Louis Brion de la Tour, 1764

3 Morbidity and mortality in patients with chronic kidney disease

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, as defined in Chapter One. Medicare data cover 95 percent of individuals age 65 and older, while the Truven Health MarketScan and Clinfomatics DataMart datasets both represent large EGHPs. 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 highlighting rates of rehospitalization among patients age 66 and older, a major quality issue advanced under the Medicare system. Thirty-three percent of hemodialysis patients are rehospitalized within 30 days, compared to 24 percent of patients with CKD, and 17.4 percent of those in the general Medicare population. These rates have not changed in the past decade, which is a major concern. Detailed causes of rehospitalization need to be addressed, and analyzed in terms of changes in medication use (reported in Chapter Five), with particular reference to the decreased use of ACE/ARBs and diuretics across such conditions as acute kidney injury. Also of concern is the increase in rehospitalization rates as CKD patients approach dialysis, to a level of 44 percent in the month prior to initiation — more than double the rate noted in the general Medicare population.

One consistent finding in the CKD population is the increasing rate of overall and cause-specific hospitalizations with advancing stages of CKD. Overall, CKD patients are hospitalized at a rate of 0.43 admissions per patient year. The rising rates of hospitalization for cardiovascular

Hence, in a season of calm weather
Though inland far we be,
Our souls have sight of that immortal sea
Which brought us hither

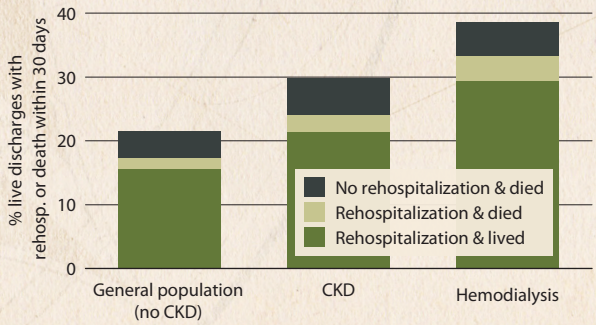
William Wordsworth
"Ode: Intimations of Immortality
From Recollections of Early Childhood"

disease and infection with CKD stage were observed by other investigators several years ago (Go et al NEJM 2004). Hospitalizations in CKD patients also increase with underlying comorbidity such as diabetes and cardiovascular disease.

In Chapter Two we illustrate the increasing recognition of CKD through diagnosis codes in the Medicare and EGHP populations, while showing that the population-level sampling of the NHANES cohort, using biochemical data, identifies smaller increases in CKD prevalence. As the increase in reported CKD through diagnosis codes represents patients with less severe disease, comparisons of event rates over time require adjustments for disease burden.

Using diagnosis codes, we show that adjusted mortality rates also increase with CKD stage, a finding consistent with studies using more direct measures of CKD, and with the risk prognosis population-level studies reported by the international CKD consortium (Lancet 2010). 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, as shown by data in Chapter One on awareness, treatment, and control of risk factors in the population-level NHANES cohort. Clearly, early detection and active treatment are important considerations in reducing morbidity and mortality in the CKD population. • **Figure 3.1;** see page 142 for analytical methods. *January 1, 2011 point prevalent Medicare patients, age 66 & older on December 31, 2010, unadjusted. Includes live hospital discharges from January 1 to December 1, 2011.*

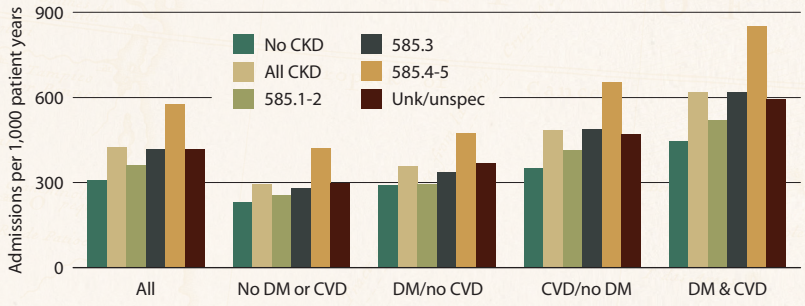
vol 1
3.1 **All-cause rehospitalization or death within 30 days after live hospital discharge in the general Medicare (no CKD), CKD, & hemodialysis populations, age 66+, 2011**



In both CKD and non-CKD populations age 66 and older, adjusted rates of hospitalization increase with greater comorbidity. In 2011, for example, admissions for Stage 4–5 CKD patients with both diabetes and cardiovascular disease reached 851 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 576 and 577 per 1,000 patient years, respectively. ✦ **Figures 3.2–3;** see page 142 for analytical methods. *January 1, 2011 point prevalent Medicare patients, age 66 & older on December 31, 2010. Adj: age/gender/race/prior hospitalization/comorbidity; rates by one factor are adjusted for the others. Ref: Medicare patients age 66 & older, 2011.*

vol 1 **3.2** **Adjusted hospitalization rates in Medicare patients, by comorbidity & CKD diagnosis code, 2011**



icd-9-cm codes

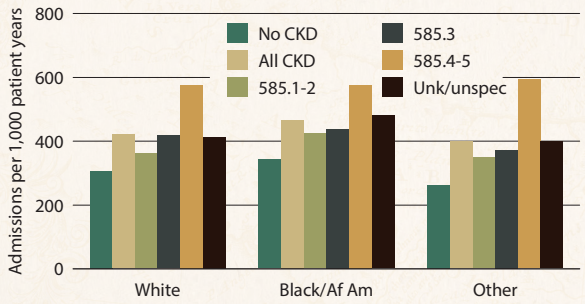
585.1	Chronic kidney disease, Stage 1
585.2	Chronic kidney disease, Stage 2 (mild)
585.3	Chronic kidney disease, Stage 3 (moderate)
585.4	Chronic kidney disease, Stage 4 (severe)
585.5	Chronic kidney disease, Stage 5 (excludes 585.6: Stage 5, requiring chronic dialysis.*)

CKD unspecified identified by multiple codes including 585.9, 250.4x, 403.9x, & others.

**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 **3.3** **Adjusted hospitalization rates in Medicare patients, by race & CKD diagnosis code, 2011**



vol 1 **3.a** **Adjusted hospitalization rates (per 1,000 patient years) in Medicare patients, by CKD diagnosis code, 2011**

	No CKD	All CKD	585.1–2	585.3	585.4–5	Unk/unspec
All	307	423	361	416	576	416
Age: 66–69	242	352	298	338	551	347
70–74	257	377	328	378	538	362
75–84	318	429	356	422	586	425
85+	443	537	514	530	602	534
Male	307	423	376	418	597	409
Female	307	422	351	415	557	421
White	307	422	362	417	577	413
Black/Af Am	343	467	424	439	576	481
Other	263	400	348	373	593	400

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. ✦ **Table 3.a;** see page 142 for analytical methods. *January 1, 2011 point prevalent Medicare patients, age 66 & older on December 31, 2010. Adj: age/gender/race/prior hospitalization/comorbidity; rates by one factor are adjusted for the others. Ref: Medicare patients age 66 & older, 2011.*

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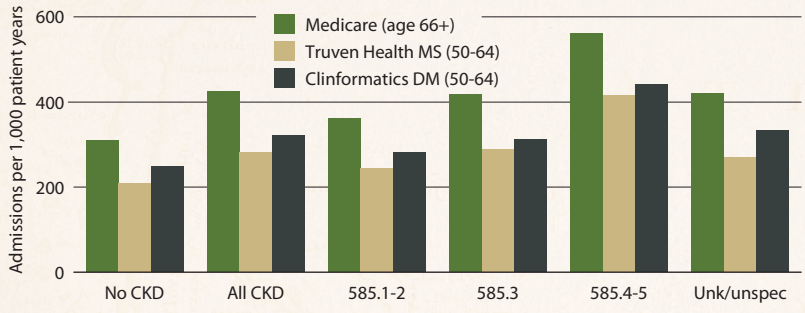
3.4

Adjusted all-cause hospitalization rates, by dataset & CKD diagnosis code, 2011



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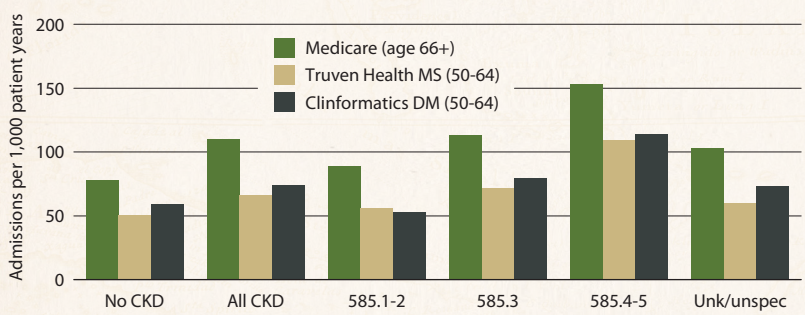
3.5

Adjusted rates of hospitalization for cardiovascular disease, by dataset & CKD diagnosis code, 2011



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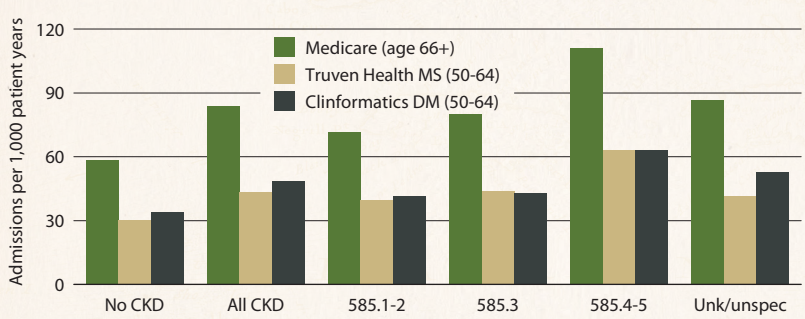
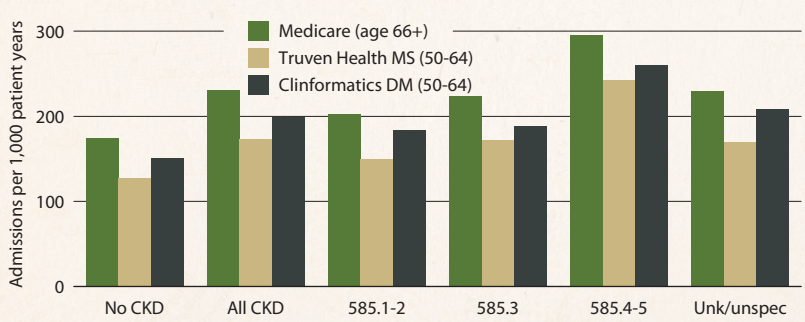
3.6

Adjusted rates of hospitalization for infection, by dataset & CKD diagnosis code, 2011



vol 1
3.7

Adjusted rates of hospitalization for other causes, by dataset & CKD diagnosis code, 2011



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 younger populations with private insurance. Rates are also greatest for patients with CKD compared to those without, and are generally higher in the later stages of the disease.

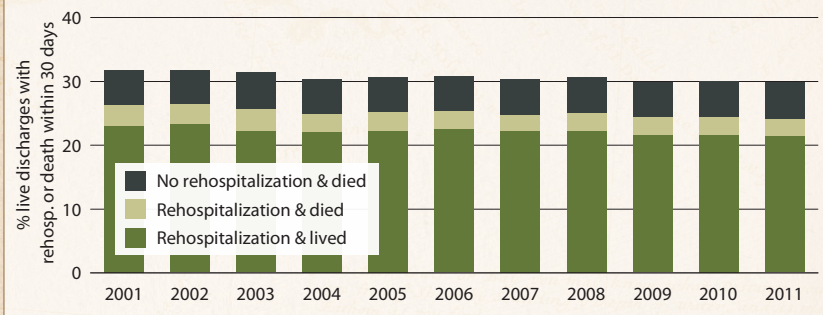
All-cause hospitalization rates, for example, are 54 percent higher among Medicare patients with Stage 4–5 CKD than among their counterparts with Stages 1–2, reaching 562 admissions per 1,000 patient years; in the Truven Health MarketScan (THMS) and Clinformatics DataMart (CDM) populations, rates are 69 and 57 percent higher in those with later-stage CKD, at 416 and 441 per 1,000, respectively.

Among Medicare patients, the rate of 153 cardiovascular admissions per 1,000 patient years in those with Stage 4–5 CKD is 71 percent higher than the rate of 89 reported for those with CKD of Stages 1–2. And rates of 109 and 114 reported for THMS and CDM patients with later-stage CKD are 96 and 115 percent greater, respectively, than those for patients in the earliest stages of the disease.

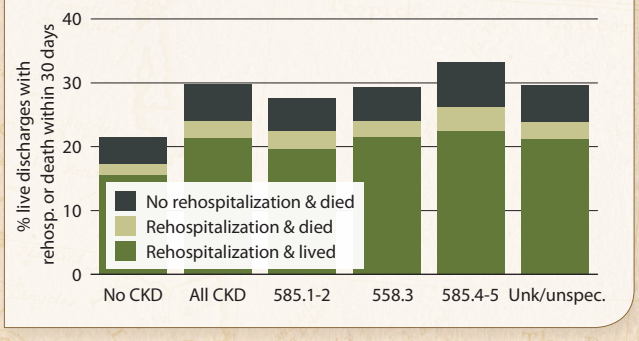
Compared to those of patients in the early stages of CKD, rates of admission for infection among patients with CKD of Stages 4–5 are 55, 59, and 51 percent greater, respectively, among Medicare, THMS, and CDM patients. ✦ **Figures 3.4–7;** see page 143 for analytical methods. *Medicare: point prevalent patients on January 1, 2011, age 66 & older on December 31, 2010. Truven Health MarketScan & Clinformatics DataMart: point prevalent patients on January 1, 2011, age 50–64 on December 31, 2010. Adj: gender/prior hospitalization/comorbidity; ref: Medicare patients age 66 & older, 2011.*

In 2011, 24 percent of CKD patients were rehospitalized within 30 days of a hospital discharge, down slightly from 26 percent in 2001. ◆ **Figure 3.8;** see page 143 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 2010. Includes discharges from January 1 to December 1 of each year.*

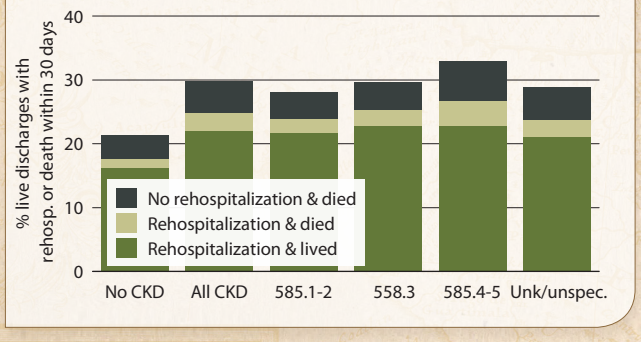
vol 1
3.8 **Adjusted all-cause rehospitalization or death within 30 days after live hospital discharge in CKD patients**



vol 1
3.9 **All-cause rehospitalization or death within 30 days after discharge from all-cause index hospitalization, by CKD stage, 2011**



vol 1
3.10 **All-cause rehospitalization or death within 30 days after discharge from cardiovascular index hospitalization, by CKD stage, 2011**



vol 1
3.b **Percent live hospital discharges in CKD patients with an all-cause rehospitalization within 30 days, 2011**

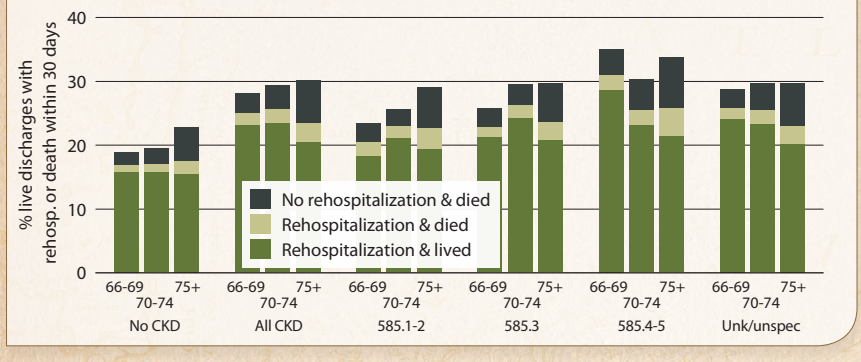
	No CKD	All CKD	585.1–2	585.3	585.4–5	Unk/unspec
All	17.4	24.1	22.5	24.0	26.4	23.9
Age: 66–69	16.9	25.0	20.6	22.9	31.1	25.8
70–74	17.1	25.7	23.0	26.4	25.6	25.6
75–84	17.5	24.3	23.4	24.1	26.8	23.8
85+	17.6	22.7	21.6	22.7	24.4	22.2
Male	18.2	24.6	22.7	24.4	26.8	24.4
Female	16.8	23.8	22.2	23.6	26.0	23.4
White	17.1	23.8	22.4	23.5	26.1	23.5
Black/Af Am	20.0	26.2	24.0	27.2	26.1	25.6
Other	17.6	25.3	19.7	24.2	30.0	25.7
No rehosp & died	4.2	5.7	5.1	5.3	6.9	5.8
Rehosp & died	1.8	2.8	2.8	2.5	3.8	2.7
Rehosp & lived	15.6	21.4	19.7	21.5	22.6	21.2

The thirty-day all-cause rehospitalization rate among patients with CKD of Stages 4–5 was 26.4 percent in 2011, compared to 22.5 percent in those with Stage 1–2 CKD; rates for death or rehospitalization were 33.3 and 27.6 percent, respectively. The rehospitalization rate among CKD patients (24.1 percent) exceeded the rate of the combined end-point of death or rehospitalization in non-CKD patients, at 21.5 percent.

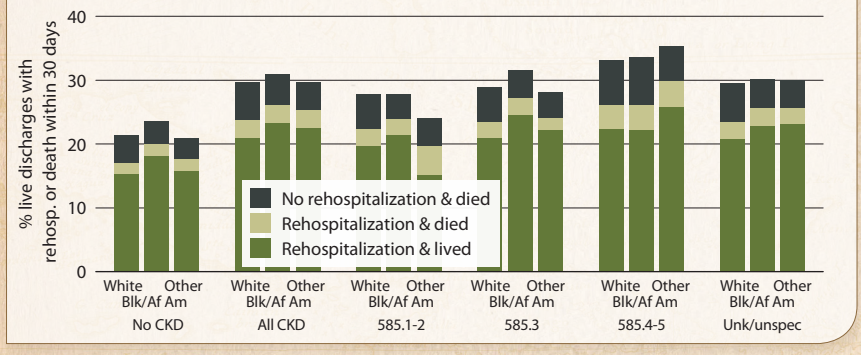
Rates of all-cause rehospitalization within thirty days of live hospital discharge increase with the severity of CKD, and are generally higher among males compared to females and blacks/African Americans compared to whites. In patients with CKD of Stages 4–5, however, the proportions of patients with a rehospitalization are similar, at 26.1 percent.

Following discharge from a cardiovascular hospitalizations, rehospitalization rates in 2011 were 17.8 and 24.8 percent, respectively, for non-CKD and CKD patients; rates for the combined end-point of death or rehospitalization were 21.4 and 29.7 percent. ◆ **Figures 3.9–10 & Table 3.b;** see page 143 for analytical methods. *January 1, 2011 point prevalent Medicare patients, age 66 & older on December 31, 2010; unadjusted. Includes live hospital discharges from January 1 to December 1, 2011*

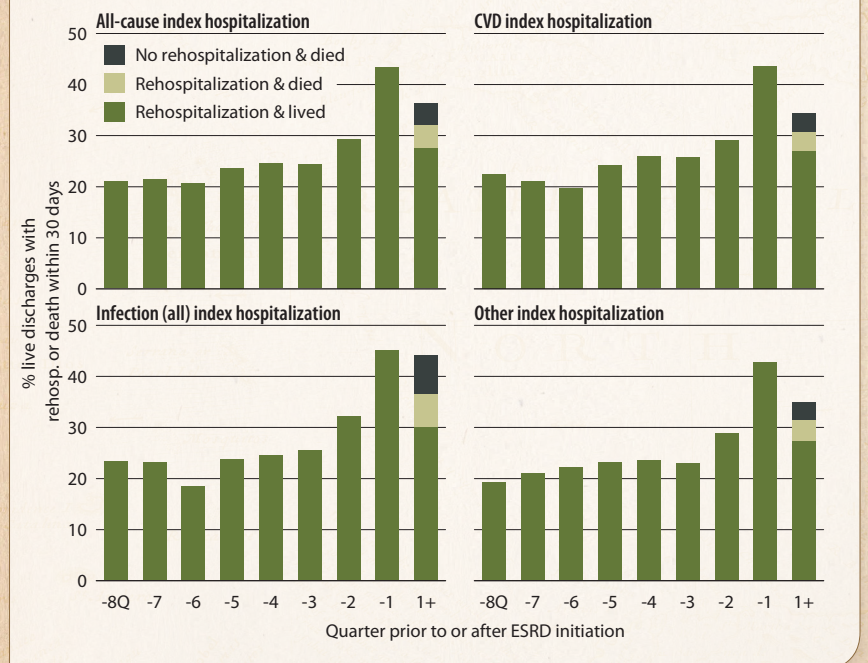
vol 1
3.11 **All-cause rehospitalization or death 30 days after live hospital discharge in Medicare patients, by age & CKD diagnosis code, 2011**



vol 1
3.12 **All-cause rehospitalization or death 30 days after live hospital discharge in Medicare patients, by race & CKD diagnosis code, 2011**



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, 2011**



In these figures we highlight the issue of competing risks of mortality and rehospitalization. Rates of rehospitalization 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.

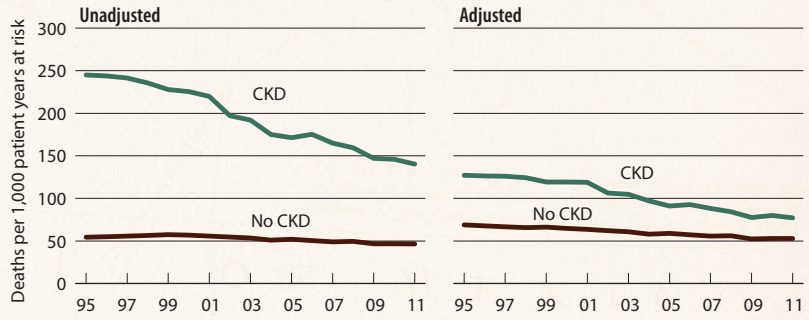
In the CKD population as a whole, rehospitalization rates by race are lower for whites than for blacks/African Americans and patients of other races. Mortality, however, is higher in whites, indicating a need for caution when interpreting trends in rehospitalization by race. ✦ **Figures 3.11–12;** see page 143 for analytical methods. *January 1, 2011 point prevalent Medicare patients, age 66 & older on December 31, 2010; unadjusted.*

The highest rehospitalization rates during the transition to ESRD are observed following an index hospitalization for infection, with 45 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 and/or rehospitalization within 30 days. ✦ **Figure 3.13;** see page 143 for analytical methods. *Incident ESRD patients, January 1 to October 1, 2011; age 67 or older, unadjusted.*

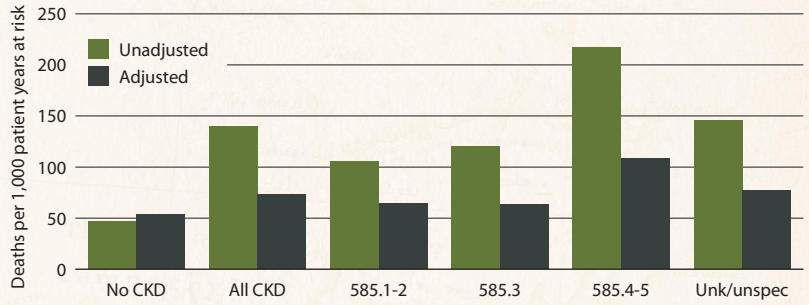
The unadjusted mortality rate in Medicare CKD patients age 66 and older has decreased 43 percent since 1995, to 140 deaths per 1,000 patient years in 2011. When adjusted for patient characteristics and complexity, however, the rate is lowered considerably, reaching 77 in 2011. • **Figure 3.14;** see page 143 for analytical methods. *January 1 point prevalent Medicare patients age 66 & older. Adj: age/gender/race/prior hospitalization/comorbidities. Ref: 2010 patients.*

Among patients age 66 and older with no CKD, adjusted mortality rates are 15 percent higher than unadjusted rates. For CKD patients, in contrast, rates adjusted for patient characteristics, hospitalizations, and comorbidities are 39–50 percent lower. Adjusted mortality reaches 109 deaths per 1,000 patient years for patients with Stage 4–5 CKD. • **Figure 3.15;** see page 143 for analytical methods. *January 1, 2011 point prevalent patients age 66 & older. Adj: age/gender/race/prior hospitalization/comorbidities. Ref: all patients, 2011.*

vol 1
3.14 **All-cause mortality rates in Medicare CKD & non-CKD patients**



vol 1
3.15 **All-cause mortality rates in Medicare CKD & non-CKD patients, by CKD diagnosis code, 2011**



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.*)

CKD unspecified identified by multiple codes including 585.9, 250.4x, 403.9x, & others.

**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.*

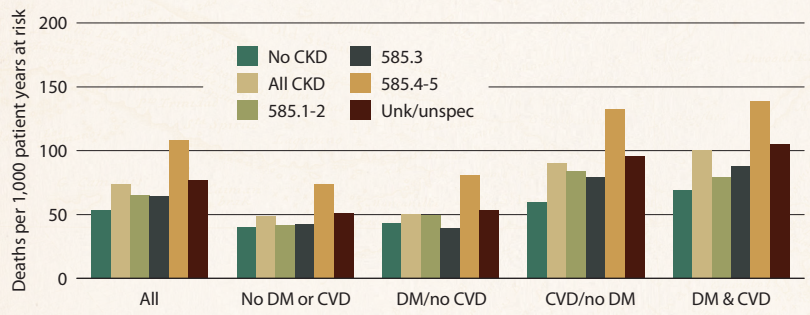
CKD stage estimates are from a single measurement. For clinical case definition, abnormalities should be present ≥3 months.

vol 1
3.c **Adjusted mortality rates (per 1,000 patient years at risk) in Medicare patients, by CKD diagnosis code, 2011**

	No CKD	All CKD	585.1–2	585.3	585.4–5	Unk/unspec
All	53.8	73.8	64.8	64.4	108.5	77.1
Age: 66–69	23.5	31.9	26.3	28.0	49.7	30.5
70–74	27.3	41.2	30.3	37.1	68.4	42.4
75–84	48.0	68.8	61.3	59.7	99.2	73.0
85+	129.6	162.9	149.7	143.7	197.5	174.8
Male	58.0	77.6	75.1	68.2	117.5	79.6
Female	49.8	70.7	54.5	62.5	93.7	76.5
White	53.4	73.7	63.4	64.8	101.0	78.4
Black/Af Am	54.2	73.2	58.6	65.3	106.1	76.1
Other	44.0	70.3	71.2	58.8	156.0	66.1

Overall, adjusted mortality per 1,000 patient years among Medicare patients age 66 and older with CKD is lowest for those with CKD of Stages 1–2, at 64.8, above the rate of 53.8 for those with no CKD. Rates rise to 108.5 in individuals with Stage 4–5 CKD. Mortality is consistently higher in men compared to women, and in patients with Stage 4–5 CKD is 5.0 percent higher for blacks/African Americans than for whites. ✦ **Table 3.c;** see page 143 for analytical methods. *January 1, 2011 point prevalent patients age 66 & older. Adj: age/gender/race/prior hospitalization/comorbidities. Ref: all patients, 2011.*

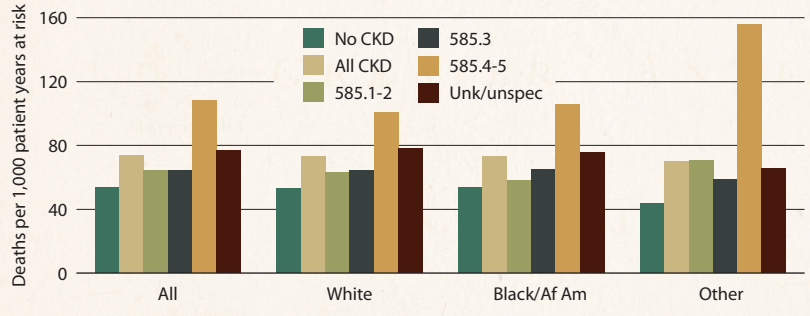
vol 1
3.16 **Adjusted mortality rates in Medicare patients, by comorbidity & CKD diagnosis code, 2011**



Adjusted rates of mortality generally increase with patient complexity. Among Stage 4–5 CKD patients without diabetes or cardiovascular disease, for example, the mortality rate is 74 per 1,000 patient years at risk; among patients with both diagnoses, it rises to 139.

By race, adjusted mortality is highest in patients with Stage 4–5 CKD, and is higher in blacks/African Americans compared to whites, at 106 and 101, respectively. Overall, the rate among blacks/African Americans with CKD is 73 per 1,000 patient years, compared to 74 and 70, respectively, among whites and individuals of other races. ✦ **Figures 3.16–17;** see page 143 for analytical methods. *January 1, 2011 point prevalent patients age 66 & older. Adj: age/gender/race/prior hospitalization/comorbidities. Ref: all patients, 2011.*

vol 1
3.17 **Adjusted mortality rates in Medicare patients, by race & CKD diagnosis code, 2011**



hospitalization rates

ADJUSTED ADMISSIONS IN MEDICARE CKD PATIENTS AGE 66 & OLDER, 2011 (PER 1,000 PATIENT YEARS; FIGURES 3.2–3)

	no CKD	all CKD	Stages 1–2	Stage 3	Stages 4–5
no diabetes, no CVD	232	292	256	280	421
diabetes, cardiovascular disease	445	617	518	618	851
white	307	422	362	417	577
black/African American	343	467	424	439	576

ADJUSTED ALL-CAUSE HOSPITALIZATION RATES IN CKD PATIENTS, 2011 (PER 1,000 PATIENT YEARS; FIGURE 3.4)

	no CKD	all CKD	Stages 1–2	Stage 3	Stages 4–5	Unk/unspec
Medicare (age 66+)	311	426	364	419	562	421
Truven Health MarketScan (age 50–64)	211	283	246	288	416	271
Clinformatics DataMart (age 50–64)	250	323	282	313	441	335

mortality

ALL-CAUSE MORTALITY RATES IN MEDICARE PATIENTS AGE 66 & OLDER, 2011 (PER 1,000 PATIENT YEARS; FIGURE 3.15)

	no CKD	all CKD	Stages 1–2	Stage 3	Stages 4–5	Unk/unspec
unadjusted	47	140	107	121	217	147
adjusted	54	74	65	64	109	77

ADJUSTED MORTALITY RATES IN MEDICARE PTS AGE 66 & OLDER, BY PATIENT COMORBIDITY, 2011 (PER 1,000 PT YEARS; FIGURE 3.16)

	no CKD	all CKD	Stages 1–2	Stage 3	Stages 4–5	Unk/unspec
all	54	74	65	64	109	77
no diabetes, no cardiovascular disease	40	49	42	42	74	51
diabetes, no cardiovascular disease	43	50	49	39	81	54
no diabetes, cardiovascular disease	59	91	84	80	132	95
diabetes & cardiovascular disease	69	100	80	88	139	106

ADJUSTED MORTALITY RATES IN MEDICARE CKD PATIENTS AGE 66 & OLDER, BY RACE, 2011 (PER 1,000 PATIENT YEARS; FIGURE 3.17)

	no CKD	all CKD	Stages 1–2	Stage 3	Stages 4–5	Unk/unspec
white	53	74	63	65	101	78
black/African American	54	73	59	65	106	76