

CHAPTER THREE

MORBIDITY AND MORTALITY IN PATIENTS WITH CHRONIC KIDNEY DISEASE

I remember the night and the Tennessee Waltz
Now I know just how much I have lost
Yes, I lost my little darlin' the night they were playing
The beautiful Tennessee Waltz

REDD STEWART & PEE WEE KING, "TENNESSEE WALTZ"

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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.

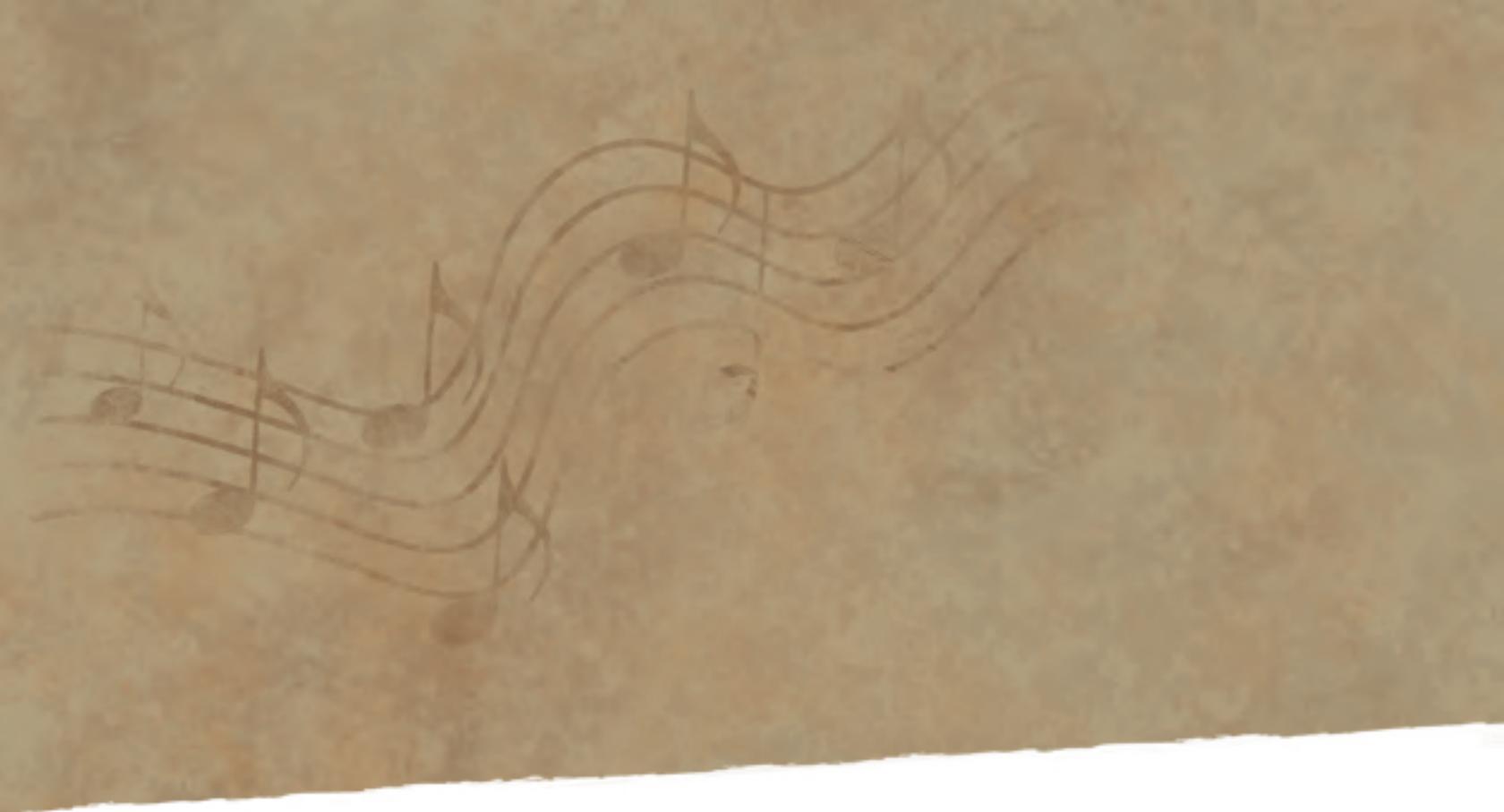
In this chapter we use data from three insurers which represent large populations. Medicare data, for instance, cover 95 percent of individuals age 65 and older. We also employ the Thomson Reuters MarketScan dataset and the United Healthcare Ingenix i3 LabRx dataset, both from large EGHPs. MarketScan 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 adjusted rates based 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 (CVD), which adjustments cannot fully address since CVD interacts so strongly with CKD itself.

Not surprisingly, rates of cardiovascular hospitalization are greater for patients with CKD — particularly those in more advanced stages of the disease — than for patients without. Hospitalization rates overall vary with comorbidity, and interact with degrees of CKD. Illustrating the graded impact of advancing kidney disease, adjusted all-cause rates are 38 percent higher in Medicare CKD patients than in patients without the disease, 27 percent higher in Stage 1–2 patients than in non-CKD patients, 7 percent greater for Stage 3 than for Stages 1–2, and 37 percent higher for Stages 4–5 versus Stages 1–2.

Secondary to multiple defects in the ability to kill bacteria, infectious complications are more frequent in patients with kidney disease, particularly those with Stage 4 CKD and those on dialysis. Adjusted rates of hospitalization for lung infections, for example, are 13–81 percent higher among Medicare patients with various stages of CKD than in those without recognized kidney disease, while hospi-

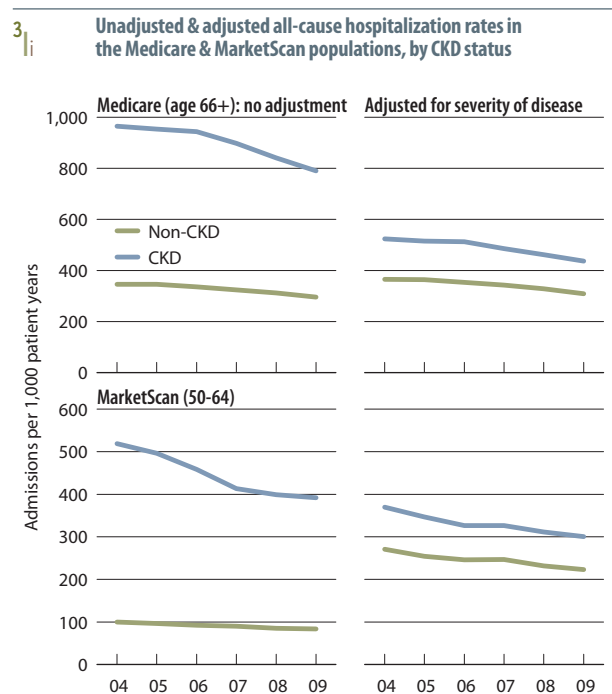


talizations secondary to circulatory infections such as bacteremia and sepsis are 1.5–2.0 times greater. After adjusting for comorbidity and prior history of hospitalizations — a measure of disease severity — rates of hospitalization due to infection are substantially higher, across organ systems, among those with CKD.

Data on mortality in CKD and non-CKD patients illustrate 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 2009 is 56 percent 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, as the drop in mortality rates since 1995 is greater than that seen among patients without CKD.

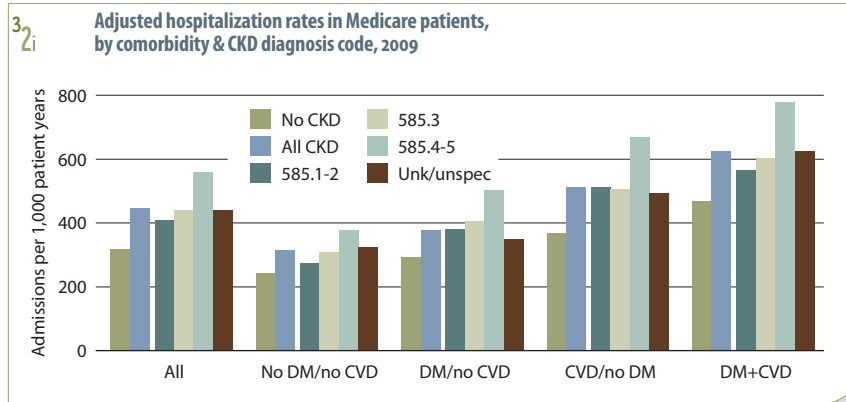
Patterns in mortality by CKD stage parallel those seen with hospitalization; the adjusted rate in patients with CKD of Stages 4–5, for example, is 76 percent greater than that in non-CKD patients. The impact of diabetes and congestive heart failure as risk multipliers is also important, particularly given that cardiovascular risk factors are relatively under-treated in the U.S.

>> **Figure 3.1;** see page 124 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.*



In both CKD and non-CKD populations age 66 and older, adjusted rates of hospitalization increase with greater comorbidity. In 2009, for example, admissions for Stage 4–5 CKD patients with both diabetes and cardiovascular disease reached 778 per 1,000 patient years — more than twice the rate among patients with neither diagnosis.

By race, hospitalization rates are generally higher among African Americans compared to whites, reaching 18 percent for those with Stage 4–5 CKD, and 6.1 percent for those with CKD of Stages 1–2. >> Figures 3.2–3; see page 124 for analytical methods. *Point prevalent Medicare patients on January 1, 2009, age 66 & older on December 31, 2008. Adj: age/gender/race/prior hospitalization/comorbidity; rates by one factor are adjusted for the others. Ref: Medicare patients age 66 & older, 2009.*

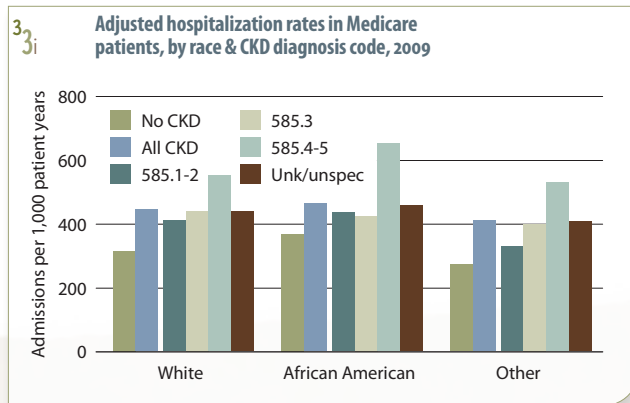


ICD-9-CM CODES

- 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.)
- Chronic kidney disease, unknown/unspecified

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

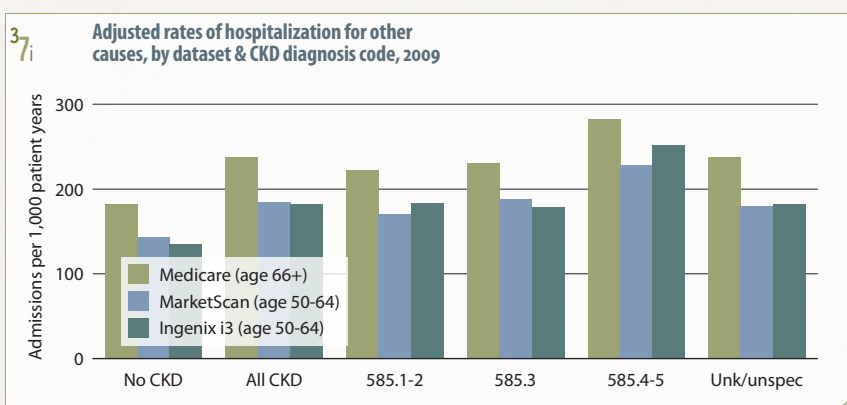
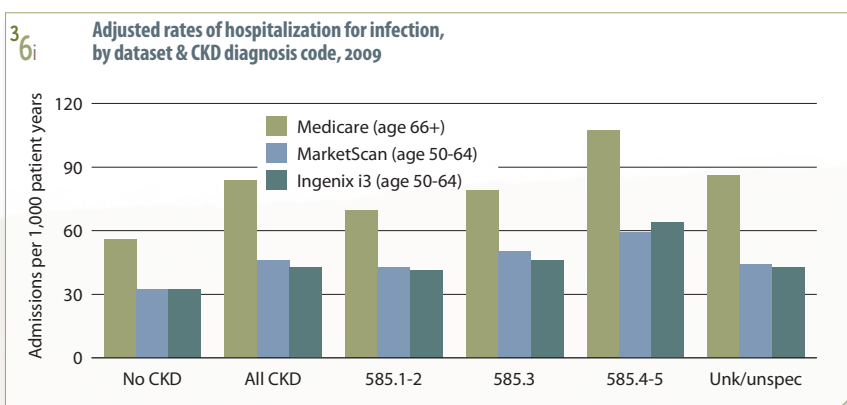
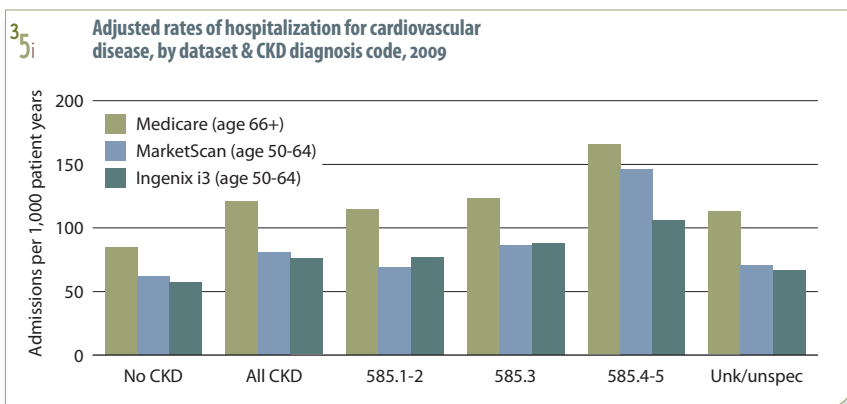
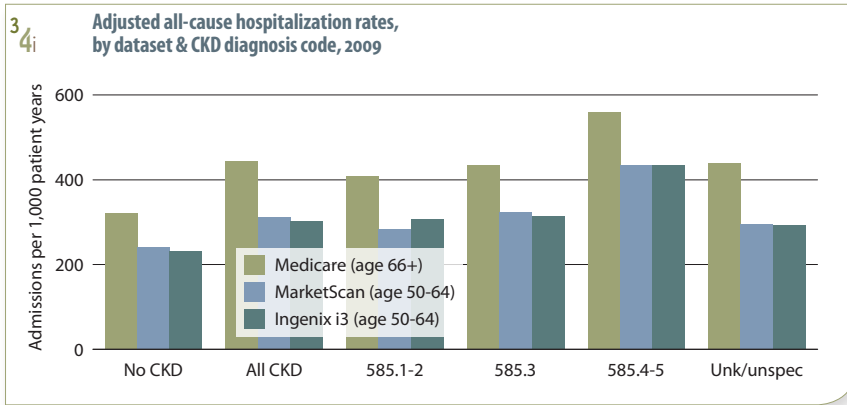
CKD stage estimates are from a single measurement. For clinical case definition, abnormalities should be present ≥ 3 months.



3.3ii Adjusted hospitalization rates (per 1,000 patient years at risk) in Medicare patients, by CKD diagnosis code, 2009

	No CKD	All CKD	585.1-2	585.3	585.4-5	Unk/unspec
Age: 66–69	247.6	391.3	394.3	381.8	593.7	371.2
70–74	267.9	379.0	324.8	370.5	494.7	372.9
75–84	332.7	455.6	429.1	448.6	518.9	456.7
85+	455.9	552.3	502.1	556.6	669.0	539.3
Male	318.4	437.9	395.7	429.2	550.8	433.6
Female	318.1	450.7	417.4	446.9	574.1	442.4
White	316.6	445.8	411.3	441.3	553.6	440.3
African American	369.6	466.1	436.5	426.4	652.4	458.9
Other	273.9	410.8	331.3	401.2	530.2	409.6
All	318.0	444.3	406.7	438.3	559.5	438.4

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 4–5 CKD compared to those in an earlier stage. With the exception of patients with Stage 3 CKD, the highest rates by race occur among African Americans. By gender, admissions for patients with some stage of CKD are consistently higher among women. >> Table 3.a; see page 124 for analytical methods. *Medicare: point prevalent patients on January 1, 2009, age 66 & older on December 31, 2008. Adj: age/gender/race/prior hospitalization/comorbidity; rates by one factor are adjusted for the others. Ref: Medicare patients age 66 & older, 2009.*



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

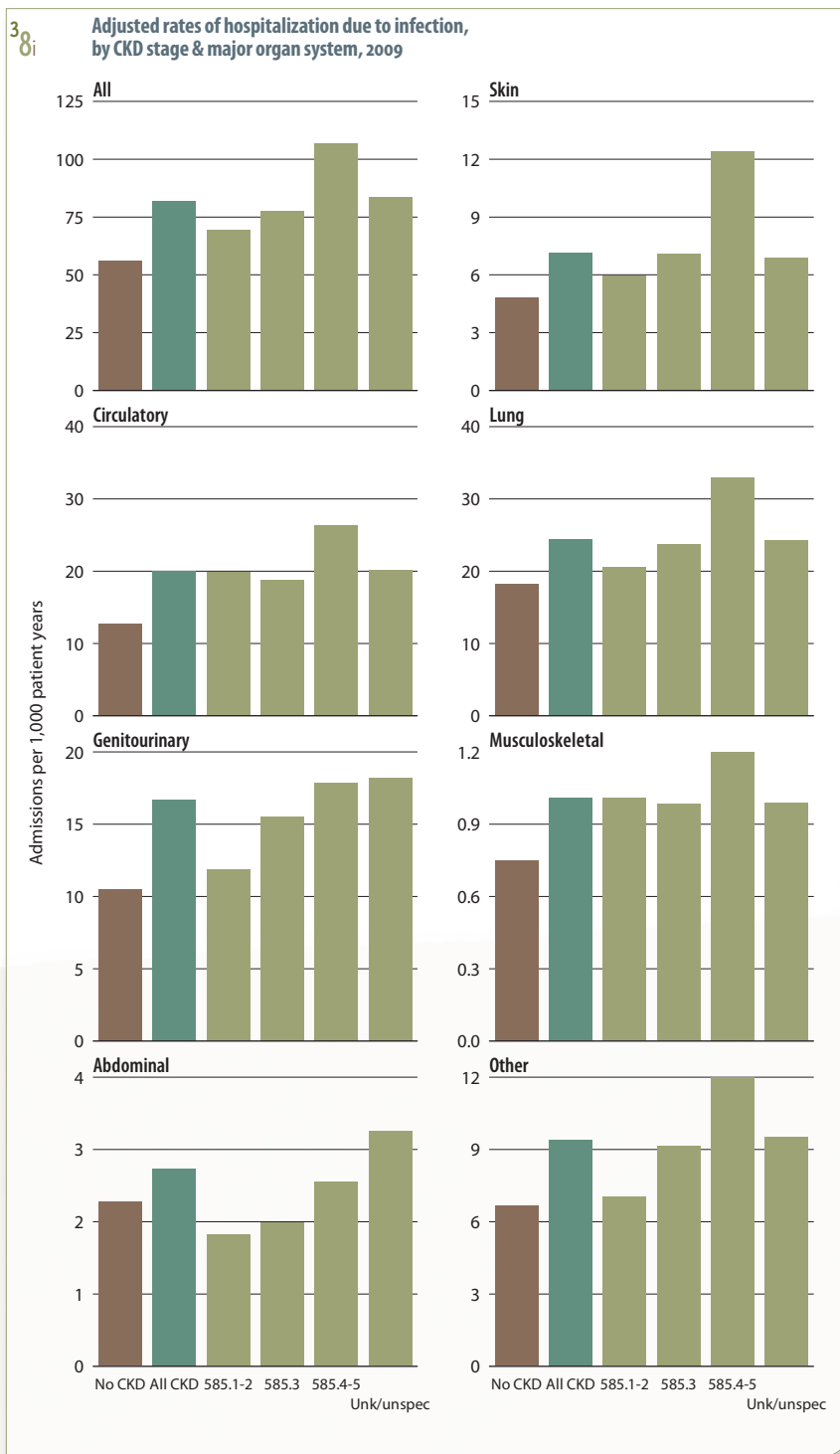
All-cause hospitalization rates, for example, are 37 percent higher among Medicare patients with Stage 4–5 CKD than among their counterparts with Stages 1–2, reaching 559 admissions per 1,000 patient years; in the MarketScan and Ingenix i3 populations, rates are 53 and 42 percent higher in those with later-stage CKD.

Among Medicare patients, the rate of 166 cardiovascular admissions per 1,000 patient years in those with Stage 4–5 CKD is 45 percent higher than the rate of 115 reported for those with CKD of Stages 1–2. And rates of 147 and 106 reported for MarketScan and Ingenix i3 patients with later-stage CKD are 111 and 37 percent greater, respectively, than those for patients in the earliest stages of the disease.

Compared to those of patients in the early stages of CKD, rates of admission for infection among patients with CKD of Stages 4–5 are 54–55 percent greater among Medicare and Ingenix i3 patients, and 38 percent higher in the MarketScan population. >> Figures 3.4–7; see page 124 for analytical methods. *Medicare: point prevalent patients on January 1, 2009, age 66 & older on December 31, 2008. MarketScan & Ingenix i3: point prevalent patients on January 1, 2009, age 50–64 on December 31, 2008. Adj: gender/prior hospitalization/comorbidity; ref: Medicare patients age 66 & older, 2009.*

In 2009, the overall adjusted rate of hospitalization due to infection among CKD patients age 66 and older reached 82 admissions per 1,000 patient years, compared to 56 among non-CKD patients. The rate rises by CKD stage, from 69 among those with CKD of Stages 1–2 to 107 in Stage 4–5 patients.

By major organ system, rates of hospitalization due to infection are consistently greater among CKD patients than among those without the disease, and generally reach their highest levels in patients with Stage 4–5 CKD. The rate of hospitalizations related to lung infections, for example, reaches 33 admissions per 1,000 patient years in Stage 4–5 patients, while the rate of hospitalizations related to infections of the circulatory system reaches 26. » Figure 3.8; see page 124 for analytical methods. *January 1, 2009 point prevalent Medicare patients, age 66 & older on December 31, 2008. Adj: age/gender/race/prior hospitalization/13 comorbidities. Ref: 2009 Medicare patients age 66 & older.*





3. Di Unadjusted & adjusted rates of hospitalization due to infection (admissions per 1,000 patient years), by organ system, 2009

	All infection		Skin		Circulatory		Lung		Genitourinary		Musculoskeletal		Abdominal		Other	
	Unadj	Adj	Unadj	Adj	Unadj	Adj	Unadj	Adj	Unadj	Adj	Unadj	Adj	Unadj	Adj	Unadj	Adj
No CKD	49.9	55.9	4.3	4.8	11.1	12.7	16.3	18.2	9.4	10.5	0.7	0.8	2.2	2.3	6.0	6.7
All CKD	158.6	81.8	14.1	7.1	42.1	20.0	47.3	24.4	30.2	16.7	2.3	1.0	4.2	2.7	18.5	9.4
585.1-2	125.9	69.2	10.3	5.9	39.4	19.9	36.2	20.6	20.2	11.9	2.2	1.0	3.5	1.8	14.0	7.0
585.3	136.3	77.6	12.9	7.1	34.9	18.8	41.7	23.7	23.9	15.6	2.0	1.0	3.7	2.0	17.2	9.1
585.4-5	198.9	106.5	21.1	12.4	54.3	26.3	58.8	33.0	34.6	17.9	3.5	1.2	4.5	2.6	22.2	12.0
Unknown/unspecified	169.8	83.6	13.8	6.9	44.5	20.2	50.3	24.2	35.1	18.2	2.2	1.0	4.6	3.3	19.3	9.5
Age: 66-69	119.3	60.6	14.7	6.4	31.1	15.6	30.0	15.8	15.3	8.3	3.2	1.0	4.0	2.7	21.1	10.3
70-74	128.6	65.0	15.2	6.3	32.7	16.3	35.0	17.5	20.4	11.1	2.4	0.8	3.9	2.6	19.1	10.1
75-84	156.0	82.6	12.6	6.6	42.8	20.2	46.9	25.1	30.0	18.4	1.7	0.9	4.1	2.7	17.9	8.5
85+	211.7	121.5	15.4	9.2	55.1	29.3	68.6	40.1	47.6	27.6	2.6	1.4	4.7	3.2	17.7	9.9
Male	154.2	82.0	13.1	6.8	42.2	21.4	50.9	27.1	20.9	11.8	2.8	1.1	4.0	2.6	20.4	10.5
Female	162.6	81.5	14.9	7.3	42.0	18.7	44.0	22.6	38.8	20.1	1.8	1.0	4.4	2.8	16.8	8.6
White	157.8	82.2	14.8	7.5	39.9	19.7	48.7	24.7	30.0	17.0	1.9	0.9	4.2	2.8	18.4	9.4
Af Am	162.3	82.0	9.4	3.9	57.5	27.6	36.0	22.0	31.3	15.6	5.3	2.1	3.8	2.0	19.0	7.3
Other	164.9	80.4	11.2	6.0	46.7	20.3	48.1	24.1	31.7	14.3	2.4	1.3	5.7	1.9	19.1	12.0

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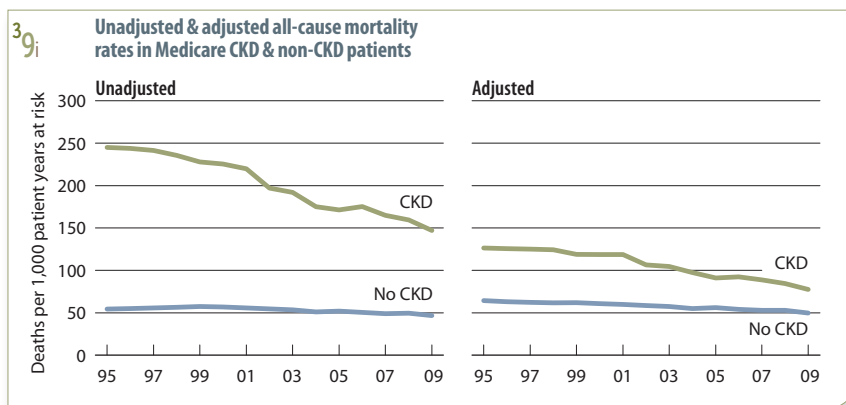
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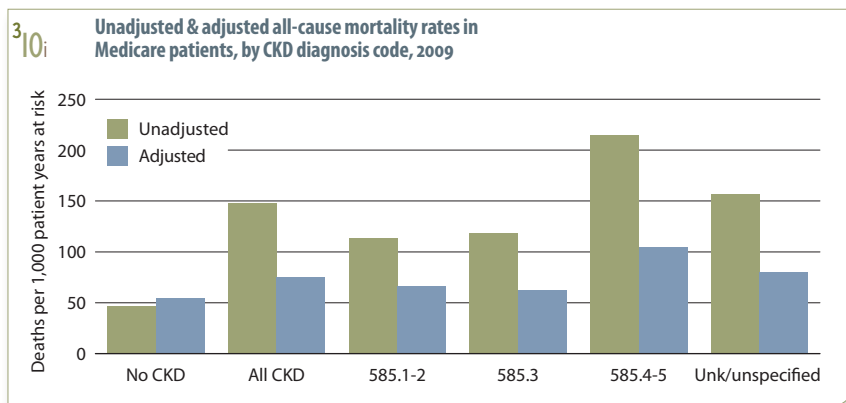
Among non-CKD patients age 66 and older, adjusted rates of hospitalization for infection are higher than unadjusted rates. Among their counterparts with CKD, in contrast, adjustments for age, gender, race, prior hospitalization, and comorbidity consistently lower the hospitalization rate.

Rates generally increase with age. Adjusted rates for all hospitalizations due to infection are the same in men and women, while rates related to circulatory and respiratory infections are greater among men, and those related to genitourinary infections are higher among women. By race, the adjusted rate for infections of the circulatory system among African Americans reaches 28 admissions per 1,000 patient years, compared to 20 among whites and patients of other races. >> **Table 3.b**; see page 124 for analytical methods. *January 1, 2009 point prevalent Medicare patients, age 66 & older on December 31, 2008. Adj: age/gender/race/prior hospitalization/13 comorbidities. Ref: 2009 Medicare patients age 66 & older.*

The unadjusted mortality rate in Medicare CKD patients age 66 and older has decreased 40 percent since 1995, to 147 deaths per 1,000 patient years in 2009. When adjusted for patient characteristics and complexity, however, the rate is lowered considerably, reaching 77 in 2009. >> **Figure 3.9**; see page 124 for analytical methods. *January 1 point prevalent Medicare patients age 66 & older. Adj: age/gender/race/prior hospitalization/comorbidities. Ref: 2005 patients.*



Among non-CKD patients age 66 and older, adjusted mortality rates are 15 percent higher than unadjusted rates. For CKD patients, in contrast, rates adjusted for patient characteristics, hospitalizations, and comorbidities are 42–51 percent lower. Adjusted mortality reaches 105 deaths per 1,000 patient years for patients with Stage 4–5 CKD. >> **Figure 3.10**; see page 124 for analytical methods. *January 1, 2009 point prevalent Medicare patients age 66 & older. Adj: age/gender/race/prior hospitalization/comorbidities. Ref: 2009 patients.*



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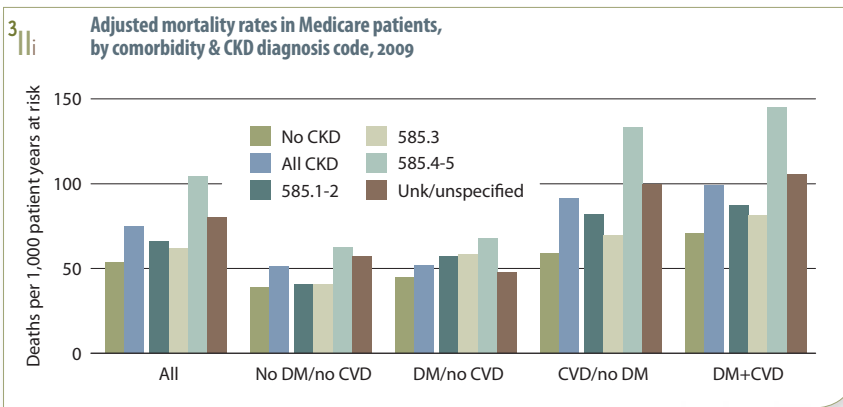
**In USRDS analyses, patients with ICD-9-CM code 585.6 are considered to have code 585.5; see Appendix A for details.*

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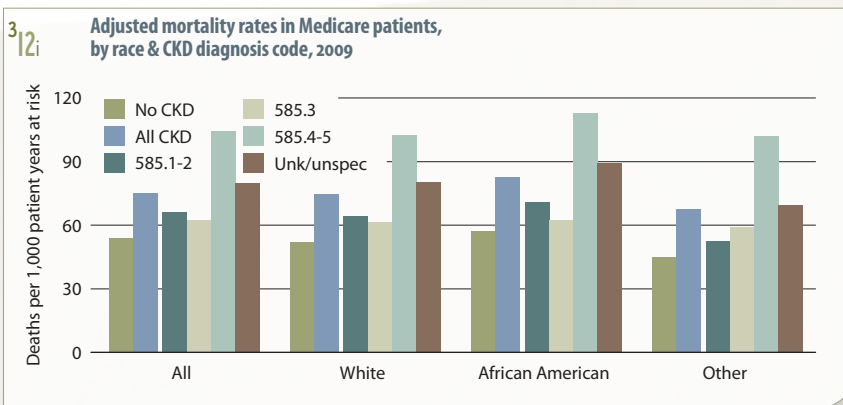
3 Ci Adjusted mortality rates (per 1,000 patient years at risk) in Medicare patients, by CKD diagnosis code, 2009

	No CKD	All CKD	585.1-2	585.3	585.4-5	Unk/unspec
Age: 66-69	23.5	36.3	40.4	26.9	79.6	34.0
70-74	28.0	43.7	40.6	38.1	62.9	45.0
75-84	48.3	70.5	54.2	59.0	98.6	73.8
85+	126.7	157.1	140.0	127.0	182.7	175.9
Male	57.3	81.5	74.6	65.7	111.2	86.9
Female	49.0	69.9	55.5	59.1	98.4	75.0
White	52.1	74.8	64.5	61.3	102.5	80.5
African American	57.4	82.8	70.9	62.1	112.9	89.5
Other	45.2	67.6	52.4	58.9	102.2	69.6
All	53.8	75.2	66.0	62.1	104.5	80.1

At 62-66 deaths per 1,000 patient years, adjusted mortality among Medicare CKD patients age 66 and older is lowest for those with CKD of Stages 1-3; the rate rises to 105 among those with Stage 4-5 CKD. Mortality is consistently higher for men than women, and for African Americans compared to whites and to patients of other races. >> Table 3.c; see page 124 for analytical methods. *January 1, 2009 point prevalent patients age 66 & older. Adj: age/gender/race/prior hospitalization/comorbidities. Ref: 2009 patients.*



Adjusted rates of mortality generally increase with patient complexity. Among Stage 4-5 CKD patients without diabetes or cardiovascular disease, for example, the rate is 63 per 1,000 patient years at risk; among those with both diagnoses, it rises to 145. >> Figure 3.Ii; see page 124 for analytical methods. *January 1, 2009 point prevalent patients age 66 & older. Adj: age/gender/race/prior hospitalization/comorbidities. Ref: 2009 patients.*



By race, adjusted mortality is highest — regardless of CKD diagnosis — for African Americans. Overall, the rate among African Americans with CKD is 83 per 1,000 patient years, compared to 75 and 68 among whites and patients of other races. In those with Stage 4-5 CKD, the rate for African Americans rises to 113. >> Figure 3.I2i; see page 124 for analytical methods. *January 1, 2009 point prevalent patients age 66 & older. Adj: age/gender/race/prior hospitalization/comorbidities. Ref: 2009 patients.*

Adjusted hospitalization rates in Medicare CKD patients age 66 and older, 2009

ADMISSIONS PER 1,000 PATIENT YEARS

NO DIABETES, NO CARDIOVASCULAR DISEASE	ALL CKD 315 » STAGES 1-2 275 » STAGE 3 307 » STAGES 4-5 377 (FIG 3.2)
DIABETES, CARDIOVASCULAR DISEASE	ALL CKD 625 » STAGES 1-2 565 » STAGE 3 601 » STAGES 4-5 778 (FIG 3.2)
WHITE	ALL CKD 446 » STAGES 1-2 411 » STAGE 3 441 » STAGES 4-5 554 (FIG 3.3)
AFRICAN AMERICAN	ALL CKD 466 » STAGES 1-2 437 » STAGE 3 426 » STAGES 4-5 652 (FIG 3.3)

Adjusted all-cause hospitalization rates in CKD patients, 2009

ADMISSIONS PER 1,000 PATIENT YEARS

MEDICARE, AGE 66+	» STAGES 1-2 408 » STAGE 3 435 » STAGES 4-5 559 (FIG 3.4)
MARKETSCAN, AGE 50-64	» STAGES 1-2 284 » STAGE 3 325 » STAGES 4-5 434 (FIG 3.4)
INGENIX I3, AGE 50-64	» STAGES 1-2 306 » STAGE 3 314 » STAGES 4-5 435 (FIG 3.4)

Adjusted rates of hospitalization due to infection in Medicare CKD patients age 66 and older, 2009

ADMISSIONS PER 1,000 PATIENT YEARS

» NO CKD 56 » ALL CKD 82 » STAGES 1-2 69 » STAGE 3 78 » STAGES 4-5 107 (FIG 3.8)

All-cause mortality rates in Medicare CKD patients age 66 and older, 2009

DEATHS PER 1,000 PATIENT YEARS

UNADJUSTED	» ALL CKD 147 » STAGES 1-2 114 » STAGE 3 119 » STAGES 4-5 215 (FIG 3.10)
ADJUSTED	» ALL CKD 75 » STAGES 1-2 66 » STAGE 3 62 » STAGES 4-5 104 (FIG 3.10)

Adjusted mortality rates in Medicare patients age 66 and older, by patient complexity, 2009

DEATHS PER 1,000 PATIENT YEARS

NO DIABETES, NO CARDIOVASCULAR DISEASE	» ALL CKD 51 » STAGES 1-2 41 » STAGE 3 41 » STAGES 4-5 63 (FIG 3.11)
DIABETES, NO CARDIOVASCULAR DISEASE	» ALL CKD 52 » STAGES 1-2 57 » STAGE 3 58 » STAGES 4-5 68 (FIG 3.11)
NO DIABETES, CARDIOVASCULAR DISEASE	» ALL CKD 92 » STAGES 1-2 82 » STAGE 3 70 » STAGES 4-5 134 (FIG 3.11)
DIABETES, CARDIOVASCULAR DISEASE	» ALL CKD 100 » STAGES 1-2 87 » STAGE 3 82 » STAGES 4-5 145 (FIG 3.11)

Adjusted mortality in Medicare CKD patients age 66 and older, by race 2009

DEATHS PER 1,000 PATIENT YEARS

WHITE	» ALL CKD 75 » STAGES 1-2 64 » STAGE 3 61 » STAGES 4-5 103 (FIG 3.12)
AFRICAN AMERICAN	» ALL CKD 83 » STAGES 1-2 71 » STAGE 3 62 » STAGES 4-5 113 (FIG 3.12)