Chapter V

Patient Mortality and Survival

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

For some results (incidence), patients are categorized primarily by the year of first treatment and secondarily by the number of years of treatment. Differences in mortality among incident cohorts could be due to changes in enrollment criteria or treatment patterns for those cohorts, for example.

For other results (prevalence), the years of followup for each patient are categorized primarily by the calendar year in which the patient followup occurs (i.e., the successive years during which the patient is treated). Differences in mortality among prevalent years could reflect innovations in treatment that affect all patients being treated in that year.

The sections are:

1. Trends in adjusted death rates among *incident patients* for the years 1983-1993 and on differential mortality during the first year of ESRD therapy. Adjusted mortality rates have decreased for nearly all successive cohorts of incident patients between 1983 and 1993 during their early years of ESRD therapy.

2. *Long-term survival* based on five year survival results for the 1989 incident cohort and 10 year survival for the 1984 incident cohort. One, two and five year survival rates are also compared for the 1979 to the 1993 cohorts. Long term survival (through 5 years) is better for more recent cohorts than for earlier cohorts although most of the gains are seen in the early years of therapy.

3. Standardized mortality rates for *prevalent patients* over the years 1984-1993. Mortality among prevalent patients decreased between 1988 and 1991 and has remained nearly constant since 1991. The results for both prevalent and incident patients are integrated in Table V-2.

4. Projected *remaining years of life* for ESRD patients, by patient age. The expected lifetimes for the entire U.S. population are between 2.4 and 5.8 times those for corresponding ESRD patient groups while the ratio is between 2.8 and 6.4 compared to dialysis patients.

5. *Facility-specific* standardized mortality ratios for 1991-1993. The average patient age and percent diabetic varies substantially among facilities, so the standardized mortality ratio is a more useful tool for facilities for evaluating mortality than the crude mortality rate.

Death Rates Among Incident Patients

Methods

The trend in death rates among incident ESRD patients is presented as death rates during the first year for each incident cohort. For those surviving the first year, death rates during the second year were very similar (1995 ADR) and are not presented. The followup trend is now presented in the long-term survival section.

We calculated adjusted survival curves for the incident groups of patients starting ESRD therapy in each calendar year for the years 1983-1993 and report the corresponding death rates for patients during the first year. 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 XII.

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 refer to the tables of unadjusted survival probabilities in Section E of the Reference Tables.

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 (incident in 1992). 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 the average death rate per 100 patient years during the first year from these estimated adjusted surviving proportions using the equation:

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

Correspondingly, the fraction alive at one year can be calculated from the reported death rates as the exponential function of (-death rate). These relationships follow from standard actuarial relationships between rates and surviving proportions (Allison).

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 that for the year before 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 rates during the first year of ESRD are shown in Figure V-1 for all ESRD patients by year of incidence or transplantation. *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 followup measured since Medicare enrollment and censored at transplantation, and for first cadaveric transplant recipients categorized by year of transplantation with followup measured from the time of first transplantation.

Death rates in the first year of therapy were lower in the 1993 cohort than they were in the 1992 incident cohort of all ESRD patients by about 5 percent. This continues the general trend that has been seen during the first year for all incident cohorts since 1983, except for the 1987 cohort. There has been an overall decline in first year mortality since 1983 for all ESRD patients, for both dialysis patients and for transplant patients.

During this decade, there has been a trend towards treating older patients and more patients with diabetes (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, sex, race and diabetes been consistent over the years. Thus, the death rate reported for the 1983 cohort, for example, gives more weight to older diabetic patients than were present in that cohort, and is thus higher than the observed crude (unadjusted) rate for that group. However, there may be other changes in the patient characteristics during the decade which are not accounted for by the

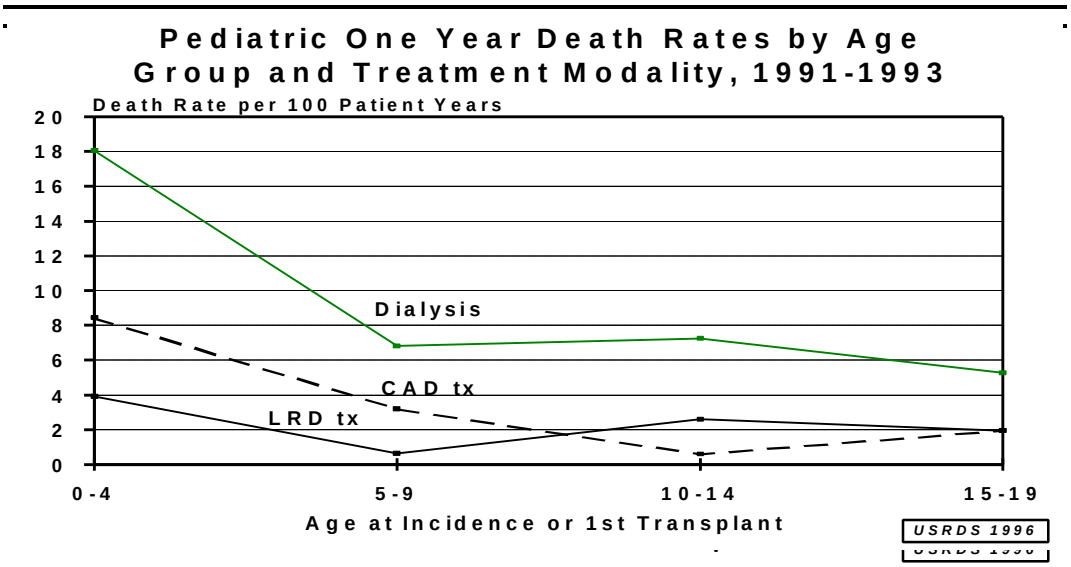

Figure V-2
Figure V-1

Unadjusted pediatric death rates by age group and treatment modality, 1991-1993. Source: Reference Tables E.5, E.7, E.9, E.30, E.38, and E.40.

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 and continued through 1 year plus 90 days (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.18, E.34 and E.42.

adjustments for age, race, sex and diagnosis, which may explain the trends seen here. For example, the current USRDS data cannot adjust for comorbidity in the overall ESRD population because these measures are not recorded for all patients.

The adjusted first year death rates for dialysis patients have decreased from 36 percent for the 1983 cohort to 26 percent for the 1993 cohort.

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.

Figure V-1 shows that the cohort of patients receiving transplants during 1992 experienced a slightly worse survival than did the 1991 cohort and that the survival for these patients did not change from 1992 to 1993. More detailed results are reported for transplant patients in Chapter VII.

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 as has been documented by a large difference in mortality risk between dialysis patients on the transplant waiting list compared to those not on the waiting list (Port). In part, the lower mortality in transplant recipients is likely related to the treatment itself. The remainder of this chapter will be limited to mortality results for dialysis patients, with followup stopped (censored) on the day of first transplantation.

Age: Figure V-2 shows first year death rates for pediatric ESRD patients by age group and treatment modality. For all pediatric age groups, patients using dialysis have much higher death rates than patients with transplants.

In the younger pediatric age groups (0-4 and 5-9), patients with living related donor transplants have lower mortality than those with cadaveric transplants. The reverse appears to be true for patients aged 10-14, with lower mortality being seen for those with cadaveric transplants than for those with living related donor transplants. For the patients aged 15-19 there is no difference in mortality between patients with cadaveric and living related donor transplants. The youngest age group (0-4) has higher mortality than any of the other pediatric age groups for all three modalities, although the difference between this group and the others is particularly large for those using dialysis.

Figure V-3 shows the first year death rates for dialysis patients by year of first ESRD therapy and age group. These death rates for all but the youngest age group (0-19) are adjusted for race, diagnosis and sex, while the death rates for the youngest age group (0-19) are adjusted for only the age characteristics of the 1992 incident cohort due to small sample sizes. There is some improvement in survival for the 1993 cohort relative to earlier cohorts for all but the youngest age group. In the 0 - 19 year age group the death rate appears to be about the same for the 1992 and 1993 incident cohorts.

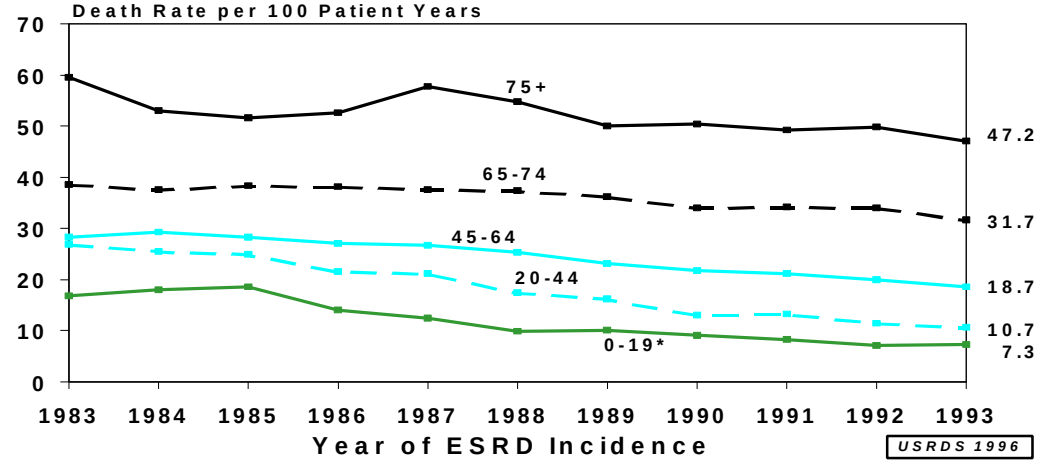

Figure V-3

Death rates based on adjusted Kaplan-Meier estimates by age at onset of ESRD and year of incidence. Starting at day 91 following onset of ESRD and continued through 1 year plus 90 days (censored at first transplant). Adjusted for the race, sex, and primary diagnosis characteristics of the 1992 incident cohort for those 20 years and older. Death rates for the 0-19 age group adjusted for only the age characteristics of the 1992 incident cohort. Source: Reference Tables E.30, E.34 and A.1.

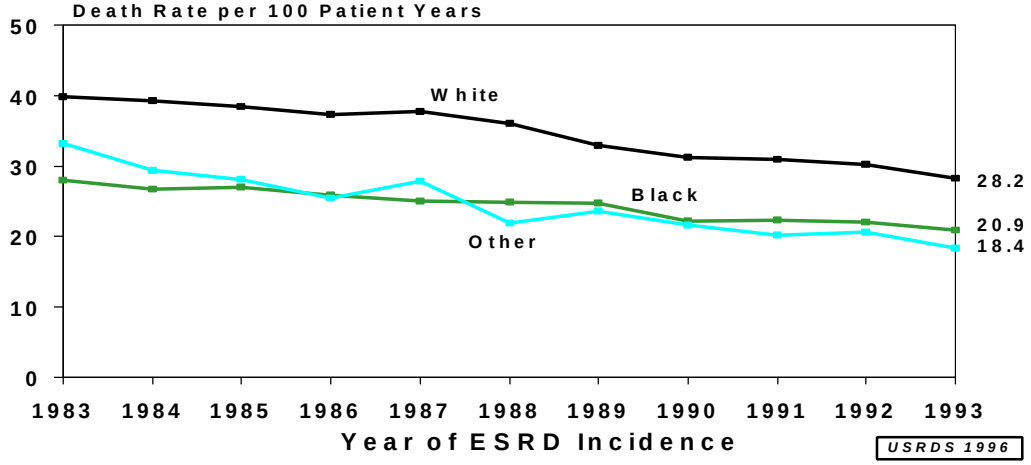

Figure V-4

Death rates based on adjusted Kaplan-Meier estimates by race and year of incidence. Starting at day 91 following the onset of ESRD and continued through 1 year plus 90 days (censored at first transplant). Adjusted for the age, sex and primary diagnosis characteristics of the 1992 cohort. Source: Reference Tables E.34.

The most consistent and greatest improvement in survival for dialysis patients has been seen in the younger adult age ranges (20-44). The death rates during the first year have decreased from 27 percent in 1983 to 11 percent in 1993 for the 20 to 44 year old age group while it has decreased from 28 percent to 19 percent for the 45-64 year old age group and it has decreased from 39 percent to 32 percent for the 65-74 year old patients in the same time interval.

Race: Figure V-4 shows death rates during the first year of ESRD 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

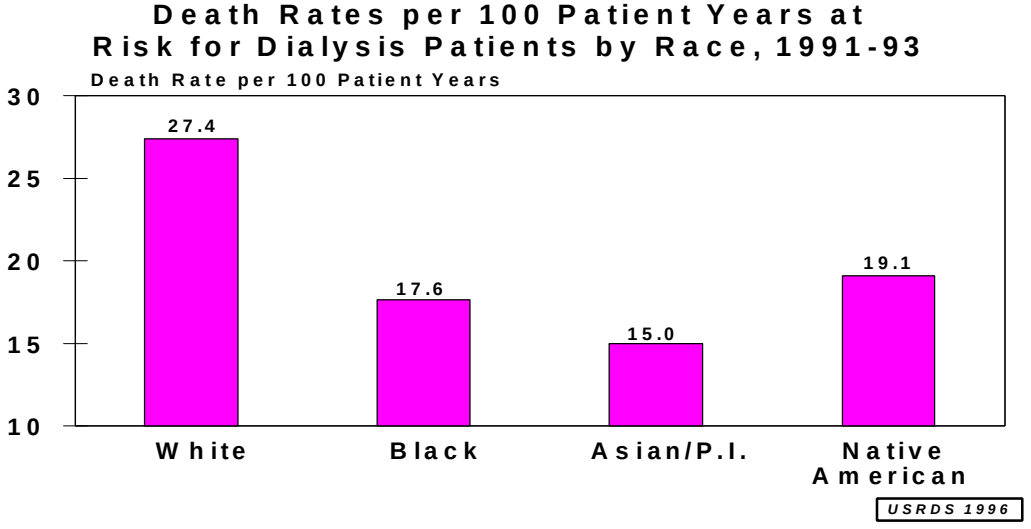

Figure V-5

Mortality rate (death/100 patient years at risk) for all dialysis patients prevalent at any time during each year by race (White, Black, Asian and Native American). Source: Reference Tables D. 2.

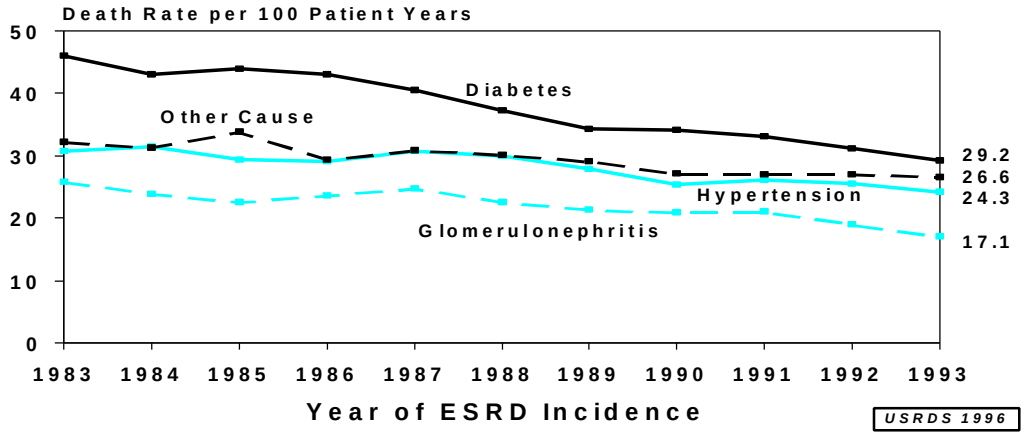

Figure V-6

Death rates based on adjusted Kaplan-Meier estimates by diagnosis and year of incidence. Starting at day 91 following the onset of ESRD and continued through 1 year plus 90 days (censored at first transplant). Adjusted for the age, race and sex characteristics of the 1992 cohort. Source: Reference Tables E.34.

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. The difference between Black and White patient one year death rates has decreased from a 12 percentage point difference in the 1983 incident cohort to a 7 percentage point difference in the 1993 incident cohort. These comparisons are adjusted for age, diagnosis and sex, and are valid on average, but may not hold for every age-diagnosis-sex subgroup.

Figure V-5 shows the unadjusted death rates per 100 patient years at risk for dialysis patients by race during 1991-93. Here, the Asian and Native American race groups are not combined into an "other" category as in Figure V-4. As in Figure V-4, the death rate for Whites is higher than that for any of the other race groups. However, this figure also shows that the death rate for Native Americans is higher than that for Blacks while the death rate for Asians and Pacific Islanders is lower than that of any of the other race groups. These death rates are not adjusted for age, sex, or primary diagnosis due to small sample sizes so the differences shown may be partially due to differences in the age-sex-diagnosis characteristics of the race groups.

Cause of ESRD: Figure V-6 shows the first year mortality rates for dialysis patients by year of first ESRD therapy and 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 1983 and 1993 for each of the four major diagnostic categories.

In 1993, the mortality during the first year was lower than that for 1991 and 1992 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 29 percent in 1993. Patients with glomerulonephritis tend to have the lowest first year mortality, 17 percent in 1993, while patients with diabetes have the highest first year mortality throughout the years shown.

Gender: Figures V-7 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. Until 1993, females have had lower one

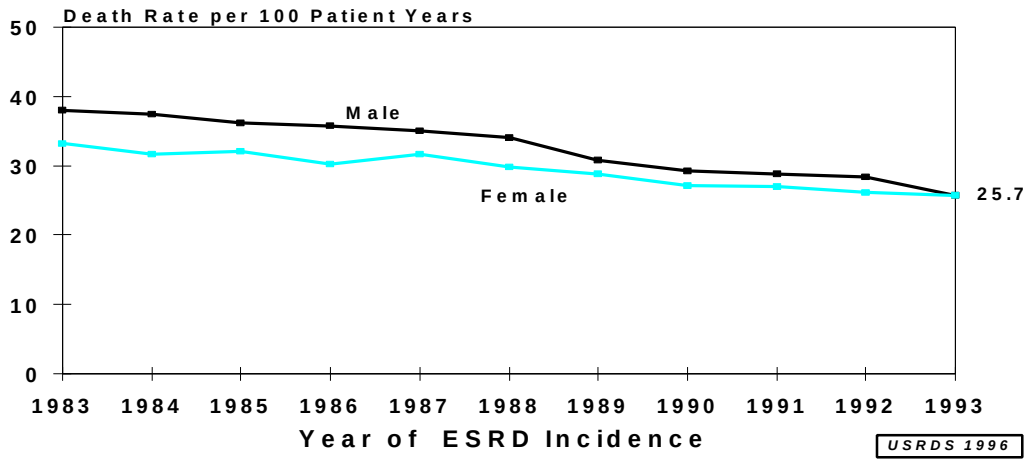

Figure V-7

Death rates based on adjusted Kaplan-Meier estimates by sex and year of incidence. Starting at day 91 following the onset of ESRD and continued through 1 year plus 90 days (censored at first transplant). Adjusted for the age, race and primary diagnosis characteristics of the 1992 cohort. Source: Reference Tables: E.34.

year adjusted mortality than males for each incident cohort. From 1983 through 1988 the difference was about 5 percentage points and this difference decreased to about 2 percentage points for the period 1989 through 1992. In the 1993 cohort the death rates have achieved parity (26 percent) for males and females.

Summary

The dramatic improvements in survival seen for the 1990 to 1992 incident cohorts are consistent across several classifications of patients and appear to have been largely sustained in the 1993 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, 1994). However, as we note below in Figure V-10, there was no decrease in mortality among prevalent patients in 1993 compared to 1992. Further, the fraction of the incident cohorts that were diabetic dropped from 36 percent to 34 percent between 1992 and 1993, reversing a consistent increasing trend between 1984 and 1992. The apparent drop in mortality for the 1993 cohort should also be qualified by the fact that the reported incidence rate for 1993 was below prior projections (see Chapter II). A shift in incidence patterns could correspond to a change in criteria for starting ESRD therapy, which would affect death rates.

It is also possible that changes in dialysis therapy may be responsible for improved survival (Hakim; Owens; Parker; Held, 1996). During this time period the renal provider community has given increasing attention to the dose of dialysis that is delivered to hemodialysis patients (see Chapter IV). 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.

Long Term Survival

Methods

We calculated adjusted survival curves for the incident groups of patients starting ESRD therapy in 1979 and 1984 and followed through 1994 resulting in adjusted five and ten year survival curves respectively.

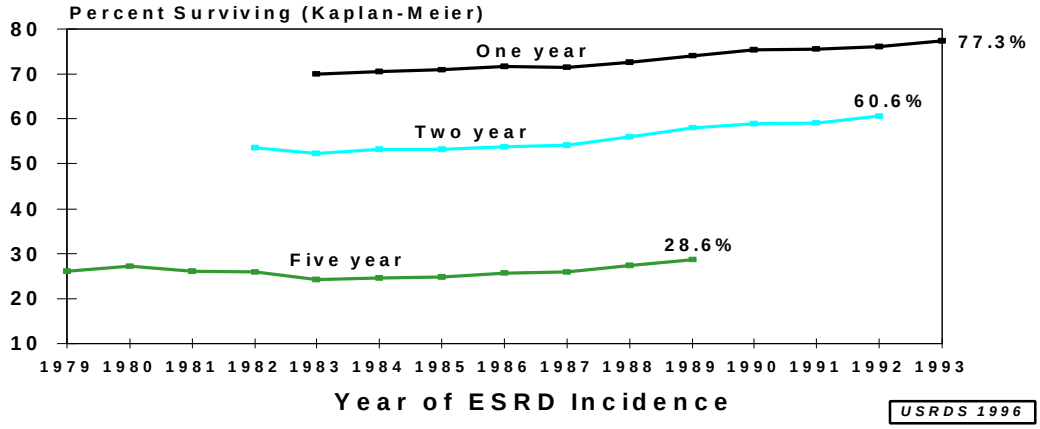

Figure V-8

Kaplan-Meier dialysis patient one, two, and five year survival estimates by year of incidence. Starting at day 91 following the onset of ESRD and continued through 1 year plus 90 days (censored at first transplant). Adjusted for the age, race, sex and primary diagnosis characteristics of the 1992 incident cohort. Source: Reference Tables E.34, E.35 and E.36.

Using Kaplan-Meier (KM) estimates as described in the Incident section of this chapter, we also report the cumulative surviving fraction at one, two and five years after day 90 of ESRD for several incident cohorts.

Results

The percent of patients surviving at one, two and five years by year of first ESRD therapy and adjusted for age, sex, race and diagnosis characteristics is shown in Figure V-8. Five year survival is shown for the 1979 through 1989 incident cohorts, two year survival for the 1982 through 1992 incident cohorts, and one year survival for the 1983 through 1993 incident cohorts. There has been a consistent improvement in one year, two year and five year survival rates since 1983. Both the two year and five year survival rates are lowest in 1983 and the five year survival rate has a trend of decreasing before 1983. This is likely due to a change in the way that the data were reported to the HCFA data and thus these survival rates may not be directly comparable to those after 1983.

Figure V-9 shows the five and ten year dialysis patient survival curves for 1984 and 1989 incident cohorts adjusted for age, race, sex and diagnosis characteristics. The 1989 cohort has better survival than the 1984 cohort throughout the first five years of ESRD therapy.

The one year survival is higher in the 1989 cohort than the 1984 cohort and of the patients who survive one year, about 4 percent more survive the second year in the 1989 cohort than in the 1984 cohort. Similarly, about 4 percent more of the patients who survive for at least two years survive through the third, fourth and fifth years in the 1989 cohort than the 1984 cohort. However, in both cohorts about 46 percent of the total incident cohort died in the second to fifth year after the onset of ESRD.

Mortality Rates for Prevalent Patients

Methods

As in the last edition of the ADR (1995), tables of mortality rates for dialysis patients are given in the appendix of this data report which include prevalent patients (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 followup for a patient was included in the SMR calculation for a particular year only after day 90 of the patient's

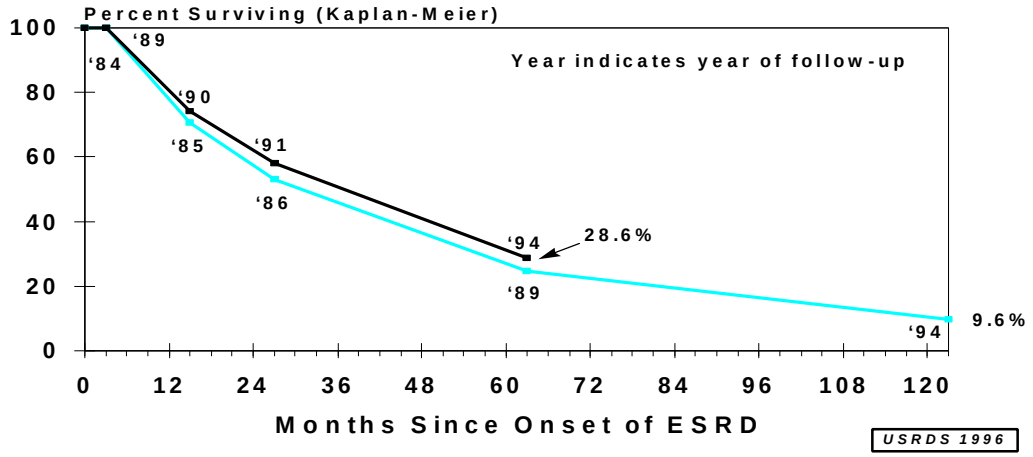

Figure V-9

Kaplan-Meier dialysis patient survival estimates (1984 and 1989 cohort). Starting at day 91 following the onset of ESRD (censored at first transplant). Adjusted for age, race, sex and diagnosis characteristics. Source: Reference Tables E.34, E.35, E.36 and E.37.

ESRD therapy or after January 1st 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 (unadjusted) mortality rate for dialysis patients of 23.3 deaths per 100 patient years based on the reference years 1991-1993 (Table D.2).

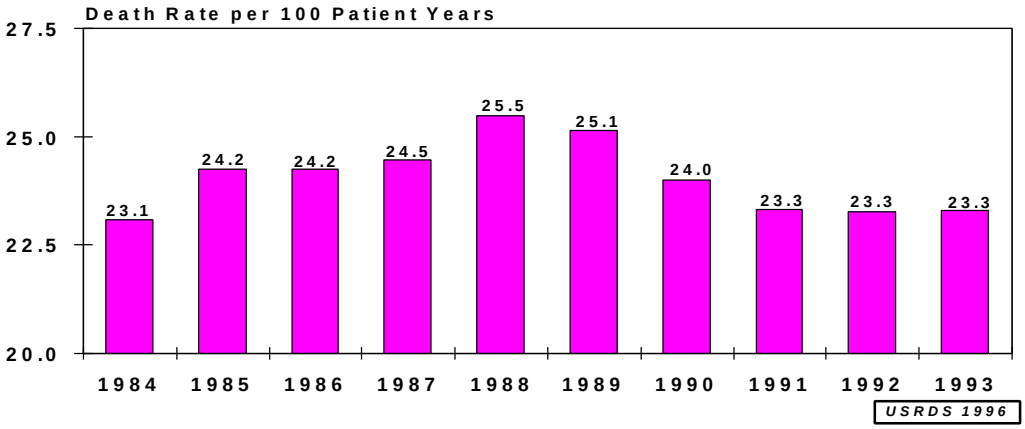

Figure V-10

Mortality rate (deaths/1000 patient years at risk) for all dialysis patients prevalent at any time during each year, this includes point prevalent patients at the beginning of each year and patients starting during each year (1984-93). Rates are adjusted for age, race (Black, White, Asian, Native American), sex and diagnosis (diabetic or nondiabetic). Patients with missing race or primary diagnosis were excluded. Source: Special Analysis.

Results

Figure V-10 shows adjusted death rates per 100 patient years at risk for prevalent dialysis patients by cohort year (1984-93).

The adjusted death rates for prevalent patients tended to increase somewhat between 1984 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 (Young; Reference Tables, Section A). 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.

Table V-1 reports crude death counts and crude death percents for successive cohorts of prevalent dialysis patients, 1984-1994. 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. Column 3 is based upon the Annual Facility Survey, as reported by individual facilities while column 4 is based upon the USRDS database. The USRDS database starts patients followup on day 90 after first ESRD treatment because of data reporting patterns. Thus, the USRDS excludes the mortality during the first 90 days which could largely explain the fact that rates in column 4 are lower than rates in column 3.

Accounting for incidence and prevalence years simultaneously

Table V-2 shows the SMRs for all patients categorized by both the year of first therapy (incidence) and year of treatment (prevalence). 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.

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 general decline in prevalent patient mortality shown over the years in Figure V-10 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 shaded 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

Crude Mortality Percent for All Dialysis Patients, 1984-1994

Survey Year[1]	Total Deaths[2]	Percent Dead [3]	Percent Dead[4]
1984	15,590	20.71	20.97
1985	18,093	22.15	19.89
1986	19,987	22.74	20.45
1987	22,116	23.43	20.68
1988	24,860	24.36	21.77
1989	26,343	23.71	21.66
1990	28,741	23.10	21.13
1991	31,667	22.98	21.14
1992	35,985	23.67	23.55
1993	39,443	23.79	21.90
1994	42,115	23.28	22.72

[1] Calendar year

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

[3] Total deaths/ total patients from AFS

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

Table V-1

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

	Year of Treatment									
Year of Incidence	1984 SMR	1985 SMR	1986 SMR	1987 SMR	1988 SMR	1989 SMR	1990 SMR	1991 SMR	1992 SMR	1993 SMR
<1984	0.98	1.00	1.04	1.03	1.09	1.08	1.08	1.03	1.01	1.04
1984	1.10	1.07	1.00	1.06	1.12	1.11	1.05	1.03	1.05	1.10
1985	.	1.15	1.04	1.04	1.10	1.16	1.11	1.12	1.03	1.02
1986	.	.	1.13	1.04	1.06	1.12	1.07	1.07	1.07	1.13
1987	.	.	.	1.14	1.09	1.04	1.07	1.07	1.10	1.11
1988	.	.	.	.	1.15	1.05	0.98	1.05	1.06	1.11
1989	.	.	.	.	.	1.11	0.99	0.94	1.04	1.05
1990	.	.	.	.	.	.	1.06	0.95	0.96	1.08
1991	.	.	.	.	.	.	.	1.06	0.95	0.97
1992	.	.	.	.	.	.	.	.	1.04	0.94
1993	.	.	.	.	.	.	.	.	.	0.97

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

Table V-2

lowest diagonal of the table (see outlined cells in Table V-2), and similarly, in the diagonals above that for third and fourth years of therapy.

The SMR of 0.97 in the main diagonal for the 1993 row is 7 percent lower than the corresponding entry for the 1992 row (SMR=1.04) reflecting lower first year mortality for the 1993 incident cohort than for the 1992 incident cohort, as reported in the earlier part of this chapter. However, the mortality increased between 1992 and 1993 among survivors from some previously incident cohorts (see columns labeled 1992 and 1993). For example, the 1989 incident cohort (1989 row of table) had an SMR of 1.04 during their 4th year of treatment (1992 column), while the 1990 incident cohort (1990 row) had an SMR of 1.08 during their 4th year of treatment (1993 column). These increases in mortality between 1992 and 1993 among earlier incident cohorts balances the improved first year mortality seen for the 1993 incident cohort, to yield no change, on average, among all prevalent patients as reported in Figure V-10.

Detailed tabulations of annual death rates for prevalent patients are reported in 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 1991 through 1993 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.

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 all White and Black ESRD patients and for all White and Black dialysis patients in the

USRDS, using death rates from reference tables D.2, which are based on the prevalent population from 1991-1993.

Results

Shown in Table V-3 are projections of the expected remaining years of life for prevalent ESRD patients by current age, based on death rates observed between 1991 and 1993 for all ESRD and for dialyzed White and Black patients. The values in Table V-3 represent averages, and the lifetimes of individual patients will often be substantially longer or shorter than these values.

The average young ESRD patient can look forward to more than one decade of life if treated for ESRD. This is true for all ESRD patients as well as for dialysis patients only. Until age 60, the expected remaining lifetime for ESRD patients is greater than that for dialysis patients. For patients over 60 there is little difference in the expected remaining lifetimes between the two groups. This is because the fraction with transplant is very low in the older population (see Chapter VII). Although the remaining lifetimes are shorter for the elderly ESRD population as a whole as well as for the dialysis population only, 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, especially for older Black males. For the entire ESRD population, the expected remaining years of life is usually between one-third and one-fourth that of the general population through age 50.

Standardized Mortality Ratios

Facility-specific reports

The USRDS distributed reports for each of N=2,053 dialysis facilities in the United States for which sufficient data were available concerning hospitalization and mortality. These reports were distributed to the facilities through the 18 regional

Expected Remaining Lifetimes for U.S. Population (1990), All ESRD Patients (1991-93) and Dialysis Patients (1991-93) by Age, Race and Sex

	U.S. Population, 1990*				ESRD population, 1991-93				Dialysis population**, 1991-93			
	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	23.7	24.1	29.2	26.8	16.6	19.1	17.5	14.4
15-19	51.3	57.4	58.5	65.0	16.7	17.3	22.3	22.2	13.9	14.6	15.4	14.9
20-24	46.8	52.9	53.8	60.1	14.0	15.5	19.1	18.8	11.6	13.0	12.6	12.2
25-29	42.5	48.7	49.2	55.3	11.7	13.4	16.3	16.0	9.7	11.4	10.4	10.1
30-34	38.2	44.6	44.6	50.4	10.5	12.2	13.6	13.6	8.7	10.5	8.4	8.4
35-39	34.1	40.6	40.0	45.6	9.8	10.7	11.5	11.6	8.2	9.4	7.2	7.5
40-44	30.1	36.8	35.4	40.8	9.2	9.7	9.6	9.8	8.1	8.6	6.3	6.8
45-49	26.2	32.4	30.9	36.1	8.3	8.7	7.9	7.9	7.6	8.1	5.5	5.8
50-54	22.5	28.2	26.5	31.5	7.3	7.4	6.4	6.5	6.7	7.0	4.6	5.1
55-59	19.1	24.3	22.4	27.0	6.0	6.4	5.1	5.1	5.6	6.1	4.0	4.3
60-64	16.0	20.6	18.6	22.8	5.0	5.2	4.0	4.0	4.8	5.1	3.4	3.6
65-69	13.3	17.2	15.2	18.9	4.0	4.2	3.3	3.3	4.0	4.2	3.1	3.1
70-74	10.8	14.2	12.0	15.2	3.3	3.5	2.7	2.7	3.3	3.5	2.6	2.7
75-79	8.8	11.3	9.3	11.8	2.9	2.9	2.3	2.3	2.9	2.9	2.2	2.3
80-84	6.9	8.7	7.0	8.8	2.4	2.5	1.9	1.9	2.4	2.5	1.9	1.9
85+	5.4	6.5	5.1	6.1	1.9	1.9	1.6	1.6	1.9	1.9	1.6	1.6

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

** censored at transplant

Table V-3

ESRD Network Offices. The reports were based on patient followup between 1991 and 1993 and these reports represent the first time that facility-specific data have been consistently calculated and distributed to facilities.

One of the main features of these reports was an adjusted mortality rate, based on the standardized mortality ratio (SMR) that compares the mortality at a facility to the norm of the death rates for virtually all US dialysis patients in the USRDS database. The SMR accounts for the age, race, sex, and diabetes status of the prevalent patients at a facility and compares the observed mortality rate at the facility to the rate that would be expected based on national death rates for these patient characteristics.

Table V-4 summarizes the differences across facilities of several mortality measures using 1991 through 1993 data. The table is limited to N=1,896 facilities with at least 5 dialysis deaths expected between 1991 and 1993. The rows of the table correspond to percentile values; for example the rows labeled 25 percent and 50 percent give the 25th percentile and median values over facilities, respectively, for each measure. The facilities in a percentile range for one measure are typically different facilities from those in the same percentile range for another measure. For example, the facilities with the 10 percent lowest crude (unadjusted) death rates are *not* the same facilities as those with the 10 percent lowest SMR values, although there is some overlap between these two groups of facilities.

Columns 2 and 3 of the table summarize crude mortality rates. Column 2 of the table shows the crude mortality per 100 patients at a facility on January 1 of a year. Of the patients prevalent on January 1, 18 percent died during the year at the median (19 percent at the average) facility, while 13 percent or fewer died for 10 percent of the facilities and 24 percent or more died for 10 percent of facilities, as indicated in the 90th percentile row. The crude mortality per 100 patients does not account for the fact that patients are at risk for only part of a year, if transplanted during that year.

Column 3 of the table summarizes rates of deaths per 100 patient years, which counts only part of a year for a patient if the patient is transplanted or dies during the year. Rates of deaths per 100 patient years vary substantially among these facilities. Of patients prevalent on January 1 or starting dialysis during a year, the median death rate was 0.24 (mean is 0.25), while the death rate was less than 0.16 for 10 percent of these facilities and was greater than 0.35 for 10 percent of facilities (90th percentile).

The death rates are expected to vary among facilities because the characteristics (age, race, sex, diabetes) of patients also vary among facilities. The

Mortality Among 1,896 Facilities with more than 5 Medicare Dialysis Deaths Expected 1991-93.

Percentile (1)	Crude Rate per 100 Patients (2)	Crude Rate per 100 Pat Years (3)	Expected per 100 PY (4)	SMR* (5)
Min	3	4	10	0.20
1	8	9	15	0.45
10	13	16	19	0.71
25	15	20	21	0.85
50	18	24	24	0.99
75	21	29	27	1.17
90	24	35	31	1.38
99	33	49	35	1.89
Max	42	74	43	2.58
Mean	19	25	25	1.03

* SMR of 1.00 is for the national average

Consistency of SMRs and Crude Death Rates for 1,896 Units

SMR	Crude Death Rate ≤ .25 (Below Nat Avg)	Crude Death Rate > .25 (Above Nat Avg)
≤ 1.0	775 (41%)	196 (10%)
> 1.0	232 (12%)	693 (37%)
All	1007 (53%)	889 (47%)

Shaded cells show agreement between the crude death rate and the SMR classifications. Off-diagonal cells show that the crude death rate and the SMR classifications disagree for 22% of facilities.

Table V-4

expected number of deaths at a facility was calculated based on the individual characteristics and duration of followup (until death or transplant) during a year for the patients at each facility and on the national death rates. This expected number of deaths was divided by the number of patient years of followup at each facility to yield an expected death rate.

Column 4 of Table V-4 reports the differences in standard death rates among facilities. For 10 percent of facilities, the death rate is expected to be 0.19 or less, based on the age, race, sex, and diabetes characteristics of the patients at those facilities. Similarly, the death rate is expected to be 31 percent or greater for 10 percent of these facilities (90^{th} percentile). This variation in expected death rates explains some of the variation in the observed crude death rates, as indicated by an r-squared correlation of 18 percent.

The SMR (column 5) compares the crude death rate to the expected death rate as a ratio. The SMR gives a way to interpret the crude death rate relative to the expected death rate. Column 5 of the table shows that the crude death rate is only 71 percent (SMR=0.71) of the expected rate for 10 percent of facilities. That is, at 10 percent of facilities, the observed crude rate is at least 29 percent lower than the rate that would be expected based on the patient characteristics at that facility. Similarly, the crude mortality rate is at least 38 percent higher (SMR=1.38) than the expected death rate for the highest 10 percent of facilities (90^{th} percentile). Thus, while the differences in the expected death rates explain some of the variation in crude death rates, the variability in the SMR indicates that the crude rates vary even more than would be expected on the basis of the different age, race, sex, and diabetes characteristics of the patients at the facilities.

Some of the variability in the crude death rates and the SMR values is due to random variation, and is thereby unimportant. The random variability in the SMR values was accounted for by calculation of the statistical significance (p-value) and confidence intervals in the individual facility reports. Here we report the estimated standard deviation of the SMR values that would arise if there were no variation due to random fluctuations, but only variation due to true differences among facilities. Using the method of McPherson, the data indicate that the standard deviation of the true SMR among facilities, is close to plus or minus 20 percent. That is, the true SMR values typically range between 0.8 and 1.2, while values as extreme as 0.6 or 1.4 can also be expected to arise. This indicates that there are substantial real differences in standardized mortality among facilities.

Table V-5 shows that classification of facilities on the basis of the crude death rate alone would not correctly identify those facilities with crude mortality rates that were higher or lower than the expected mortality rates based on the patient characteristics at those facilities. In fact, of the facilities with crude death rates less than 0.25 (the national average), nearly a quarter had mortality higher than expected from the patient characteristics at that facility. Similarly, of the facilities with crude death rates greater than 0.25, nearly a quarter had mortality lower than expected from the patient characteristics at that facility. Thus, if facilities were classified as high or low mortality on the basis of crude mortality alone, the classification would be wrong 22 percent of the time, relative to the standard of having higher or lower mortality than would be expected for the patients being treated at that facility.

Calculation of expected death rates

The calculation of expected death rates relies on national death rates tabled by age, race, sex, and diabetes categories. The USRDS methodology for the calculation of these death rates tables has changed this year. The changes are technical and relate to the fact that some data components of patient followup are missing in the USRDS data base. Starting this year, the USRDS methodology excludes patients whose race (African-American, Asian-American, European-American, Native-American) or diabetes status is not recorded in the USRDS data base. Previously, those patients were included in calculations by using non-specific death rates. Patients whose cause of ESRD was recorded as "unknown" continue to be categorized as nondiabetic. In addition, the time at which patients are identified as lost to followup due to a cessation of billing information has been extended slightly in comparison to the previous method. The overall impact is that new USRDS calculations of standardized mortality are based on approximately 5 percent fewer patients than previously, but the remaining patients are included for a longer period of time at loss to followup.

These technical changes in methodology have a relatively small impact on the SMR calculation for most facilities. However in addition to these technical changes, the standard death rate tables have changed as mortality among prevalent dialysis patients has fallen over recent years. SMR values based on the new death rate tables tend to be higher than SMR

values based on older tables because the expected death rate is lower when based on the new tables.

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