

Chapter 4: Cardiovascular Disease in Patients With CKD

Introduction

Cardiovascular disease is an important comorbidity for patients with chronic kidney disease (CKD). CKD patients are at high-risk for cardiovascular disease, and the presence of CKD often complicates its treatment and prognosis. In this chapter, we review recent trends in the prevalence and outcomes of cardiovascular disease in CKD patients and compare these to outcomes of cardiovascular disease in patients without CKD, focusing on the high-risk, elderly Medicare population.

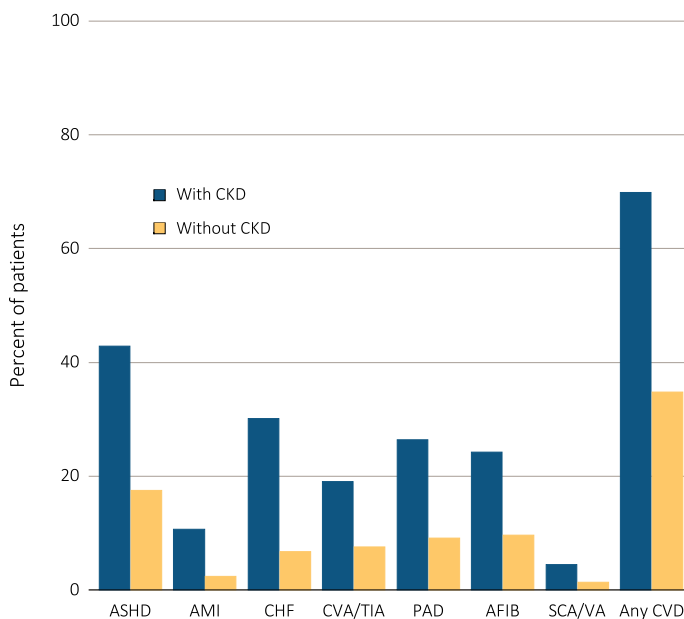
Analytical Methods

See the *CKD Analytical Methods* chapter for an explanation of analytical methods used to generate the figures and tables in this chapter.

Cardiovascular Disease Prevalence and Outcomes in CKD

As shown in Figure 4.1, elderly CKD patients have a greater burden of cardiovascular disease than do their non-CKD counterparts for a wide range of conditions. Stable atherosclerotic heart disease (ASHD), acute myocardial infarction (AMI), congestive heart failure (CHF), stroke (cerebrovascular accident/transient ischemic attack, CVA/TIA), peripheral arterial disease (PAD), atrial fibrillation (AFIB), sudden cardiac arrest and ventricular arrhythmias (SCA/VA) are all more common in CKD patients aged 66 and older when compared with those without CKD. Indeed, the prevalence of any cardiovascular disease is double in CKD patients (69.8 percent versus 34.8 percent).

vol 1 Figure 4.1 Cardiovascular disease in patients with or without CKD, 2012



Data Source: Medicare 5 percent sample. Patients age 66 and older, alive, without end-stage renal disease, and residing in the U.S. on 12/31/2012 with fee-for-service coverage for the entire calendar year. Abbreviations: AFIB, atrial fibrillation; AMI, acute myocardial infarction; ASHD, atherosclerotic heart disease; CHF, congestive heart failure; CKD, chronic kidney disease; CVA/TIA, cerebrovascular accident/transient ischemic attack; CVD, cardiovascular disease; PAD, peripheral arterial disease; SCA/VA, sudden cardiac arrest and ventricular arrhythmias.

The prevalence of these conditions also generally increases with age and presence of CKD (Table 4.1). The relationship with race/ethnicity and sex is less straightforward. Major procedures utilized for the treatment of cardiovascular disease are more common among CKD patients, including percutaneous coronary intervention (PCI), coronary artery bypass grafting (CABG), and the placement of implantable cardioverter defibrillators (ICD) and cardiac resynchronization (CRT) devices.

vol 1 Table 4.1 Prevalence of cardiovascular comorbidities & procedures (percent), by CKD status, age, race & sex, 2012**Cardiovascular Comorbidities^a**

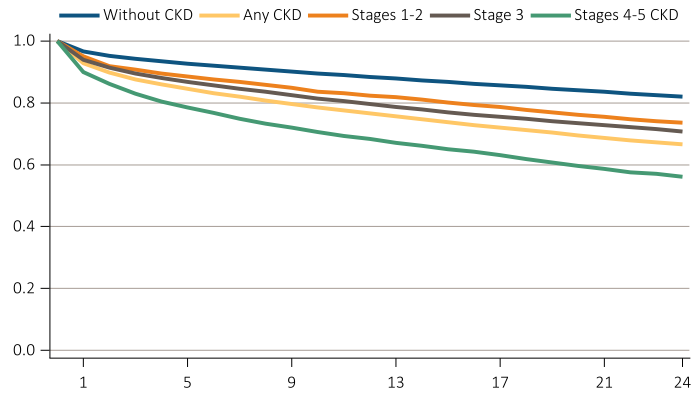
	Overall	66-69	70-74	75-84	85+	White	Black / Af Am	Other	Male	Female
Atherosclerotic heart disease (ASHD)										
Without CKD	17.4	11.6	15.4	20.6	23.1	17.9	14.2	14.7	23.2	13.3
Any CKD	42.9	35.2	39.5	44.8	46.1	43.9	36.4	40.1	50.2	36.3
Acute myocardial infarction (AMI)										
Without CKD	2.4	1.7	2.1	2.7	3.3	2.5	1.9	1.6	3.1	1.9
Any CKD	10.6	9.7	9.7	10.6	11.8	11.0	8.9	8.1	12.6	8.9
Congestive heart failure (CHF)										
Without CKD	6.7	3.3	4.5	7.6	14.0	6.7	8.1	5.4	6.9	6.6
Any CKD	30.1	22.2	24.3	29.4	39.5	30.1	32.3	26.4	30.2	30.1
Cerebrovascular accident/transient ischemic attack (CVA-TIA)										
Without CKD	7.5	4.3	5.9	9.1	12.1	7.5	8.5	6.4	7.5	7.6
Any CKD	19.1	14.7	16.2	20.0	21.9	18.9	21.4	17.8	19.0	19.2
Peripheral artery disease (PAD)										
Without CKD	9.1	4.6	6.4	10.5	17.9	9.2	10.1	7.1	9.2	9.1
Any CKD	26.4	19.5	22.4	26.8	32.0	26.6	26.2	22.9	27.3	25.6
Atrial fibrillation (AFIB)										
Without CKD	9.6	4.3	6.6	11.9	18.0	10.3	4.8	5.3	10.8	8.7
Any CKD	24.2	14.1	18.2	25.0	32.3	26.0	14.6	16.1	26.5	22.1
Cardiac arrest and ventricular arrhythmias (SCA/VA)										
Without CKD	1.3	0.9	1.2	1.6	1.6	1.4	1.1	0.8	1.9	0.9
Any CKD	4.5	4.0	4.5	4.8	4.3	4.6	4.5	2.9	6.2	3.0
Cardiovascular Procedures^b										
Revascularization - percutaneous coronary interventions (PCI)										
Without CKD	4.2	6.2	5.1	3.9	2.1	4.3	3.5	3.8	4.7	3.6
Any CKD	5.3	7.8	6.7	5.5	3.3	5.4	4.7	4.8	5.9	4.6
Revascularization - coronary artery bypass graft (CABG)										
Without CKD	1.1	1.7	1.4	1.1	0.3	1.2	0.8	0.9	1.4	0.8
Any CKD	1.8	2.9	2.8	1.9	0.6	1.9	1.3	1.3	2.2	1.2
Implantable cardioverter defibrillators & cardiac resynchronization therapy with defibrillator (ICD/CRT-D)										
Without CKD	0.8	1.4	1.1	0.9	0.3	0.8	0.5	0.8	1.3	0.4
Any CKD	1.2	2.0	1.8	1.5	0.5	1.3	0.9	1.2	1.9	0.6

Data Source: Medicare 5 percent sample. Patients age 66 and older, alive, without end-stage renal disease, and residing in the U.S. on 12/31/2012 with fee-for-service coverage for the entire calendar year. Abbreviations: AFIB, atrial fibrillation; AMI, acute myocardial infarction; ASHD, atherosclerotic heart disease; Af Am, African American; CABG, coronary artery bypass grafting; CHF, congestive heart failure; CKD, chronic kidney disease; CVA/TIA, cerebrovascular accident/transient ischemic attack; CVD, cardiovascular disease; ICD/CRT-D, implantable cardioverter defibrillators/cardiac resynchronization therapy with defibrillator devices; PAD, peripheral arterial disease; PCI, percutaneous coronary interventions; SCA/VA, sudden cardiac arrest and ventricular arrhythmias. ^a The denominators for all cardiovascular comorbidities are Medicare enrollees age 66+. ^b The denominators for PCI and CABG are Medicare enrollees age 66+ with ASHD. The denominator for ICD/CRT-D is Medicare enrollees age 66+ with CHF.

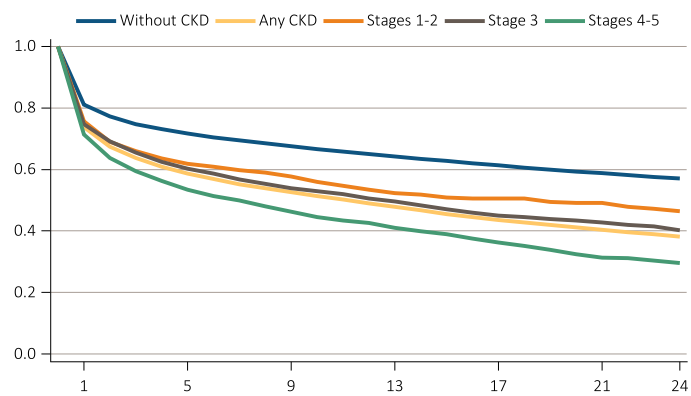
The presence of CKD also worsens the short- and long-term prognosis for many of these common cardiovascular diseases. Figures 4.2a through 4.2j illustrate survival in patients with cardiovascular disease stratified by the presence of CKD and its severity. In general, CKD patients have worse survival across all of the conditions reported, with late stages of CKD associated with the worst outcomes. This pattern also is true in patients who undergo common major procedures for the treatment of cardiovascular diseases. For example, the two-year survival of non-CKD AMI patients is 57 percent, compared to 46 percent for CKD Stage 1-2 patients and 30 percent for CKD Stage 4-5 patients.

vol 1 Figure 4.2 Survival of patients with a cardiovascular diagnosis or procedure, by CKD status, 2010-2012

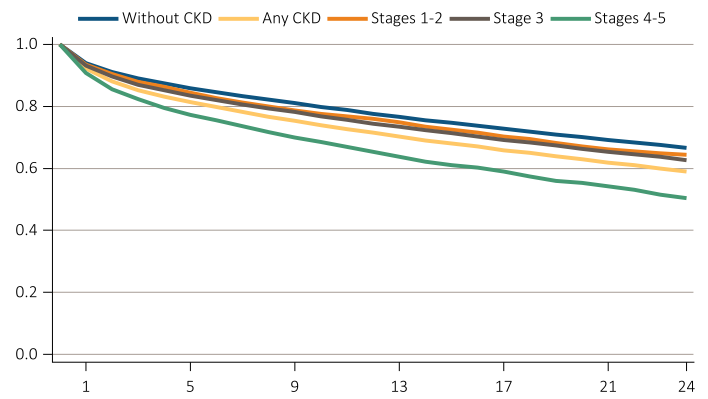
(a) ASHD



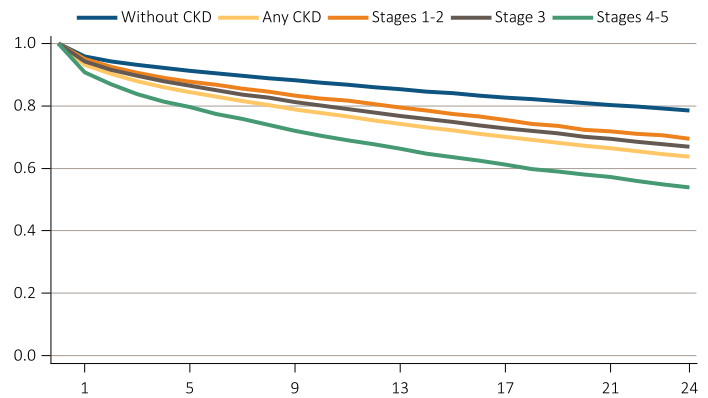
(b) AMI



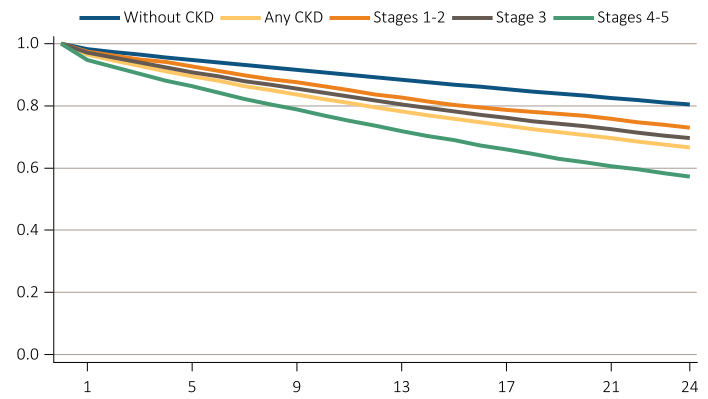
(c) CHF



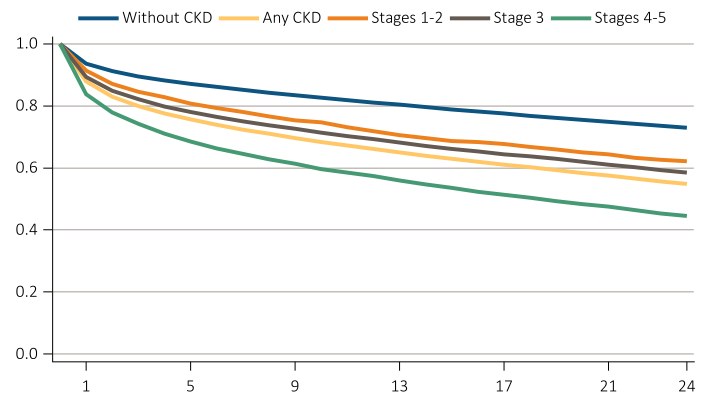
(d) CVA / TIA



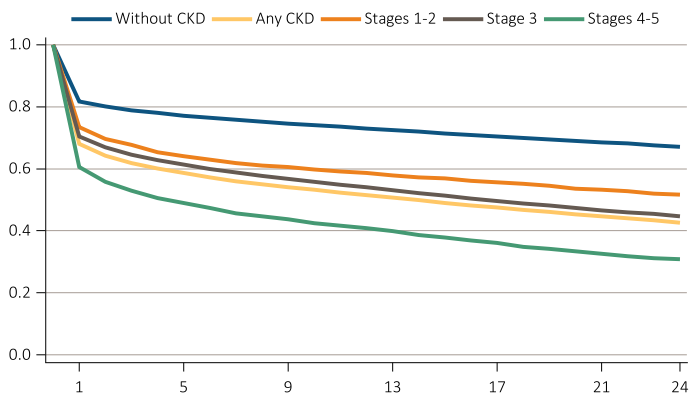
(e) PAD



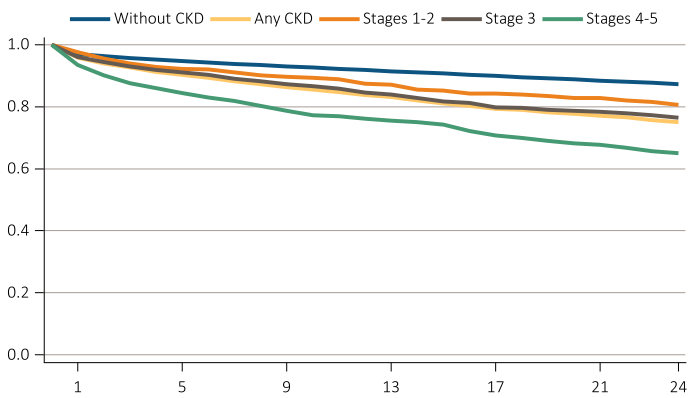
(f) AFIB



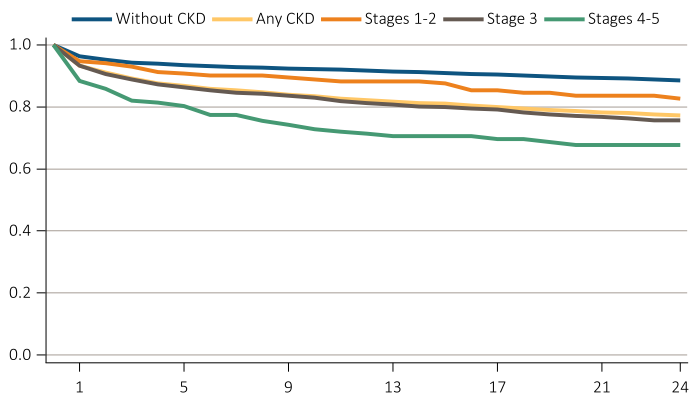
(g) SCA / VA



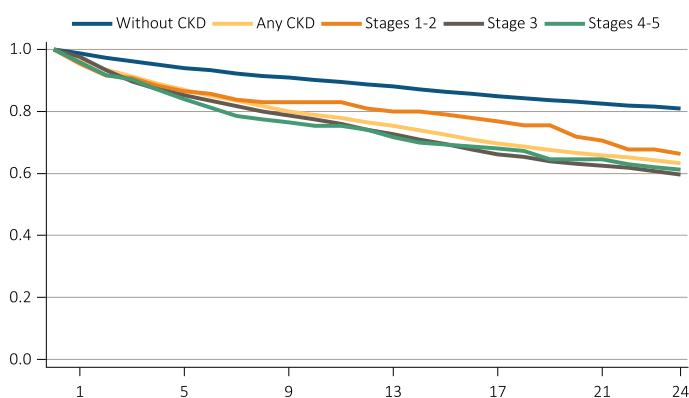
(h) PCI



(i) CABG



(j) ICD / CRT / D



Data Source: Medicare 5 percent sample. Patients age 66 and older, alive, without end-stage renal disease, and residing in the U.S. on 12/31/2012 with fee-for-service coverage for the entire calendar year. Abbreviations: AFIB, atrial fibrillation; AMI, acute myocardial infarction; ASHD, atherosclerotic heart disease; CABG, coronary artery bypass grafting; CHF, congestive heart failure; CKD, chronic kidney disease; CVA/TIA, cerebrovascular accident/transient ischemic attack; CVD, cardiovascular disease; ICD/CRT-D, implantable cardioverter defibrillators/cardiac resynchronization therapy with defibrillator devices; PAD, peripheral arterial disease; PCI, percutaneous coronary interventions; SCA/VA, sudden cardiac arrest and ventricular arrhythmias.

Congestive Heart Failure and Chronic Kidney Disease

Congestive heart failure (CHF) is the most frequent cardiovascular disease that has been linked to CKD, with its prevalence in CKD patients aged 66 and older exceeding 40 percent in 2012. Given its importance in this population, key characteristics of CHF in CKD patients are further examined in Table 4.2 after stratifying CHF based on systolic dysfunction (i.e., heart failure with decreased ejection fraction), diastolic dysfunction (i.e., heart failure with preserved ejection fraction), or unspecified. For ease of reporting and because of consistency of clinical approaches, systolic CHF includes patients with systolic dysfunction regardless of the presence of concomitant diastolic dysfunction. Patients with isolated diastolic CHF are treated separately since long-term risk assessments and treatments vary for this group.

vol 1 Table 4.2 Characteristics of patients with heart failure, by CKD status, 2012

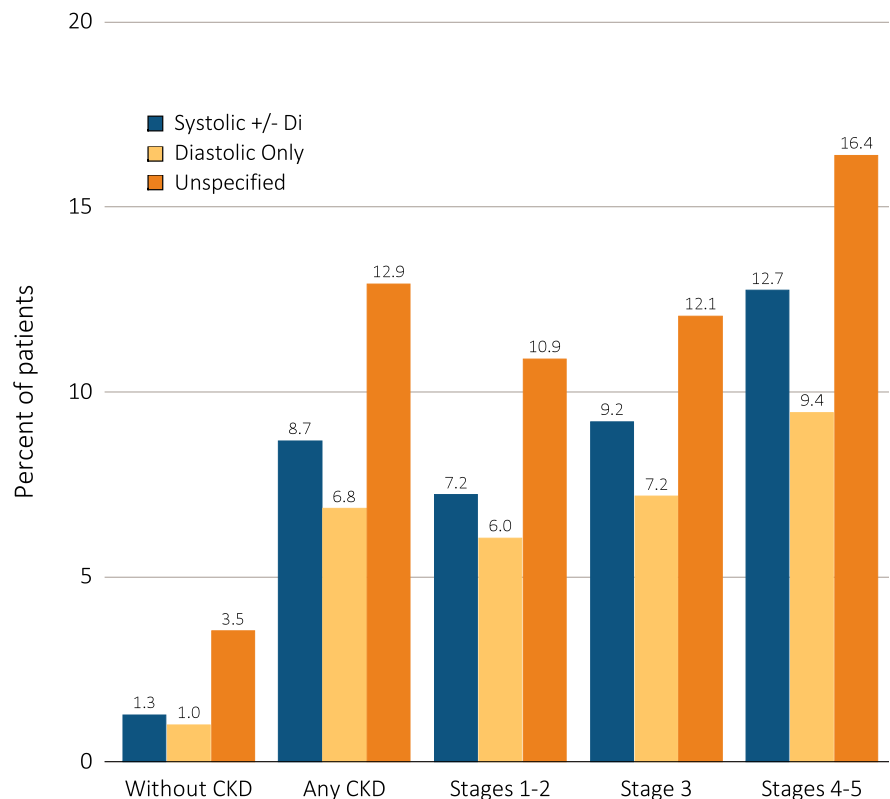
	Systolic +/- Diastolic heart failure		Diastolic only heart failure		Heart failure, unspecified	
	Without CKD	Any CKD	Without CKD	Any CKD	Without CKD	Any CKD
Age:						
66-69	13.9	10.2	10.2	9.4	10.5	9.0
70-74	18.2	16.9	15.2	14.0	15.7	14.9
75-84	39.6	40.5	39.0	39.1	37.2	38.8
85+	28.3	32.4	35.7	37.4	36.6	37.3
Male	52.7	56.3	31.1	35.3	39.0	45.4
Female	47.3	43.7	68.9	64.7	61.0	54.6
White	88.0	84.1	87.7	84.1	86.0	82.4
Black/African American	7.7	11.2	8.3	11.4	9.2	12.1
Other race	4.3	4.7	4.1	4.5	4.8	5.5
Non-diabetes	61.4	43.6	61.7	42.9	62.0	45.3
Diabetes	38.6	56.4	38.3	57.1	38.0	54.7

Data Source: Medicare 5 percent sample. Patients age 66 and older, alive, without end-stage renal disease, and residing in the U.S. on 12/31/2012 with fee-for-service coverage for the entire calendar year. Abbreviation: CKD, chronic kidney disease.

In general, the distribution of age and sex show similar patterns among patients with CHF and CKD when compared with those with CHF without CKD. However, the proportion of Black/African Americans and diabetic patients was higher among patients with CHF and CKD. These patterns were consistent regardless of whether systolic, diastolic, or unspecified CHF was identified. The relative proportion of patients with systolic CHF is slightly higher than diastolic CHF in CKD patients, and increases with greater severity of CKD (e.g., Stages 1-2 vs. Stage 3 vs. Stages 4-5), although the vast majority of patients have unspecified CHF in all instances (Figure 4.3).

Tables 4.3a and 4.3b show the complex relationship and interplay between CKD and CHF due to common risk factors as well as patho-physiological dependencies related to management of volume status. For example, the presence of CHF is an important risk factor for all-cause death in the Medicare population with CKD with a risk-adjusted odds ratio of 2.6 (Table 4.3a). Conversely, we also found that CKD was an important risk factor for all-cause death in the Medicare population with CHF with a risk-adjusted odds ratio of 1.5 (Table 4.3b).

vol 1 Figure 4.3 Heart failure in patients with or without CKD, 2012



Data Source: Medicare 5 percent sample. Patients age 66 and older, alive, without end-stage renal disease, and residing in the U.S. on 12/31/2012 with fee-for-service coverage for the entire calendar year. Abbreviation: CKD, chronic kidney disease.

vol 1 Table 4.3 Adjusted hazard ratio of all-cause death (a) associated with the presence of CHF in patients with CKD, and (b) associated with the presence of CKD in patients with CHF, 2011-2012

		(a)		
		Hazard ratio	Confidence Interval	p-value
Age:	66-69	reference		
	70-74	1.25	1.18 - 1.33	<.0001
	75-84	1.83	1.74 - 1.93	<.0001
	85+	3.63	3.44 - 3.82	<.0001
Male		reference		
Female		0.83	0.81 - 0.85	<.0001
White		reference		
Black/African American		0.95	0.92 - 0.99	0.0223
Other race		0.82	0.77 - 0.87	<.0001
CHF	Yes vs. No	2.57	2.50 - 2.63	<.0001
Diabetes	Yes vs. No	1.08	1.06 - 1.11	<.0001
Hypertension	Yes vs. No	0.88	0.83 - 0.92	<.0001
		(b)		
		Hazard ratio	Confidence Interval	p-value
Age:	66-69	reference		
	70-74	1.18	1.11 - 1.25	<.0001
	75-84	1.74	1.66 - 1.83	<.0001
	85+	3.30	3.14 - 3.47	<.0001
Male		reference		
Female		0.87	0.85 - 0.89	<.0001
White		reference		
Black/African American		0.89	0.85 - 0.92	<.0001
Other race		0.76	0.72 - 0.81	<.0001
CKD	Yes vs. No	1.52	1.49 - 1.56	<.0001
Diabetes	Yes vs. No	1.09	1.07 - 1.12	<.0001
Hypertension	Yes vs. No	0.91	0.88 - 0.94	<.0001

Data Source: Medicare 5 percent sample. Patients age 66 and older, alive, without end-stage renal disease, and residing in the U.S. on 12/31/2012 with fee-for-service coverage for the entire calendar year. Abbreviations: CKD, chronic kidney disease; CHF, congestive heart failure.