



Louis Hennepin, 1698

Précis: an introduction  
 to chronic kidney  
 disease in the U.S.

- 26 CKD in the general population
- 28 identification & care of patients with CKD
- 30 identification of CKD
- 31 hospitalization & mortality
- 33 CVD
- 35 part D drug coverage
- 37 AKI
- 39 costs of CKD

Since the United Nations Summit on Non-Communicable Diseases (NCDs) in September, 2011, chronic kidney disease has received greater attention by member states. For the first time, because of its impact on morbidity and mortality and its substantial costs, CKD was mentioned in the summary political declaration as an important complicating disease that member states should consider as they define their health-care priorities.

The growing number of ESRD patients needs to be addressed in terms not only of its public health disease burden, but of its costs to the health-care system, and of the high demand for replacement organs. And the overall prevention of kidney disease needs to be viewed in the context of competing demands for resources, particularly in the difficult economic times currently faced around the world.

As shown in the Venn diagrams on the next page, 9.3 and 8.5 percent of patients in the general population had diabetes and cardiovascular disease, respectively, in 2005–2010, while 13.1 percent had some evidence of kidney disease, defined by a one-time estimated GFR less than 60 ml/min/1.73 m<sup>2</sup> or a urine albumin/creatinine ratio (ACR) of 30 mg/g or higher. Using only the eGFR, CKD prevalence was 6.3 percent; using only the ACR, it reached 9.2 percent — on a par with diabetes and cardiovascular disease. There is now substantial evidence that both eGFR and urine ACR are predictors of all-cause death, cardiovascular events, and ESRD (Lancet 2010).

While greater precision is needed for the diagnosis of an individual patient, with repeated measurements of both urine and blood tests, abnormal eGFR and ACR levels are known to be associated with diabetes and hypertension — both major risk factors for ESRD. Awareness, treatment, and control of these conditions are thus crucial. NHANES data show that blood pressure control in the general population reaches almost 70 percent in the non-CKD general population, but only 45–47 percent in those with low eGFRs and elevated urine ACRs, while control of LDL cholesterol control is 57 percent in the non-CKD population, but only 33 percent in the CKD cohort.

While CKD has been characterized from population-level estimates in the NHANES data, much of the disease is silent and unrecognized, complicating any full assessment of its impact. We present data on CKD recognized through diagnosis codes reported on claims — an approach which clearly underestimates CKD in the Medicare population, but has been shown to have high specificity, indicating individuals likely to have the disease. As identified from these codes within the 2011 prevalent population, CKD is recognized in 10 percent of older Medicare patients, and 1.5 percent of the younger employed population.

Despite this high CKD disease burden, the rate of new cases of ESRD has been relatively stable over the last several years, and has in fact begun to decline, suggesting that CKD patients are either dying before they reach ESRD or progressing to ESRD at a slower rate secondary to better risk factor control (see data from NHANES in Chapter One). The continuing decline

behold the threaden sails,  
 Borne with the invisible and creeping wind,  
 Draw the huge bottoms through the furrow'd sea,  
 Breasting the lofty surge...

William Shakespeare  
 HENRY V

in rates of death from cardiovascular disease — the major cause of mortality in the CKD population — along with improved treatment and control of hypertension and increased use of ACEIs/ARBs/renin inhibitors, suggest that progression of CKD to ESRD may indeed have slowed.

Care of CKD patients after diagnosis is challenging to assess. In the Medicare CKD population age 65 and older, it appears that 93 percent see a primary care physician within a year of diagnosis, while 63 percent visit a cardiologist; only 31 percent, however, see a nephrologist. When restricted to patients with CKD of Stages 3–5 (based on diagnosis codes), these rates reach 93, 64, and 57 percent. Similar data are reported for the employed population. And as we show in Chapter Two, only one-sixth of patients with diabetes, and 5 percent of those with hypertension, receive a urine albumin test in the year, despite the fact that these measurements are recommended by the American Diabetes Association and the American Heart Association.

Rates of hospitalization, and of rehospitalization within 30 days, are progressively higher with advancing CKD. The issue of rehospitalization has received more attention for patients in the general population than for those with CKD, despite the fact that the rate for CKD patients is almost 40 percent higher. The rate accelerates as patients approach ESRD, reaching 43 percent in the month prior to ESRD initiation (2012 ADR). These data show the substantial burden of disease and needed care in the CKD population, burdens illustrated as well in our data on mortality and cardiovascular disease in CKD patients.

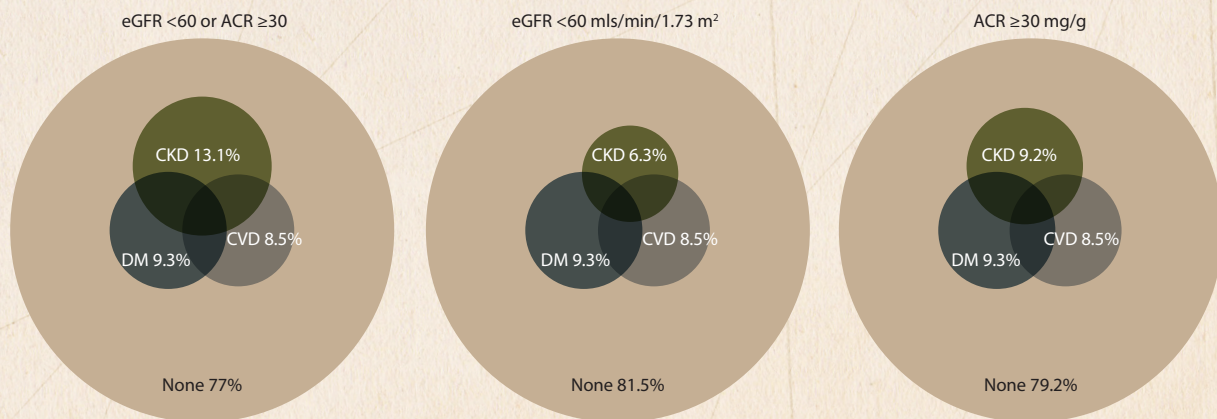
New figures this year show that, when compared to use in the general population, Medicare Part D prescription drug use for those with CKD is dominated by diuretics, statins, beta blockers, ACEIs, and calcium channel blockers. Interestingly, thyroid replacement therapy is very common in the CKD population, a fact which has received little attention. It appears that in 2011 a greater portion of individuals with Part D coverage opted for a higher premium plan, possibly reflecting interest in better coverage for medications.

This year we again highlight data on acute kidney injury (AKI). In both the Medicare and employed populations, rates of AKI rise with age. Next to the code for the AKI event itself, septicemia is the most commonly reported principal diagnosis code. Recurrent hospitalizations for AKI are common, with rates reaching 34 percent overall, and rising to 41 percent for blacks/African Americans. The rate of outpatient follow-up with a nephrologist in the year following AKI, however, is under 20 percent, a major concern for continuity of care.

The costs associated with the recognized CKD population are considerable, and increase with CKD stage — a fact that is consistent with the heavy burden of CVD and other chronic diseases. The costs of medications for this population are also substantial; more than half of Medicare patients with recognized CKD use diuretics, statins, beta blockers, and ACEIs/ARBs, demonstrating active treatment but also showing where under-treatment may exist.

♦ **Figure 1.1;** see page 140 for analytical methods. NHANES participants 2005–2010, age 20 & older; single-sample estimates of eGFR & ACR.

vol 1  
 1.1 Distribution of NHANES 2005–2010 participants with diabetes, cardiovascular disease, & single-sample markers of CKD



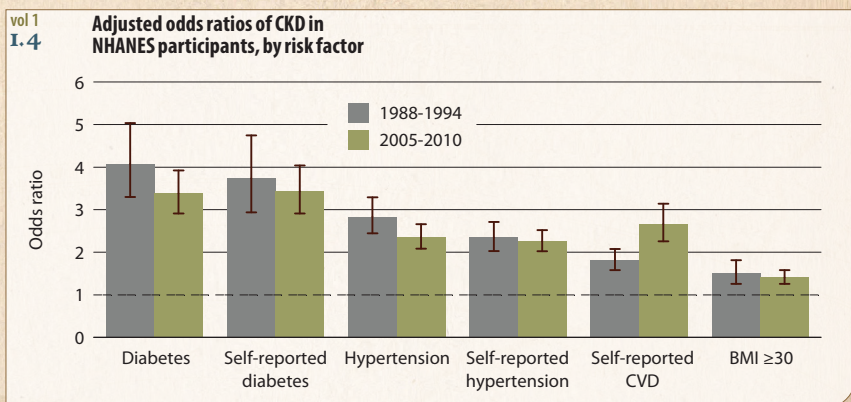
Spot estimates of eGFR less than 60 ml/min/1.73 m<sup>2</sup> and ACR ≥30 mg/g for adult NHANES 1988–1994 and 2005–2010 participants are shown in Table 1.a. For the presence of either spot eGFR <60 or spot ACR ≥30, prevalence estimates rose from 12.3 to 14.0 percent. The largest relative increase (1.6-fold) was seen in those with cardiovascular disease, for whom estimates rose from 25.4 percent to 40.8 percent. For spot eGFR <60, prevalence rose from 4.9 to 6.7 percent overall, with the largest relative increase (1.7-fold) in those age 40–59; prevalence for spot ACR ≥30 rose from 8.8 to 9.4 percent overall, and from 16.6 to 24.3 percent for those with cardiovascular disease. + Table 1.a; see page 140 for analytical methods. NHANES 1988–1994 & 2005–2010 participants age 20 & older; single sample estimates of eGFR & ACR; eGFR calculated using the CKD-EPI equation.

Adjusted odds ratios for spot eGFR <60 ml/min/1.73 m<sup>2</sup> or spot ACR ≥30 mg/g were lower in NHANES 2005–2010 participants than in 1988–1994 participants for all associations except self-reported cardiovascular disease, where adjusted odds ratios rose from 1.81 to 2.66. + Figure 1.4; see page 140 for analytical methods. NHANES 1988–1994 & 2005–2010 participants age 20 & older; single sample estimates of eGFR & ACR. Adj: age, gender, & race; eGFR calculated using the CKD-EPI equation.

vol 1  
1.a

**Prevalence (%) of CKD in the NHANES population within age, gender, race/ethnicity, & risk factor categories**

	All CKD		eGFR <60 ml/min/1.73 m <sup>2</sup>		ACR ≥30 mg/g	
	1988–1994	2005–2010	1988–1994	2005–2010	1988–1994	2005–2010
20–39	5.1	5.7	0.1	0.2	5.0	5.7
40–59	8.4	9.1	1.3	2.2	7.7	7.6
60+	32.2	35.0	19.5	24.1	18.3	18.4
Male	10.2	12.1	4.1	5.6	7.4	8.6
Female	14.2	15.8	5.6	7.7	10.2	10.2
Non-Hispanic white	12.3	14.3	5.5	7.9	8.2	8.6
Non-Hispanic black/Af Am	14.5	16.0	4.1	6.2	12.7	12.6
Other	10.5	11.9	2.2	2.6	9.2	10.6
Diabetes	43.1	40.1	15.6	19.3	36.3	29.9
Self-reported diabetes	42.7	41.6	16.4	20.4	35.9	30.8
Hypertension	22.2	23.2	10.4	12.9	15.4	14.8
Self-reported hypertension	25.3	26.8	12.9	15.6	17.1	16.7
CVD	25.4	40.8	14.5	27.9	16.6	24.3
BMI ≥30	16.6	16.8	6.2	7.4	12.3	11.7
All	12.3	14.0	4.9	6.7	8.8	9.4



pr

1

2

3

4

5

6

7

Between 1988–1994 and 2005–2010, improvements in the management of hypertension and diabetes were present regardless whether spot eGFR or spot ACR were used for subgroup definition. • **Figures 1.12 & 1.15**; see page 140 for analytical methods. *NHANES 1988–1994 & 2005–2010 participants age 20 & older; single sample estimates of eGFR & ACR; dialysis patients excluded from NHANES 2005–2010; eGFR calculated using the CKD-EPI equation.*

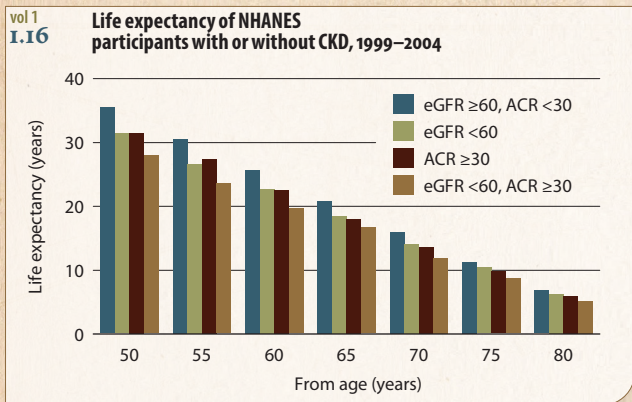
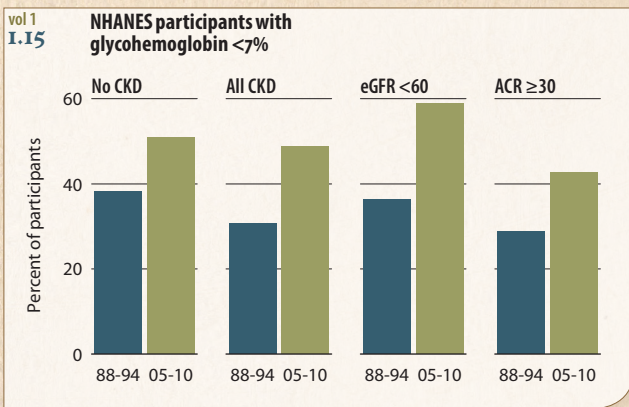
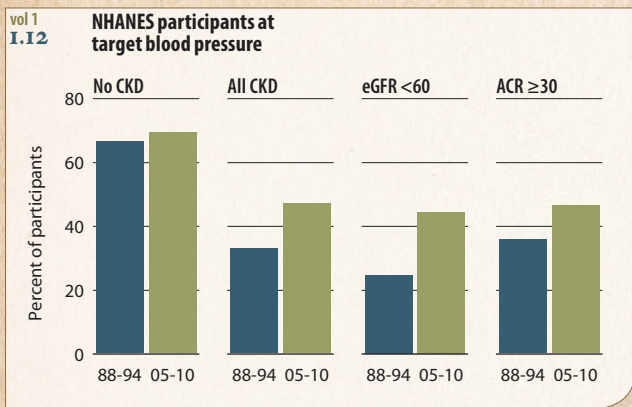
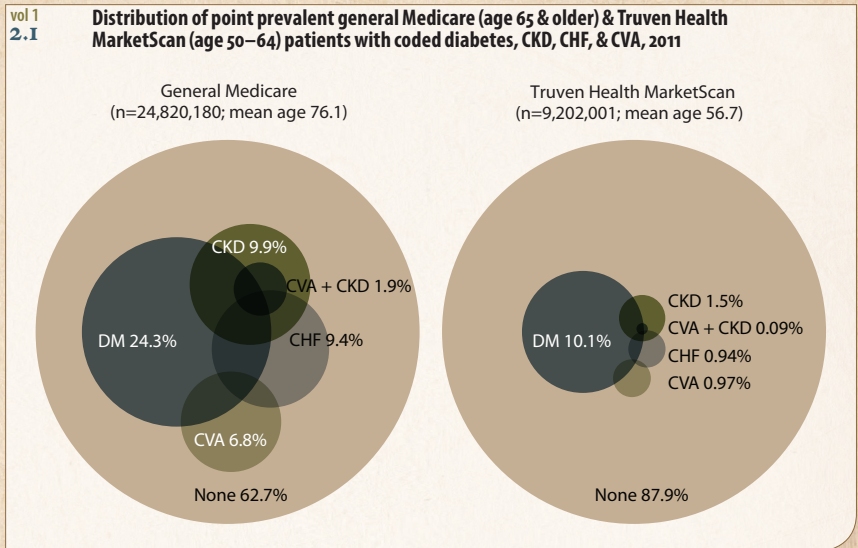


Figure 1.16 shows life expectancy estimates for adult NHANES 1999–2004 participants with single-sample estimates of GFR <60 ml/min/1.73 m<sup>2</sup> and ACR ≥30 mg/g. At age 50, estimated life expectancy for subjects with eGFR ≥ 60 and ACR <30 was 35.5 years; the reduction in life expectancy associated with eGFR <60, ACR ≥30 and both conditions were 4.1 years (11.4% of 35.5 years), 4.0 years (11.3%) and 7.5 years (21.2%), respectively. When life expectancy is calculated from successively older starting points, absolute reductions decline and percentage reductions remain similar. • **Figure 1.16**; see page 140 for analytical methods. *NHANES 1999–2004 participants age 20 & older. Single-sample estimates of eGFR & ACR; eGFR calculated using the CKD-EPI equation.*

As expected, disease prevalence is lower for the younger EGHP patients than those age 65 and older in the general Medicare population. Diabetes affects 24.3 percent of general Medicare patients age 65 and older compared to 10.1 percent in patients with private insurance age 50–64. Heart failure is present in 9.4 percent of the general population and affects less than one percent of those in the employed group. And when compared to EGHP patients, the presence of CKD is nearly 7-fold higher in the general population. ♦ **Figure 2.1;** see page 141 for analytical methods. Point prevalent general (fee-for-service) Medicare pts age 65 & older; point prevalent MarketScan pts age 50–64. DM, CKD, CHF, & CVA determined from claims.



The type of physician seen after a CKD diagnosis changes with CKD severity. In Medicare CKD patients, the probability of seeing a nephrologist is 0.24–0.35 across demographic groups and 0.42–0.60 in those with a diagnosis code of 585.3 or higher. In employed CKD patients, the probability is 0.27 overall, 0.54 in patients with a code of 585.3 or higher. ♦ **Tables 2.g–h;** see page 142 for analytical methods. Patients alive & eligible all of 2010. CKD diagnosis represents date of first CKD claim during 2010; physician claims searched during the following 12 months.

vol 1  
2.g

**Cumulative probability of a physician visit by month 12 after CKD diagnosis in 2010, by demographic characteristics, physician specialty, & dataset**

	Medicare (65+)			Truven Health MarketScan (50–64)		
	Primary care	Cardiologist	Nephrologist	Primary care	Cardiologist	Nephrologist
50-54				0.78	0.31	0.25
55-59				0.80	0.36	0.27
60-64				0.82	0.40	0.29
65-74	0.91	0.60	0.33			
75-84	0.93	0.66	0.31			
85+	0.93	0.66	0.24			
Male	0.92	0.67	0.31	0.80	0.38	0.27
Female	0.93	0.61	0.29	0.82	0.35	0.28
White	0.92	0.64	0.29			
Black/Af Am	0.91	0.61	0.35			
Other	0.90	0.58	0.30			
All	0.93	0.63	0.31	0.82	0.35	0.27

vol 1  
2.h

**Cumulative probability of a physician visit by month 12 after a CKD diagnosis code of 585.3 or higher in 2010, by demographic characteristics, physician specialty, & dataset**

	Medicare (65+)			Truven Health MarketScan (50–64)		
	Primary care	Cardiologist	Nephrologist	Primary care	Cardiologist	Nephrologist
50-54				0.79	0.37	0.57
55-59				0.81	0.40	0.56
60-64				0.83	0.43	0.55
65-74	0.91	0.61	0.60			
75-84	0.93	0.67	0.54			
85+	0.94	0.67	0.42			
Male	0.93	0.61	0.52	0.81	0.43	0.56
Female	0.92	0.69	0.56	0.83	0.38	0.56
White	0.93	0.65	0.53			
Black/Af Am	0.91	0.62	0.58			
Other	0.91	0.58	0.53			
All	0.93	0.64	0.57	0.85	0.45	0.54

pr

1

2

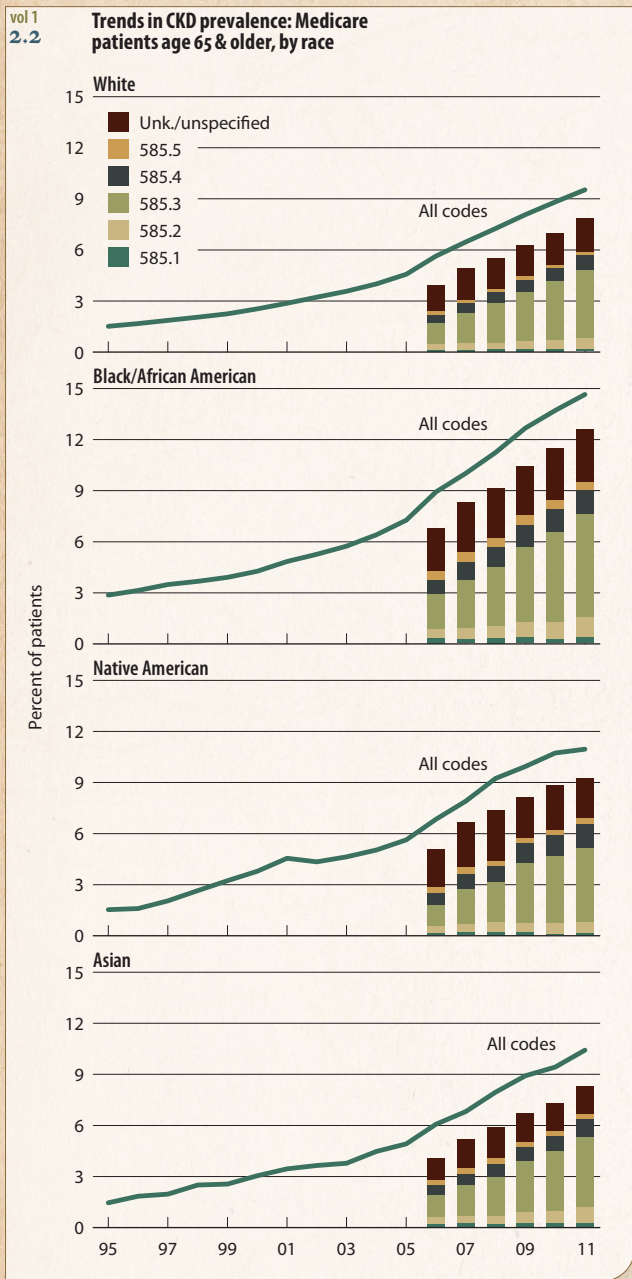
3

4

5

6

7



Among Medicare patients, claims data continue to identify more prevalent CKD than found using only the combined 585 codes. In 2011, for example, 14.7 percent of black/African American patients in the Medicare database, and 11 percent of Native American patients, were identified as having prevalent CKD, compared to 12.6 and 9.2 percent found using the 585 codes alone.

The most commonly reported stage-specific code in the prevalent CKD population is 585.3 (Stage 3), at 6.1 percent for black/African American Medicare patients and 4.0–4.3 percent for Medicare patients of other races. ♦ **Figure 2.2**; see page 141 for analytical methods. *Prevalent Medicare patients surviving cohort year, without ESRD, age 65 & older.*

#### 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.*

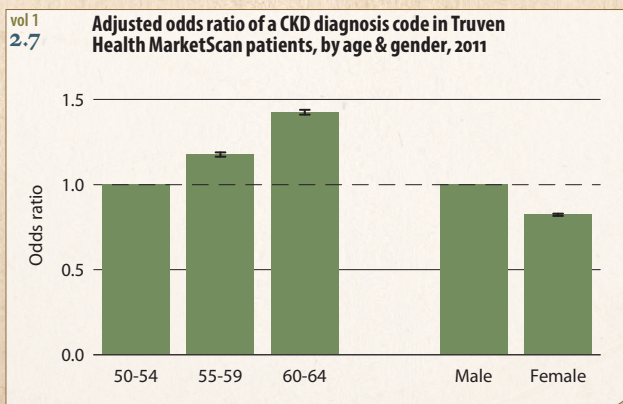
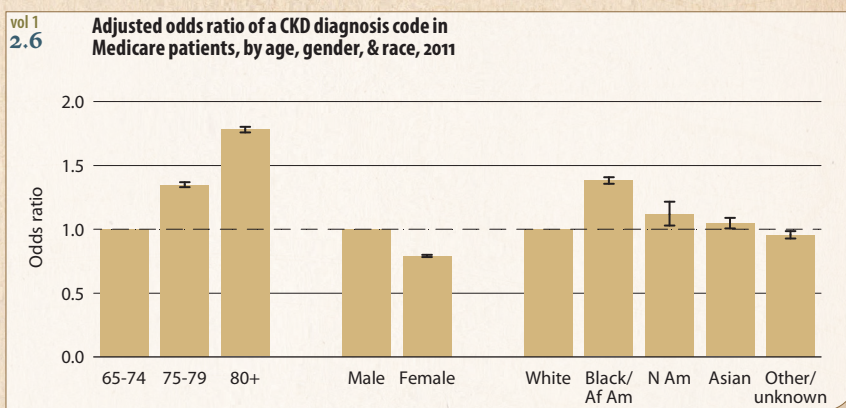
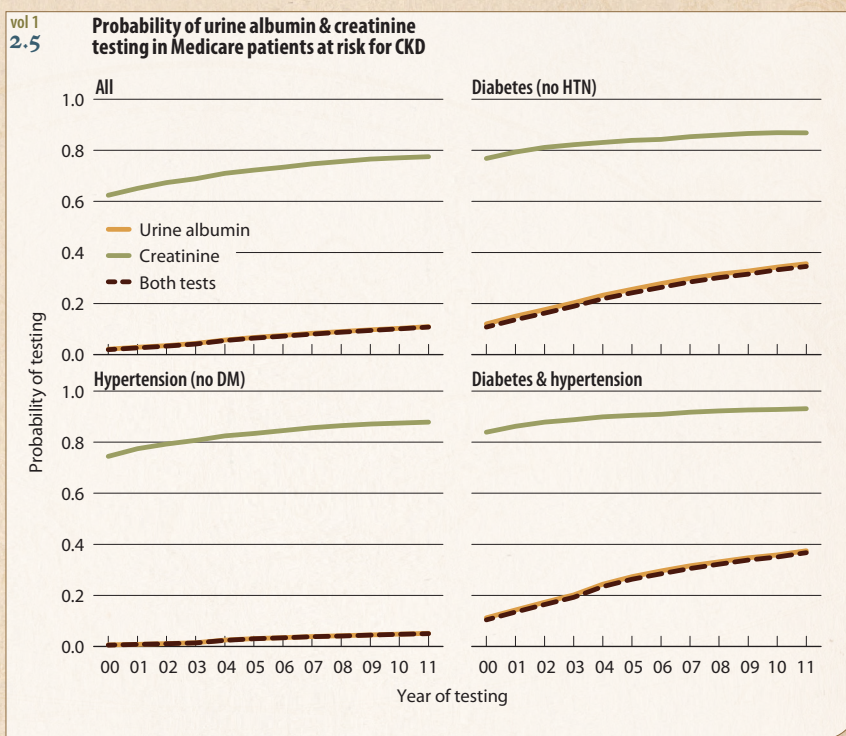
*CKD stage estimates are from a single measurement. For clinical case definition, abnormalities should be present ≥3 months.*

It is important that individuals at risk for CKD be screened periodically for kidney disease. Urine albumin and creatinine tests are valuable laboratory markers used to detect early signs of kidney damage. In 2011, the probability of creatinine testing in Medicare patients at risk for CKD was 0.78; the probability of receiving a urine albumin test (which must be ordered separately), in contrast, was 0.11.

In patients with either diabetes or hypertension alone, the probability of creatinine testing in 2011 was 0.87–0.88; the probability of urine albumin testing in those with diabetes alone was 0.36, compared to 0.05 in patients with hypertension alone.

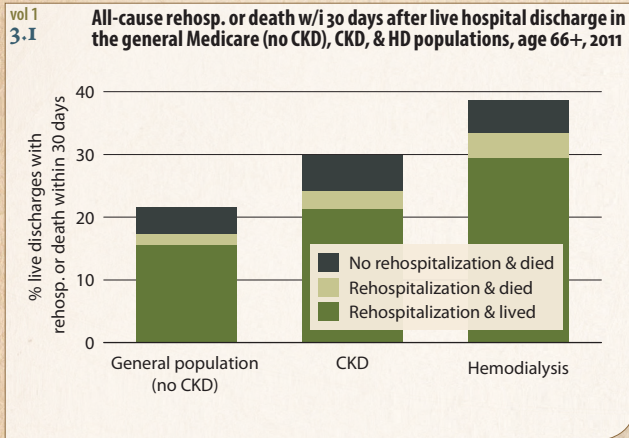
Having both diabetes and hypertension greatly increases the odds of developing CKD. The probability of creatinine testing in patients with both conditions was 0.93 in 2011, while the probability of a urine albumin test was 0.37; the probability of receiving both tests was 0.37. Because urine albumin testing must be ordered separately, it may represent a true intent to assess kidney disease. + **Figure 2.5**; see page 142 for analytical methods. *Medicare patients from the 5 percent sample, age 20 & older, with Parts A & B coverage in the prior year; patients diagnosed with CKD or ESRD during prior year are excluded. Tests tracked during each year.*

The odds of a CKD diagnosis code in Medicare patients age 65 and older, and in Truven Health MarketScan patients age 50–64, are higher in older patients and males compared to their respective reference populations; for Medicare patients, the odds are greater for blacks/African Americans than for patients of other races. + **Figures 2.6–7**; see page 142 for analytical methods. *Medicare patients age 65 & older & Truven Health MarketScan patients age 50–64, alive & eligible for all of 2011. CKD claims as well as other diseases identified in 2011.*



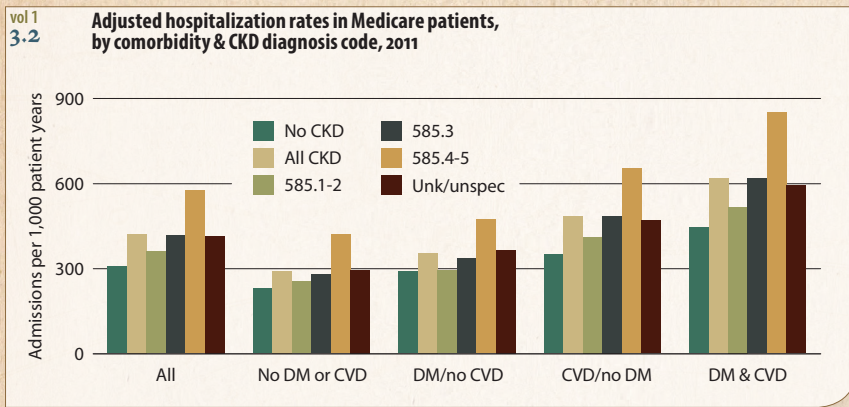


Thirty-three percent of hemodialysis patients are rehospitalized within 30 days, compared to 24 percent of patients with CKD, and 17.4 percent of those in the general Medicare population. These rates have not changed in the past decade, which is a major concern. + **Figure 3.1**; see page 142 for analytical 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.

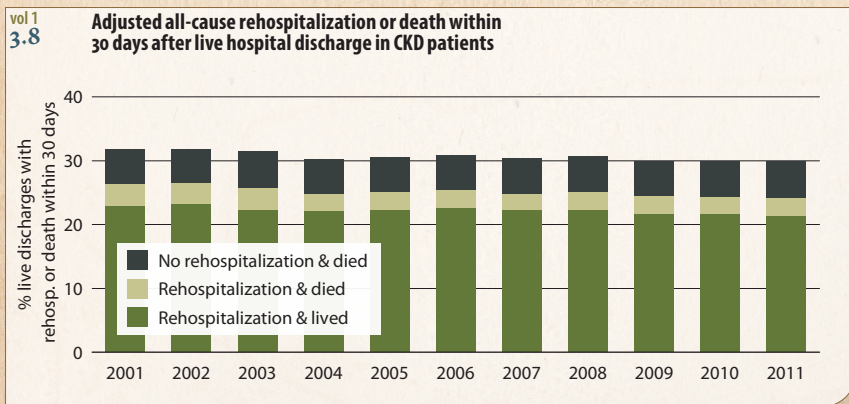


**vol 1 3.b** Percent live hospital discharges in CKD patients with an all-cause rehospitalization within 30 days, 2011

	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 rehospi & died	4.2	5.7	5.1	5.3	6.9	5.8
Rehospi & died	1.8	2.8	2.8	2.5	3.8	2.7
Rehospi & lived	15.6	21.4	19.7	21.5	22.6	21.2

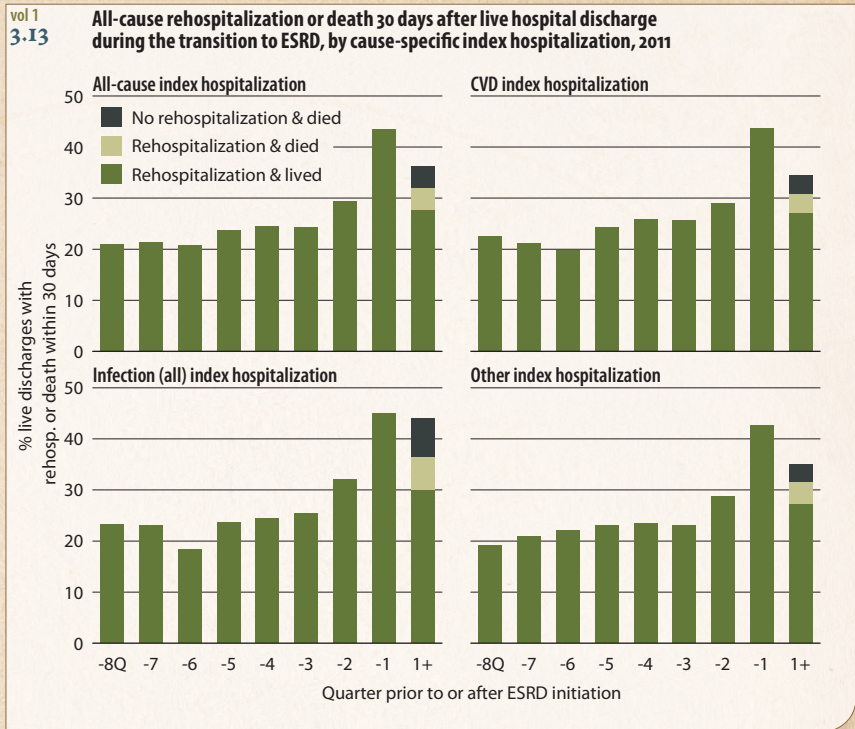


In both CKD and non-CKD populations age 66 and older, adjusted rates of hospitalization increase with greater comorbidity. In 2011, for example, admissions for Stage 4-5 CKD patients with both diabetes and cardiovascular disease reached 851 per 1,000 patient years — more than twice the rate among patients with neither diagnosis. + **Figure 3.2**; see page 142 for analytical methods. January 1, 2011 point prevalent Medicare pts, age 66 & older on December 31, 2010. See chapter for adjustments.

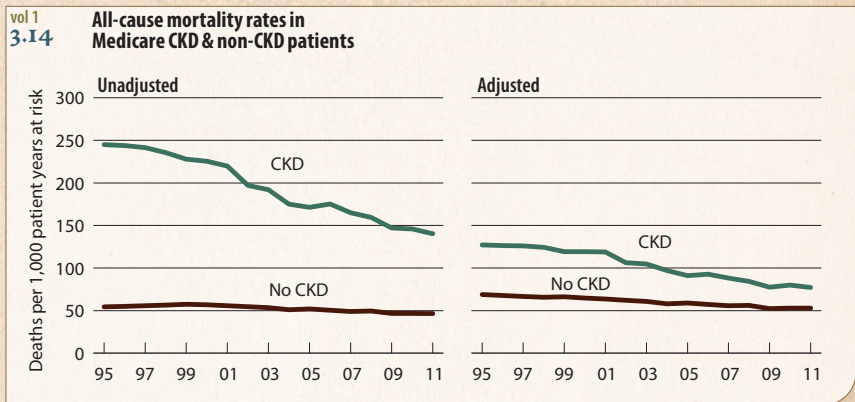


In 2011, 24 percent of CKD patients were rehospitalized within 30 days of a hospital discharge, down slightly from 26 percent in 2001. + **Figure 3.8**; see page 143 for analytical methods. Point prevalent Medicare CKD patients on January 1 of each year, age 66 & older on December 31 of the prior year. Adj: age/gender/race; ref: discharges in 2010. Includes discharges from January 1 to December 1 of each year.

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.*

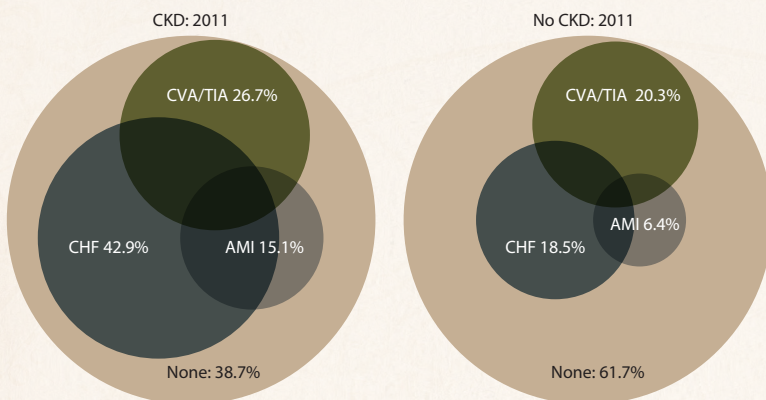


Overall, adjusted mortality per 1,000 patient years among Medicare patients age 66 and older with CKD is lowest for those with CKD of Stages 1–2, at 64.8, above the rate of 53.8 for those with no CKD. Rates rise to 108.5 in individuals with Stage 4–5 CKD. Mortality is consistently higher in men compared 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.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

vol 1  
4.1 Cardiovascular disease in patients with or without CKD, 2011

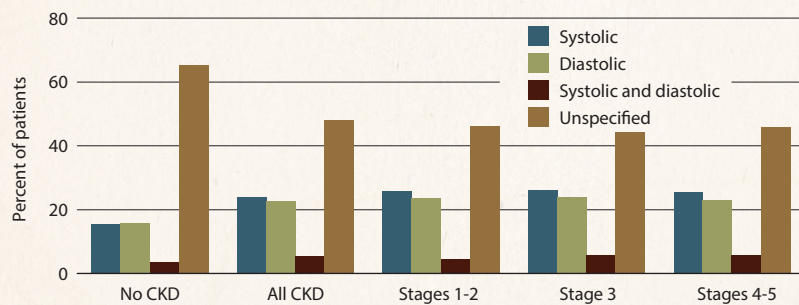


Elderly patients with CKD had a greater burden of cardiovascular disease (CVD) in 2011 than did their non-CKD counterparts. Congestive heart failure, for example, was identified in 43 percent of CKD patients, compared to just 18.5 percent of their non-CKD counterparts. ♦ **Figure 4.1**; see page 144 for analytical methods. December 31, 2011 point prevalent Medicare enrollees with CVD, age 66 & older, with fee-for-service coverage for the entire calendar year.

vol 1  
4.C Characteristics of patients with heart failure, by CKD status, 2011

	Systolic heart failure					Diastolic heart failure					Systolic & diastolic heart failure					Unspecified heart failure				
	No CKD	All CKD	1-2	3	4-5	No CKD	All CKD	1-2	3	4-5	No CKD	All CKD	1-2	3	4-5	No CKD	All CKD	1-2	3	4-5
Age: 66-69	14.6	12.1	13.6	12.4	11.5	11.1	9.4	11.7	9.1	8.5	10.9	10.4	17.3	10.1	7.7	10.6	9.8	11.8	9.6	8.9
70-74	19.8	17.2	15.7	18.2	16.2	17.0	15.5	16.1	15.1	17.4	16.7	15.8	16.0	14.4	17.5	15.5	14.9	18.4	15.4	13.3
75-84	38.5	40.8	41.2	41.7	38.2	38.8	39.7	39.0	40.2	37.5	41.1	39.9	37.3	44.4	38.8	36.9	38.7	34.9	40.5	41.0
85+	27.1	30.0	29.5	27.8	34.1	33.0	35.4	33.2	35.5	36.6	31.3	34.0	29.3	31.1	36.1	36.9	36.6	35.0	34.5	36.8
Male	46.1	50.4	53.8	51.2	47.3	26.2	28.8	28.8	29.2	28.9	38.6	42.0	53.3	43.4	40.4	32.6	38.9	39.9	41.5	38.7
Female	53.9	49.6	46.2	48.8	52.7	73.8	71.2	71.2	70.8	71.1	61.4	58.0	46.7	56.6	59.6	67.4	61.1	60.1	58.5	61.3
White	86.0	81.7	81.2	81.3	77.1	85.4	81.1	78.4	81.6	79.6	84.9	81.2	74.7	81.7	76.0	82.9	79.3	76.5	79.0	79.3
Black/Af Am	8.7	12.4	14.0	12.9	14.4	8.9	12.5	14.0	12.4	13.7	8.1	11.0	14.7	10.1	14.8	10.5	13.7	16.2	14.1	13.0
Other	5.4	5.9	4.8	5.7	8.5	5.7	6.3	7.5	6.1	6.7	7.0	7.9	10.7	8.2	9.3	6.6	7.0	7.3	6.9	7.7
Non-diabetes	59.5	41.6	46.0	39.2	35.4	59.1	40.8	42.3	39.2	36.8	57.8	39.1	49.3	35.2	32.2	59.8	43.3	41.1	41.8	40.6
Diabetes	40.5	58.4	54.0	60.8	64.6	40.9	59.2	57.7	60.8	63.2	42.2	60.9	50.7	64.8	67.8	40.2	56.7	58.9	58.2	59.4
ACEI/ARB	74.5	76.9	70.6	61.2	74.1	62.9	70.4	64.1	58.3	67.1	71.4	70.7	68.5	54.6	67.1	59.9	65.3	64.3	55.6	61.5
Beta blocker	82.0	86.0	86.3	86.9	84.6	67.0	73.0	75.8	78.2	73.5	76.0	76.0	81.7	81.4	74.4	62.6	70.1	71.0	74.2	66.6
Digoxin	24.5	28.3	22.7	18.7	26.3	14.4	10.9	10.9	8.0	14.2	20.4	10.7	15.8	10.4	17.6	16.2	12.7	11.9	8.7	13.8

vol 1  
4.6 Heart failure in patients with or without CKD, 2011



Based on clinical trials in patients with systolic heart failure (HF), both ACEIs/ARBs and beta-blockers are indicated treatments. Consistent with these strong evidence-based recommendations, 75 and 82 percent of non-CKD patients receive ACEI/ARB and beta blocker therapy, respectively, compared to 77 and 86 percent in the CKD population.

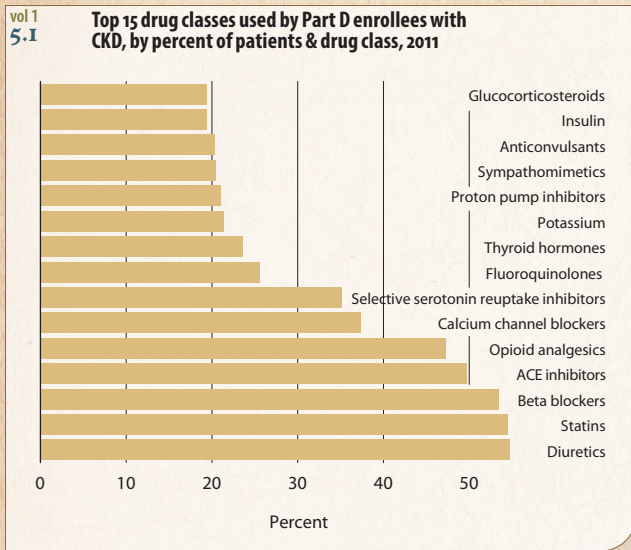
In non-CKD patients with "pure" diastolic HF, 62.9 percent receive an ACEI/ARB, 73 percent beta blocker therapy, and 14.4 percent digoxin therapy. For CKD, the respective numbers are 70, 73, and 10.9 percent. ♦ **Table 4.c & Figure 4.6**; see page 145 for analytical methods. December 31 point prevalent patients with Medicare Parts A, B, & D enrollment, 2011.

Although prior publications have demonstrated a strong inverse relationship between the likelihood of cardioprotective therapy use and advanced CKD stage, our overview of 2011 prevalent Medicare patients with Part D coverage provides some reassurance that this practice pattern has changed. While ACEI/ARB use in CHF patients does decline with advancing CKD, the same is not true of beta blocker therapy, which increases with CKD stage. The use of beta blocker therapy after AMI also demonstrates a change with respect to CKD. Despite earlier data indicating underutilization inversely related to eGFR, 76 percent of 2011 CKD patients with AMI — and a surprising 82 percent of those with Stage 4–5 CKD — received a beta blocker.

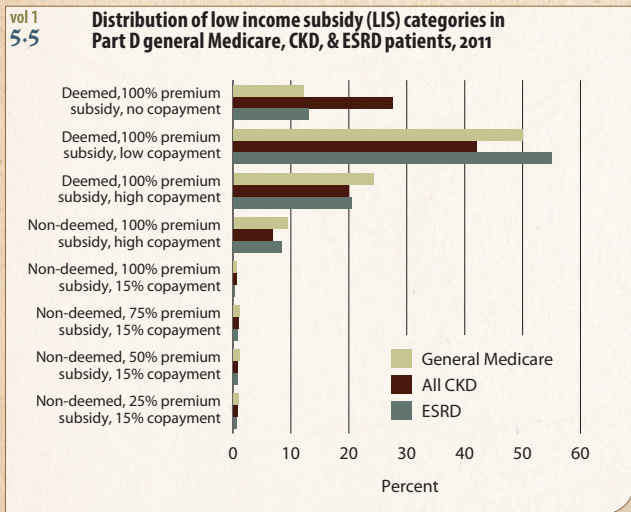
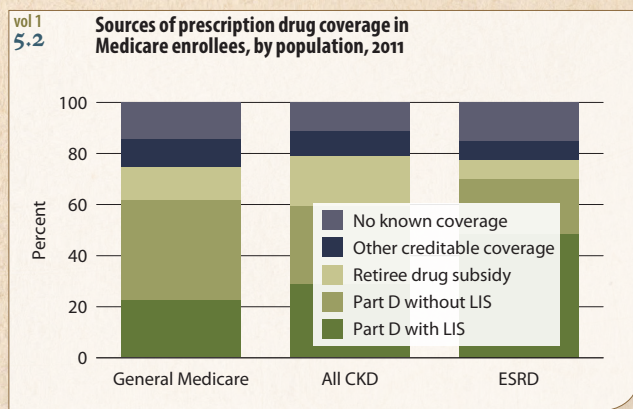
The treatment of AFIB presents a special clinical problem in CKD patients. In comparisons of warfarin to newer oral anticoagulants in CKD patients, dabigatran was associated with the largest reduction in risk of ischemic stroke and apixaban with the greatest reduction in risk of serous hemorrhage (Hart et al, 2012). None of these trials, however, enrolled patients with estimated creatinine clearances of <25 ml/min. Despite the absence of clinical trial data, approval in the U.S. was given to newer oral anticoagulants — dabigatran, rivaroxaban, and apixaban — for prevention of ischemic stroke in non-valvular AFIB in patients with estimated creatinine clearances as low as 15. All three agents are approved for use in patients with CKD of Stage 3 or Stage 4, but not for those with Stage 5 CKD. In 2011, 2.4 percent of AFIB and with CKD of Stages 4–5 received dabigatran. Close attention will need to be paid to the expected increase in serious hemorrhagic events associated with these agents in patients with advanced CKD, but available data imply that newer oral anticoagulants are superior to warfarin in efficacy and safety. + **Table 4.b**; see page 144 for analytical methods. *January 1 point prevalent patients with Medicare Parts A, B, & D enrollment & with a cardiovascular diagnosis or procedure in 2011.*

vol 1 4.b Cardiovascular disease & pharmacological interventions (row percent), by CKD status, 2011								
	N	ACEI/ARB	Beta Blocker	Clopidogrel	Warfarin	Dabigatran	Statin	Amiodarone
<b>CHF</b>								
No CKD	50,637	57.3	61.6	15.7	23.8	1.2	49.2	5.4
All CKD	17,659	52.0	67.0	19.9	23.3	0.9	53.2	7.5
Stages 1–2	782	57.8	66.4	18.5	24.3	0.9	53.3	6.3
Stage 3	5,403	55.3	68.2	21.5	24.4	1.1	57.6	7.5
Stages 4–5	3,617	42.4	72.3	19.9	21.0	0.6	55.1	9.3
<b>AMI</b>								
No CKD	3,581	64.5	76.9	48.3	12.6	1.1	68.8	6.0
All CKD	1,110	58.8	76.4	42.3	16.9	0.9	63.7	7.2
Stages 1–2	45	55.6	80.0	35.6	22.2	0.0	60.0	13.3
Stage 3	342	56.7	76.3	45.9	19.3	0.9	63.2	8.2
Stages 4–5	236	58.5	81.8	43.2	15.7	0.0	71.6	8.1
<b>PAD</b>								
No CKD	62,503	49.0	45.0	16.8	12.3	0.5	48.3	2.0
All CKD	14,713	50.5	58.3	22.3	17.2	0.8	53.9	4.7
Stages 1–2	751	55.1	62.3	22.6	14.8	0.5	53.8	5.2
Stage 3	4,648	54.3	60.9	23.3	17.3	0.8	57.9	4.2
Stages 4–5	2,538	44.1	65.1	24.7	17.9	0.7	58.0	6.3
<b>CVA/TIA</b>								
No CKD	41,016	51.6	46.3	22.8	14.6	0.8	55.6	2.1
All CKD	8,739	53.2	59.7	26.4	18.1	0.8	57.8	4.5
Stages 1–2	459	58.2	59.7	25.5	17.6	0.7	56.2	3.7
Stage 3	2,820	55.9	60.9	27.9	17.8	0.7	62.8	4.3
Stages 4–5	1,418	46.0	64.9	28.0	16.8	0.6	59.4	6.2
<b>AFIB</b>								
No CKD	57,243	50.4	61.4	9.2	53.3	2.8	48.1	8.3
All CKD	12,432	50.1	66.5	14.2	48.7	1.8	51.7	12.8
Stages 1–2	598	56.7	66.2	14.7	49.7	2.5	57.0	11.9
Stage 3	4,005	52.7	67.3	13.9	50.4	2.1	56.4	13.2
Stages 4–5	2,180	42.3	69.6	15.0	47.5	1.4	51.7	16.1
<b>ICD/CRT-D</b>								
No CKD	430	77.9	84.9	26.5	32.1	3.5	65.1	20.7
All CKD	178	64.0	88.2	26.4	35.4	2.2	62.9	18.5
Stages 1–2	13	53.8	84.6	30.8	46.2	0.0	69.2	7.7
Stage 3	66	65.2	87.9	28.8	31.8	4.5	66.7	13.6
Stages 4–5	31	58.1	87.1	29.0	32.3	0.0	48.4	38.7
<b>Revascularization: PCI</b>								
No CKD	4,275	67.2	76.8	83.8	9.1	1.2	79.1	3.8
All CKD	767	62.8	78.4	79.0	14.5	1.7	72.9	5.7
Stages 1–2	43	76.7	76.7	79.1	16.3	0.0	72.1	7.0
Stage 3	298	62.1	81.5	80.5	14.4	2.7	73.5	5.0
Stages 4–5	130	46.9	75.4	76.2	17.7	0.0	77.7	10.0
<b>Revascularization: CABG</b>								
No CKD	956	65.9	86.9	33.3	18.3	1.4	80.3	31.8
All CKD	142	63.4	85.9	33.1	23.9	2.1	81.0	31.0
Stages 1–2	10	70.0	90.0	20.0	30.0	0.0	80.0	50.0
Stage 3	60	63.3	86.7	28.3	28.3	3.3	85.0	30.0
Stages 4–5	13	61.5	92.3	23.1	30.8	0.0	84.6	23.1
<b>No cardiac event</b>								
No CKD	390,635	44.8	29.8	5.0	2.4	0.0	45.2	0.2
All CKD	25,334	63.1	47.4	8.4	4.7	0.1	56.0	0.6
Stages 1–2	1,630	66.1	42.2	7.4	3.7	0.0	57.4	0.7
Stage 3	9,418	68.3	49.7	8.9	4.4	0.1	61.6	0.5
Stages 4–5	3,853	60.8	58.4	9.9	4.5	0.1	57.9	1.0

In the 2012 ADR, we reported the top 15 drug classes used in CKD patients, looking at days supply in order to give weight to those drugs prescribed for chronic conditions. This year, the top 15 classes are ranked based on the percentage of patients with at least one claim for a drug. Not surprisingly, the list is led by cardiovascular therapies (diuretics, statins, beta blockers, angiotensin-converting enzyme inhibitors, calcium channel blockers). Opioid analgesics, however assume a more prominent position, with 47 percent of CKD patients receiving at least one prescription in 2011. ♦ **Figure 5.1**; see page 146 for analytical methods. *CKD patients in the Medicare 5 percent sample.*



Approximately 60 percent of CKD patients are enrolled in Medicare Part D, a number similar to that found in the general Medicare population. A higher percent of CKD patients, however, have the low-income subsidy (LIS). ♦ **Figure 5.2**; see page 146 for analytical methods. *Point prevalent Medicare enrollees alive on January 1, 2011.*



The Medicare low income subsidy (LIS) provides extra help to Medicare Part D beneficiaries with limited income and resources to help them pay for their Medicare Part D drug plan premiums, annual deductible and co-payments. There are several categories of Medicare beneficiaries that automatically qualify for LIS and are automatically eligible for benefits (deemed). These individuals include full-benefit dual eligible individuals, partial dual eligible individuals (Qualified Medicare Beneficiaries (QMB-only), Specified Low-Income Medicare Beneficiaries (SLMB-only), Qualifying Individuals (QI), and people who receive Supplemental Security Income (SSI) benefits but not Medicaid. Other Medicare beneficiaries with limited incomes and resources that do not automatically qualify for LIS (non-deemed) can apply for LIS and have their eligibility determined by their State Medicaid agency or the Social Security Administration.”

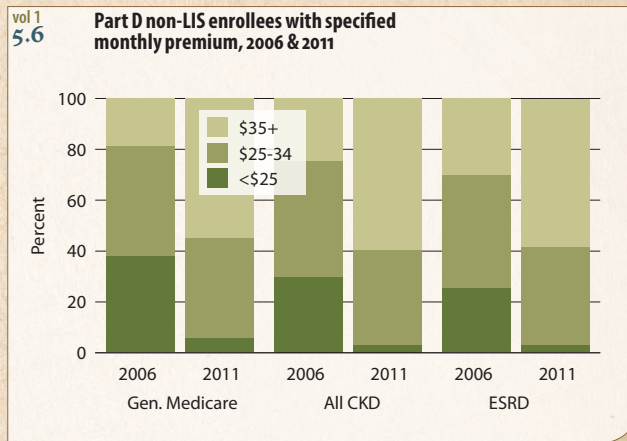
There are several levels of the low income subsidy (LIS). Compared to general Medicare patients, those with CKD are more likely to be in LIS categories with a 100 percent premium subsidy and low or no copayments. ♦ **Figure 5.5**; see page 146 for analytical methods. *Point prevalent Medicare enrollees alive on January 1, 2011.*

pr  
1  
2  
3  
4  
5  
6  
7

Patients without the low-income subsidy (LIS) pay full monthly premiums. Between 2006 and 2011, the weighted average premium for Medicare Part D stand-alone prescription drug plans (PDPs) increased from \$25.93 to \$38.29.\*

In 2011, 59 percent of CKD patients were enrolled in plans with premiums greater than \$35 per month, compared to 55 percent of Medicare patients. The overall percentage of CKD patients with premiums less than \$35 increased from 31 percent in 2010 (2011 USRDS ADR) to 41 percent 2011, probably due to several factors including patient enrollment in the new Humana Walmart-Preferred Rx plan, which had the lowest premium in every region, as well as an overall decrease in MA prescription drug plan premiums from 2010 to 2011.\*

♦ **Figure 5.6;** see page 146 for analytical methods. Point prevalent Medicare enrollees alive on January 1, excluding those in Medicare Advantage Part D plans. \*<http://kaiserfamilyfoundation.files.wordpress.com/2013/01/8237.pdf>.



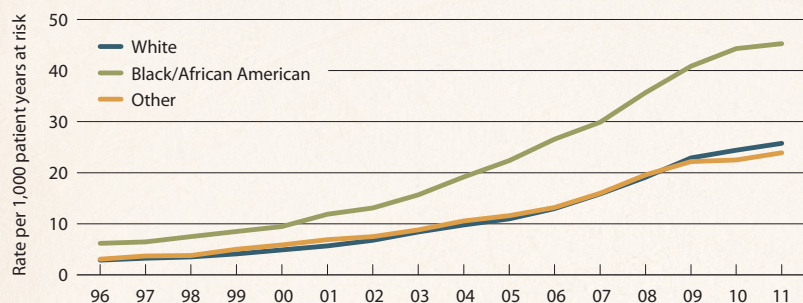
Total per person per year (PPPY) Medicare Part D costs vary widely between those with and without the LIS. Overall, ESRD patients have the highest costs in both categories. By race, and regardless of LIS status, PPPY costs in the general Medicare and CKD populations are highest for whites, but in the ESRD LIS population are highest for blacks/African Americans. In the general Medicare and CKD populations, younger patients have higher Part D costs than older patients. ♦ **Table 5.d;** see page 146 for analytical methods. All Medicare patients enrolled in Part D, 2011. CKD determined from claims. ESRD: period prevalent ESRD patients, 2011. Costs are per person per year for calendar year 2011. Medicare PPPY is the sum of Medicare payment amount & low income subsidy (LIS) amount. LIS status is determined from the Part D enrollment. A person is classified as LIS if they are eligible for the LIS for at least one month during 2011.

vol 1  
5.d

**Total per person per year (PPPY) Part D costs (\$) for enrollees, by low income subsidy (LIS) status, 2011**

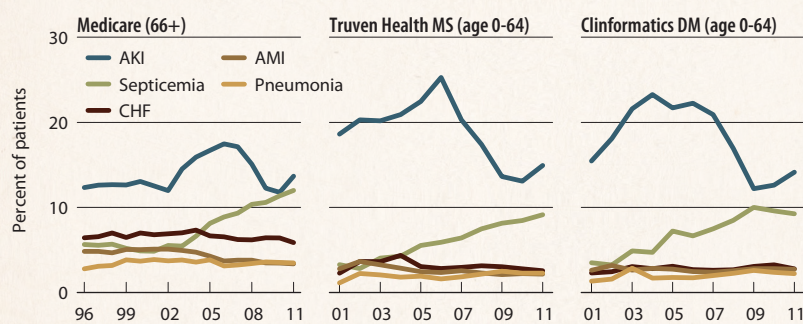
	General Medicare		All CKD		ESRD	
	LIS	No LIS	LIS	No LIS	LIS	No LIS
All	4,194	1,043	6,212	1,817	7,549	2,215
20-44	4,513	1,633	9,519	2,243	7,329	1,548
45-64	5,488	1,434	8,374	2,704	8,102	2,221
65-74	3,474	952	6,314	2,011	7,285	2,448
75+	3,451	1,055	5,050	1,654	6,293	2,029
Male	4,187	1,050	6,380	1,869	7,621	2,272
Female	4,199	1,038	6,114	1,771	7,482	2,178
White	4,449	1,058	6,408	1,831	7,469	2,294
Black/Af Am	3,855	938	5,753	1,523	7,684	1,981
Other race	3,567	894	6,083	1,971	7,341	2,041

vol 1  
6.4 Unadjusted rates of first AKI within the cohort year among Medicare patients age 66 & older, by race



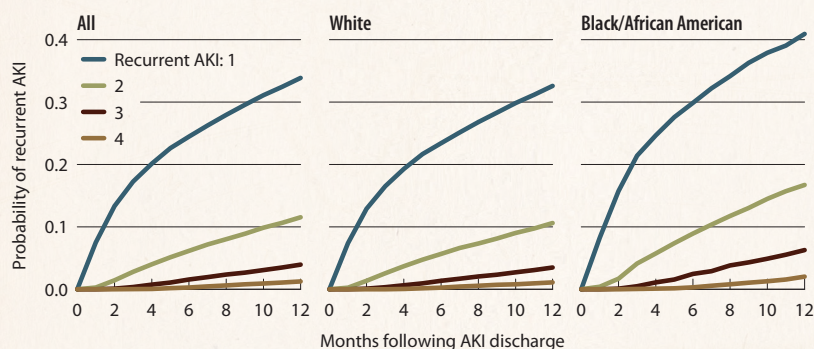
The incidence of AKI in Medicare patients age 66 and older varied considerably by race in 2011, reaching 45.3 per 1,000 patient years in blacks/African Americans compared to 25.8 and 23.9, respectively, in whites and individuals of other races. + Figure 6.4; see page 147 for analytical methods. Medicare patients age 66 & older.

vol 1  
6.6 Principal diagnosis code on AKI claim, by dataset



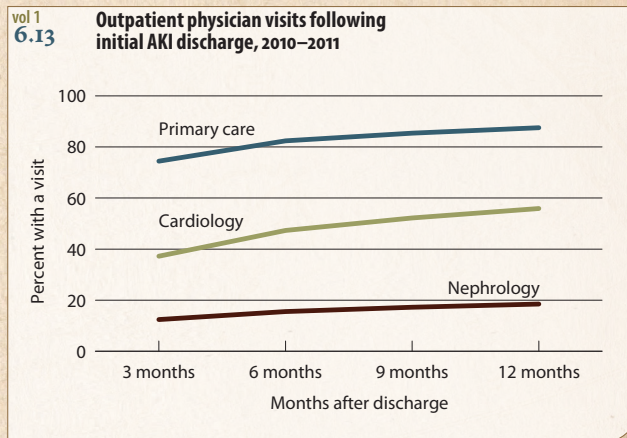
While the AKI event itself remains a major reason for AKI hospitalization, the percentage of patients with AKI as their primary diagnosis has been steadily declining, from a high of 17.5 percent in 2006 to 13.7 percent in 2011 in Medicare patients, from 25 to 15 percent in the Truven Health MarketScan population, and from 22 to 14 percent for patients in the Clinformatics DataMart cohort. + Figure 6.6; see page 147 for analytical methods. Medicare AKI patients age 66 & older, & Truven Health MarketScan & Clinformatics DataMart AKI patients age 0-64.

vol 1  
6.9 Probability of a recurrent AKI hospitalization in Medicare patients, by number of recurrent events & race, 2010-2011

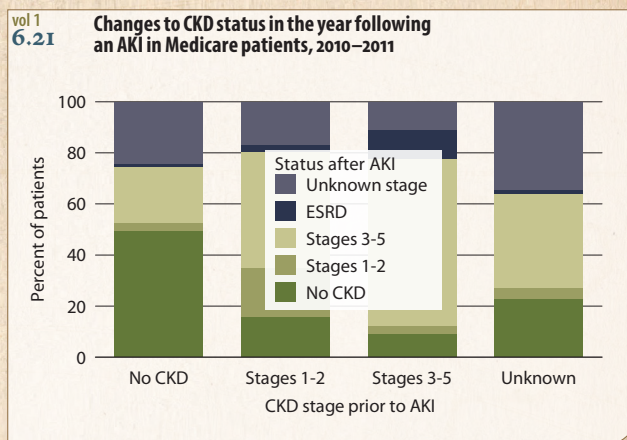


Following an AKI hospitalization, the probability of one recurrent AKI event in the next 12 months is 0.34 overall and 0.33 and 0.41, respectively, in whites and blacks/African Americans. The probability of having more than one AKI event is highest in blacks/African Americans compared to whites — at 0.17 versus 0.11 for two events and 0.06 versus 0.03 for three. + Figure 6.9; see page 147 for analytical methods. Medicare AKI patients age 66 & older, 2010-2011.

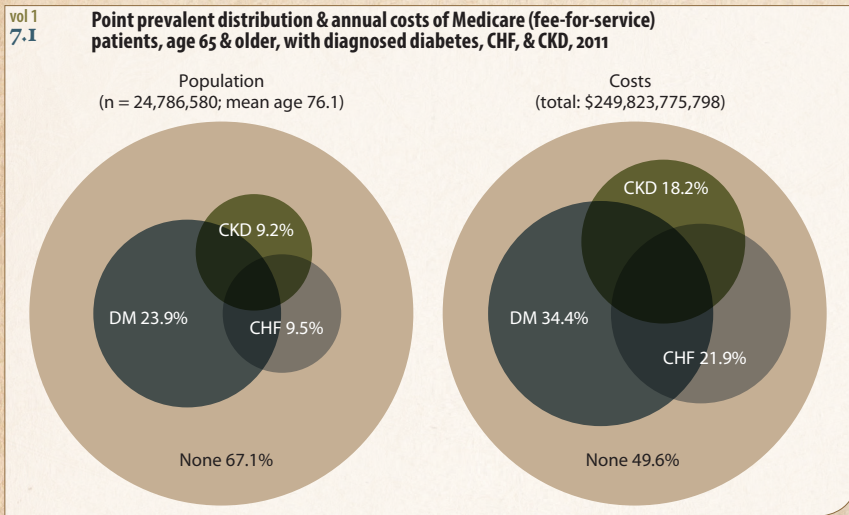
Following an initial AKI hospitalization, 75 percent of patients see a primary physician within three months of discharge, while 37 and 13 percent, respectively, see a cardiologist or nephrologist. ♦ **Figure 6.13**; see page 147 for analytical methods. *Medicare AKI patients age 66 & older, 2010–2011.*



CKD status changes significantly in the year following an AKI hospitalization. Among those with CKD of Stages 1–2 prior to the hospitalization, for example, 45 percent are later classified as having Stage 3–5 CKD. And of those with Stage 3–5 CKD pre-hospitalization, 11.5 percent reach ESRD. ♦ **Figure 6.21**; see page 147 for analytical methods. *Medicare AKI patients age 66 & older, 2010–2011.*

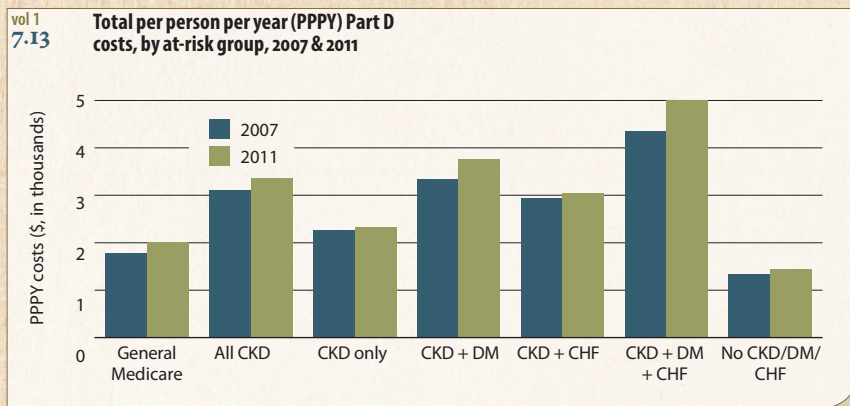
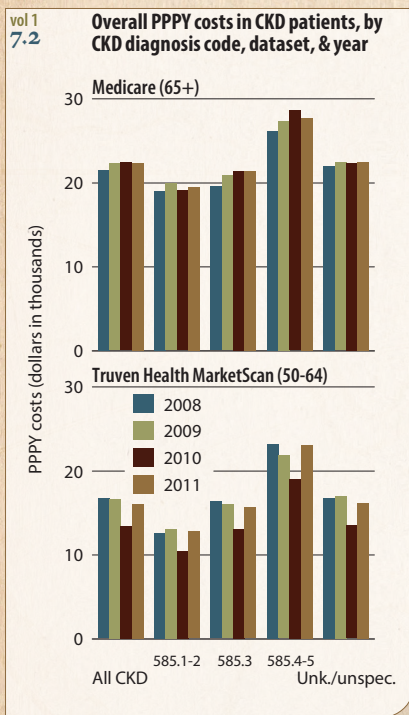






Congestive heart failure (CHF) affects 9.5 percent of patients in the fee-for-service Medicare population, and accounts for nearly 22 percent of expenditures. More than 34 percent of expenditures go toward the 24 percent of patients with diabetes. And patients with recognized CKD, who represent 9.2 percent of the point prevalent population, account for 18.2 percent of total expenditures. Patients with diabetes, CKD, and/or CHF thus account for 32.9 percent of the population, and 50.4 percent of costs.

♦ **Figure 7.1;** see page 147 for analytical methods. Populations estimated from the 5 percent Medicare sample using a point prevalent model (see appendix for details). Further restricted to patients age 65 & older, without ESRD. Diabetes, CHF, & CKD determined from claims; costs are for calendar year 2011.



In 2011, overall PPPY costs for patients with CKD reached \$22,348 for Medicare patients age 65 and older, and \$16,086 for patients age 50–64 in the THMS database. (These costs include Part D.) Compared to costs for patients with CKD of Stages 1–2, costs for those with Stage 4–5 CKD were 42 percent greater in the Medicare population and 81 percent higher among THMS patients. ♦ **Figure 7.2;** see page 147 for analytical methods. Point prevalent Medicare patients age 65 & older (5 percent Medicare sample) & Truven HealthMarketScan patients age 50–64.

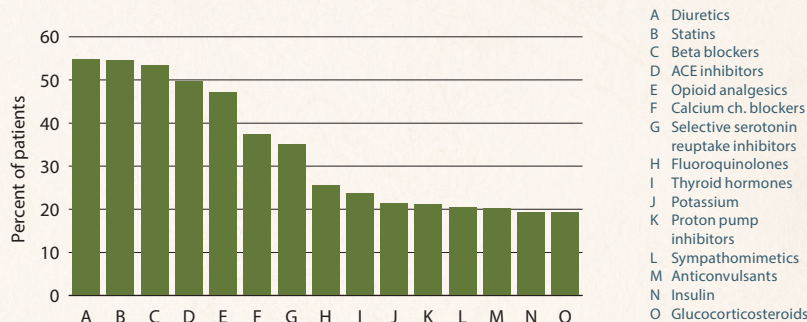
While total PPPY Part D costs (including out-of-pocket costs) increased between 2007 and 2011 in both the CKD and general Medicare populations, growth was larger for general Medicare patients, at 13 versus 8 percent. Costs for patients with CKD, diabetes, and CHF rose 15 percent. ♦ **Figure 7.13;** see page 147 for analytical methods. Point prevalent Medicare CKD patients age 65 & older, 2011.

Diuretics, statins, and beta blockers are three classes of drugs used by 53–55 percent of Part D enrollees with CKD, while ACE inhibitors and opioid analgesics are used by 50 and 47 percent, respectively. More than a third of enrollees use a calcium channel blocker or a selective serotonin reuptake inhibitor. Fluoroquinolones, thyroid hormones, potassium, proton pump inhibitors, sympathomimetics, and anticonvulsants are used by 20–26 percent of enrollees with CKD, and 19 percent use insulin or glucocorticosteroids.

Furosemide, a loop diuretic, is the most frequently used drug in CKD patients, at 39 percent. Simvastatin, a drug used to control hypercholesterolemia, and hydrocodone, an opioid analgesic, are used by nearly 30 percent of patients with CKD, while amlodipine and lisinopril — medications used to treat high blood pressure — are used by 28 and 25 percent, respectively. Insulin is the most costly drug used by CKD patients, alone accounting for over 8 percent of total Part D CKD drug costs. **• Figure 7.17 & Table 7.b; see page 147 for analytical methods. Medicare patients with CKD; costs scaled up by a factor of 20 to estimate totals.**

Among patients incident in 2011, total per person per month (PPPM) costs in the month following ESRD initiation reached \$19,343 for Medicare patients age 67 and older, compared to \$40,578 for those younger than 65 in the Truven Health MarketScan program — 2.1 times greater. **• Figure 7.19; see page 148 for analytical methods. Medicare (age 67 & older) & Truven Health MarketScan (younger than 65) ESRD patients, initiating in 2008.**

vol 1  
7.17 **Top 15 drug classes used by Part D enrollees with CKD, by percent of patients & drug class, 2011**



vol 1  
7.b **Top 15 drugs used by Part D enrollees with CKD, by percent of patients & net cost, 2011**

By percent of patients	Percent of patients	By net cost	Total cost (dollars)
Furosemide	38.7	Insulin	394,404,860
Simvastatin	29.4	Clopidogrel	277,601,420
Hydrocodone	29.4	Atorvastatin	142,820,280
Amlodipine	28.1	Quetiapine	135,719,520
Lisinopril	25.2	Esomeprazole	129,682,620
Levothyroxine	25.1	Fluticasone/salmeterol	100,221,540
Omeprazole	23.9	Pioglitazone	98,567,500
Potassium chloride	22.1	Lenalidomide	90,704,140
Ciprofloxacin	20.2	Olanzapine	89,710,740
Azithromycin	18.6	Sitagliptin	80,352,180
Metoprolol tartrate	18.4	Tiotropium	78,010,940
Clopidogrel	15.7	Memantine	76,562,900
Carvedilol	15.4	Rosuvastatin	74,643,660
Prednisone	15.0	Valsartan	65,418,300
Warfarin	15.0	Aripiprazole	65,383,400

vol 1  
7.19 **Per person per month (PPPM) expenditures during the transition to ESRD, by dataset, 2011**

