The wrong of unshapely things is a wrong too great to be told; 
I hunger to build them anew and sit on a green knoll apart, 
With the earth and the sky and the water, remade, like a casket of gold 
For my dreams of your image that blossoms a rose in the deeps of my heart.

William Butler Yeats
"The Lover Tells of the Rose in His Heart"
Chronic kidney disease (CKD), the precursor to ESRD, received little attention prior to the 2002 publication of the National Kidney Foundation’s Chronic Kidney Disease Guidelines. This document created a CKD classification system, using five stages defined by increasing evidence of kidney damage, as shown by microalbuminuria and estimated glomerular filtration rates (eGFRs).

Applying this new classification system to NHANES III data, Coresh and Levey et al. estimated that eight million people in the U.S. had an eGFR less than 60 ml/min/1.73 m², and another 12 million had evidence of microalbuminuria.

The USRDS uses diagnosis codes from hospital and outpatient encounters to determine the size of the CKD population—a method which utilizes only those codes identified by providers. In the Précis we define the CKD population over a two-year period, looking at those who survive until the end of the year, and considering them point prevalent at the start of the next year. To approximate a period prevalent CKD population, we also include new patients identified with CKD in the next year; expenditures are determined in the second year.

In this chapter, however, we use a slightly different definition for CKD patients, requiring survival for the entire second year in order to give each patient equal opportunity for access to care. This definition may exclude the sickest CKD patients, since they may have early mortality.

Figure 1.1 shows that in almost two-thirds of Medicare patients with CKD—identified by diagnosis codes over the two-year period—CKD is accompanied by diabetes, CHF, or both diseases combined. In employed CKD patients under 65, a similar proportion has diabetes, but far fewer patients have CHF alone or with diabetes. Over the past decade the CKD population has become more complex, with rates of diabetes alone and in combination with CHF growing 38 and 26 percent, respectively, in the Medicare population, while in the employed population rates of CKD accompanied by diabetes, CHF, or both diseases have grown 9–13 percent.

Figure 1.4 illustrates these changes in further detail. The percent of CKD patients with diabetes increased in the Medicare population from 16.7 in 1992–1993 to 23.7 in 2002–2003, and in the EGHP population from 23.8 in 1999–2000 to 26.6 in 2002–2003. While the percent whose CKD is accompanied by heart failure has remained steady or fallen, the burden of CKD with both diabetes and heart failure has grown.

Few patients who are at risk for CKD receive optimal assessment. Testing for microalbuminuria or proteinuria is done in only 20 percent of diabetic patients, and testing rates are even lower in diabetic patients who also have CHF.

Preventive care in CKD patients is similarly infrequent. Measurement of at least two glycosylated hemoglobins each year, as recommended by the American Diabetes Association, occurs in only 56 percent of Medicare patients with both diabetes and CKD, and 35 percent of the EGHP population with the same diagnoses.
Limited data show that the use of ACE inhibitors and ARBs for renal protective treatment has almost doubled. CKD patients with diabetes are almost twice as likely to receive this treatment, and those with CHF almost three times as likely, as those with other diagnoses.

All-cause hospitalization rates are almost 50 percent greater in CKD patients than in those without the disease. Of note is the fact that hospitalizations for pneumonia and bacteremia/sepsis have changed little over the last ten years, in contrast to the progress made in cardiovascular hospitalizations.

Growing comorbidity increases the likelihood of hospitalization for acute kidney failure (AKF). Patients with CKD, diabetes, and CHF combined, for example, have a 38 percent chance of hospitalization for AKF within the next three years, compared to only 14 percent in non-CKD patients. After an AKF hospitalization, patients with a history of CKD are five times more likely to die than to progress to ESRD; for those without prior CKD, the likelihood is 20 times greater.

Assessment of CKD patients will change based on public policy initiatives by the CDC and CMS. The CDC, for example, will be adding CKD surveillance programs. ICD-9-CM and ICD-10-CM diagnosis codes for individual stages of CKD have been approved, and will be introduced in October, 2005. And performance standards are being considered by both the National Center for Quality Assurance and the Joint Commission for Accreditation of Health Care Organizations to address standardized methods for measuring serum creatinines, calculating estimated GFRs, conducting urine albumin testing, and defining care through NKF’s clinical practice guidelines.

**Figure 1.6** The overall probability of microalbuminuria or proteinuria testing reaches only 0.04 in the Medicare population, and 0.01 for EGHP patients. 

**Figure 1.14** In the Medicare CKD population, the probability of receiving at least two HbA1c tests within a year is 0.56, compared to 0.36 for EGHP patients. 

**Figure 1.19** The use of ACE-Is and ARBs for renal protective treatment has almost doubled in the CKD population. 

**Figure 1.32** In the Medicare population, the overall hospitalization rate for CKD patients reached 1,068 per 1,000 patient years in 2003—nearly three times greater than that in patients without CKD. 

**Figure 1.39** For patients with a prior diagnosis of CKD, the rate of death in the first three months after hospitalization is 2.7–4 times greater than the rate of an ESRD diagnosis.
Since 1993 the rate of recognized chronic kidney disease (CKD) has more than doubled across the country (Figure 1.3). Areas showing the highest CKD rates are located in the Gulf Coast states and the eastern third of the country. These patterns are generally similar to those found in incident ESRD rates noted in Figure 2.8. In the mid-Atlantic states, for instance, rates of ESRD and CKD appear to be similar. There are, however, some notable geographic differences. One, for example, occurs in the southwestern states, where high rates of ESRD exist but rates of CKD are inconsistent. A variation such as this may reflect regional differences in how CKD is identified, i.e., use of diagnosis codes versus the actual estimated glomerular filtration rate and stage of CKD.

Figure 1.4 illustrates changes over time in the general Medicare and EGHP populations with CKD, both alone and in combination with diabetes and CHF. It shows, first of all, the steady growth of the overall recognized CKD population. The Medicare CKD population, for example, grew 146 percent between 1992–1993 and 2002–2003. In the EGHP population the same amount of growth occurred in a much shorter time period, with the number of CKD patients increasing 148 percent between 1999–2000 and 2002–2003. In the Medicare population the greatest growth, of almost 250 percent, has been seen among patients with both CKD and diabetes; in the EGHP population growth has been highest among those with CHF as well.

The figure also shows the evolution of the disease burden in the recognized CKD population. In the general Medicare population, for example, the percentage of patients whose CKD is not accompanied by either diabetes or CHF has dropped from 41 to 33 since the early 1990s, while the percentage who have CKD together with congestive heart failure has fallen from 24 to 19. Diabetes, in contrast, now has a larger impact on the CKD population, occurring in 24 percent of patients compared to 17 percent in 1992–1993. And the most complicated disease burden—CKD in combination with both diabetes and CHF—is increasing as well. Nineteen percent of CKD patients in 1992–1993 had both additional diagnoses; by 2002–2003 this had grown to nearly one in four patients.
1.4 Trends in the interactions of diabetes, congestive heart failure, & CKD

Medicare, 1992–1993

| CKD only: 257,980 (40.7%) |
| CKD+DM: 106,000 (16.7%) |
| CKD+CHF: 149,960 (18.9%) |

CKD total: 633,840 (2.34% of total Medicare)

Medicare, 1997–1998

| CKD only: 307,140 (35.4%) |
| CKD+DM: 175,840 (20.2%) |
| CKD+CHF: 193,220 (22.2%) |

CKD total: 868,680 (3.38% of total Medicare)

Medicare, 2002–2003

| CKD only: 520,520 (33.4%) |
| CKD+DM: 368,780 (23.7%) |
| CKD+CHF: 289,380 (18.6%) |

CKD total: 1,558,980 (5.62% of total Medicare)

EGHP, 1999–2000

| CKD only: 4,233 (63.6%) |
| CKD+DM: 1,586 (23.8%) |
| CKD+CHF: 480 (7.2%) |

CKD total: 6,651 (0.47% of total EGHP)

EGHP, 2002–2003

| CKD only: 9,789 (59.4%) |
| CKD+DM: 4,382 (26.6%) |
| CKD+CHF: 1,400 (8.5%) |

CKD total: 16,482 (0.66% of total EGHP)

*Figure 1.3* per 1,000 patients, by HSA, unadjusted. General Medicare patients continuously enrolled in Medicare Parts A & B during two consecutive years; patients enrolled in an HMO or diagnosed with ESRD during the period are excluded. *Figure 1.4* Medicare: general Medicare CKD patients continuously enrolled in Medicare Parts A & B for two consecutive years (numbers estimated from 5 percent sample); patients enrolled in an HMO or diagnosed with ESRD during the period are excluded. EGHP: CKD patients younger than 65 & continuously enrolled in a fee-for-service-plan for two consecutive years.
In this spread we examine the medical assessments received in both Medicare and Employer Group Health Plan (EGHP) populations without an existing diagnosis of chronic kidney disease (CKD), and focus on patients whose diabetes and/or congestive heart failure places them at high risk for CKD.

For all of the diagnostic tests presented here, Medicare patients are more likely than patients with EGHP coverage to receive testing. The probability of receiving a targeted serum creatinine to assess kidney function, for example, is 0.13 in Medicare non-CKD patients, compared to 0.03 in their EGHP counterparts (Figure 1.5). The probability rises to 0.24 for Medicare patients with both diabetes and CHF, but reaches only 0.13 in the equivalent EGHP population. Patients residing in the Upper Midwest, the Ohio Valley, areas in New England and areas along the Atlantic Coast have the highest probability of receiving a targeted serum creatinine test within a year.

The overall probability of microalbuminuria or proteinuria testing reaches only 0.04 in the Medicare population, and 0.01 for EGHP patients (Figure 1.6). The greatest likelihood—0.22 and 0.19, respectively—occurs in patients with diabetes but without accompanying CHF. Patients residing in the western third of the country, the Upper Midwest, and northern New England are most likely to be tested.

In the non-CKD population the probability of a renal ultrasound is 0.04 and 0.01 for Medicare and ESRD patients, respectively (Figure 1.7). It rises to 0.10 and 0.07 in patients with combined diabetes and CHF, and is slightly higher for those with CHF alone than for those with diabetes alone. Renal ultrasounds appear to be
more highly utilized in the eastern half of the nation as well as in areas in the Southwest and Gulf Coast states.

The probability of calcium and phosphorus assessment is 0.06 in Medicare non-CKD patients overall, and 0.02 in the EGHP population (Figure 1.8). The greatest probability of assessment occurs in patients with both diabetes and CHF, at 0.12 for Medicare patients and 0.08 for those with EGHP coverage. Geographically, the likelihood of a calcium and phosphorus assessment appears to be highest in regions along the Atlantic Seaboard and in the Southwest, the Midwest, and the Ohio Valley.

Not unexpected, parathyroid hormone testing is rare in the non-CKD population (Figure 1.9). The probability of testing exceeds 0.01 only in Medicare patients with diabetes and in Medicare and EGHP patients with both diabetes and CHF. Patients in the western third of the country are the most likely to be tested.

In the non-CKD Medicare population, the probability of receiving a battery of assessment tests reaches 0.38, 0.24, and 0.37 in patients with diabetes, CHF, and both diagnoses combined, respectively (Figure 1.10). Compared to that in the EGHP population, the likelihood of testing is nearly four times greater in Medicare patients overall and in those with other diagnoses, 1.4 times greater for those with diabetes, 1.6 times for those with diabetes and CHF combined, and twice as high for those with CHF alone. Nationwide, the probability of patients receiving a battery of tests within a year is highest in the Upper Midwest, the Ohio Valley and scattered areas throughout New England.

These data suggest that assessment strategies in the at risk population are markedly underutilized, particularly in the EGHP populations.

(Figures 1.5–1.10) general Medicare: patients entering Medicare before January 1, 2002, alive & remaining in the program through December 31, & without CKD diagnosed during 2002. Patients enrolled in an HMO, with Medicare as secondary payor, or with ESRD diagnosed during the year are excluded. EGHP: patients enrolled for the entire year 2002 in a fee-for-service plan, younger than 65, & without a diagnosis of CKD during 2002. Patients diagnosed with ESRD before or during the year are excluded.

For both populations, diabetes, CHF, & other comorbidities are defined in 2002. Patients censored at end of plan & end of 2003; prevalent Medicare patients also censored at death. All testing tracked in 2003. In Figure 1.5, data on serum creatinine testing obtained from individual tests & panels. Maps by HSA, unadjusted. (Figure 1.5) CPT codes used for assessment of serum creatinine include 80069 & 82565. (Figure 1.10) testing includes serum creatinine, microalbuminuria or proteinuria, & calcium & phosphorus testing.
Preventive healthcare monitoring in CKD patients

Data here illustrate the likelihood of, and geographic variations in, preventive healthcare monitoring given to patients with chronic kidney disease. For all types of preventive care examined here, the probability of receiving care is considerably higher for Medicare patients than for those with EGHP coverage.

The probability of a CKD patient receiving calcium and phosphorus testing is 0.27 for those with Medicare coverage, and 0.17 for those under EGHP; the probability is slightly higher for patients with diabetes as well (Figure 1.11). Evaluation of bone and mineral metabolism through parathyroid hormone testing is even less frequent, with the probability reaching a high of only 0.1 in Medicare patients with CKD, diabetes, and CHF combined (Figure 1.12). The probability of receiving a PTH assessment is only 0.08 nationwide.

For patients with diabetes, the probability of microalbuminuria or proteinuria testing reaches only 0.19 in the Medicare CKD population, and 0.16 in EGHP patients with CKD (Figure 1.13). The probability is slightly lower in patients who also have CHF, and higher in those with other
diagnoses. Regionally, more patients residing in the western third of the country and in upper New England receive microalbuminuria or proteinuria testing.

The American Diabetes Association recommends that people with diabetes receive 2−4 glycosylated hemoglobin tests each year. In the Medicare CKD population, the probability of receiving at least two HbA1c tests within a year is 0.56, compared to 0.36 for EGHP patients (Figure 1.14). Testing for glycosylated hemoglobin is more common in the northern half of the country.

In the CKD population as a whole, the probability of lipid monitoring is 0.59 in Medicare patients, and 0.37 in EGHP patients (Figure 1.16). This rises to 0.71 and 0.50, respectively, in patients with diabetes alone, but falls to 0.61 and 0.36 in those with combined diagnoses of diabetes and CHF.

Nationwide, the probability of receiving a test for lipids is highest on the West and East Coasts and in the Southwest. Under Healthy People 2010 guidelines, 90 percent of people should receive an influenza vaccination each year. In Medicare CKD patients, however, the probability of a vaccination is only 0.52−0.54 (Figure 1.17). In EGHP patients with CKD, the probability is even lower, ranging from 0.12 in patients with CHF or other diagnoses to 0.20 in those with diabetes. Some of these patients may, however, receive vaccinations through their employers. Patients in the Upper Midwest and Ohio valley are the most likely to receive the flu vaccine.

Vaccinations for pneumococcal pneumonia are even less frequent (Figure 1.18). The probability of receiving this vaccination within a two-year period is only 0.13 in Medicare CKD patients (slightly higher for those with diabetes and CHF), and 0.03−0.07 in the EGHP population. Geographically, the probability of receiving a pneumococcal vaccination is 0.21 for patients residing in areas represented by the top quintile.

(All figures) general Medicare: patients enrolled in an HMO, with Medicare as secondary payor, or with ESRD diagnosed during the year are excluded. EGHP: patients diagnosed with ESRD before or during the year are excluded. Both populations: patients censored at end of plan & end of 2002; Medicare patients also censored at death. Maps by HSA, unaclu. (Figures 1.11–12 & 1.16) general Medicare: patients entering Medicare before January 1, 2002, alive & remaining in the program through December 31, & with CKD diagnosed during 2002. EGHP: patients enrolled for the entire year 2002 in a fee-for-service plan, younger than 65, & with CKD diagnosed during 2002. For both populations, CHF & other comorbidities are defined in 2002. First calcium & phosphorous testing, PTH testing, & lipid monitoring tracked in 2003. (Figures 1.13−15) general Medicare: patients entering Medicare before January 1, 2002, alive & remaining in the program through December 31, & with CKD & diabetes diagnosed during 2002. EGHP: patients enrolled for the entire year 2002 in a fee-for-service plan, younger than 65, & with CKD & diabetes diagnosed during 2002. For both populations, CHF & other comorbidities are defined in 2002. First calcium & phosphorous testing, PTH testing, & lipid monitoring tracked in 2003. (Figures 1.17) general Medicare: patients entering Medicare before January 1, 2002, alive & remaining in the program through August 31, & with CKD & diabetes diagnosed during 2002. EGHP: patients enrolled for the entire year 2002 & through August 31, 2003, in a fee-for-service plan, younger than 65, & with CKD diagnosed during 2002. For both populations, diabetes, CHF, & other comorbidities are defined in 2002. First influenza vaccine tracked between September 1 and December 31, 2003. (Figure 1.18) general Medicare: patients entering Medicare before January 1, 2003, alive & remaining in the program through December 31, & with CKD diagnosed during 2001. EGHP: patients enrolled for the entire year 2001 in a fee-for-service plan, younger than 65, & with CKD diagnosed during 2001. For both populations, diabetes, CHF, & other comorbidities are defined in 2001. First pneumococcal pneumonia vaccine tracked in 2002 & 2003.
Given the high percentage of CKD patients with diabetes and/or congestive heart failure, there are several preventive and maintenance therapies that one would expect to see routinely prescribed. We use the NHANES III (1988–1994) and NHANES 1999–2002 datasets to evaluate prescription drug use in CKD patients. These data represent a cross-sectional evaluation of medication use in the past month, in contrast to the evaluation we performed on the Medstat database for the 2004 ADR, in which cumulative use of medications in CKD Stages 3–5 over a one-year period of time was evaluated. It is important to note that CKD Stage 5 patients are excluded from these analyses because it is not possible to evaluate dialysis status. These data thus represent CKD Stages 1–4, with Stages 1 and 2 determined by a calculated GFR plus a positive urine microalbumin. In addition, because inclusion of all age groups leads to erratic results and there are too few patients younger than 60 to evaluate, this spread represents patients age 60 and older with Stage 1–4 CKD.

Overall, older CKD patients in 1999–2002 were treated more aggressively with medications than in previous years. The use of angiotensin-converting enzyme inhibitors (ACE-Is) and angiotensin receptor blockers (ARBs) has more than doubled in CKD patients with diabetes, from 22 to 46 percent, and has almost doubled in CKD patients with hypertension (Figure 1.19). Further growth in use of these agents should be fueled by National Kidney Foundation (NKF) CKD practice guidelines, released in 2002, which support ACE-I and ARB use in CKD patients with diabetes, by 2004 guidelines advocating ACE-I and ARB use in CKD patients with hypertension, and by congestive heart failure guidelines published in 2001 advocating ACE-Is and ARBs in CHF patients.

CHF and hypertension practice guidelines advocate the use of beta blockers in the treatment of these diseases. Use of these agents has increased from 19 to 26 percent and 15 to 28 percent in older CKD patients with hypertension and congestive heart failure, respectively (Figure 1.20). Interestingly, beta blocker use has also increased tremendously in CKD patients with diabetes. Increased use overall, in hypertensive
patients, and in patients with diabetes may reflect lower blood pressure goals and the fact that beta blockers and diuretics were advocated by Joint National Committee on Prevention, Detection, Evaluation and Treatment 6 (JNC 6) guidelines in 1997 as first-line therapy to reach new blood pressure goals.

Use of dihydropyridine calcium-channel blockers (CCBs—amlodipine, felodipine, isradipine, nicardipine, nifedipine, nimodipine, nisoldipine) has risen substantially in older CKD patients with either diabetes or hypertension (Figure 1.21). This is in stark contrast to nondihydropyridine CCB (diltiazem and verapamil) use, which has declined in the same timeframe. These results are not surprising, given the superior antihypertensive effect of the dihydropyridine CCB group.

This year we evaluate the use of both loop and thiazide (including metolazone) diuretics in CKD patients. Use of loop diuretics (bumetanide, furosemide or torsemide) has increased in all groups of older CKD patients (Figure 1.22). This may indicate that more CKD patients are being identified and treated. In contrast, except for use in CKD patients with congestive heart failure, use of thiazide diuretics has declined. The use of diuretics—particularly thiazide diuretics—may increase, since JNC 7 guidelines published in 2003 strongly advocate the use of thiazide diuretics as a first-line agent, and new NKF clinical practice guidelines on hypertension in CKD patients advocate diuretic use following institution of an ACE-I or ARB.

The use of lipid-lowering agents has dramatically increased in all older CKD patients, from virtually no use in the NHANES III study to over 28 percent in the NHANES 1999–2002 population (Figure 1.23). This most likely represents the influence of the National Cholesterol Education Program: Second Report of the Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults (Adult Treatment Panel II—NCEP II), published in 1994 and advocating more aggressive treatment of high cholesterol levels in the general population. In particular, Figure 1.23 shows that statin use has increased up to ten-fold, while use of non-statin ( bile acid sequestrants, fibrate acid derivatives, and niacin) actually fell slightly over the same period. In CKD patients with cardiovascular disease, statin use increased from 4 to 39 percent. Presumably, the use of statins will be even higher in the next NHANES dataset due to even more aggressive lipid goals as advocated by NCEP III, new NKF CKD guidelines on dyslipidemia, and increased safety data on statins.

We evaluated the use of glucose-lowering medications in older CKD and non-CKD patients in the two NHANES populations (Figure 1.24). The use of insulin was substantially higher (30 percent and 28 percent versus 21 percent and 15 percent) in CKD Stage 1–4 patients than in non-CKD patients, most likely reflecting more severe diabetes in CKD patients. Accordingly, secretagogue use (sulfonylureas) was lower in CKD patients. Use of thiazolidinedione (pioglitazone, rosiglitazone, and troglitazone, which was taken off the market in 2000) is approximately the same in CKD and non-CKD patients in the 1999–2002 NHANES population. As expected, metformin use is substantially less in CKD patients than non-CKD patients (21 versus 34 percent), as it is contraindicated in patients with kidney disease. The manufacturer has recently tightened its recommendation for use of metformin in patients with kidney disease, and currently states that patients whose serum creatinine concentrations exceed the upper limit of normal for their age should not receive metformin due to increased risk of lactic acidosis.

Figures 1.23–24] NHANES III 1988–1994 & NHANES 1999–2002 participants age 60 & older; patients with eGFRs of less than 15 ml/min/1.73 m² are excluded. *Sample size less than 30, or coefficient of variation is not less than 30 percent.
n the non-CKD Medicare population as a whole, the probability of a serum creatinine assessment is 0.14 for whites, and 0.12 for blacks. (Figure 1.25). Compared to that in blacks, the probability of testing in whites is only 1.1–1.2 percent higher in those with diabetes, CHF, the two combined, or in those with other diagnoses. Geographically, the highest probability of a serum creatinine test in white patients occurs in the Upper Midwest, the Ohio Valley, and portions of New England. Patterns are generally similar for black patients.

The probability of microalbuminuria or proteinuria testing is only 0.04 and 0.06 for whites and blacks, respectively, without CKD, and reaches 0.22 and 0.19 in those with diabetes (Figure 1.26). In the non-CKD population overall and in those with CHF or other diagnoses, the probability of testing is greater for blacks, while among those with diabetes alone or in combination with CHF whites are more likely to receive testing. Nationwide, patients residing in the mid-sections and southern portions of the country are less likely to be tested.
In both the CKD and non-CKD diabetic populations, and regardless of accompanying diagnoses, white patients are more likely than black patients to receive at least two glycosylated hemoglobin tests within a year—the minimum recommended by the American Diabetes Association (Figure 1.27). Among CKD patients, for example, the probability of testing in whites is 10.5 percent greater overall, and 15 and 8 percent higher, respectively, for those with CHF or with other diagnoses.

Non-white patients are slightly more likely than whites to receive TZDs, secretagogues, or metformin (Figure 1.28).

The probability of lipid assessment is 15 percent higher in CKD patients overall than in those without the disease (Figure 1.29). Among those with diabetes, CHF, or both diagnoses, however, the probability of testing is nearly equal. By race, and regardless of diagnoses, the probability of testing is greater in whites than in blacks—10 percent higher in the CKD population overall, and 14 percent higher for those with diabetes or CHF.

In the NHANES 1999–2002 population, use of lipid lowering agents is much more common in whites compared to people of other races. In contrast, 62.8 percent of non-white patients with congestive heart failure receive ACE inhibitors compared to 42.5 percent in the white population (Figures 1.30–31).

(Figures 1.25–26) General Medicare: patients entering Medicare before January 1, 2002, alive & remaining in the program through December 31, & without CKD diagnosed during 2002. Patients enrolled in an HMO, with Medicare as secondary payor, or with ESRD diagnosed during the year are excluded. Diabetes, CHF, & other comorbidities are defined in 2002. Patients censored at end of plan, death, & end of 2003. All testing tracked in 2003. In Figure 1.25, data on serum creatinine testing obtained from individual tests. CPT codes used for assessment of serum creatinine include 80069, & 82565. Maps by HSA, unadjusted. (Figure 1.27) General Medicare patients entering Medicare before January 1, 2002, alive & remaining in the program through December 31, with diabetes diagnosed during 2002. Patients enrolled in an HMO, with Medicare as secondary payor, or with ESRD diagnosed during the year are excluded. CKD, CHF, & other comorbidities are defined in 2002. Patients censored at end of plan, death, & end of 2003. First glycosylated hemoglobin testing tracked in 2003. (Figure 1.28) NHANES III 1988–1994 & NHANES 1999–2002 patients age 60 & older; patients with eGFRs of less than 15 ml/min/1.73 m² are excluded. *Sample size less than 30 or coefficient of variation is not less than 30 percent. (Figure 1.29) General Medicare patients entering Medicare before January 1, 2002, alive & remaining in the program through December 31, with diabetes diagnosed during 2002. Patients enrolled in an HMO, with Medicare as secondary payor, or with ESRD diagnosed during the year are excluded. CKD, CHF, & other comorbidities are defined in 2002. Patients censored at end of plan, death, & end of 2003. First lipid monitoring tracked in 2003. (Figures 1.30–31) NHANES III 1988–1994 & NHANES 1999–2002 patients age 60 & older; patients with eGFRs of less than 15 ml/min/1.73 m² are excluded. *Sample size less than 30 or coefficient of variation is not less than 30 percent.
In this spread we compare all-cause and cause-specific hospitalization rates in Medicare patients with and without CKD, and in their counterparts with EGHP coverage. For all types of hospitalization examined here, the highest rates occur in CKD patients with both diabetes and congestive heart failure (CHF) in the entry period. CKD patients with CHF alone have the next highest rates, followed by those with diabetes.

In the Medicare population, the overall hospitalization rate for CKD patients reached 1,068 per 1,000 patient years in 2003—nearly three times greater than that in patients without CKD (Figure 1.32). The rate for patients with diabetes is 2.3 times higher in CKD patients, reaching 1,276, while rates for patients with CHF or with both CHF and diabetes combined are 1.6–1.7 times greater. In the EGHP population, the differences are even more dramatic. The overall 2003 rate of 494 in CKD patients is 6.5 times higher than in the non-CKD population, while rates for patients with diabetes, CHF, or the two diseases combined are 3.8, 2.2, and 2.2 times greater, respectively, in patients with CKD.

Since 1993, hospitalization rates have declined slightly among Medicare patients with CKD—from 4 percent in those with CHF to 13 percent in those with diabetes. In the non-CKD cohort, rates have risen 6 percent overall and 2 percent in CHF patients, while falling 4.4–4.9 percent in patients with diabetes alone or in conjunction with CHF. Because of the smaller cohort size, changes in the EGHP population have been more variable.

Hospitalization rates for patients with or without CKD tend to be highest in the eastern portions of the country (Figure 1.33). Rates for patients with CKD, however, are nearly three-fold higher than those found in patients without CKD.

Since 1993, admissions for CHF have fallen 26 percent in the Medicare CKD population overall, and 35 percent in patients with diabetes (Figure 1.34). Among non-CKD patients, in contrast, the overall rate has dropped only 7 percent, while the rate for diabetic patients has fallen 19 percent. Compared to their non-CKD counterparts, Medicare CKD patients have hospitalizations that are 6.5 times greater overall, four times higher for patients with diabetes during the entry period, and twice as high for those with CHF—whether or not it is accompanied by diabetes. In the EGHP population, the CHF hospitalization rate in CKD versus non-CKD patients is 8.5, 2.3, and 2.8 times higher for patients with diabetes, CHF, and diabetes combined with CHF, respectively.

Rates of hospitalization for ASHD have also declined since 1993—and to the greatest extent, as with CHF admissions, in the Medicare CKD population (Figure 1.35). Compared to those of non-CKD patients, overall ASHD admission rates are 2.6 times greater in Medicare patients, and 4.7 times higher in those with EGHP coverage.

In 2003, pneumonia admission rates reached 8 per 1,000 patient years in Medicare CKD patients overall, and 109 in patients with both diabetes and CHF—2.8 and 1.4 times higher, respectively, than in the non-CKD population (Figure 1.36). Among EGHP patients, rates of 18 overall and 93 for those with the combined diagnoses were 11 and four times greater, respectively, in CKD than in non-CKD patients. In the Medicare population, rates of hospitalization for pneumonia have remained stable since the mid-1990s.
Differences between the CKD and non-CKD populations are even greater for bacteremia/septicemia hospitalizations (Figure 1.37). For all patients and for those with diabetes, for example, rates are 4.6 and 3.0 times higher, respectively, in the Medicare population, and 27.5 and 7.5 times greater in those with EGHP coverage.

For both all-cause hospitalizations and the cause-specific rates examined here, the greatest differences between CKD and non-CKD patients consistently occur in the EGHP population—in overall rates and in rates for patients diagnosed with diabetes during the entry period.

(Figures 1.32–37) Medicare: prevalent patients continuously enrolled in Medicare Parts A & B, with no HMO coverage, & alive during the one-year entry period; adjusted for age, gender, & race. EGHP: prevalent patients age 20–65 with fee-for-service coverage during the entire calendar year, & alive on the last day of the entry period; adjusted for age & gender. Patients diagnosed with ESRD before or during the entry period are omitted; 2003 patients used as reference cohort. Because of different age distributions in the two cohorts, rates are comparable only within the Medicare & EGHP cohorts, not between them. In Figures 1.32–33, rates exclude hospitalizations related to pregnancy & childbirth. In Figure 1.33, maps by HSA, unadjusted.
On this spread we examine hospitalizations for acute kidney failure, along with their subsequent outcomes. In the Medicare population without CKD, the probability of a hospitalization for acute kidney failure is 0.034 at three years (Figure 1.38). As we look at complicating diagnoses of diabetes, congestive heart failure, and diabetes combined with CHF, this three-year probability rises steadily—to 0.07, 0.11, and 0.16, respectively. Among patients with a diagnosis of CKD, the probability of an acute kidney failure hospitalization is, not surprisingly, far higher, from 0.22 overall to 0.39 for those with diabetes and CHF combined. In this CKD population, the probability of hospitalization in patients with both diabetes and CHF is 49 percent greater at one year, and 43 percent greater at three years, than that of patients with diabetes alone.

Similar patterns occur when we categorize hospitalizations by whether acute kidney failure is the primary or secondary diagnosis at admission. For acute kidney failure as a primary diagnosis, the one-year probability of hospitalization in CKD patients ranges from 0.03 overall to 0.05 in those with diabetes and CHF; while the three-year probability ranges from 0.07 to 0.13. Probabilities are greater for hospitalizations in which acute kidney failure is the secondary admitting diagnosis, at three years reaching 0.18 overall and 0.32 for those with combined diabetes and CHF.

In Figures 1.39–42 we present data on ESRD and death following a hospitalization for acute kidney failure. Across outcomes and diagnoses, the highest event rates occur within the first three months after an acute kidney failure hospitalization, with rates then leveling out or decreasing slightly in the following 33 months.

For patients who have a prior diagnosis of CKD, the rate of death in the first three months after hospitalization is 2.7–4 times greater than the rate of an ESRD diagnosis. Patients without a CKD diagnosis prior to that hospitalization, however, face a death rate that is 13–20 percent greater than the risk of developing ESRD.

In the prevalent Medicare population as a whole, 2.6 percent of patients without prior CKD are diagnosed with ESRD in the first three months, compared to 11.1 percent of patients with an earlier CKD diagnosis. The three-month rates do not vary widely by diag-

![Graph showing probability of hospitalization for acute kidney failure across different diagnoses and CKD status.](image-url)
nosis: 3.2 and 12.5, respectively, for patients with diabetes, 2.4 and 10.6 for those with CHF, and 3.1 and 12.0 for those with diabetes and CHF combined. Patients with CKD are, then, 3.9–4.4 times more likely than patients without prior CKD to be diagnosed with ESRD during the three months following an acute kidney failure hospitalization.

Results differ significantly for death after an acute kidney failure hospitalization. Across diagnoses, three-month death rates are higher in patients without prior CKD than in those who have the diagnosis—21.4 percent higher overall, and 19.4, 13.5, and 15.9 percent higher in those with diabetes, CHF, and the two combined, respectively. After this three-month period, however, rates are consistently greater in the CKD population.

(Figure 1.38) patients continuously enrolled in Medicare Parts A & B, with no HMO coverage during 2000, & alive on December 31, 2000. Patients diagnosed with ESRD before December 31, 2000 are excluded. (Figures 1.39–42) prevalent Medicare patients with hospitalization for acute kidney failure during 1999–2000; adjusted for age, race, & gender. A one-year entry period prior to the first hospitalization is used to define cardiovascular disease & diabetes.
Figure 1.1 In almost two-thirds of Medicare patients age 65 and older with CKD, CKD is accompanied by diabetes, CHF, or both diseases combined.

Figure 1.4 The percent of CKD patients with just diabetes increased in the Medicare population from 16.7 in 1992–1993 to 23.7 in 2002–2003, and in the EGHP population from 23.8 in 1999–2000 to 26.6 in 2002–2003.

Figure 1.6 The overall probability of microalbuminuria or proteinuria testing reaches only 0.04 in the Medicare population, and 0.01 for EGHP patients. Figure 1.8 The probability of calcium and phosphorus assessment is 0.06 in Medicare non-CKD patients overall, and 0.02 in the EGHP population.

Figure 1.11 The probability of a CKD patient receiving calcium phosphorus testing is 0.27 for those with Medicare coverage, and 0.17 for those under EGHP. Figure 1.14 In the Medicare CKD population, the probability of diabetic patients receiving at least two HbA1c tests within a year is 0.56, compared to 0.36 for EGHP patients.

Figure 1.19 The use of ACE-Is and ARBs for renal protective treatment has almost doubled in the CKD population. Figures 1.22–23 Use of diuretic therapy in CKD patients with CHF has grown, as has the use of lipid-lowering agents in both diabetics and those with CVD.

Figure 1.27 In both the CKD and non-CKD diabetic populations, and regardless of accompanying diagnoses, white patients are more likely than black patients to receive at least two glycosylated hemoglobin tests within a year.

Figure 1.32 The overall hospitalization rate for Medicare CKD patients reached 1,068 per 1,000 patient years in 2003—nearly three times greater than that in non-CKD patients. The rate for diabetic patients is 2.3 times higher in those with CKD, reaching 1,276.

Figure 1.38 In non-CKD Medicare patients, the probability of a hospitalization for acute kidney failure is 0.034 at three years. Among patients with a diagnosis of CKD, the probability is far higher, from 0.22 overall to 0.39 for those with diabetes and CHF combined.

Figure 1.39 For patients with a prior diagnosis of CKD, the rate of death in the first three months after hospitalization for AKF is 2.7–4 times greater than the rate of an ESRD diagnosis. Patients without a CKD diagnosis prior to that hospitalization, however, face a death rate that is 13–20 percent greater than the risk of developing ESRD.