Meier estimates of the survival curve, as described in the methods for incident patients.

Dialytic modality was assigned as of day 90 of ESRD therapy.

Results

Figures V-6 and V-7 show death rates for incident cohorts from years 1989-91 classified by age, race, dialytic modality (on day 90), year of therapy (months 4-15 versus 16-27), and diabetes status. Figures 6 A-B and Figures 7 A-B give results for non-diabetic and for diabetic patients, respectively. The “A” panels of these figures

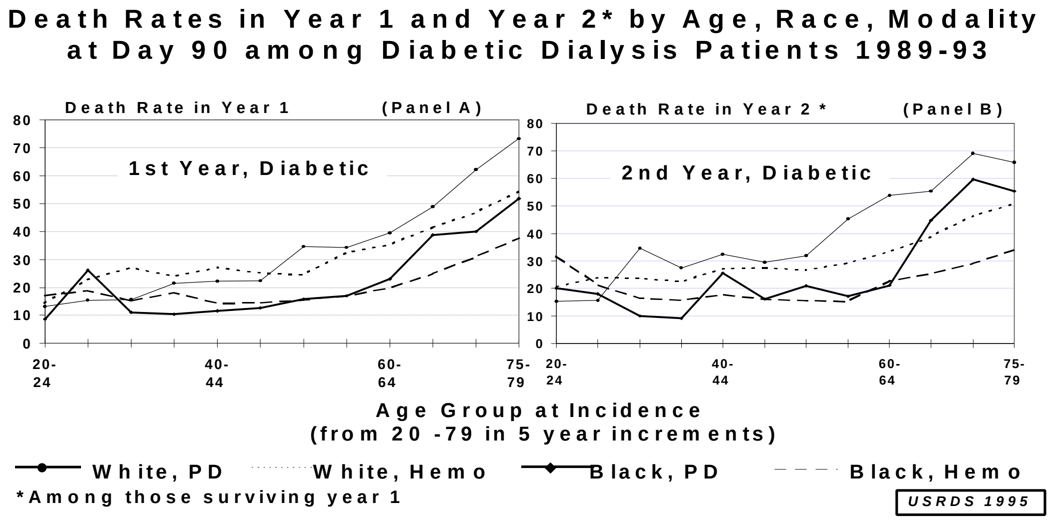

Figure V-7

First and second year death rates based on Kaplan-Meier estimates for diabetics by age, race, and dialytic modality. Starting at day 91 following onset of ESRD and censored at first transplant. Incident cohorts of 1/1/89- 6/30/91, followed through June 1993. Source: Special Analyses

show mortality during the first year (months 4-15) while the "B" panels give results for the second year (months 16-27). Death rates (percent per year) are shown in the vertical axes and age, in the range 20-79, is shown on the horizontal axes.

Figure V-6A shows that among non-diabetic patients there is no clear consistent difference in mortality rates between hemodialysis and PD patients. First year death rates among black patients are typically higher than among white patients below age 40, while the reverse is true at older ages, regardless of dialytic modality. Figure V-6B shows that second year death rates among non-diabetic patients do not differ substantially

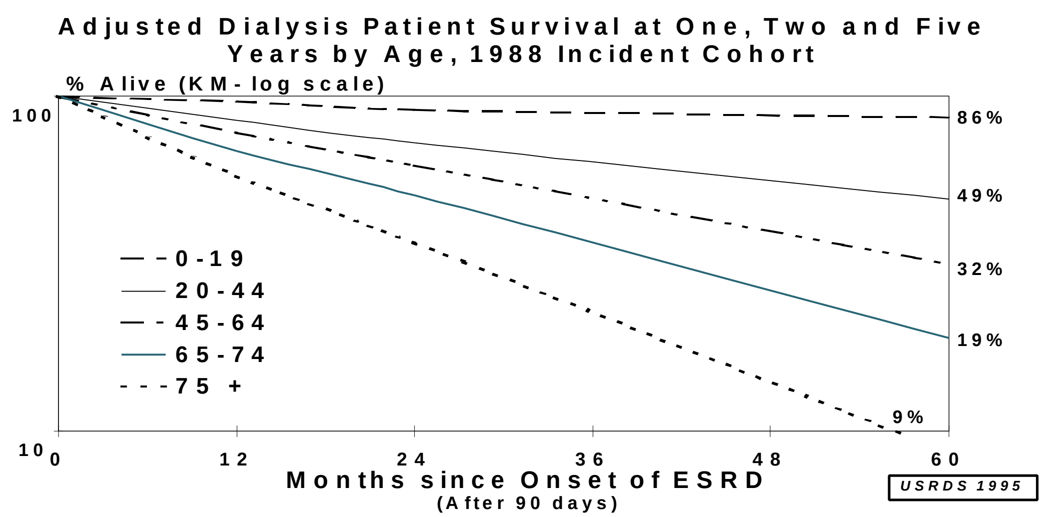

Figure V-8

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 1988. Adjusted for the diagnosis, race, and sex characteristics of the 1992 incident cohort. Five-year survival estimates are considered preliminary. Source: Reference Tables E.46, E.47 and E.48.

Adjusted Dialysis Patient Survival at One, Two and Five Years by Race, 1988 Incident Cohort

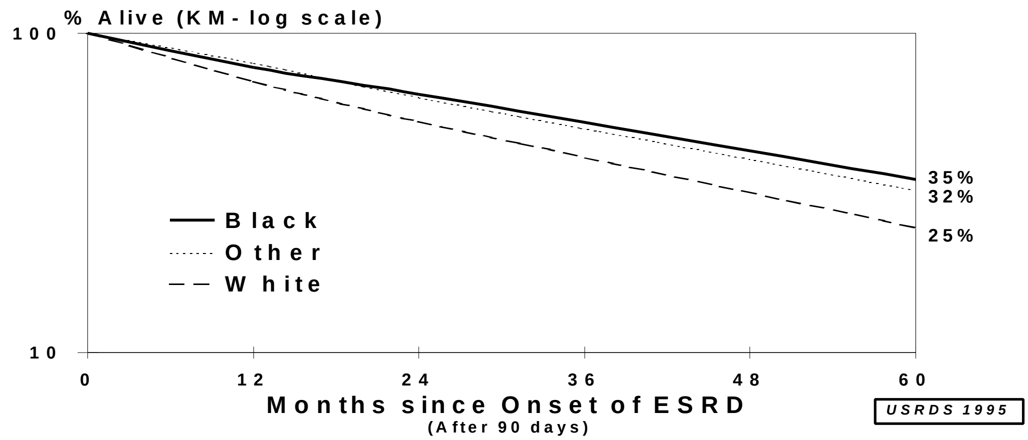

Figure V-9

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 1988. Adjusted for the age, diagnosis, and sex characteristics of the 1992 incident cohort. Five-year survival estimates are considered preliminary. Source: Reference Tables E.46, E.47 and E.48

by race or by dialytic modality.

By contrast, for diabetic patients Figures V-7A and B show that death rates are higher for older PD patients than for hemodialysis patients of the same race. The age above which PD patients have clearly higher death rates than do hemodialysis patients occurs at an age in the range 45-60, which appears to vary somewhat by race and by first or second year of dialysis for these diabetic patients.

Adjusted Dialysis Patient Survival at One, Two and Five Years by Primary Diagnosis, 1988 Incident Cohort

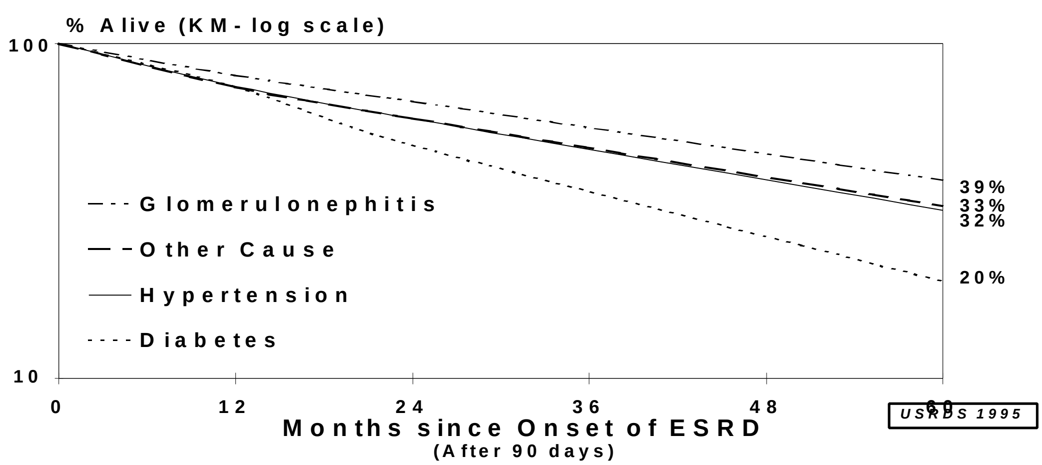

Figure V-10

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 1988. Adjusted for the age, race, and sex characteristics of the 1992 incident cohort. Five-year survival estimates are considered preliminary. Source: Reference Tables E.46, E.47 and E.48

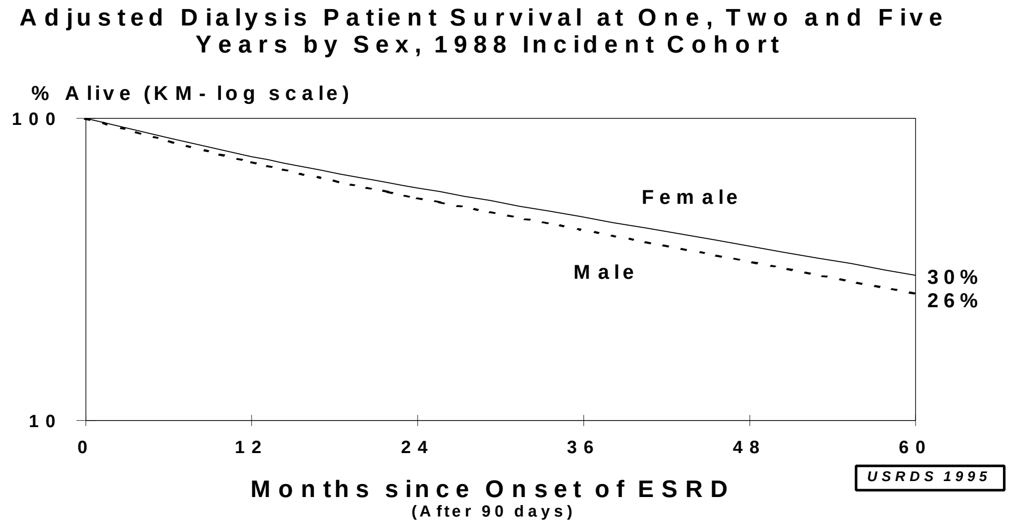

Figure V-11

Kaplan-Meier dialysis patient survival estimates by sex. Starting at day 91 following the onset of ESRD and censored at first transplant. Incident cohort is 1988. Adjusted for the age, race, and diagnosis characteristics of the 1992 incident cohort. Five-year survival estimates are considered preliminary. Source: Reference Tables E.46, E.47 and E.48

Figure V-7A shows that, among diabetic patients during the first year, white patients have higher death rates than do black patients for all ages over 30.

The relationship between age and mortality rates during the second year, shown in Panel B, is similar to that in Panel A.

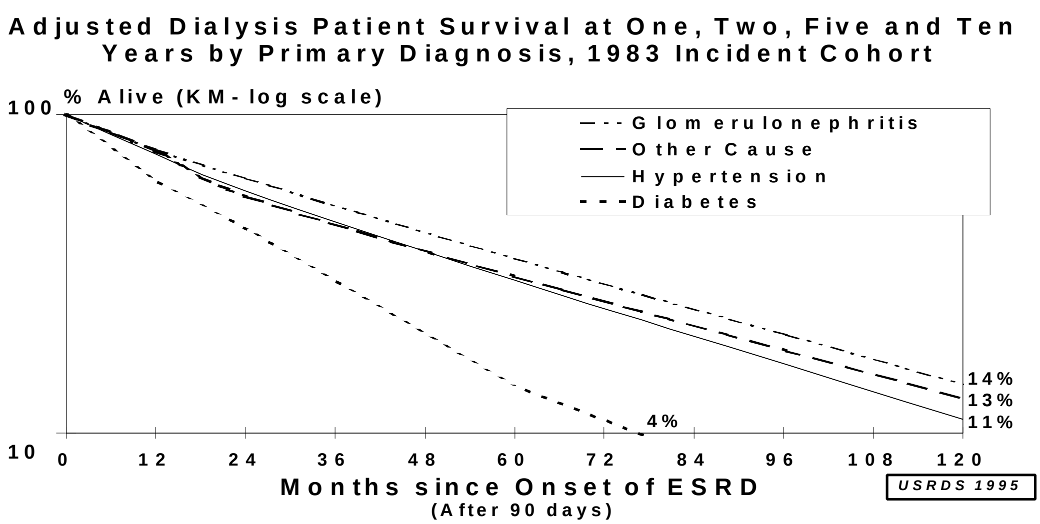

Figure V-12

Kaplan-Meier dialysis patient survival estimates by sex. Starting at day 91 following the onset of ESRD and censored at first transplant. Incident cohort is 1983. Adjusted for the age, race, and sex characteristics of the 1992 incident cohort. Ten-year survival estimates are considered preliminary. Source: Reference Tables E.46, E.47, E.48 and E.49.

Long Term Survival

Methods

We calculated adjusted survival curves for the incident groups of patients starting ESRD therapy in 1988 and followed through 1993.

Using KM estimates as described in the Incident section of this chapter, we report the cumulative surviving fraction at one, two and five years after day 90 of ESRD. For the 1983 incident cohort we also report one, two, five and ten year surviving fractions by diagnosis.

Results

Adjusted survival percent at one, two, and five years are shown in Figures V-8 to V-11 for various subgroups of dialysis patients whose first ESRD therapy occurred in 1988 (note the log scale). A constant slope for the log survival curve over a time interval indicates that the death rate is constant during the same interval of time. In most of these figures, the slopes are nearly constant over the 5 year range of follow-up, with slightly steeper slopes during year 1, for some plots. This is consistent with the generally higher death rates during year 1 noted in the results for incident patients. An exception is in Figure V-10 which shows a steeper slope for diabetic patients after year 1 than during year 1. This anomaly indicates that the pattern for diabetic patients in 1988 differs from that for other patients, implying that diagnosis had a non-proportional effect on mortality for this cohort.

Figure V-8 shows that survival is best for younger patients (86% at 5 years among the 0-19 year age group) and worst in the oldest age group (9% at 5 years at ages 75+). Figure V-9 shows that black patients have the best survival (35% at 5 years) and white patients have the worst survival (25% at 5 years). Among the 4 diagnostic categories shown in Figure V-10, patients with diabetes have the worst survival (20% at 5 years) and patients with glomerulonephritis have the best survival (39% at 5 years). Figure V-11 shows that females had somewhat better survival at 5 years (30%) than did males (26%). Generally, these figures show that the differences in mortality by age, race,

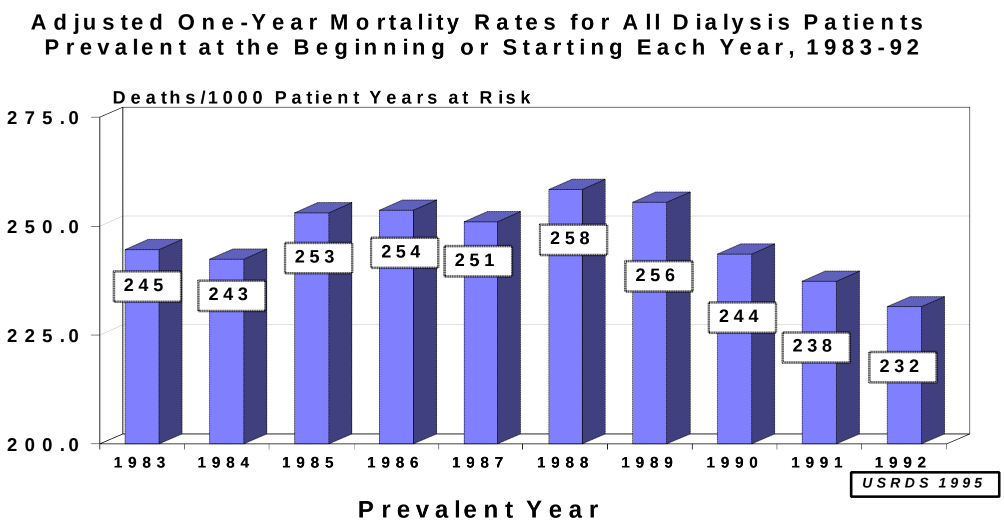

Figure V-13

Mortality rate (deaths/1000 patient years at risk) for all prevalent dialysis patients whose first treatment was after 1/1/1993. Patients prevalent at the beginning of each year, 1983-92. Rates are adjusted for age, race (black, white), sex and diagnosis (diabetic or non-diabetic). Source: Special Analysis.

Crude Mortality Percent for All Dialysis patients, 1984-1993

Survey Year	Total Deaths[1]	Percent Dead [2]	Percent Dead[3]
1984	15,590	20.71	20.97
1985	18,093	22.15	22.52
1986	19,987	22.74	23.12
1987	22,116	23.42	23.32
1988	24,860	24.36	24.30
1989	26,343	23.71	24.43
1990	28,741	23.10	24.13
1991	31,667	22.98	23.83
1992	35,985	23.67	23.80
1993	39,443	23.78	23.87

[1] Facility reported deaths excluding transplant only facilities and facilities with missing data.

[2] Total deaths/ total patients

[3] Medicare deaths/ Medicare patients from Patient Data Base

Table V-1

sex, and diagnosis that were apparent at one year of ESRD were generally sustained at later years for this cohort.

Figure V-12 shows the adjusted survival through year 10 for the 1983 incident cohort of dialyzed patients, by diagnostic classification.

The survival is worst for patients with diabetes (4% at 10 years) and is best for patients with glomerulonephritis (14% at 10 years).

Mortality Rates for Prevalent Patients

Methods

As in the last edition of the ADR (1994), tables of mortality rates for dialysis patients are given in the appendix of this data report which include prevalent (patients already being treated), incident patients (patients starting ESRD therapy) and previously transplanted patients. These new mortality rates were used to compute adjusted mortality rates for prevalent patients.

Death rates were calculated for dialysis patients. The rates have been adjusted for age, race, sex, and diabetes based on the standardized mortality ratio (SMR) methodology (Wolfe). The follow-up for a patient was included in the SMR calculation for a particular year only after day 90 of the patient's ESRD therapy or after January 1 of that year, whichever came later. Only patients who were receiving dialysis on that date are included for that year.

The adjusted death rates were calculated by multiplying the SMR for each prevalent cohort by the overall crude mortality rate for dialysis patients of 234.7 deaths per 1000 patient years based on the reference years 1990-1992 (Table D.2).

Results

Figure V-13 shows adjusted death rates per 1,000 patient years at risk for prevalent dialysis patients by cohort year (1983-92).

The adjusted death rates for prevalent patients tended to increase somewhat between 1983 and 1988. Throughout this time period, and continuing until now, there has been a tendency to start renal replacement therapy for older patients and for more diabetic patients (Figures IV-4, IV-8). Thus, it is plausible that the level of unmeasured comorbidity was also increasing during this time period and was responsible for the rise in adjusted death rates. Such unmeasured comorbidity is not accounted for by the adjustments made here.

Since 1988, standardized mortality rates have fallen, with a drop of 2.6% between 1991 and 1992, even though the average age and the percent of new patients with diabetes has continued to increase during this period. Thus, it is unlikely that the decline in death rates is due to a decrease in unmeasured comorbidities, and is more likely due to improvements in therapeutic methods.

Table V-1 reports crude death percents for successive cohorts of prevalent dialysis patients, 1983-1992. These crude rates do not adjust for the increasing age and frequency of diabetes as a cause of ESRD in successive cohorts of ESRD patients. Consequently, the crude death rates do not show clearly the reduction in death rates that has occurred among prevalent patients since 1988, for most specific age-diagnosis subgroups.

Table V-2 shows the SMRs for all prevalent patients categorized by both the year of first therapy and the year of treatment. The SMRs for successive incident cohorts during their first year of therapy are shown by the entries on the lower diagonal of the table. The general decline in prevalent patient mortality shown over the years in Figure V-13 is seen to hold when restricted to the first year of therapy, as can be seen by the declining SMR values when moving down the diagonal in Table V-2. The SMRs for successive incident cohorts during their second year of therapy are shown by the entries on the second lowest diagonal of the table (see outlined cells in Table V-2), and similarly for third and fourth years of therapy.

SMRs for Dialysis Patients by Year of Incidence and Treatment Year

	Year of Treatment									
Year of Incidence	1983 SMR	1984 SMR	1985 SMR	1986 SMR	1987 SMR	1988 SMR	1989 SMR	1990 SMR	1991 SMR	1992 SMR
<1983	1.02	1.00	1.03	1.03	1.03	1.06	1.07	1.04	1.01	1.02
1983	1.17	1.07	1.14	1.14	1.09	1.11	1.08	1.15	1.04	0.97
1984	.	1.11	1.08	1.12	1.06	1.11	1.11	1.03	1.04	1.03
1985	.	.	1.16	1.06	1.15	1.11	1.16	1.10	1.12	1.02
1986	.	.	.	1.16	1.03	1.15	1.12	1.06	1.07	1.04
1987	.	.	.	.	1.13	1.08	1.12	1.08	1.09	1.09
1988	.	.	.	.	.	1.14	1.04	1.05	1.05	1.05
1989	.	.	.	.	.	.	1.11	0.98	1.01	1.03
1990	.	.	.	.	.	.	.	1.05	0.94	0.93
1991	.	.	.	.	.	.	.	.	1.05	0.94
1992										1.02

For each incident cohort, the SMRs during the second year of treatment are outlined.

Table VI-2

Results from the Casemix Adequacy Study
Hemodialysis Patients Prevalent on 1/1/91 (N=4,790)

Patient Characteristics	Mean or Percent	RR[1]
Patient Age at First ESRD Service (years)	57.8	1.04 *
Anthropometric Characteristics		
Log of Body Mass Index (BMI) (kg/m-squared)	3.17	0.41 *
BMI Missing (%)	17	1.41
Comorbid Conditions (% yes at Start of Study)		
Total Performance Inabilities [2]	0.25	1.50
Active Smoking	40	1.40
Congestive Heart Failure	42	1.62
Coronary Heart Disease [3]	45	1.44
Myocardial Infarction	15	1.50
Cardiac Arrest	3	2.10
Arrhythmia or Atrial Fibrillation	31	1.51
Pericarditis	7	1.22
Cerebral Vascular Disease, including TIA	16	1.31
Peripheral Vascular Disease [4]	22	1.62
Diabetes	36	1.68
Active Insulin Therapy	20	1.57
Chronic Obstructive Pulmonary Disease	12	1.62
Neoplasm or Metastases	9	1.32
Labratory Values		
Serum Albumin (g/dl)	3.76	0.54 *
Serum Phosphorus (mg/dl)	6.21	1.08 *

[1] Relative risk is adjusted only for age, sex, race and cause of ESRD. All are significantly different from 1.0 ($p<0.01$) except pericarditis ($p<0.05$).
[2] Total Performance Inability's is an index of physical limitations with a scale between 0 and 2, (the ability to transfer and ambulate) with missing values set to the average.]
[3] Coronary Heart Disease defined as any history or treatment of CHD including CABG, Angioplasty, abnormal angiography, Myocardial Infarction.
[4] Peripheral Vascular Disease defined as any history or treatment of absent foot pulses, amputation or claudication.
**RR per one unit (1.0) of measurement.*

Table V-3

There has been a decline over the years in mortality during the second year of therapy, as

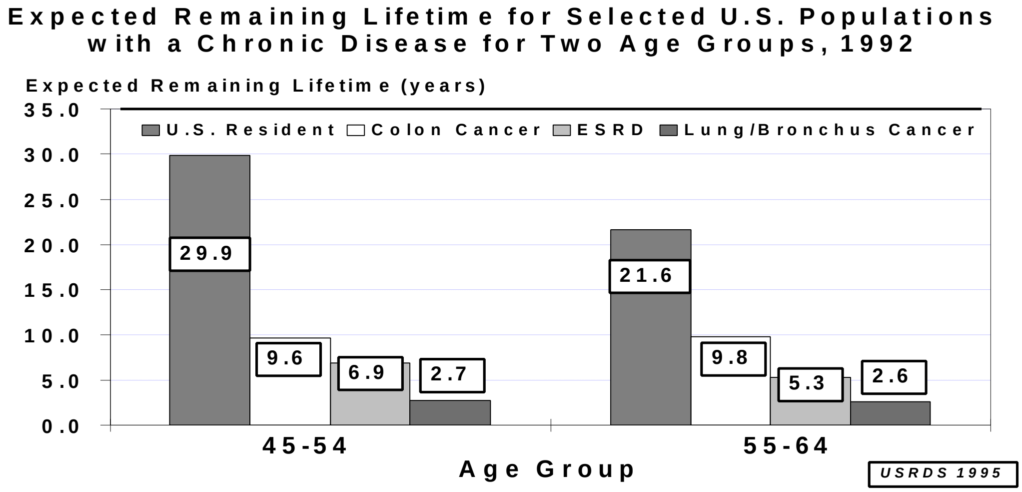

Figure V-14

Expected lifetime for age groups 45-54 and 55-64 for US. Resident population (1990) and selected subpopulations with chronic disease, including colon cancer (1983-89), ESRD (1992) and lung/bronchus cancer (1983-89). Age at incidence of disease for cancer and ESRD populations. Sources: Reference table E.14, Miller and U.S. Census Bureau.

can be seen by moving down the second diagonal of the table.

The SMRs 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 lower during the second year than it is during other years.

Detailed tabulations of annual death rates for prevalent patients 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 1990 through 1992 and correspond to the summary death rates for the last 3 columns from table V-2. They can be used to calculate expected mortality for many study groups of ESRD patients using the methodology described by Wolfe, 1992.

Comorbidity

Methods

In this edition of the ADR we also included results from the Case-Mix Adequacy (CMA) special study. We show relative mortality risks (RR) for the prevalent patients in this study for each of the comorbid conditions that are currently listed on the new Medicare ESRD Medical Evidence Form (instituted on April 1, 1995). We estimate this RR for each comorbidity based on a Proportional Hazard regression model (Cox). These RRs are not adjusted for any other comorbidities, but they are adjusted for possibly non-proportional effects of age, race, sex and diagnosis of ESRD.

Results

Column 3 of Table V-3 reports the relative mortality risks (RR). Column 2 of the table gives the percentage of the CMA population with each comorbidity (or average value for the population, when applicable). These relative risks are each significantly different from 1.0 ($p < .05$) and show that there is an increase in risk of mortality with the presence of each comorbidity. For example, patients with congestive heart failure experience 1.6 times higher risk of death than those without congestive heart failure. Congestive heart failure is present in 42 percent of the prevalent CMA population. Among the various comorbidities, the RRs ranged from a high value of 2.1 for patients with a prior cardiac arrest to a low value of 1.2 for patients with pericarditis.

The RRs for characteristics measured on a continuous scale show the relative mortality for each unit increase in the value of the measure. For each 1.0 unit increase on the scale, the mortality risk was only 41% as high for body mass index, 54% as high for serum albumin, and 8% higher for phosphorus. Figure V-15, described below, shows that the mortality for the patients in the CMA study is similar to that of the USRDS hemodialysis population as a whole.

Remaining Years of Life

Methods

The expected remaining years of life have been calculated 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 of several age-race-sex groups in order to estimate the expected remaining years of life that would result if the population were subject to those death rates. This was done for the all dialysis patients in the USRDS, using death rates from tables D.3 and D.4, which are based on the prevalent population from 1990-1992. We also compare the expected remaining years of life for all ESRD patients versus other diseases in the U.S.(U.S. Census Bureau). The ESRD death rates for this calculation were based on age-specific death rates, not race-sex specific rates.

For comparison we also calculated expected remaining lifetimes using death rates from the CMA study population. Age-race specific death rates were obtained from a proportional hazards regression model (Cox). These death rates are adjusted for the comorbid conditions given in Table V-3, along with adjustment for BMI, missing BMI, and serum albumin. Based on the coefficients from the regression model we calculated the death rates and expected remaining lifetimes corresponding to the 5th percentile of the level of risk (i.e., the 95th percentile of health) associated with comorbidity among the CMA study population. In order to represent the average CMA study patient, we also calculated death rates and expected remaining lifetimes based on the Kaplan-Meier estimated survival for the CMA study group.

Expected Remaining Lifetimes for All ESRD Patients (1990-92) and U.S. Population (1991) by Age, Race and Sex

	U.S. Population, 1991 [1]				USRDS population, 1990-1992			
Age	Black M	Black F	White M	White F	Black M	Black F	White M	White F
0-14	61.5	67.0	71.1	78.0	16.4	12.9	18.6	14.0
15-19	51.3	57.4	58.5	65.0	13.6	14.2	15.5	14.8
20-24	46.8	52.9	53.8	60.1	11.6	12.3	12.1	12.1
25-29	42.5	48.7	49.2	55.3	9.5	10.8	9.8	10.1
30-34	38.2	44.6	44.6	50.4	8.5	10.3	8.1	8.4
35-39	34.1	40.6	40.0	45.6	8.0	9.2	7.0	7.7
40-44	30.1	36.8	35.4	40.8	7.9	8.5	6.2	6.8
45-49	26.2	32.4	30.9	36.1	7.3	7.8	5.5	5.8
50-54	22.5	28.2	26.5	31.5	6.5	6.7	4.6	5.1
55-59	19.1	24.3	22.4	27.0	5.7	6.0	3.9	4.3
60-64	16.0	20.6	18.6	22.8	4.7	5.0	3.3	3.6
65-69	13.3	17.2	15.2	18.9	3.9	4.1	3.0	3.1
70-74	10.8	14.2	12.0	15.2	3.2	3.5	2.5	2.7
75-79	8.8	11.3	9.3	11.8	2.7	2.9	2.2	2.3
80-84	6.9	8.7	7.0	8.8	2.4	2.5	1.9	2.0
85+	5.4	6.5	5.1	6.1	2.0	2.0	1.6	1.6

[1] Vital Statistics of the US, vol 2: Mortality, Part A

Table V-4

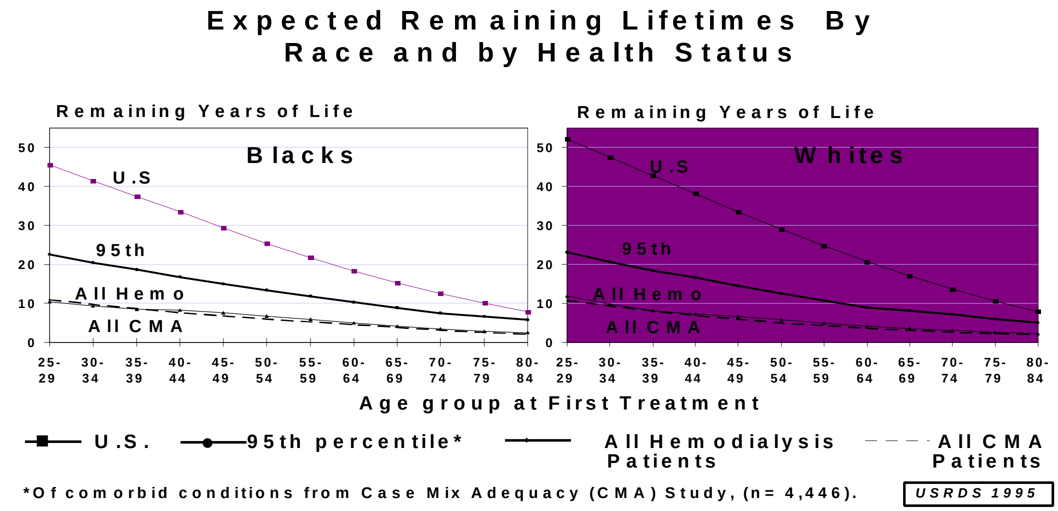

Figure V-15

Expected Remaining lifetimes for all hemodialysis ESRD patients, the prevalent patient population in the special study Casemix data and U.S. general population. Includes adjustment for comorbid conditions with the CMA data. Source: Special Analysis

Results

Despite the improvements in survival in recent years, expected remaining years of life in the ESRD population is low relative to the general population, and is similar to several other severe diseases (Figure V-14). The expected remaining lifetime for patients with ESRD is longer than that for patients with lung cancer, but shorter than that for patients with colon cancer of similar age.

Shown in Table V-4 are projections of the expected remaining years of life for prevalent ESRD patients by current age, based on death rates observed between 1990 and 1992 for dialyzed ESRD patients. The values in Table V-4 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 expected 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 as expected, 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.

Figure V-15 shows the race-age specific expected remaining lifetimes for the healthiest 95th percentile of the CMA population, along with that for the U.S. general population, all hemodialysis population, and CMA hemodialysis study group. It is interesting to note even with the dramatically higher expected lifetimes for those 'healthier' CMA patients compared to the average CMA, their expected lifetime is still typically less than half that for the general US population. Note that the correspondence between the expected remaining life estimates for the CMA and the all hemodialysis population is almost perfect, indication that the CMA study is representative of the ESRD hemodialysis population.

Figure V-15 shows that blacks in the US population have lower expected remaining lifetimes than do whites across all ages. In the hemodialysis population, blacks have slightly lower expected remaining lifetimes in younger ages than do whites.

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 1990-1992 in the calculation for ESRD patients, prevalent as of Dec. 31, 1991 in the calculation for CMA 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 here should only be used to make approximate projections and comparisons.

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