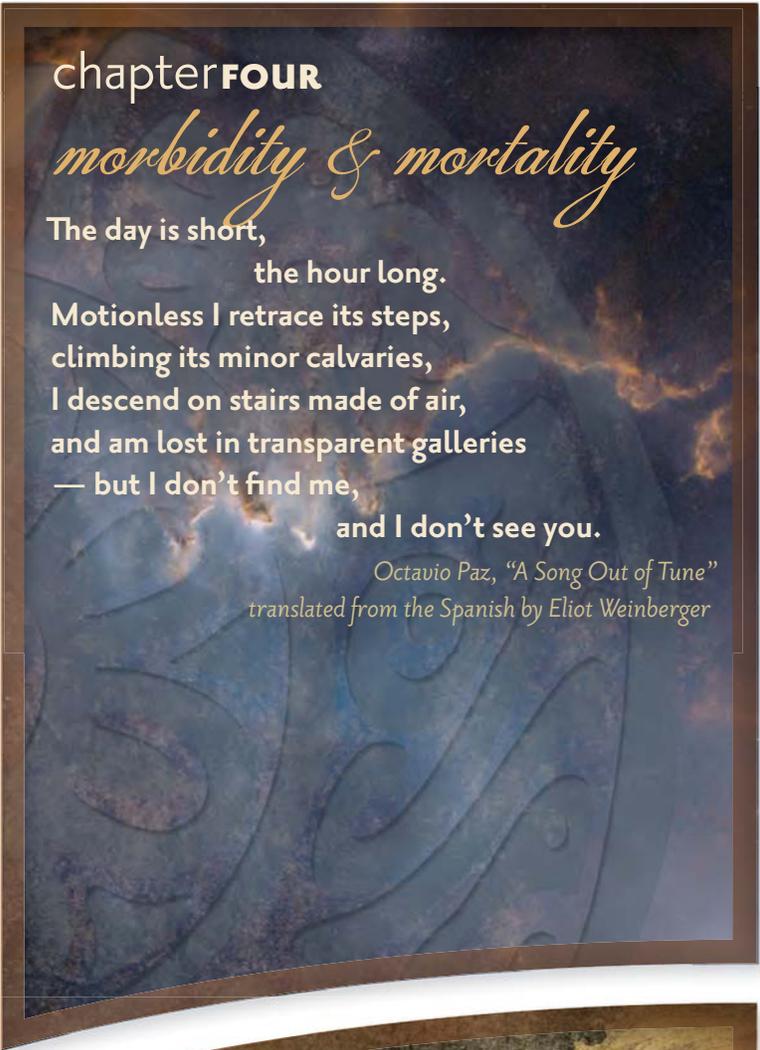


chapter**FOUR**

morbidity & mortality

The day is short,
the hour long.
Motionless I retrace its steps,
climbing its minor calvaries,
I descend on stairs made of air,
and am lost in transparent galleries
— but I don't find me,
and I don't see you.

*Octavio Paz, "A Song Out of Tune"
translated from the Spanish by Eliot Weinberger*





ASSESSING MORBIDITY IN PATIENTS WITH CHRONIC KIDNEY DISEASE REQUIRES LONGITUDINAL DATA FROM A DEFINED POPULATION, WITH RELATIVELY COMPLETE INFORMATION ON ALL-CAUSE AND CAUSE-SPECIFIC HOSPITALIZATION. SUCH DATA ARE RARELY AVAILABLE ON A

random sample of the U.S. population, since it is very difficult to track patients across multiple insurers. Health plan datasets from Medicare and from employer group health plans (EGHPs), however, can capture information well, particularly over a one-year period, and they provide a unique opportunity to assess morbidity.

In this chapter we use data from three insurers which represent large populations. Medicare data, for instance, cover 95 percent of individuals age 65 and older. We also employ the Thomson Reuters MarketScan dataset and the Ingenix i3 LabRx dataset, both from large EGHPs. MarketScan data cover health plan expenditure claims for employers that are approximately 80 percent self-insured, compared to just 20 percent in the Ingenix i3 data. For each dataset we use diagnosis codes to define CKD during a one-year entry period, noting hospitalizations and services in the one-year follow-up period.

Because increasing recognition of CKD can create biases in the data, with a potentially lower disease burden in patients diagnosed earlier in the course of their disease, we have added information on comorbidity and disease severity. On the next page, for example, we examine hospitalization rates in Medicare and MarketScan patients with and without CKD. Unadjusted rates in the CKD population — reflecting its total disease burden — are 3–5 times those of non-CKD patients. Once adjustments have been added for gender, prior hospitalizations, and comorbidity, rates for CKD patients are 1.4 times higher. This illustrates the net impact of CKD if the populations were to have similar comorbidity and severity of disease. CKD patients, however, carry a heavy burden of cardiovascular disease, which adjustments cannot fully address since CVD interacts so strongly with CKD itself.

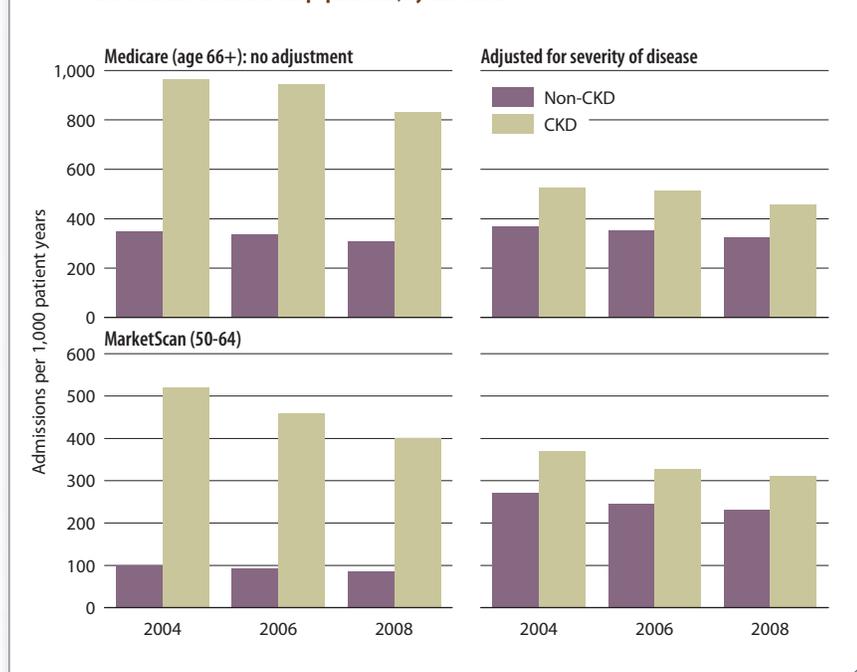
Hospitalization rates vary with comorbidity, and interact with degrees of CKD. Adjusted rates are 38 percent higher in Medicare CKD patients than in patients without the disease, 19 percent greater in patients with Stage 3–5 CKD than in those with CKD of Stages 1–2, and 20 percent higher in Stage 1–2 patients than in non-CKD patients — illustrating the graded impact of advancing kidney disease. Not surprisingly, rates of cardiovascular hospitalization are greater for CKD patients, particularly those in more advanced stages of the disease. Both the CKD and non-CKD populations, however, have experienced a similar decline in adjusted mortality rates over the past 13 years.

Secondary to multiple defects in the ability to kill bacteria, infectious complications are more frequent in the CKD and dialysis populations. Adjusted rates of hospitalization for pneumonia, for example, are 31–68 percent higher among Medicare patients with CKD than in those without rec-

ognized kidney disease. Hospitalizations secondary to bacteremia/sepsis show cyclical trends in both the CKD and non-CKD populations, a pattern whose cause is unknown, but which may reflect changes in the virulence of influenza over time. Overall rates of hospitalization for bacteremia/sepsis, however, now reach or exceed those noted more than a decade ago, which is a source of concern.

We next compare mortality in CKD and non-CKD patients, illustrating the impact of adjustments for comorbidity and disease severity on absolute death rates. Adjusting for age, gender, race, comorbidity, and prior hospitalizations, mortality among CKD patients in 2008 was 1.7 times greater than among non-CKD patients. As with hospitalization, CKD is thus a risk multiplier for mortality. The decline in rates since 1995 may partially reflect increased recognition of CKD, as illustrated by the increasing percentage of patients carrying the diagnosis; it may also indicate classification bias rather than a true reduction. Adjustments over time, however, appear to mitigate some of these issues.

4 i Unadjusted & adjusted all-cause hospitalization rates in the Medicare & MarketScan populations, by CKD status

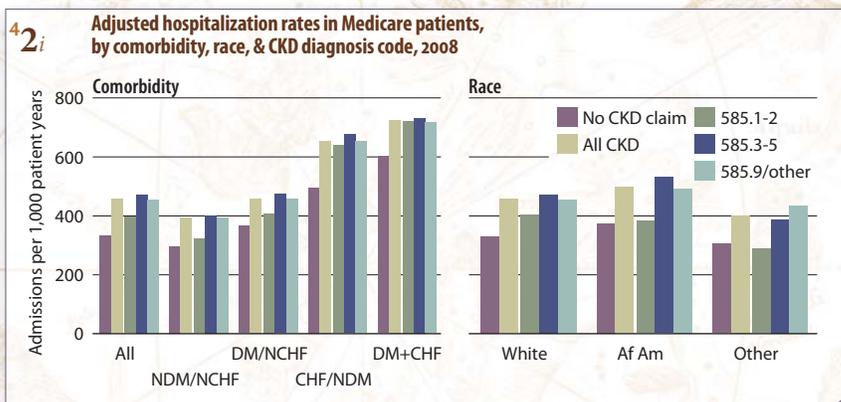


Patterns in mortality by CKD stage parallel those seen with hospitalization; rates in patients with CKD of Stages 3–5, for example, are 40 percent greater than those of non-CKD patients. The impact of diabetes and congestive heart failure as risk multipliers is also important, particularly given that cardiovascular risk factors are relatively under-treated in the U.S. **FIGURE 4.1;** see page 168 for analytical methods. Medicare: point prevalent patients on January 1 of the year, age 66 & older on December 31 of the prior year. MarketScan: point prevalent patients on January 1 of the year, age 50–64 on December 31 of the prior year. Adj: gender/prior hospitalization/13 comorbidities; ref: Medicare patients age 66 & older, 2005.

Among Medicare patients age 66 and older, adjusted admission rates are greater for patients with CKD compared to those without, and for patients with Stage 3–5 CKD compared to those with CKD of Stages 1–2. By race, the highest rates for non-CKD patients, all CKD patients, and those with Stage 3–5 CKD occur among African Americans. By gender, rates for those with Stage 3–5 CKD are 5.2 percent higher in women than in men. **TABLE 4.A;** see page 168 for analytical methods. Medicare patients point prevalent on January 1, 2008, age 66 & older on December 31, 2007. Adj: age/gender/race/prior hospitalization/comorbidity; rates presented by one factor are adjusted for the others; ref: Medicare patients age 66 & older, 2008.

4.a Adjusted hospitalization rates (per 1,000 patient years at risk) in Medicare patients, by CKD diagnosis code, 2008

	No CKD claim	All CKD	585.1–2	585.3–5	585.9/other
66–69	268	402	311	403	405
70–74	284	398	348	408	401
75–84	349	464	399	487	453
85+	475	578	551	581	586
Male	334	448	397	458	448
Female	333	466	393	481	464
White	331	458	406	472	454
African American	375	497	382	532	494
Other	305	402	288	388	435
All	333	458	397	472	456



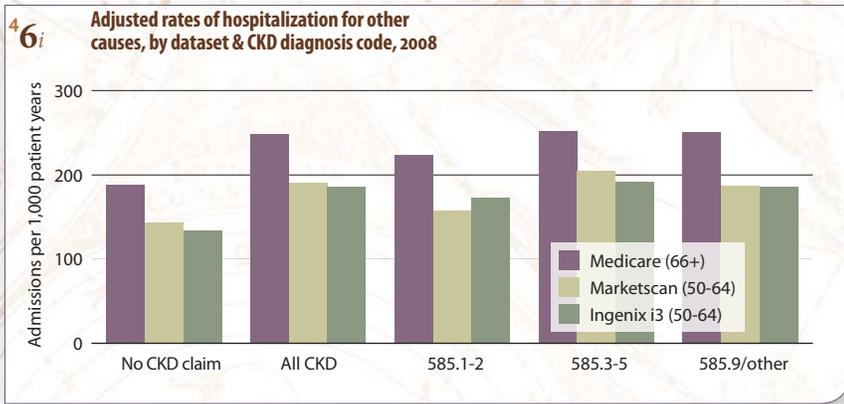
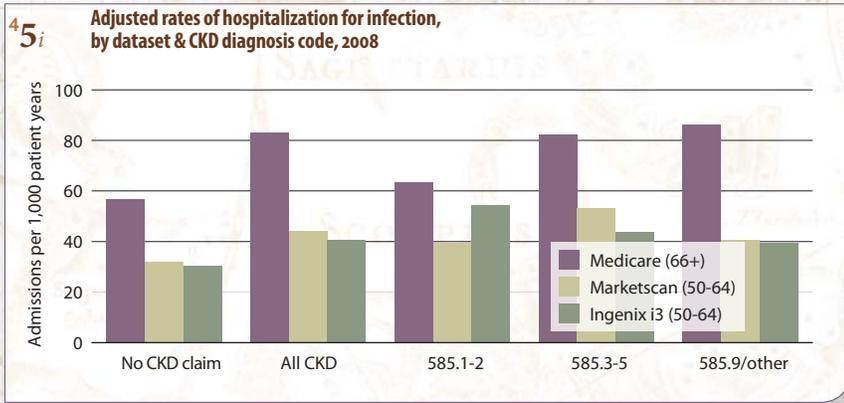
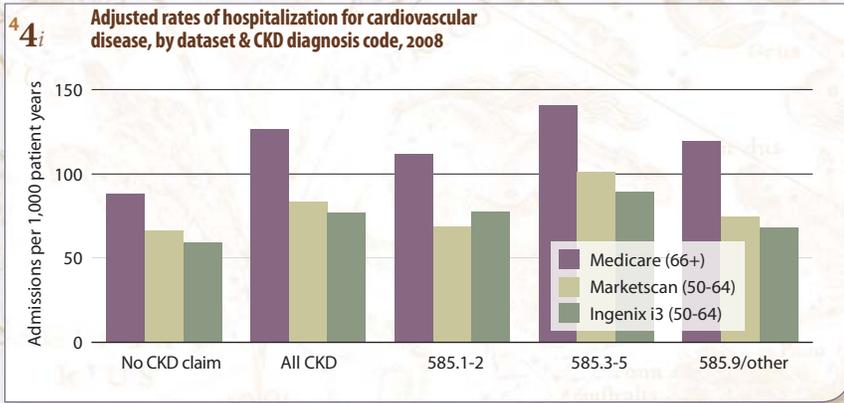
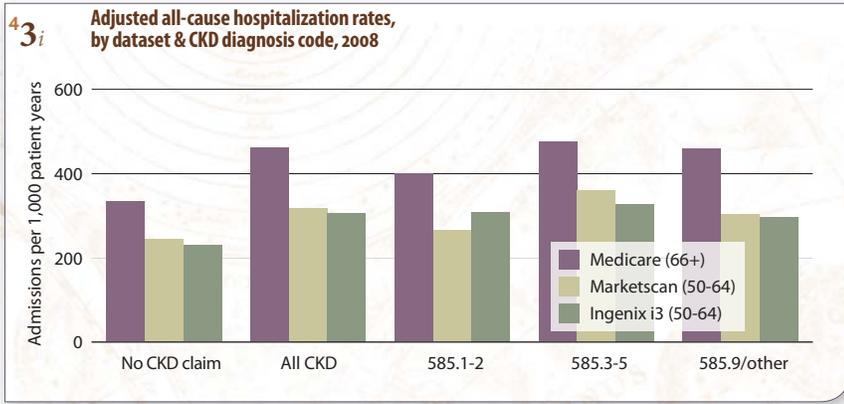
In both the CKD and non-CKD populations, adjusted rates of hospitalization increase with greater comorbidity. In 2008, for example, the rate for CKD patients with both diabetes and congestive heart failure was 726 per 1,000 patient years at risk — 85 percent greater than the rate of 393 among patients with neither diagnosis. **FIGURE 4.2;** see page 168 for analytical methods. Medicare patients point prevalent on January 1, 2008, age 66 & older on December 31, 2007. Adj: age/gender/race/prior hospitalization/comorbidity; rates presented for one factor are adjusted for the others; ref: Medicare patients age 66 & older, 2008.

ICD-9-CM codes

585.1	Chronic kidney disease, Stage 1
585.2	Chronic kidney disease, Stage 2 (mild)
585.3	Chronic kidney disease, Stage 3 (moderate)
585.4	Chronic kidney disease, Stage 4 (severe)
585.5	Chronic kidney disease, Stage 5 (excludes 585.6: Stage 5, requiring chronic dialysis. [^])
585.9/oth.	Chronic kidney disease, unspecified

[^] In USRDS analyses, patients with ICD-9-CM code 585.6 are considered to have code 585.5; see Appendix A for details.

CKD stage estimates are from a single measurement. For clinical case definition, abnormalities should be present ≥ 3 months.



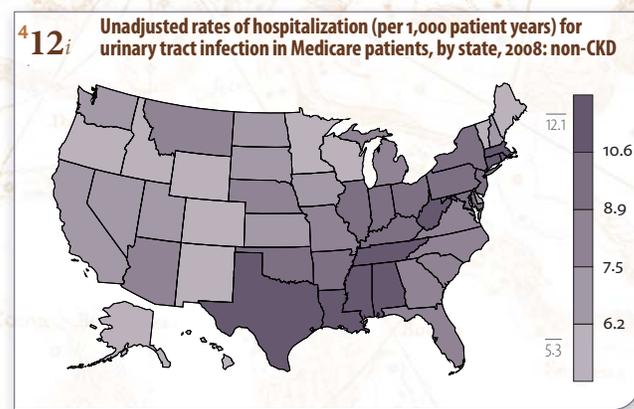
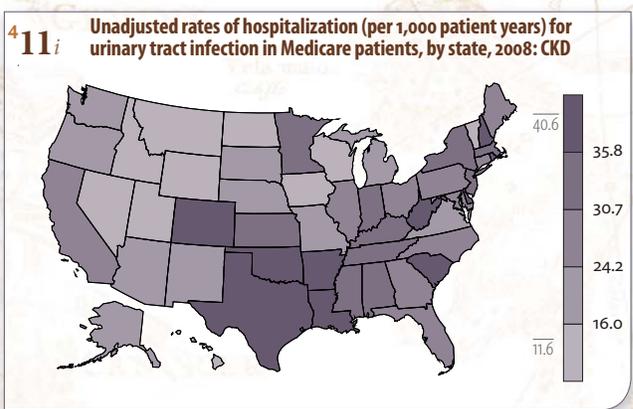
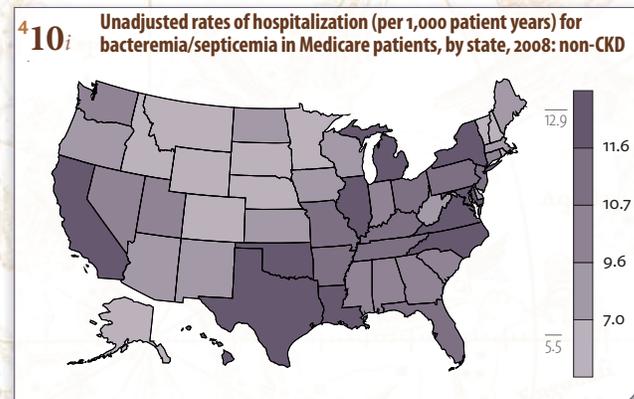
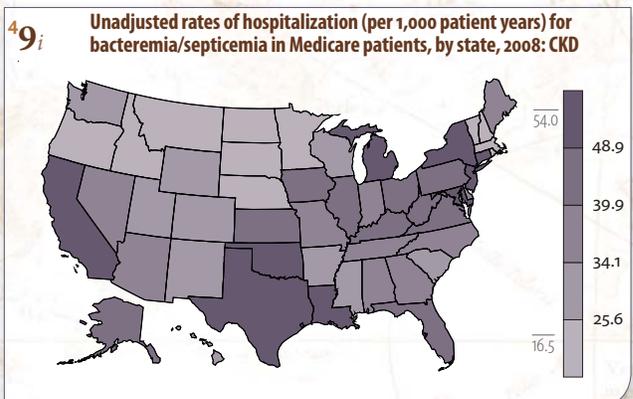
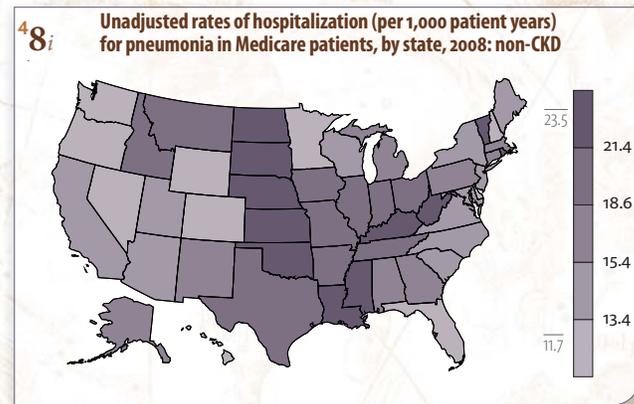
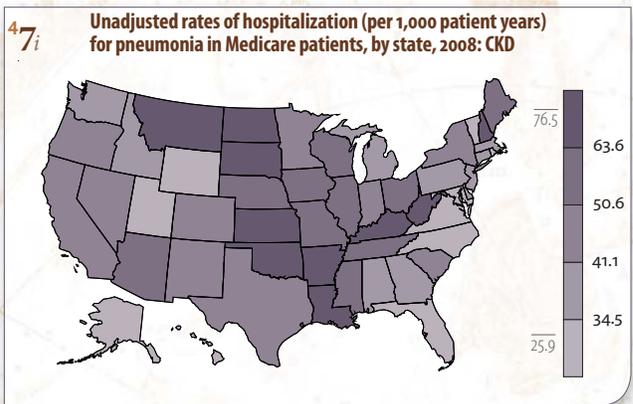
Adjusted all-cause hospitalization rates, and rates of hospitalization for cardiovascular disease, infection, and other causes, are each highest among Medicare patients age 66 and older than in the younger MarketScan and Ingenix i3 populations. Rates are also greatest for CKD patients compared to those without CKD, and are generally higher in the later stages of CKD.

All-cause rates, for example, are 19 percent higher among Medicare patients with Stage 3–5 CKD — reaching nearly 476 admissions per 1,000 patient years — than among their counterparts with CKD of Stages 1–2; in the MarketScan and Ingenix i3 populations, rates are 36 and 6.2 percent higher in those with later-stage CKD.

Rates of admission for cardiovascular disease increase even more in the higher stages of CKD. Among Medicare patients, the rate of 141 admissions per 1,000 patient years for those with Stage 3–5 CKD is 26 percent higher than the rate of 112 reported for those with CKD of Stages 1–2. And the rates of 101 and 90 reported for MarketScan and Ingenix i3 patients with Stage 3–5 CKD are 48 and 16 percent greater, respectively, than those occurring in patients with early-stage CKD.

In the Medicare and MarketScan populations, rates of admission for infection are 29 and 35 percent greater in those with Stage 3–5 CKD than in those with CKD of Stages 1–2. Among Ingenix i3 patients, in contrast, the rate is 19 percent lower in patients with later-stage CKD.

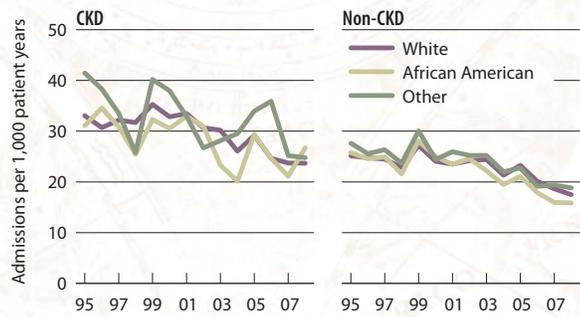
Among Medicare patients, admission rates for all causes, cardiovascular disease, and infection are 38–46 percent higher for those with CKD than for those without. Similar differences are seen in the MarketScan and Ingenix i3 populations. **FIGURES 4.3–6; see page 168 for analytical methods.** Medicare: point prevalent patients on January 1, 2008, age 66 & older on December 31, 2007. MarketScan & Ingenix i3: point prevalent patients on January 1, 2008, age 50–64 on December 31, 2007. Adj: gender/prior hospitalization/comorbidity; ref: Medicare patients age 66 & older, 2008.



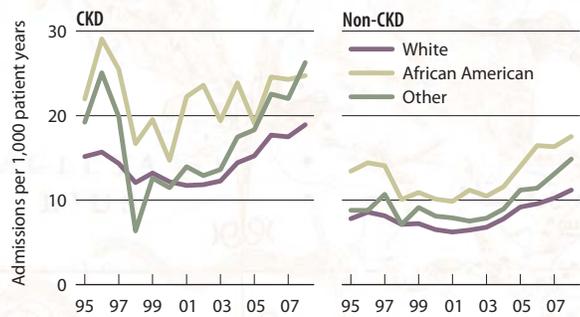
While geographic patterns of unadjusted hospitalization rates (per 1,000 patient years) for pneumonia, bacteremia/septicemia, and urinary tract infections in 2008 were similar between CKD and non-CKD patients age 66 and older, actual rates were much higher in those with CKD. Nationwide, rates for pneumonia in CKD patients, for instance, were nearly three times higher than those for non-CKD patients, and averaged 76.5 in the upper quintile compared to 23.5. In patients hospitalized for bacteremia/septicemia, rates nation-

wide were nearly four times higher for CKD patients, averaging 54.0 in the upper quintile compared to 12.9 for those with no CKD. And rates of hospitalization for urinary tract infection were three-fold higher for CKD patients nationwide, averaging 40.6 compared to 12.1 in the upper quintile. **FIGURES 4.7-12**; see page 169 for analytical methods. Point prevalent Medicare patients on January 1, 2008, age 66 & older on December 31, 2007; unadjusted.

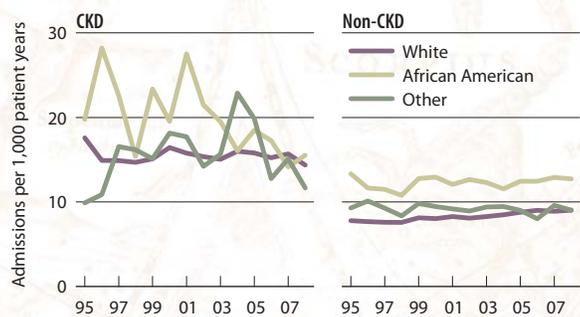
413_i Adjusted rates of hospitalization for pneumonia in Medicare patients, by CKD status & race



414_i Adjusted rates of hospitalization for bacteremia/septicemia in Medicare patients, by CKD status & race



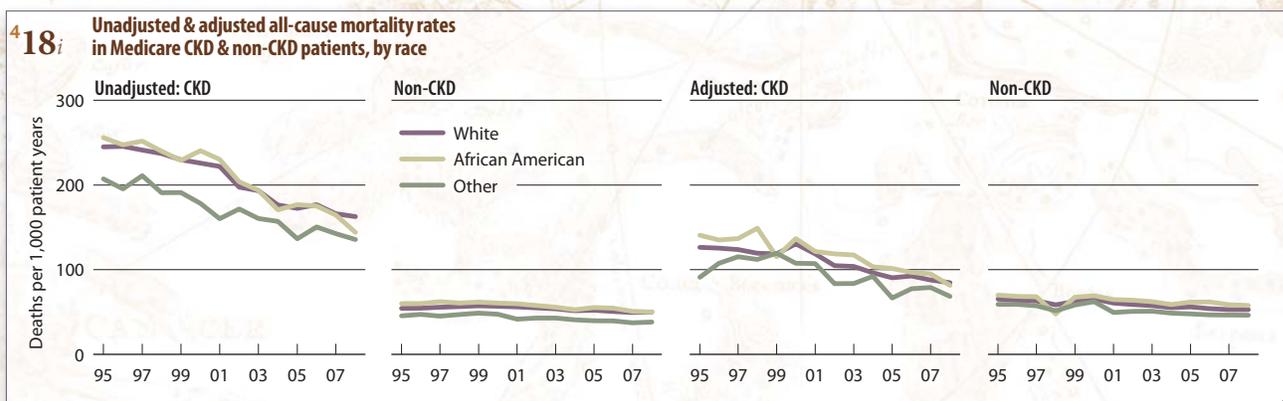
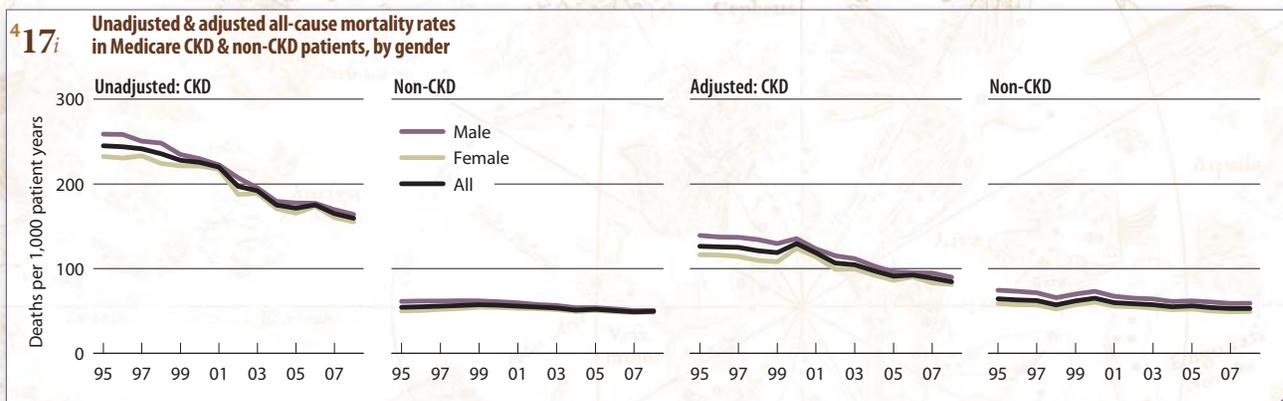
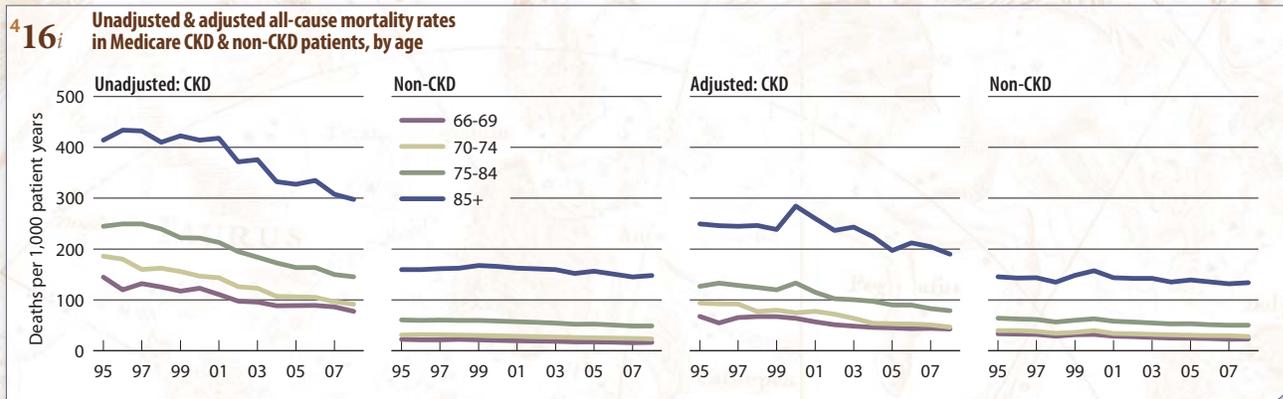
415_i Adjusted rates of hospitalization for urinary tract infection in Medicare patients, by CKD status & race



In 2008, adjusted rates of hospitalization for pneumonia in Medicare patients varied little by race in both the CKD and non-CKD populations. At 23.7 admissions per 1,000 patient years, the rate among white CKD patients was nearly 36 percent greater than that occurring among their non-CKD counterparts; for African Americans, the rate for CKD patients was more than 68 percent higher.

Rates of hospitalization for bacteremia/septicemia vary more by race. In 2008, for example, the rate among African Americans with CKD reached nearly 25 admissions per 1,000 patient years, 31 percent higher than the rate of 18.9 among whites. While admissions related to pneumonia have generally been declining since 2000, those for bacteremia/septicemia have increased since falling in the beginning of the decade. The rate for white patients with CKD is now almost 25 percent greater than in 1995.

The rate of hospitalizations for urinary tract infection has remained relatively steady for white CKD patients and, across races, for patients without CKD. In 2008, the rate of 14.4 among white CKD patients was 59 percent greater than the rate of 9.0 among their non-CKD counterparts; rates for African Americans and for patients of other races were 22 and 29 percent greater, respectively, in the CKD population. † FIGURES 4.13–15; see page 169 for analytical methods. Point prevalent Medicare patients on January 1 of the year, age 66 & older on December 31 of prior year. Adj: age/gender/prior hospitalization/comorbidity; ref: Medicare patients age 66 & older, 2005.



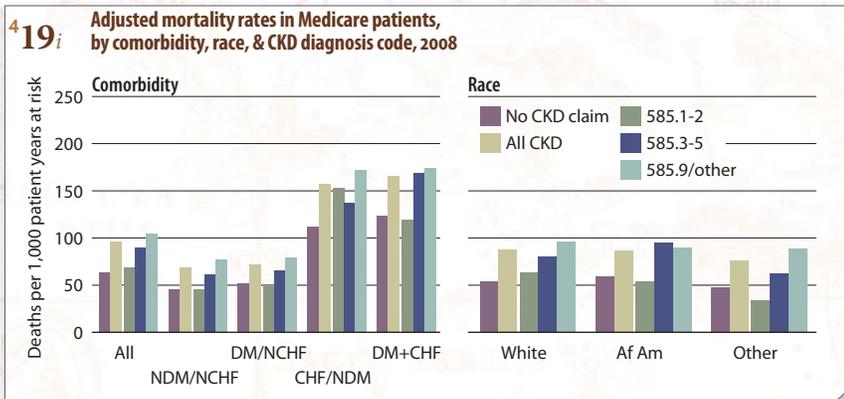
These figures show mortality rates among Medicare patients age 66 and older. Unadjusted rates show what seem to be significant declines in mortality in the CKD population, with an overall decrease of 35 percent since 1995, and of 47–51 percent in those age 66–74. But when rates are adjusted for factors which address patient complexity—such as hospitalization and comorbidities—they begin to flatten out, implying that decreasing comorbidity and severity of disease in the pa-

tient population may explain part of the decline in mortality. More complete models, containing patient information not currently available in the claims data, may make these rates flatten even more. † **FIGURES 4.16–18**; see page 169 for analytical methods. Point prevalent Medicare patients age 66 & older. Adj: age (4.17–18)/gender (4.16 & 4.18)/race (4.16–17)/prior hospitalization/comorbidity; ref: 2005 cohort.

4bⁱ Adjusted mortality rates (per 1,000 patient years at risk) in Medicare patients, by CKD diagnosis code, 2008

	No CKD claim	All CKD	585.1-2	585.3-5	585.9/oth.
66-69	24.3	45.0	15.9	41.6	51.0
70-74	28.8	49.4	28.6	49.5	52.5
75-84	49.9	80.8	58.5	73.3	89.5
85+	133.9	191.3	161.6	177.0	205.4
Male	59.3	91.8	57.6	86.6	101.3
Female	51.1	85.6	66.0	75.5	94.8
White	54.2	87.6	63.0	80.5	96.0
African American	59.3	87.2	54.0	95.0	90.4
Other	47.7	76.5	33.6	62.8	88.4
All	63.9	96.1	69.1	89.7	104.8

Adjusted rates of mortality in 2008 increased with age, and were highest in patients with advanced stages of CKD: 31-72 percent higher, for example, in patients with Stage 3-5 CKD compared to those with no CKD. By gender, rates in men with CKD were 91.8 per 1,000 patient years at risk compared to 85.6 in women. Rates for CKD patients overall were similar in whites and African Americans, but in patients with Stage 3-5 CKD, rates for African Americans were 18 percent higher than those for whites, at 95.0 and 80.5 per 1,000 patient years, respectively. † **TABLE 4.B**; see page 169 for analytical methods. Point prevalent Medicare patients age 66 & older, 2008. Adj: age/gender/comorbidity; ref: 2008 cohort.



Patients with multiple comorbid conditions are at increased risk of mortality. In those with diabetes, congestive heart failure, and Stage 3-5 CKD, for example, the mortality rate in 2008 was 169 per 1,000 patient years at risk, compared to 89.7 in Stage 3-5 patients with neither comorbid condition. † **FIGURE 4.19**; see page 169 for analytical methods. Point prevalent Medicare patients age 66 & older, 2008. Adj: age/gender/comorbidity; ref: 2008 cohort.

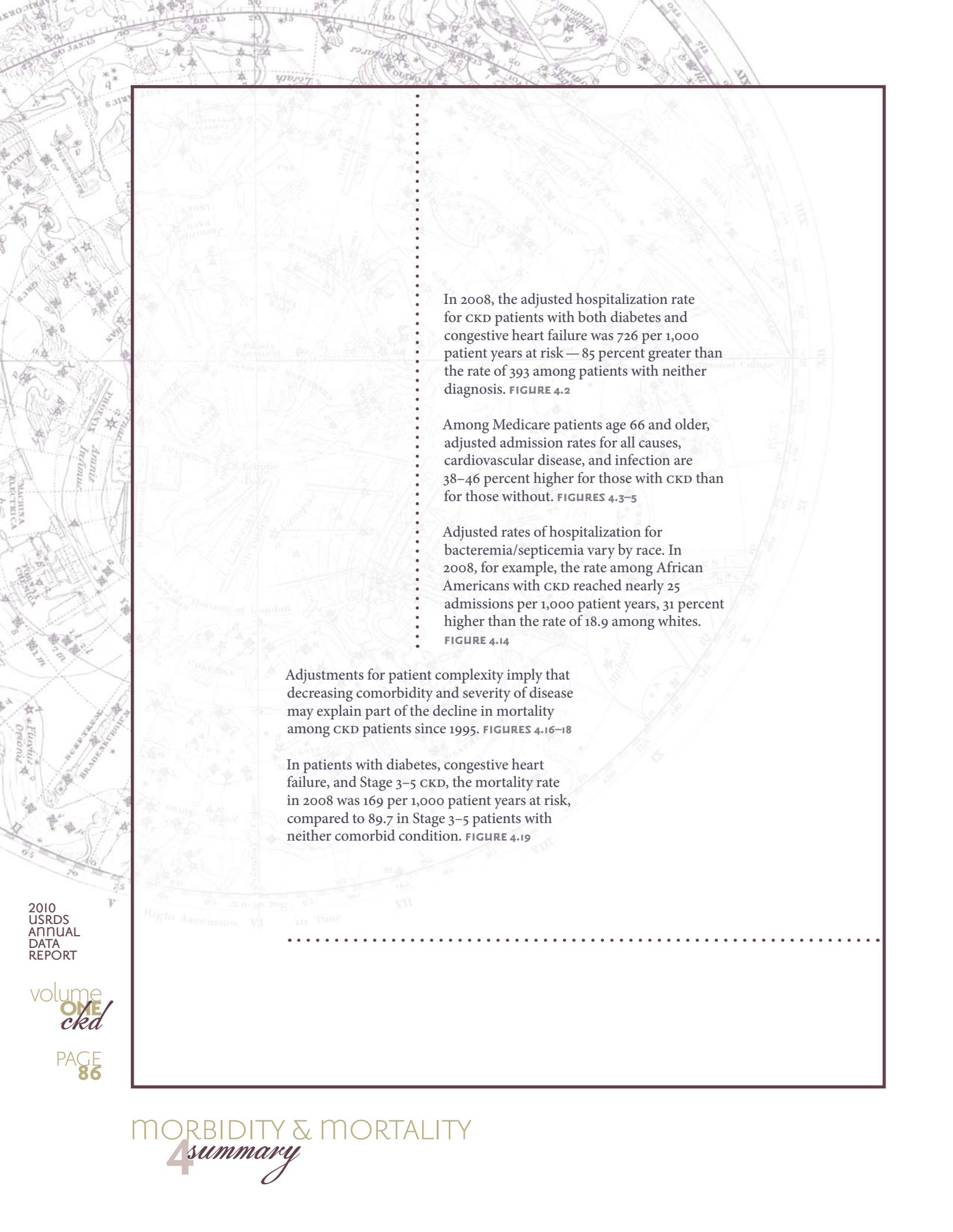
ICD-9-CM codes

- 585.1 Chronic kidney disease, Stage 1
- 585.2 Chronic kidney disease, Stage 2 (mild)
- 585.3 Chronic kidney disease, Stage 3 (moderate)
- 585.4 Chronic kidney disease, Stage 4 (severe)
- 585.5 Chronic kidney disease, Stage 5 (excludes 585.6: Stage 5, requiring chronic dialysis.[^])
- 585.9/oth. Chronic kidney disease, unspecified

[^] In USRDS analyses, patients with ICD-9-CM code 585.6 are considered to have code 585.5; see Appendix A for details.

CKD stage estimates are from a single measurement. For clinical case definition, abnormalities should be present \geq 3 months.





In 2008, the adjusted hospitalization rate for CKD patients with both diabetes and congestive heart failure was 726 per 1,000 patient years at risk — 85 percent greater than the rate of 393 among patients with neither diagnosis. **FIGURE 4.2**

Among Medicare patients age 66 and older, adjusted admission rates for all causes, cardiovascular disease, and infection are 38–46 percent higher for those with CKD than for those without. **FIGURES 4.3–5**

Adjusted rates of hospitalization for bacteremia/septicemia vary by race. In 2008, for example, the rate among African Americans with CKD reached nearly 25 admissions per 1,000 patient years, 31 percent higher than the rate of 18.9 among whites. **FIGURE 4.14**

Adjustments for patient complexity imply that decreasing comorbidity and severity of disease may explain part of the decline in mortality among CKD patients since 1995. **FIGURES 4.16–18**

In patients with diabetes, congestive heart failure, and Stage 3–5 CKD, the mortality rate in 2008 was 169 per 1,000 patient years at risk, compared to 89.7 in Stage 3–5 patients with neither comorbid condition. **FIGURE 4.19**