chapter six
morbidity & mortality

I come into the peace of wild things
Who do not tax their lives with forethought
Of grief. I come into the presence of still water.
And I feel above me the day-blind stars
waiting with their light.

Wendell Berry
“*The Peace of Wild Things*”
The recent lack of improvement in mortality during the first year of hemodialysis, even as interval mortality rates after the first year have declined across all modalities, has raised concerns regarding hemodialysis practices during the initial period of ESRD treatment. We examine these concerns throughout the ADR, particularly in Chapter One. This year we focus on infectious complications, especially those related to vascular access, and report that mortality in the first year of hemodialysis has at last begun to decline, an important public health finding for the hemodialysis population. Since 1998 the first-year death rate among hemodialysis patients has fallen 10.3 percent, with most of the decline occurring after 2003–2004; this is in contrast to a 16–17 percent decrease during years 2–5, but still indicates significant progress.

While overall hospital admission rates have altered little since the mid-1990s, the types of hospitalization have changed considerably. Since 1994, rates of hospitalization for infection among hemodialysis patients have increased 45.8 percent. Hospitalizations related to cardiovascular disease have risen 8.6 percent, but have declined in the last four years, consistent with changes in the use of cardiovascular procedures noted later in the chapter. There has also been a decline in the number of hospital days for both peritoneal and hemodialysis patients, so that days per year are now similar for both populations. While rates of hospitalization for pneumonia appear stable, those for bacteremia/sepsis have increased since their low in 2001, and among both hemodialysis and peritoneal dialysis patients. Overall, the odds of an infectious hospitalization are now 18 percent greater than in 1997–1998.

All-cause mortality differs quite dramatically in the ESRD, dialysis, transplant, and general Medicare populations. Rates for prevalent dialysis patients age 65 and older, for example, are nearly seven times higher than those in the general population. These rates — essentially flat during the 1990s — have been falling for the past five years across all patient vintages. And five-year survival rates for ESRD patients improved 8.4 percent between 1994–1998 and 1999–2003.
This year we present new mortality analyses that use matched hemodialysis and peritoneal dialysis populations. Since selection bias related to the choice of peritoneal dialysis therapy is very complex, with many hemodialysis patients not candidates for peritoneal dialysis, we attempted to match patients directly based on all available information from the Medical Evidence form — including age, gender, race, cause of kidney failure, comorbidity, eGFR, BMI, and hemoglobin level. This makes the populations more comparable than does the use of simple adjustments that do not address issues of confounding by indication. In future ADRs we will follow these first-year comparisons with analyses of changes over time in years 2–5 of follow-up.

The last spread of this chapter addresses cause-specific hospitalization and mortality. Rates of hospitalization for infection, cardiovascular procedures, and inpatient vascular access procedures have changed in important ways. Those for cardiovascular disease, for example, have declined since 2004, even as mortality rates are falling, suggesting that patients are not as sick or that treatment with oral medications may be more effective than previously thought. And while there has been some decline in hospitalizations for infections due to an internal device, hospitalizations for bacteremia/sepsis have increased. It is not clear if this is related to the change to longer-term cuffed catheters, or to other factors such as influenza virulence.

The USRDS Coordinating Center will continue to explore trends in morbidity and mortality to determine the impact of programs addressing high early mortality and of the new CKD Stage 4 education benefit, which is intended to improve the planned transition to dialysis.

*Figure 6.1:* see page 475 for analytical methods. Incident ESRD patients. Adj: age/gender/race/primary diagnosis; ref: incident ESRD patients, 2005.
After peaking in 2005, rates of hospitalization for infection in hemodialysis patients showed a decline in the following two years. In 2008, however, they increased again, to a point 45.8 percent above their 1993 level. Vascular access admissions continue to fall, with more procedures now performed in an outpatient setting, and are 45.1 percent below levels noted in 1993. Other encouraging results include a 22.9 percent fall in dialysis access admissions since 1999 for peritoneal dialysis patients, and declines of 14.5, 32.2, and 10.7 percent, respectively, in all-cause, cardiovascular, and infectious admissions for transplant patients. + Figure 6.2; see page 474 for analytical methods. Period prevalent ESRD patients. Adj: age/gender/race/primary diagnosis; ref: ESRD patients, 2005.

In 2008, hospital admissions per patient year for hemodialysis patients were nearly identical to those in 1993, at 1.9. Rates for peritoneal dialysis and transplant patients, in contrast, have fallen 9.6 and 14.5 percent. Hospital days per patient year have fallen to 12.8 and 13.3 for hemodialysis and peritoneal dialysis patients, and to 5.9 for those with a transplant. + Figure 6.3; see page 474 for analytical methods. Period prevalent ESRD patients. Adj: age/gender/race/primary diagnosis; ref: ESRD patients, 2005.
Admissions for pneumonia in hemodialysis patients rose to 83.4 per 1,000 patient years in 2008, 1.9–2.6 times greater than the rates of 43.8 and 31.9 among peritoneal dialysis and transplant patients. Among hemodialysis patients, admissions for bacteremia/septicemia continue to rise sharply, reaching 112 per 1,000 patient years — similar to the rate of 109 for vascular access infections, and possibly reflecting an increased use of cuffed catheters. 

By two-year time period, the adjusted relative risks of all-cause and cardiovascular hospitalization among hemodialysis patients vary little when compared to the reference period of 1997–1998; the risk of hospitalization for infection, however, is now 18 percent greater than in the reference period, while that of a vascular access hospitalization is 30 percent less.

In 2007–2008, women treated with hemodialysis were 16 percent more likely to be hospitalized, overall, than their male counterparts. They also had a greater risk than men of cardiovascular, infectious, and vascular access hospitalizations — 11, 14, and 20 percent greater, respectively. Among African American patients, the relative risk of an all-cause hospitalization or one related to infection is almost equal to that of white patients; the risk of a vascular access hospitalization, however, is 24 percent higher. 

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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 2008 the rate of 236 per 1,000 patient years in patients on therapy for five or more years was 19.2 percent higher than the rate of 197 in patients of younger vintage. *Figure 6.8*; see page 475 for analytical methods. *Incident dialysis patients, 2007; unadjusted.*

*Unadjusted survival of dialysis patients, using HD matched to PD patients. 6b*

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The five-year probability of survival among 1999–2003 incident ESRD patients was 0.39, an 8.4 percent increase when compared to survival among new patients in 1994–1998. Between the two periods, survival increased most in patients on peritoneal dialysis, at 17.6 percent, and rose 8.4 and 5.3 percent in hemodialysis and transplant patients, respectively. Survival improved 15.3 and 27.1 percent in hemodialysis and peritoneal dialysis with diabetes, and 4.2 and 14.6 percent in those with hypertension; in patients with glomerulonephritis, it increased 6.4 and 12.3 percent. *Figure 6.7; see page 475 for analytical methods. Incident dialysis patients & patients receiving a first transplant in the calendar year. Adj: age/gender/race; overall also adj. for primary diagnosis; ref: ESRD patients, 2005.*
In hemodialysis matched to peritoneal dialysis populations, hospitalization rates are lower overall for hemodialysis patients than for peritoneal patients, at 140.6 and 146.7, respectively, per 1,000 patient years. Rates for infectious hospitalizations, however, are higher for matched hemodialysis patients, at 42.5 versus 32.2 overall, 42.2 versus 33.4 in whites, and 48.2 versus 31.5 in African Americans. *Figure 6.8: see page 474 for analytical methods. Incident dialysis patients, 2007; unadjusted.*

Among patients with diabetes, unadjusted one-year survival in matched hemodialysis to peritoneal dialysis populations is slightly higher in those on hemodialysis compared to patients on a peritoneal modality, at 0.86 and 0.84, respectively. Survival in patients with no diabetes is similar, at 0.88 and 0.89. By race, white hemodialysis patients with diabetes have a slight survival advantage over their peritoneal counterparts, while the opposite is true for African Americans. *Figure 6.9: see page 475 for analytical methods. Incident dialysis patients, 2007; unadjusted.*

When comparing unadjusted survival by modality in hemodialysis matched to peritoneal populations, no distinct patterns are evident. In males age 20–64 with diabetes, for example, neither dialysis modality shows any survival advantage; this is also true in males with no diabetes. Among females of this age with diabetes, in contrast, survival is approximately 5 percent better in patients on peritoneal dialysis.

Among patients age 65 and older, survival in male hemodialysis patients with diabetes is approximately 6 percent higher than among their peritoneal counterparts. In women with diabetes, survival among those on hemodialysis is more than 8 percent higher. The reverse is true in females with no diabetes, with survival in those on peritoneal dialysis approximately 5 percent higher. *Figure 6.10: see page 475 for analytical methods. Incident dialysis patients, 2007; unadjusted.*
All-cause admissions by age remained stable in 2008, with the exception of a 2 percent decline among those age 45–64. Cardiovascular admissions declined across age groups, and in 2008 ranged from 0.46 per patient year at risk among those age 20–44 to 0.63 among those 75 and older.

Event rates for inpatient coronary revascularization procedures are greatest in patients age 65–74. Rates for this age group continue to decline, in 2008 reaching 51.1 events per 1,000 patient years at risk overall, 36.8 for angioplasty, and 14.1 and 33.3 for bypass and coronary stents.

Adjusted all-cause and cause-specific mortality rates are highest in the third month after the initiation of dialysis, and in following months return to levels close to or lower than those found in month one.

For month three, the overall number of deaths per 1,000 patient years at risk fell 3.0 percent in 2007, to 399, and has decreased 8.5 percent since peaking in 2003 at 433. Mortality rates in month 12 have fallen nearly 27 percent since 1991, but may be flattening, as evidenced by a slight 0.4 percent rise in 2007.

In 2007, cardiovascular death rates in month one were more than six times higher than those for infection, and in months three, six, and twelve were 3–4 times higher. Not surprisingly, rates in all months were highest in older patients. *Figures* 6.14–16; see page 475 for analytical methods. Incident dialysis patients. Adj: age/gender/race/primary diagnosis; ref: incident dialysis patients, 2005.
Rates of vascular access admissions continue to fall, with more procedures now performed in an outpatient setting, and are 45.1 percent below levels noted in 1993. **FIGURE 6.2**

In 2008, rates of hospital admissions per patient year for hemodialysis patients were nearly identical to those in 1993, at 1.9; rates for peritoneal dialysis and transplant patients, in contrast, have fallen 9.6 and 14.5 percent. **FIGURE 6.3**

In 2007–2008, women treated with hemodialysis were 16 percent more likely to be hospitalized than their male counterparts. **TABLE 6.A**

When hemodialysis patients are matched to peritoneal dialysis patients, overall unadjusted survival is similar for both modalities, at 0.87, and is generally similar across all age, gender, race, and comorbidity groups. **TABLE 6.B**

Adjusted rates of all-cause mortality are 6.4–7.8 times higher for dialysis patients than for individuals in the general population. **FIGURE 6.5**

The five-year probability of survival among 1999–2003 incident ESRD patients was 0.39, an 8.4 percent increase when compared to survival among new patients in 1994–1998. **FIGURE 6.7**

Among hemodialysis patients age 65 and older, rates of inpatient vascular access placements have fallen 57–61 percent since 1993. **FIGURE 6.13**