



Mortality

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Assessing mortality in the ESRD population is a unique challenge, in that two sources of death records are available to the USRDS Coordinating Center (CC).

Universal reporting to CMS of ESRD patient deaths is required as a condition of coverage for dialysis units and transplant centers. Since all ESRD patients have Social Security numbers, the CC can also link patients to the National Death Index files, which are added to the Medicare and Social Security enrollment databases. The USRDS was formerly able to report deaths only from day 90 of treatment, as Medicare did not cover services for those younger than 65. Now, however, with mandatory reporting through the Medical Evidence form (2728), which identifies each person with ESRD, the comprehensive tracking of ESRD patient deaths allows us to identify all deaths occurring after the first outpatient dialysis session.

This year we have changed the mortality analyses in the atlas and reference tables to start from day one of registered ESRD, eliminating missed deaths from the first 90 days. Figure 5.1 contrasts death rates from day one and day 90, showing that, between 1997 and 2011, rates from day one are 17–20 percent greater for hemodialysis patients than those tracked from day 90.

Trends in mortality rates by vintage are unchanged, since the issue of day one versus day 90 only affects patients in the first year. Between 1993 and 2003 there was little improvement in first-year death rates in the ESRD population. Between 2003 and 2010, however, rates fell more than 16 percent, while second-year death rates declined 21 percent between 2002 and 2009. Month-by-month mortality rates in the first year of hemodialysis have shown similar improvements, overall and for deaths due to cardiovascular disease and infection. Compared to rates at the end of the first year of therapy for incident hemodialysis patients in 2000, those for 2010 fell 22 percent for all-cause death, 38 percent for cardiovascular death, and 50 percent for death due to infection. Mortality due to other causes, in contrast, has increased 10 percent since 2000, a finding which requires further investigation. Still striking are the high rates of all-cause mortality in the early months of therapy, and the fact that mortality in the dialysis population remains ten times greater than among Medicare patients of similar age without kidney disease.

In the prevalent hemodialysis population, mortality rates have declined nearly 26 percent since 1985, and 21 percent since 2000.



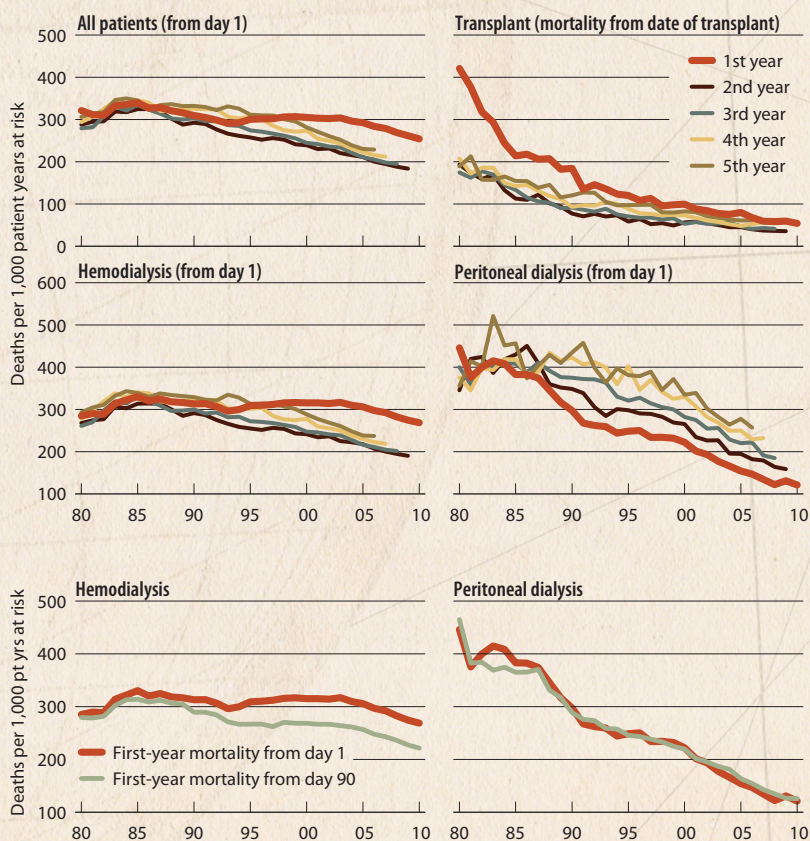
Day is ended, dim my eyes,
 But journey long before me lies.
 Farewell, friends! I hear the call.
 The ship's beside the stony wall.
 Foam is white and waves are grey;
 Beyond the sunset leads my way.
 Foam is salt, the wind is free;
 I hear the rising of the Sea.

J.R.R. Tolkien
 "BILBO'S LAST SONG"

Despite these improvements, only 52 percent of hemodialysis patients, and 61 percent of those who receive peritoneal dialysis, are still alive three years after the start of ESRD therapy in 2006 — numbers that help illustrate the extreme vulnerability of these patients when compared to the general population. Among dialysis patients age 65 and older, mortality is twice as high as for patients in

the general population who have diabetes, cancer, congestive heart failure, CVA/TIA, or AMI. ♦ **Figure 5.1**; see page 439 for analytical methods. Top figure: Incident ESRD patients followed from day one of onset of ESRD; transplant patients who received first transplant in the calendar year, followed from date of transplant. Bottom figure: Incident ESRD patients followed from day one & day 90 of onset of ESRD.

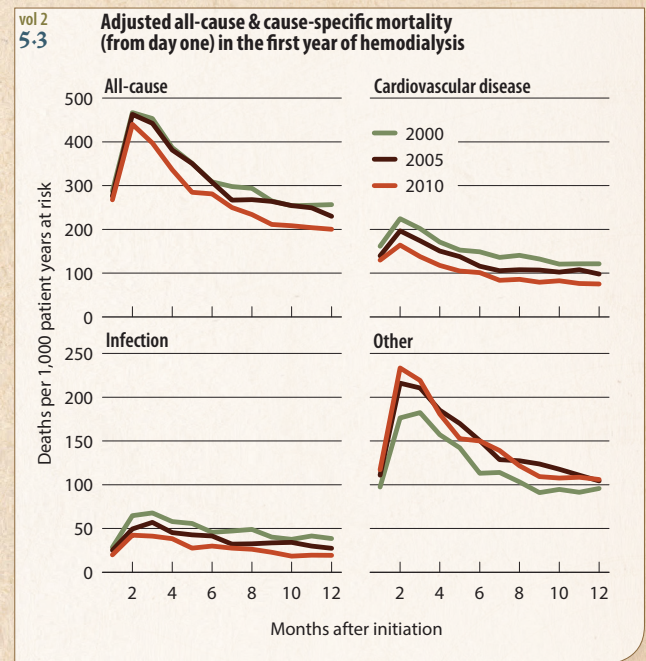
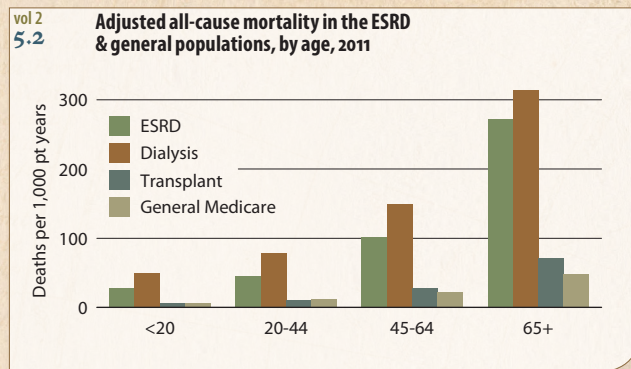
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 5.1 **Adjusted all-cause mortality rates (from day 1 & day 90), by modality & year of treatment**



Adjusted rates of all-cause mortality are 6.5–7.9 times greater for dialysis patients than for individuals in the general population. For renal transplant patients, rates approach those of the general population, yet remain 1.0–1.5 times higher. Rates rise by age, reaching 273 per 1,000 patient years at risk for ESRD patients age 65 and older, and 314 for dialysis patients of the same age.

In the first year of hemodialysis, all-cause mortality and mortality due to cardiovascular disease or to other causes peak in month two following initiation, then fall. For incident hemodialysis patients in 2010, for example, all-cause mortality reached 440 deaths per 1,000 patient years at risk in month two, then fell to 201 in month 12. Cardiovascular mortality peaked at 164, then decreased to 76. Mortality due to infection peaks in months 2 and 3, at 43 and 41, respectively, per 1,000 patient years, and falls to 19.4 in month 12. ♦ **Figures 5.2–3;** see page 439 for analytical methods. 5.2: prevalent ESRD patients

from day one, 2011, & general Medicare (non-ESRD) patients with at least one month of Medicare eligibility in 2011. Adj: gender/race; ref: Medicare patients, 2011. 5.3: incident hemodialysis patients defined on the day of dialysis onset, without the 60-day rule. Adj: age/gender/race/Hispanic ethnicity/primary diagnosis; ref: incident hemodialysis patients, 2010.

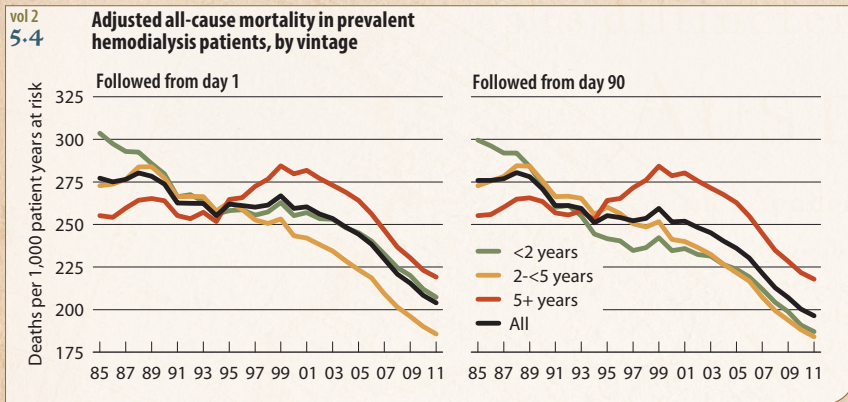


One of the most compelling differences in expected remaining lifetimes in the general and ESRD populations is found among female dialysis patients in their 30s, 40s, and 50s, who are expected to live just one-fourth as long as their counterparts without ESRD. Transplant patients fare better, with expected remaining lifetimes 75–80 percent as long as those in the general population. ♦ **Table 5.a;** see page 439 for analytical methods. U.S. data: calculated from Table 7 in the U.S. life tables (Arias E). ESRD data: prevalent dialysis & transplant patients, 2011. Expected remaining lifetimes by race & gender can be found in Reference Table H.13. Prevalent ESRD population, 2011, used as weight to calculate overall combined-age remaining lifetimes.

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5.a

Expected remaining lifetimes (years) of the general U.S. population, & of prevalent dialysis & transplant patients

	General U.S. Population 2009									ESRD patients 2011								
	All races			White			Black/Af Am			Dialysis			Transplant					
	All	M	F	All	M	F	All	M	F	All	M	F	All	M	F			
0-14	72.8	70.3	75.1	73.0	70.6	75.4	69.2	65.8	72.2	16.0	16.7	15.1	57.6	56.7	59.0			
15-19	59.4	56.9	61.6	59.6	57.2	61.8	55.9	52.6	58.8	19.0	19.8	18.0	45.5	44.7	46.6			
20-24	54.6	52.3	56.8	54.8	52.6	57.0	51.2	48.1	54.0	16.2	16.9	15.2	41.6	40.9	42.6			
25-29	49.9	47.6	51.9	50.0	47.9	52.1	46.6	43.5	49.2	14.2	14.8	13.4	37.7	37.1	38.7			
30-34	45.1	42.9	47.1	45.3	43.2	47.3	42.0	39.0	44.5	12.6	13.1	12.0	33.7	33.1	34.7			
35-39	40.4	38.3	42.3	40.6	38.5	42.5	37.4	34.5	39.8	11.2	11.5	10.8	30.1	29.5	31.1			
40-44	35.8	33.7	37.7	36.0	34.0	37.8	33.0	30.2	35.3	9.7	9.9	9.4	26.4	25.7	27.4			
45-49	31.4	29.4	33.1	31.5	29.6	33.2	28.7	26.0	31.0	8.3	8.3	8.2	22.8	22.2	23.9			
50-54	27.1	25.3	28.7	27.2	25.4	28.8	24.8	22.3	26.9	7.1	7.1	7.1	19.7	19.0	20.7			
55-59	23.1	21.3	24.4	23.1	21.5	24.5	21.2	18.9	23.0	6.1	6.0	6.2	16.7	16.1	17.7			
60-64	19.2	17.6	20.3	19.1	17.7	20.4	17.8	15.8	19.3	5.1	5.1	5.3	14.0	13.4	15.0			
65-69	15.5	14.2	16.5	15.5	14.2	16.5	14.6	13.0	15.8	4.3	4.2	4.4	11.7	11.2	12.7			
70-74	12.2	11.0	12.9	12.1	11.0	12.9	11.7	10.3	12.6	3.6	3.5	3.8	9.7	9.2	10.5			
75-79	9.2	8.2	9.7	9.1	8.2	9.7	9.1	7.9	9.7	3.1	2.9	3.2	8.2	7.7	8.9			
80-84	6.7	5.9	7.0	6.6	5.8	7.0	6.8	5.9	7.2	2.5	2.4	2.6						
85+	3.5	3.0	3.6	3.4	3.0	3.5	3.9	3.4	4.0	2.0	1.9	2.1						
Overall	22.5	20.9	23.7	22.5	21.0	23.7	20.9	18.9	22.5	6.2	6.2	6.2	17.2	16.6	18.1			



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Adjusted survival probabilities, from day one, in the ESRD population

	6 months	12 months	24 months	36 months	48 months	60 months
Dialysis						
1998	0.84	0.74	0.59	0.47	0.38	0.30
2000	0.84	0.74	0.60	0.48	0.39	0.31
2002	0.84	0.74	0.60	0.49	0.40	0.33
2004	0.84	0.75	0.61	0.51	0.42	0.34
2006	0.85	0.76	0.63	0.52	0.44	0.36
Hemodialysis						
1998	0.84	0.74	0.59	0.47	0.38	0.30
2000	0.84	0.74	0.59	0.48	0.38	0.31
2002	0.83	0.74	0.60	0.49	0.40	0.32
2004	0.84	0.74	0.61	0.50	0.41	0.34
2006	0.84	0.75	0.62	0.52	0.43	0.36
Peritoneal dialysis						
1998	0.90	0.80	0.63	0.49	0.38	0.31
2000	0.90	0.81	0.64	0.51	0.40	0.32
2002	0.92	0.83	0.68	0.55	0.44	0.36
2004	0.93	0.85	0.71	0.59	0.48	0.40
2006	0.94	0.87	0.73	0.61	0.51	0.42
Transplant						
1998	0.96	0.95	0.91	0.88	0.85	0.81
2000	0.95	0.94	0.91	0.87	0.82	0.78
2002	0.96	0.94	0.91	0.87	0.84	0.81
2004	0.97	0.96	0.94	0.91	0.88	0.85
2006	0.97	0.96	0.94	0.92	0.89	0.85
2006 cohort						
Dialysis	0.85	0.76	0.63	0.52	0.44	0.36
Hemodialysis	0.84	0.75	0.62	0.52	0.43	0.36
Peritoneal dialysis	0.94	0.87	0.73	0.61	0.51	0.42
Transplant	0.97	0.96	0.94	0.92	0.89	0.85
0-19	0.93	0.88	0.82	0.77	0.74	0.70
20-44	0.95	0.91	0.84	0.78	0.72	0.67
45-64	0.91	0.84	0.74	0.64	0.55	0.47
65-74	0.84	0.74	0.59	0.48	0.38	0.30
75+	0.73	0.59	0.43	0.31	0.22	0.15
Male	0.85	0.76	0.64	0.53	0.45	0.38
Female	0.85	0.76	0.63	0.53	0.45	0.38
White	0.84	0.74	0.61	0.50	0.41	0.34
Black/African American	0.87	0.78	0.66	0.57	0.49	0.42
Other	0.89	0.83	0.72	0.64	0.55	0.47
Diabetes	0.86	0.77	0.63	0.51	0.42	0.34
Hypertension	0.85	0.77	0.65	0.56	0.48	0.40
Glomerulonephritis	0.90	0.84	0.75	0.66	0.58	0.51
Other	0.79	0.69	0.58	0.50	0.43	0.38

Through the 1980s, patients newer to dialysis had higher mortality rates than those on treatment for five years or more. In the mid-1990s, however, this trend began to change.

Figure 5.4 shows adjusted all-cause mortality rates from day one of hemodialysis and from day 90. Rates are somewhat different between the two cohorts.

Using data from day 1, for example, for years 2000 and after the death rate among patients with a vintage of 2-5 years is lower than the rate for those with a vintage of less than two years, a phenomenon less evident when looking at data from day 90.

Another difference between the two cohorts relates to patients with a vintage of less than two years. Rates calculated from day one are 10.8 percent higher than those calculated using data from day 90, at 207.3 versus 187.1 per 1,000 patient years in 2011.

While six- and twelve-month survival probabilities have remained stable since 1998 in the hemodialysis population, they have improved somewhat for both peritoneal dialysis and transplant patients. Five-year survival has improved across all modalities — from 0.30 to 0.36 for hemodialysis, from 0.31 to 0.42 for peritoneal dialysis, and from 0.81 to 0.85 for transplant.

In the 2006 incident cohort, survival over the first five years of therapy is consistently highest in the transplant population and among younger patients, blacks/African Americans (compared to whites), and patients with a primary diagnosis of glomerulonephritis (compared to patients with diabetes or hypertension). + **Figure 5.4 & Table 5.b;** see page 439 for analytical methods. 5.4: period prevalent dialysis patients defined on day one or day 90 of dialysis. 5.b: incident ESRD patients defined at the onset of ESRD without the 60-day rule, followed from day one to December 31, 2011; Adj: age/gender/race/Hispanic ethnicity (5.b)/primary diagnosis. Ref: incident hemodialysis patients, 2010 (5.4) & incident ESRD patients, 2010 (5.b).

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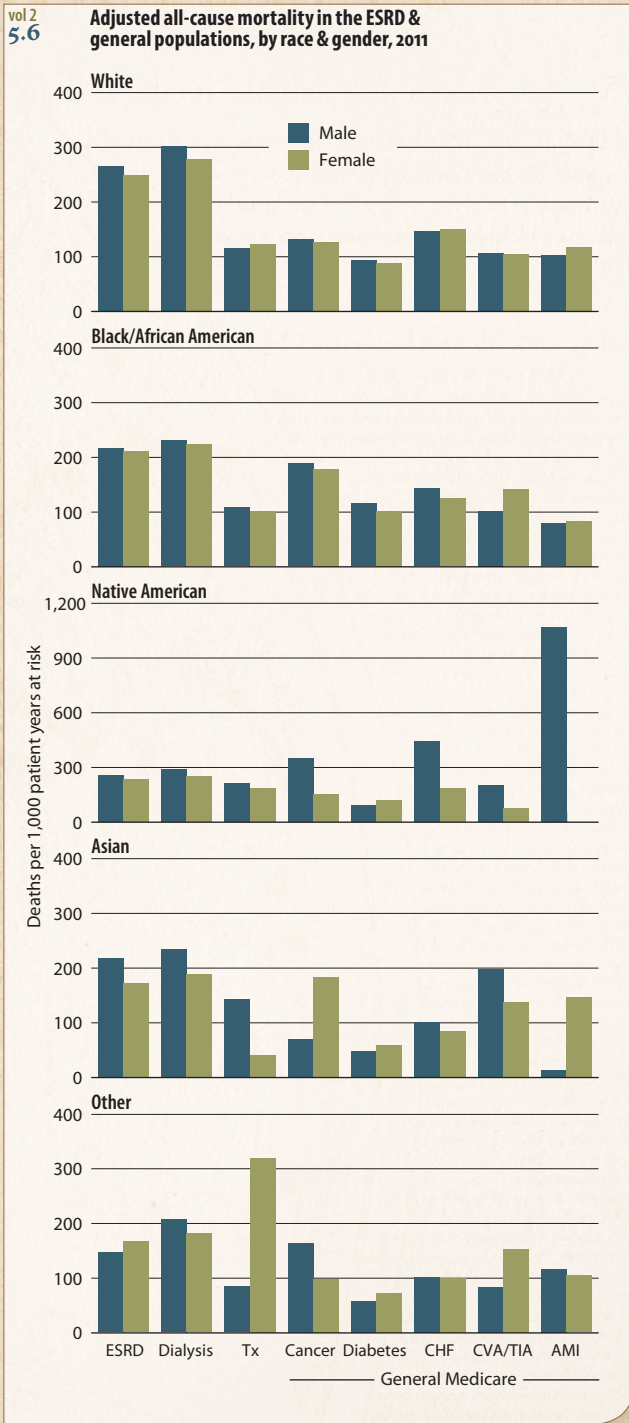
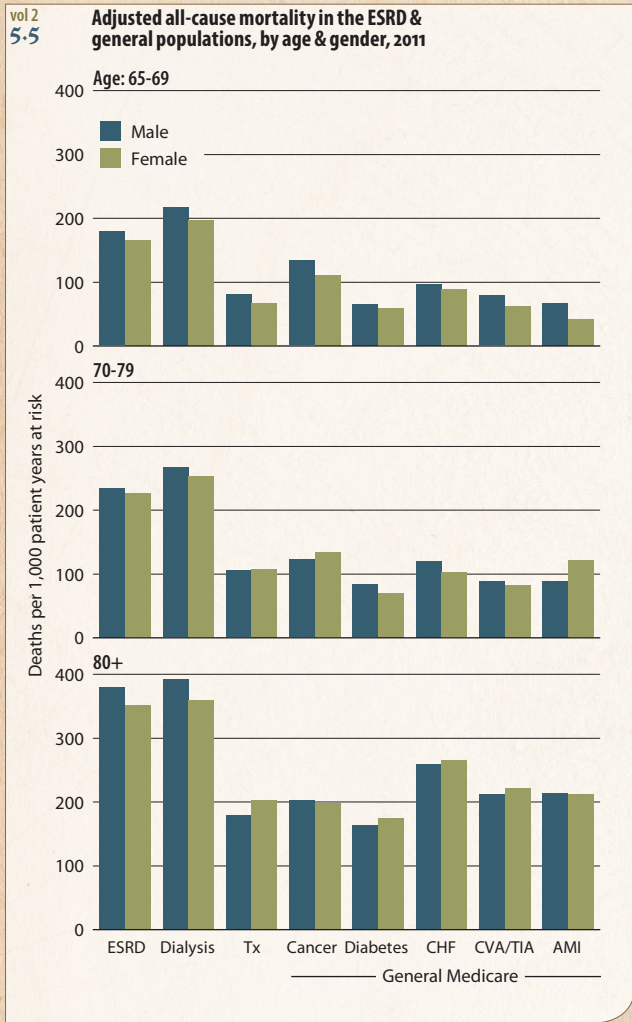
vol 2 5.c Unadjusted & adjusted mortality rates in the ESRD & general populations, age 65 & older (per 1,000 patient years at risk)																
	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Unadjusted																
ESRD	331	327	333	335	329	326	319	312	307	303	291	281	269	261	251	246
Dialysis	348	346	353	357	351	351	345	339	336	334	325	315	306	298	289	284
Transplant	94	87	97	92	97	93	89	91	87	84	81	81	75	77	76	73
General Medicare																
Cancer	150	146	142	139	138	132	128	125	121	122	119	117	115	113	111	109
Diabetes	93	93	94	94	90	87	85	82	77	79	76	74	74	71	71	71
CHF	205	208	208	206	208	202	197	196	189	192	191	190	196	183	189	188
CVA/TIA	156	156	158	154	152	151	145	143	134	137	135	133	133	125	129	127
AMI	149	149	155	155	157	156	152	153	149	149	148	145	155	146	153	153
Adjusted																
ESRD	351	340	342	343	339	334	323	310	303	275	282	275	265	257	250	241
Dialysis	362	353	355	358	354	349	339	327	319	296	303	298	288	280	275	266
Transplant	164	179	178	150	183	156	150	153	160	123	134	124	117	128	107	121
General Medicare																
Cancer	205	199	200	193	186	180	178	166	160	161	158	152	146	147	140	137
Diabetes	133	133	133	128	122	120	116	112	103	104	101	96	97	92	90	88
CHF	174	177	173	169	164	160	156	153	144	144	142	141	141	133	134	132
CVA/TIA	147	146	144	140	137	140	131	129	121	122	118	120	116	109	111	108
AMI	135	133	137	139	131	133	128	127	117	118	122	118	120	113	120	116

Since 1996, unadjusted mortality among prevalent ESRD patients has fallen 25.8 percent, to 245.6 deaths per 1,000 patient years. Mortality adjusted for age, gender, race, and comorbidity (defined in the previous year), however, has fallen 31.4 percent, to 241. In the dialysis population, the unadjusted rate has fallen 18.3 percent, to 284, while the adjusted rate is now 26.5 percent lower than in 1996, falling to 266 in 2011.

♦ **Table 5.c;** see page 440 for analytical methods. January 1 point prevalent ESRD & general Medicare patients age 65 & older. Adj: age/gender/race/comorbidity; ref: ESRD patients, 2010.

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Adjusted rates of mortality in the prevalent ESRD population age 65 and older rise, not surprisingly, by age, are commonly greater in men than in women, and are 2–3 times greater for dialysis patients than for those with a transplant. In the transplant population, rates among patients age 65–79 are lower than rates of mortality among patients with cancer in the general Medicare population.

Rates are generally higher in men compared to women — 15 and 25 percent higher, respectively, in Native Americans and Asians. For black/African American transplant patients of both genders, mortality is often lower than that among general Medicare patients with cancer, congestive heart failure, or in those with CVA/TIA. ♦ **Figures 5.5–6; see page 440 for analytical methods.** January 1, 2011, point prevalent ESRD & general Medicare patients age 65 & older. Adj: age/gender/race/comorbidity; ref: ESRD patients, 2011.

mortality & survival

ADJUSTED ALL-CAUSE FIRST-YEAR MORTALITY, FROM DAY 1, IN 2010 (PER 1,000 PATIENT YEARS AT RISK; FIGURE 5.1)
 all: 254.4; hemodialysis: 268.8; peritoneal dialysis: 121.4; transplant (from date of transplant): 54.4

ADJUSTED ALL-CAUSE MORTALITY, FROM DAY 1 OR 90, IN 2010 (PER 1,000 PATIENT YEARS AT RISK; FIGURE 5.1)
 hemodialysis (day 1): 268.8; peritoneal dialysis (day 1): 121.4; hemodialysis (day 90): 221.5; peritoneal dialysis (day 90): 126.0

ADJUSTED ALL-CAUSE MORTALITY IN THE ESRD & GENERAL POPULATIONS, 2011 (PER 1,000 PATIENT YEARS AT RISK; FIGURE 5.2)

	ESRD	dialysis	transplant	general Medicare
age <20	27.2	49.6	6.4	6.3
age 20-44	44.5	78.2	10.7	11.2
age 45-64	101.6	149.9	27.5	21.7
age 65+	272.5	314.3	71.8	48.0

ADJUSTED ALL-CAUSE & CAUSE SPECIFIC MORTALITY FROM DAY ONE, 2010 (PER 1,000 PATIENT YEARS AT RISK; FIGURE 5.3)
 month two after initiation; all-cause: 440.2; cardiovascular disease: 164.4; infection: 42.5
 month 12 after initiation; all-cause: 200.5; cardiovascular disease: 75.7; infection: 19.4

ADJUSTED ALL-CAUSE MORTALITY IN PREVALENT HEMODIALYSIS PTS, BY VINTAGE, 2011 (PER 1,000 PT YEARS AT RISK; FIGURE 5.4)

day 1: <2 years: 207.3; 2-<5 years: 185.7; 5+ years: 219.2
 day 90: <2 years: 187.1; 2-<5 years: 184.1; 5+ years: 217.9

ADJUSTED FIVE-YEAR SURVIVAL PROBABILITIES AMONG INCIDENT ESRD PATIENTS, 2006 (FROM DAY ONE; TABLE 5.B)

modality dialysis: 0.36; hemodialysis: 0.36; peritoneal dialysis: 0.42; transplant: 0.85
 age 0-19: 0.70; 20-44: 0.67; 45-64: 0.47; 65-74: 0.30; 75+: 0.15
 gender male: 0.38; female: 0.38
 race white: 0.34; black/African American: 0.42; other: 0.47
 primary diagnosis diabetes: 0.034; hypertension: 0.40; glomerulonephritis: 0.51; other: 0.38

MORTALITY RATES IN PREVALENT PATIENTS AGE 65 & OLDER, 2011 (PER 1,000 PATIENT YEARS AT RISK; TABLE 5.C)

unadjusted	ESRD: 246	dialysis: 284	transplant: 73
adjusted for age, gender, race, & comorbidity	ESRD: 241	dialysis: 266	transplant: 121