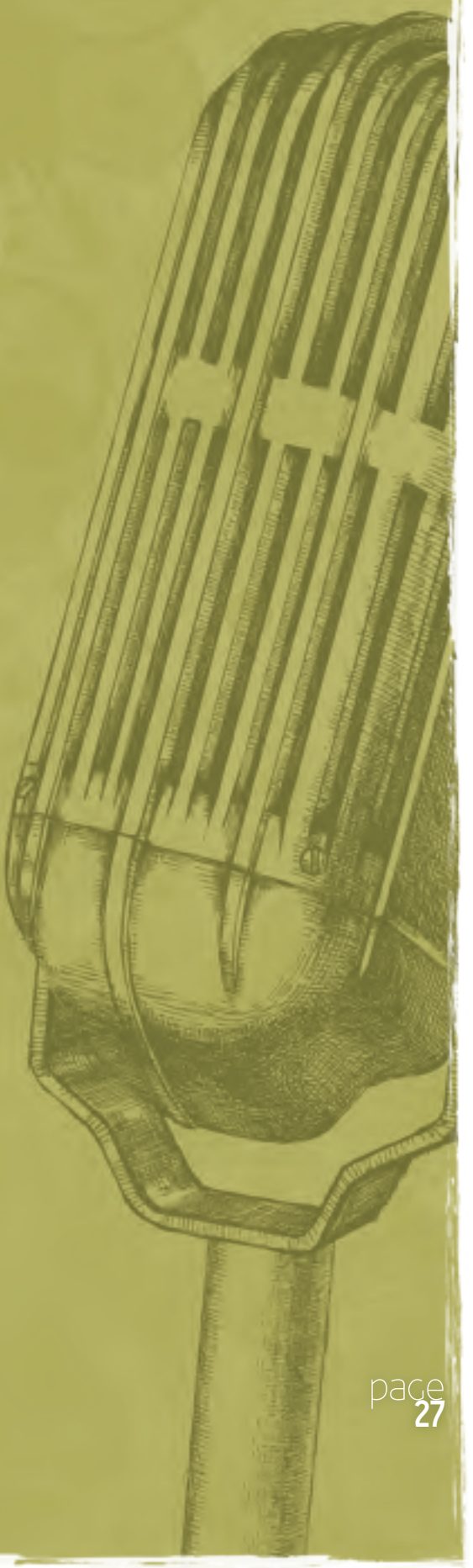
précis

An Introduction to Chronic Kidney Disease in the United States



Unforgettable in every way
And forever more, that's how you'll stay
That's why, darling, it's incredible
That someone so unforgettable
Thinks that I am unforgettable too

Irving Gordon, "Unforgettable"

In this edition of the ADR we have consolidated chapters to bring greater focus to issues affecting those with kidney disease, and have highlighted data on racial disparities. New areas this year include prescription drug use and the extensive burdens of hospitalization.

The universal impact of chronic diseases was codified in 2005 in a report from the World Health Organization. The presentation focused on premature loss of life and on the economic impact of deaths during individuals' most productive years. While there has been little attention paid to kidney disease on a public health level, the reality is that many countries struggle with the costs of providing end-stage renal disease (ESRD) care through dialysis and kidney transplantation, costs which place ministries of finance at odds with ministries of health. The enormous demand for organs — particularly kidneys — has also led to transplant tourism, in which patients travel elsewhere to buy living donor kidneys for transplantation. While this practice has been denounced by the Istanbul Declaration on organ trafficking and transplant tourism, the large number of patients across the globe who have advancing kidney disease continues to fuel demand.

The growing number of ESRD patients thus needs to be addressed in terms not only of its public health disease burden, but of costs to the healthcare system, and of the high demand for replacement organs. And the overall prevention of kidney disease needs to be viewed in context of competing demands for resources, particularly in the difficult economic times faced around the world in 2011.

As shown in the Venn diagrams on the next page, the prevalence of CKD and congestive heart failure in the general population has changed little since the beginning of the decade, while the burden of diabetes has increased. Because diabetes is a major cause of kidney disease, it should be a primary target for early detection and intervention to reduce the development of CKD and slow the progression to ESRD.

With diabetes and hypertension major risk factors for CKD, awareness, treatment, and control of these conditions are crucial. NHANES data show that blood pressure control in the general population improved between 2001–2004 and 2005–2009. The overall prevalence of hypertension is 28–29 percent, but reaches 80–85 percent in those with an eGFR less than 60 ml/min/1.73 m^2, while elevated LDL cholesterol is present in 36 and 81 percent of these populations, respectively.

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, CKD has grown from 3.3 percent in 1998 to 8.5 percent in 2009. It is probable that this represents increased recognition of the disorder, since the disease burden identified through NHANES data has grown little over the same period. Costs for CKD patients are now 23 percent of Medicare expenditures in the fee-for-service sector; when added to costs for ESRD patients, it appears

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that 31 percent of all Medicare expenditures are incurred by patients with a diagnosis of kidney disease.

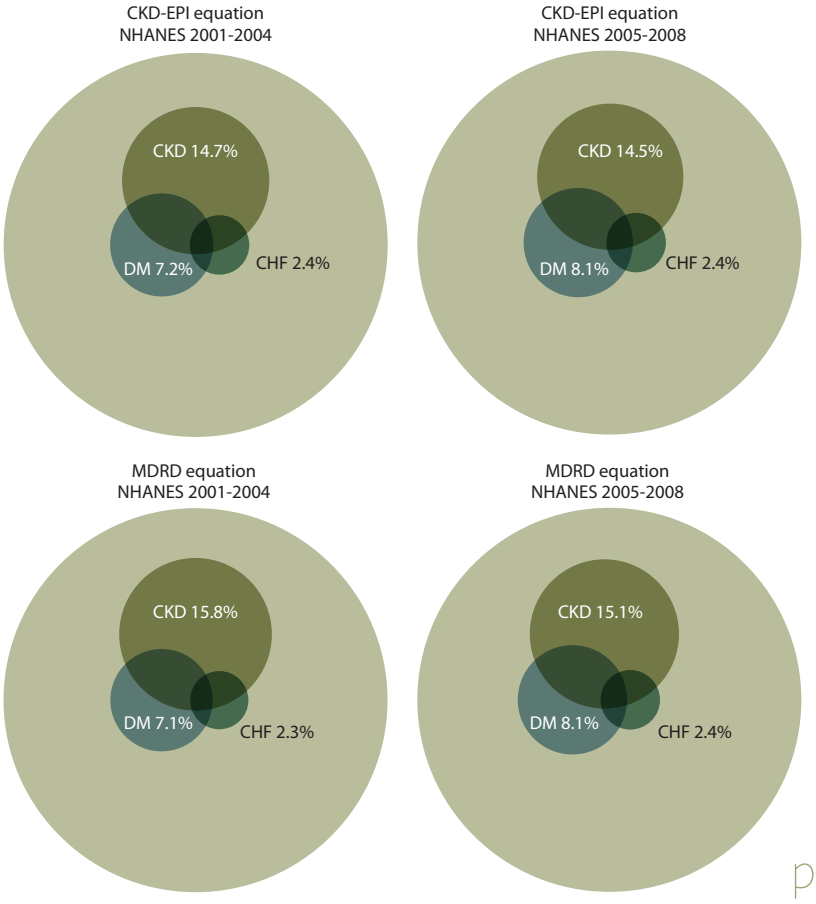
Despite this high disease burden, the rate of progression to ESRD has been relatively stable over the last several years, suggesting that CKD patients are dying at a higher rate before they reach ESRD or that they are progressing to ESRD at a slower rate. The continuing decline in rates of death from 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.

Data on testing of patients at high risk of kidney disease show that, while creatinine testing is fairly routine among patients with diabetes, at 87 percent, only 33 percent receive urine microalbumin testing; this number falls to just 5 percent in patients with hypertension. These data suggest a lack of screening for kidney disease in high-risk patients, despite the fact that these measurements are recommended by the American Diabetes Association and the American Heart Association. In addition, referral to a nephrologist after CKD diagnosis is only 31 percent at 12 months; patients are twice as likely to see a cardiologist.

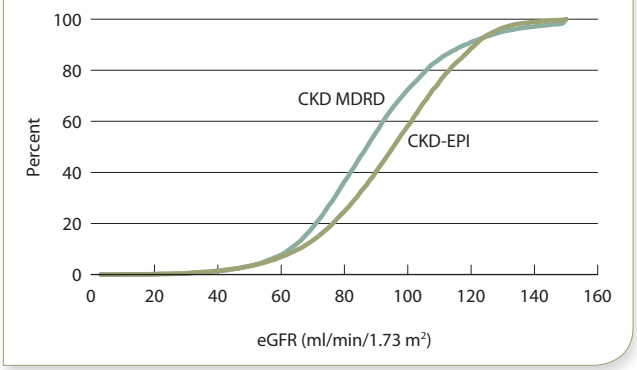
New figures show that, when compared to the general population, Medicare Part D prescription drug coverage with the low income subsidy is 50 percent higher among CKD patients, and twice as high for patients with ESRD. CKD patients also have a 40 percent probability of reaching the coverage gap, or "donut hole," compared to 22 percent of patients in the general Medicare population.

>> **Figure I.I;** see page 122 for analytical methods. *NHANES participants age 20 & older.*

I.i **Distribution of NHANES participants with diabetes, congestive heart failure, & markers of CKD, with GFR estimated by MDRD & CKD-EPI equations (page 39)**



I3i Cumulative distribution curves of NHANES 2001–2008 participants, by method used to estimate GFR (page 40)



In cumulative frequency distributions of eGFR in U.S. adults, the creatinine-based CKD-EPI methodology for eGFR calculations yields higher estimates of GFR than those achieved with the creatinine-based MDRD method. » **Figure I.3;** see page 122 for analytical methods. *NHANES 2001–2008 participants age 20 & older.*

Ib Awareness, treatment, & control of hypertension, hypercholesterolemia, HDL, total cholesterol, & diabetes, by ACR, eGFR, & method used to estimate GFR (percent of NHANES participants; page 42)

	2001–2004 MDRD ml/min/1.73 m²		CKD-EPI ml/min/1.73 m²		ACR mg/g		2005–2008 MDRD ml/min/1.73 m²		CKD-EPI ml/min/1.73 m²		ACR mg/g	
	<60	≥60	<60	≥60	<30	30+	<60	≥60	<60	≥60	<30	30+
Hypertension, by current hypertensive status[1]												
Non-hypertensive status	19.0	71.9	14.9	71.5	71.7	30.1	19.6	70.6	15.0	70.0	70.7	30.8
Hypertensive (measured/treated)	81.0	28.1	85.1	28.6	28.3	70.0	80.4	29.4	85.0	30.0	29.4	69.2
Control of hypertension among hypertensive patients[2]												
Unaware	39.5	76.5	35.4	76.2	75.8	54.1	34.0	72.9	29.1	72.6	72.5	46.3
Aware, not treated	7.1	8.7	7.2	8.7	8.5	9.4	5.6	8.8	6.1	8.7	8.3	10.9
Aware, treated, uncontrolled	38.3	7.4	42.3	7.6	7.7	29.8	39.1	7.0	41.6	7.3	7.2	31.1
Aware, treated, controlled	15.1	7.4	15.1	7.6	8.1	6.7	21.3	11.4	23.3	11.5	12.0	11.6
Hypercholesterolemia (LDL): LDL cholesterol[3]												
Within ATP-III target LDL range	18.8	64.5	19.2	64.0	62.5	44.9	31.2	78.4	34.2	77.5	75.9	68.7
Hypercholesterolemic (measured or treated)	81.2	35.5	80.8	36.0	37.5	55.1	68.8	21.6	65.9	22.6	24.1	31.3
Control of hypercholesterolemia (LDL) among participants with hypercholesterolemia (LDL)[4]												
Unaware	50.7	71.0	49.8	70.9	70.5	56.3	49.4	71.7	51.6	71.0	70.4	67.0
Aware, not treated	8.2	7.9	6.2	8.0	7.9	10.1	9.3	6.6	6.8	6.8	7.1	3.7
Aware, treated, uncontrolled	23.0	8.0	22.9	8.2	8.6	16.3	22.4	5.7	18.2	6.3	6.6	10.3
Aware, treated, controlled	18.1	13.1	21.1	12.9	13.0	17.3	18.9	16.1	23.5	15.8	15.8	19.1
HDL cholesterol in ATP III target range[5]												
HDL <40 mg/dl (ATP III target)	14.4	16.0	14.0	16.0	15.5	18.7	15.0	15.5	15.0	15.5	15.1	18.8
HDL 40 mg/dl or higher (at/above ATP III target)	85.6	84.0	86.0	84.0	84.5	81.3	85.0	84.5	85.1	84.5	84.9	81.3
Total cholesterol[6]												
<200 (desirable)	51.8	54.0	53.8	53.8	53.8	55.9	58.9	56.2	61.8	56.1	56.1	58.3
200–239 (borderline high)	33.1	31.2	30.8	31.4	32.1	23.4	26.0	29.5	23.8	29.5	29.8	24.8
240+ (high)	15.1	14.8	15.4	14.8	14.1	20.7	15.1	14.3	14.4	14.4	14.1	17.0
Control of diabetes among diabetic patients[7]												
Glycohemoglobin <7% (controlled)	54.8	46.8	54.8	47.0	53.0	39.1	56.9	54.6	58.4	54.3	59.5	46.7
Glycohemoglobin 7% or higher (uncontrolled)	45.2	53.2	45.2	53.0	47.0	60.9	43.1	45.4	41.6	45.7	40.5	53.3

In 1999–2004, using the MDRD method, 81 percent of participants with an eGFR less than 60 ml/min/1.73 m² had hypertension; only 15 percent, however, were aware of their condition and on a successful treatment regime. In 2005–2008 participants, 80 percent were hypertensive and 21 percent were being treated successfully. With the CKD-EPI method, 85 percent of the 1999–2004 cohort were hypertensive and 15 percent were being treated sucessfully, compared to 85 and 23 percent in 2005–2008.

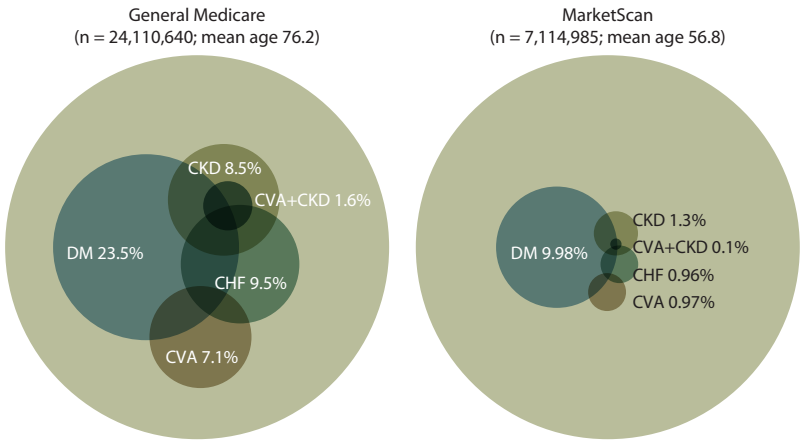
With both methods , 81 percent of 1999–2004 participants with eGFRs less than 60 had hypercholesterolemia (based on elevated LDL), but only 18–21 percent were successfully treated. The proportion of participants with hypercholesterolemia in the later period was lower, at 66–69 percent, but little improvement was observed in rates of treatment.

In 2005–2008, approximately 15 percent of participants with CKD had a high total cholesterol level, while 40–50 percent had glycohemoglobin levels above the recommended 7 percent. » **Table I.b** ; see page 123 for analytical methods. *NHANES 1999–2008 participants age 20 & older; those with Stage 5 CKD excluded. For analysis definitions, see page 42.*

Nearly 24 percent of prevalent Medicare patients age 65 and older had coded diabetes in 2009, compared to 10 percent of MarketScan patients age 50–64. One in ten Medicare patients had diagnosed congestive heart failure, and 7 percent had diagnosed CVA, compared to 1 percent of their MarketScan counterparts. » **Figure 2.1;** see page 123 for analytical methods. *Point prevalent general (fee-for-service) Medicare patients age 65 & older; point prevalent MarketScan patients age 50–64. Diabetes, CKD, CHF, & CVA determined from claims.*

The prevalence of recognized CKD in the Medicare population increased threefold between 2000 and 2009, from 2.7 to 8.5 percent. While the proportions of patients with CKD in the MarketScan and Ingenix i3 populations are smaller, the net increases from 2000 and 2001 to 2009 parallel the growth in the Medicare population. » **Table 2.b ;** see page 123 for analytical methods. *Prevalent pts surviving cohort year, age 65 & older (Medicare, 2009) & 20–64 (MarketScan & Ingenix i3, 2008).*

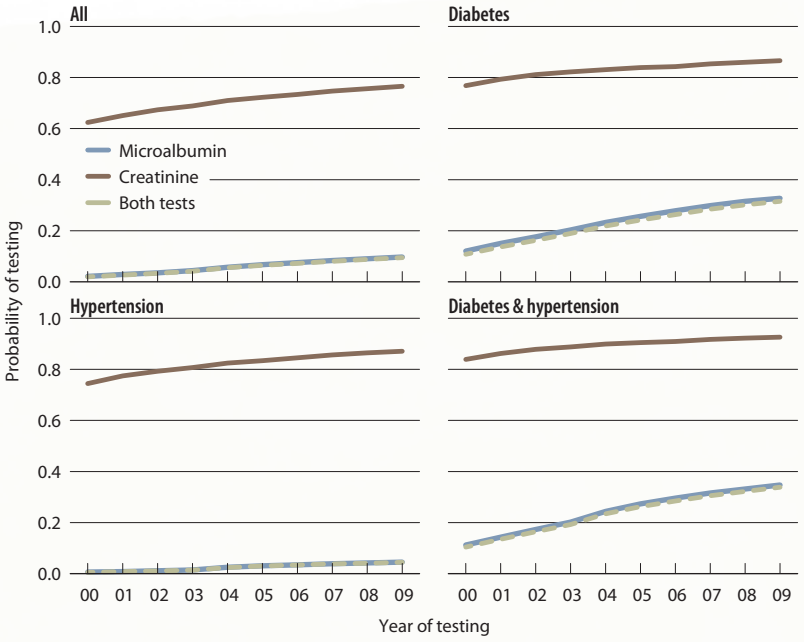
2 1i Distribution of point prevalent general Medicare (age 65+) & MarketScan (age 50–64) patients with coded diabetes, CKD, CHF, & CVA, 2009 (page 47)



2 bi Prevalence (%) of recognized CKD, by dataset, year, & age (page 48)

	Medicare	MarketScan	Ingenix i3
2000	2.7	0.3	
2001	3.1	0.4	0.4
2002	3.4	0.5	0.4
2003	3.8	0.5	0.5
2004	4.2	0.5	0.5
2005	4.8	0.5	0.6
2006	6.0	0.6	0.6
2007	6.8	0.6	0.7
2008	7.7	0.7	0.7
2009	8.5	0.8	0.8
2009			
20-44		0.3	0.4
45-54		0.7	0.9
55-64		1.7	2.0
65-74	6.1		
75-74	10.3		
85+	13.1		

2 6i Probability of microalbumin & creatinine testing in Medicare patients at risk for CKD, (page 50)

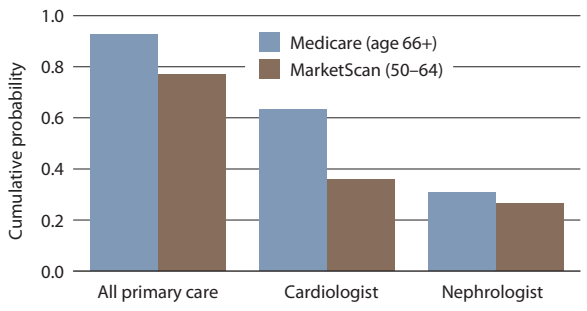


In 2009, the probability of creatinine testing in Medicare patients at risk for CKD was 0.77; the probability of receiving a microalbumin test (which must be ordered separately), in contrast, was 0.10.

The probability of microalbumin testing in those with diabetes was 0.33, compared to 0.05 in patients with hypertension. Having both diagnoses greatly increases the odds of developing CKD. The probability of creatinine testing in patients with both conditions was 0.93, while that of a urine microalbumin test was 0.35. Because microalbumin testing must be ordered separately, it may represent a true intent to assess kidney disease. » **Figure 2.6;** see page 123 for analytical methods. *Medicare patients from the 5 percent sample, age 20 & older, with both Part A & Part B coverage in the prior year; patients diagnosed with CKD or ESRD during prior year are excluded. Tests tracked during each year.*

In the year after being diagnosed with CKD, the probability of seeing a primary care physician is much higher than the probability of seeing a cardiologist or nephrologist, at 0.77 in the MarketScan population, and 0.93 in patients with Medicare coverage. And in both populations, the probability of a cardiology visit is much higher than that of a nephrologist visit, at 0.63 versus and 0.31, respectively, in Medicare patients and 0.36 versus 0.27 in the MarketScan population. » Figure 2.10; see page 123 for analytical methods. *Patients alive & eligible all of 2008. CKD diagnosis represents date of first CKD claim during 2008; physician claims searched during 12 months following that date.*

2.10i Cumulative probability of a physician visit at month 12 following CKD diagnosis, by physician specialty & dataset (page 54)

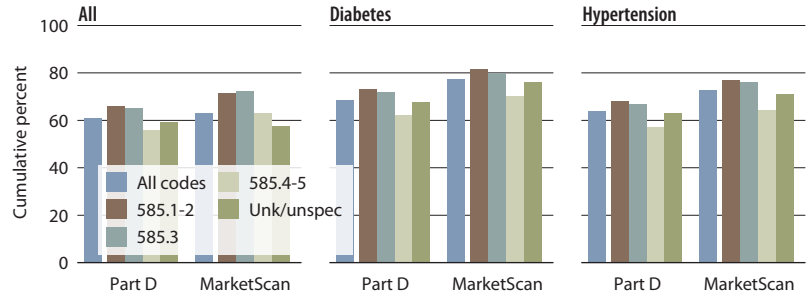


These figures present data on medication use among CKD patients in the Medicare 5 percent and MarketScan databases in 2009. Among Medicare Part D patients with a diagnosis of diabetes or hypertension, 69 and 64 percent, respectively, had evidence of ACEI/ARB/renin inhibitor use, compared to 77 and 73 percent in the MarketScan population; use was generally higher in patients with earlier stages of CKD.

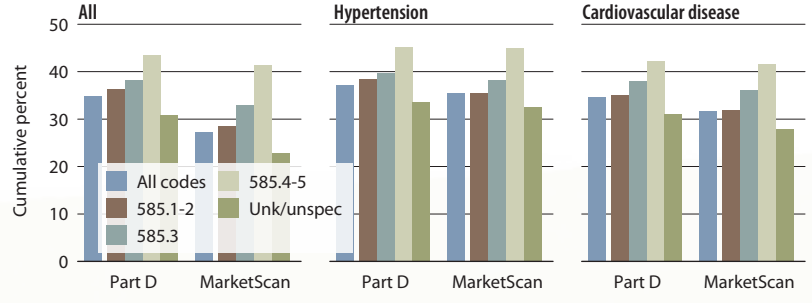
In patients with hypertension or cardiovascular disease, use of a dihydropyridine calcium channel blocker was slightly higher in the Medicare population, and more common in those with later-stage CKD.

Potassium-sparing diuretics or combination diuretic products (e.g. potassium-sparing plus thiazide diuretics) are rarely used in CKD patients. Thiazide and loop diuretics, in contrast, receive much wider use, with 30 and 33 percent, respectively, of Medicare and MarketScan patients receiving a thiazide diuretic, and 46 and 25 percent a loop diuretic. Across all stages of CKD, loop diuretic use is more common in Medicare patients than in the MarketScan population. » Figures 2.14, 16, & 17; see page 123 for analytical methods. *Point prevalent Medicare CKD patients age 65 & older & MarketScan CKD patients age 50–64.*

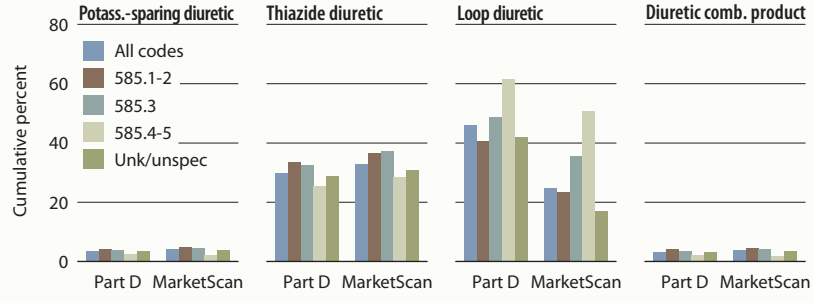
2.14i Medicare Part D & MarketScan CKD patients with at least one claim for an ACEI/ARB/renin inhibitor in the 12 months following the disease-defining entry period, by CKD diagnosis code, 2008 (pg 56)



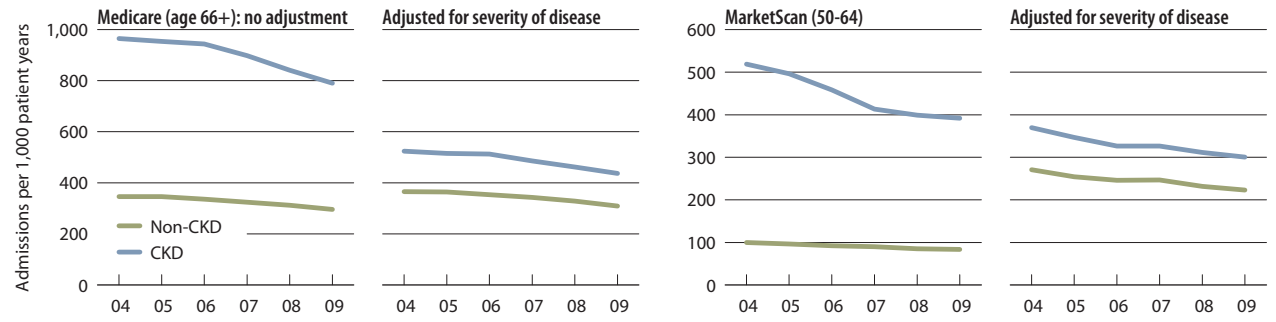
2.16i Medicare Part D & Marketscan CKD pts with at least one claim for a DHP calcium channel blocker in the 12 months following the disease-defining entry period, by CKD diagnosis code, 2008 (page 56)



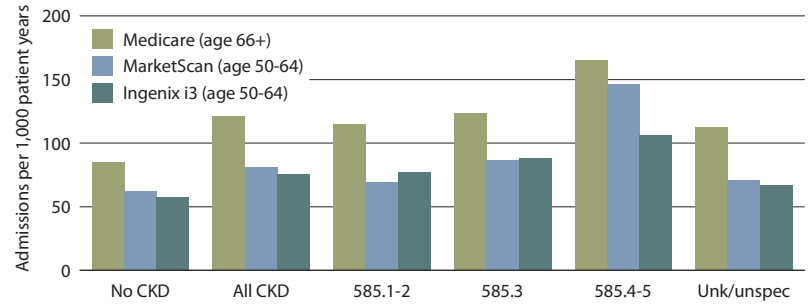
2.18i Medicare Part D & Marketscan CKD patients with at least one claim for a diuretic in the 12 months following the disease-defining entry period, by CKD diagnosis code, 2008 (page 57)



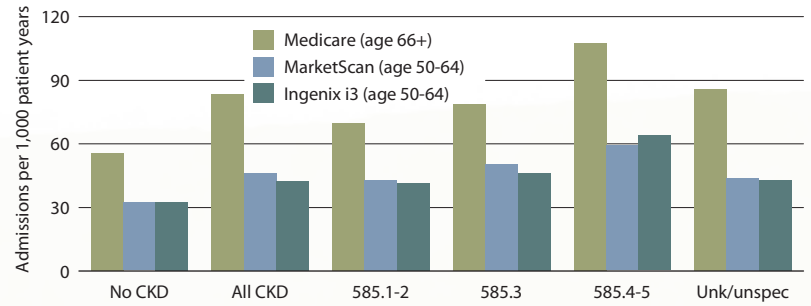
3.1i **Unadjusted & adjusted all-cause hospitalization rates in the Medicare & MarketScan populations, by CKD status (page 61)**



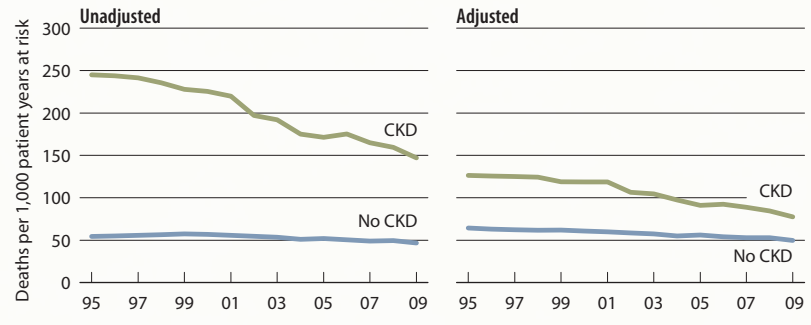
3.5i **Adjusted rates of hospitalization for cardiovascular disease, by dataset & CKD diagnosis code, 2009 (page 63)**



3.6i **Adjusted rates of hospitalization for infection, by dataset & CKD diagnosis code, 2009 (page 63)**



3.9i **Unadjusted & adjusted all-cause mortality rates in Medicare CKD & non-CKD patients, 2009 (page 66)**



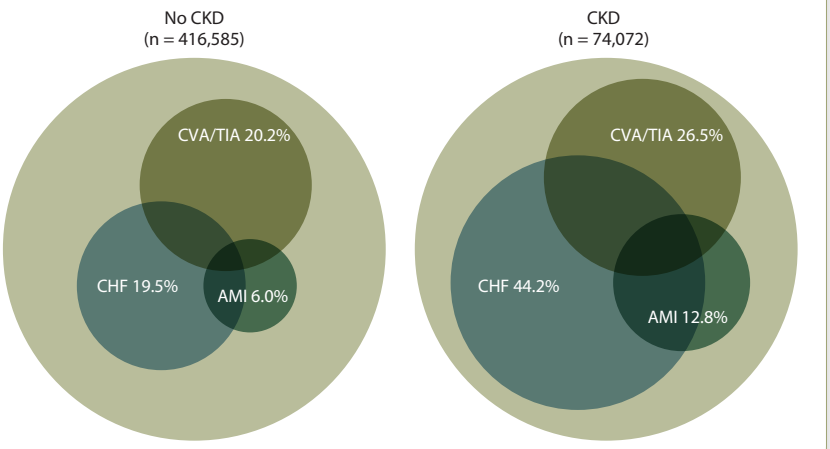
Unadjusted hospitalization rates in the CKD population — reflecting total disease burden — are 3–5 times those of non-CKD patients. When adjusted, rates for CKD patients are 1.4 times higher, illustrating CKD's net impact if the populations had similar comorbidity and disease severity. CKD patients, however, carry a heavy burden of CVD, which adjustments cannot fully address since CVD interacts so strongly with CKD itself. » **Figure 3.1;** see page 124 for analytical methods. *Medicare: Jan. 1 point prev. pts, age 66+ on Dec. 31 of prior year. MarketScan: Jan. 1 point prev. pts, age 50–64 on Dec. 31 of prior year. Adj: gender/prior hosp./comorbidity; ref: Medicare pts age 66+, 2005.*

Among Medicare patients, the rate of 166 cardiovascular admissions per 1,000 patient years in those with Stage 4–5 CKD is 45 percent higher than the rate of 115 reported for those with CKD of Stages 1–2. Compared to those of patients in the early stages of CKD, rates of admission for infection are 38–55 percent greater among patients with CKD of Stages 4–5. » **Figures 3.5–6;** see page 124 for analytical methods. *Medicare: Jan 1, 2009 point prev. pts, age 66 & older on Dec. 31, 2008. MarketScan & Ingenix i3: Jan 1, 2009 point prev. pts, age 50–64 on Dec 31, 2008. Adj: gender/prior hosp./comorbidity; ref: Medicare pts age 66 & older, 2009.*

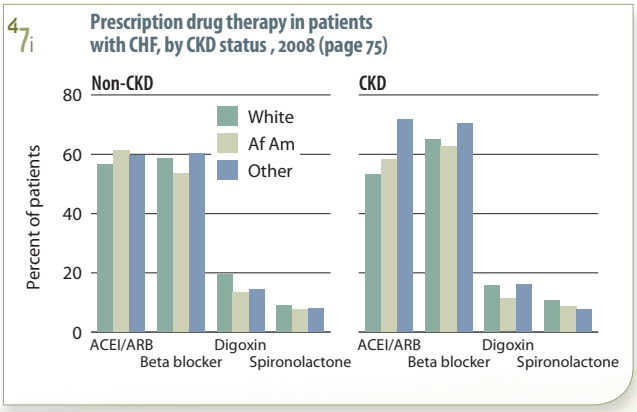
The unadjusted mortality rate in Medicare CKD patients age 66 and older was 147 in 2009. When adjusted for patient characteristics and complexity, however, the rate is lowered considerably, reaching 77 in 2009. » **Figure 3.9;** see page 124 for analytical methods. *Jan, 1 point prev. Medicare pts age 66 & older. Adj: age/gender/race/prior hosp./comorbidities. Ref: 2005 pts.*

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. » 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.*

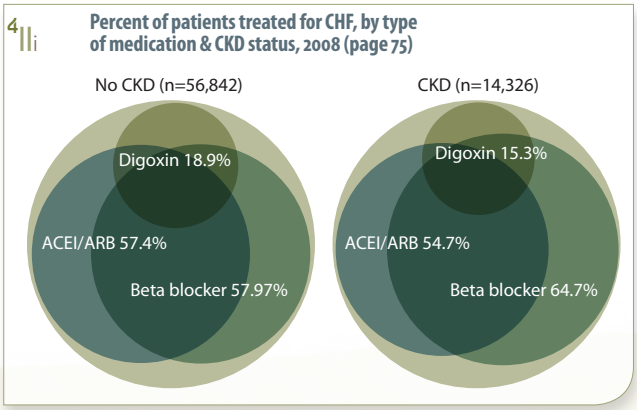
4.1i Cardiovascular disease in patients with or without chronic kidney disease, 2009 (page 71)



4.7i Prescription drug therapy in patients with CHF, by CKD status , 2008 (page 75)



4.11i Percent of patients treated for CHF, by type of medication & CKD status, 2008 (page 75)



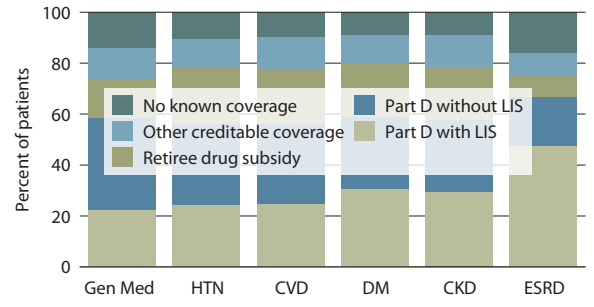
Data on drug therapy for CHF show that in whites and African Americans the use of beta blockers is, surprisingly, higher in CKD patients than in their non-CKD counterparts, at 63–65 compared to 54–59 percent. Beta blocker use is also high in patients with AMI, particularly non-whites. » Figure 4.7; see 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.*

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. » Figure 4.11; 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.*

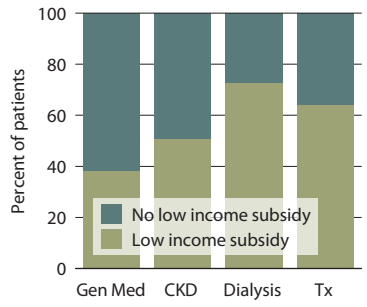
Fifty-six to 60 percent of general Medicare patients and patients with CKD, diabetes, or cardiovascular disease were enrolled in Part D in 2008, as were 67 percent of patients with ESRD. The proportion with other creditable coverage is similar among CKD and Medicare patients, at about 12 percent, but a higher proportion of CKD patients have retiree drug subsidy coverage, at 21 compared to 15 percent. » **Figure 5.1;** see page 126 for analytical methods. *Point prevalent Medicare enrollees alive on January 1, 2008.*

Fifty-one percent of CKD patients with part D coverage had LIS benefits in 2008, compared to 73 and 64 percent of dialysis and transplant patients. CKD patients are thus more likely to reach the coverage gap and have higher premiums, deductibles, and drug copayments. » **Figure 5.5;** see page 126 for analytical methods. *January 1, 2008 point prevalent Medicare enrollees.*

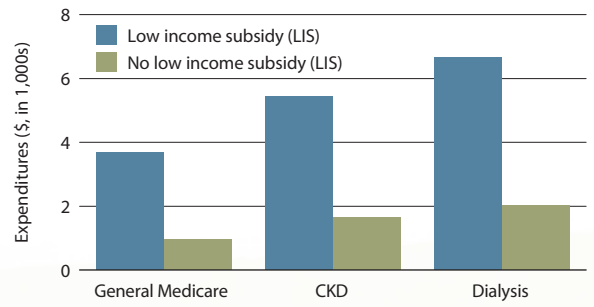
5 1i Sources of prescription drug coverage in Medicare enrollees, 2008 (page 79)



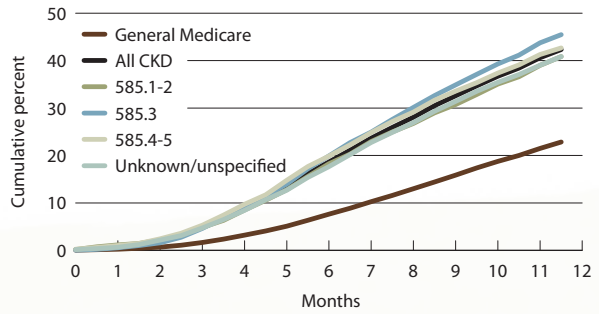
5 5i Medicare Part D enrollees, by low income subsidy (LIS) status, 2008 (page 81)



5 13i Per person per year costs for Medicare Part D enrollees, by low income subsidy (LIS) status, 2008 (page 84)



5 16i Cumulative percent of Part D non-LIS enrollees who reach the coverage gap, by CKD stage, 2008 (page 86)



5 9i Top 15 drugs used in Medicare Part D enrollees with Stage 3–5 CKD, by frequency & net cost, 2008 (page 88)

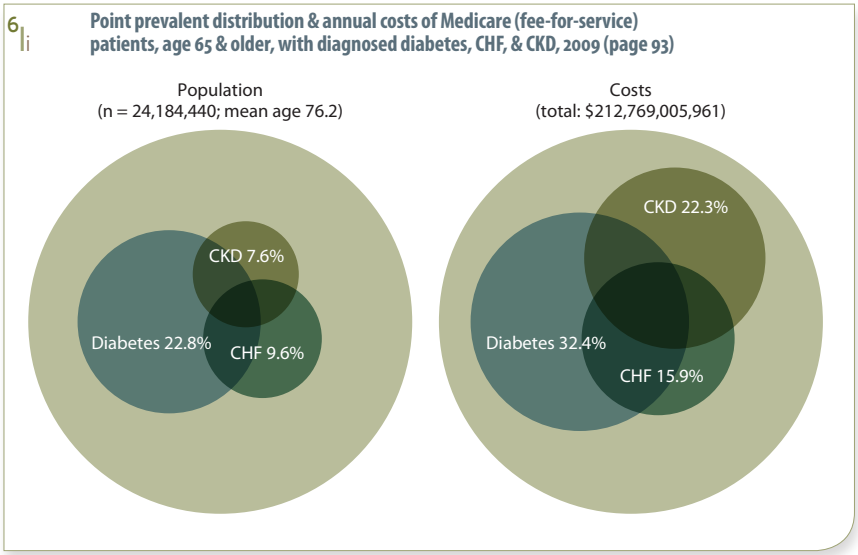
By frequency Generic name	Number of claims (total days supply)	By net costs Generic name	Number of claims (total days supply)	Total cost (dollars)
Furosemide	27,289,280	Insulin	16,384,020	61,164,340
Metoprolol	22,685,680	Clopidogrel bisulfate	11,821,660	39,430,800
Levothyroxine	18,963,740	Atorvastatin	11,813,340	30,251,640
Amlodipine	16,757,980	Epoetin alfa	696,000	21,252,860
Insulin	16,384,020	Pioglitazone	4,619,960	20,300,120
Lisinopril	15,731,220	Esomeprazole	4,437,660	19,314,500
Simvastatin	15,666,800	Fluticasone/salmeterol	2,802,100	15,066,980
Potassium chloride	12,087,080	Donepezil	3,113,740	14,227,260
Clopidogrel bisulfate	11,821,660	Pantoprazole	4,542,080	13,250,320
Atorvastatin	11,813,340	Quetiapine	1,992,100	13,135,020
Warfarin	10,743,680	Lansoprazole	2,753,300	12,599,460
Allopurinol	10,006,460	Olanzapine	891,580	12,129,340
Omeprazole	9,686,280	Valsartan	6,263,760	11,353,040
Carvedilol	9,179,120	Tamsulosin	4,596,400	10,236,720
Atenolol	7,522,160	Omeprazole	9,686,280	9,584,160

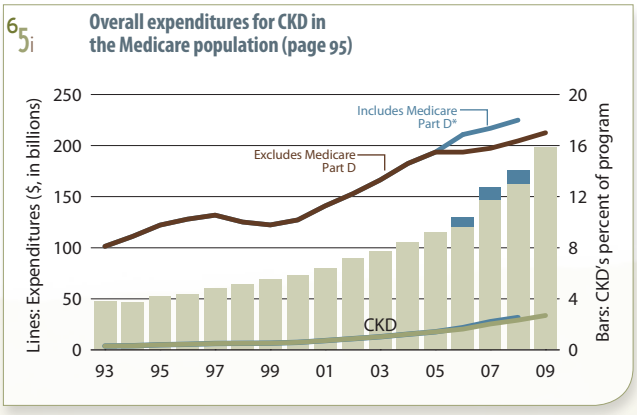
PPPY total costs for Part D-covered medications in 2008 were 3.3–3.8 times greater for LIS patients than for those without LIS. » **Figure 5.13;** see page 126 for analytical methods. *Medicare pts surviving 2007 with Medicare as primary payor & enrolled in Part D, & period prevalent dialysis pts, 2008, with Medicare as primary payor.*

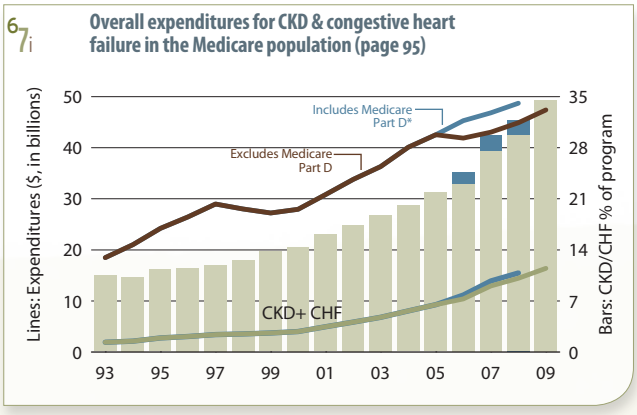
In 2008, 42 percent of all CKD patients (not on dialysis) reached the coverage gap, compared to 23 percent of general Medicare patients ; this varied little by CKD stage. » **Figure 5.16;** see page 126 for analytical methods. *Jan 1 point prev. Medicare enrollees.*

» **Table 5.g;** see page 126 for analytical methods. *Part D claims for all patients in the Medicare 5 percent sample.*

Congestive heart failure (CHF) affects 9.6 percent of patients in the fee-for-service population, and accounts for 15.9 percent of costs. Nearly 23 percent of patients have diabetes; 32.4 percent of expenditures go toward their care. And while patients with CKD represent only 7.6 percent of the population, their care accounts for 22.3 percent of total expenditures. » Figure 6.1; see page 126 for analytical methods. *Populations estimated from the 5 percent Medicare sample using a point prevalent model (see appendix for details). Population further restricted to patients age 65 & older, without ESRD. Diabetes, CHF, & CKD determined from claims; costs are for calendar year 2009.*







In 1993, costs for Medicare patients with CKD accounted for 3.8 percent of overall Medicare expenditures. In 2009, excluding Medicare Part D drug benefits, CKD costs reached $34 billion, and accounted for nearly 16 percent of total Medicare dollars.

Costs for CKD patients with congestive heart failure (CHF) accounted for 34.6 percent of total Medicare CHF dollars in 2009 — accounting for $16 billion of the $47 billion spent by Medicare on patients with this disease. » Figures 6.5 & 6.7; see page 126 for analytical methods. *Point prevalent Medicare CKD patients age 65 & older. *Medicare Part D data not available for 2009.*