It was a flight, a kind of fleeing, a kind of falling, falling higher and higher, spinning off the edge of the earth and beyond the sun and through the vast, silent vacuum where there were no burdens and where everything weighed exactly nothing.

Tim O'Brien
“The Things They Carried”
Recent years have brought concern over the lack of progress in lowering death rates in the first year of hemodialysis. At the same time, interval mortality rates after the first year of ESRD therapy have been declining across all modalities. This disparity has raised questions over practices in the first year of hemodialysis that may affect early mortality. Throughout the ADR, and particularly in the Emerging Issues chapter, we examine some of these issues, including anemia correction, overshooting of target hemoglobin levels, use of dialysis catheters, and use of IV iron and vitamin D.

In this chapter we review incident- and prevalent-based death rates as well as cause-specific rates, assessing trends and geographic patterns. As seen on the next page, interval mortality rates (adjusted for age, gender, race, and primary diagnosis) are consistently down across all modalities and lengths of therapy, with the exception of first-year mortality in the hemodialysis population. Rates by month in the first year, presented in our Emerging Issues chapter, show similar findings. Even with more detailed adjustments for severity of disease, the first-year death rate for hemodialysis patients shows little change over the last nine years; rates for peritoneal dialysis patients have declined over the same period. Although the USRDS has begun the process of assessing this issue, considerable work is yet needed to understand the impact of such factors as high catheter use rates and early referral on first-year mortality.

In the peritoneal dialysis population, mortality rates have fallen consistently across patient vintages. Among transplant patients, first-year mortality rates have fallen dramatically over the last 24 years, but progress has been slower in the last five. Long-term survival of transplant patients is vulnerable to cardiovascular disease, and death with a functioning graft is the second leading cause of graft failure behind graft rejection. Long-term care of the transplant population, particularly as related to cancer, cardiovascular disease, and diabetes care, is illustrated in Chapter Seven.

Overall hospital admission rates have altered little since 1993. Cause-specific rates, however, have changed dramatically. Since 1993, hospitalization rates for infection have risen 19 percent for pneumonia, 29 percent for sepsis/bacteremia and 24 percent for cellulitis. Hospitalizations for bacteremia/septicemia show a cyclical trend over time, a finding which has received little attention. Rates for coronary revascularization procedures have doubled, with bypass procedures peaking in the late 1990s. Hospitalizations for vascular access procedures, in contrast, are down 34 percent, consistent with the growing use of outpatient interventions.

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 four times higher than those in the general population. These rates—essentially flat during the mid-1990s—have been falling for the past four years across all patient vintages. And five-year survival rates improved approximately 10 percent between the 1991–1995 and 1996–2000 periods.

Figures on cause-specific mortality provide further detail on how mortality rates in the incident population have improved less than those among prevalent patients. Of note is the
growth in cardiovascular mortality during the first three months of dialysis—growth which peaked during the mid-1990s. Rates of reported mortality at one year, in contrast, have remained unchanged since 1991. These data raise questions about recent reports of lower mortality among incident patients treated with IV vitamin D. As we discuss in the Emerging Issues chapter, a large increase in vitamin D use has been concurrent with stable mortality in the first year.

This year we devote four pages to the disabled population, assessing the occurrence of blindness, amputation, limb paresis/paralysis, and dementia. The latter accounts for a significant portion of reported disability, raising concerns as to its impact on patient care, living conditions, and cognitive function in this vulnerable population. Data also illustrate the considerable costs associated with disability, particularly with amputations and dementia.

We conclude with data on the impact of Hurricane Katrina among ESRD and general Medicare patients in affected areas. With flooding, loss of power, and transportation issues forcing many to leave their homes, outcomes in these patients have previously been unclear. Not unexpectedly, overall outpatient dialysis treatments fell during the month of the storm, rebounding after patients settled into new treatment settings. Interestingly, monthly billings for ESAs were maintained, while those for IV iron and Vitamin D fell; this may reflect data access biases in that iron data is usually collected every three months, while hemoglobin levels are assessed weekly. Hospitalization, as expected, spiked in the dialysis population, with patients needing hospital access for complications such as fluid overload and high potassium levels. This cohort of Katrina survivors will be followed by the USRDS, the ESRD networks, and CMS to determine how patient management can be improved when disasters affect the dialysis population.

Overall, then, hospitalization rates in dialysis patients have stabilized, while mortality continues to decline. Improvements in preventive care are most likely associated with falling event rates, such as those for vascular access hospitalizations, and with progressively lower mortality in both the incident and prevalent populations. These findings suggest that increased attention to clinical practice guidelines may be having an impact on the morbidity and mortality of ESRD patients. Flat death rates in first-year hemodialysis patients, however, demand careful attention, as they show a marked contrast to the improvements noted for other patient vintages.

6.1 Mortality rates, by modality incident ESRD patients

**Contents**

- overall hospitalization
- admissions & days
- rates, by vintage
- cause-specific hospitalization
- admissions, by age
- admissions, by modality & state
- overall mortality
- mortality
- survival
- expected remaining lifetimes
- cause-specific mortality
- mortality due to CVD, infection, & other causes
- disability in CKD & ESRD
- blindness, amputation, limb paresis/paralysis, & dementia
- costs & mortality in patients with disabilities
- yearly costs
- probability of death
- effects of Hurricane Katrina on outcomes
- hospitalization & mortality
- hemoglobin levels

**Highlights**

- figure 6.1 Interval mortality rates (adjusted for age, gender, race, and primary diagnosis) are consistently down across all modalities and lengths of therapy, with the exception of first-year mortality in the hemodialysis population. From the early 1980s through the mid-1990s, dialysis patients of younger vintage had higher mortality rates than those on dialysis five years or longer. This trend began to change in 1994, and, as of 2005, rates for patients who have had ESRD for less than two years are 18 percent lower, at 210.7 versus 258.2 per 1,000 patient years.
Adjusted hospitalization rates in the dialysis population have not changed since 1993, while rates in the peritoneal dialysis and transplant populations have fallen 8.9 and 6.1 percent (Figure 6.2). Hospital days, however, have shown more variation. After falling across modalities in the mid-1990s, hospital days per patient year stabilized overall and for hemodialysis patients, and since 2001 have decreased 12 percent for both peritoneal dialysis and transplant.

Hospital admissions for vascular access in hemodialysis patients continue to decline—34 percent since 1993 (Figure 6.3). Admissions for bacteremia/septicemia have increased since 2001, now reaching a rate nearly 29 percent greater than in 1993.

Admissions per patient year for dialysis patients are greatest in the eastern half of the country and in areas of the Southwest (Figure 6.4). Admissions for transplant patients, in contrast, are highest in the Upper Midwest and the northeastern states.

By modality, rates of hospital admissions for pneumonia are 1.9–2.2 times greater in hemodialysis patients than in those on peritoneal dialysis or with a transplant, and rose slightly in 2005 to reach 86.3 per 1,000 patient years (Figure 6.4). Admissions for bacteremia/septicemia have increased across modalities since 2003, reaching 102 for hemodialysis patients, and 2.4 times higher than in the transplant population. Admissions for vascular access infections in hemodialysis patients seem to be stabilizing; peritoneal dialysis patient admissions for peritonitis continue to fall.

Since 1995, the rate of all-cause admissions has dropped less than 1 percent (Figure 6.6). Vascular access admissions, however, have decreased 31 percent overall, 42 percent for patients 75 and older, and 44 percent for Native American patients. Admissions for infection, in contrast, are up nearly 19 percent overall, 27 percent for patients 75 and older, and 28 percent for African Americans.

Hospitalization rates by vintage are shown in Tables 6.a–c. In the hemodialysis population, patients who have had ESRD for less than two years have the highest admission rates, while the greatest rates for peritoneal dialysis and transplant patients occur most often in those who have had ESRD for five years or longer.

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6.a Adjusted hospital admission rates per patient year, by vintage: hemodialysis period prevalent patients age 20 & older

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6.b Adjusted hospital admission rates per patient year, by vintage: peritoneal dialysis period prevalent patients age 20 & older

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6.c Adjusted hospital admission rates per patient year, by vintage: transplant period prevalent patients age 20 & older

More on hospitalization: p.20–22, 6.7–11 (next page), 8.34–36 (pediatric patients), 10.50–54 (Bayesian ratios, by provider).
Adjusted cause-specific hospital admissions, by age
period prevalent dialysis patients age 20 & older

Adjusted inpatient coronary revascularization procedures, by age
period prevalent dialysis patients age 20 & older

Adjusted inpatient vascular access procedures, by age
period prevalent hemodialysis patients age 20 & older

Il-cause hospitalizations in patients age 20–44 and those 75 and older have been nearly equal since the beginning of the decade, at 2.2 admissions per patient year (Figure 6.7). Admissions for cardiovascular disease, in contrast, rise with age, while the youngest patients have the highest rates of admission for infection due to internal devices.

Rates for all coronary revascularization procedures, for angioplasty, and for stents have, for most ages, grown steadily since the early 1990s; the rate of bypass procedures, however, peaked at the end of that decade and has since fallen (Figure 6.8).

Rates of inpatient vascular access placements—overall and of catheters and grafts—continue to fall, as more procedures are performed on an outpatient basis (Figure 6.9). Inpatient fistula placement rates have remained relatively steady; the overall rate, however, continues to climb (see Figure hp.13 in the Healthy People 2010 chapter).

Hospital admissions for cardiovascular disease are highest for hemodialysis patients in Michigan, Illinois, Arkansas, Louisiana, Massachusetts, and the Ohio Valley, averaging 714 per 1,000 patient years in the upper quintile (Figure 6.10). In the peritoneal dialysis population, cardiovascular admissions are also greatest in the eastern half of the country, with an average rate of 648.

Since 1995, inpatient catheter placement rates have fallen across much of the country, with a mean percent decrease of 55 percent in the lowest quintile and a mean growth of just 3.6 percent in the upper quintile (Figure 6.11). Admissions for infec-
6.10 Geographic variations in cause-specific admissions, per 1,000 patient years, 2005, by modality & state

Period prevalent ESRD patients


Period prevalent hemodialysis patients

More on hospitalization: p.20–22, 6.2–6 (previous page), 8.34–36, 8.39–41 (pediatric patients), 10.50–54 (Bayesian ratios, by provider).
Among ESRD patients age 65 and older, mortality rates are six times greater than in the general population; for pediatric patients, in contrast, rates are not quite three times as high (Figure 6.12). The major contributor to high all-cause mortality in ESRD patients is the dialysis population, with rates 4–7 times higher than those of transplant patients. All-cause mortality rates are greatest in the eastern half of the country (Figure 6.13). In the general population, individuals younger than 30 are expected to live more than four times longer than comparably aged dialysis patients (Table 6.d). Transplant patients fare much better, with expected remaining lifetimes that are approximately two-thirds as long as those found in the general population.

As noted in the Précis (Figure p.23), from the early 1980s through the mid-1990s dialysis patients of younger vintage had higher mortality rates than did those on dialysis five years or longer. This trend began to change in 1994, and, as of 2005, rates for patients who have had ESRD for less than two years are 18 percent lower, at 210.7 versus 258.2 per 1,000 patient years (Figure 6.14). Since 1999, rates in younger patients age 45–64 are more than three times greater, at 180.8 per 1,000 patient years versus 49.8. Rates for malignancy in those age 65 and older are 298.0 in ESRD patients compared to 114.1 in the general population, more than a two-fold difference.

Five-year survival probabilities continue to rise, reaching 0.39 overall for 1996–2000 incident patients, 0.35 for those on dialysis, and 0.75 for those with a transplant (Figure 6.16). Compared to those of 1991–1995 incident patients, probabilities for patients initiating in 1996–2000 grew 6.2 percent overall—5.8, 11.1, and 7.3 percent for hemodialysis, peritoneal dialysis, and transplant, respectively. Survival continues to improve most for patients with diabetic ESRD, though their rates remain lowest by diagnosis.

Survival after a major disease diagnosis is dramatically greater in the general population, and lowest in patients on dialysis (Fig-
Following a diagnosis of heart disease, for example, first-year survival probabilities in the general population in 2004 were 0.92, compared to 0.73 in dialysis patients and 0.88 in the transplant population. At five years this difference is even more pronounced—dialysis patients have a 0.18 survival probability compared to 0.64 in the general population and 0.47 in transplant patients. Following a diagnosis for malignancy, the probability of first-year survival in dialysis patients is 0.73 compared to 0.90 in both the general and transplant populations. At five years, the probability falls to 0.17 in dialysis patients compared to 0.62 and 0.53, respectively, in the general and transplant populations. A diagnosis of septicemia appears to have the most significant impact on survival. The first-year survival probability after this diagnosis is highest for transplant patients, at 0.69, and comparable in the general and dialysis populations, at 0.58 and 0.59, respectively. At five years, however, probabilities in all populations are noticeably low, at 0.12 in the dialysis population and 0.25 and 0.30, respectively, in the general and transplant populations.

**Figure 6.14** Adjusted mortality rates, by vintage period prevalent dialysis patients

**Figure 6.15** All-cause mortality: pts with major diseases, 2005 general Medicare & ESRD pts

**Figure 6.16** Adjusted five-year survival, by modality & primary diagnosis incident dialysis patients & patients receiving a first transplant in the calendar year

**Figure 6.17** Survival rates after major disease diagnosis in the ESRD & general populations prevalent general Medicare & ESRD patients

Table 6.e illustrates factors associated with cardiovascular and infectious mortality at three and twelve months following ESRD initiation. In the first three months, for instance, African American dialysis patients are 17 percent less likely to die of cardiovascular disease than whites, and in the first year 16 percent less likely. The likelihood of death within the first three months and at month 12 is similar in patients with diabetes and in those with hypertension, but is 48 and 46 percent lower in patients with glomerulonephritis when compared to those with diabetes.

Adjusted mortality overall rises between months one and three, but falls during the following month (Figure 6.18). In new 2004 patients, for example, the overall mortality rate per 1,000 patient years increased from 210.8 in month one to 307.8 in month three, ultimately falling to 246.1 in month 12. Mortality rates due to infection increased between months one and three, from 24.5 to 47.5 per 1,000 patient years, but decreased slightly in month 12 to 40.5. Overall, one-year mortality rates have been relatively stable since the early 1990s.

In 2001–2004, one-year cardiovascular mortality was highest in Idaho, Nevada, Nebraska, Arkansas, Louisiana, Tennessee, and West Virginia, averaging 156 per 1,000 patient years in the upper quintile (Figure 6.19). One-year infectious mortality was highest in Wisconsin, North Dakota, Arkansas, and areas of New England.
adjusted cause-specific mortality, by time after initiation, age, & race: cardiovascular disease

adjusted cause-specific mortality, by time after initiation, age, & race: infection

adjusted cause-specific mortality, by time after initiation, age, & race: other cause

averaging nearly 50 per 1,000 patient years for patients residing in areas represented by the the upper quintile.

Not surprisingly, mortality rates due to cardiovascular disease, infection, and other causes all rise with age (Figures 6.20–22). Cardiovascular mortality at one year, however, has fallen 16–17 percent since 1995 for those age 20–74, and 11.6 percent for those age 75 and older. By race, one-year mortality due to cardiovascular disease is greatest in white patients, at 114.9 per thousand in 2004—5.0 percent higher than in African Americans. Rates in whites have fallen 18.2 percent since 1995. Among African Americans, after an increase through 2003, rates have begun to approach the lower rates seen in the 1990s.

Since 1995, mortality due to infection at three months and one year has fallen 58.5 and 67.6 percent, respectively, for patients age 20–44. In contrast to cardiovascular mortality, rates of death due to infection are greatest among African Americans. In 2004, three- and twelve-month mortality was 28.1 and 29.8 percent higher, respectively, among African American patients than among whites.

One-year rates of mortality due to other causes have risen 33.6 percent since 1995 in patients age 20–44, and 42.3 percent in African Americans.\[table 6.4\] incident dialysis patients, 2004.\[figure 6.18\] incident dialysis patients; adjusted for age, gender, race, & primary diagnosis. Incident ESRD patients, 1996, used as reference cohort.\[figure 6.19\] incident dialysis patients, 2001–2004; unadjusted. Excludes patients residing in Puerto Rico & the Territories.\[figure 6.20–22\] incident dialysis patients. Rates by age adjusted for gender, race, & primary diagnosis; rates by race adjusted for age, gender, & primary diagnosis. Incident ESRD patients, 1996, used as reference cohort.
One recent initiative of the USRDS Rehabilitation Special Study Center is the Comprehensive Dialysis study, a survey designed to measure quality of life in dialysis patients. The ability to function independently contributes strongly to quality of life. Here we use the presence of a disability as a measure of the loss of independence, providing another picture of quality of life in the CKD and ESRD populations.

Physical function and disability in population-based studies can be measured by the ability to perform activities of daily living (ADLs): walking, eating, dressing, transferring, toileting, and bathing, along with instrumental activities (IADLs) such as cooking, shopping, and managing finances and medications. Although Medicare claims do not address these specific measures of physical function, they contain information on disabilities that affect the ability to function independently.

We have chosen four disabilities that are associated with a decreased ability to function independently, and that are also quite common in the growing diabetic CKD and ESRD populations: blindness (especially affecting IADLs), amputation (affecting mobility), paresis or paralysis of one or more limbs (affecting potentially many or all ADLs and mobility), and dementia (affecting IADLs initially, followed progressively by ADLs.) Many of the analyses are stratified by diabetic status, since these disabilities represent both microvascular (blindness, peripheral vascular disease leading to amputation, small vessel cerebral disease contributing to dementia) and macrovascular (stroke leading to limb paresis and dementia) outcomes of diabetes.

The prevalence of each disability by age, modality, and diabetic status are described in the figures on this page. Dementia is the most common of the disabilities among CKD patients, at 10.1 percent among all ages, rising to 21.3 percent among those 85 years and older (Figure 6.23). The prevalence of dementia among ESRD patients is about half as common as in the CKD population, likely due to severe under-detection and diagnosis.
of dementia in the dialysis population (Murray et al.). Dementia is three times more common among hemodialysis patients compared to peritoneal patients, and four times more common than in the transplant population.

Blindness is the least common of the disabilities, but still affects 2.1 percent of CKD patients, and 4 percent of those with ESRD. In the non-ESRD elderly population, the combination of severe visual impairment and dementia is associated with a six-fold increased odds ratio for incident ADL disability over six years (Whitson et al.).

Amputation here includes minor and major upper and lower amputations. Amputation is the most common prevalent disability in the ESRD cohort, at 8.2 percent. The prevalence of amputation actually decreases with age in both the CKD and ESRD cohorts. This is likely due to the extremely high one-year mortality rates associated with amputation, at up to 62.0 percent in one USRDS study (Logar et al.). We included toe amputations in the prevalence figures because they are often the prelude to subsequent below- and above-the-knee amputations, and represent a potential opportunity to initiate aggressive management of severe peripheral vascular disease to prevent amputation.

Limb paresis or paralysis is prevalent in about 4 percent of both the CKD and ESRD patients. It is usually secondary to acute stroke, which is highly prevalent in both the older CKD (about 9.0 percent) and ESRD (about 17.0 percent) populations (2006 ADR).

Relatively few prevalent CKD or ESRD patients have more than one of the four disabilities described here (Figure 6.25). The most common combination of two disabilities is dementia and limb paresis/paralysis for the CKD cohort, and dementia and amputation for the ESRD cohort (not shown). The prevalence of any one disability in the CKD population is 15.0 percent and increases with age; only 1.7 percent have two disabilities. Among hemodialysis patients, 17.7 percent have any one disability and 2.7 percent have two, but prevalence does not increase with age. This suggests a high mortality rate associated with these disabilities in the ESRD cohort, among patients that already have relatively low organ reserve compared to those in the CKD cohort. In the transplant cohort, 7.8 percent have at least one disability. Most common is amputation, in 3.9 percent, followed by blindness, in 2.3 percent.

In the 2003 cohorts described here, diabetes is present in 45.0 percent of the CKD patients, and 61.8 percent of the prevalent dialysis patients. The prevalence of all four disabilities is higher among diabetics compared to non-diabetics, but diabetes has the biggest impact on the risk of amputation (Figure 6.26). The unadjusted prevalence of amputation is 4.6 times greater among diabetic CKD patients than among non-diabetics, and 5.8 times greater in diabetic compared to non-diabetic dialysis patients.

For dementia, the prevalence in the dialysis cohort is only slightly higher in diabetics than in non-diabetics. This suggests that much of recently reported higher risk of dementia among the community diabetic population may be associated with factors related to their renal disease (hypertension and chronically elevated inflammatory factors), and less with their diabetes. The prevalence of blindness is 1.4-fold greater in diabetic CKD patients and 2.8-fold greater in diabetic dialysis patients than among their respective non-diabetic counterparts.

Incident disability rates in the 2003 point prevalent population are described in Figure 6.27. Dementia is the most common incident disability among the CKD diabetic and non-diabetic cohorts, at 2.6 percent, and in the non-diabetic dialysis cohort, at 3.4 percent, but amputation is most common among dialysis patients with diabetes.

The greatest relative effect of diabetes on incident disability rates is again related to amputation. The incidence of amputation is 5.0 percent among diabetic dialysis patients, compared to 1.3 percent in their non-diabetic counterparts. This rate of 5.0 percent is approximately ten times greater than the recently published rate of 0.5 percent in the general community population of diabetic non-ESRD patients (Bethel et al.). These results are identical to a previous analysis of the 1991 and 1994 USRDS cohorts, which also reported a ten-fold increased risk of lower limb amputation among diabetic ESRD patients compared to diabetic patients without ESRD (Eggers et al.).
expenditures & mortality in patients with disabilities

MORBIDITY & MORTALITY

6.28 Per person per year costs in dialysis patients, by diabetic status, type of disability, & age incident dialysis patients, 2003

6.29 Per person per year costs in dialysis patients, by diabetic status, number of disabilities, & age incident dialysis patients, 2003

6.30 Probability of blindness in dialysis & CKD patients incident dialysis & point prevalent CKD patients, 2003

6.31 Probability of amputation in dialysis & CKD patients incident dialysis & point prevalent CKD patients, 2003

6.32 Probability of limb paresis/paralysis in dialysis & CKD patients incident dialysis & point prevalent CKD patients, 2003

6.33 Probability of dementia in dialysis & CKD patients incident dialysis & point prevalent CKD patients, 2003
Not surprisingly, the cumulative per person per year (PPPY) costs associated with each of the disabilities examined here are, for the most part, substantially greater for dialysis patients with diabetes than for those without, and overall differences in cost vary by approximately 3 to 21 percent depending on the type of disability (Figure 6.28).

Amputation is the most costly disability regardless of diabetic status, with associated costs of $122,000 for diabetic patients—approximately $20,000 higher than in patients without diabetes. Costs for limb paresis/paralysis are $102,590 and $90,900, respectively, in patients with or without diabetes, and for diabetic patients with dementia are approximately 3 percent higher than in those with no diabetes.

Overall, PPPY costs do not vary substantially with age. In diabetic patients age 85 and older, however, the associated costs for dementia are 18 percent lower than those found in the younger cohort. This may be due in part to the low number of subjects in the 85 and older age group and a “healthy survivor” effect—those who are able to survive until age 85 may have lower comorbidity burden than those who didn’t survive.

PPPY costs of $108,820 in diabetic patients with two disabilities are considerably higher than costs of $64,020 incurred in patients with no disabilities (Figure 6.29). A similar pattern is seen in non-diabetics, but baseline PPPY costs for non-diabetics with no disabilities are $8,280 lower, at $55,740. There is no appreciable effect of age on the relationship between cost and number of disabilities (costs for more than two disabilities are not shown because of low patient numbers).

The adjusted 24-month cumulative risk of each disability is far higher among dialysis patients compared to those with CKD (Figures 6.30–33). The cumulative risk of incident amputation in dialysis patients, for example, is 8.4 percent, more than six times that of CKD patients, at 1.3 percent; the risk of incident limb paresis/paralysis in dialysis patients, at 6.1 percent, is twice as high as the 3.0 percent risk found in CKD patients.

The burden of disability due to blindness, amputation, paresis/paralysis, and dementia is high in the CKD and dialysis populations. Amputation is the most common disability among dialysis patients, and dementia the most common among those with CKD. Diabetes increases the risk of all disabilities, but especially amputation.

More aggressive diabetic foot care and management of peripheral vascular disease are especially needed to decrease the risk of amputation and the associated loss of mobility. Intensive diabetes management and control of blood pressure are critical to lower the risk of all four disabilities, and in turn would contribute to a higher quality of life and increased ability to function independently.

**Figures 6.28–29** incident dialysis patients, 2003. **Figures 6.30–33** incident dialysis & point prevalent CKD patients, 2003; Medicare as primary payor on the first service date for dialysis patients & on January 1 for CKD patients. Adjusted for age, gender, diabetic status, & ASHD; 2003 dialysis patients used as reference.
and relocate the dialysis population were largely performed by local services, volunteers, dialysis units, and national and local affiliates of non-profit organizations such as the National Kidney Foundation and the American Association of Kidney Patients.

The counties officially damaged by Hurricane Katrina are listed in Table 6.f, with Louisiana having the largest dialysis population affected by the storm. In total, 3,609 dialysis patients were located in the area before the hurricane, while 2,602 can be identified in the same area after the event, suggesting that more than 1,000 individuals left the area to receive care in other locations or did not survive the catastrophe.

Changes in the number of treatments and in the use of injectables are shown in Figures 6.34–35. As expected, records of dialysis treatments declined in September, with a rebound in subsequent months. Billings for EPO, interestingly, remained constant, but those for Vitamin D and IV iron declined. These latter findings may reflect the timing and availability of laboratory data needed to guide treatment; EPO dosing, in contrast, is governed by weekly hemoglobin levels.

As expected, hospitalization rates for the dialysis population increased, with these patients needing acute care; plans to evacuate these victims most likely addressed this issue.

Mortality rates increased after Katrina in both the dialysis and general Medicare populations (Figures 6.37–38). Katrina victims on dialysis, however, experienced a larger increase in mortality after the event compared to patients in the general Medicare population.

Causes of death increased in the “other” category, consistent with acute loss of life and death outside the hospital. Given that a dialysis patient can rarely survive after missing two or more treatments, this growth in mortality rates may reflect limited access to dialysis.

Hurricane Katrina tested disaster response for all participants located in the risk area, and showed clearly that the dialysis population requires special attention from all levels of the healthcare and disaster assistance systems. The USRDS will continue to follow the affected dialysis population to determine the short- and long-term effects caused by this catastrophic event.

### Table 6.f

<table>
<thead>
<tr>
<th>State</th>
<th>County</th>
<th>Pre-Katrina (n)</th>
<th>Post-Katrina (n)</th>
<th>% change</th>
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6.34 Change in the number of dialysis treatments before & following Hurricane Katrina period prevalent dialysis patients

6.35 Change in injectable use before & following Hurricane Katrina period prevalent dialysis patients

6.36 Hospitalization rates before & following Hurricane Katrina period prevalent dialysis patients

6.37 Overall mortality before & following Hurricane Katrina period prevalent dial. pts

6.38 Mortality before & following Hurricane Katrina, by time period prevalent dial. pts

6.39 Causes of death before & following Hurricane Katrina period prevalent dial. pts

6.40 Hemoglobin levels (g/dl) before & following Hurricane Katrina period prevalent dialysis patients
Overall hospitalization

Figure 6.3 Hospital admissions for vascular access in hemodialysis patients continue to decline—34 percent since 1993. Admissions for bacteremia/septicemia have been increasing since 1995, figure 6.6 Since 1995, admissions for infection have increased nearly 19 percent overall, 27 percent for patients 75 and older, and 28 percent for African Americans. Table 6.a–c In the hemodialysis population, patients who have had ESRD for less than two years have the highest admission rates, while the greatest rates for peritoneal dialysis and transplant patients occur most often in those with ESRD for five years or longer.

Cause-specific hospitalization

Figure 6.7 All-cause hospitalizations in patients age 20–44 and those 75 and older have been nearly equal since the beginning of the decade, at 2.2 admissions per patient year. Admissions for cardiovascular disease, in contrast, rise with age, while the youngest patients have the highest rates of admission for infection due to internal devices. Figure 6.9 Rates of inpatient vascular access placements—overall and for catheters and grafts—continue to fall, as more procedures are performed on an outpatient basis.

Overall mortality

Figure 6.12 Among ESRD patients 65 and older, mortality rates are six times higher than in the general population; for patients younger than 20, in contrast, rates are not quite three times as high. Figure 6.14 Since 1985, mortality rates in patients who have had ESRD less than two years have fallen 27 percent, while rates for those of older vintage (five or more years) have increased 7 percent. Figure 6.17 Five years after a diagnosis of heart disease, the probability of survival in dialysis patients is only 0.18, compared to 0.64 in the general population and 0.47 in transplant patients.

Cause-specific mortality

Table 6.2 In the first three months of ESRD therapy, African American dialysis patients are 17 percent less likely to die of cardiovascular disease than are their white counterparts, and 16 percent less likely to die within the first year. Figure 6.20 Cardiovascular mortality at one year has fallen 16–17 percent since 1995 for patients age 20–74, and 11.6 percent for those age 75 and older.

disability in CKD & ESRD patients

Figure 6.23 Dementia is the most common disability among CKD patients, at 10.1 percent among all ages, rising to 21.3 percent among those 85 years and older. The prevalence of dementia among ESRD patients is about half as common as in the CKD population, likely due to severe under-detection and diagnosis of dementia in the dialysis population. Dementia is three times more common among hemodialysis patients compared to peritoneal patients, and four times more common than in the transplant population.

Expenditures & mortality in patients with disabilities

Figure 6.28 Among incident dialysis patients in 2004, amputation was the most costly disability regardless of diabetic status, with associated costs of $122,000 for patients with diabetes—approximately $20,000 higher than in patients with no diabetes. Costs for limb paresis/paralysis are $102,590 and $90,000, respectively, in patients with or without diabetes, and for diabetic patients with dementia are approximately 5 percent higher than in those with no diabetes.

Effects of Hurricane Katrina on patient outcomes

Figures 6.37–38 Mortality rates increased after Katrina in both the dialysis and general Medicare populations. Katrina victims on dialysis, however, experienced a larger increase in mortality after the event compared to patients in the general Medicare population.

Maps National means & patient populations for maps can be found in the Excel file for this chapter—on our website at www.usrds.org, & also on the CD-ROM included at the back of this book.