
Chapter 3:

Morbidity and Mortality in Patients With CKD

MORTALITY

- When adjusted for sex, age, and race, the 2014 mortality rates for Medicare patients with CKD of 111.2 per 1,000 patient years, remained more than double that of those without, at 45.2 per 1,000 patient years. These rates increased with CKD severity, and the gap has narrowed between CKD and Non-CKD patients from 2002-2014 (Table 3.1, reference year 2014).
- Male patients without CKD experienced higher mortality rates of 50.8 per 1,000 patient years than did females, at 41.1 per 1,000. This relative difference was somewhat less among those with CKD, with a mortality rate of 122.7 per 1,000 patient years for males and 103.6 per 1,000 for females (Table 1 and Figure 3.4, reference year 2014).
- When adjusted for sex and age, a comparison of 2014 Medicare patients with CKD showed higher rates of mortality for those of White race at 113.1 per 1,000 patient years, than for Blacks/African Americans at 110.6 per 1,000. This racial difference contrasts to that seen in ESRD dialysis patients, where Whites have significantly higher mortality than Blacks (Table 1 and Figure 3.5).

HOSPITALIZATION

- A notable decrease in hospitalization rates occurred from 2013 to 2014; even after adjustment, admissions decreased by 7.4% for CKD patients and by 7.5% for those without CKD (Figure 3.7).
- Not surprisingly, older patients exhibited greater rates of hospitalization than did the younger age cohorts after adjustment for sex and race. In the CKD group, those over 85 years of age had 735.2 admissions per 1,000 patient years. This was 43.7% higher than the 511.5 per 1,000 rate of those aged 66 to 69 years (Figure 3.12).
- Racial differences in hospitalization rates were notable; Black patients with CKD had higher adjusted rates of 686.78 per 1,000 patient years than did Whites, with 582.06 per 1,000, and those of other races at 512.48 per 1,000; disparity increased with disease severity (Figure 3.14).

REHOSPITALIZATION

- Rates of rehospitalization for CKD patients were higher at 21.4% than the 15.3% for those without CKD (Table 3.3).
- For Medicare patients without CKD, males exhibited a higher rehospitalization rate than did females, with age and race adjusted percentages of 16.4 and 14.7 (Table 3.3).

Introduction

In this chapter we evaluate the morbidity and mortality of patients with chronic kidney disease (CKD). All analysis samples were limited to patients aged 66 and older who were continuously enrolled in Medicare; employing a one-year entry period allowed us to identify CKD and other medical conditions using ICD-9-CM (International Classification of Diseases, 9th

revision, clinical modification) diagnosis codes from Medicare claims. We then report patients' hospitalizations, services, and deaths for the calendar year following entry. For example, the rates reported for 2014 were based on events in 2014 for patients with and without CKD in 2013. We initially present results on mortality, then focus on hospitalizations, and end with an examination of patient readmission to the hospital within 30 days of discharge from their first

hospitalization of the calendar year (referred to as the index hospitalization).

Adjusted mortality rates were higher for Medicare patients with CKD than for those without, and rates increased with advancing CKD stage, a finding consistent with studies using biochemical measures to define CKD¹. The co-occurrence of diabetes mellitus (DM) and cardiovascular disease (CVD) with CKD increased a patient's risk of death. This is clinically significant, as cardiovascular risk factors are relatively undertreated in CKD patients in the United States (U.S.); we illustrate this in Volume 1, Chapter 1, *CKD in the General Population*, through data on disease awareness, treatment, and control of risk factors from the population-level National Health and Nutrition Examination Survey (NHANES) cohorts. Clearly, early detection and active treatment are important considerations in reducing morbidity and mortality in the CKD population.

As with mortality, hospitalization rates in the CKD population increased with advancing stages of CKD, for both overall and cause-specific admissions. When data were adjusted for age, race, and sex, CKD patients overall were hospitalized at a rate of 0.59 admissions per patient year—0.49 for those in Stages 1-2, 0.57 for Stage 3, and 0.86 for Stages 4-5 (0.57 where stage was not specified; see Table A for ICD-9-CM definitions). It has been established for over a decade that rates of hospitalization for CVD and infection also rise with CKD stage (Go et al., 2004). In general, and not surprisingly, rates of hospitalizations among CKD patients also increased in the presence of underlying comorbidities, such as DM and CVD.

Hospital readmissions are a key quality indicator for the Medicare program. In an attempt to lower the rate of readmission, the Medicare Hospital Readmission Reduction Program was instituted as part of the Patient Protection and Affordable Care Act (CMS, 2010), to reduce Medicare payments to hospitals with excess readmissions. Rates of rehospitalization for CKD patients were higher than

those for patients without diagnosed CKD. In 2014, 21.4% of patients with CKD were readmitted within 30 days, compared to only 15.3% of those without CKD. These rates have not changed significantly in the past decade, which is of major concern.

In Volume 1, Chapter 2, *Identification and Care of Patients with Chronic Kidney Disease*, we analyzed diagnosis codes from Medicare claims to document the increasing recognition of CKD. The ascertainment of CKD cases through claims data has increased in recent years, likely resulting in decreased estimates of average disease severity, as influenced by the early disease stage of those identified most recently. Thus, changes in mortality and hospitalization rates over time should be interpreted with some caution.

Methods

This chapter uses data from the Medicare 5% sample's fee-for-service patients aged 66 and older. Roughly 98% of Americans age 65 and older qualify for Medicare, and as a result, analysis of Medicare data is representative of patients age 65 and older. However, Medicare data for those under 65 is skewed towards the sickest of patients in that age group; therefore we do not include those under 65 in this Chapter.

¹ Serum creatinine with validated equations to estimate glomerular filtration rate; Matsushita et al., 2010

See the section on *Chapter 3* in the *CKD Analytical Methods* chapter for an explanation of analytical methods used to generate the study cohorts, figures, and tables in this chapter.

Mortality Rates

As with many chronic conditions, patient mortality in those with CKD is of paramount importance as a major outcome. In Table 3.1 we present mortality rates for several demographic subgroups of patients, both unadjusted and adjusted for age, sex, and race. This year we again applied modified adjustment variables; in the 2014 ADR and in prior years, data was also adjusted for prior year hospitalization and disease comorbidities. We removed these covariates in the 2015 ADR as we believed that adjustment to this extent would result in artificially low mortality rates.

This modification should be kept in mind when comparing adjusted rates with those in prior ADRs, as differences are apparent.

For patients with CKD, the unadjusted mortality rate was 134.8 per 1,000 patient years; this decreased to 111.2 per 1,000 after adjusting for age, sex and race (Reference population: 2014). As expected, mortality rates rose as age increased, particularly for the oldest cohort. In all cases, male patients had slightly higher mortality rates than did females, more so for those with CKD, and when adjusted.

For patients with CKD, White patients had both higher unadjusted and adjusted mortality rates than did Black patients. This contrasts to the trend for those receiving dialysis, where Whites have much higher mortality rates.

vol 1 Table 3.1 Unadjusted and adjusted all-cause mortality rates (per 1,000 patient years at risk) for Medicare patients aged 66 and older, by CKD status, 2014

	Unadjusted		Adjusted	
	No CKD	All CKD	No CKD	All CKD
All	43.5	134.8	45.2	111.2
Age				
66–69	15.0	62.7	14.7	60.5
70–74	20.8	76.4	20.6	75.5
75–84	43.8	116.7	43.9	114.8
85+	137.4	247.6	138.3	247.2
Sex				
Male	44.0	139.6	50.8	122.7
Female	43.2	130.4	41.1	103.6
Race				
White	44.3	138.8	45.5	113.1
Black/African American	43.5	120.3	48.8	110.6
Other	32.1	102.0	36.1	82.9

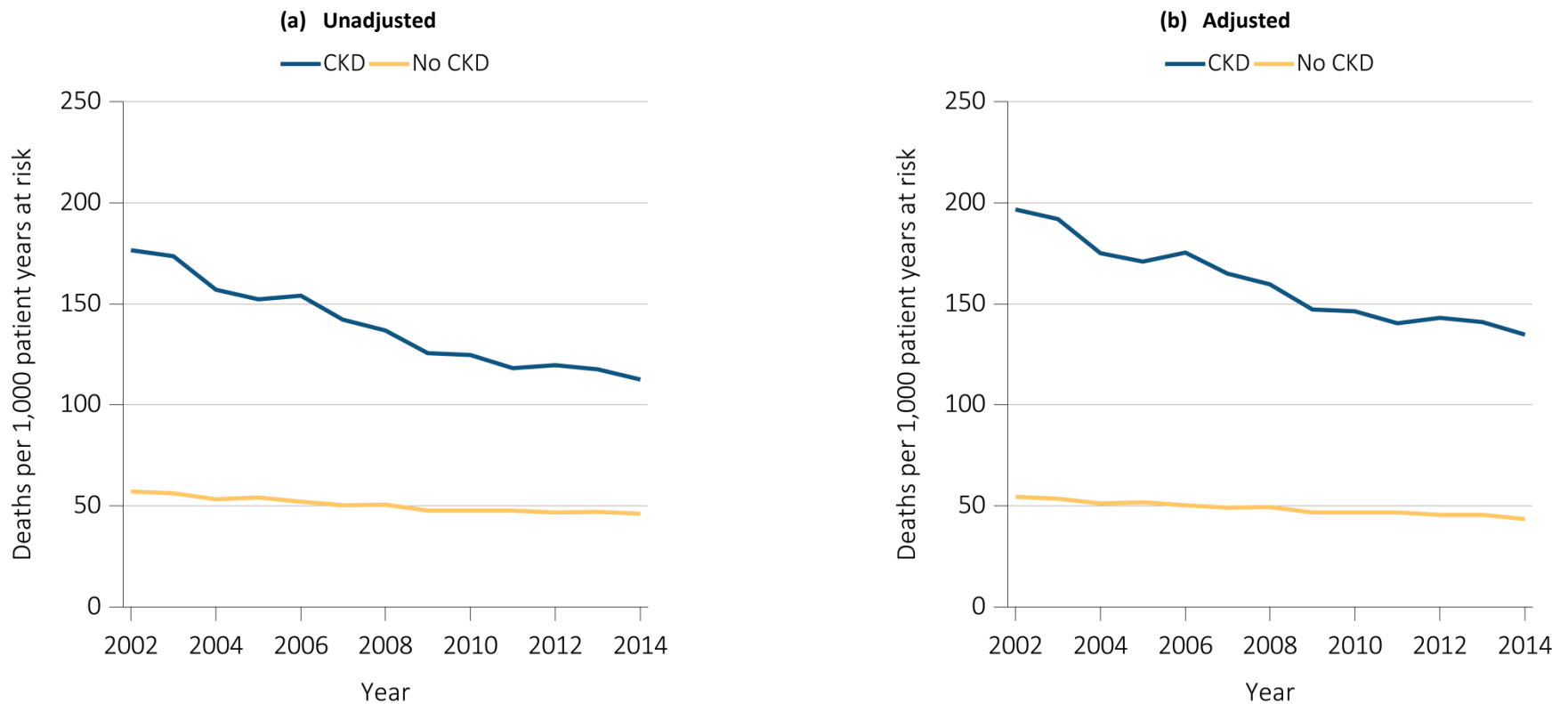
Data source: Medicare 5% sample. January 1, 2014 point prevalent patients aged 66 and older. Adjusted for age/sex/race. Reference population all patients, 2014. Abbreviation: CKD, chronic kidney disease.

Trends in the mortality rates for Medicare patients aged 66 and older are shown in Figure 3.1. Unadjusted mortality in CKD patients has decreased by 31.5% since 2002, from 197 deaths per 1,000 patient years to 135 deaths in 2014. For those without CKD, the unadjusted rate decreased from 55 deaths per 1,000 patient years in 2002 to 44 deaths in 2014, a reduction of 20.0%.

When adjusted for age, race, and sex, the 2014 mortality rate for CKD patients reduced considerably, to 113 deaths per 1,000 patient years at risk

(Reference population: 2013). Among those without CKD, adjustment for these factors resulted in a slightly higher mortality rate of 47 deaths per 1,000, as compared to the unadjusted rate of 44. One major contributor to the discrepancy between adjusted and unadjusted death rates was the relative age difference between with the CKD and no-CKD cohorts. In 2014, the mean age of patients with CKD was 76.4 years, compared to 70.1 years for those without, and 71.5 years for the sample as a whole.

vol 1 Figure 3.1 Unadjusted and adjusted all-cause mortality rates (per 1,000 patient years at risk) for Medicare patients aged 66 and older, by CKD status and year, 2002-2014

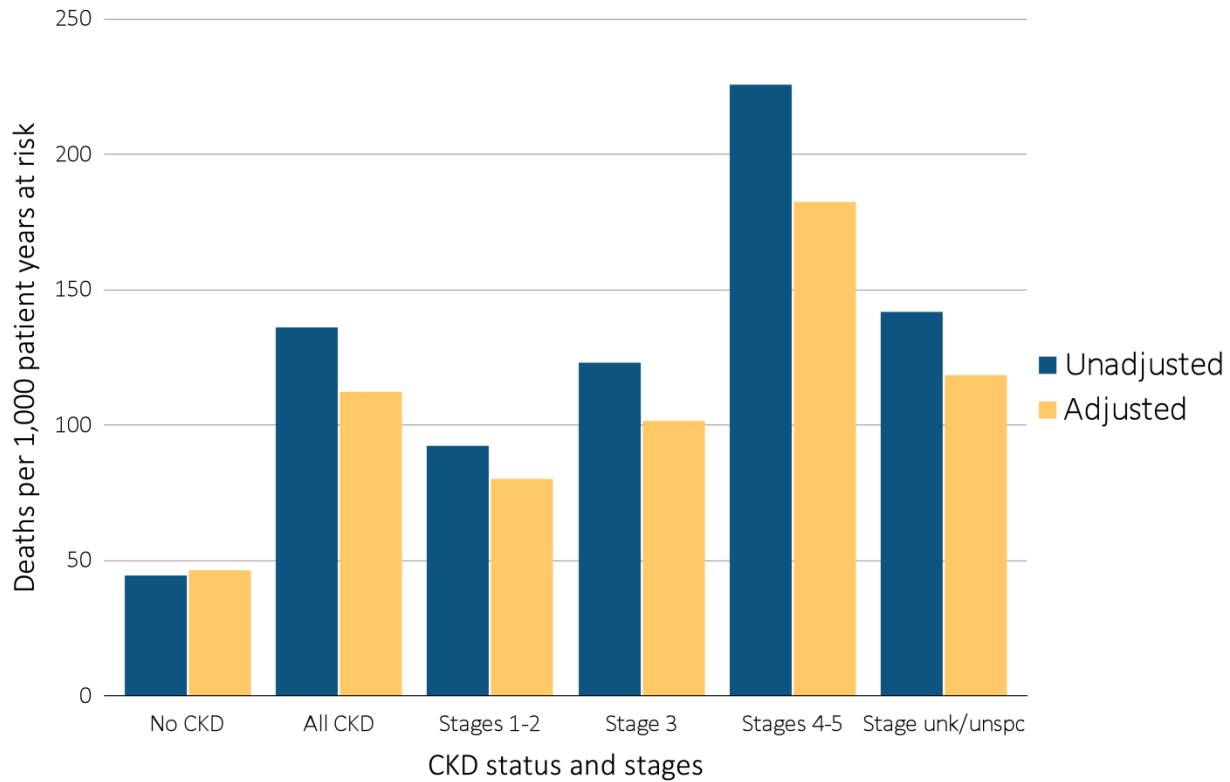


Data source: Medicare 5% sample. January 1 of each reported year, point prevalent Medicare patients aged 66 and older. Adjusted for age/sex/race. Reference population 2013 patients. Abbreviation: CKD, chronic kidney disease.

As expected, unadjusted mortality rates increased with progressing stage of CKD, as shown in Figure 3.2. These rose progressively, from 92 deaths per 1,000 patient years for those in Stages 1 and 2, to 122 for Stage 3, and 225 for Stages 4 and 5 (without ESRD; stages identified by the ICD-9-CM codes, see Table A). Those without an identified CKD stage or with a diagnosis other than from the 585 code series had an

unadjusted mortality rate falling between that of Stage 3 and Stages 4-5, at 141 deaths per 1,000 patient years at risk. After adjustment, death rates for Stages 1-2 and Stage 3 were 79 and 101 deaths per 1,000 patient years. The adjusted rate for Stages 4-5 was higher, at 182 deaths per 1,000. Those with an unspecified CKD stage had death rates at 118 per 1,000 patient years.

vol 1 Figure 3.2 Unadjusted and adjusted all-cause mortality rates (per 1,000 patient years at risk) for Medicare patients aged 66 and older, by CKD status and stage, 2014



Data source: Medicare 5% sample. January 1, 2014 point prevalent Medicare patients aged 66 and older. Adjusted for age/sex/race. Reference population all patients, 2014. See Table A for CKD stage definitions. Abbreviations: CKD, chronic kidney disease; unk/unspc, CKD stage unidentified.

Table A. ICD-9-CM codes for Chronic Kidney Disease (CKD) stages

ICD-9-CM code ^a	Stage
585.1	CKD, Stage 1
585.2	CKD, Stage 2 (mild)
585.3	CKD, Stage 3 (moderate)
585.4	CKD, Stage 4 (severe)
585.5	CKD, Stage 5 (excludes 585.6: Stage 5, requiring chronic dialysis ^b)
CKD Stage unspecified	For these analyses, identified by multiple codes including 585.9, 250.4x, 403.9xm & others

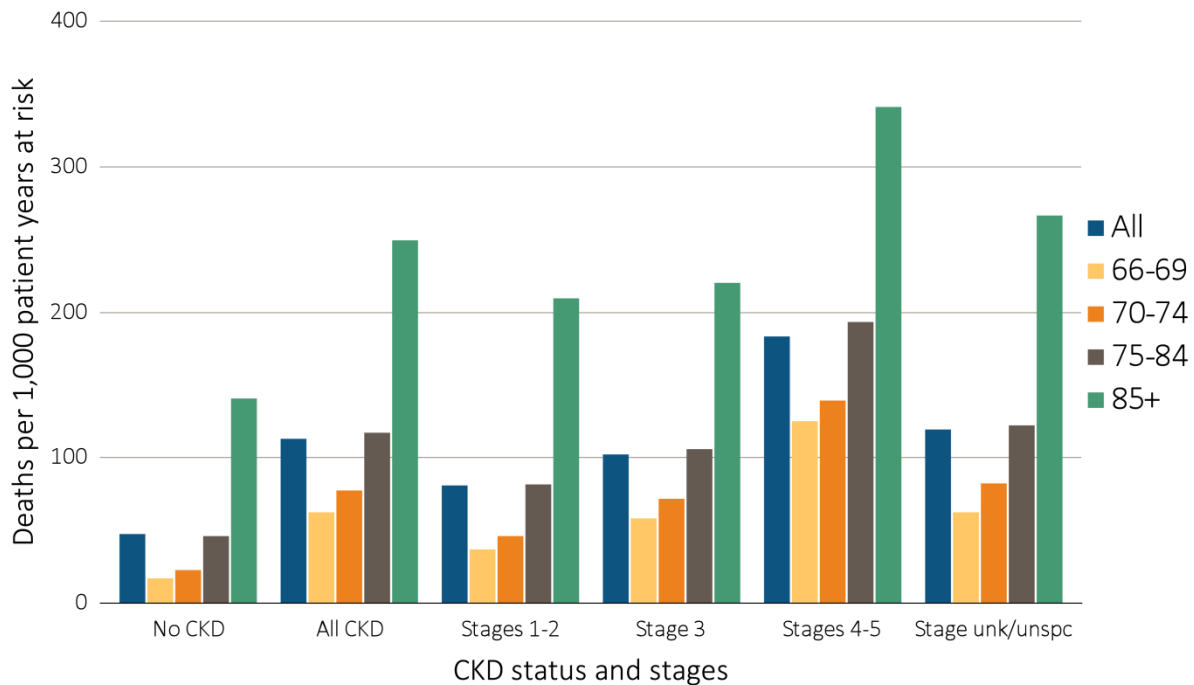
^a For analyses in this chapter, CKD stage estimates require at least one occurrence of a stage-specific code, and the last available CKD stage in a given year is used.

^b In USRDS analyses, patients with ICD-9-CM code 585.6 & with no ESRD 2728 form or other indication of end-stage renal disease (ESRD) are considered to have code 585.5.

Adjusted mortality rates for 2014 are shown in Figure 3.3 by CKD status and age group. As expected, the mortality rates for older patient groups were higher. In the CKD group, those aged 66-69 years had a mortality rate of 61 deaths per 1,000 patient years at

risk, while those aged 75-84 had nearly double that, at 115 deaths. As also might be expected, patients aged 85 and older experienced the highest rates of mortality, with 248 deaths per 1,000 patient years.

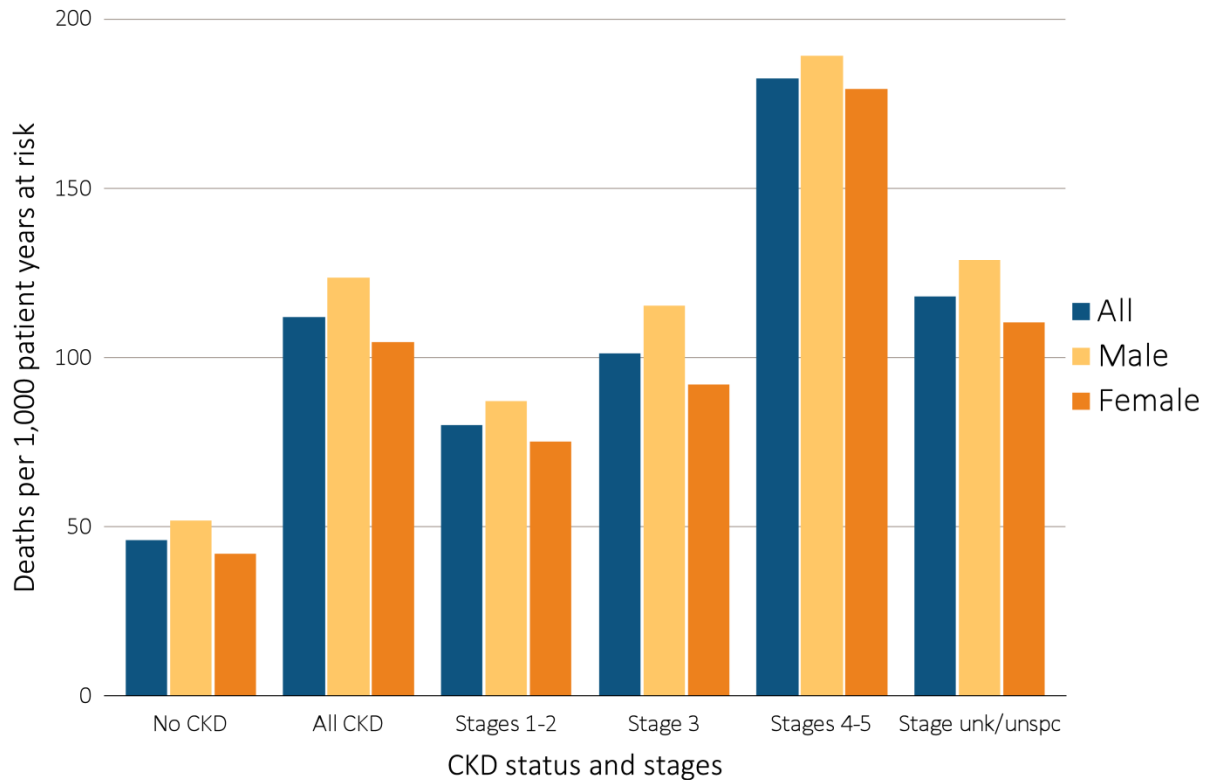
vol 1 Figure 3.3 Adjusted all-cause mortality rates (per 1,000 patient years at risk) for Medicare patients aged 66 and older, by age, CKD status, and stage, 2014



Data source: Medicare 5% sample. January 1, 2014 point prevalent patients aged 66 and older. Adjusted for age/sex/race. Reference population all patients, 2014. Abbreviations: CKD, chronic kidney disease; unk/unspc, CKD stage unidentified.

A comparison of adjusted 2014 mortality rates by sex for males were higher than for females in all stages. CKD group and sex is shown in Figure 3.4. The rates

vol 1 Figure 3.4 Adjusted all-cause mortality rates (per 1,000 patient years at risk) for Medicare patients aged 66 and older, by sex, CKD status, and stage, 2014

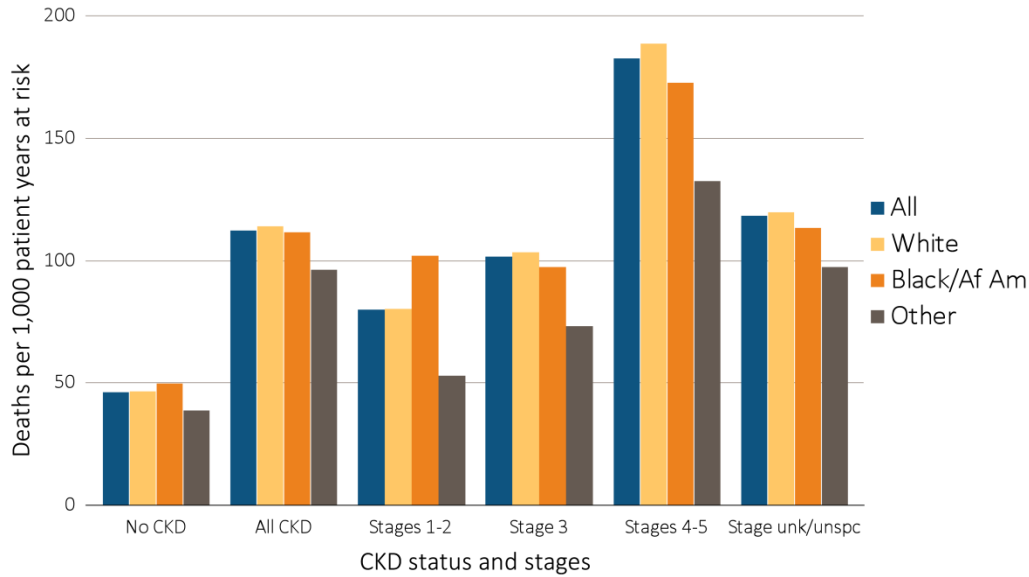


Data source: Medicare 5% sample. January 1, 2014 point prevalent patients aged 66 and older. Adjusted for age/sex/race. Reference population all patients, 2014. Abbreviations: CKD, chronic kidney disease; unk/unspc, CKD stage unidentified.

Figure 3.5 illustrates mortality rates adjusted by race, CKD status, and stage. The rates for the CKD group were more than twice those of the no-CKD group for patients of all races. Variation by race was inconsistent across CKD stages. Black rates were lower than Whites in all stages except for 1-2; the mortality rates for Whites were higher than Blacks in Stages 3,

and 4-5. For Whites the adjusted rates were 80 per 1,000 patient years at risk for Stages 1-2, with 103 per 1,000, and 188 per 1,000 for Stages 3 and 4-5, respectively. The Black patient groups showed adjusted rates of 101 deaths per 1,000 patient years at risk in Stages 1-2, with 97 per 1,000 and 172 per 1,000 in Stages 3 and 4-5.

vol 1 Figure 3.5 Adjusted all-cause mortality rates (per 1,000 patient years at risk) for Medicare patients aged 66 and older, by race, CKD status, and stage, 2014

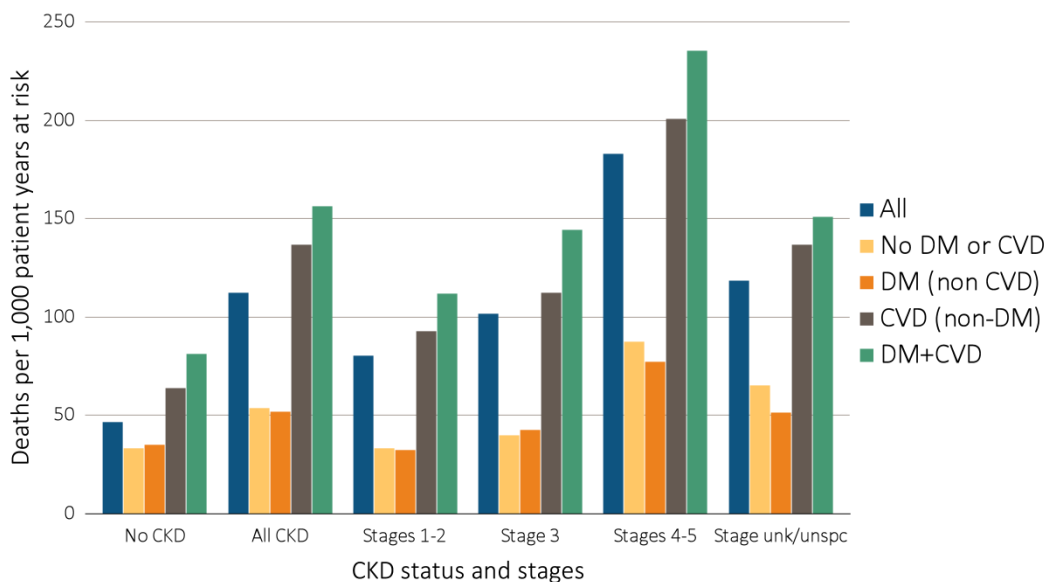


Data source: Medicare 5% sample. January 1, 2014 point prevalent patients aged 66 and older. Adjusted for age/sex/race. Reference population all patients, 2014. Abbreviations: Af Am, African American; CKD, chronic kidney disease; unk/unspc, CKD stage unidentified.

Adjusted rates of mortality were observed to increase with greater patient health complexity. Figure 3.6 presents mortality rates by the presence of two common comorbidities of CKD—DM and CVD. These comorbid conditions dramatically influenced the health outcomes of these patients. In 2014, those with CKD but without DM or CVD had an adjusted

mortality rate of 53 deaths per 1,000 patient years at risk, while those with both DM and CVD experienced triple that rate, at 156 deaths per 1,000 patient years. Diabetes alone, however, did not increase mortality risk among persons with CKD (52 deaths per 1,000 patient years at risk).

vol 1 Figure 3.6 Adjusted all-cause mortality rates (per 1,000 patient years at risk) for Medicare patients aged 66 and older, by cardiovascular disease and diabetes mellitus, CKD status, and stage, 2014



Data source: Medicare 5% sample. January 1, 2014 point prevalent patients aged 66 and older. Adjusted for age/sex/race. Reference population all patients, 2014. Abbreviations: CKD, chronic kidney disease; CVD, cardiovascular disease; DM, diabetes mellitus; unk/unspc, CKD stage unidentified.

Hospitalization Rates

Table 3.2 shows all-cause hospitalization rates in 2014 for older Medicare patients, by whether they had recognized CKD during 2013. The unadjusted rate for those with CKD was 617 hospitalizations per 1,000 patient years at risk, compared to a much lower rate of 230 for patients without CKD. Encouragingly, these 2014 admission rates for CKD patients showed a reduction from the unadjusted 2013 levels of 656 per 1,000 for those with CKD and 245 per 1,000 with no-CKD. Across all demographic characteristics, the 2014 unadjusted hospitalization rate for patients with CKD

was two to three times the corresponding rate for patients without CKD. Once adjustment was made for age, race, and sex, the hospitalization rate for patients with CKD of 586 per 1,000 patient years at risk was 150.4% greater than for those without CKD, at 234 per 1,000. As with mortality, the adjusted hospitalization rate increased with age for all patients. In contrast to the mortality findings, however, women with CKD had higher adjusted hospitalization rates of 598 per 1,000 patient years at risk than did men, at 578 per 1,000, whereas women without CKD had lower adjusted hospitalization rates of 232 per 1000 than did men at 237.

vol 1 Table 3.2 Unadjusted and adjusted all-cause hospitalization rates (per 1,000 patient years at risk) for Medicare patients aged 66 and older, by CKD status, 2014

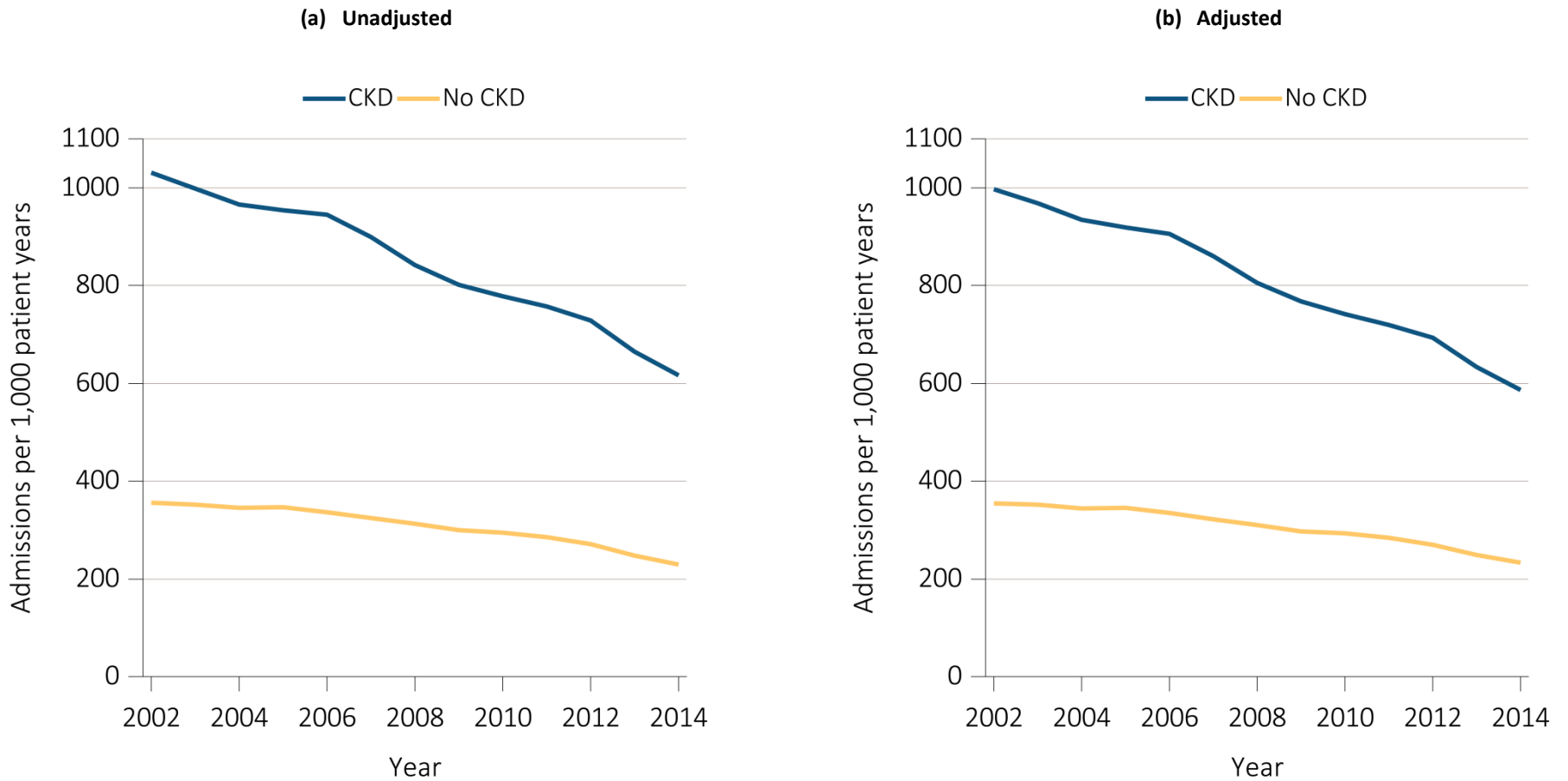
	Unadjusted		Adjusted	
	No CKD	All CKD	No CKD	All CKD
All	229.3	616.3	233.1	586.0
Age				
66–69	141.5	514.8	142.1	511.5
70–74	181.1	540.3	180.8	541.4
75–84	262.5	615.1	262.4	613.1
85+	404.8	732.6	408.1	735.2
Sex				
Male	221.2	603.3	236.4	577.3
Female	235.2	628.1	231.4	597.3
Race				
White	231.6	611.1	234.1	582.1
Black/African American	246.3	700.0	258.3	686.8
Other	174.3	541.3	186.7	512.5

Data source: Medicare 5% sample. January 1, 2014 point prevalent Medicare patients, aged 66 and older. Adjusted for age/sex/race; rates by one factor are adjusted for the others. Reference population all patients, 2014. Abbreviations: CKD, chronic kidney disease.

Figure 3.7 presents the trends in hospitalization rates for Medicare patients over the past 13 years. The overall trends between adjusted and unadjusted rates, CKD and no-CKD, were consistent with other data presented thus far. After adjustment, the pattern of hospitalization rates across this time frame showed a gradual decline and less variability. A

notable decrease in hospitalization rates occurred from 2013 to 2014; even after adjustment the CKD group decreased by 17.6%, from 634 to 586 per 1,000 patient years at risk for the CKD group, and by 5.6%, from 248 to 234 per 1,000 for the no-CKD group.

vol 1 Figure 3.7 Unadjusted and adjusted all-cause hospitalization rates (per 1,000 patient years at risk) for Medicare patients aged 66 and older, by CKD status and year, 2002-2014

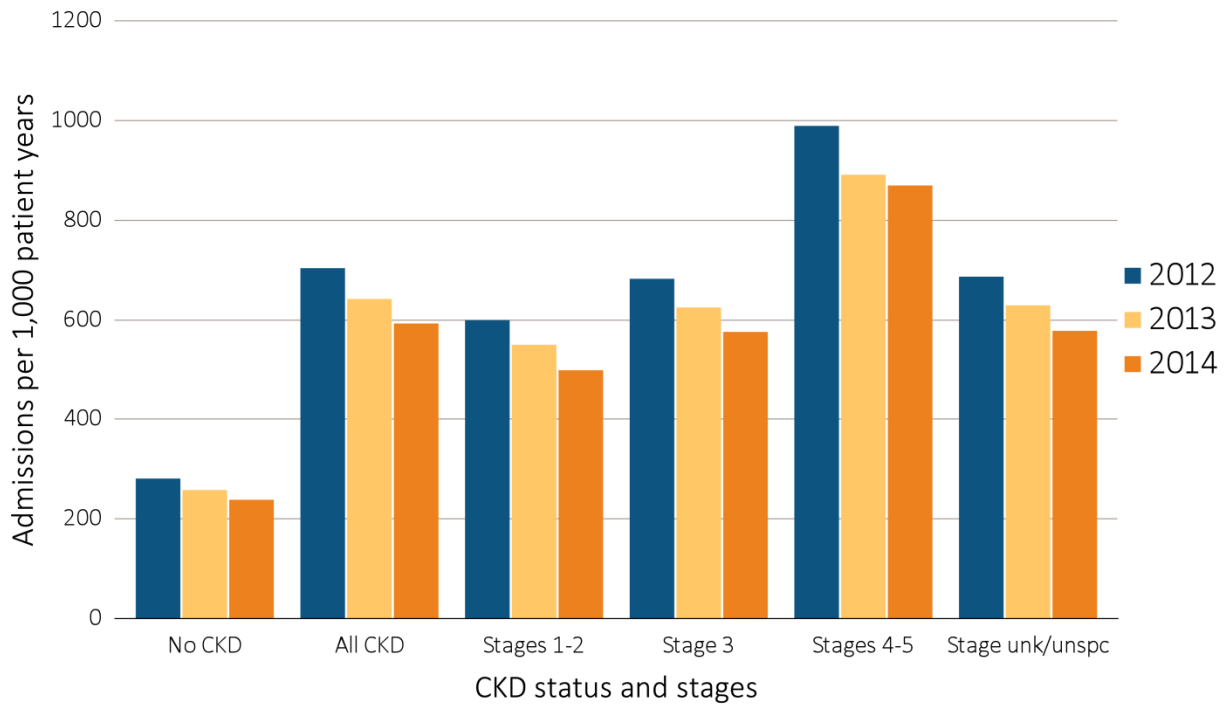


Data source: Medicare 5% sample. January 1 of each reported year point prevalent Medicare patients aged 66 and older. Adjusted for age/sex/race. Reference population 2014 patients. Abbreviations: CKD, chronic kidney disease.

For patients with CKD, differences were observed in the rates of hospitalizations necessary to treat different comorbid conditions. Figure 3.8 shows the adjusted hospitalization rates for all causes; in Figures 3.9 through 3.11, we present hospitalization rates resulting from CVD (23.0% of all-cause admissions), infection (20.9%), and all other cause categories (56.1%). As the covariates in the adjusted model no longer include comorbidities and prior year hospitalizations, the adjusted rates may vary noticeably from results presented prior to the 2014 ADR.

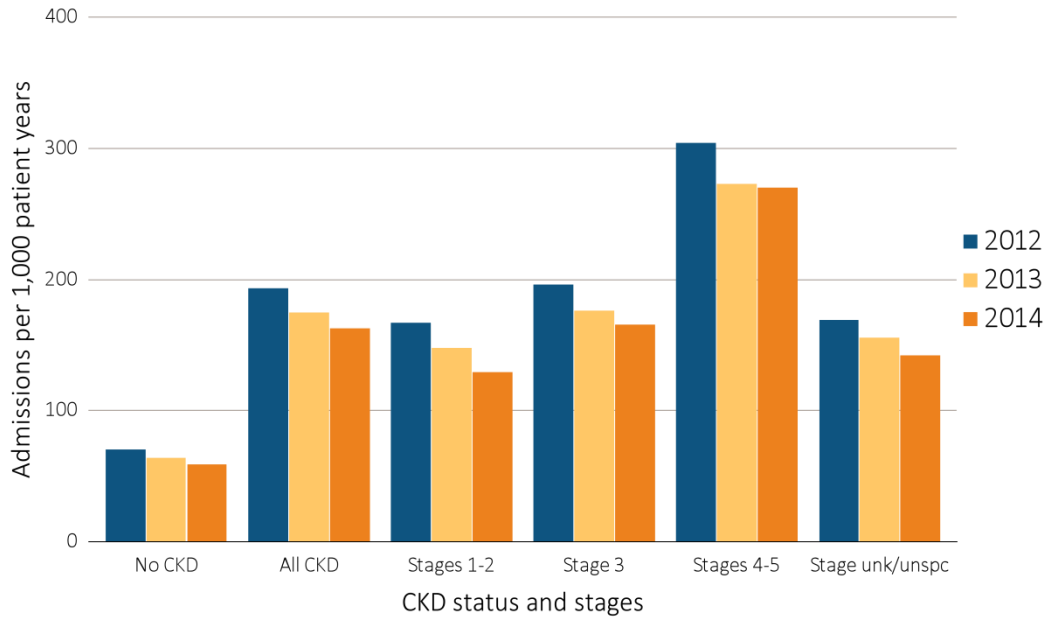
Rates of all-cause hospitalizations in 2014 increased with disease severity, from 492 admissions per 1,000 patient years for those in Stages 1 and 2, to 569 for Stage 3, and 864 for Stages 4 and 5; these were uniformly lower than those that occurred in 2012 and 2013 (see Figure 3.8). The pattern of increase for hospitalizations resulting from a primary diagnosis of CVD was similar, with rates rising from 128 admissions per 1,000 patient years for CKD Stages 1 and 2, to 164 for Stage 3, and 268 for Stages 4 and 5 (see Figure 3.9).

vol 1 Figure 3.8 Adjusted all-cause hospitalization rates (per 1,000 patient years at risk) for Medicare patients aged 66 and older, by CKD status and stage, 2012-2014



Data source: Medicare 5% sample. January 1 of each reported year, point prevalent Medicare patients aged 66 and older. Adjusted for age/sex/race. Reference population all patients, 2014. See Table A for CKD stage definitions. Abbreviations: CKD, chronic kidney disease; unk/unspc, CKD stage unidentified.

vol 1 Figure 3.9 Adjusted rates of hospitalization for cardiovascular disease (per 1,000 patient years at risk) for Medicare patients aged 66 and older, by CKD status and stage, 2012-2014

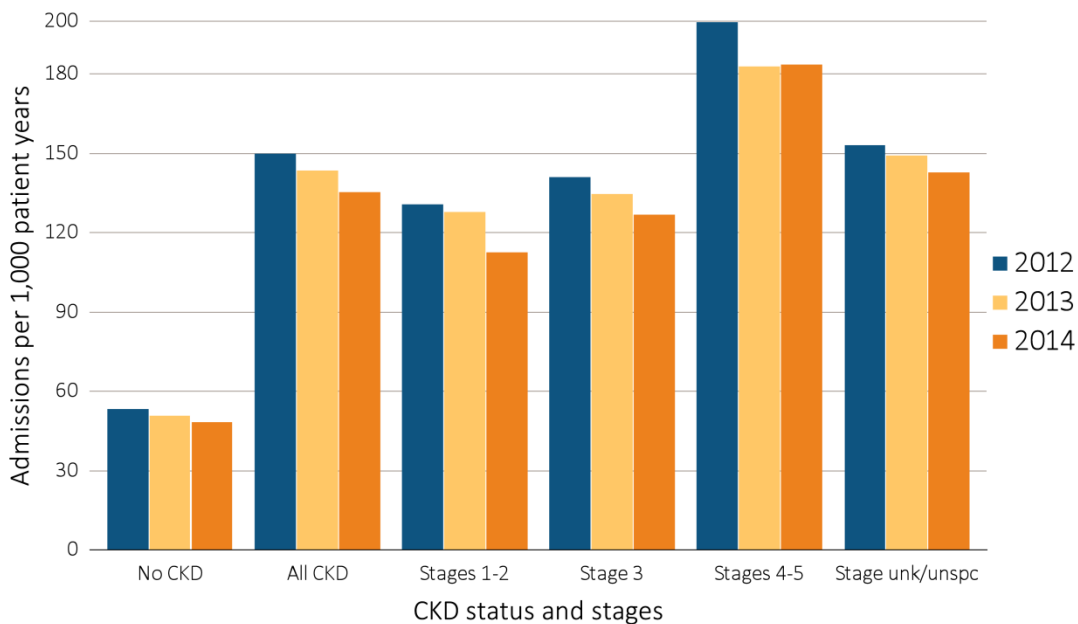


Data source: Medicare 5% sample. January 1 of each reported year, point prevalent Medicare patients aged 66 and older. Adjusted for age/sex/race; rates by one factor are adjusted for the others. Reference population all patients, 2014. See Table A for CKD stage definitions. Abbreviations: CKD, chronic kidney disease; unk/unspc, CKD stage unidentified.

Adjusted rates of hospitalization for infection are shown by CKD status and stage in Figure 3.10. Rates

across all areas decreased from 2012 to 2014, with a small exception for Stages 4 to 5 in 2013 to 2014.

vol 1 Figure 3.10 Adjusted rates of hospitalization for infection (per 1,000 patient years at risk) for Medicare patients aged 66 and older, by CKD status and stage, 2012-2014

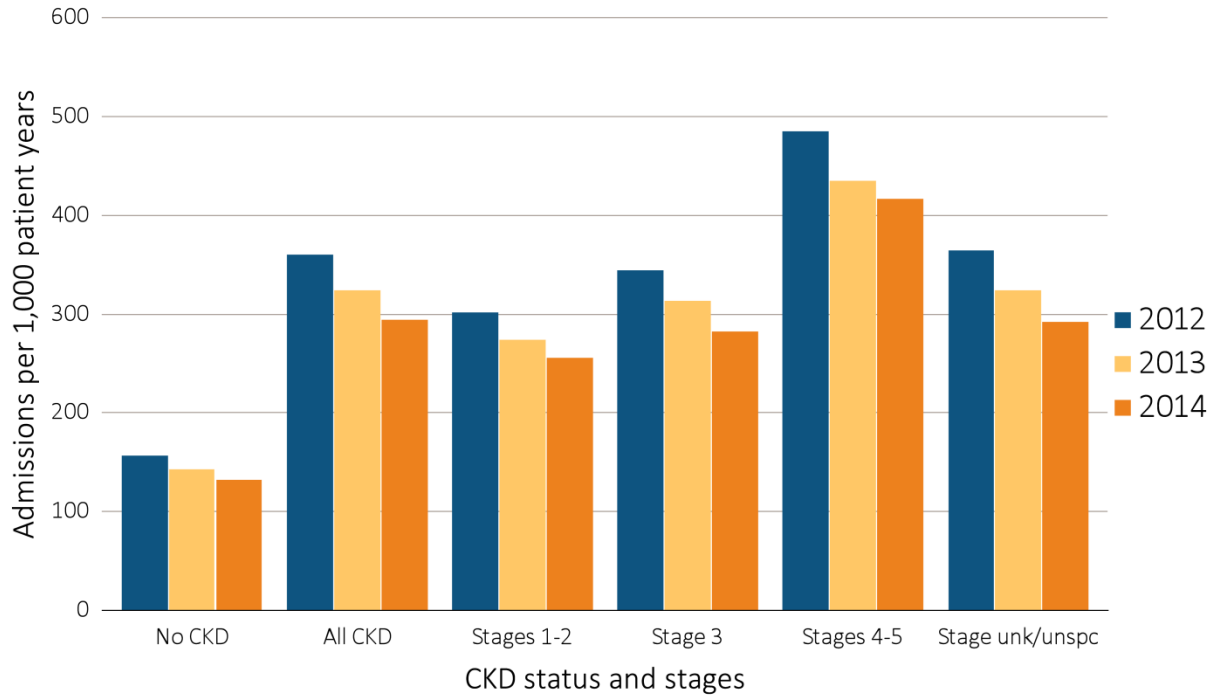


Data source: Medicare 5% sample. January 1 of each reported year, point prevalent Medicare patients aged 66 and older. Adjusted for age/sex/race; rates by one factor are adjusted for the others. Reference population all patients, 2014. See Table A for CKD stage definitions. Abbreviations: CKD, chronic kidney disease; unk/unspc, CKD stage unidentified.

Figure 3.11 presents the adjusted rates of hospitalization resulting from all other health causes.

The pattern was similar to that seen in Figure 3.8, with rates steadily decreasing from 2012 to 2014.

vol 1 Figure 3.11 Adjusted rates of hospitalization for causes other than cardiovascular disease and infection (per 1,000 patient years at risk) for Medicare patients aged 66 and older, by CKD status and stage, 2012-2014

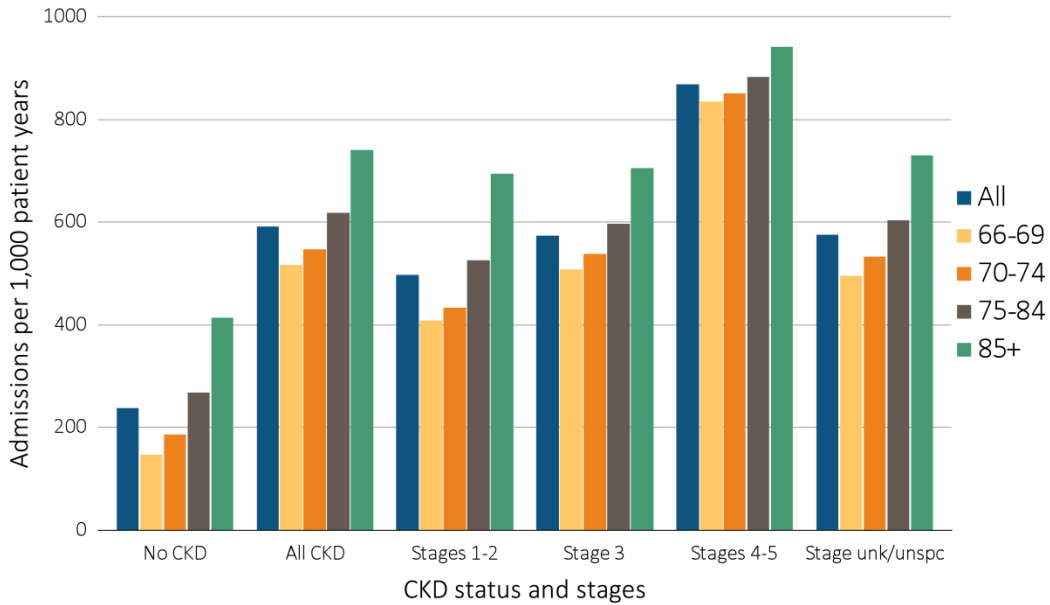


Data source: Medicare 5% sample. January 1 of each reported year, point prevalent Medicare patients aged 66 and older. Adjusted for age/sex/race; rates by one factor are adjusted for the others. Reference population all patients, 2014. See Table A for CKD stage definitions. Abbreviations: CKD, chronic kidney disease; unk/unspc, CKD stage unidentified.

Demographic comparisons also highlight differences in all-cause hospitalization rates for CKD, as shown in Figures 3.12-3.14. In general, and

consistent with mortality patterns, older patients exhibit higher rates of hospitalization than did the younger age cohorts.

vol 1 Figure 3.12 Adjusted all-cause hospitalization rates (per 1,000 patient years at risk) for Medicare patients aged 66 and older, by age, CKD status, and stage, 2014

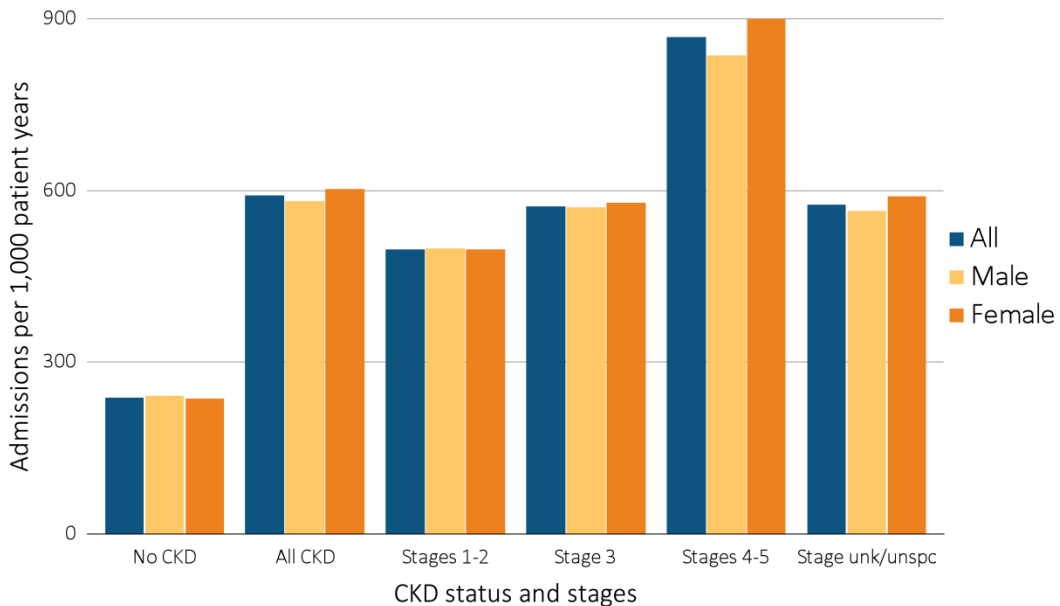


Data source: Medicare 5% sample. January 1, 2014 point prevalent Medicare patients aged 66 and older. Adjusted for age/sex/race; rates by one factor are adjusted for the others. Reference population all patients, 2014. See Table A for CKD stage definitions. Abbreviations: CKD, chronic kidney disease; unk/unspc, CKD stage unidentified.

A comparison of adjusted 2014 all-cause hospitalization rates by CKD group and sex is shown

in Figure 3.13. The rates for females were higher than for males in later stages of CKD.

vol 1 Figure 3.13 Adjusted all-cause hospitalization rates (per 1,000 patient years at risk) for Medicare patients aged 66 and older, by sex, CKD status, and stage, 2014

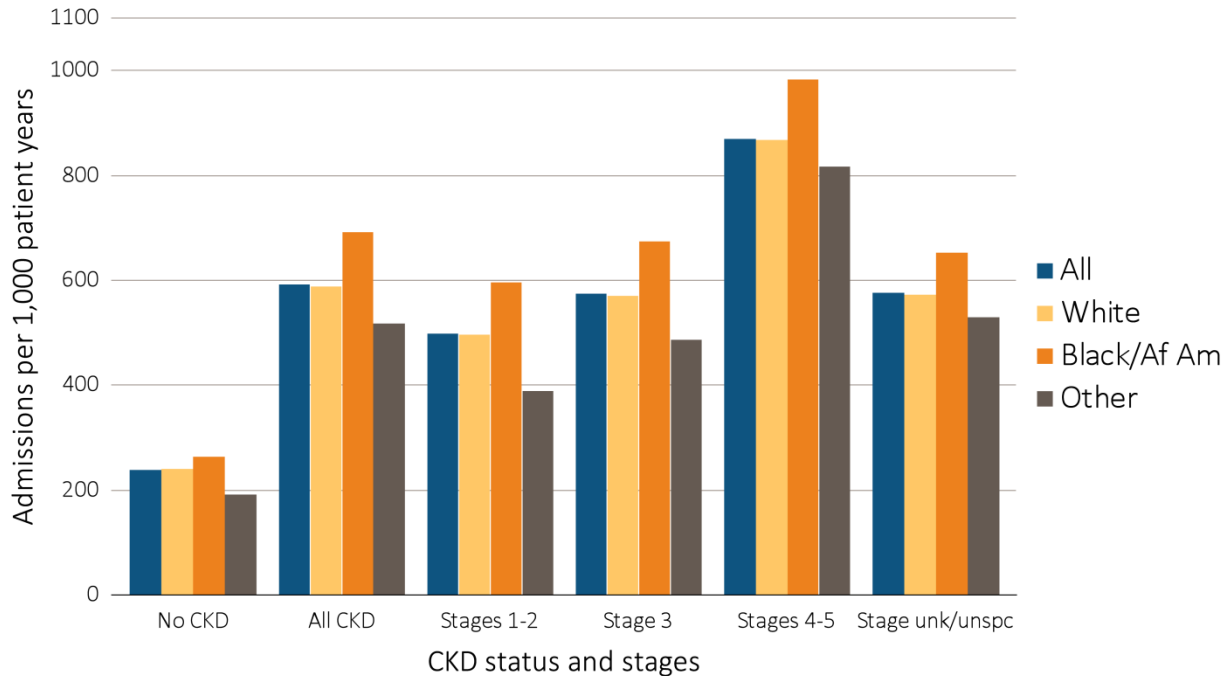


Data source: Medicare 5% sample. January 1, 2014 point prevalent Medicare patients aged 66 and older. Adjusted for age/sex/race; rates by one factor are adjusted for the others. Reference population all patients, 2014. See Table A for CKD stage definitions. Abbreviations: CKD, chronic kidney disease; unk/unspc, CKD stage unidentified.

Racial differences in hospitalization were notable. In both the no-CKD and CKD populations, Black patients were hospitalized more frequently than those of other races. In 2014, Black patients in the CKD group showed higher rates than did Whites or those of other races (687 per 1,000 patient years vs. 583 and 513, respectively; Figure 3.14). This disparity decreased

with disease severity, with rates for Black patients 20.1% higher than Whites in Stages 1-2 (591 vs 492), 18.4% higher in Stage 3 (669 vs 565) and 13.4% higher in Stages 4-5 (976 vs 861). Patients of other races experienced the lowest rates of hospitalization in all disease stages.

vol 1 Figure 3.14 Adjusted all-cause hospitalization rates (per 1,000 patient years at risk) for Medicare patients aged 66 and older, by race, CKD status, and stage, 2014

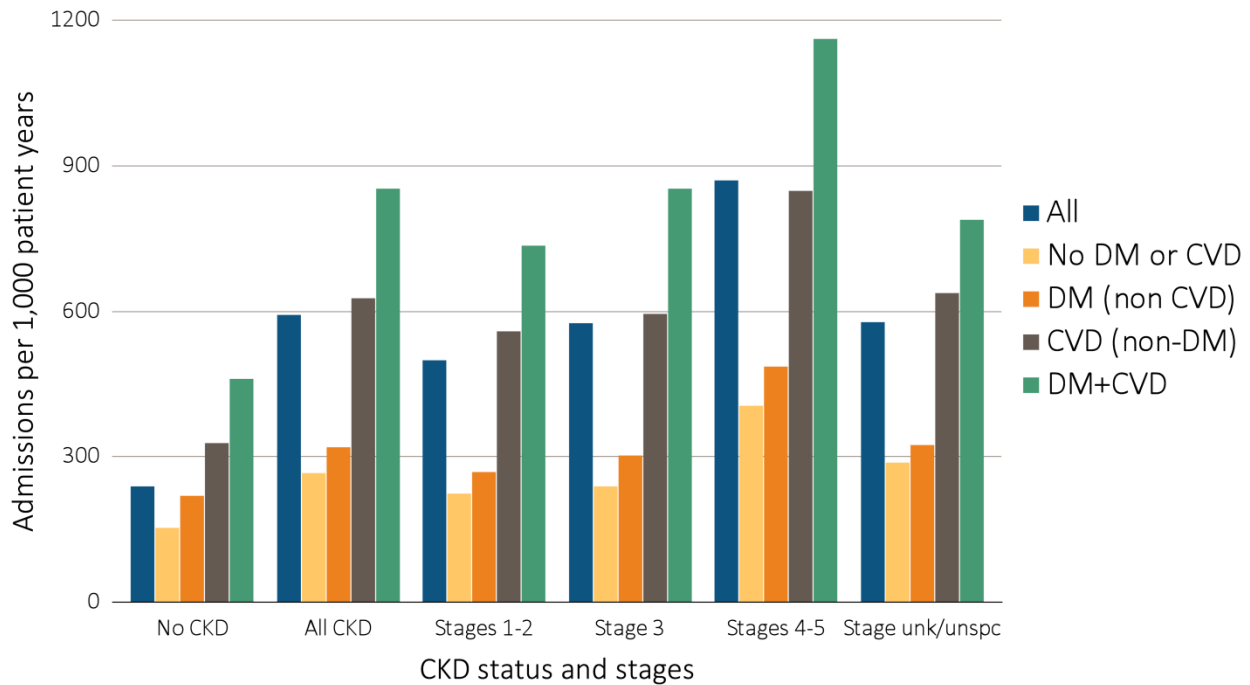


Data source: Medicare 5% sample. January 1, 2014 point prevalent Medicare patients aged 66 and older. Adjusted for age/sex/race; rates by one factor are adjusted for the others. Reference population all patients, 2014. See Table A for CKD stage definitions. Abbreviations: Af Am, African American; CKD, chronic kidney disease; unk/unspsc, CKD stage unidentified.

Adjusted rates of all-cause hospitalization increased in the presence of DM and CVD for patients both with and without CKD (see Figure 3.15). In the no-CKD population, the adjusted hospitalization rates were 148 per 1,000 patient years for those no DM or CVD, 215 per 1,000 for patients with DM only, 323 per 1,000 for those with CVD only, and 455 per 1,000 for patients with both DM and CVD. In 2014, admissions per 1,000 patient years increased from 260 for CKD

patients without DM or CVD, to 314 for those with only DM and 621 with only CVD, to a high of 846 for CKD patients with both comorbidities. This additional disease burden was most striking for patients with Stage 4 or 5 CKD; patients with both DM and CVD in addition to late-stage CKD had an all-cause hospitalization rate of 1,156 admissions per 1,000 patient years, compared to only 398 for late-stage CKD patients without either comorbidity.

vol 1 Figure 3.15 Adjusted all-cause hospitalization rates (per 1,000 patient years at risk) for Medicare patients aged 66 and older, by cardiovascular disease and diabetes mellitus, CKD status, and stage, 2014



Data source: Medicare 5% sample. January 1, 2014 point prevalent Medicare patients aged 66 and older. Adjusted for age/sex/race; rates by one factor are adjusted for the others. Reference population all patients, 2014. See Table A for CKD stage definitions. Abbreviations: CKD, chronic kidney disease; CVD, cardiovascular disease; DM, diabetes mellitus; unk/unspc, CKD stage unidentified.

Rehospitalization

Reducing the rate of patient readmission to a hospital within 30 days of discharge from their original hospitalization is a quality assurance goal for many healthcare systems, including the Medicare program. Table 3.3 shows the distribution of unadjusted percentages of rehospitalization in the 2014 Medicare population among those with and without recognized CKD, by CKD stage, stratified by

age group, sex and race. The unadjusted proportion of Medicare patients aged 66 and older who were readmitted to the hospital within 30 days of discharge from a first, all-cause hospitalization was 15.3% for those without CKD and 21.4% for those with CKD (see Table 3.3). These rates represent a slight decrease from 2013 levels. Rehospitalization rates increased slightly with stage of CKD, from 20.3% in Stages 1-2 to 22.9% in Stages 4-5.

vol 1 Table 3.3 Unadjusted percentage of patients readmitted to the hospital within 30 days of discharge, among Medicare patients aged 66 and older who were discharged alive from an all-cause index hospitalization between January 1 and December 1, by CKD status and stage, 2014

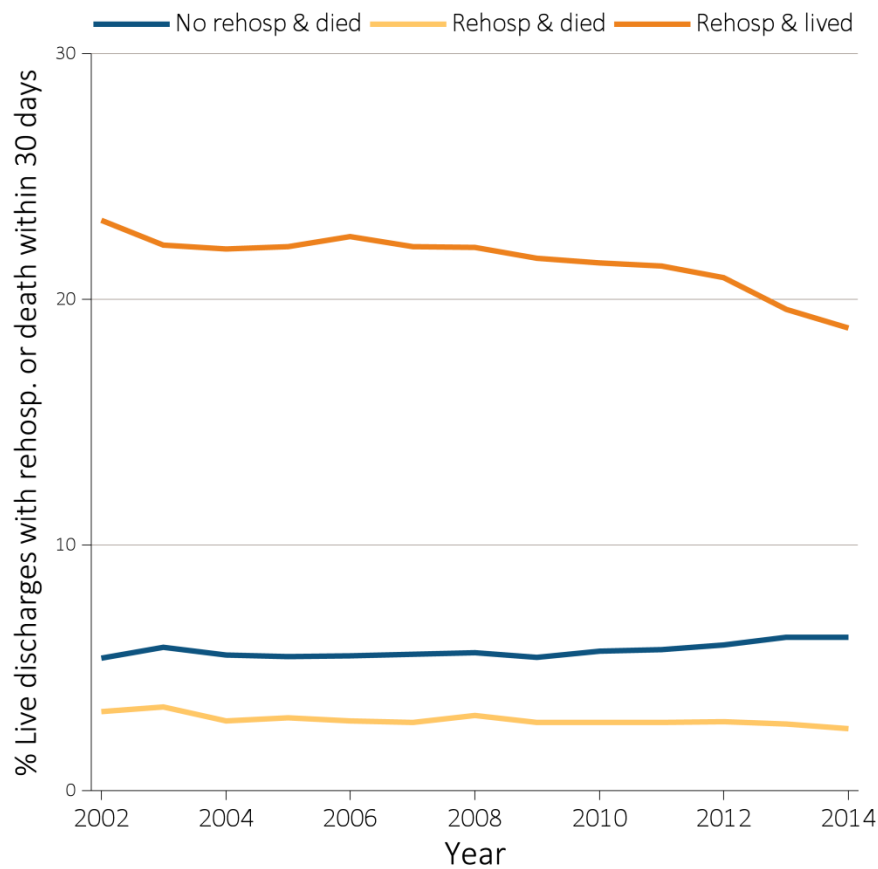
	No CKD (%)	All CKD (%)	Stages 1-2 (%)	Stage 3 (%)	Stages 4-5 (%)	Stage Unknown /unspecified (%)
All	15.3	21.4	20.3	21.4	22.9	20.9
Age						
66-69	14.8	23.4	24.7	23.1	23.8	23.3
70-74	15.0	22.1	19.5	22.4	25.2	21.4
75-84	15.8	21.6	20.8	21.8	23.2	21.0
85+	15.3	19.8	17.8	19.8	21.4	19.6
Sex						
Male	16.4	21.7	22.0	21.7	22.7	21.5
Female	14.7	21.0	18.8	21.2	23.1	20.5
Race						
White	15.2	20.8	19.6	20.9	22.0	20.6
Black/African American	17.7	24.6	24.4	25.1	26.7	22.7
Other	14.8	22.4	20.5	21.7	26.0	22.6
Rehospitalization						
No rehospitalization & died	4.5	6.3	4.8	6.1	7.6	6.4
Rehospitalization & died	1.6	2.5	1.9	2.4	3.2	2.6
Rehospitalization & lived	13.7	18.8	18.4	19.0	19.7	18.4

Data source: Medicare 5% sample. January 1, 2014 point prevalent Medicare patients aged 66 and older, discharged alive from an all-cause index hospitalization between January 1, 2014, and December 1, 2014; unadjusted. See Table A for CKD stage definitions. Abbreviations: CKD, chronic kidney disease.

The trend for adjusted readmissions from 2002-2014 is shown in Figure 3.16. Results may differ from those presented in previous edition ADRs, in part because the adjustment variables of disease comorbidity and prior year hospitalization are no longer applied in the model. Specifically, the percentage of patients who were rehospitalized and lived within 30 days of their initial discharge declined from 22.6% in 2006 to 18.8% in 2014, a decrease of

3.7% over the 13-year period. While any reductions are encouraging, the proportion of patients who were rehospitalized and subsequently died within 30 days of the initial discharge has not changed significantly—reducing by only 0.8% from 2013 levels. Of note, the rate of patients who were not rehospitalized but died within 30 days of the initial discharge has increased somewhat, by 0.9% since 2009.

vol 1 Figure 3.16 Adjusted percentage of patients readmitted to the hospital within 30 days of discharge, among Medicare CKD patients aged 66 and older who were discharged alive from an all-cause index hospitalization between January 1 and December 1, by year, 2002-2014

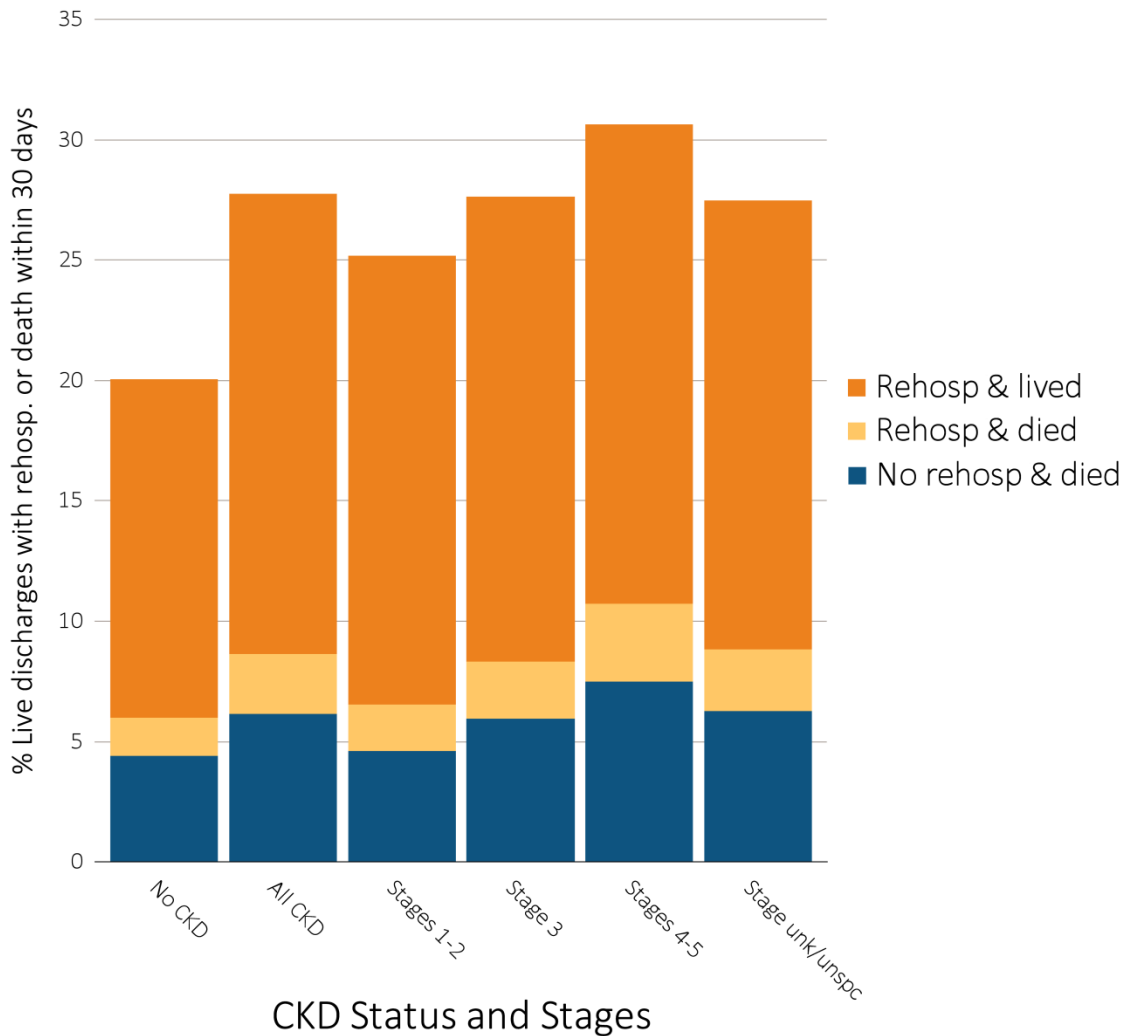


Data source: Medicare 5% sample. January 1 of each reported year, point prevalent Medicare patients aged 66 and older with CKD (defined during the prior year), discharged alive from an all-cause index hospitalization between January 1 and December 1 of the reported year. Adjusted for age/sex/race. Reference population 2014. Abbreviations: CKD, chronic kidney disease; Rehosp, rehospitalized.

Figure 3.17 presents the percentages of Medicare patients who were rehospitalized and/or died, with or without rehospitalization, within 30 days of discharge following an index hospitalization. Compared to those

without a diagnosis of CKD, those with CKD had a higher proportion of live discharges linked to a rehospitalization or death.

vol 1 Figure 3.17 Unadjusted percentage of patients readmitted to the hospital within 30 days of discharge, among Medicare patients aged 66 and older who were discharged alive from an all-cause index hospitalization between January 1 and December 1, by CKD status and stage, 2014

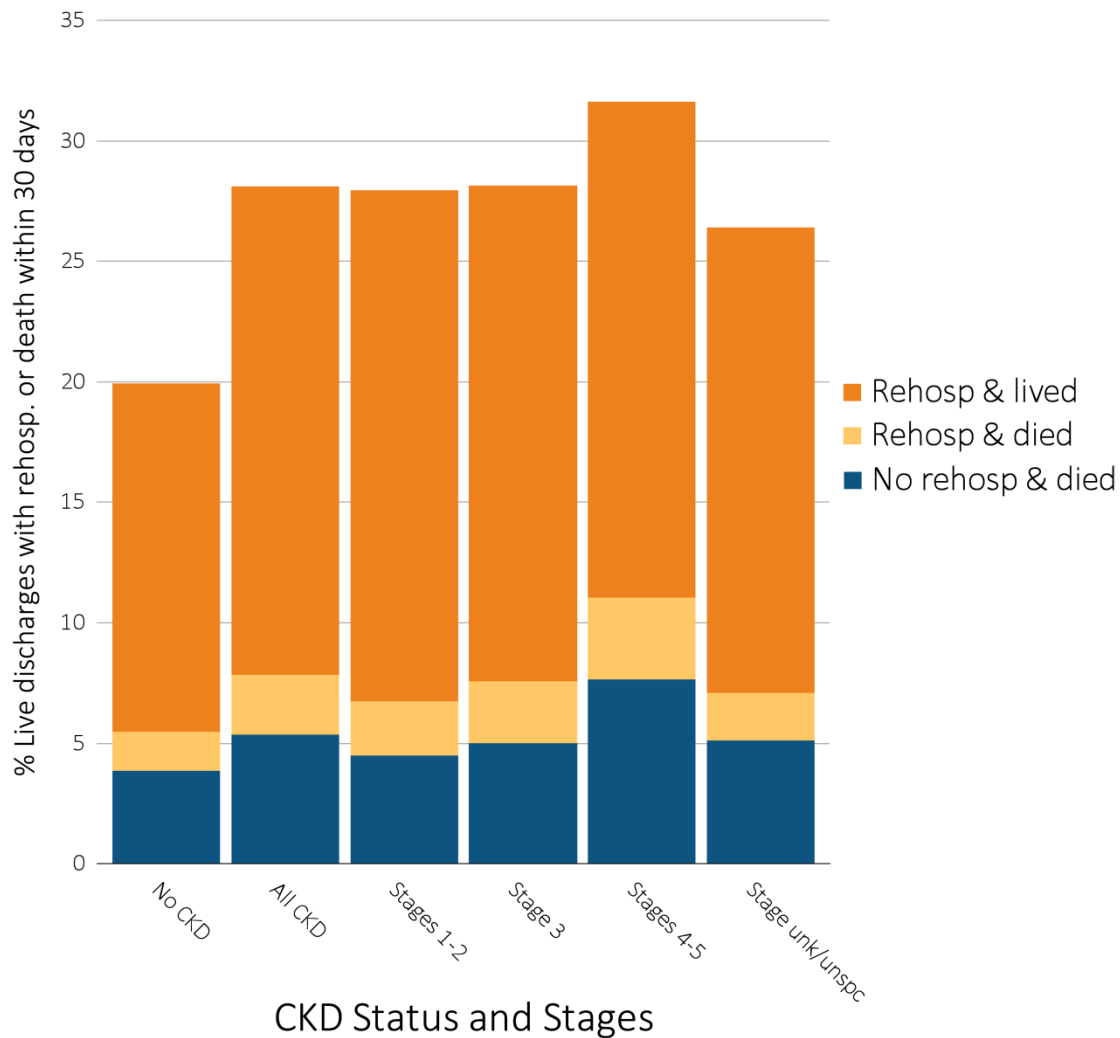


Data source: Medicare 5% sample. January 1, 2014 point prevalent Medicare patients aged 66 and older, discharged alive from an all-cause index hospitalization between January 1, 2014, and December 1, 2014, unadjusted. Abbreviations: CKD, chronic kidney disease; Rehosp, rehospitalized; unk/unspc, CKD stage unidentified.

Figure 3.18 shows the death and rehospitalization percentages for older Medicare patients who were discharged alive from a CVD index hospitalization; 20.0% of patients with CKD and 14.2% of those

without required rehospitalization within 30 days. Otherwise, the magnitude and pattern of these readmission rates were similar to those for all-cause index hospitalizations.

vol 1 Figure 3.18 Unadjusted percentage of patients readmitted to the hospital within 30 days of discharge, among Medicare patients aged 66 and older who were discharged alive from a cardiovascular-related index hospitalization between January 1 and December 1, by CKD status and stage, 2014

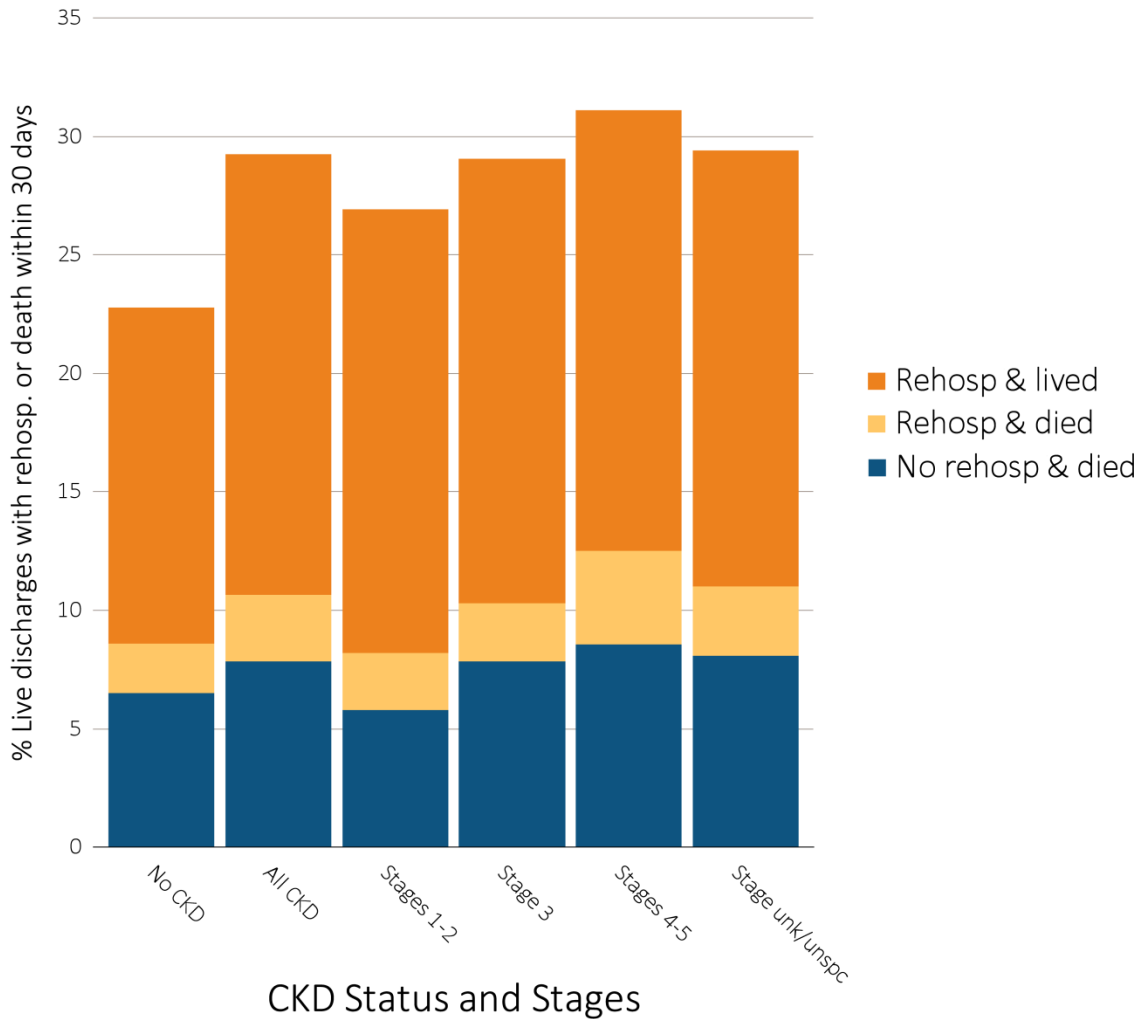


Data source: Medicare 5% sample. January 1, 2014 point prevalent Medicare patients aged 66 and older, discharged alive from an all-cause index hospitalization between January 1, 2014, and December 1, 2014; unadjusted. Abbreviations: CKD, chronic kidney disease; Rehosp, rehospitalized; unk/unspc, CKD stage unidentified.

Of all patients without CKD who experienced an infection-related admission, 13.9% required rehospitalization (see Figure 3.19). Of these patients, 2.1% died following rehospitalization, and 6.6% of patients were not rehospitalized and later died. In the

CKD group, 18.3% of patients were subsequently rehospitalized and lived within 30 days of the initial discharge, and an additional 2.8% died following rehospitalization; 8.0% of patients were not rehospitalized, and later died.

vol 1 Figure 3.19 Unadjusted percentage of patients readmitted to the hospital within 30 days of discharge, among Medicare patients aged 66 and older who were discharged alive from an infection-related index hospitalization between January 1 and December 1, by CKD status and stage, 2014

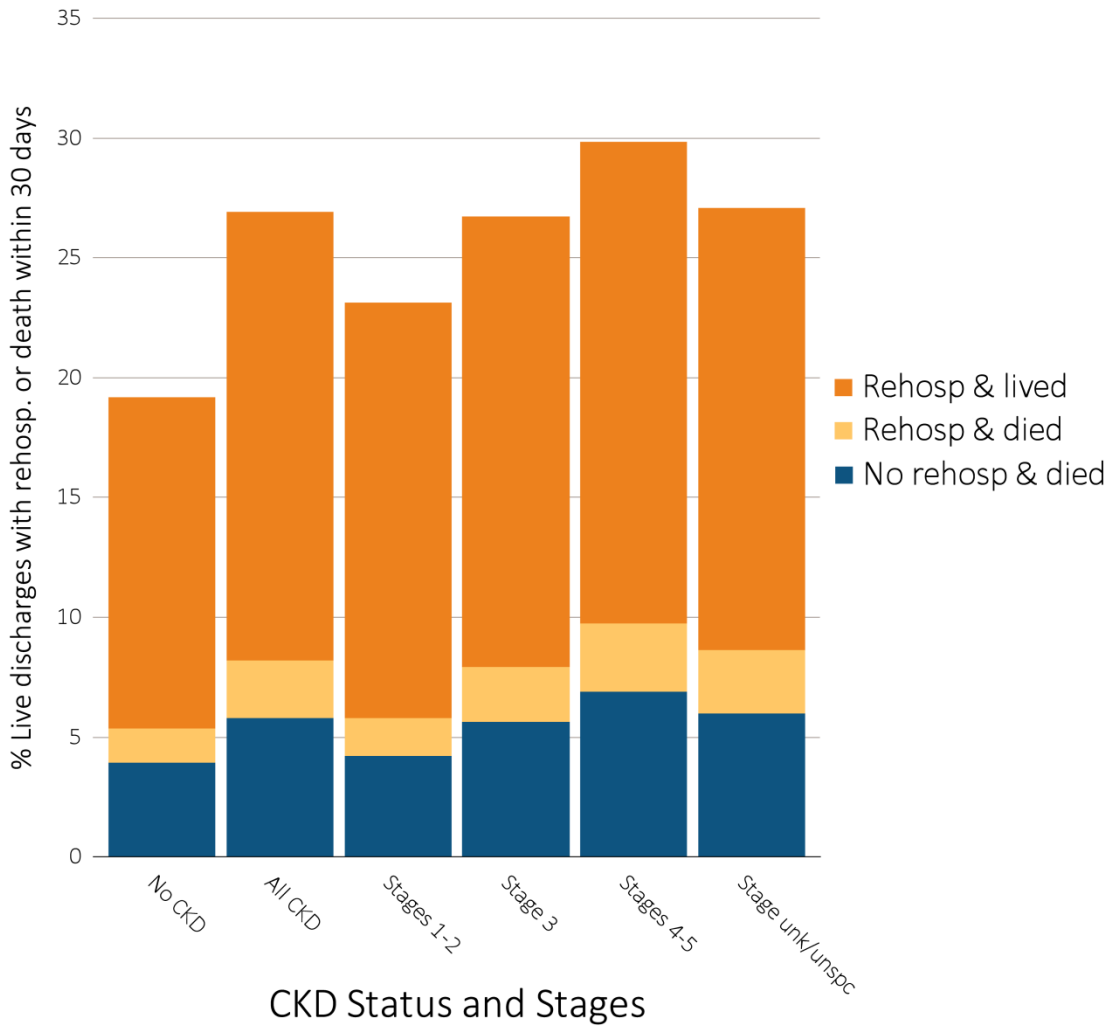


Data source: Medicare 5% sample. January 1, 2014 point prevalent Medicare patients aged 66 and older, discharged alive from an all-cause index hospitalization between January 1, 2014, and December 1, 2014, unadjusted. Abbreviations: CKD, chronic kidney disease; Rehosped, rehospitalized; unk/unspc, CKD stage unidentified.

Figure 3.20 shows the death and rehospitalization percentages for Medicare patients aged 66 and older who were discharged alive from index hospitalization for all causes other than CVD and infection. The patterns of these percentages were similar to those for all-cause index hospitalizations. For the CKD group,

patients who were not rehospitalized but died, rehospitalized and died, or rehospitalized and lived were 5.9%, 2.4%, and 18.4%. In the no-CKD group, these percentages were somewhat lower at 4.1%, 1.4%, and 13.5%.

vol 1 Figure 3.20 Unadjusted percentage of patients readmitted to the hospital within 30 days of discharge, among Medicare patients aged 66 and older who were discharged alive from a no-cardiovascular and no-infection related index hospitalization between January 1 and December 1, by CKD status and stage, 2014

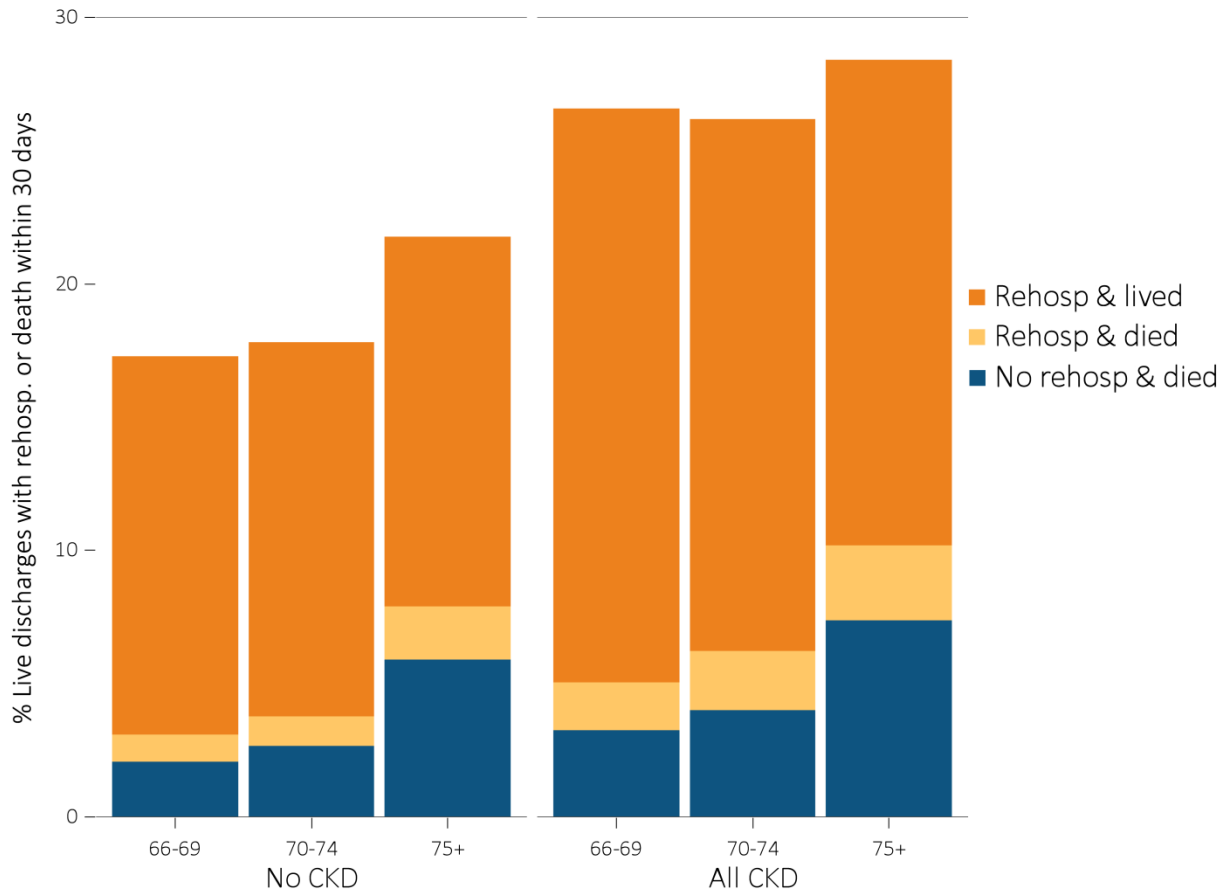


Data Source: Medicare 5% sample. January 1, 2014 point prevalent Medicare patients aged 66 and older, discharged alive from an all-cause index hospitalization between January 1, 2014, and December 1, 2014; unadjusted. Abbreviations: CKD, chronic kidney disease; Rehosp, rehospitalized; unk/unspc, CKD stage unidentified.

Figure 3.21 illustrates a comparison by age group of the percentages of Medicare patients who were re-hospitalized or died within 30 days of discharge from an all-cause, index hospitalization, among those with CKD and those without. Rates of rehospitalization with survival in patients with CKD decreased with age across all stages of CKD in the Medicare population.

These findings were likely influenced by the competing risk of death in older age groups. For both patients with and without CKD, the proportion returning to the hospital and dying within 30 days of discharge, or dying without rehospitalization, increased with older age.

vol 1 Figure 3.21 Unadjusted percentage of patients readmitted to the hospital within 30 days of discharge, among Medicare patients aged 66 and older who were discharged alive from an all-cause index hospitalization between January 1 and December 1, by age and CKD status, 2014

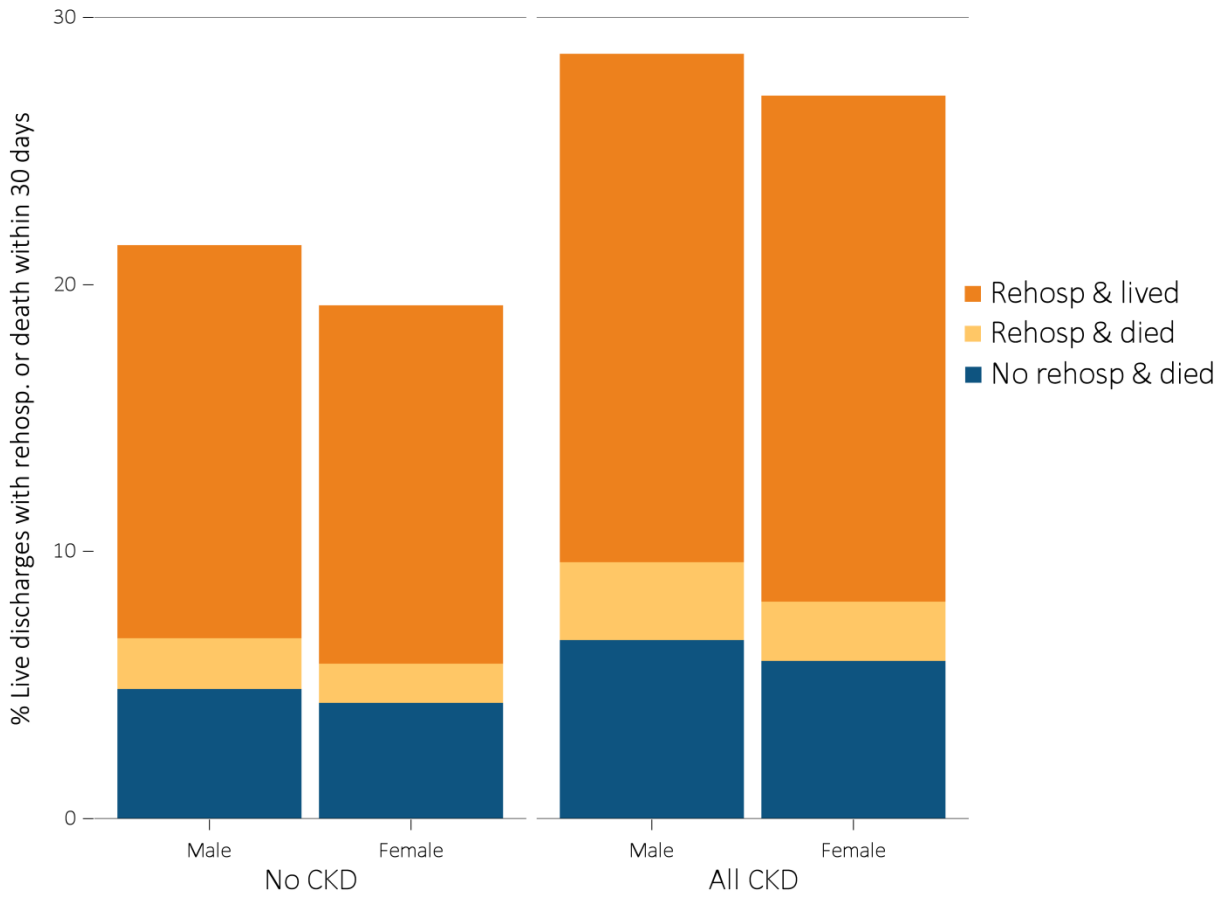


Data source: Medicare 5% sample. January 1, 2014 point prevalent Medicare patients aged 66 and older, discharged alive from an all-cause index hospitalization between January 1, 2014, and December 1, 2014; unadjusted. Abbreviations: CKD, chronic kidney disease; Rehospi, rehospitalized.

Figure 3.22 compares the rates of all-cause hospitalization rates by sex. Male patients exhibited higher rates than did females in all outcome categories. Specifically, 6.8% of males did not require rehospitalization but later died, 2.9% were

rehospitalized and later died within 30 days of the initial discharge, and 18.8% were rehospitalized and lived. CKD patients in all categories showed higher rates of rehospitalization than did those without CKD.

vol 1 Figure 3.22 Unadjusted percentage of patients readmitted to the hospital within 30 days of discharge, among Medicare patients aged 66 and older who were discharged alive from an all-cause index hospitalization between January 1 and December 1, by sex and CKD status, 2014

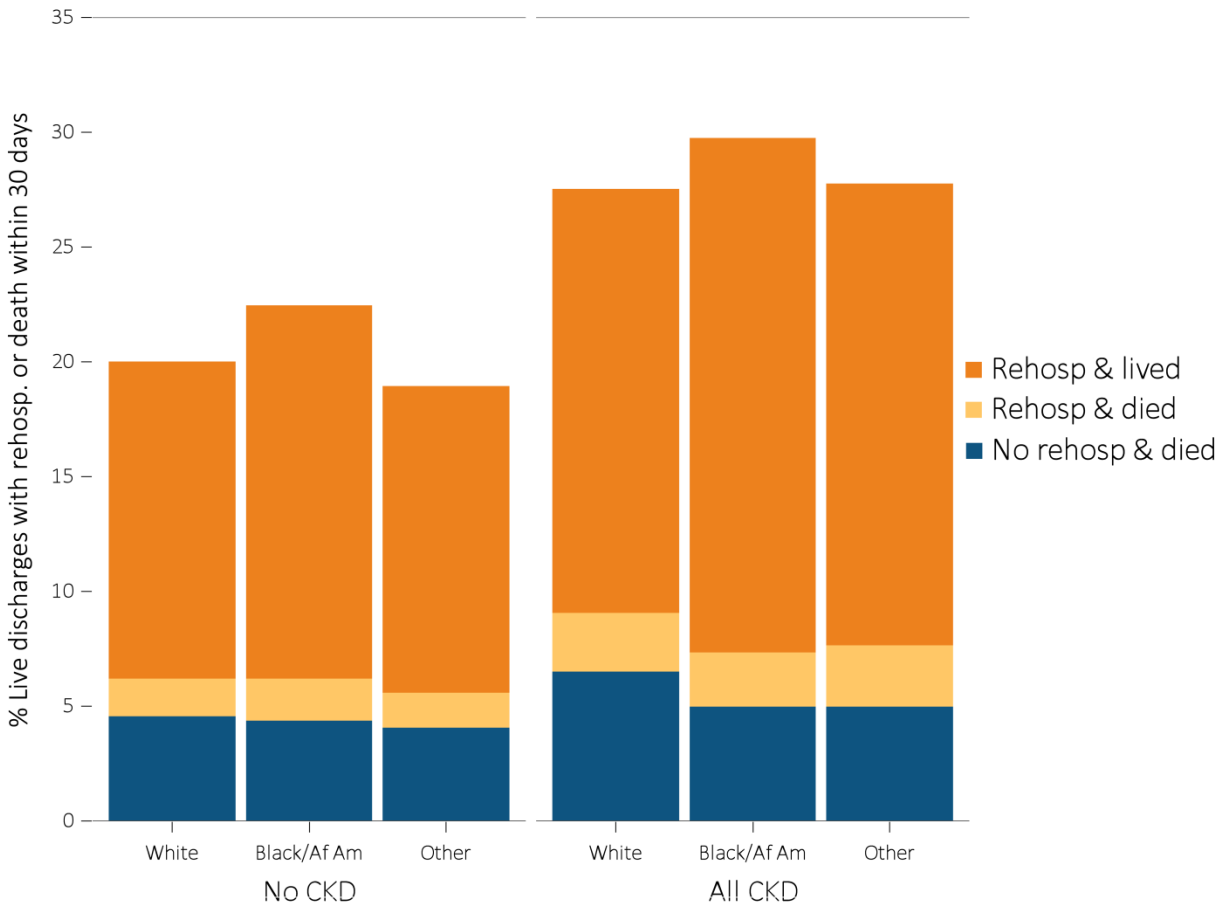


Data source: Medicare 5% sample. January 1, 2014 point prevalent Medicare patients aged 66 and older, discharged alive from an all-cause index hospitalization between January 1, 2014, and December 1, 2014; unadjusted. Abbreviations: CKD, chronic kidney disease; Rehosp, rehospitalized.

Racial trends in post-discharge outcomes were mixed. As shown in Figure 3.23, for patients without CKD, those of Black race who were rehospitalized subsequently survived at greater rates (16.0%) than did both Whites (13.6%) and patients of other races (13.1%). For patients with CKD, Blacks survived

rehospitalization at 22.1%, Whites at 18.2%, and those of other races at 19.8%. Whites with or without CKD experienced the highest rates of death without rehospitalization (4.7% for no-CKD, 6.6% with CKD); more CKD patients of other races were observed to have died following their rehospitalization (2.7%).

vol 1 Figure 3.23 Unadjusted percentage of patients readmitted to the hospital within 30 days of discharge, among Medicare patients aged 66 and older who were discharged alive from an all-cause index hospitalization between January 1 and December 1, by race and CKD status, 2014



Data Source: Medicare 5% sample. January 1, 2014 point prevalent Medicare patients aged 66 and older, discharged alive from an all-cause index hospitalization between January 1, 2014, and December 1, 2014; unadjusted. Abbreviations: Af Am, African American; CKD, chronic kidney disease; Rehosp, rehospitalized.

This chapter focused on mortality and morbidity in Medicare patients with and without CKD. While hospitalization rates have been decreasing over time, the underlying causes for this decline and the lessons learned from these data trends require both further research and the application of enhanced quality

improvement efforts. In future iterations of the ADR, we will also examine data on morbidity and mortality in the CKD population from additional non-Medicare data sources.

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