



*Arches National Park, Utah*

**MORBIDITY & MORTALITY IN PATIENTS WITH CKD**

68	hospitalization rates in CKD & non-CKD patients
70	rehospitalization
72	mortality rates
74	summary

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.

We begin by examining rehospitalization rates in the CKD, hemodialysis, and general Medicare populations. Thirty-four percent of hemodialysis patients are rehospitalized within 30 days, compared to 24 percent of patients with CKD and 18 percent in the general Medicare population. Rehospitalization rates have not changed in the past decade, a major concern. Detailed causes of rehospitalizations need to be addressed and to be matched up with the changes in medication use (reported in Chapter Two), with particular reference to the decreased use of ACE/ARBs and diuretics.

Overall, the rate of hospitalizations approaches 0.6 per patient year, a rate less than half of that noted for hemodialysis patients (see Chapter Three of Volume Two). Rates of hospitalization for cardiovascular disease and infection continue to rise with CKD stage, an observation reported by other investigators more than seven years ago.

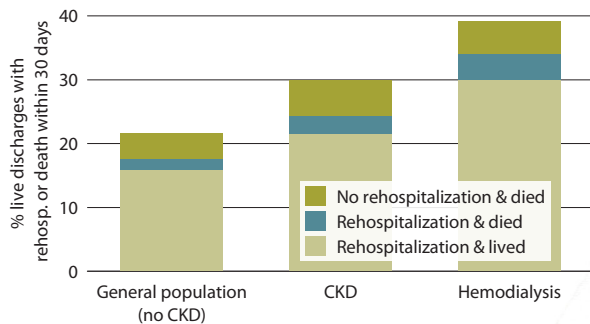
On no subject are our ideas more warped and pitiable than on death...  
 Let children walk with nature, let them see the beautiful blendings and communions of death and life, their joyous inseparable unity, as taught in woods and meadows, plains and mountains and streams of our blessed star, and they will learn that death is stingless indeed, and as beautiful as life, and that the grave has no victory, for it never fights. All is divine harmony.

JOHN MUIR  
*A Thousand-Mile Walk to the Gulf*

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 2010 is 59 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.

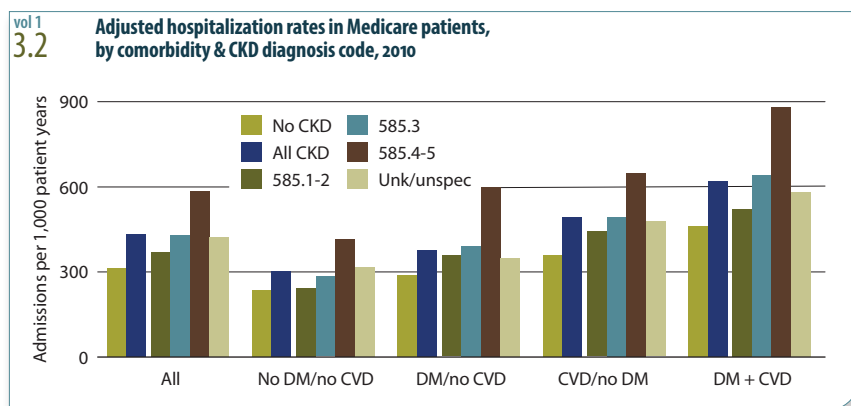
Patterns in mortality by CKD stage parallel those seen with hospitalization; the adjusted rate in patients with CKD of Stages 4–5, for example, is 53 percent greater than that in non-CKD patients. The impact of diabetes and congestive heart failure as risk multipliers is also important, particularly given that cardiovascular risk factors are relatively under-treated in U.S. patients with CKD. » **Figure 3-1**; see page 142 for analytical methods. *January 1, 2010 point prevalent Medicare patients, age 66 & older on December 31, 2009, unadjusted. Includes live hospital discharges from January 1 to December 1, 2010.*

vol 1  
3.1 **All-cause rehospitalization or death within 30 days after live hospital discharge in the general Medicare (no CKD), CKD, & hemodialysis populations, age 66+, 2010**



In both CKD and non-CKD populations age 66 and older, adjusted rates of hospitalization increase with greater comorbidity. In 2010, for example, admissions for Stage 4–5 CKD patients with both diabetes and cardiovascular disease reached 882 per 1,000 patient years — more than twice the rate among patients with neither diagnosis.

By race, hospitalization rates are generally higher among blacks/African Americans compared to whites, but differences are negligible in those with Stage 4–5 CKD, at 598 and 596 per 1,000 patient years, respectively. » **Figures 3.2–3;** see page 142 for analytical methods. January 1, 2010 point prevalent Medicare patients, age 66 & older on December 31, 2009. Adj: age/gender/race/prior hospitalization/comorbidity; rates by one factor are adjusted for the others. Ref: Medicare patients age 66 & older, 2010.



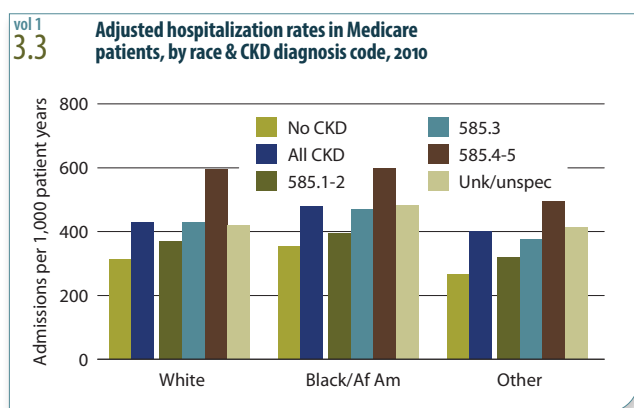
**ICD-9-CM codes**

- 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 & with no ESRD 2728 form or other indication of ESRD 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.*

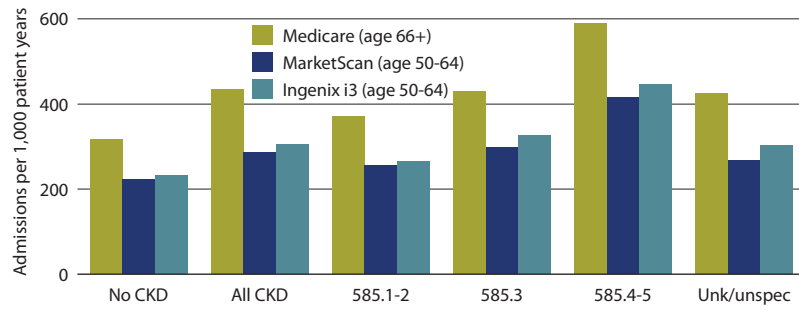


**vol 1 3.a** Adjusted hospitalization rates (per 1,000 patient years) in Medicare patients, by CKD diagnosis code, 2010

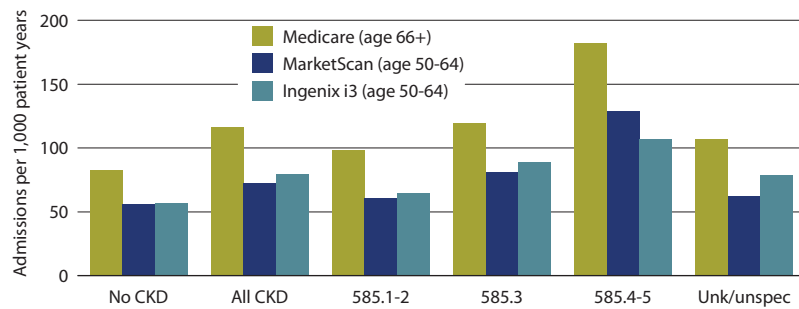
	No CKD	All CKD	585.1-2	585.3	585.4-5	Unk/unspec
All	314.5	433.6	370.4	431.2	587.1	424.3
Age: 66–69	246.3	365.0	294.4	394.2	539.1	338.9
70–74	266.2	384.2	330.3	360.0	599.4	378.8
75–84	327.8	441.5	379.6	441.5	577.9	433.2
85+	449.5	539.6	475.5	526.0	637.5	539.0
Male	317.1	425.7	368.5	424.2	587.8	413.8
Female	313.1	441.4	373.5	437.2	589.0	434.7
White	314.1	431.7	370.8	430.1	595.7	420.7
Black/Af Am	355.6	481.4	394.9	469.6	598.4	483.7
Other	268.5	400.4	319.0	374.9	494.5	412.9

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. The highest rates by race occur among blacks/African Americans; by gender, admissions for women with CKD are consistently higher than those found in their male counterparts. » **Table 3.a;** see page 142 for analytical methods. January 1, 2010 point prevalent Medicare patients, age 66 & older on December 31, 2009. Adj: age/gender/race/prior hospitalization/comorbidity; rates by one factor are adjusted for the others. Ref: Medicare patients age 66 & older, 2010.

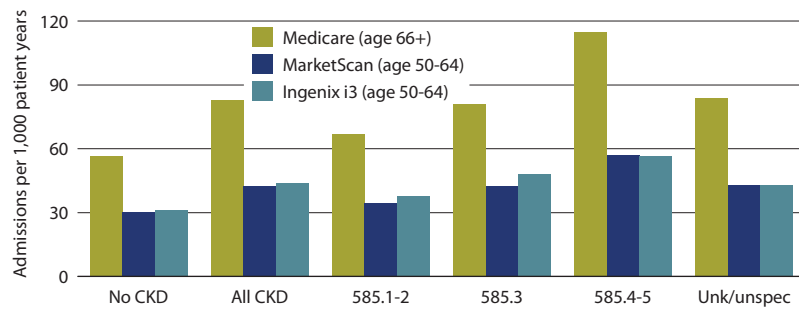
vol 1  
3.4 Adjusted all-cause hospitalization rates, by dataset & CKD diagnosis code, 2010



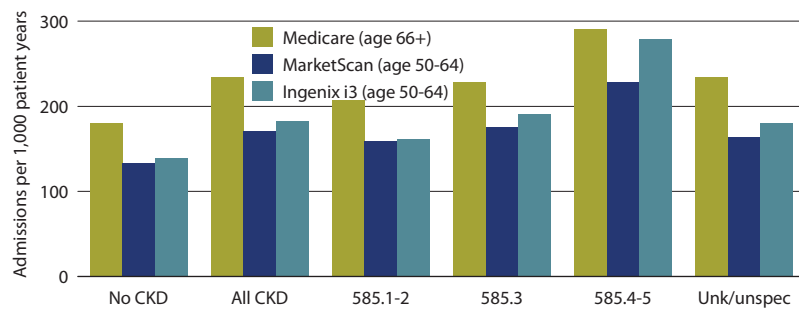
vol 1  
3.5 Adjusted rates of hospitalization for cardiovascular disease, by dataset & CKD diagnosis code, 2010



vol 1  
3.6 Adjusted rates of hospitalization for infection, by dataset & CKD diagnosis code, 2010



vol 1  
3.7 Adjusted rates of hospitalization for other causes, by dataset & CKD diagnosis code, 2010



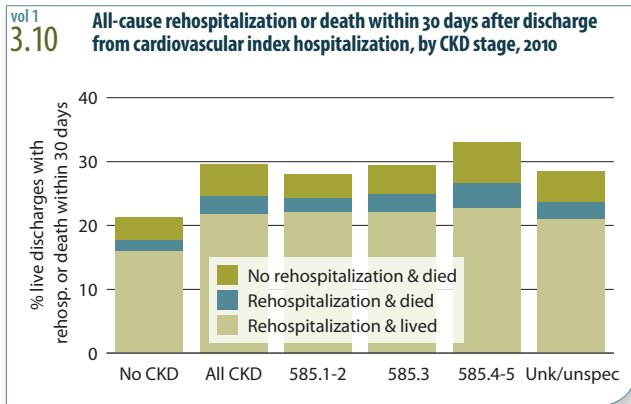
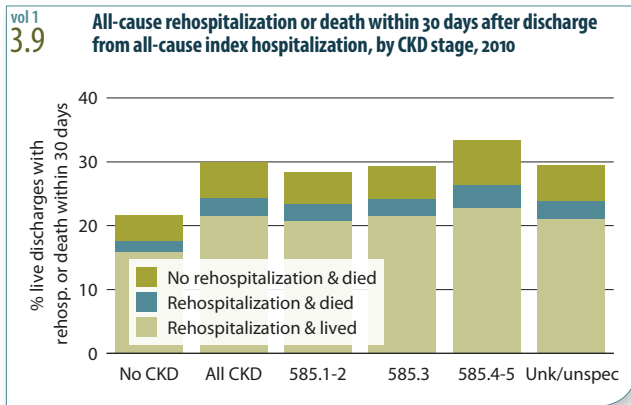
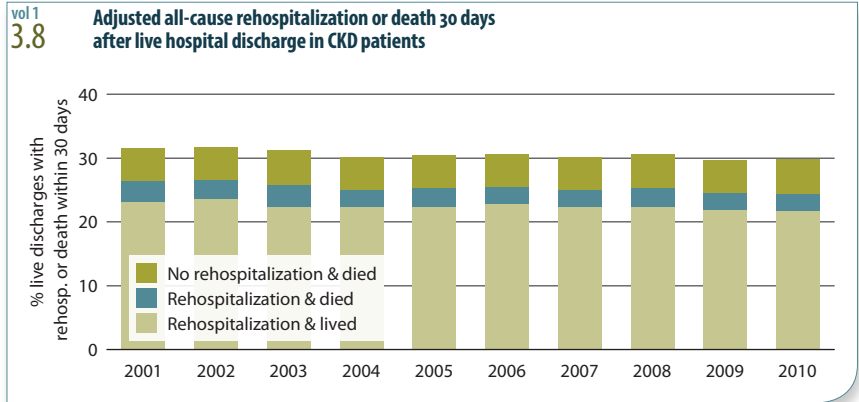
Adjusted all-cause hospitalization rates, and rates of hospitalization for cardiovascular disease, infection, and other causes, are each higher among Medicare patients age 66 and older than in the younger MarketScan and Ingenix i3 populations. Rates are also greatest for patients with CKD compared to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

All-cause hospitalization rates, for example, are 58 percent higher among Medicare patients with Stage 4–5 CKD than among their counterparts with Stages 1–2, reaching 589 admissions per 1,000 patient years; in the MarketScan and Ingenix i3 populations, rates are 63 and 67 percent higher in those with later-stage CKD.

Among Medicare patients, the rate of 182 cardiovascular admissions per 1,000 patient years in those with Stage 4–5 CKD is 86 percent higher than the rate of 98 reported for those with CKD of Stages 1–2. And rates of 129 and 107 reported for MarketScan and Ingenix i3 patients with later-stage CKD are 112 and 65 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 72, 66, and 50 percent greater, respectively, among Medicare, MarketScan, and Ingenix i3 patients. » Figures 3.4–7; see page 142 for analytical methods. Medicare: point prevalent patients on January 1, 2010, age 66 & older on December 31, 2009. MarketScan & Ingenix i3: point prevalent patients on January 1, 2010, age 50–64 on December 31, 2009. Adj: gender/prior hospitalization/comorbidity; ref: Medicare patients age 66 & older, 2010.

Adjusted all-cause rehospitalization rates in Medicare CKD patients have slowly decreased during the last decade, from 27 percent in 2002 to 24 percent in 2010. » **Figure 3.8**; see page 142 for analytical methods. *Point prevalent Medicare CKD patients on January 1 of each year, age 66 & older on December 31 of the prior year. Adj: age/gender/race; ref: discharges in 2005. Includes discharges from January 1 to December 1 of each year.*



**vol 1 3.b** Percent live hospital discharges in CKD patients with an all-cause rehospitalization within 30 days, 2010

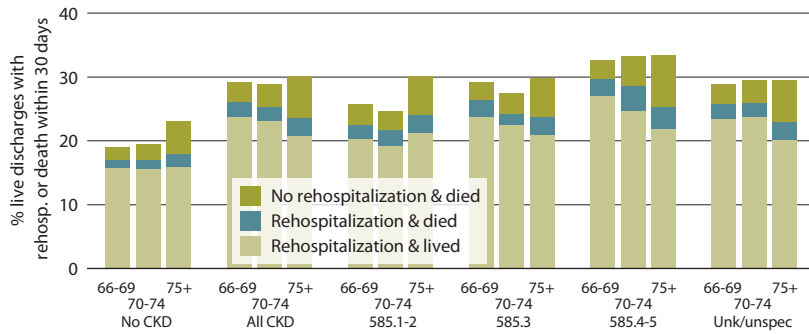
	No CKD	All CKD	585.1-2	585.3	585.4-5	Unk/unspec
All	17.7	24.3	23.4	24.2	26.3	23.9
Age: 66-69	17.0	26.2	22.6	26.4	29.8	25.8
70-74	17.0	25.4	21.7	24.2	28.6	26.0
75-84	18.1	24.3	26.0	24.3	26.0	23.5
85+	18.0	22.8	20.4	23.0	24.4	22.4
Male	18.5	24.6	24.0	24.3	26.3	24.5
Female	17.1	24.0	22.9	24.0	26.4	23.4
White	17.4	23.6	22.3	23.7	25.3	23.3
Black/Af Am	20.4	27.6	27.5	26.7	30.0	27.5
Other	17.6	26.8	26.9	26.4	31.6	25.2
No rehos & died	4.0	5.6	5.0	5.1	7.0	5.6
Rehos & died	1.8	2.8	2.7	2.6	3.5	2.7
Rehos & lived	15.9	21.5	20.8	21.6	22.8	21.2

The thirty-day all-cause rehospitalization rate among patients with CKD of Stages 4-5 was 26 percent in 2010, compared to 23 percent in those with Stage 1-2 CKD; rates for death or rehospitalization were 33 and 28 percent, respectively. The rehospitalization rate among CKD patients (24 percent) exceeded the rate of the combined end-point of death or rehospitalization in non-CKD patients, at 22 percent.

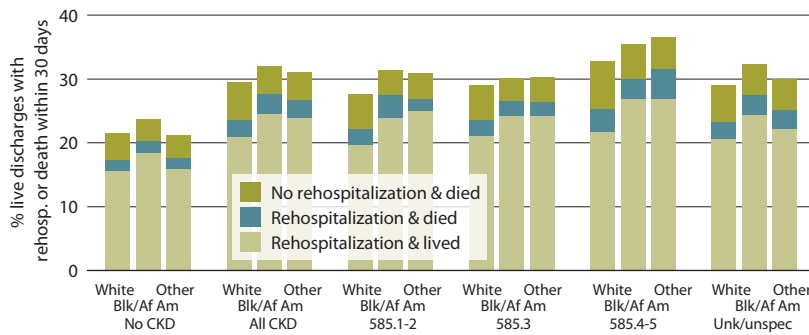
Rates of rehospitalization increase with the severity of CKD, and are highest among males and blacks/African Americans within all groups except patients with CKD of Stages 4-5; rates in these patients are similar by gender and highest in races other than white or black/African American.

Following discharge from a cardiovascular hospitalizations, rehospitalization rates in 2010 were 18 and 25 percent, respectively, for non-CKD and CKD patients; rates for rehospitalization or death were 21 and 30 percent. » **Table 3.b & Figures 3.9-10**; see page 142 for analytical methods. *January 1, 2010 point prevalent Medicare patients, age 66 & older on December 31, 2009; unadjusted. Includes live hospital discharges from January 1 to December 1, 2010*

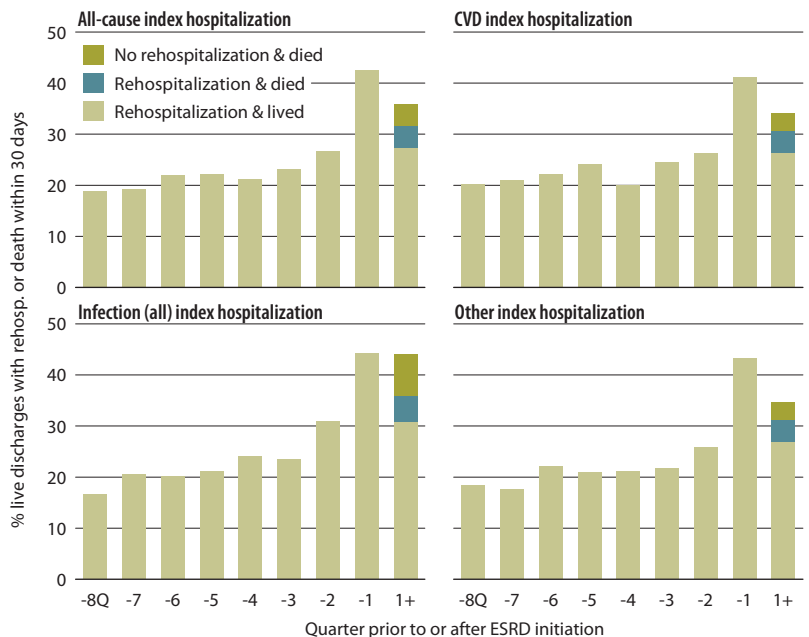
vol 1  
3.11 All-cause rehospitalization or death 30 days after live hospital discharge in Medicare patients, by age & CKD diagnosis code, 2010



vol 1  
3.12 All-cause rehospitalization or death 30 days after live hospital discharge in Medicare patients, by race & CKD diagnosis code, 2010



vol 1  
3.13 All-cause rehospitalization or death 30 days after live hospital discharge during the transition to ESRD, by cause-specific index hospitalization, 2010



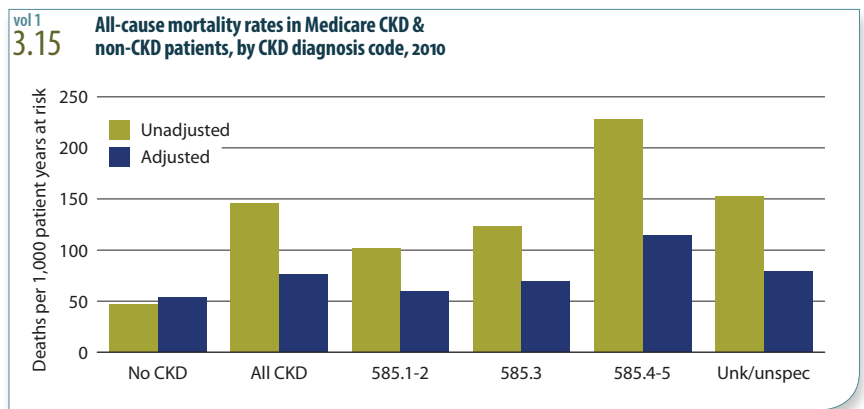
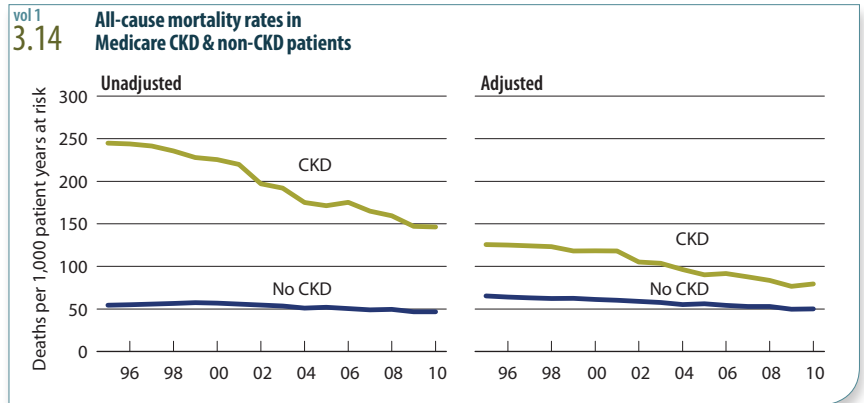
Here we highlight the issue of competing risks of mortality and rehospitalization. Rates of rehospitalization rates tend to be lower for older patients, as death precludes the opportunity for readmission. Figure 3.11 demonstrates a pattern of increasing mortality and decreasing rehospitalization rates in older patients with CKD overall and by CKD stage.

Rates by race show lower rehospitalization rates among whites compared to blacks/African Americans patients of other races within all stages of CKD. Mortality, however, is also higher in whites, indicating a need for caution when interpreting trends in rehospitalization by race. » Figures 3.11–12; see page 142 for analytical methods. *January 1, 2010 point prevalent Medicare patients, age 66 & older on December 31, 2009; unadjusted.*

The highest rehospitalization rates during the transition to ESRD are observed following an index hospitalization for infection, with 44 percent of discharges followed by a rehospitalization within 30 days during the first quarter before ESRD initiation. In the quarter following ESRD initiation, 44 percent of discharges from hospitalizations for infection are followed by death or rehospitalization within 30 days. » Figure 3.13; see page 142 for analytical methods. *Incident ESRD patients, January 1 to October 1, 2010; age 67 or older, unadjusted.*

The unadjusted mortality rate in Medicare CKD patients age 66 and older has decreased 40.3 percent since 1995, to 146.2 deaths per 1,000 patient years in 2010. When adjusted for patient characteristics and complexity, however, the rate is lowered considerably, reaching 79.5 in 2010. » **Figure 3.14**; see page 142 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 41–50 percent lower. Adjusted mortality reaches 115 deaths per 1,000 patient years for patients with Stage 4–5 CKD. » **Figure 3.15**; see page 142 for analytical methods. *January 1, 2010 point prevalent Medicare patients age 66 & older. Adj: age/gender/race/prior hospitalization/comorbidities. Ref: 2010 patients.*



### 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 & with no ESRD 2728 form or other indication of ESRD 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.*

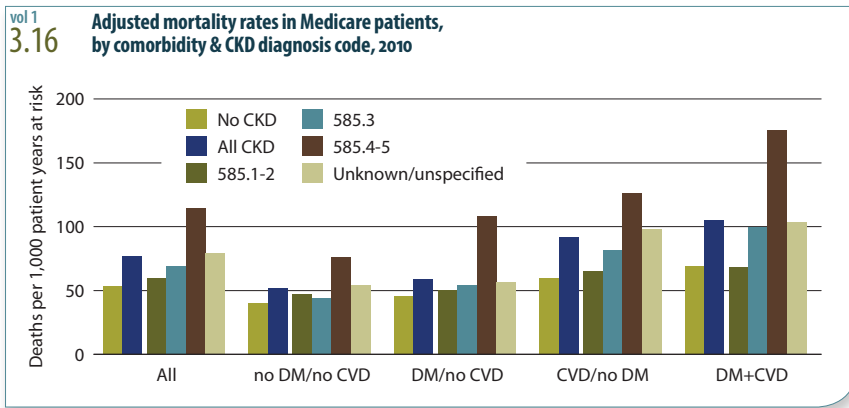


vol 1  
3.C

**Adjusted mortality rates (per 1,000 patient years at risk) in Medicare patients, by CKD diagnosis code, 2010**

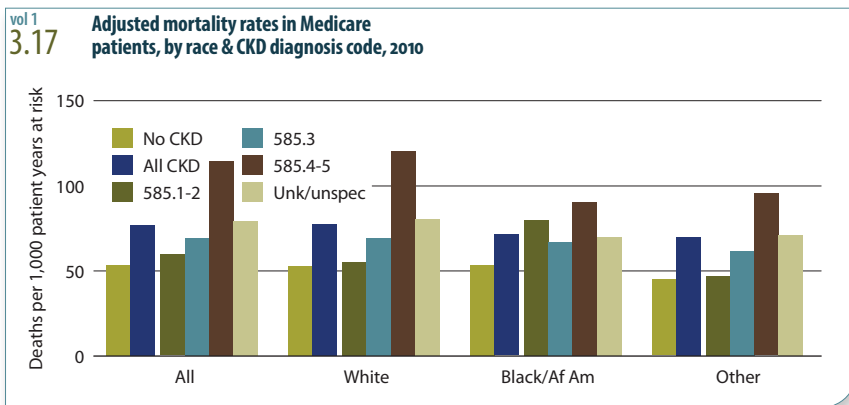
	No CKD	All CKD	585.1-2	585.3	585.4-5	Unk/unspec
All	53.7	77.0	59.7	69.5	114.7	79.3
Age: 66-69	23.3	37.2	20.7	41.4	44.2	37.1
70-74	27.5	42.4	26.7	35.6	79.2	42.1
75-84	48.3	72.7	48.4	64.6	137.5	72.4
85+	127.5	166.7	152.1	143.5	198.8	183.1
Male	58.0	81.4	67.1	77.2	122.1	80.5
Female	49.2	75.0	50.6	63.2	112.7	81.2
White	53.0	77.6	55.1	69.5	120.5	80.7
Black/Af Am	53.8	71.4	79.9	67.1	90.7	70.2
Other	44.9	70.1	46.9	61.8	95.6	71.3

Adjusted mortality per 1,000 patient years among Medicare CKD patients age 66 and older is lowest for those with CKD of Stages 1-2, at 20.7; the rate rises to 115 in those with Stage 4-5 CKD. Mortality is consistently higher for men than women, and in patients with Stage 4-5 CKD is 32 percent higher for whites compared to black/African American patients. » **Table 3.c**; see page 142 for analytical methods. January 1, 2010 point prevalent patients age 66 & older. Adj: age/gender/race/prior hospitalization/comorbidities. Ref: 2010 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 76 per 1,000 patient years at risk; among those with both diagnoses, it rises to 176.

By race, adjusted mortality is highest in patients with Stage 4-5, and is highest in whites than in blacks/African Americans. Overall, the rate among blacks/African Americans with CKD is 71 per 1,000 patient years, compared to 78 and 70 among whites and patients of other races. » **Figures 3.16-17**; see page 142 for analytical methods. January 1, 2010 point prevalent patients age 66 & older. Adj: age/gender/race/prior hospitalization/comorbidities. Ref: 2010 patients.



## HOSPITALIZATION RATES IN CKD & NON-CKD PATIENTS

*adjusted admissions in Medicare CKD patients age 66 & older, 2010 (per 1,000 patient years; Figures 3.2–3)*

no diabetes, no CVD	» no CKD · 238	» all CKD · 302	» Stages 1–2 · 244	» Stage 3 · 284	» Stages 4–5 · 416
diabetes, cardiovascular disease	· 462	· 621	· 523	· 642	· 882
white	· 314	· 432	· 371	· 430	· 596
black/African American	· 356	· 481	· 395	· 470	· 598

*adjusted all-cause hospitalization rates in CKD patients (per 1,000 patient years; Figure 3.4)*

Medicare, age 66+	» Stages 1–2 · 372	» Stage 3 · 430	» Stages 4–5 · 589
MarketScan, age 50–64	· 256	· 299	· 417
Ingenix i3, age 50–64	· 267	· 328	· 447

## MORTALITY

*all-cause mortality rates in Medicare patients age 66 & older, 2010 (per 1,000 patient years; Figure 3.15)*

unadjusted	» all CKD · 146	» Stages 1–2 · 102	» Stage 3 · 124	» Stages 4–5 · 228
adjusted	· 77	· 60	· 69	· 115

*adjusted mortality rates in Medicare patients age 66 & older, by patient comorbidity, 2010 (per 1,000 patient years; Figure 3.16)*

no diabetes, no cardiovascular disease	» all CKD · 52	» Stages 1–2 · 48	» Stage 3 · 44	» Stages 4–5 · 76
diabetes, no cardiovascular disease	· 59	· 50	· 54	· 109
no diabetes, cardiovascular disease	· 92	· 65	· 82	· 126
diabetes & cardiovascular disease	· 105	· 68	· 100	· 176

*adjusted mortality rates in Medicare CKD patients age 66 & older, by race, 2010 (per 1,000 patient years; Figure 3.17)*

white	» all CKD · 78	» Stages 1–2 · 55	» Stage 3 · 70	» Stages 4–5 · 121
black/African American	· 71	· 80	· 67	· 91