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, the comprehensive tracking of all ESRD patient deaths allows the USRDS to identify all deaths occurring after the first outpatient dialysis session.

Between 1993 and 2003 there was little improvement in first-year death rates in the ESRD population. Between 2003 and 2009, however, these rates fell more than 14 percent, while second-year death rates declined 16.5 percent. 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. Progress has been made as well in mortality due to infection, and to a greater extent than seen with cardiovascular deaths. Mortality due to other causes, in contrast, has increased since 1999, 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 population, mortality rates have declined nearly 25 percent over the last two decades, and 19 percent since 2000.

Despite these improvements, however, only 51 percent of dialysis patients, and 82 percent of those who receive a preemptive transplant, are still alive three years after the start of ESRD therapy — numbers that help illustrate the extreme vulnerability of these patients when compared to the general population. Among dialysis patients age 65 and older, for example, mortality is twice as high as for patients in the general population who have diabetes, cancer, congestive heart failure, CVA/TIA, or AMI.

Patients with kidney disease are clearly at a high risk of death and, as shown in the hospitalization data, have very high event rates as well. In Chapter Three

Our dead never forget the beautiful world that gave them being. They still love its winding rivers, its great mountains and its sequestered vales, and they ever yearn in tenderest affection over the lonely-hearted living, and often return to visit and comfort them.

CHIEF SEATTLE
we examine hospitalization rates by interdialytic interval; here we look at the
interval in terms of mortality. Deaths due to infection, for example, peak on the
day after the first run of the week. Thrice-weekly treatment may be inadequate
for addressing the critical problems of persistent fluid overload, hypertension, and
left ventricular hypertrophy. Recent publication of the Frequent Hemodialysis
Trial (NEJM Nov 2010), comparing treatment of three days per week to that of
six days, demonstrated significant reductions in left ventricular hypertrophy and
hyperphosphatemia among patients receiving more frequent therapy. Mortality
comparisons still need to be considered, as do questions of how more frequent
sessions might be implemented across the country. In the meantime, there should
be a focus on improving care and outcomes through medication interventions
and reductions in the use of dialysis catheters, with their high rates of associated
complications. » Figure 5.1; see page 438 for analytical methods. Incident ESRD patients. Adj:
age/gender/race/primary diagnosis; ref: incident ESRD patients, 2005.

Adjusted all-cause mortality rates (from
day 90), by modality & year of treatment
Adjusted rates of all-cause mortality are 6.3–8.2 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 1.1–1.5 times higher. Rates rise by age, reaching 264 per 1,000 patient years at risk for ESRD patients age 65 and older, and 304 for dialysis patients of the same age. » Figure 5.2; see page 438 for analytical methods. Prevalent ESRD & general Medicare (non-ESRD) patients. Adj: gender/race; ref: Medicare patients, 2010.

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 2009, for example, all-cause mortality reached 435 deaths per 1,000 patient years at risk in month two, then fell to 206 in month 12. Cardiovascular mortality peaked at 169, and decreased to 78. Mortality due to infection peaks in months 2 and 3, at 40–43 per 1,000 patient deaths. » Figure 5.3; see page 438 for analytical methods. 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, 2005.

Through the 1980s, patients newer to dialysis had higher mortality rates than those on treatment for five years or more. This trend began to change in the early 1990s, and in 2010 the rate of 222 per 1,000 patient years in patients receiving hemodialysis therapy for five or more years was 17 percent higher than the rate of 190 in patients treated for less than two years. » Figure 5.4; see page 438 for analytical methods. Period prevalent hemodialysis patients. Adj: age/gender/race/primary diagnosis; ref: hemodialysis patients, 2005.
While six- and twelve-month survival probabilities have remained stable since 1997 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 0.35 for hemodialysis, from 0.29 to 0.41 for peritoneal dialysis, and from 0.65 to 0.73 for transplant.

In the 2005 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).  

### Table 5.a

See page 438 for analytical methods. Incident dialysis patients defined on the day of dialysis onset, without the 60-day rule, from day one of dialysis to December 31, 2010; transplant patients receiving a first transplant in the calendar year, followed from day of transplant to December 31, 2010. Adj: age/gender/race/Hispanic ethnicity/primary diagnosis; ref: incident ESRD patients, 2005.
Since 1995, unadjusted mortality among prevalent ESRD patients has fallen 23.7 percent, to 245 deaths per 1,000 patient years. Mortality adjusted for age, gender, race, and comorbidity (defined in the previous year), however, has fallen 28.4 percent, to 270. In the dialysis population, the unadjusted rate has fallen 15.6 percent, to 283, while the adjusted rate is now 23.7 percent lower than in 1995, falling to 294 in 2010. Table 5.b: see page 438 for analytical methods. January 1 point prevalent ESRD & general Medicare patients age 65 & older. Adj: age/gender/race/comorbidity; ref: ESRD patients, 2005.
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.

By race, the contrast in mortality rates between dialysis and transplant patients is even more pronounced. Rates among white and black/African American women on dialysis, for example, are 2.6 and 2.4 times greater than those seen in their counterparts with a transplant. For black/African American transplant patients of both genders, mortality is most often lower than that among patients with cancer, congestive heart failure, or acute myocardial infarction in the general population. » Figures 5.5–6; see page 438 for analytical methods. January 1, 2010, point prevalent ESRD & general Medicare patients age 65 & older. Adj: age/gender/race/comorbidity; ref: 2010 ESRD patients.
Maintenance hemodialysis is typically delivered three times a week, and concern has emerged that the two-day, or “long,” interval may be associated with higher than expected rates of adverse outcomes. To explore this issue, we look here at mortality rates by different days of the hemodialysis week among prevalent adult hemodialysis patients in 2010.

In the framework of the “hemodialysis week,” HD₁, for example, is defined as Monday for patients dialyzed on Monday, Wednesday, and Friday (MWF) and as Tuesday for those treated on Tuesday, Thursday, and Saturday (TTS). HD₁₊₁, the second day of the long interval, is Sunday for MWS and Monday for TTS.

Mortality rates in the overall population are highest, at 174 per 1,000 patient years, on the day following the long interval (HD₁), and a sawtooth pattern is apparent, with rates declining and increasing every two days thereafter. This pattern is replicated in patients age 65 and older, with rates varying between 185 and 226, but some differences are seen in younger age groups.

In patients age 20–39, mortality rates are highest on HD₁₊₁ (57), lowest on HD₃ (35), and the sawtooth pattern is absent. For ages 40–64, rates are substantially higher on HD₁ (119), stable between HD₁₊₁ (86) and HD₃₊₁ (84), and intermediate on HD₃₊₂ (96).

Figures 5.8 and 5.9 show corresponding analyses for mortality rates attributed to cardiovascular disease and infection. Rates are highest on HD₁ (87) for cardiovascular disease, and on HD₁₊₁ (17.7) for infection. »Figures 5.7–9; see page 438 for analytical methods. January 1, 2010 point prevalent Medicare hemodialysis patients alive on January 31. Includes patients age 20 & older receiving hemodialysis three times weekly on a Monday–Wednesday–Friday or Tuesday–Thursday–Saturday schedule; HD₁, HD₂, & HD₃ are the first, second, & third hemodialysis sessions. Rates for all patients are adjusted for age, gender, race, Hispanic ethnicity, & primary diagnosis; rates by age are adjusted for the other four factors. Ref: all included hemodialysis patients in 2010.
Here we summarize all-cause mortality rates on three types of days of the hemodialysis week: after the single long interval dialysis day, after the two short interval days, and on the four days without dialysis. Mortality rates in 2010 were 174 for the first category, 151 for the second, and 142 for the third.

Analyses of subgroups defined by age, gender, race, ethnicity, and cause of ESRD show similar patterns except for patients age 20–39 (with rates of 53, 43, and 44 in the three categories) and those age 40–64 (119, 86, and 88). For all subgroups, however, rates are highest on the day after the long interval. » Table 5.c; see page 438 for analytical methods. January 1, 2010 point prevalent Medicare hemodialysis patients alive on January 31. Includes patients age 20 & older receiving hemodialysis three times weekly on a Monday–Wednesday–Friday or Tuesday–Thursday–Saturday schedule. Rates for all patients, & groups by ESRD duration, are adjusted for age, gender, race, Hispanic ethnicity, & primary diagnosis; rates by age, gender, & primary diagnosis are adjusted for the other four factors. Rates by race & ethnicity are adjusted for age, gender, & primary diagnosis. Ref; all included hemodialysis patients in 2010.
**MORTALITY & SURVIVAL**

*adjusted all-cause first-year mortality (from day 90, per 1,000 patient years at risk; Figure 5.1)*
- hemodialysis · 225
- peritoneal dialysis · 125
- transplant · 59

*adjusted all-cause fifth-year mortality (from day 90, per 1,000 patient years at risk; Figure 5.1)*
- hemodialysis · 236
- peritoneal dialysis · 254
- transplant · 60

*adjusted all-cause mortality in the ESRD & general populations, 2010 (per 1,000 patient years at risk; Figure 5.2)*

<table>
<thead>
<tr>
<th>Age</th>
<th>ESRD</th>
<th>Dialysis</th>
<th>Transplant</th>
<th>General Medicare</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;20</td>
<td>43.9</td>
<td>78.7</td>
<td>12.0</td>
<td>11.3</td>
</tr>
<tr>
<td>20–44</td>
<td>99</td>
<td>148.5</td>
<td>28.4</td>
<td>22.0</td>
</tr>
<tr>
<td>45–64</td>
<td>264</td>
<td>304</td>
<td>73.4</td>
<td>48.1</td>
</tr>
</tbody>
</table>

*adjusted all-cause & cause specific mortality from day one in the first year of hemodialysis, 2010 (per 1,000 patient years at risk; Figure 5.3)*

- all-cause · 435
- cardiovascular disease · 169
- infection · 40

- all-cause · 206
- cardiovascular disease · 78
- infection · 21

*adjusted all-cause mortality in prevalent hemodialysis patients, by vintage, 2010 (per 1,000 patient years at risk; Figure 5.4)*

<table>
<thead>
<tr>
<th>Vintage</th>
<th>ESRD</th>
<th>Dialysis</th>
<th>Transplant</th>
<th>General Medicare</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;2 years</td>
<td>190</td>
<td>283</td>
<td>77</td>
<td></td>
</tr>
<tr>
<td>2–&lt;5 years</td>
<td>189</td>
<td>283</td>
<td>77</td>
<td></td>
</tr>
<tr>
<td>5+ years</td>
<td>222</td>
<td>283</td>
<td>77</td>
<td></td>
</tr>
</tbody>
</table>

*adjusted five-year survival probabilities among incident ESRD patients, 2010 (from day one; Table 5.a)*

- dialysis · 0.35
- hemodialysis · 0.35
- peritoneal dialysis · 0.41
- transplant · 0.73
- age 0–19 · 0.66
- 20–44 · 0.62
- 45–64 · 0.44
- 65–74 · 0.27
- 75+ · 0.14
- male · 0.35
- female · 0.36
- white · 0.32
- black/African American · 0.39
- other race · 0.46
- primary diagnosis · diabetes · 0.32
- hypertension · 0.38
- glomerulonephritis · 0.48
- other · 0.34

**MORTALITY IN THE GENERAL & ESRD POPULATIONS**

*mortality rates in prevalent patients age 65 & older, 2010 (per 1,000 patient years at risk; Table 5.b)*

<table>
<thead>
<tr>
<th>ESRD</th>
<th>Dialysis</th>
<th>Transplant</th>
</tr>
</thead>
<tbody>
<tr>
<td>unadjusted</td>
<td>245</td>
<td>283</td>
</tr>
<tr>
<td>adjusted for age, gender, race, &amp; comorbidity</td>
<td>270</td>
<td>294</td>
</tr>
</tbody>
</table>

**MORTALITY RATES BY INTERDIALYTIC INTERVAL**

*annualized all-cause mortality rates on different days of the dialysis week, by age (per 1,000 patient years; Figure 5.7)*

<table>
<thead>
<tr>
<th>Day of Week</th>
<th>All</th>
<th>20–39</th>
<th>40–64</th>
<th>65+</th>
</tr>
</thead>
<tbody>
<tr>
<td>HD1 (Monday or Tuesday)</td>
<td>all · 174</td>
<td>20–39 · 53</td>
<td>40–64 · 119</td>
<td>65+ · 226</td>
</tr>
<tr>
<td>HD2 (Wednesday or Thursday)</td>
<td>147</td>
<td>20–39 · 50</td>
<td>85</td>
<td>204</td>
</tr>
<tr>
<td>HD3 (Friday or Saturday)</td>
<td>155</td>
<td>20–39 · 35</td>
<td>87</td>
<td>215</td>
</tr>
</tbody>
</table>

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2012 USRDS Annual Data Report

**Summary**