

Chapter VI

Causes of Death

Analyses of cause-specific mortality may serve as a source of new hypotheses to explain the high mortality rate of the ESRD population, and through further in-depth epidemiologic and clinical research efforts, facilitate its reduction. This chapter describes death rates for specific causes of death per year at risk among various subgroups of prevalent dialysis and transplant patients.

Analytical Methods

The primary source of information on causes of death among the ESRD population is the HCFA ESRD Death Notification Form. This form was revised and the new form fielded in 1990. It now includes 59 cause of death categories (including categories for “other known” and “unknown” cause) as compared to the 22 causes listed on the previous form. In addition, withdrawal from dialysis was listed as one of the 22 causes on the previous form. The new form inquires whether withdrawal from dialysis occurred prior to death as a separate item. Thus for each death, the patient’s physician reports both the cause of death and whether the patient withdrew from dialysis prior to death. In view of these changes in reporting (effective during 1990), the current USRDS report includes data for years 1991-1992 only. Future ADR’s will allow analysis of trends in cause specific mortality using information provided by this new Death Notification Form.

The USRDS includes a “missing” cause of death category for those patients who, by means of the Social Security Death Benefits files and hospital discharge records, are known to have died but for whom no Death Notification Form was received. Analyses of these sources reveals that the Death Notification Form is missing or incomplete in about 12 percent of total reported deaths. For completeness, the death rates for patients with missing cause are also shown as a category in all tables. For the purpose of this report, the 59 causes on the HCFA Death

Notification Form plus the “missing” category, were collapsed into 14 cause of death categories as shown in Table VI-1. More detailed information is provided in the Reference Tables, section D (collapsed to 22 causes). This chapter presents data for adult ESRD patients (age 20 and over). Causes of death for pediatric patients are described in Chapter VIII.

Death rates by primary cause of death were analyzed among patients who were prevalent at the beginning of, or incident (defined as 90 days following start of ESRD) during, the years 1991 and 1992. Patients were followed through each year and the days at risk were calculated for each patient by year, so that patients dying during a year contribute only the days from Jan 1 (if prevalent) or inception (if incident) to date of death. On this basis, statistics for patient years at risk were calculated. A patient prevalent at the beginning of both 1991 and 1992 contributed data to both years. In all analyses, patients were censored at loss to follow-up or end of the calendar year, and in analyses of dialysis groups, patients were censored at transplantation. Patient follow-up was characterized by age (20-44, 45-64, 65+), race (black, white), sex, and modality (PD, never transplanted; HD, never transplanted; unknown dialysis, never transplanted; functioning transplant; PD, failed transplant; HD, failed transplant; unknown dialysis, failed transplant) at the beginning of each cohort year for prevalent patients or at 90 days of ESRD for incident patients, better reflecting the effect of modality, which may change in a given patient from one year to the next. The total number of patient deaths by cause and years at risk for both years were aggregated to enhance the stability of the estimated death rates.

As compared to stratified unadjusted death rates in prior ADRs, cause-specific death rates for various patient subgroups presented in this chapter were statistically adjusted for demographic covariates (age, race, sex, diabetes and as indicated, for modality)

**Adjusted Cause Specific Death Rates for All ESRD Patients
Collapsed Categories from Causes of Death on Death Notification
By Sex, Race, Age (20-64, 65+), and Diabetic Status, 1991-1992**

Cause of Death ¹	Deaths per 1,000 Dialysis Patient Years ³								
	Total	Male	Female	Black	White	Age 20-64	Age 65+	Diab	Non-Diab
Acute Myocardial Infarction (Acute MI)									
Cardiac Arrest, cause unknown	21.1	16.7		14.5	21.9			28.2	15.1
Cardiac Arrest	30.6	31.7	29.6	27.6	29.8			35.1	24.7
Cardiac, other	28.6	30.7	26.2	20.6	32.7			36.2	25.2
Atherosclerotic heart disease	9.4	11.5		10.2	10.9			8.4	
Cardiac arrhythmia	18.2	17.0	19.3	18.6	18.5			26.2	25.9
Other myocardial	6.2	6.9	5.5	5.1	6.8			9.7	7.2
Pericarditis, including cardiac tamponade	1.2	0.5		2.3	0.3	1.7	0.1	0.2	1.5
Pulmonary edema, due to exogenous fluid	6.3	6.3		6.3	7.3	4.4	11.6	4.2	8.0
Malignancy	8.8	8.1	5.4	2.9	3.8	2.5	5.0	3.0	3.7
Heart disease	3.5	3.4	3.6	2.9	3.8	2.5	5.0	3.0	3.7
Hyperkalemia	3.6	3.7	3.5	2.3	4.5	2.9	4.4	5.3	3.1
Cerebrovascular (CVD)	1.9	1.6	2.3	1.4	2.2	0.9	3.3	2.1	1.8
Cerebrovascular accident	23.3	22.6	24.0	17.6	26.5	16.1	34.2	28.8	21.1
Ischemic brain damage	12.2	12.6	11.8	12.3	12.2	8.9	17.0	16.2	10.3
Missing	23.5	25.7	21.1	18.9	26.0	19.3	40.3	31.1	20.6
Septicemia	188.8	196.3	180.9	160.6	205.1	129.2	285.3	248.7	164.1
Septicemia, due to vascular access									
Cholangitis									
Polycystic liver disease									
Liver failure, cause unknown									

Source: Special Analysis. Liver failure, cause unknown

¹ Adjusted for sex, race, age (20-64 years) and diabetic status
² Collapsed from Death Notification Form (HCFA 2746) as per Table VI-1
³ Death Rates add vertically to the total.

Other Infection

- Pulmonary infection, bacterial
- Pulmonary infection, fungal
- Pulmonary infection, other
- Viral infection, CMV
- Viral infection, other
- Tuberculosis
- Fungal peritonitis
- Infection, other
- Hepatitis B
- Other viral hepatitis

Table VI-2

- Perforation of bowel
- Bone marrow depression
- Dementia
- Seizures
- Diabetic coma, hypo/hyperglycemia
- Chronic obstructive pulmonary disease
- Complications of surgery
- Air embolism
- Accident related to treatment
- Accident unrelated to treatment
- Suicide
- Drug overdose-street drugs
- Drug overdose
- Other identified cause

AIDS

Malignancy

- Malignant disease, Hx of immunosupp. Rx
- Malignant disease, other

Unknown

Missing (Cause of death not recorded or no Death Notification Form)

* Revised, 1990

Table VI-1

using direct standardization. Adjustments for age were by 5 year age categories. Patients less than age 20 were excluded. Stratified unadjusted death rates for a variety of subgroups are presented in the Reference Tables, Section D. Both adjusted and unadjusted death rates due to different causes of death (columns) can be added within a given patient subgroup.

Although death rates tend to be more informative, it is also of interest to analyze the distribution of causes of death among patients who died. This also allows comparisons with other studies and data from other registries which present the percent distribution of cause of death. Percentages can be calculated for various subgroups from death rates in the reference

tables and from the "total" columns of Tables VI-3 to VI-6 by dividing the cause-specific death rate by the overall reported death rate (i.e. death rate for total minus missing). For patient subgroups listed in Tables VI-3 to VI-6, dividing an adjusted death rate by the overall reported death rate would result in the expected percent of deaths.

Cause Specific Death Rates

Table VI-2 shows death rates among prevalent and incident ESRD patients (dialysis and transplant) by cause of death for sex, race, age (20-64 years and greater than 65 years) and cause of ESRD (diabetes versus all others) subgroups, adjusted for all other covariates. Cardiac arrest of unknown cause, acute

Adjusted¹ Death Rates and Percent Distribution of Specific Cardiac Causes, Among All Cardiac Causes for All ESRD Patients, 1991-92

Cause of Death	Total DR	% of Cardiac	% of Total
Acute myocardial infarction	18.9	23.2	10.0
Cardiac arrest, cause unknown	30.6	37.4	16.2
Cardiac arrhythmia	11.0	13.5	5.8
Cardiomyopathy	7.3	9.0	3.9
Atherosclerotic Heart Disease	7.2	8.9	3.8
Valvular	1.1	1.4	0.6
Pericarditis	0.4	0.5	0.2
Pulmonary edema	1.5	1.8	0.8
Total Cardiac	81.8	100.0	43.3
Overall Total	188.8		

¹ Adjusted for age (5 yr categories), race, sex, and diabetic status Medicare patients over age 20. Source: Special Analysis

Table VI-3

myocardial infarction and all other cardiac causes combined are the most commonly reported causes of ESRD patient deaths, with adjusted death rates of 30.6, 18.9 and 28.6 deaths per 1000 patient years, respectively. The high prevalence of cardiac disorders in ESRD patients has been noted previously and has been shown to be associated with an elevated risk of mortality (USRDS 1992; Churchill 1992; Foley 1995). As expected, these rates increase in older age groups, reaching respectively, 44.7, 27.3 and 46.1 deaths per 1000 patient years for patients age 65 and older. Death rates due to these cardiac causes are substantially higher among diabetics than among non-diabetics. They are also higher among white than black and among male than female ESRD patients (particularly acute MI).

Prior USRDS reports have shown that the category "cardiac causes other than acute MI" accounted for the largest percentage of deaths. The new Death Notification Form has provided more detailed information on cardiac causes of death which are shown in Table VI-3. This table shows the percent distribution of specific cardiac causes among all cardiac deaths and among all deaths. It shows that the majority of deaths in the "other cardiac" category used in prior reports are attributed to "cardiac arrest, cause unknown". This category accounts for the largest proportion of cardiac deaths (37 percent). Acute myocardial infarction, cardiac arrhythmia, atherosclerotic heart disease and cardiomyopathy account for 23 percent, 13 percent, 9 percent and 9 percent of cardiac deaths respectively. Pulmonary edema, valvular disease, and pericarditis are relatively uncommon cardiac causes of death.

The overall death rate due to cerebrovascular disease was 10.5 deaths per 1000 patient years (Table VI-2). The death rates due to this cause increased substantially by age, were almost twice as high among diabetics than non-diabetics, were higher among females than males and were similar by race.

If one assumes that virtually all cardiac deaths are due to atherosclerotic disease, then the combination of acute myocardial infarction, cardiac arrest, other cardiac and cerebrovascular accident gives an estimate of the contribution of atherosclerotic cardiovascular disease to all deaths in ESRD patients. This sum accounts for a death rate of 88.6 per 1000 patient years overall (47 percent of all deaths) and a death rate as high as 133.5 per 1000 years among the over 65 age group (47 percent of all deaths in this age category).

The overall death rate due to septicemia was 18.2 per 1000 patient years and due to other infections (excluding AIDS) was 6.2. Combined, these infectious causes had a higher death rate than acute myocardial infarction overall and for all subgroups shown. ESRD patients are known to have a high incidence of infection due to defects in cellular immunity, neutrophil function and complement activation (Khan 1993; Vanholder 1993). Although death rates due to septicemia were higher for females than males, the death rate due to other infections was higher among males. Adjusted death rates due to septicemia were similar among blacks and whites, whereas death rates due to other infections were higher among whites. Death rates due to both infectious etiologies were higher among patients age

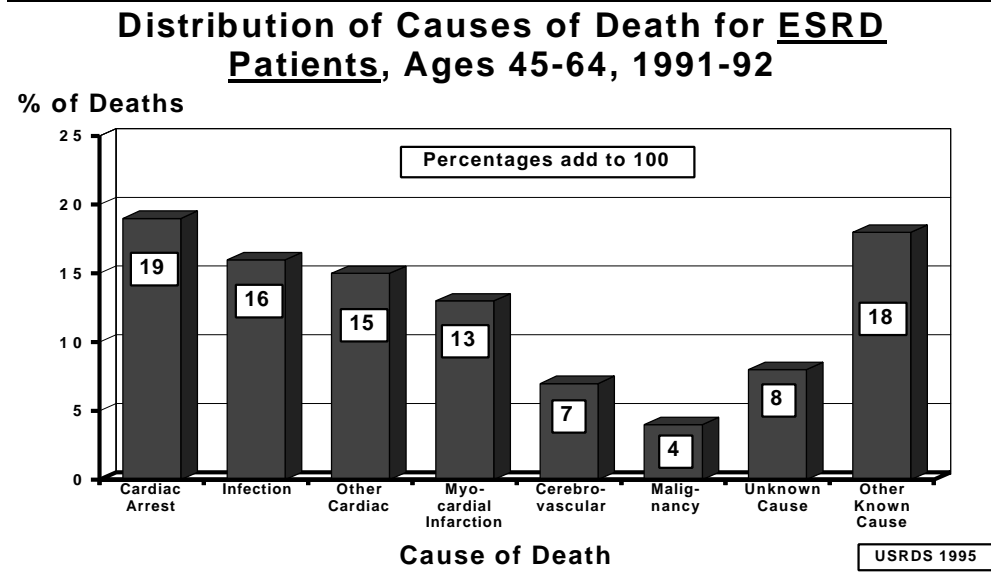


Figure VI-1

The categories are collapsed from the Death Notification Form as per Table VI-1. Infection includes Septicemia, Other infection, and AIDS. Other known cause includes Hemorrhage, Cachexia, Hyperkalemia, and Other. Missing cause of death is excluded. Patients in Puerto Rico and the U.S. Territories are included. Medicare patients only. Source: Reference Table D. 31.

65 and older compared to younger categories and among diabetics compared to non-diabetics. AIDS was an uncommon reported cause of death for the ESRD population (< 1 percent overall). Adjusted death rates due to AIDS were over 3 times higher for males than females, over 8 times higher among blacks than whites and over 20 times higher among patients 20-64 compared to those over 65, which seems to reflect the risk of acquiring AIDS. Death rates due to AIDS were much lower among diabetics than non-diabetics, probably due to competing risks.

Death rates due to malignancy (6.8 deaths per 1000 patient years) indicate that malignancy is not a common cause of death. Previous studies have suggested an increased risk of certain malignancies in the dialysis (Port, Ragheb 1989; Kantor 1987; Inamoto 1991) and transplant (Penn 1988) population as compared to the general population. Although this may be due to the effect of uremia or a side-effect of renal replacement therapy, the recent USRDS Case Mix studies found a diagnosis of malignancy in 9 percent of patients at initiation of therapy (USRDS 1992), suggesting that acceptance of patients with malignancy is relatively common. Death rates due to this cause are almost 3 times higher among ages 65+ compared to ages 20-64 and almost 2 times higher among non-diabetics than diabetics. The latter may again reflect the issue of competing risks among

diabetics i.e. the high probability of dying of other causes.

Figure VI-1 shows the percent distribution (rather than death rates) for the major categories of cause of death among all ESRD patients aged 45-64 years. Nineteen percent of all deaths were attributed to the category cardiac arrest, cause unknown, followed by infection (16 percent), “other cardiac causes” (15 percent), myocardial infarction (13 percent), cerebrovascular disease (7 percent) and malignancy (4 percent). The distribution is similar for patients over 65 with the exception that “other cardiac causes” are somewhat more common and infection less common as causes of death than in patients age 45-64.

Causes of Death among Dialysis Patients

Death rates by cause of death were analyzed for prevalent and incident ESRD patients treated with hemodialysis or peritoneal dialysis who had never received a transplant. Patients with a history of prior transplant and receiving “unknown” dialysis were excluded. Patients transplanted during the year of observation were censored (removed from the analysis) on day of transplantation. Results of this analysis are shown in Table VI-4. These death rates

are adjusted for age, race, sex, modality and diabetic status. Overall, patterns of cause of death for *dialysis* patients are similar to those described above for all *ESRD*. However, death rates due to all causes of death are higher for *dialysis* patients than for the general *ESRD* population because the *transplant* population, which is generally younger and healthier and which has lower death rates, is included in the total *ESRD* category. Cardiac causes of death predominate with cardiac arrest, acute MI, other cardiac causes and cerebrovascular disease accounting for 48 percent of deaths, with death rates of 42.8, 26.1, 40.2 and 14.4 per 1000 dialysis patient years respectively.

A comparison of the all-cause mortality rates by dialysis modality adjusted for age, sex, gender, and diabetes (Table VI-4) reveals an 18 percent higher risk of death among prevalent peritoneal dialysis compared to prevalent hemodialysis patients, consistent with a prior study which used similar USRDS prevalent patient data, for years 1987-89 (Bloembergen, in press). This difference has previously been shown to be attributed to an increased risk of death due to infection, acute myocardial infarction, all other cardiac causes (including cardiac arrest), cerebrovascular disease, and withdrawal from dialysis (Bloembergen, in press). Table VI-4 allows a similar comparison of cause of death and shows that death rates due to acute myocardial infarction, "other cardiac causes", cerebrovascular disease, septicemia, and cachexia are greater among PD than HD treated patients. This analysis adds more detailed information regarding cardiac causes of death, by indicating that although there is a substantial difference in death rates due to acute MI and "other cardiac causes" there is virtually no difference in death rates due to cardiac arrest

among PD and HD treated patients. The death rate due to malignancy is lower for peritoneal dialysis than hemodialysis, also consistent with the prior study. This analysis also reveals that death rates due to hyperkalemia and hemorrhage are higher among hemodialysis patients. These differences in cause-specific mortality among PD and HD treated patients may be due to the technical differences of these dialysis modalities, differences in medical care, compliance, or dose of dialysis. Difference in case-mix severity among these patient groups may also play a role although a previous study has shown relatively small differences in comorbidity between PD and HD treated incident patients (Held et al 1994).

The all-cause death rate remains higher (7 percent) among male than female dialysis patients although this difference has decreased over the past decade (Chapter V). Table VI-4 shows that this difference is mainly attributable to higher adjusted death rates due to acute myocardial infarction, malignancy, cardiac arrest, and other cardiac causes. This is consistent with a previous study that compared cause-specific mortality between males and females (Bloembergen 1994), although the relative risks (male/female) are lower due to the decrease in the difference of all-cause mortality between males and females, over recent years. Also consistent with this study and of note is that death rates due to cerebrovascular disease are higher among females. Death rates reported to be due to septicemia were higher among females while death rates due to other infections were higher among males. Death rates due to hemorrhage and cachexia are higher among females and due to AIDS and hyperkalemia are higher among males, although the death rates for each of these causes are low.

**Adjusted¹ Cause Specific Death Rates for Never Transplanted Dialysis Patients²
By Treatment Modality, Age, Sex, Race and Diabetic status, 1991-1992**

Cause of Death ³	Deaths Per 1000 Patient Years ⁴										
	Total	HD	PD	Male	Female	Black	White	20-64	65+	Diab	No-Diab
Acute MI	26.1	25.3	32.4	28.8	23.3	19.3	29.6	18.1	35.6	36.7	21.1
Cardiac Arrest	42.8	43.1	44.1	44.4	41.3	37.3	46.1	29.1	59.8	60.2	34.9
Other Cardiac	40.2	39.1	49.9	40.6	37.1	28.3	46.4	24.0	59.5	37.7	35.7
CVD	14.4	14.1	17.8	12.9	15.8	13.7	14.8	9.8	20.2	19.7	11.7
Septicemia	24.7	23.4	38.8	22.9	26.4	24.8	25.3	18.3	33.4	34.3	20.1
Other Infection	7.9	7.8	8.3	8.9	7.1	6.2	8.9	4.7	11.8	9.1	7.4
AIDS	1.7	1.5	3.5	2.5	0.7	2.8	0.4	2.4	0.1	0.3	2.1
Malignancy	9.1	9.5	7.1	11.1	7.3	8.6	9.9	5.8	13.7	5.3	10.9
Hemorrhage	4.8	4.9	3.8	4.6	5.0	3.9	5.2	3.3	6.4	3.9	5.1
Hyperkalemia	5.0	5.4	3.1	5.2	4.8	3.0	6.3	4.0	6.1	6.8	4.3
Cachexia	2.7	2.6	4.4	2.3	3.2	1.9	3.2	1.3	4.4	2.9	2.6
Other	31.7	31.2	36.3	30.9	32.5	22.8	36.7	21.3	43.4	37.2	29.1
Unknown	16.6	16.4	19.3	17.0	16.3	16.5	16.8	12.0	22.4	21.1	14.2
Missing	29.5	29.7	30.8	32.5	26.8	21.9	33.5	17.9	43.4	37.4	26.2
TOTAL	257.2	254.0	299.4	264.5	247.4	210.8	283.0	172.0	360.1	312.4	225.4

Medicare patients over age 20. Source: Special Analysis

¹ Adjusted for sex, race, age (5-year categories), modality and diabetic status

² Excludes patients with a history of prior transplant and on "unknown dialysis".

³ Categories collapsed from Death Notification Form (HCFA-2746) as per Table VII-1

⁴ Death Rates add vertically to the total.

Table VI-4

The risk of death is also known to be higher among white than black dialysis patients. This has previously been shown to be attributed to an increased risk of death due to acute myocardial infarction, all other cardiac causes, withdrawal from dialysis and infection (Bloembergen 1994). Table VI-4 confirms that the adjusted death rates for all causes are higher among whites than blacks with the exception of AIDS for which death rates are markedly lower for whites. The largest excess risk is for "other cardiac causes", acute MI, cardiac arrest and infection. Although the numbers are small, the relative risk of death due to hyperkalemia, cachexia

and hemorrhage are substantially higher among whites.

Among dialysis patients, diabetics have substantially higher adjusted death rates due to acute myocardial infarction, cardiac arrest, septicemia, cerebrovascular disease, and hyperkalemia than non-diabetics. Death rates due to AIDS, malignancy and hemorrhage are lower among diabetic than non-diabetic patients.

Causes of Death among Transplant Recipients

Adjusted¹ Cause Specific Death Rates for All Patients with a Functioning Transplant², by Age, Sex, Race and Diabetic status, 1991-1992

Cause of Death ³	Deaths Per 1000 Patient Years ⁴								
	Total	Male	Female	Black	White	20-44	45-64	Diab	No-Diab
Acute MI	2.58	3.11	1.83	2.89	2.54	1.58	4.12	6.20	1.53
Cardiac Arrest	2.40	2.26	2.60	3.10	2.24	1.68	3.52	5.39	1.54
Other Cardiac	1.51	1.64	1.30	2.21	1.38	1.04	2.18	3.27	1.04
CVD	1.44	1.35	1.51	1.76	1.37	0.91	2.24	3.66	0.76
Septicemia	2.00	2.20	1.73	3.47	1.77	1.26	3.32	4.31	1.54
Other Infection	1.47	1.66	1.16	1.78	1.36	1.19	1.76	2.46	1.13
AIDS	0.11	0.11	0.11	0.63	0.02	0.13	0.10	0.12	0.12
Malignancy	1.60	1.81	1.26	1.51	1.63	0.60	3.10	1.99	1.65
Hemorrhage	0.43	0.41	0.43	0.76	0.34	0.35	0.54	0.30	0.42
Hyperkalemia	0.14	0.16	0.11	0.15	0.13	0.11	0.19	0.26	0.11
Cachexia	0.04	0.04	0.04	0.06	0.04	0.00	0.11	0.11	0.03
Other	3.18	3.26	3.04	4.47	2.93	2.30	4.45	5.32	2.50
Unknown	1.99	2.26	1.61	3.01	1.79	1.40	2.91	3.96	1.42
Missing	9.9	10.86	8.28	12.65	9.33	5.70	16.31	16.41	7.76
TOTAL	28.79	31.13	25.01	38.45	26.87	18.25	44.85	53.76	21.55

Medicare patients over age 20. Source: Special Analysis

¹ Adjusted for sex, race, age (5-year categories), modality and diabetic status

² Prevalent patients with a functioning transplant on January 1.

³ Categories collapsed from Death Notification Form (HCFA-2746) as per Table VII-1

⁴ Death Rates add vertically to the total.

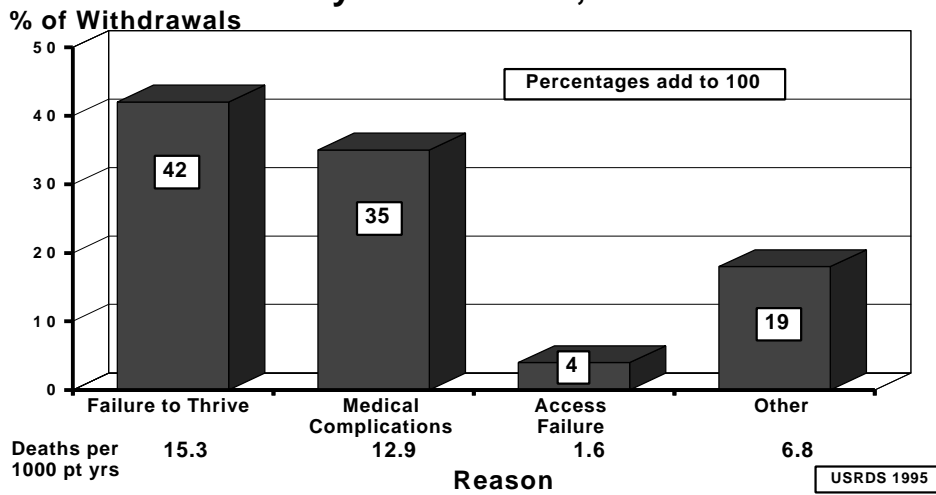
Table VI-5

Table VI-5 shows cause-specific death rates per 1000 patient years for all prevalent patients with a *functioning transplant* on Jan 1 of 1991 and of 1992, adjusted for sex, race, age and diabetes status. Patients are followed through the remainder of each year independent of transplant failure. Comparison of patients with similar age reveals markedly lower death rates for patients with a functioning transplant

than for those on dialysis. This is likely due in part to selection of healthier patients to transplantation (Port 1992, Gaylin 1993; USRDS 1992).

Similar to the *dialysis* population, death rates due to acute myocardial infarction, other cardiac causes, and malignancy were higher among males than females among patients with a functioning transplant.

Reasons for Withdrawal from Dialysis, All Dialysis Patients, 1991-92



Medicare patients over age 20. Source: Special Analysis

¹ Adjusted for sex, race, age (5-year categories) and diabetic status

² Categories collapsed from Death Notification Form (HCFA-2746) as per Table VII-1

Reasons for Withdrawal from dialysis, all dialysis patients, 1991-1992. Patients in Puerto Rico and the U.S. Territories are included. Medicare patients only. Source: Reference Table D.35

Table VI-6

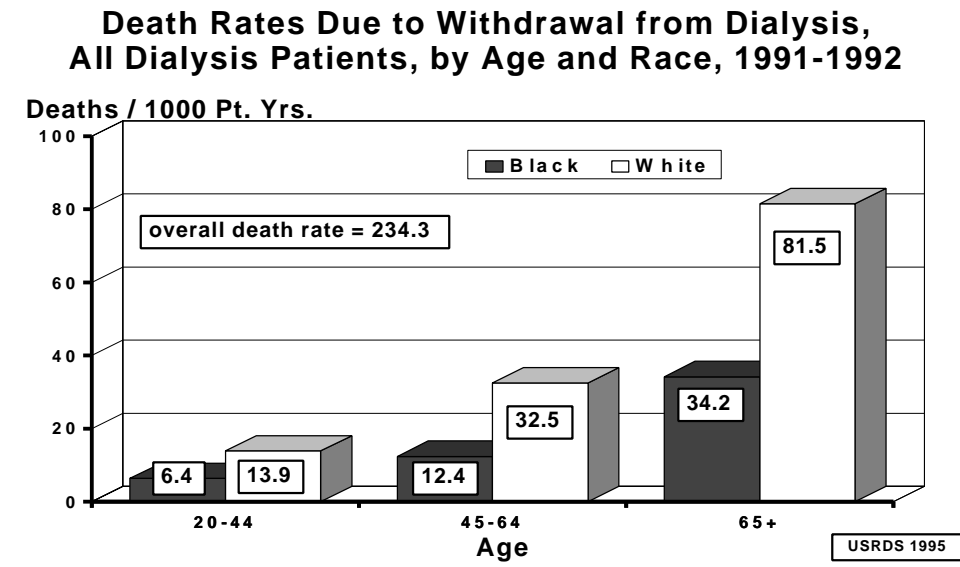


Figure VI-2

Death rate due to withdrawal among dialysis patients by age (on Jan 1 or at incidence) and race, 1991-1992. Patients in Puerto Rico and the U.S. Territories are included. Medicare patients only. Source: Reference Table D. 35.

Death rates due to septicemia and other infections were also higher among males than females in this modality group. Death rates due to AIDS, hemorrhage, and cachexia were similar for both sexes.

Of interest by race is that death rates due to all causes except malignancy are higher among blacks which is in direct contrast to the dialysis population where death rates due to most causes were higher among whites. As expected, death rates for all causes except AIDS were higher among the older transplant population, and death rates due to most causes were higher among diabetics.

Table VI-6 includes adjusted death rates for all patients who were ever transplanted and allows comparison of cause-specific death rates for patients who have a *functioning transplant* with death rates among patients with a *failed transplant* (on dialysis). Although both groups had been selected for transplantation, the all-cause death rate is approximately 5 times higher among patients with a failed transplant. Death rates for all cause of death categories are higher among the failed transplant group, particularly for deaths due to all cardiac and all infectious causes.

Withdrawal from Dialysis

In addition to data on causes of death, the new Death Notification Form provides data on whether or not the patient withdrew from dialysis prior to death. Overall, approximately 17 percent of patients withdraw from dialysis prior to death due to any cause. As seen in Figure VI-2 death rates for deaths preceded by (not necessarily due to) withdrawal increased with age and were approximately two fold higher in whites compared to blacks for all age categories over age 20. This is consistent with previous studies which have also shown that withdrawal from dialysis is over twice as commonly reported for white patients than for black patients (Port, Wolfe 1989; Bloembergen 1994) and that withdrawal rates increase with age (Mailloux 1993, Nelson 1994) . These differences by race may be explained by a greater acceptance of white patients likely to withdraw, differences in cultural attitudes or religious beliefs toward the discontinuation of therapy, or perhaps a lesser degree of trust of black patients and their families toward their predominantly white physicians. Analysis of other racial groups revealed that, in terms of the percentage of deaths preceded by withdrawal from dialysis, Asian patients were similar to black patients (both 11 percent) and Native Americans were similar to whites

(approximately 20 percent). Withdrawal from dialysis preceded death more commonly in females than males (18.9 percent versus 15.6 percent). Although death rates of deaths preceded by withdrawal were higher in diabetics than non-diabetics, the percentage of deaths associated with withdrawal were similar. The percentage of HD and PD patients withdrawing were also similar.

Figure VI-3 shows the reported reasons for withdrawal from dialysis. The leading reason for withdrawal was chronic failure to thrive (42 percent), followed by acute medical complications (35 percent). Four percent of withdrawals were due to access failure and the remainder were due to undefined or other reasons. As a percentage of all deaths, whites and the older age groups were more likely to withdraw from dialysis due to chronic failure to thrive than the younger age groups and blacks. Deaths among females and whites were more likely to be preceded by withdrawal due to acute medical complications than among males and blacks (See Reference Tables for more detail.).

Table VI-7 shows the percent distribution of specific causes of death for dialysis patients who withdrew from dialysis prior to death and for those

Percent Distribution¹ of Cause of Death for Dialysis Patients By Withdrawal and Non-Withdrawal 1991-1992

Cause of Death	Non Withdrawal	Total Withdrawal	Reason for Withdrawal			
			Access Failure	Failure to Thrive	Medical Complications	Other
Acute M. I.	13.4	2.8	1.6	2.0	4.4	2.1
Hyperkalemia	1.3	6.1	10.3	8.0	3.4	6.1
Pericarditis	0.3	0.2	< 0.1	0.1	0.3	< 0.1
Atherosclerot H D	4.7	4.3	4.2	5.5	3.4	3.3
Cardiomyopathy	4.6	5.1	5.6	6.8	4.0	3.2
Card Arrhythmia	7.7	3.4	3.3	3.3	3.7	3.2
Cardiac Arrest	20.5	10.5	8.7	11.0	9.5	11.7
Valv. Heart Dis.	0.7	0.6	< 0.1	0.6	0.7	0.4
Pulmonary Edema	0.8	1.5	3.6	1.7	1.0	1.2
Cerebro-Vasc Dis	5.6	8.6	4.7	3.8	17.1	4.6
G.I. Hemorrhage	1.4	1.0	0.4	0.8	1.5	0.4
Other Hemorrhage	1.0	0.3	0.4	0.2	0.6	0.2
Septicemia	11.3	8.6	10.0	5.9	13.4	5.4
Pulmonary Infect	2.9	2.1	1.6	1.9	3.3	0.8
Viral Infection	0.2	0.2	< 0.1	0.2	0.3	0.3
AIDS	0.8	0.6	1.1	0.6	0.7	0.5
Other Infection	0.6	0.8	0.7	0.6	1.1	0.6
Cachexia	0.8	2.8	2.2	5.6	0.6	0.8
Malignancy	3.3	7.3	5.8	6.1	6.1	12.1
Other Cause	10.9	26.7	28.8	29.0	21.5	30.6
Unknown Cause	7.4	6.6	6.9	6.3	3.3	12.8
Total	100.0	100.0	100.0	100.0	100.0	99.9

¹ Percent of total deaths for all Medicare dialysis patients. Source: Special Analysis.

Table VI-5

who did not withdraw from dialysis. It also shows the percent distribution of specific causes of death for each reason of withdrawal. As is noted, a greater percent of patients who withdrew died of hyperkalemia, malignant disease, cachexia and other identified causes than patients who did not withdraw. A comparison of the original 59 cause of death categories revealed that a greater percent of patients who withdrew also died of dementia (2.2 percent) as compared to patients who did not withdraw (0.3 percent), although total numbers of death due to this cause are small.

Withdrawal from dialysis reflects, on the one hand failure of renal replacement therapy, but on the other hand acceptance of patients for whom benefits from therapy may be uncertain at initiation of ESRD therapy. As individual patient outcome is not predictable, some have advocated an approach of liberal acceptance policies combined with a willingness to support patients in their decision to withdraw from dialysis (Port 1994).

Further study of cause-specific mortality is necessary to enhance the understanding and reduction of preventable deaths in the ESRD population. Future longitudinal analyses may help to explain the decrease in overall mortality rates among dialysis patients that have occurred in recent years.

References

- Bloembergen WE, Port FK, Mauger EA, Wolfe RA. A Comparison of mortality between patients treated with hemodialysis and peritoneal dialysis. *J Am Soc Nephrol* (in press).
- Bloembergen WE, Port FK, Mauger EA, Wolfe RA. A Comparison of cause of death between patients treated with hemodialysis and peritoneal dialysis. *J Am Soc Nephrol* (in press).
- Bloembergen WE, Port FK, Mauger EA, Wolfe RA. Causes of death in dialysis patients: racial and gender differences. *J Am Soc Nephrol* 1994;5:1231-1242.
- Churchill DN, Taylor DW, Cook RJ et al. Canadian Hemodialysis Morbidity Study. *Am J Kidney Dis* 1992;19:214-234.
- Foley RN, Parfrey PS, Harnett JD et al. Clinical and echocardiographic disease in patients starting end-stage renal disease therapy. *Kidney Int* 1995;47:186-192.
- Gaylin DS, Held PJ, Port FK, Hunsicker LG, Wolfe RA, Kahan BD, Jones CA, Agodoa LYC. The impact of comorbid and sociodemographic factors on access to renal transplantation. *JAMA* 1993; 269:603-608.
- Held PJ, Port FK, Turenne MN, Gaylin DS, Hamburger RJ, Wolfe RA. Continuous ambulatory peritoneal dialysis and hemodialysis: Comparison of patient mortality with adjustment for comorbid conditions. *Kidney Int* 1994; 45:1163-1169.
- Inamoto H, Osaki R, Matsuzaki T, Wakui M, Saruta T, Osawa A. Incidence and mortality patterns of malignancy and factors affecting the risk of malignancy in dialysis patients. *Nephron* 1991;59:611-617.
- Kantor AF, Hoover RN, Linlen LJ, McMullan MR, Fraumanti JF, Jr. Cancer in patients receiving long-term dialysis treatment. *Am J Epidemiol* 1987; 126:370-376.
- Khan IH, Catto GRD. Long-term complications of dialysis: Infection. *Kidney Int* 1993;43:S143-148.
- Mailloux LU, Bellucci AG, Napolitano B, Mossey RT, Wilkes BM, Bluestone PA. Death by withdrawal from dialysis: a 20 year clinical experience. *J Am Soc Nephrol* 1993;3:1631-7.
- Mailloux LU, Bellucci AG, Wilkes BM, Napolitano B, Mossey RT, Lesser M, Bluestone PA. Mortality in dialysis patients: Analysis of the causes of death. *Am J Kidney Dis* 1991; 18:326-335.
- Nelson CB, Port FK, Wolfe RA, Guire KE. The association of diabetic status, age, and race to withdrawal from dialysis. *J Am Soc Nephrol* 1994; 4:1608-1614.
- Penn I, Brunson ME. Cancers following cyclosporine therapy. *Transpl Proc* 1988; 20:885-892.
- Port FK. Morbidity and Mortality in dialysis patients. *Kidney Int* 1994;46:1728-1737.
- Port FK, Ragheb N, Schwartz AG, Hawthorne VM. Neoplasms in dialysis patients: a population-based study. *Am J Kidney Dis* 1989; 14:119-123.

- Port FK, Wolfe RA, Mauger EA, Berling DP, Jiang K. Comparison of Survival Probabilities for Dialysis Patients vs Cadaveric Renal Transplant Recipients. *JAMA* 1993; 270:1339-1343
- Port FK, Wolfe RA, Hawthorne VM, Ferguson CW. Discontinuation of dialysis therapy as a cause of death. *Am J Nephrol* 1989; 9:145-149.
- Vanholder R, Ringoir S. Infectious mortality and defects of phagocytic function in end-stage renal disease: A review. *J Am Soc Nephrol* 1993;3:1541-1554
- U.S. Renal Data System. Comorbid Conditions and Correlations with Mortality Risk among 3,399 Incident Hemodialysis Patients. *USRDS 1992 Annual Data Report*. The National Institutes of Health, National Institute of Diabetes and Digestive and Kidney Diseases, Bethesda, MD, 1992.
- U.S. Renal Data System. Mortality Rate Comparisons of Never, Previously, and Currently Transplanted ESRD patients. *USRDS 1992 Annual Data Report*. The National Institutes of Health, National Institute of Diabetes and Digestive and Kidney Diseases, Bethesda, MD, 1992.

