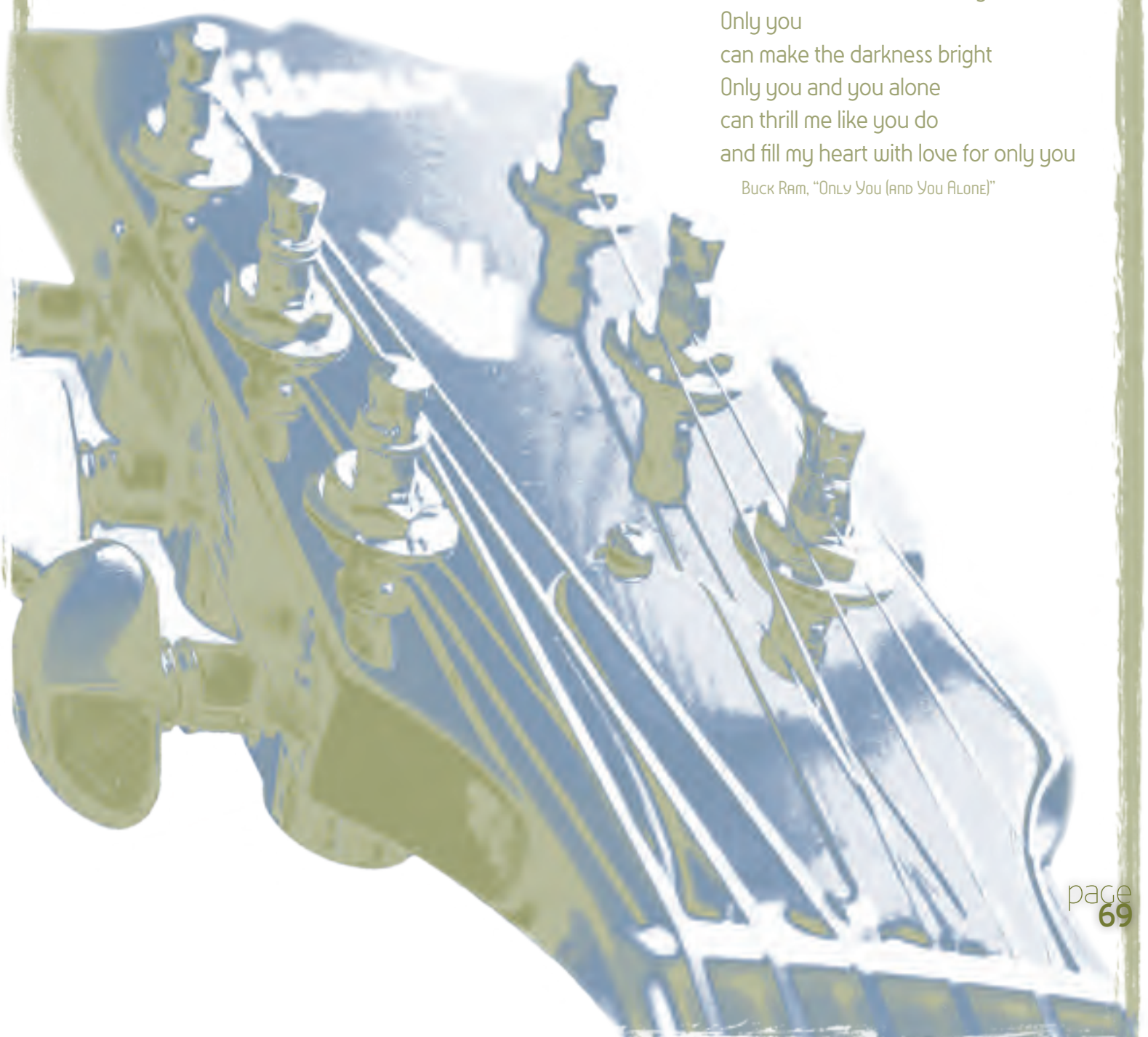


# CHAPTER four

## CARDIOVASCULAR DISEASE IN PATIENTS WITH CHRONIC KIDNEY DISEASE

Only you  
can make this world seem right  
Only you  
can make the darkness bright  
Only you and you alone  
can thrill me like you do  
and fill my heart with love for only you

Buck Ram, "Only You (And You Alone)"



72	rates of cardiovascular disease
74	drug therapy in patients with cardiovascular disease
76	summary

This chapter focuses on the association of cardiovascular disease and CKD. As shown on the next page, elderly patients with CKD carry a larger burden of comorbid cardiovascular illness than do those those without CKD, and have a significant additional burden of CHF, AMI, and stroke.

Forty-four percent of elderly CKD patients, for example, have CHF, compared to just 20 percent of their counterparts without CKD.

On the following page we present data on the relation of CKD stage to CHF, AMI, PAD, cerebrovascular disease, atrial fibrillation, and the use of defibrillators and coronary revascularization. One general finding is that the characteristics of patients with unknown or unspecified CKD stage typically mirror those of patients with advanced CKD. Not surprisingly, the burden of comorbid cardiovascular disease increases with age. Among Stage 4–5 CKD patients age 85 and older, for example, 49 percent also have CHF.

We next illustrate geographic variations and temporal trends in rates of CHF and CVA/TIA among CKD patients, and look as well at the use of diagnostic testing in these patients.

The last section of the chapter explores drug therapy in patients with cardiovascular disease, and begins with a table providing drug-specific data on the treatment of cardiovascular illness as related to CKD stage. We then pres-

ent maps showing the percentage of CHF patients who receive an ACEI/ARB or beta blocker. Rates range from a low of 73 percent both for non-CKD patients in the District of Columbia and for CKD patients in Wyoming, to a high of 89 and 96 percent for non-CKD and CKD patients, respectively, in Rhode Island.

Data on drug therapy for CHF show that in whites and African Americans the use of beta blockers is, surprisingly, higher in CKD patients than in their non-CKD counterparts, at 63–65 compared to 54–59 percent. Beta blocker use is also high in patients with AMI, particularly non-whites. Despite earlier concerns relating to the effectiveness of statin therapy in CKD patients, there is no apparent difference in use between CKD and non-CKD patients with AMI.

Among patients with atrial fibrillation, beta blockers are more commonly used in those with CKD, at 64–65 percent compared to 55–59 in the non-CKD population. Warfarin therapy is used to a lesser extent in African Americans than in patients of other races, regardless of CKD status. One interesting finding is the more frequent use of amiodarone

in CKD patients with atrial fibrillation, at 11–19 percent across racial groups compared to 7–10 percent in those without CKD.

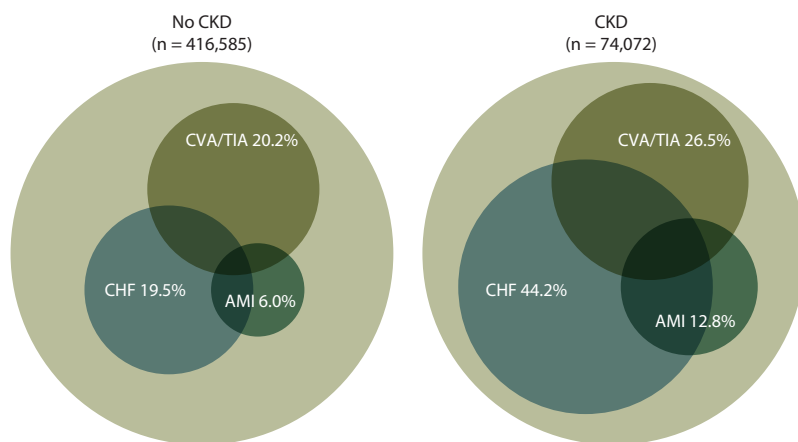
In patients with CVA/TIA, warfarin is used more frequently in those with CKD than in those without, at 14–17 compared to 9–13 percent. Clopidogrel, in contrast, is used in 57 percent of white patients without CKD and 51 percent of whites with the disease.

Venn diagrams at the end of the chapter illustrate medication use in CKD and non-CKD patients with CHF. Despite prior reports of the underutilization of evidence-based therapies in patients with CKD, it appears that this finding is no longer accurate, as beta blocker use is now more common in these patients than in their non-CKD counterparts. Use of ACEIs/ARBs is nearly identical in both populations, despite possible concerns over deterioration of renal function or hyperkalemia in CKD patients. Combination therapy with ACEIs/ARBs and beta blockers is also nearly identical in both CKD and non-CKD patients, at 38–39 percent. Perhaps reflecting the potential toxicity of digoxin therapy in CKD patients, a slightly lower percentage of CKD patients with CHF receive this medication.

Digoxin is no longer considered first-line therapy for CHF, but it should be remembered that some agents have multiple treatment indications; it is possible that some CHF patients are receiving digoxin therapy for other reasons, such as atrial fibrillation.

>> **Figure 4.1;** see page 125 for analytical methods. *December 31 point prevalent Medicare enrollees age 66 & older, with fee-for-service coverage for all of 2009.*

**4.1** Cardiovascular disease in patients with or without chronic kidney disease, 2009





This table provides a snapshot of cardiovascular disease prevalence related to demography and CKD stage. CHF, common in elderly patients and those with advanced CKD, was identified in 7.4 percent of non-CKD patients age 66 and older in 2009. In patients with the most advanced CKD, in contrast, this number reached 42 percent. Only 0.5 percent of Stage 4–5 patients, however, received an implantable defibrillator. Although the frequencies are considerably lower, CKD stage and age are also associated with a higher occurrence of AMI, which is more frequent in men.

Peripheral arterial disease is a common cardiovascular condition in patients with CKD, identified in 28 percent of those with Stage 4–5 CKD — three times the rate in non-CKD patients. And cerebrovascular ischemia occurs more than twice as frequently in later-stage CKD patients, at 20 versus 8 percent. Advanced age is also associated with an increased occurrence of CVA/TIA.

Consistent with prior publications, data here show that CKD stage, as well as advanced age and male gender, are associated with the prevalence of atrial fibrillation. Thirty percent of patients age 85 or older and with CKD of Stages 4–5 had atrial fibrillation in 2009. >> [Table 4.a](#); see page 124 for analytical methods. *December 31 point prevalent Medicare enrollees age 66 & older, with fee-for-service coverage for all of the calendar year.*

### ICD-9-CM CODES

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

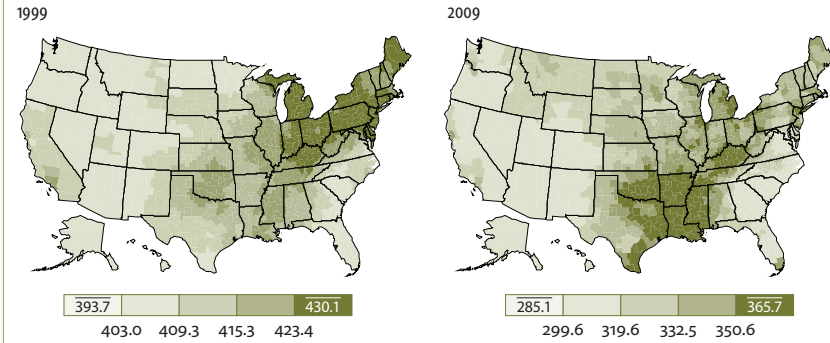
*In USRDS analyses, patients with ICD-9-CM code 585.6 are considered to have code 585.5; see Appendix A for details.*

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

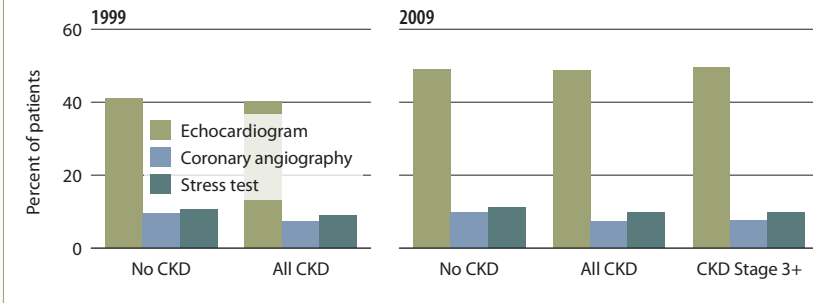
4 Cardiovascular disease & intervention (percent), by CKD status & diagnosis code, 2009										
	Overall	66–69	70–74	75–84	85+	Male	Female	White	Af Am	Other
<b>Congestive heart failure (CHF)</b>										
Non-CKD	7.4	3.6	4.8	8.3	15.4	7.5	7.4	7.4	8.9	6.0
585.1-2	27.3	19.4	20.8	27.8	39.6	26.7	27.8	27.1	28.4	26.7
585.3	31.1	22.9	26.0	30.7	40.6	32.1	30.1	31.1	31.0	30.0
585.4-5	41.6	33.5	35.0	41.4	48.7	42.6	40.7	41.6	41.2	42.3
Unknown/unspecified	32.1	21.1	24.4	32.2	43.2	31.3	32.9	32.2	33.2	28.6
<b>Acute myocardial infarction (AMI)</b>										
Non-CKD	2.3	1.7	1.9	2.6	3.1	3.0	1.8	2.4	1.9	1.6
585.1-2	8.1	6.7	6.7	8.9	9.3	9.6	6.8	8.4	6.8	7.7
585.3	8.9	8.3	8.1	9.1	9.5	10.8	7.1	9.2	6.9	7.5
585.4-5	10.7	8.2	10.2	11.3	11.2	13.1	8.7	11.0	9.3	10.5
Unknown/unspecified	9.7	8.5	9.0	10.1	10.3	11.3	8.3	10.0	8.1	8.2
<b>Peripheral arterial disease (PAD)</b>										
Non-CKD	9.2	4.6	6.5	10.5	17.8	9.2	9.3	9.2	10.2	7.7
585.1-2	23.2	17.0	20.4	24.0	29.6	23.2	23.1	22.9	24.2	24.5
585.3	25.1	19.6	21.4	25.8	30.2	26.8	23.5	25.6	22.7	21.7
585.4-5	28.4	22.7	25.3	29.1	31.3	31.0	26.2	28.7	28.0	24.6
Unknown/unspecified	28.3	21.8	24.0	29.9	32.4	28.2	28.5	28.6	27.6	25.2
<b>CVA/TIA</b>										
Non-CKD	7.7	4.2	5.9	9.3	12.4	7.6	7.8	7.7	8.8	6.7
585.1-2	17.8	12.7	14.7	18.9	23.1	17.4	18.2	17.5	19.8	17.5
585.3	18.1	13.9	15.2	19.0	21.3	18.7	17.6	18.1	18.4	17.1
585.4-5	19.9	17.0	17.8	21.1	20.6	20.4	19.5	19.6	22.3	18.7
Unknown/unspecified	20.7	14.9	17.6	22.2	23.6	20.3	21.1	20.5	23.9	18.4
<b>Atrial fibrillation (AFIB)</b>										
Non-CKD	9.2	4.0	6.2	11.3	16.6	10.3	8.4	9.8	4.3	4.9
585.1-2	18.9	11.3	13.4	20.6	28.0	20.6	17.4	20.7	11.4	13.1
585.3	22.0	13.1	16.1	23.3	29.6	24.5	19.6	23.7	11.8	14.6
585.4-5	24.5	15.2	18.0	25.6	30.1	27.1	22.3	26.9	13.9	16.0
Unknown/unspecified	23.0	12.7	16.6	24.5	30.4	24.8	21.3	24.7	13.3	14.3
<b>ICDs/CRT-D</b>										
Non-CKD	0.1	0.1	0.1	0.1	0.1	0.2	0.0	0.1	0.1	0.1
585.1-2	0.5	0.6	0.5	0.5	0.2	0.7	0.2	0.4	0.5	0.7
585.3	0.7	0.8	0.7	0.8	0.3	1.0	0.4	0.7	0.6	0.3
585.4-5	0.5	0.6	0.9	0.6	0.2	0.9	0.3	0.5	0.6	0.1
Unknown/unspecified	0.6	0.6	0.8	0.7	0.2	0.9	0.3	0.6	0.7	0.4
<b>Revascularization: PCI</b>										
Non-CKD	0.8	0.8	0.9	0.9	0.5	1.2	0.6	0.9	0.6	0.6
585.1-2	2.5	2.8	2.7	2.8	1.8	3.2	1.9	2.6	1.7	3.3
585.3	2.6	3.1	2.9	2.8	1.8	3.2	2.0	2.7	1.9	2.0
585.4-5	2.2	2.2	2.7	2.5	1.4	2.7	1.7	2.3	1.2	2.8
Unknown/unspecified	2.8	3.6	3.2	3.1	1.7	3.5	2.2	2.9	2.1	2.3
<b>Revascularization: CABG</b>										
Non-CKD	0.3	0.3	0.3	0.3	0.1	0.4	0.1	0.3	0.1	0.2
585.1-2	1.0	1.2	1.0	1.2	0.4	1.5	0.5	1.0	0.9	0.7
585.3	0.9	1.0	1.1	1.1	0.3	1.3	0.5	1.0	0.6	1.0
585.4-5	0.6	1.0	0.9	0.7	0.3	0.9	0.4	0.6	0.7	1.0
Unknown/unspecified	1.1	1.4	1.7	1.3	0.2	1.5	0.7	1.2	0.5	0.8

PATIENTS WITH CHF

4.2i Geographic variations in rates (per 1,000 population) of congestive heart failure (CHF) in patients with CKD, by HSA

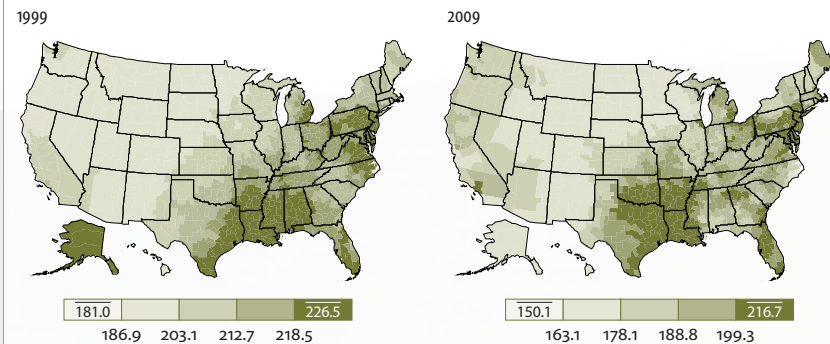


4.3i Patients with CHF who receive diagnostic testing, by CKD status

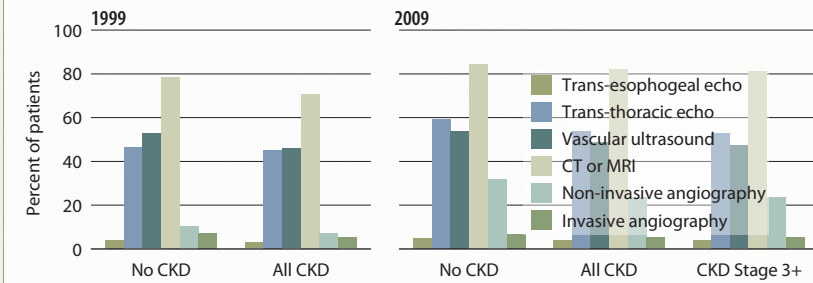


PATIENTS WITH A CVA/TIA

4.4i Geographic variations in rates (per 1,000 population) of CVA/TIA in CKD patients, by HSA



4.5i Patients hospitalized for CVA/TIA who receive diagnostic testing, by CKD status



There has been a striking reduction in the rate of CHF in CKD patients, from 416 per 1,000 population in 1999 to 325 in 2009; these findings may suggest selection bias. The change in geographic pattern, however, is unexplained, with the earlier clustering of CHF in the northeast shifting to a higher concentration in the southern states. Geographic patterns for CVA/TIA, in contrast, have remained stable, and the rate has declined more modestly, from 210 to 194.

There has been minimal change in the use of coronary angiography or stress testing to detect ischemic heart disease. Use of echocardiography, in contrast, has increased from 40–41 percent of both CKD and non-CKD patients in 1999 to 49–50 ten years later.

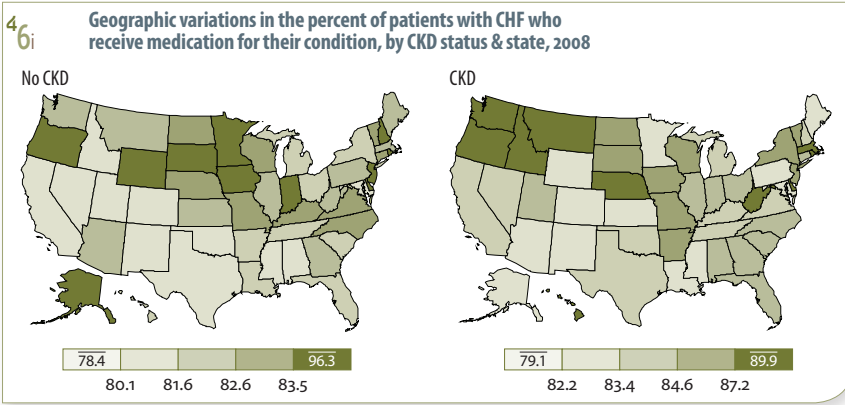
Among patients hospitalized for cerebrovascular events, the greatest change in diagnostic testing has occurred in the use of non-invasive angiography, which tripled between 1999 and 2009 — reaching 24 percent in CKD patients, and 32 percent in those without CKD. Trans-thoracic echocardiography, used in 45–46 percent of patients in 1999, was employed in 54 and 60 percent of CKD and non-CKD patients, respectively, in 2009. Trans-esophageal echocardiography, in contrast, continues to be used in only 3–5 percent of patients. Given to 82–85 percent of patients in 2009, CT scan or MRI are the most commonly used diagnostic tests. >> Figures 4.2–5; see page 125 for analytical methods. *January 1 point prevalent Medicare enrollees with a first CHF diagnosis (4.3) or first hospitalized CVA/TIA (4.5) in 1999 or 2009, age 66 & older, with fee-for-service coverage for 12 months before CHF diagnosis or admission for stroke.*

Despite prior reports on the underutilization of evidence-based therapies in the CKD population, there appears to have been a sea change in the treatment of cardiovascular disease in these patients. Although there are likely to be concerns over deteriorating renal function and hyperkalemia, more than half of patients with CHF and milder stages of CKD — and 48 percent of those with Stage 4–5 CKD — receive ACEIs/ARBs. Close to two-thirds of CKD patients with CHF, and an impressive 84 percent of Stage 4–5 CKD patients with AMI, receive a beta blocker.

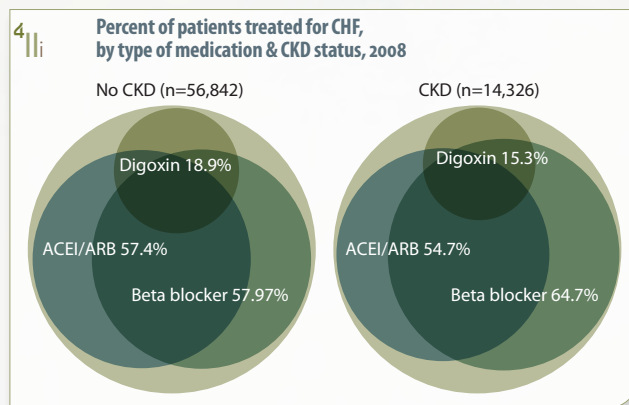
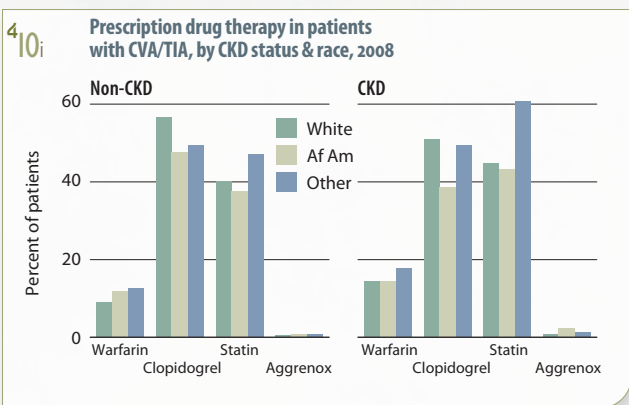
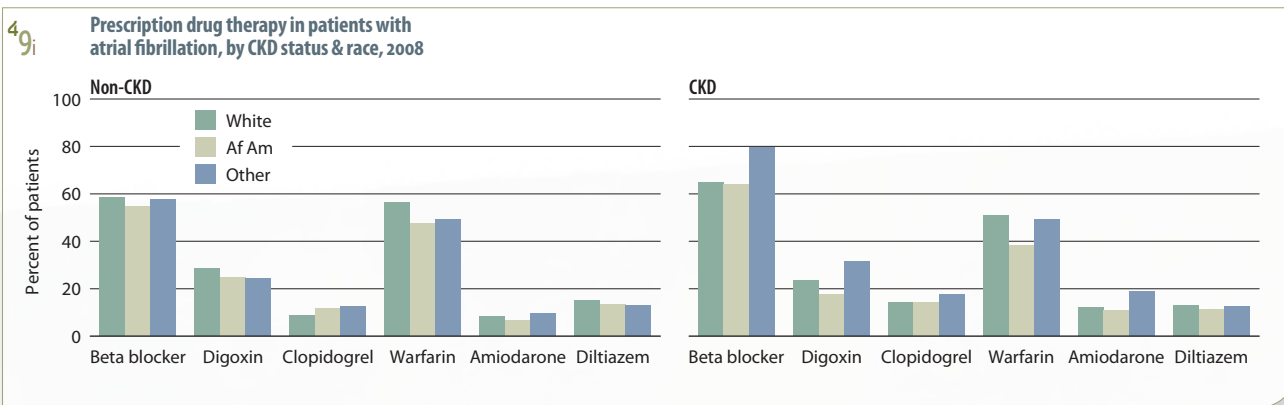
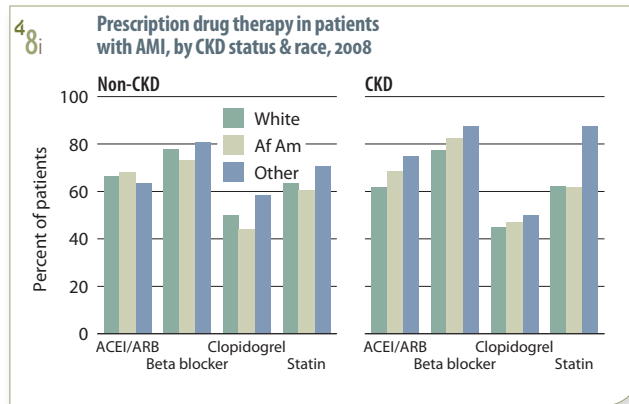
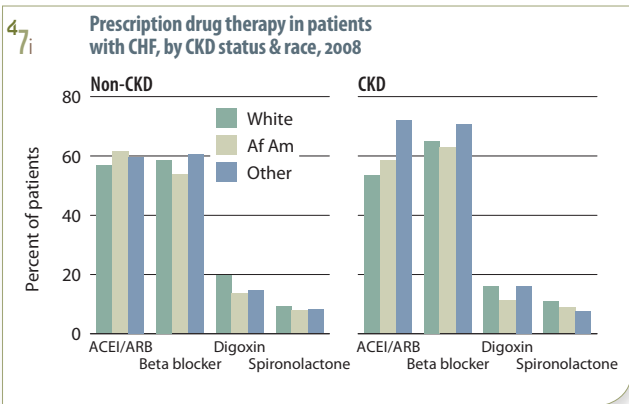
Although the efficacy of statin therapy in CKD patients has been controversial (these agents were widely prescribed in 2008, particularly for patients in the setting of “secondary prevention”), 66 percent of Stage 4–5 patients with AMI, and 49 percent of those with CVA/TIA, received a statin in 2009; this number reached 71 percent in patients undergoing coronary revascularization.

Warfarin therapy is used in 56 percent of non-CKD patients with atrial fibrillation, compared to 45 percent of patients with Stage 4–5 CKD. Use of amiodarone, in contrast, is more frequent in Stage 4–5 patients, at 14 versus 8 percent. >> [Table 4.b](#); see page 125 for analytical methods. *January 1 point prevalent Medicare enrollees age 66 & older, with a first cardiovascular diagnosis or procedure between January 1 & November 30, 2008, & with survival & Part D coverage for one month after event.*

Di	Cardiovascular disease & pharmacological intervention (percent), by CKD status & diagnosis code, 2008												
	N	ACEI/ARB	Beta blocker	Digoxin	Spironolactone	Eplerenone	Clopidogrel	Warfarin	Cilostazol	Pentoxifylline	Dipyridamol	Statin	Amiodarone
Congestive heart failure (CHF)													
Non-CKD	56,842	57.4	58.0	18.9	8.8	0.2	15.2	23.5	0.9	0.7	1.1	42.0	5.1
585.1-2	989	57.2	63.6	15.5	9.6	0.1	21.2	20.7	1.1	0.9	1.9	47.1	6.9
585.3	3,690	57.2	67.3	15.1	11.1	0.6	21.2	24.2	1.7	0.8	1.3	50.7	7.6
585.4-5	2,312	47.5	68.6	11.1	8.3	0.4	20.6	19.2	1.5	1.2	1.2	49.0	7.9
Unk/unsp	7,335	55.3	62.3	16.6	10.7	0.3	18.9	23.0	1.3	0.9	1.3	44.1	6.7
Acute myocardial infarction (AMI)													
Non-CKD	3,820	66.6	77.0	11.0	6.3	0.1	49.8	13.9	1.2	0.4	1.5	63.2	6.3
585.1-2	70	62.9	77.1	15.7	5.7	0.0	50.0	17.1	0.0	2.9	0.0	61.4	15.7
585.3	225	65.8	79.1	10.7	6.7	0.4	46.2	13.8	1.8	2.7	2.2	63.6	4.4
585.4-5	140	50.7	83.6	11.4	11.4	0.0	45.0	16.4	4.3	0.7	0.7	65.7	13.6
Unk/unsp	441	64.4	75.3	14.1	10.4	0.2	45.4	17.0	1.1	1.8	2.3	61.2	5.2
Peripheral arterial disease (PAD)													
Non-CKD	65,675	47.4	42.9	7.3	3.2	0.1	15.8	12.5	2.6	1.6	1.5	41.4	2.1
585.1-2	903	55.4	56.5	9.7	7.3	0.2	24.4	15.8	2.7	1.4	2.2	51.1	4.4
585.3	3,127	56.3	59.0	7.5	6.7	0.4	24.3	17.4	3.7	1.7	1.6	54.0	5.1
585.4-5	1,657	47.0	62.6	8.4	7.0	0.1	22.9	15.6	2.7	2.3	1.5	48.6	5.4
Unk/unsp	6,241	51.1	53.8	9.7	6.0	0.1	22.3	15.8	2.5	1.5	1.5	44.4	3.9
CVA/TIA													
Non-CKD	46,811	50.2	44.4	7.3	2.6	0.0	21.9	15.1	1.2	0.7	4.9	47.4	2.0
585.1-2	584	53.9	57.0	9.9	5.0	0.2	27.1	14.9	1.5	0.3	6.0	55.0	4.1
585.3	1,904	56.6	58.7	7.4	5.6	0.3	28.6	18.0	2.1	0.9	4.0	53.9	4.8
585.4-5	938	48.6	65.5	7.5	5.1	0.0	27.3	16.7	2.0	1.8	4.4	48.7	5.4
Unk/unsp	3,825	54.7	55.2	9.7	5.3	0.1	26.7	18.7	2.3	1.2	4.5	49.3	4.1
Atrial fibrillation (AFIB)													
Non-CKD	53,957	50.1	58.3	28.4	5.5	0.1	9.3	56.1	0.6	0.5	0.8	40.3	8.6
585.1-2	626	52.6	63.4	25.1	8.9	0.2	16.0	46.6	1.3	0.8	1.3	44.1	10.7
585.3	2,287	55.4	66.9	21.6	10.5	0.7	13.9	54.4	1.2	0.9	1.4	48.5	14.6
585.4-5	1,171	47.6	68.3	19.2	8.5	0.4	16.4	44.9	1.1	0.9	1.5	47.5	14.0
Unk/unsp	4,634	52.6	63.6	24.9	9.7	0.3	14.4	48.8	1.1	0.8	1.1	42.8	11.5
ICDs/CRT-D													
Non-CKD	564	75.2	82.1	28.0	22.3	0.2	26.2	35.8	0.5	0.5	0.4	58.5	14.0
585.1-2	17	58.8	76.5	17.6	11.8	0.0	35.3	35.3	0.0	0.0	0.0	70.6	5.9
585.3	69	71.0	89.9	27.5	20.3	0.0	26.1	33.3	0.0	2.9	0.0	68.1	23.2
585.4-5	31	51.6	83.9	25.8	9.7	0.0	32.3	25.8	3.2	0.0	3.2	61.3	12.9
Unk/unsp	88	64.8	80.7	27.3	21.6	1.1	25.0	37.5	0.0	0.0	0.0	61.4	21.6
Revascularization: PCI													
Non-CKD	4,441	65.6	75.9	6.7	3.5	0.2	90.1	11.3	1.2	0.5	1.3	74.2	3.5
585.1-2	55	58.2	70.9	7.3	1.8	0.0	81.8	18.2	1.8	1.8	0.0	69.1	9.1
585.3	192	63.0	75.0	6.3	5.7	0.5	85.9	11.5	4.2	1.6	1.6	71.4	3.6
585.4-5	77	57.1	84.4	11.7	11.7	0.0	83.1	11.7	3.9	0.0	0.0	71.4	2.6
Unk/unsp	344	66.6	77.0	9.3	6.1	1.2	87.8	11.9	1.7	1.5	1.5	72.4	6.4
Revascularization: CABG													
Non-CKD	1,152	64.3	84.2	10.2	4.3	0.0	32.4	20.7	0.5	0.3	1.3	78.9	30.9
585.1-2	5	40.0	100.0	20.0	0.0	0.0	0.0	20.0	0.0	0.0	0.0	100.0	60.0
585.3	38	71.1	86.8	5.3	5.3	0.0	39.5	21.1	0.0	2.6	0.0	76.3	28.9
585.4-5	11	54.5	81.8	0.0	0.0	0.0	45.5	9.1	9.1	0.0	0.0	63.6	9.1
Unk/unsp	65	69.2	83.1	4.6	7.7	0.0	40.0	20.0	0.0	0.0	0.0	81.5	35.4



>> Figures 4.6–II; see page 125 for analytical methods. January 1 point prevalent Medicare enrollees age 66 & older, with a first cardiovascular diagnosis or procedure between January 1 & November 30, 2008, & with survival & Part D coverage for one month after event.





## Prevalence of Cardiovascular Disease in CKD and non-CKD Patients, by CKD status and diagnosis code, 2009 (table 4.a)

PERCENT OF PATIENTS

CHF: non-CKD	» ALL 7.4 » AGE 66-69 3.6 » 70-74 4.8 » 75-84 8.3 » 85+ 15.4 » WHITE 7.4 » AFRICAN AMERICAN 8.9
CHF: CKD STAGE 4-5	» ALL 4.2 » AGE 66-69 3.4 » 70-74 3.5 » 75-84 4.1 » 85+ 4.9 » WHITE 4.2 » AFRICAN AMERICAN 4.1
AMI: non-CKD	» ALL 2.3 » AGE 66-69 1.7 » 70-74 1.9 » 75-84 2.6 » 85+ 3.1 » WHITE 2.4 » AFRICAN AMERICAN 1.9
AMI: CKD STAGE 4-5	» ALL 1.1 » AGE 66-69 0.8 » 70-74 1.0 » 75-84 1.1 » 85+ 1.1 » WHITE 1.1 » AFRICAN AMERICAN 0.9
CVA/TIA: non-CKD	» ALL 7.7 » AGE 66-69 4.2 » 70-74 5.9 » 75-84 9.3 » 85+ 12.4 » WHITE 7.7 » AFRICAN AMERICAN 8.8
CVA/TIA: CKD STAGE 4-5	» ALL 2.0 » AGE 66-69 1.7 » 70-74 1.8 » 75-84 2.1 » 85+ 2.1 » WHITE 2.0 » AFRICAN AMERICAN 2.2
AFIB: non-CKD	» ALL 9.2 » 66-69 4.0 » 70-74 6.2 » 75-84 11.3 » 85+ 16.6 » WHITE 9.8 » AFRICAN AMERICAN 4.3
AFIB: CKD STAGE 4-5	» ALL 2.5 » AGE 66-69 1.5 » 70-74 1.8 » 75-84 2.6 » 85+ 3.0 » WHITE 2.7 » AFRICAN AMERICAN 1.4

## Cardiovascular Disease and Pharmacological Interventions, by CKD status and diagnosis code, 2008 (table 4.b)

PERCENT OF PATIENTS

CHF: non-CKD	» ACEI/ARB 57.4 » BETA BLOCKER 58.0 » DIGOXIN 18.9 » SPIRONOLACTONE 8.8
CHF: CKD STAGE 4-5	» ACEI/ARB 47.5 » BETA BLOCKER 68.6 » DIGOXIN 11.1 » SPIRONOLACTONE 8.3
AMI: non-CKD	» ACEI/ARB 66.6 » BETA BLOCKER 77.0 » CLOPIDOGREL 49.8 » STATINS 63.2
AMI: CKD STAGE 4-5	» ACEI/ARB 50.7 » BETA BLOCKER 83.6 » CLOPIDOGREL 45.0 » STATINS 65.7
CVA/TIA: non-CKD	» CLOPIDOGREL 21.9 » WARFARIN 15.1 » DIPYRIDAMOLE 4.9 » STATINS 47.4
CVA/TIA: CKD STAGE 4-5	» CLOPIDOGREL 27.3 » WARFARIN 16.7 » DIPYRIDAMOLE 4.4 » STATINS 48.7
AFIB: non-CKD	» ACEI/ARB 50.1 » BETA BLOCKER 58.3 » DIGOXIN 28.4 » WARFARIN 56.1
AFIB: CKD STAGE 4-5	» ACEI/ARB 47.6 » BETA BLOCKER 68.3 » DIGOXIN 19.2 » WARFARIN 44.9