2012

volume one

USRDS Annual Data Report

Atlas of Chronic Kidney Disease in the United States

national institutes of health
national institute of diabetes & digestive & kidney diseases
division of kidney, urologic, & hematologic diseases

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Walk away quietly in any direction and taste the freedom of the mountaineer. Camp out among the grasses and gentians of glacial meadows, in craggy garden nooks full of nature's darlings. Climb the mountains and get their good tidings, Nature's peace will flow into you as sunshine flows into trees. The winds will blow their own freshness into you and the storms their energy, while cares will drop off like autumn leaves. As age comes on, one source of enjoyment after another is closed, but nature's sources never fail.

JOHN MUIR,
Our National Parks

volume one
Atlas of Chronic Kidney Disease in the United States

volume two
Atlas of End-Stage Renal Disease in the United States

guide to topics
in the Annual Data Report

TREATMENT

OUTCOMES

COSTS

DATA ANALYSIS

data on chronic kidney disease
appearing each year in the Annual Data Report

CHAPTER FIVE

CHAPTER SIX

CHAPTER SEVEN

volume one highlights

patients

6.7% prevalence of eGFR <60 in NHANES 2005–2010 participants (CKD-EPI formula; Table 1.a)
among those with self-reported diabetes: 20.4% » among those with cardiovascular disease: 27.9%

9.4% prevalence of ACR ≥30 in NHANES 2005–2010 participants (Table 1.a)
among those with self-reported diabetes: 30.8% » among those with cardiovascular disease: 24.3%

9.2% prevalence of recognized CKD in Medicare patients age 65 & older, 2010 (Table 2.b & Figure 2.2)
white: 8.8% » black/African American: 13.7%

patient care

85% hypertension among NHANES 2005–2010 participants with eGFR <60 (CKD-EPI formula; Table 1.b)

32% NHANES 2005–2010 participants with eGFR <60 whose hypertension is treated & controlled (CKD-EPI formula; Table 1.b)

81% hyperlipidemia among NHANES 2005–2010 participants with eGFR <60 (Table 1.b)

27% NHANES 2005–2010 participants with eGFR <60 whose hyperlipidemia is treated & controlled (Table 1.b)

42% NHANES 2005–2010 participants with diabetes & eGFR <60 whose diabetes is uncontrolled (Table 1.b)

0.6 cumulative probability of a nephrologist visit at month 12 after a CKD diagnosis of 585.3 or higher, 2010: Medicare patients age 65+ (Table 2.h)

0.56 cumulative probability of a nephrologist visit at month 12 after a CKD diagnosis of 585.3 or higher, 2010: Marketscan patients age 50–64 (Table 2.h)

outcomes

432 adjusted hospitalization rate in white Medicare CKD patients age 66 & older, 2010 (admissions per 1,000 patient years; Figure 3.3)
Stage 1–2: 371 » Stage 3: 430 » Stage 4–5: 596

481 adjusted hospitalization rate in black/African American Medicare CKD patients age 66 & older, 2010 (admissions per 1,000 patient years; Figure 3.3)
Stage 1–2: 395 » Stage 3: 470 » Stage 4–5: 598

78 adjusted mortality rate in white Medicare CKD patients age 66 & older, 2010 (deaths per 1,000 patient years; Table 3.c)
Stage 1–2: 55 » Stage 3: 70 » Stage 4–5: 121

71 adjusted mortality rate in black/African American Medicare CKD patients age 66 & older, 2010 (deaths per 1,000 patient years; Table 3.c)
Stage 1–2: 80 » Stage 3: 67 » Stage 4–5: 91

expenditures

$4.5 billion total net Part D payment for Medicare enrollees with CKD, 2010 (Figure 5.9)

$3,843 per person per year Medicare Part D costs for enrollees with CKD, 2010 (Figure 5.10)

$738 per person per year out-of-pocket Part D costs for enrollees with CKD, 2010 (Figure 5.1)

$41 billion total Medicare expenditures for CKD, 2010 (Figure 7.5)
Non-Part D: $37.7 billion » Part D: $3.3 billion

$22.1 billion Medicare expenditures for patients with CKD & diabetes, 2010 (Figure 7.6)
Non-Part D: $20.0 billion » Part D: $2.1 billion

$19.4 billion Medicare expenditures for patients with CKD & congestive heart failure, 2010 (Figure 7.7)
Non-Part D: $18.1 billion » Part D: $1.4 billion

$22,323 per person per year expenditures for CKD patients in the general Medicare population, 2010 (includes Part D; Figure 7.8)
non-DM/non-CHF: $15,607
» CKD + DM + CHF: $37,490

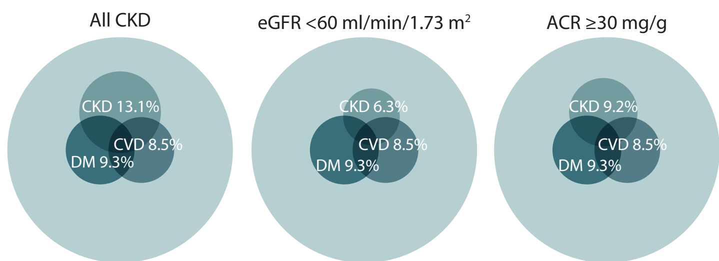
chronic kidney disease (CKD)
IN THE UNITED STATES

February 2002: the National Kidney Foundation introduces a five-stage classification system for chronic kidney disease based on an estimated glomerular filtration rate **(eGFR)**, calculated from serum creatinine levels and levels of proteinuria, and using data from the National Health and Nutrition Examination Survey **(NHANES)**.

CKD STAGE MARKERS

1 eGFR ≥90 ml/min/1.73 m², albumin/creatinine ratio (ACR) ≥30 mg/g
2 eGFR 60–89, ACR ≥30
3 eGFR 30–59
4 eGFR 15–29
5 eGFR <15

Diabetes, congestive heart failure (CHF), and CKD are three interrelated chronic diseases of clear public health relevance.



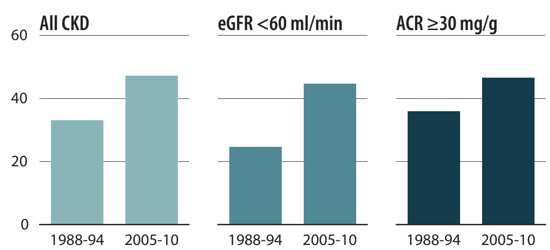
NHANES 2005-2010 participants

eGFR <60 ml/min/1.73 m² and high ACR are associated with older age, diabetes, hypertension, and cardiovascular disease.

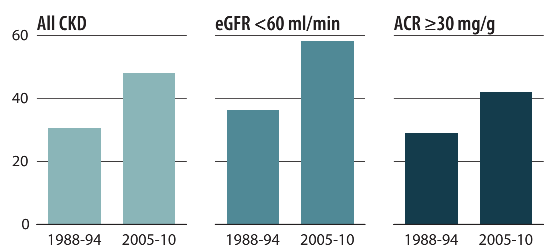
% with CKD	eGFR <60		ACR ≥30 mg/g	
	1988–94	2005–10	1988–94	2005–10
60+	19.5	24.1	18.3	18.4
Diabetes	15.6	19.3	36.3	29.9
Self-reported diabetes	16.4	20.4	35.9	30.8
Hypertension	10.4	12.9	15.4	14.8
Self-reported hypertension	12.9	15.6	17.1	16.7
CVD	14.5	27.9	16.6	24.3
BMI ≥30	6.2	7.4	12.3	11.7

Control of risk factors for CKD

Percent of NHANES participants at target blood pressure (<130/<80 for those with CKD and diabetes; otherwise <140/<90)



Percent of NHANES participants with glycohemoglobin (A1c) <7%



New **ICD-9-CM stage-specific codes for CKD** were introduced in the fall of 2005, providing opportunities to use different datasets — like those from employer group health plans (EGHPs) — to track younger populations with reported diagnosis codes over time.

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

EGHP patients are much younger than Medicare patients.

MEAN AGE

75.0 MEDICARE
44.3 MARKETSCAN
42.9 INGENIX I3

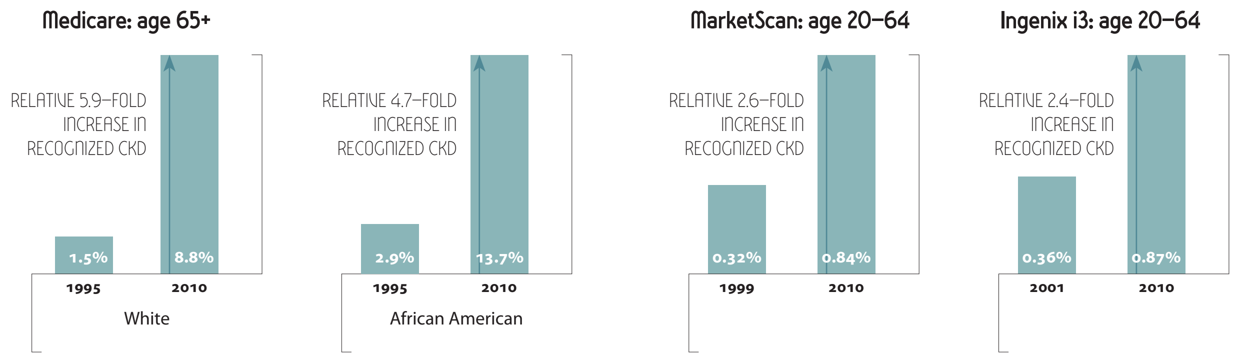
CKD is recognized more frequently in Medicare patients age 65 and older than in the Ingenix i3 and MarketScan populations, age 20–64.

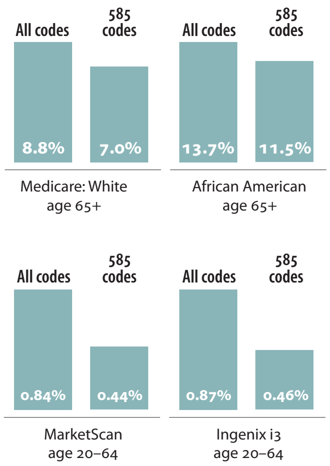
RECOGNIZED CKD

	Medicare	MarketScan	Ingenix i3
20–44		0.4%	0.4%
45–54		0.8%	0.9%
55–64		1.8%	2.0%
65–74	6.5%		
75–84	11.2%		
85+	14.5%		

Circle diagrams: Figure 1.1
Disease burden: Table 1.a
Risk factors: Figures 1.12 & 1.15
Recognized CKD: Table 2.b

The prevalence of recognized CKD has increased significantly since 1995.





CKD can be underrecognized when using only stage-specific codes to estimate its prevalence.

URINE ALBUMIN TESTING can detect early signs of **KIDNEY DAMAGE** in patients at risk for CKD

PROBABILITY OF TESTING IN 2010

10%
All patients

34%
Patients with diabetes (no hypertension)

5%
Patients with hypertension (no diabetes)

36%
Patients with both diabetes and hypertension

In patients with **DIABETES, HYPERTENSION, OR CARDIOVASCULAR DISEASE,** the odds of a CKD diagnosis code are **2–4 TIMES HIGHER** than in patients without these conditions.

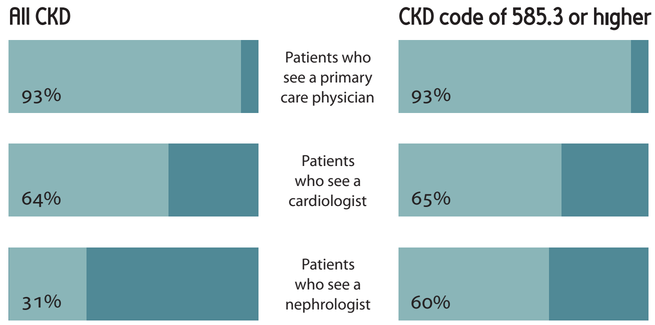
Medicare	Adjusted odds of a CKD diagnosis	MarketScan
2.1	Diabetes	3.2
3.7	Hypertension	3.3
2.4	Cardiovascular disease	2.7

Prevalence of CKD: Figures 2.2–4
Recognition of CKD: Figures 2.2–4
Urine albumin testing: Figure 2.5
Odds of CKD diagnosis: Table 2.f

chronic kidney disease (CKD)

IN THE UNITED STATES

Medicare patients age 65 and older are **twice** as likely to see a **cardiologist** as a **nephrologist** following any diagnosis for **CKD**. Among patients with a CKD diagnosis of **Stage 3** or higher, approximately **two-thirds** see either a **cardiologist** or **nephrologist**.

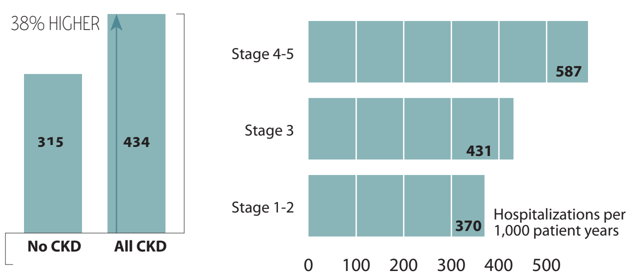


Acute kidney injury is highly associated with age, & its reported prevalence (%) has increased significantly

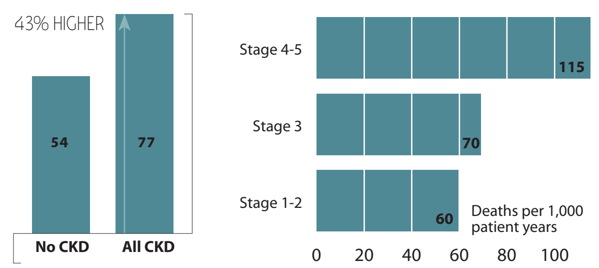
	Medicare		MarketScan		Ingenix i3	
	2000	2010	2000	2010	2001	2010
20–44			0.11	0.6	0.14	0.63
45–54			0.36	1.71	0.45	1.83
54–64			1.00	4.07	1.07	4.19
66–69	3.1	13.6				
70–74	4.1	18.1				
75–79	5.7	24.9				
80–84	6.7	34.2				
85+	8.2	46.9				
White	2.9	6.2				
Black/Af Am	24.3	44.2				

adjusted all-cause HOSPITALIZATION AND MORTALITY RATES are HIGHER IN CKD PATIENTS than in those without the disease

Hospitalization rates



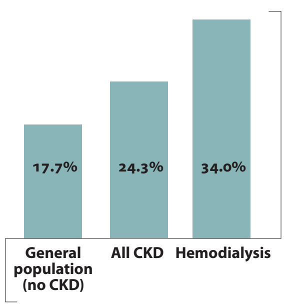
Mortality rates



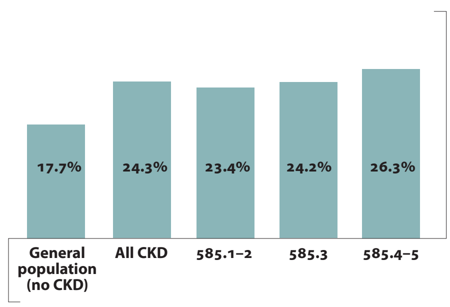
adjusted rates of REHOSPITALIZATION are also HIGHER IN CKD PATIENTS than in those without the disease

Patients rehospitalized within 30 days of a live hospital discharge (age 66 & older)

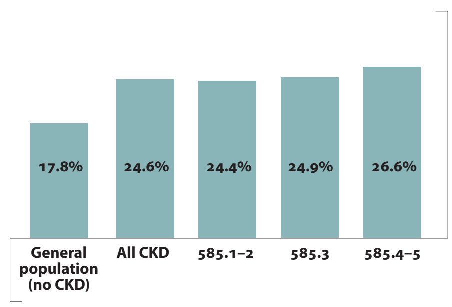
All-cause rehospitalization



Rehospitalization after all-cause index hospitalization

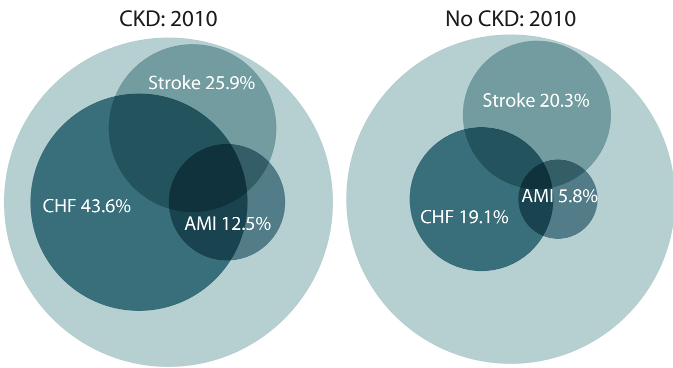


Rehospitalization after cardiovascular index hospitalization



Physician care: Tables 2.g–h
Acute kidney injury: Figure 6.3
Hospitalization: Table 3.a
Mortality: Table 3.c
Rehospitalization: Figures 3.1 & 3.9–10

Patients with CKD carry a larger burden of cardiovascular disease than those without CKD.



52% of CKD patients with CHF receive an **ACEI/ARB**

66% of CKD patients with CHF receive a **BETA BLOCKER**

55% of CKD patients with a stroke receive a **STATIN**

78% of CKD patients with AMI receive a **BETA BLOCKER**

JANUARY 1, 2006: MEDICARE PART D GOES INTO EFFECT

to help subsidize the costs of prescription drugs in Medicare beneficiaries

DAYS SUPPLY top three drug classes used by Part D enrollees with CKD

203 million diuretics	7.7%
192 million statins	7.3%
142 million beta blockers	5.4%
	20.4% of total Medicare Part D drug use in 2010

COSTS top three drug classes used by Part D enrollees with CKD

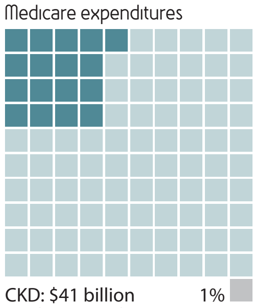
$360 million insulin	7.9%
$297 million antipsychotics	6.5%
$244 million antiplatelet drugs	5.6%
	20.0% of total Medicare Part D drug costs in 2010

NET PART D COSTS FOR MEDICARE CKD PATIENTS IN 2010

$4.53 BILLION

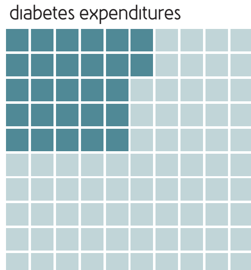
Costs of caring for patients with CKD in 2010
(fee-for-service Medicare patients age 65 & older)

Overall, **CKD patients** account for 17% of total Medicare expenditures



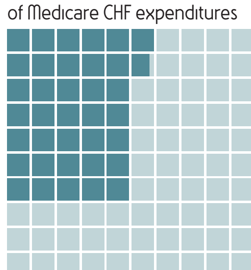
CKD: $41 billion
Medicare total: $241 billion

CKD patients with **diabetes** account for 27% of Medicare diabetes expenditures



CKD + diabetes: $22.1 billion
Medicare diabetes: $81.4 billion

CKD patients with **congestive heart failure** account for 37% of Medicare CHF expenditures



CKD + CHF: $19.4 billion
Medicare CHF: $52.8 billion

Circle diagram: Figure 4.1
Medication use: Table 4.b
Medication frequency & costs: Figure 5.16
Total Part D costs: Figure 5.9
Costs of patient care: Figure 7.5–7

This is the twenty-fourth annual report of the United States Renal Data System, and the thirteenth in our atlas series. For the fifth year we include a volume on chronic kidney disease (CKD), defining its burden in the general population, and looking at cardiovascular and other comorbidities, adverse events, preventive care, prescription medication therapy, and costs to Medicare and employer group health plans. In Volume Two we provide information on the size and impact of the end-stage renal disease (ESRD) population — the traditional focus of the USRDS — presenting an overview of the ESRD program, along with detailed data on incidence, prevalence, comorbidity of new ESRD patients, severity of disease, clinical care, hospitalization and mortality rates, pediatric patients, renal transplantation, the provider delivery system, the economics of the ESRD program, and international comparisons. In Chapter Ten of Volume Two we also present new data on changes to patient care after the introduction of the bundled payment system in January, 2011.

This year's ADR presents data on the breadth of kidney disease and its impact on both individuals and society as a whole. Increased attention has been given recently to CKD, its progression to more advanced stages, and, most importantly, its high rates of adverse events, including death and end-stage renal disease. From a public health perspective, core issues center on prevention and on the preservation of kidney function over time.

To punctuate these issues, we turn this year to one of the most important preservation initiatives in the United States: the national parks. Yellowstone National Park, considered the first such park in the world, was established by an act signed by President Ulysses S. Grant on March 1, 1872; on August 25, 1916, President Woodrow Wilson signed an act creating the National Park Service. The parks, which preserve the national history of the United States' most treasured sights and geographic locations, are visited by millions of Americans and foreign visitors each year, and often serves as spiritual places in which people may pause to consider how precious life is and the challenges faced in maintaining it.

In this ADR we reflect on the implications of kidney disease and on how this organ system can have such a widespread impact on health: on the functioning of the heart, brain, and nervous system, on hormonal balance, on bone and mineral metabolism, and on anemia and our ability to resist infections. The replacement of kidney function through a kidney transplant is certainly a new beginning, but it too has its challenges, not the least of which is preserving the function of the transplanted kidney over time.

The emotional implications of life with kidney disease are substantial, and relate not only to the physical elements of the disease but to the enormous stresses of financial issues and the impact on personal relationships. Understanding these broad implications, we hope that the emotional connections realized when viewing the breathtaking landscapes preserved in the national parks help give readers a broader perspective on the disease.

We approach Volume One from the perspective that the implications of CKD were underappreciated prior to February, 2002, when a new CKD classification staging system was proposed. The five-stage system was developed using population-level data from the National Health and

Nutrition Examination Survey (NHANES), a surveillance system coordinated by the National Center for Health Statistics at the Centers for Disease Control and Prevention. The conceptual model of this system was based on similar approaches for populations at risk for diabetes and hypertension, two well-known diseases that damage the kidney as well as other organ systems. The model characterizes progressive stages of CKD, from early evidence of kidney damage — such as albumin in the urine — to overt reductions in the filtering capacity of the kidney, defined by the estimated glomerular filtration rate (eGFR).

There are many issues related to defining the levels of eGFR and urine albumin that indicate "true disease" in the kidney during the early stages of CKD, versus what is considered normal reduction in kidney filtering capacity. This is particularly challenging in the elderly. Improving on the method to define glomerular filtration, a new estimating formula — the CKD-EPI equation — was published in the Annals of Internal Medicine in May, 2009. In the past two ADRs we have compared the initial Modification of Diet in Renal Disease (MDRD) formula and the CKD-EPI equation, providing important insight into improvements in defining risk and disease burden. Since the CKD-EPI method has proven to have superior characteristics, we now use only this method in the ADR.

While the USRDS and others will continue to investigate these issues in both the clinical and public health arenas, already there are important data available on the impact of CKD, data based both on biochemical information and on the definition of the disease within the Medicare and health plan datasets. The impact of the CKD staging system as a predictor of morbidity and mortality is now well known on a population level, but its translation into the care of individual patients must continue to evolve to help clinicians provide the best care to their patients affected by kidney disease.

In the Précis we highlight some of the most important data from the chapters, and address the burden of CKD — an area of major public policy and public health concern. In Chapter One we then define the CKD population, using NHANES data to examine how chronic conditions such as diabetes and cardiovascular disease interact with CKD in a random sample of the U.S. population. We show trends in risk groups, assess improvements in the awareness, treatment, and control of hypertension, diabetes, and lipid disorders, and conclude by looking at the impact of reduced kidney function on life expectancy.

Using data from the Medicare claims system and the employer group health plan datasets, we present data on identification and care of CKD patients in Chapter Two. We first summarize basic descriptive and comorbidity information from the major datasets used by the USRDS — the 5 percent Medicare sample, which includes individuals age 65 and older, and the MarketScan and Ingenix i3 databases, with employed populations that are 20 years younger. We then illustrate that while the identification of CKD is increasing in the health plan datasets, particularly for Stage 3, recognized disease in these datasets remains less than the actual burden shown in the NHANES estimates. Rates of testing for evidence of kidney disease, using serum creatinine and urine albumin tests in high-risk groups, are far lower than needed — a major concern.

We conclude the chapter by looking at the likelihood of receiving nephrologist care after a CKD diagnosis, and at prescription drug therapy among patients with CKD.

In Chapter Three we address morbidity and mortality among patients with CKD. We compare hospitalization and rehospitalization rates in CKD and non-CKD patients, giving particular attention to rehospitalization patterns related to the primary condition of the first event. Interestingly, CKD patients not only have higher overall hospitalization rates than those seen in the general population, but their rehospitalization rates are higher as well. These rates accelerate as patients progress toward ESRD, reflecting increasing complications which are challenging to manage on an outpatient basis. We conclude the chapter with data on mortality rates by CKD stage and across risk groups.

Cardiovascular disease in the CKD population is the focus of Chapter Four, in which we evaluate, by CKD stage, major cardiovascular diagnoses, types of evaluations, adverse events and interventions, and the broad area of medication use. Data on Part D prescription drug therapy address recommended therapies for major cardiovascular diagnoses and for patients receiving certain revascularization procedures.

This year's chapter on Medicare Part D prescription drug use again defines the populations using the benefit, and looks at various types of coverage, including the low income subsidy (LIS). We begin by showing the top fifteen medications used by CKD patients, reflecting the totality of the disease burden faced by this population. We then look at enrollment patterns in the general Medicare, CKD, and ESRD populations with Part D coverage, and present data on monthly premiums, deductibles, gap coverage, and copayments.

Acute kidney injury is a condition with implications beyond the immediate event. In Chapter Six we bring back our examination of AKI, exploring trends in AKI hospitalization with and without the use of dialysis. We look at racial disparities, an area of major concern, at the medical conditions occurring with the AKI event, and at data on recurrent AKI events. We then focus on physician care after an event, at prescription drug therapy, and on changes in CKD stage.

Chapter Seven addresses the costs associated with CKD. We look at the relative burden of CKD versus other major chronic diseases such as diabetes and congestive heart failure, at per

continued on page 22

a USRDS contacts

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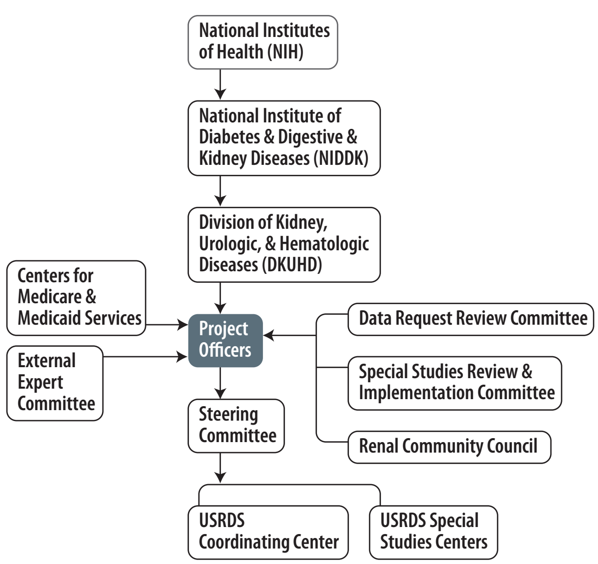
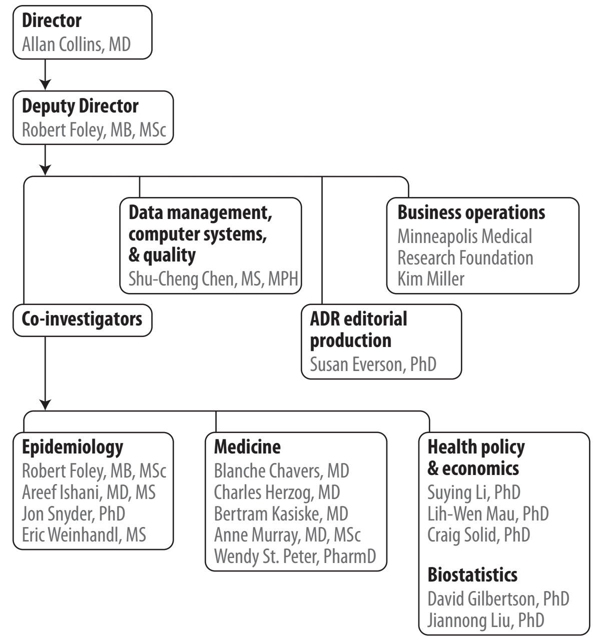
1 Administrative oversight of the USRDS



2 Departmental organization of the Coordinating Center



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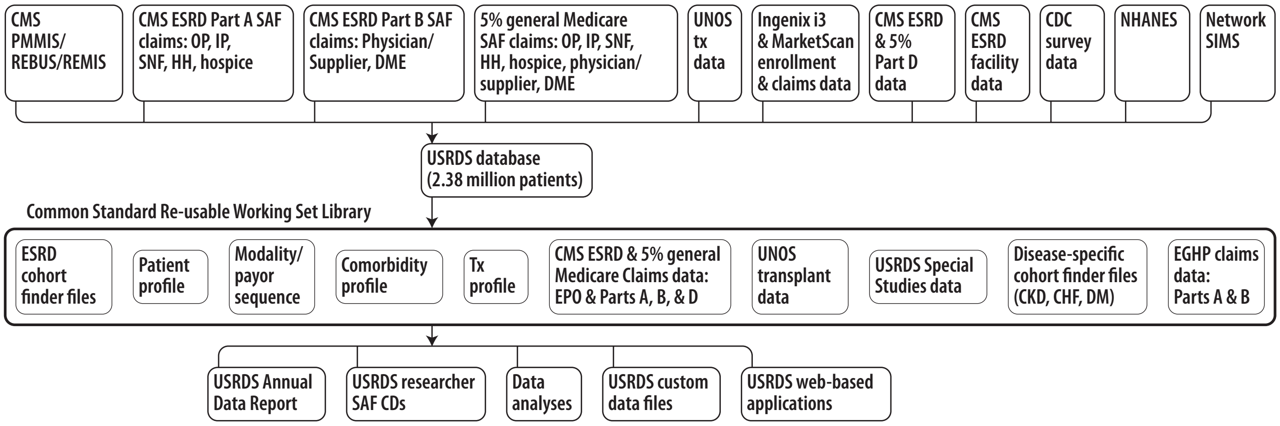
Structure of the USRDS database



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person per year costs, at costs by CKD stage and for Part D prescription drugs, and at the impact of the low income subsidy.

Data in this volume illustrate the challenges that CKD, its complications, and its costs pose to the healthcare system, policy makers, and individuals and families facing this condition. Programs to detect CKD — some ongoing since 2000 — have been initiated by the CDC and by non-profit patient organizations. By their nature, detection programs are broad-based approaches to define, through the use of simple tests, populations at risk of a disease or its complications, targeting individuals for detailed evaluation and intervention. The data we present here indicate that the CKD population is under-recognized, and that care of CKD patients is less than expected based on clinical practice guidelines; both issues may contribute to the increased morbidity and mortality of this high-risk population.

Begun in 2010, the CKD education benefit is intended to improve access to care, modality selection, consideration of home therapies, access to preemptive transplant, vascular access planning, management of risk factors, and referral to nephrologists and nutritional counseling for those with Stage 4 CKD. We plan to fully evaluate the implementation of the CKD education benefit in the 2013 ADR, when data are available for its first 18 months (codes for services were implemented in July, 2010).

The *Researcher's Guide*, USRDS database, and USRDS administrative oversight are described in the introduction to Volume Two.

Maps in the ADR present data divided into quintiles. In the sample map here, for example, approximately one-fifth of all data points have a value of 10.8 or above. Ranges include the number at the lower end of the range, and exclude that at the upper end (i.e, the second range here is 8.2–<9.2). To facilitate comparisons of maps for different periods, we commonly apply a single legend to each map in a series. In this case the data in each individual map are not evenly distributed, and a map for a single year may not contain all listed ranges. Numbers in the first and last boxes indicate the mean values of data points in the highest and lowest quintiles.

The Excel page for each map (on our website and CD-ROM) includes additional data. The map-specific mean is calculated using only the population included in the map; this does not usually match other data in the ADR, and should be quoted with caution. The overall mean includes all patients for whom data are available, whether or not their residency is known. We also include the number of patients excluded in the map-specific mean, and the total number of patients used in the calculation.

Throughout the ADR, with the exception of NHANES data, CKD cohorts exclude ESRD patients.

d

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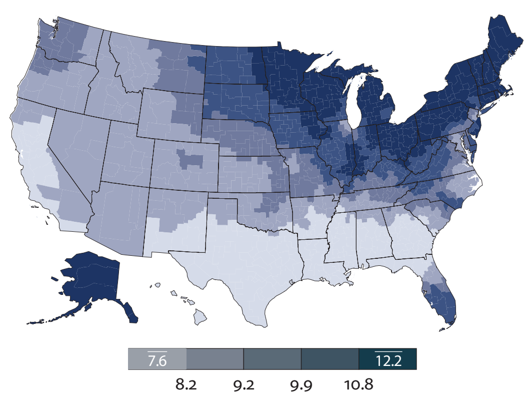


Précis

Grand Canyon National Park, Utah

AN INTRODUCTION TO CHRONIC KIDNEY DISEASE IN THE U.S.

For many years the World Health Organization has stressed that the primary threat to public health in this century lies in four major chronic diseases: diabetes, cardiovascular disease, chronic lung disease, and cancer. These conditions now account for the majority of deaths not only in high-income countries but in the middle- and now the low-income nations as well.

By reducing alcohol and tobacco use, controlling salt and calorie intake, and combating a sedentary lifestyle, these diseases are largely preventable. In September, 2011, the United Nations held a summit on chronic diseases, looking at how member states can address their impact, and discussing the widespread problems of premature loss of life, loss of economic productivity, and financial stress on families, which can contribute to advancing poverty. For the first time, because of its impact on morbidity and mortality and its substantial cost to the healthcare system, chronic kidney disease was added to the list of major diseases.

All countries now recognize the substantial impact of an increasing population with kidney failure, people who face premature death if they do not receive dialysis or a kidney transplant. The reality is that many countries struggle with the costs of providing end-stage renal disease (ESRD) care, costs which place ministries of finance at odds with ministries of health. The demand for transplant organs has led to the emergence of transplant tourism, with the buying and selling of organs. Some have expressed that a regulated market system would help fill this demand. Others suggest that prevention is a more sustainable approach, for without it the need will continue to grow, outpacing the pool of potential donors and increasing the known risks of the exploitation of poor populations at the expense of the wealthy. While the Istanbul Declaration on organ trafficking and transplant tourism has denounced the practice, 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 its 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 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 2010, while 13.1 percent had CKD, defined by an estimated GFR less than 60 ml/min/1.73 m^2 or a urine albumin-to-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).

With diabetes and hypertension known to be major risk factors for CKD, the awareness, treatment, and control of these conditions are crucial. NHANES data show that blood pressure control in the general population improved between 1988–1995 and 2005–2010, reaching almost 50 percent. LDL cholesterol control increased from 25 to 33 percent, while glycemic control rose from 31 to 48 percent overall, and from 37 to 58 percent in patients whose CKD is defined by an eGFR less than 60. These improvements in treatment and control may be contributing to the flat ESRD rate, despite the greater burden of diabetes in the general population.

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

The river was cut by the world's great flood and runs over rocks from the basement of time. On some of those rocks are timeless raindrops. Under the rocks are the words, and some of the words are theirs. I am haunted by waters.

NORMAN MACLEAN, *A River Runs Through It* 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 2010 prevalent population, CKD is recognized in 9.2 percent of older Medicare patients, and 1.4 percent of the younger employed population. When CKD patients newly identified during the year are included as well, CKD represents 11.9 percent of the Medicare population, and accounts for 27.5 percent of fee-for-service costs (see see Figure p.1 in the Volume Two Précis). When added to costs for ESRD patients, it appears that 35 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.

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 64 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, 65, and 60 percent. Similar data are reported for the employed population. And as we show in Chapter Two, only one-third of patients with diabetes, and 5 percent of those with hypertension, receive a urine albumin test within a year, despite the fact that these measurements are recommended by the American Diabetes Association and the American Heart Association.

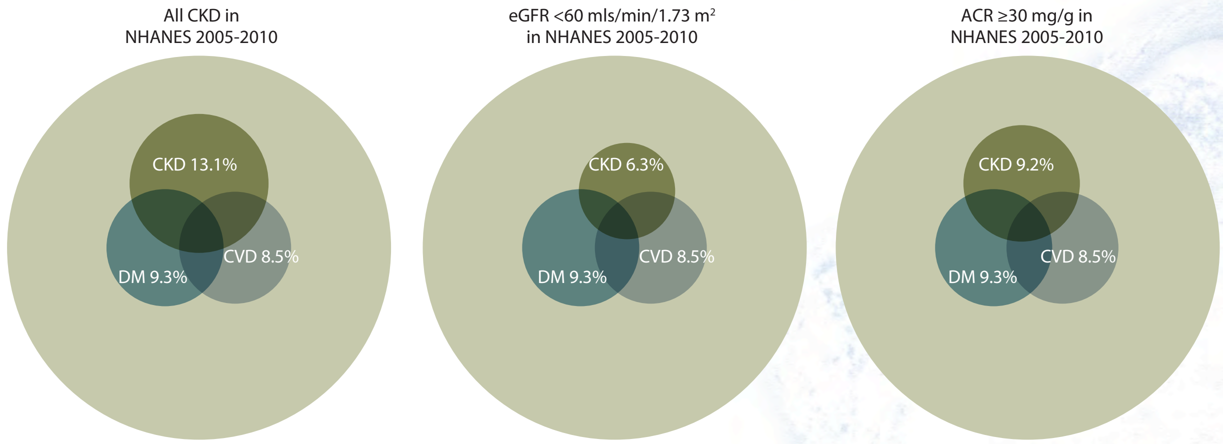
Rates of hospitalization, and of rehospitalization within 30 days, are progressively higher with advancing CKD. The issue of rehospitalization has received more attention for patients in the general population than for those with CKD, despite the fact that the rate for CKD patients is almost 40 percent higher. The rate accelerates as patients approach ESRD, reaching 43 percent in the month prior to ESRD initiation. 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 show that, when compared to 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.

This year we again highlight data on acute kidney injury (AKI). In both the Medicare and employed populations, rates of AKI rise with age. Recurrent hospitalizations for AKI are common, with rates reaching 28 percent for patients whose original AKI did not require dialysis, and 33 percent for those dialyzed during the original hospitalization; these numbers rise to 34 and 49 percent for blacks/African Americans. The rate of outpatient follow-up with a nephrologist in the year following AKI, however, is barely 20 percent.

Drug treatment changes considerably after an AKI event. The use of ACEIs/ARBs, for example, declines in the three months after discharge, but returns to the pre-AKI rate. It does not, however, exceed this initial rate, despite that fact that CKD has progressed. **» Figure 1.1;** see page 140 for analytical methods. *NHANES participants 2005–2010, age 20 & older; eGFR calculated using CKD-EPI equation; urine albumin creatinine ratio (ACR).*

vol 1 **1.1** **Distribution of NHANES participants with diabetes, congestive heart failure, & markers of CKD, 2005–2010**



Between 1988–1994 and 2005–2010, the overall prevalence estimate for CKD — defined by an eGFR <60 ml/min/1.73 m² or an ACR ≥30 mg/g — rose from 12.3 to 14.0 percent. The largest relative increase, from 25.4 to 40.8 percent, was seen in those with cardiovascular disease. For eGFR <60, prevalence rose from 4.9 to 6.7 percent, with the largest increase in those age 40–59; for ACR ≥30 mg/g, the estimate rose from 8.8 to 9.4. » **Table 1.a;** see page 140 for analytical methods. *NHANES III (1988–1994) & 2005–2010 participants age 20 & older; eGFR calculated using CKD-EPI equation; urine albumin creatinine ratio (ACR).*

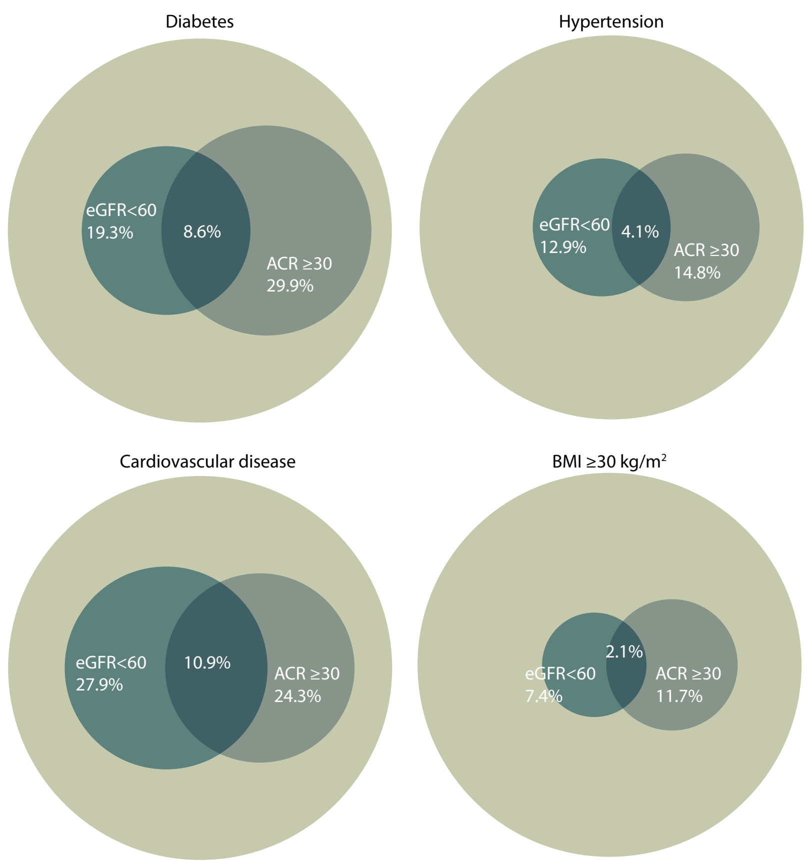
Here we look at several subgroups of NHANES 2005–2010 participants, showing the percentage in each population with an eGFR <60 m/min/1.73 m² and an ACR ≥30 mg/g. Nearly 28 percent of participants with cardiovascular disease (CVD) had an eGFR less than 60, compared to 19.3, 12.9, and 7.4 percent of those with diabetes, hypertension, and a high body mass index, respectively. Participants with diabetes were the most likely to have an ACR ≥30 mg/g, at 29.9 percent, compared to 24.3, 14.8, and 11.7 percent among those with CVD, hypertension, and a high BMI.

Nearly 11 percent of participants with CVD had both an eGFR <60 and an ACR ≥30, compared to 8.6 percent of those with diabetes and 4.1 and 2.1 percent, respectively, of those with hypertension and a high BMI. » **Figure 1.11;** see page 140 for analytical methods. *NHANES III (1988–1994) & 2005–2010 participants age 20 & older; eGFR calculated using CKD-EPI equation; urine albumin creatinine ratio (ACR).*

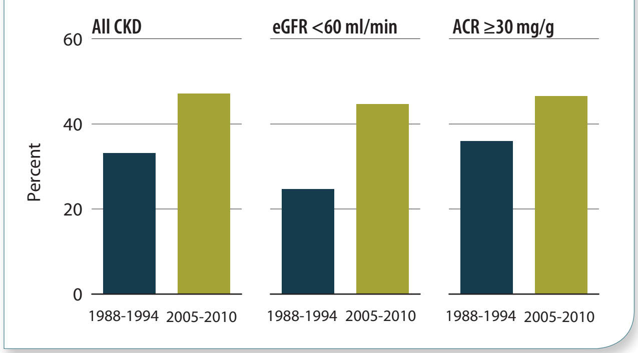
vol 1 **1.a** **Prevalence (%) of CKD in the NHANES population within age, gender, race/ethnicity, & risk-factor categories**

	All CKD		eGFR <60 ml/min/1.73m²		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 Blk/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

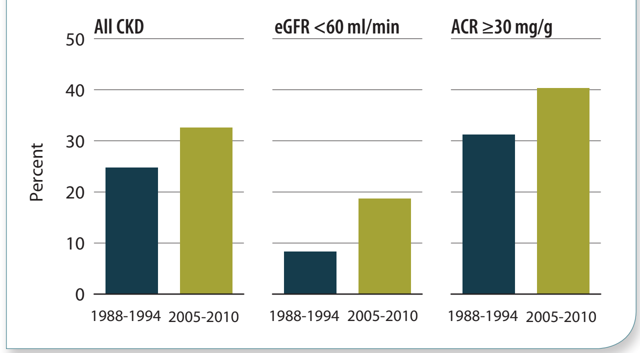
vol 1 **1.11** **Distribution of markers of CKD in NHANES participants with diabetes, hypertension, cardiovascular disease, & obesity, 2005–2010**



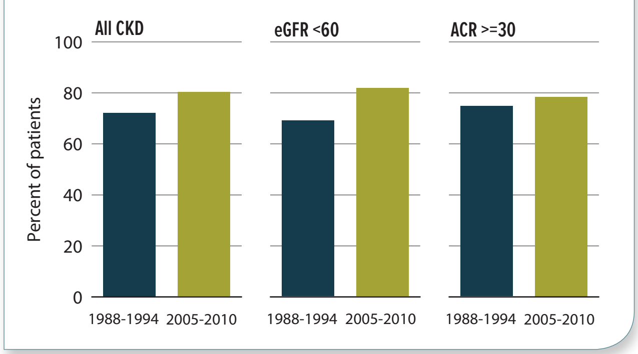
vol 1 1.12 **NHANES participants at target blood pressure**



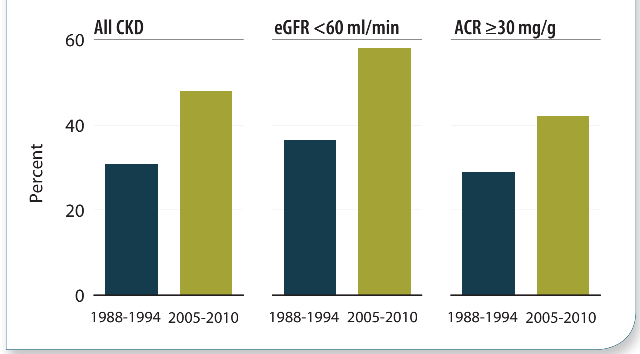
vol 1 1.13 **NHANES participants within LDL cholesterol target range**



vol 1 1.14 **NHANES participants within HDL cholesterol target range**



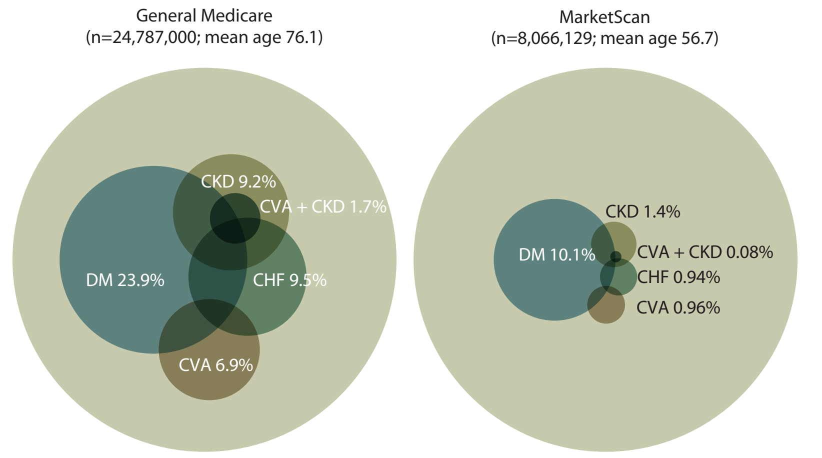
vol 1 1.15 **NHANES participants with glycohemoglobin <7%**



Between 1988–1994 and 2005–2010, management of hypertension, hyperlipidemia, hyperglycemia, and diabetes in the NHANES cohorts improved, regardless of how CKD is defined — by eGFR or by ACR. » **Figures 1.12–15;** see page 140 for analytical methods. *NHANES III (1988–1994) & 2005–2010 participants age 20 & older; dialysis patients excluded from NHANES 2005–2010; eGFR calculated using CKD-EPI equation; urine albumin/creatinine ratio (ACR).*

Among 2010 point prevalent general Medicare patients age 65 and older, diabetes was reported in 24 percent, and CKD in 9.2 percent. In the younger MarketScan population (with a mean age of 56.7), these rates were 10.1 and 1.4 percent. » **Figure 2.1;** see page 141 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.*

vol 1 **2.1** **Distribution of point prevalent general Medicare (age 65 & older) & MarketScan (age 50–64) patients with coded diabetes, CKD, CHF, & CVA, 2010**



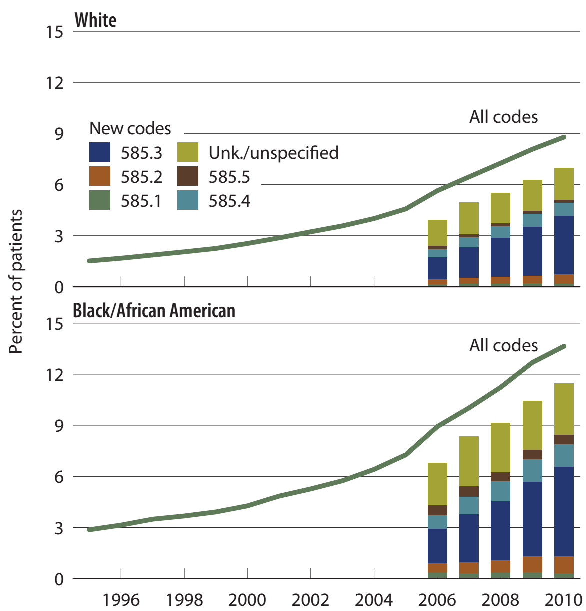
ICD-9-CM codes

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 & 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.

vol 1 **2.2** **Trends in CKD prevalence: Medicare patients age 65 & older, by race**



Among Medicare patients, claims data identify 13.7 percent of blacks/African Americans, and 8.8 percent of whites, as having prevalent CKD in 2010, compared to 11.5 and 7.0 percent identified using only the combined 585 codes. The most commonly reported stage-specific code in the prevalent CKD population is 585.3 (Stage 3), at 3.4 and 5.2 percent for white and black/African American Medicare patients, respectively. » **Figure 2.2;** see page 141 for analytical methods. *Prevalent Medicare patients surviving cohort year, without ESRD, age 65 & older.*

vol 1
2.d **Percent of patients with CKD, by demographic characteristics, comorbidity, & dataset, 2010**

	NHANES	Medicare (65+)			MarketScan (50–64)		
	Any CKD	DM (no HTN)	HTN (no DM)	CVD	DM (no HTN)	HTN (no DM)	CVD
All	14.0	10.3	15.8	23.1	6.1	5.4	10.0
20-49	6.5						
50-54	8.4				5.1	4.4	7.9
55-59	13.3				5.8	5.1	9.7
60-64	17.2				7.1	6.4	11.5
65-74	29.1	8.5	11.3	19.4			
75-79	49.5	11.1	16.1	23.3			
80+	65.5	14.1	21.5	26.8			
Male	12.1	11.5	18.3	24.4	6.6	6.1	10.6
Female	15.8	9.1	14.3	22.0	5.5	4.7	9.3
White	14.3	10.3	15.6	22.3			
Black/Af Am	16.0	11.2	19.6	32.3			
Other	11.9	10.2	14.3	24.9			

vol 1
2.g **Cumulative probability of a physician visit at month 12 after CKD diagnosis in 2009, by demographic characteristics, physician specialty, & dataset, 2010**

	Medicare (65+)			MarketScan (50–64)		
	Primary care	Cardiologist	Nephrologist	Primary care	Cardiologist	Nephrologist
50-54				0.74	0.31	0.23
55-59				0.77	0.35	0.26
60-64				0.79	0.40	0.28
65-74	0.91	0.60	0.33			
75-84	0.93	0.66	0.31			
85+	0.93	0.66	0.24			
Male	0.93	0.61	0.29	0.76	0.38	0.26
Female	0.92	0.67	0.31	0.78	0.35	0.26
White	0.93	0.65	0.29			
Black/Af Am	0.91	0.61	0.35			
Other	0.90	0.59	0.31			
All	0.93	0.64	0.31	0.79	0.37	0.27

vol 1
2.h **Cumulative probability of a physician visit at month 12 after a CKD diagnosis code of 585.3 or higher in 2009, by demographic characteristics, physician specialty, & dataset, 2010**

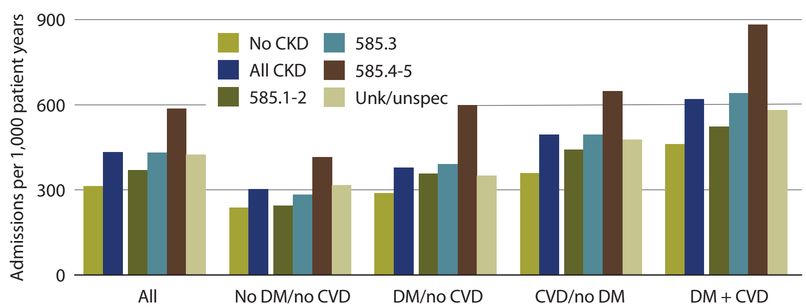
	Medicare (65+)			MarketScan (50–64)		
	Primary care	Cardiologist	Nephrologist	Primary care	Cardiologist	Nephrologist
50-54				0.75	0.37	0.53
55-59				0.78	0.39	0.52
60-64				0.80	0.43	0.52
65-74	0.92	0.61	0.62			
75-84	0.93	0.67	0.57			
85+	0.93	0.66	0.44			
Male	0.93	0.61	0.54	0.77	0.42	0.52
Female	0.92	0.69	0.59	0.79	0.38	0.52
White	0.93	0.65	0.56			
Black/Af Am	0.92	0.61	0.61			
Other	0.90	0.60	0.55			
All	0.93	0.65	0.60	0.79	0.41	0.56

Fourteen percent of NHANES participants have CKD. The likelihood of CKD increases with age, is recognized in women more often than in men, and occurs in 14.3 percent of whites and 16 percent of blacks/African Americans. Among Medicare patients age 65 and older, a CKD diagnosis code is more likely in older patients, men, and blacks/African Americans, and in patients with cardiovascular disease (CVD), at 23.1 percent compared to 10.3 and 15.8 percent in patients with diabetes or hypertension. In MarketScan patients age 55–59 and 60–64, the odds of a CKD diagnosis code are 18 and 43 percent higher compared to patients age 50–64, are lower in women compared to men, and are three times higher in patients with diabetes, hypertension, or cardiovascular disease than in patients without these conditions. **» Table 2.d;** see page 141 for analytical methods. *Medicare pts age 65 & older & MarketScan pts age 50–64, alive & eligible for all of 2010. CKD claims as well as other diseases identified in 2010. NHANES 2005–2010 participants, age 20 & older; eGFR estimated by CKD-EPI equation.*

The type of physician seen by month 12 following a CKD diagnosis changes dramatically with the severity of CKD. In Medicare patients with any CKD, for example, the probability of seeing a nephrologist is 0.24–0.35 across demographic groups; in those with a diagnosis code of 585.3 or higher, the probability is 0.44–0.62. In the MarketScan CKD population, the probability of seeing a nephrologist is 0.27 overall, increasing to 0.56 in patients with a diagnosis code of 585.3 or higher. **» Tables 2.g–h;** see page 141 for analytical methods. *Patients alive & eligible all of 2009. CKD diagnosis represents date of first CKD claim during 2009; physician claims searched during 12 months following that date.*

In both CKD and non-CKD populations age 66 and older, adjusted rates of hospitalization increase with greater comorbidity. In 2010, for example, admissions for Stage 4–5 CKD patients with both diabetes and cardiovascular disease reached 882 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, 2010 point prevalent Medicare patients, age 66 & older on December 31, 2009. Adj: age/gender/race/prior hospitalization/comorbidity; rates by one factor are adjusted for the others. Ref: Medicare patients age 66 & older, 2010.*

vol 1 3.2 **Adjusted hospitalization rates in Medicare patients, by comorbidity & CKD diagnosis code, 2010**



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)

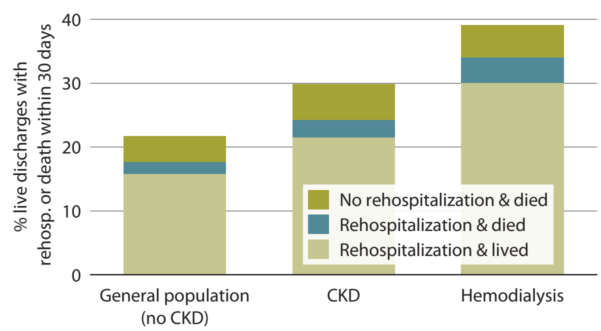
585.5 Chronic kidney disease, Stage 5 (excludes 585.6: Stage 5, requiring chronic dialysis.*)

Chronic kidney disease, unknown/unspecified

**In USRDS analyses, patients with ICD-9-CM code 585.6 & with no ESRD 2728 form or other indication of ESRD are considered to have code 585.5; see Appendix A for details.*

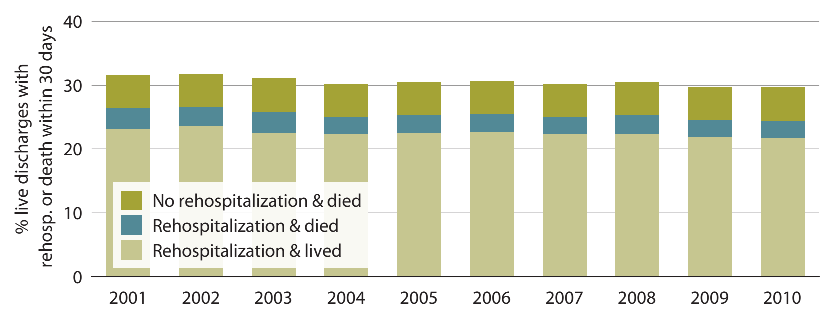
CKD stage estimates are from a single measurement. For clinical case definition, abnormalities should be present ≥ 3 months.

vol 1 3.1 **All-cause rehosp. or death within 30 days of live hospital discharge in the general Medicare (no CKD), CKD, & HD populations, age 66+, 2010**



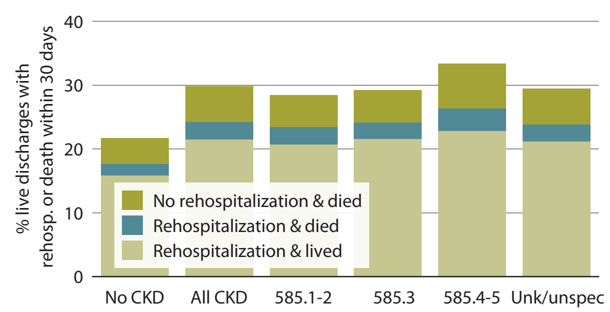
Thirty-four percent of hemodialysis patients are rehospitalized within 30 days, compared to 24 percent of patients with CKD and 18 percent in the general Medicare population. » **Figure 1.1;** see page 142 for analytical methods. *January 1, 2010 point prevalent Medicare patients, age 66 & older on December 31, 2009, unadjusted. Includes live hospital discharges from January 1 to December 1, 2010.*

vol 1
3.8
Adjusted all-cause rehospitalization or death 30 days after live hospital discharge in CKD patients



Adjusted all-cause rehospitalization rates in Medicare CKD patients have slowly decreased during the last decade, ranging from 27 percent in 2002 to 24 percent in 2010. » **Figure 3.8;** see page 142 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 2005. Includes discharges from January 1 to December 1 of each year.*

vol 1
3.9
All-cause rehospitalization or death within 30 days after discharge from all-cause index hospitalization, by CKD stage, 2010

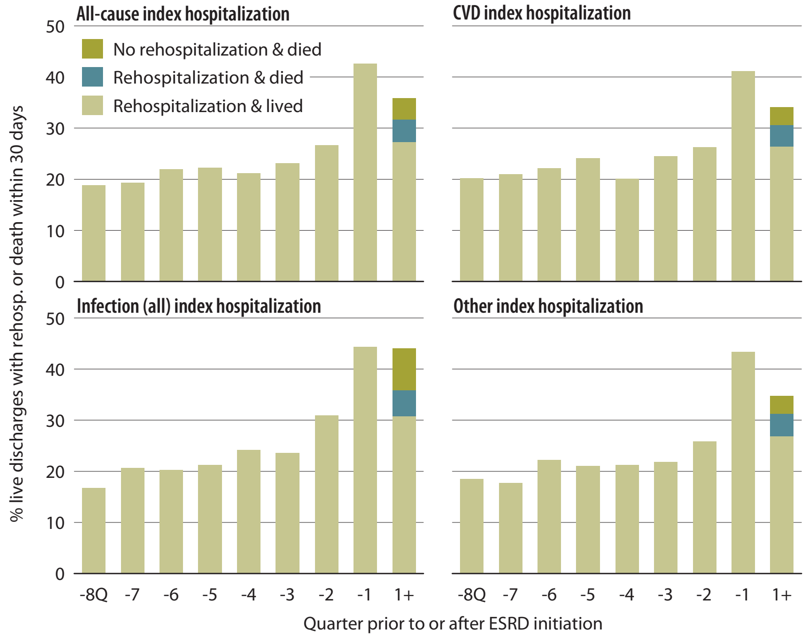


The thirty-day all-cause rehospitalization rate among patients with CKD of Stages 4–5 was 26 percent in 2010, compared to 23 percent in those with Stage 1–2 CKD; rates for death or rehospitalization were 33 and 28 percent, respectively. The rehospitalization rate among CKD patients (24 percent) exceeded the rate of the combined end-point of death or rehospitalization in non-CKD patients, at 22 percent.

Rates of rehospitalization increase with the severity of CKD, and are highest among males and blacks/African Americans within all groups except patients with CKD of Stages 4–5; rates in these patients are similar by gender and highest in races other than white or black/African American. » **Figure 3.9;** see page 142 for analytical methods. *January 1, 2010 point prevalent Medicare patients, age 66 & older on December 31, 2009; unadjusted. Includes live hospital discharges from January 1 to December 1, 2010*

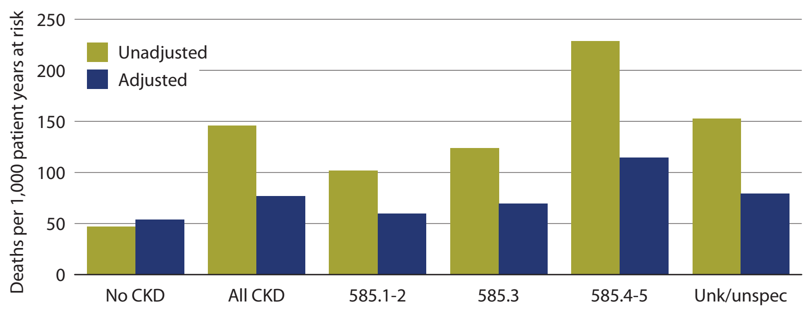
The highest rehospitalization rates during the transition to ESRD are observed following an index hospitalization for infection, with 44 percent of discharges followed by a rehospitalization within 30 days during the first quarter before ESRD initiation. In the quarter following ESRD initiation, 44 percent of discharges from hospitalizations for infection are followed by death or rehospitalization within 30 days. » Figure 3.13; see page 142 for analytical methods. *Incident ESRD patients, January 1 to October 1, 2010; age 67 or older, unadjusted.*

vol 1 3.13 **All-cause rehospitalization or death 30 days after live hospital discharge during the transition to ESRD, by cause-specific index hospitalization, 2010**



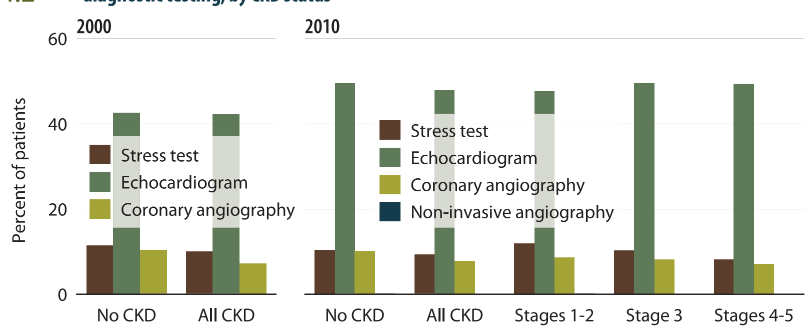
Among non-CKD patients age 66 and older, adjusted mortality rates are 15 percent higher than unadjusted rates. For CKD patients, rates adjusted for patient characteristics, hospitalizations, and comorbidities are 41–50 percent lower. Adjusted mortality reaches 115 deaths per 1,000 patient years for patients with Stage 4–5 CKD. » Figure 3.15; see page 142 for analytical methods. *January 1, 2010 point prevalent patients age 66 & older. Adj: age/gender/race/prior hosp./comorbidities. Ref: 2010 all patients.*

vol 1 3.15 **All-cause mortality rates in Medicare CKD & non-CKD patients, by CKD diagnosis code, 2010**

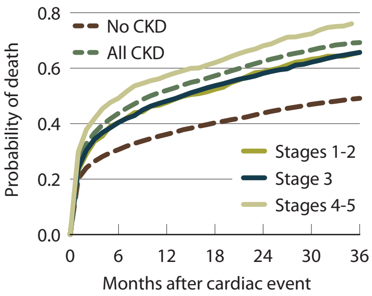


There has been little change by CKD status in the percentage of patients receiving stress tests, nor has the use of coronary angiography changed appreciably, despite recognition of CKD as a risk factor for both coronary events and increased mortality. The use of echocardiography in CKD patients with CHF, in contrast, has grown, from 42 percent in 2000 to 48 percent in 2010. » Figure 4.2; see page 143 for analytical methods. *January 1 point prevalent Medicare patients age 66 & older. CKD stages not available from claims data in 2000.*

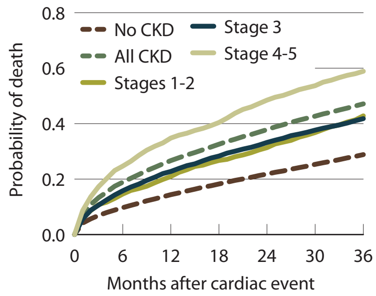
vol 1 4.2 **Patients with CHF who receive diagnostic testing, by CKD status**



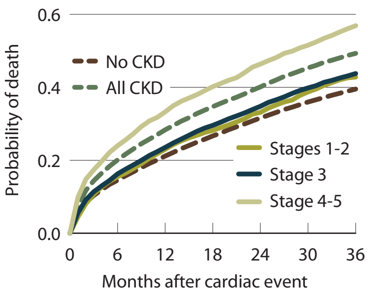
vol 1 **4.4** **Probability of death following an AMI, by CKD status, 2007–2008**



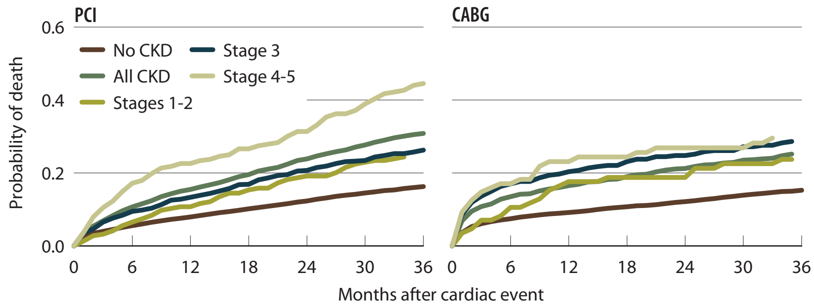
vol 1 **4.5** **Probability of death following a CVA/TIA, by CKD status, 2007–2008**



vol 1 **4.6** **Probability of death following a diagnosis of CHF, by CKD status, 2007–2008**



vol 1 **4.7** **Probability of death following a CV procedure (PCI/CABG), by CKD status, 2007–2008**



There is a graded increased risk of mortality with advancing CKD; the two-year mortality rate after MI, for example, at 44 percent in patients with no CKD, rises to 58 and 68 percent for those with Stage 3 and 4–5 CKD. Similar trends occur for death following CVA/TIA, CHF diagnosis, and coronary revascularization. Although the probability of death is lower in patients with advanced CKD who have CABG surgery compared to PCI, these are observational data and there may be confounding by indication. **» Figures 4.4–7;** see page 143 for analytical methods. *January 1 point prevalent Medicare patients age 66 & older. CKD stages not available from claims data in 2000.*

vol 1 4.b **Cardiovascular disease & pharmacological interventions (row percent), by diagnosis & CKD stage**

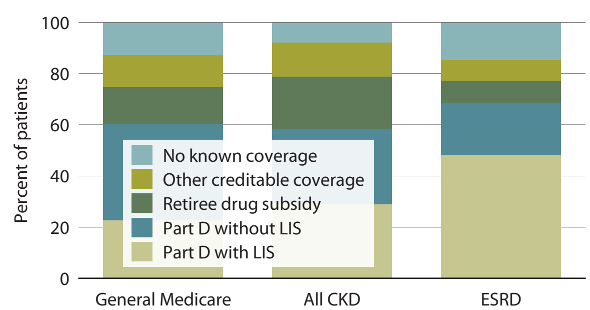
	2007 N	ACEI/ARB	Beta blocker	Clopid-ogrel	Warfarin	Statin	Amio-darone	2010 N	ACEI/ARB	Beta blocker	Clopid-ogrel	Warfarin	Statin	Amio-darone
CHF														
No CKD	59,922	53.8	52.2	14.2	21.2	36.9	4.6	50,894	57.2	60.3	16.0	24.3	46.6	5.2
All CKD	12,611	47.4	56.4	18.3	19.0	38.9	5.7	16,348	52.2	66.4	20.3	23.2	50.8	7.7
Stages 1–2	650	50.5	54.2	19.2	18.9	39.5	3.8	666	57.1	64.3	21.3	19.2	50.6	7.5
Stage 3	2,274	52.6	60.6	19.6	19.7	45.8	5.9	4,505	55.0	68.2	21.4	24.8	55.0	8.0
Stages 4–5	2,129	42.4	62.0	19.7	16.8	41.2	6.1	3,316	44.4	69.9	21.4	21.3	52.8	8.8
AMI														
No CKD	4,078	64.7	74.5	49.4	13.7	59.5	6.5	3,491	65.5	77.4	50.5	14.4	66.8	6.7
All CKD	800	55.5	74.3	44.1	14.5	57.6	4.4	964	57.3	78.0	46.2	17.0	63.7	7.5
Stages 1–2	38	65.8	86.8	44.7	21.1	65.8	2.6	37	54.1	83.8	40.5	10.8	62.2	5.4
Stage 3	144	56.3	76.4	48.6	14.6	63.2	4.9	268	56.7	77.2	48.9	17.9	65.3	6.0
Stages 4–5	149	42.3	80.5	40.9	15.4	52.3	3.4	189	46.0	78.8	51.3	13.2	69.8	5.8
PAD														
No CKD	65,809	44.8	39.3	15.1	11.7	36.6	1.9	60,263	48.4	44.2	16.9	12.4	46.3	2.0
All CKD	9,938	47.3	52.2	20.9	15.1	40.8	4.3	12,988	51.1	57.8	22.8	16.8	51.9	4.7
Stages 1–2	538	52.0	51.9	22.1	14.7	41.3	4.1	625	55.4	56.6	24.6	14.9	55.0	4.3
Stage 3	1,855	53.1	54.3	22.8	15.0	49.7	4.6	3,646	54.9	60.6	25.0	17.6	56.6	4.8
Stages 4–5	1,555	44.8	59.0	21.0	13.0	45.2	5.0	2,289	45.0	64.1	23.9	16.0	56.5	6.2
CVA/TIA														
No CKD	48,437	46.9	40.8	21.4	14.0	41.8	1.9	40,372	51.2	45.4	23.1	14.8	53.5	2.1
All CKD	6,378	49.4	53.0	26.5	15.9	43.3	3.9	7,671	52.7	58.3	26.3	19.3	54.6	4.3
Stages 1–2	317	50.5	53.6	28.1	13.9	42.6	3.8	361	58.2	59.8	26.0	15.5	54.8	3.3
Stage 3	1,164	51.7	56.6	26.7	17.1	50.2	4.9	2,207	54.6	59.6	28.0	20.2	58.4	4.3
Stages 4–5	912	46.7	59.4	28.3	14.0	47.4	4.2	1,232	46.3	64.6	26.7	18.7	57.2	6.2
AFIB														
No CKD	53,590	44.7	50.4	9.0	47.5	33.1	7.8	54,002	50.2	60.4	9.6	56.2	46.1	8.5
All CKD	7,245	45.0	54.9	13.9	40.2	35.5	10.5	10,917	50.6	66.5	14.2	49.4	50.4	12.9
Stages 1–2	372	50.5	55.1	13.2	43.0	34.1	8.1	498	54.2	66.1	16.5	45.6	52.6	12.4
Stage 3	1,269	48.7	55.9	14.3	44.6	40.3	12.4	3,117	52.8	67.3	14.2	52.6	54.1	14.3
Stages 4–5	1,094	43.2	59.0	14.3	38.4	37.8	12.7	1,888	44.2	68.9	15.7	48.0	53.0	15.5
ICD/CRT-D														
No CKD	654	74.8	80.3	25.1	30.9	57.2	15.9	455	79.8	84.6	31.9	36.0	65.1	20.2
All CKD	241	65.1	82.2	28.2	32.8	53.5	18.7	179	64.8	88.3	31.3	43.6	60.9	21.2
Stages 1–2	7	42.9	71.4	42.9	57.1	42.9	14.3	5	100.0	100.0	40.0	20.0	40.0	0.0
Stage 3	54	66.7	83.3	29.6	38.9	51.9	18.5	61	59.0	93.4	31.1	39.3	59.0	16.4
Stages 4–5	41	53.7	73.2	31.7	29.3	58.5	17.1	36	47.2	86.1	33.3	44.4	63.9	19.4
Revascularization: PCI														
No CKD	4,695	64.7	73.5	89.3	10.3	72.2	4.0	4,319	66.1	75.3	87.0	10.7	76.1	3.7
All CKD	530	59.1	77.7	87.2	12.5	66.6	5.1	728	67.2	80.2	84.1	14.3	71.0	6.0
Stages 1–2	32	53.1	78.1	93.8	9.4	81.3	0.0	33	75.8	81.8	90.9	6.1	81.8	0.0
Stage 3	127	57.5	74.0	85.0	15.0	62.2	3.1	229	65.5	76.9	83.4	13.5	67.7	5.2
Stages 4–5	71	60.6	76.1	88.7	12.7	59.2	8.5	107	50.5	77.6	88.8	13.1	76.6	4.7
Revascularization: CABG														
No CKD	1,299	62.2	83.4	31.6	18.2	72.6	26.8	1,000	64.0	86.6	32.4	21.2	82.6	33.6
All CKD	129	63.6	82.9	32.6	27.9	67.4	29.5	139	56.8	85.6	36.7	17.3	77.7	23.7
Stages 1–2	12	75.0	91.7	41.7	33.3	66.7	33.3	8	37.5	62.5	25.0	0.0	87.5	37.5
Stage 3	29	79.3	82.8	44.8	24.1	69.0	27.6	51	56.9	88.2	41.2	17.6	80.4	25.5
Stages 4–5	15	53.3	80.0	20.0	33.3	86.7	33.3	18	33.3	88.9	38.9	11.1	83.3	16.7
No cardiac event														
No CKD	360,270	41.1	27.7	4.3	2.3	37.0	0.2	377,558	44.5	30.0	5.3	2.4	44.1	0.2
All CKD	13,360	59.5	43.8	7.5	4.5	45.4	0.5	22,513	62.5	47.3	8.8	5.0	53.9	0.6
Stage 1-2	791	65.5	45.3	8.1	3.3	52.1	0.3	1,254	65.9	45.1	8.1	4.6	58.0	0.2
Stage 3	3,133	69.3	48.1	8.1	3.8	53.6	0.5	7,572	69.2	49.9	9.2	4.3	60.1	0.6
Stage 4-5	2,253	60.1	53.5	8.4	3.8	48.3	1.0	3,555	60.6	57.8	10.1	5.1	55.6	1.0

» **Table 4.b;** see page 143 for analytical methods. *January 1 point prevalent Medicare patients with Medicare Parts A, B, & D enrollment.*

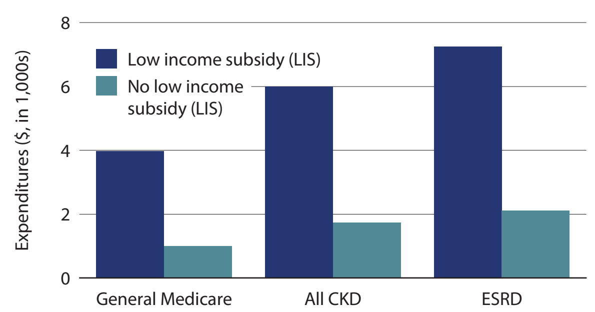
Sixty percent of general Medicare patients, and 58 percent of patients with CKD, were enrolled in Part D in 2010, as were 69 percent of patients with ESRD. The proportion of patients with other creditable coverage is similar among CKD and Medicare patients, at about 13 percent, but a higher proportion of CKD patients have retiree drug subsidy coverage, at 21 compared to 15 percent. Eight percent of CKD patients have no known source of drug coverage — a level lower than the 13 percent seen in the general Medicare population. » **Figure 5.2;** see page 145 for analytical methods. *Point prevalent Medicare enrollees alive on January 1, 2010.*

PPPY total costs for Part D-covered medications in 2010 were 3.3–3.9 times greater for LIS patients than for those without LIS. Costs in LIS and non-LIS patients vary from $3,985 and $1,010 PPPY, respectively, in the general Medicare population to $5,997 and $1,733 among patients with CKD, and to $7,243 and $2,114 among those on dialysis. » **Figure 5.11;** see page 145 for analytical methods. *Medicare patients surviving 2010. General Medicare totals include Part D claims for all patients in the Medicare 5 percent sample enrolled in Part D. CKD total includes Medicare CKD patients, as determined from claims. ESRD totals include all Part D claims for Medicare ESRD patients enrolled in Part D.*

vol 1 **5.2** **Sources of prescription drug coverage in Medicare enrollees, by population, 2010**



vol 1 **5.11** **Per person per year Part D costs for enrollees, by low income subsidy (LIS) status, 2010**



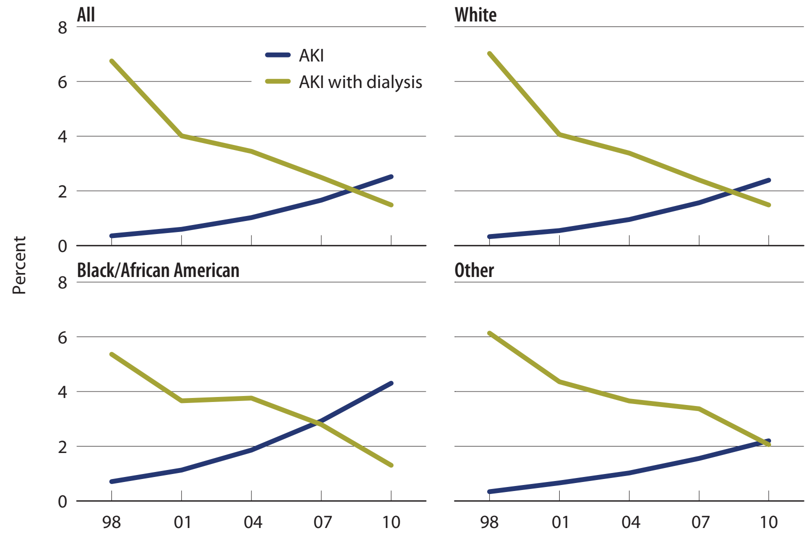
In terms of frequency of use, the top 15 drugs covered by Medicare Part D are similar in the general Medicare and CKD populations. Simvastatin, for example, is the most frequently used drug in general Medicare population, and second on the list for CKD patients. Three drugs — atenolol, metformin and hydrochlorothiazide — appear in the top 15 for general Medicare patients, but not for CKD patients, in whom furosemide (a loop diuretic) has a more potent diuretic effect, and metformin is contraindicated secondary to the increased risk of lactic acidosis. Carvedilol, allopurinol, and hydrocodone, in contrast, make the list only for CKD patients. Interestingly, potassium chloride is one of the most frequently used medications in the CKD population, which may indicate a more aggressive use of diuretics in these patients. » **Table 5.h;** see page 145 for analytical methods. *Part D claims for all patients in the Medicare 5 percent sample; claims & costs scaled up by a factor of 20 to estimate totals.*

vol 1 **5.h** **Top 15 drugs used by general Medicare Part D enrollees with CKD, by days supply & net cost, 2010**

By days supply Generic name	Total days supply	By net cost Generic name	Total days supply	Total cost (dollars)
Furosemide	116,549,920	Insulin	74,735,540	359,843,460
Simvastatin	96,025,260	Clopidogrel bisulfate	53,989,880	227,155,480
Metoprolol	95,041,300	Donepezil	19,567,440	122,565,260
Levothyroxine	88,402,280	Esomeprazole	21,754,600	114,521,000
Amlodipine	84,617,740	Atorvastatin	38,651,260	113,114,980
Lisinopril	76,513,600	Quetiapine	13,461,420	108,079,420
Insulin	74,735,540	Pioglitazone	17,299,760	93,359,820
Omeprazole	64,962,340	Fluticasone/salmeterol	14,054,300	86,148,580
Potassium chloride	58,766,760	Olanzapine	4,762,140	78,968,440
Clopidogrel bisulfate	53,989,880	Memantine	13,856,500	63,059,380
Warfarin	50,785,740	Epoetin alfa	1,938,100	61,496,720
Carvedilol	47,520,840	Tiotropium	11,196,580	58,903,920
Atorvastatin	38,651,260	Sitagliptin	11,133,600	56,650,900
Allopurinol	37,697,680	Valsartan	24,878,640	55,643,200
Hydrocodone/acetaminophen	31,742,560	Rosuvastatin	18,313,300	54,392,300

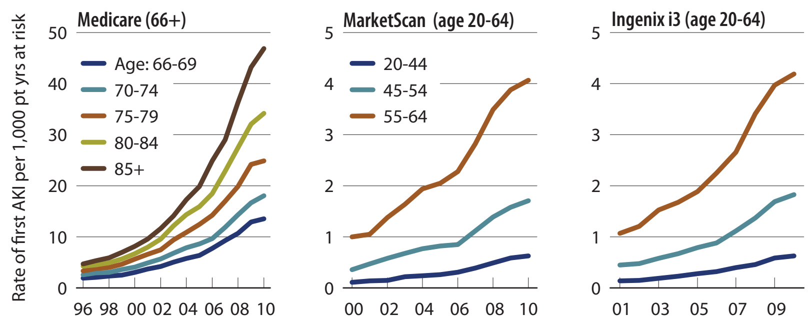
Data here show the rising incidence of AKI. While in isolation there appears to be an epidemic, it is likely that a proportion of this change is the result of code creep. Superimposed on this figure is the proportion of reported AKI patients requiring dialysis. While the threshold for defining AKI has changed over time, the threshold for when to initiate dialysis has likely remained fairly stable. In contrast to the incidence of AKI, the incidence of AKI requiring dialysis has been declining, further supporting the notion of code creep for AKI diagnoses. **» Figure 6.1;** see page 145 for analytical methods. *Medicare patients age 66 & older.*

vol 1 **6.1** **Hospitalizations for acute kidney injury, with or without dialysis, by race**



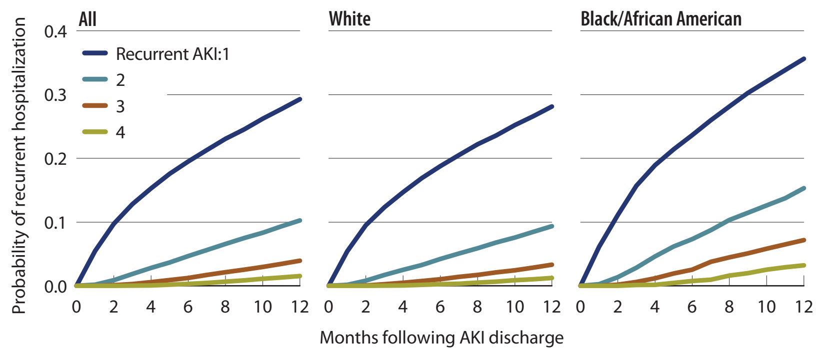
Acute kidney injury is highly associated with age. Among Medicare patients age 66–69, for example, the rate of AKI in 2010 was 13.6 per 1,000 patient years, and increased to 18.1, 24.9, 34.2, and 46.9, respectively, with increasing ages of 70–74, 75–79, 80–84, and 85 and older. Similar patterns are seen in both the MarketScan and Ingenix i3 populations. **» Figure 6.3;** see page ___145 for analytical methods. *Medicare AKI patients age 66 & older, & MarketScan & Ingenix i3 patients age 20–64.*

vol 1 **6.3** **Rates of AKI, by age & dataset**



Following hospital discharge for an AKI hospitalization, the probability of one recurrent hospitalization event is 0.29 overall and 0.28 and 0.36, respectively, in whites and blacks/African Americans. The probability of having more than one AKI event is highest in black/African Americans compard to whites — at 0.15 versus 0.09 for two events and 0.07 versus 0.03 for three. **» Figure 6.9;** see page 145 for analytical methods. *Medicare AKI patients age 66 & older. 2009–2010.*

vol 1 **6.9** **Probability of a recurrent AKI hospitalization in Medicare patients, by number of recurrent events & race, 2009–2010**



2012 USRDS Annual Data Report

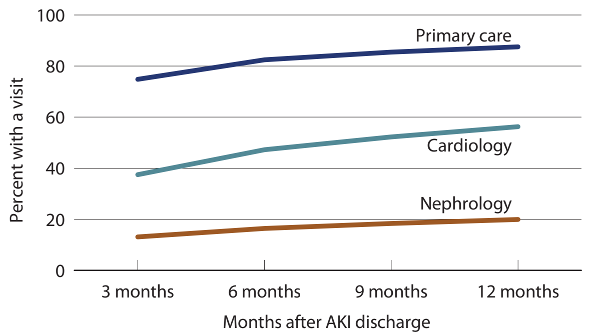
volume 1 CKD

Following an AKI hospitalization, 75 percent of patients see a primary physician within three months of discharge, while 38 and 13.2 percent, respectively, see a cardiologist or nephrologist.

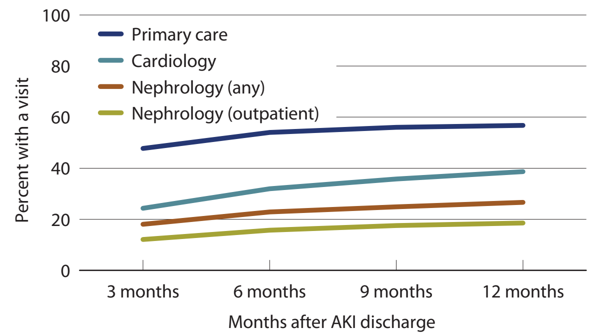
Surprisingly, fewer than half of the patients with a recurrent AKI see a primary care physician within three months of their second discharge, while 24.4 percent see a cardiologist and 18.1 and 12.2 percent, respectively, see a nephrologist (any or outpatient).

Outpatient visits to a nephrologist following an initial or recurrent AKI event are more likely in patients with CKD than in those without. **» Figures 6.13–14;** see page 145 for analytical methods. *Medicare AKI patients age 66 & older, 2009–2010..*

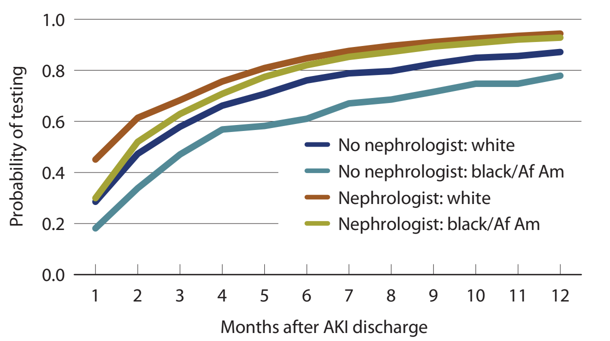
vol 1 **6.13** **Outpatient physician visits following initial AKI discharge, 2009–2010**



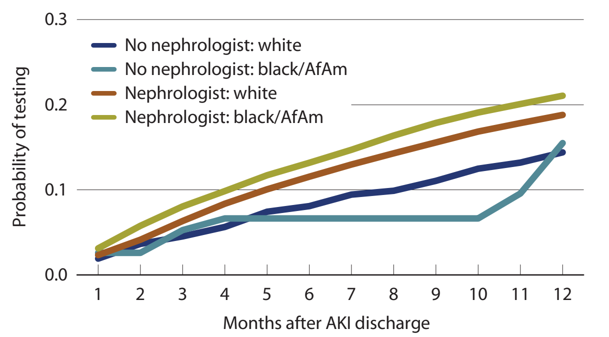
vol 1 **6.14** **Physician visits in the year following a recurrent AKI discharge, 2009–2010**



vol 1 **6.16** **Probability of serum creatinine testing after hospitalization for acute kidney injury, 2009–2010**



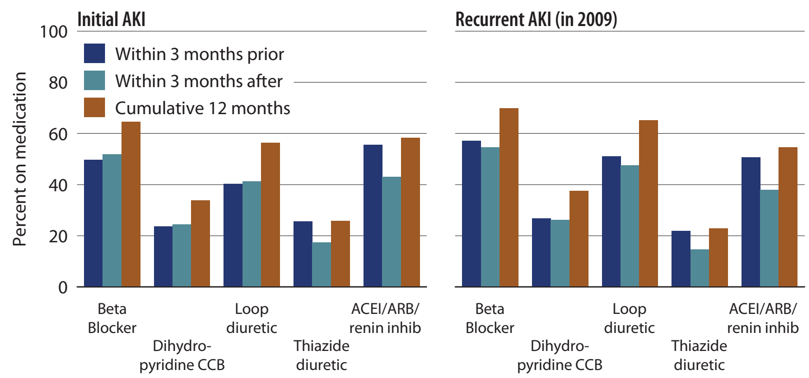
vol 1 **6.17** **Probability of urine protein testing after hospitalization for acute kidney injury, 2009–2010**



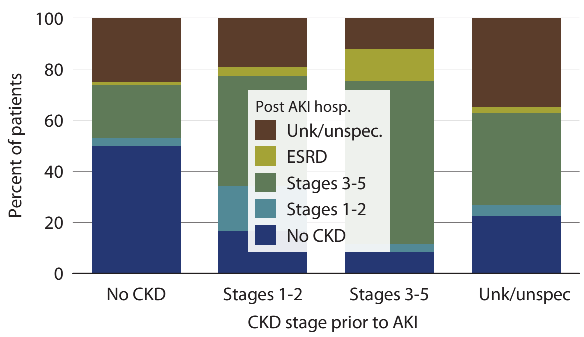
Among individuals suffering an AKI event, the probability of serum creatinine and urine protein testing is higher, regardless of race, in those seeing a nephrologist than in those who do not. **» Figures 6.16–17;** see page 145 for analytical methods. *Medicare AKI patients, age 66 & older, 2009.*

When comparing cardiovascular medication use in patients prior to, in the first three months after, and at one year following an AKI or recurrent AKI event, the greatest increases in medication use occur in patients who had dihydropyridine calcium channel blockers, loop diuretics, or beta blockers prescribed within the three months prior to their AKI event. Patients using thiazide diuretics or an ACEI/ARB/renin inhibitor, in contrast, are likely to use less of these medications at three months post-AKI, but generally return to their pre-AKI use levels by twelve months. » **Figure 6.18;** see page 145 for analytical methods. *AKI patients with Part D coverage, 2009.*

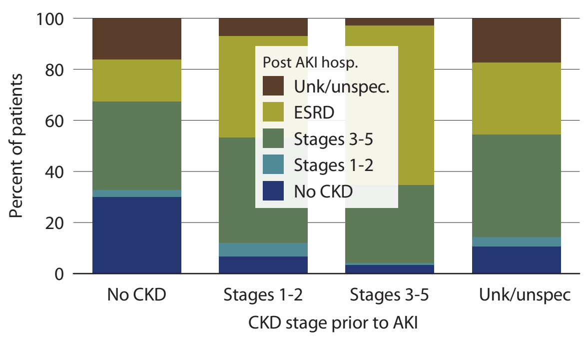
vol 1 **6.18** **Drug therapy prior to & after hospitalization for AKI in patients with Medicare Part D coverage, for initial & recurrent AKI**



vol 1 **6.21** **Changes to CKD status following hospitalization for AKI in Medicare patients, 2010**

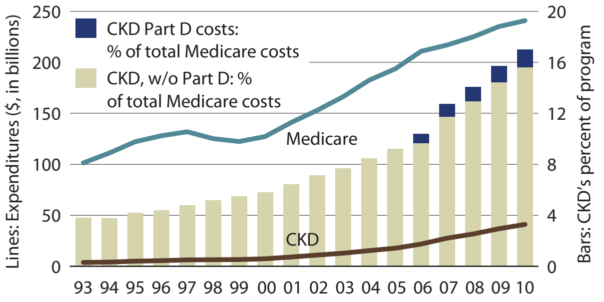


vol 1 **6.23** **Changes to CKD status following a hospitalization for AKI with dialysis in Medicare patients, 2010**



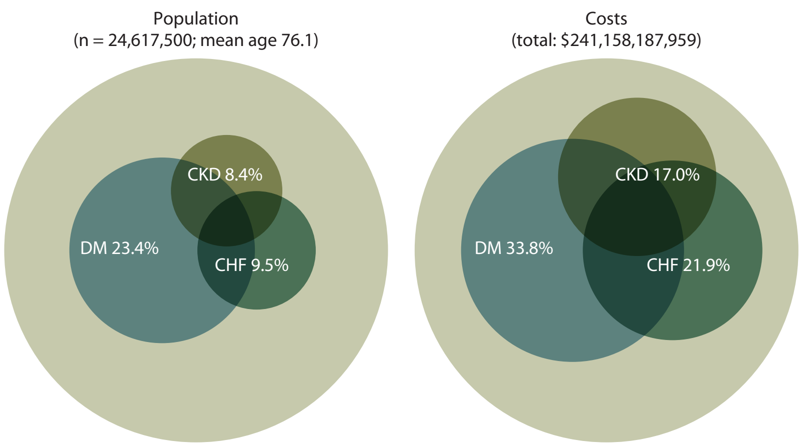
CKD status changes significantly following an AKI hospitalization. Among those with CKD of Stages 1–2 prior to the hospitalization, for example, 43 percent are classified as having Stage 3–5 CKD. And of those with Stage 3–5 CKD pre-hospitalization, 12.6 reach ESRD. Among patients with an AKI hospitalization requiring dialysis, of those classified as Stage 1–2 CKD, 41.4 percent are reclassified as having CKD of Stages 3–5 after their hospitalization; among patients with Stage 3–5 CKD pre-hospitalization, 62 percent reach ESRD. » **Figures 6.21 & 6.23;** see page 145 for analytical methods. *Medicare AKI patients age 66 & older, 2010. Figure 6.23: data limited to AKI events with dialysis.*

vol 1
7.5
Overall expenditures for CKD in the Medicare population

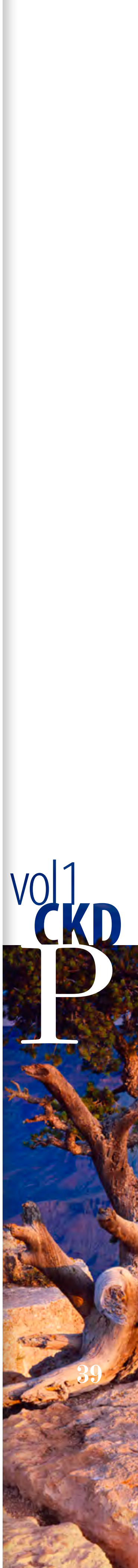


In 1993, total costs for Medicare patients age 65 and older with CKD accounted for just 3.9 percent of overall Medicare expenditures. In 2010, non-Part D costs for these patients reached $41 billion, 17 percent of total Medicare dollars, while their Part D expenditures accounted for 1.4 percent of Medicare dollars, up from 0.7 percent in 2006. **» Figure 7.5;** see page 146 for analytical methods. *Point prevalent Medicare CKD patients age 65 & older.*

vol 1
7.1
Point prevalent distribution & annual costs of Medicare (fee-for-service) patients, age 65 & older, with diagnosed diabetes, CHF, & CKD, 2010



Congestive heart failure affects 9.5 percent of patients in the fee-for-service Medicare population, and accounts for nearly 22 percent of expenditures. Nearly 34 percent of expenditures go toward the 23.4 percent of patients with diabetes. And patients with CKD, who represent 8.4 percent of the point prevalent population, account for 17.0 percent of total expenditures. **» Figure 7.1;** see page 146 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 2010.*



2012
USRDS
Annual
Data
Report

volume 1
CKD

1

Bryce Canyon National Park, Utah

CKD IN THE GENERAL POPULATION

In this chapter we assess the burden of CKD by using data from the National Health and Nutrition Examination Survey (NHANES), a valuable source of information for assessing disease prevalence and high-risk subsets among representative U.S. adults. The biochemical data collected by NHANES is an especially important resource for looking at CKD, which is defined in large part by the estimation of glomerular filtration rate (eGFR) and by evidence of albumin in the urine. As is done with other disease burdens assessed in the national survey, we define CKD at a single point prevalent point in time. Some estimates of CKD incorporate additional estimates of persistent albumin in the urine over weeks or months. But because such data was assessed only in the 1988–1994 NHANES sample, we have chosen to report the single measure to broadly define CKD on a population level. The clinical definition for a single patient may require greater precision and repeated measurements to be certain of actual disease and prognosis.

Recent publications by the CKD Consortium (Lancet, 2010) examine the risk of death, cardiovascular events, and ESRD based on eGFR and urine albumin levels. In past ADRs we have reported eGFR by two widely used methods, the MDRD approach and the newer CKD-EPI equation. As the latter has been shown to give more precise estimates with fewer false positives, this year we report eGFR using only the CKD-EPI equation.

We begin the chapter by showing the overall burden and interactions of diabetes, cardiovascular disease, and CKD — three interrelated diseases of clear public health relevance — and compare prevalence estimates based on an eGFR less than 60 ml/min/1.73 m^2 to those based on a urine albumin/creatinine ratio (ACR) of ≥30 mg/g. When defined by eGFR, the prevalence of CKD in 2005–2010 was 6.3 percent, compared to 9.3 and 8.5 percent for diabetes and cardiovascular disease, respectively. If kidney disease is defined, however, by ACR, the prevalence of CKD rises to 9.2 percent.

Exploring the implications of CKD, diabetes, and cardiovascular disease in the general population, this chapter sets the stage for Chapter Two, in which we discuss CKD as identified in datasets that are less well defined in terms of biochemical data, but that provide extensive information on morbidity, interventions, and costs.

Overall, the prevalence of CKD appears to have increased slightly from 1988–1994 to 2005–2010; the level of albuminuria, however, has not changed. Risk factors associated with CKD have declined slightly, but their overall pattern is similar. The main source of the increase in CKD appears to be defined by eGFRs

A conservationist is one who is humbly aware that with each stroke [of the axe] he is writing his signature on the face of the land.

ALDO LEOPOLD,
A Sand County Almanac

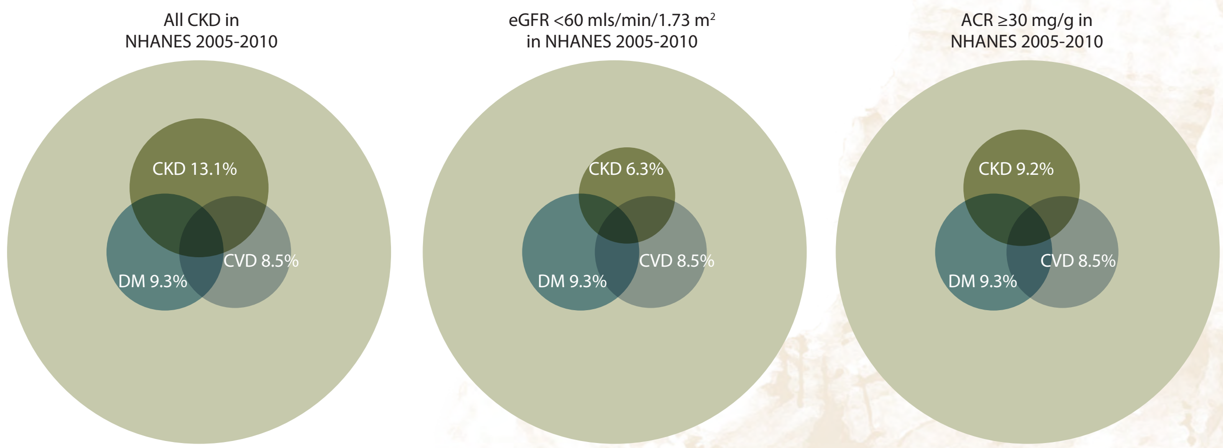
CHRONIC KIDNEY DISEASE IN THE GENERAL POPULATION
introduction

less than 60. Data on CKD within major risk populations with diabetes and cardiovascular disease show the common association of these three diseases, though findings are less prominent among those with a BMI of 30 kg/m² or above.

We conclude the chapter by examining awareness, treatment, and control of major risk factors, looking at hypertension, lipid disorders, and glycemic control within CKD populations to see if any progress has been made. Hypertension was as common in 2005–2010 as it was in 1988–1994, though awareness of the condition has improved, and control of blood pressure to target levels has increased three-fold, a positive sign that patients and providers are addressing major risk factor for adverse events. Awareness of LDL cholesterol levels has doubled, and control has increased 15-fold, an important finding. And glycemic control among diabetic patients with CKD has improved as well, again demonstrating the marked improvement in care.

It will be important to determine if these changes in the awareness, treatment, and control of major risk factors translates into reduced rates of cardiovascular events, death, and progression of CKD to ESRD. » **Figure 1.1;** see page 140 for analytical methods. *NHANES participants 2005–2010, age 20 & older; eGFR calculated using CKD-EPI equation; urine albumin creatinine ratio (ACR).*

vol 1
1.1 **Distribution of NHANES participants with diabetes, congestive heart failure, & markers of CKD, 2005–2010**



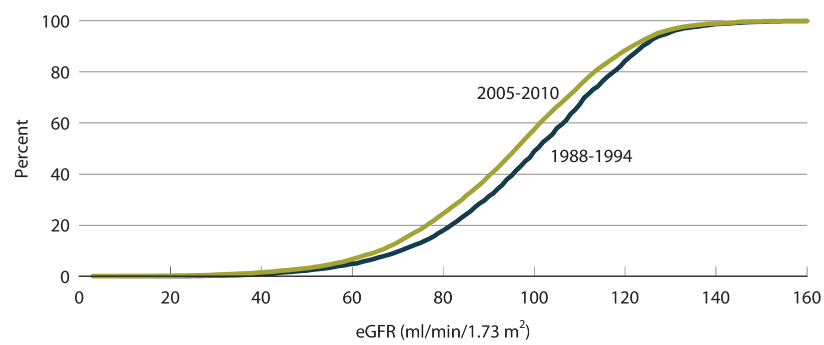
Between 1988–1994 and 2005–2010, the overall prevalence estimate for CKD — defined by an eGFR <60 ml/min/1.73 m² or an ACR ≥30 mg/g — rose from 12.3 to 14.0 percent. The largest relative increase, from 25.4 to 40.8 percent, was seen in those with cardiovascular disease. For eGFR <60, prevalence rose from 4.9 to 6.7 percent, with the largest increase in those age 40–59; for ACR ≥30 mg/g, the estimate rose from 8.8 to 9.4. » **Table 1.a;** see page 140 for analytical methods. *NHANES III (1988–1994) & 2005–2010 participants age 20 & older; eGFR calculated using CKD-EPI equation; urine albumin creatinine ratio (ACR).*

Figure 1.2 shows cumulative distributions of eGFR in 1988–1994 and 2005–2010. Overall, a population shift towards lower eGFR levels was observed over time, with most of the leftward shift confined to levels between 50 and 125 ml/min/1.73 m². Corresponding findings for albumin/creatinine ratio (ACR) in Figure 1.3 show that a slight leftward shift occurred for ACR values less than 20 mg/g. » **Figures 1.2–3;** see page 140 for analytical methods. *NHANES III (1988–1994) & 2005–2010 participants age 20 & older; eGFR calculated using CKD-EPI equation.*

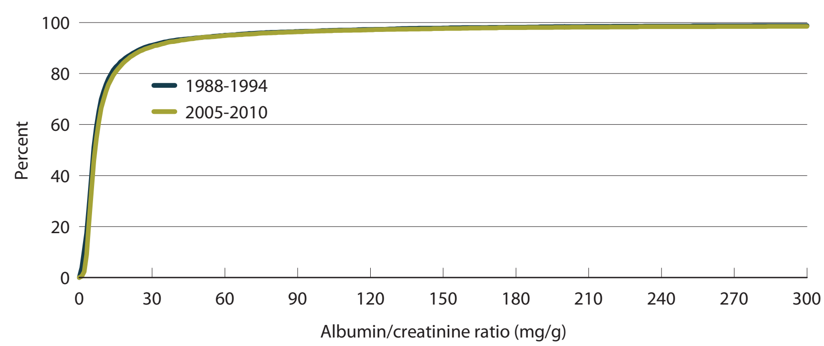
vol 1 1.a **Prevalence (%) of CKD in the NHANES population within age, gender, race/ethnicity, & risk-factor categories**

	All CKD		eGFR <60 ml/min/1.73m²		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 Blk/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

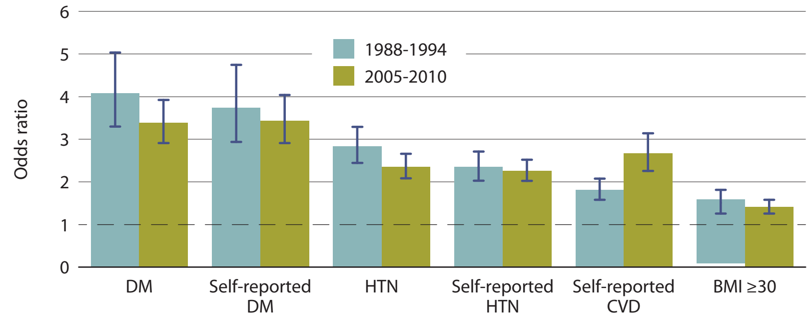
vol 1 1.2 **Cumulative eGFR distribution curves of NHANES participants**



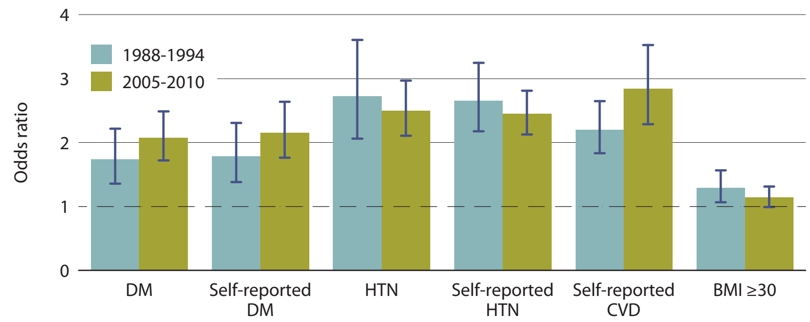
vol 1 1.3 **Cumulative urine albumin/creatinine ratio (ACR) distribution curves of NHANES participants**



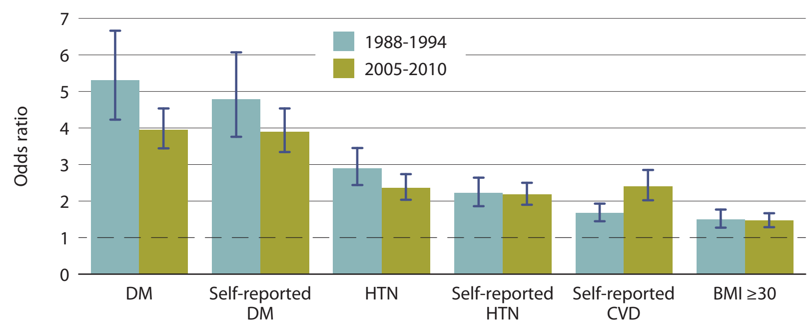
vol 1
1.4 **Adjusted odds ratios of CKD in NHANES participants, by risk factor**



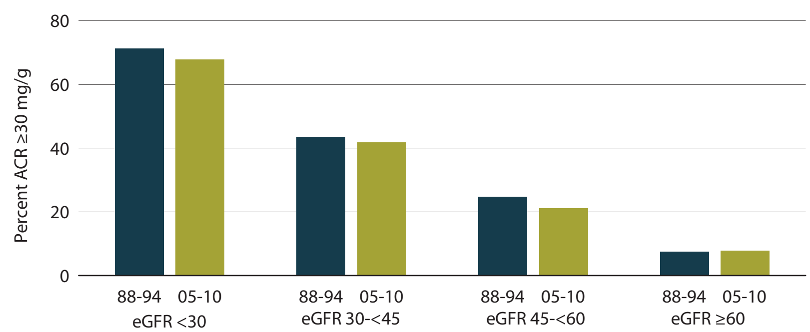
vol 1
1.5 **Adjusted odds ratios of eGFR <60 in NHANES participants, by risk factor**



vol 1
1.6 **Adjusted odds ratios of urine albumin/creatinine ratio (ACR) ≥30 mg/g in NHANES participants, by risk factor**



vol 1
1.7 **NHANES participants with urine albumin /creatinine ratio (ACR) ≥ 30 mg/g, by eGFR range**



Figures 1.4–6 show comorbidity associations of CKD in two time frames, presented as odds ratios that are adjusted for age, gender, race, and ethnicity.

While diabetes, hypertension, cardiovascular disease and body mass index ≥30 kg/m² are all associated with CKD, the highest odds ratios occur in participants with diabetes, at 4.08 in 1988–1994 and 3.38 in 2005–2010.

In participants with eGFR <60, hypertension showed the highest odds ratio (2.73) in 1988–1994, and cardiovascular disease the highest odds ratio (2.84) in 2005–2010. For ACR ≥30, diabetes showed the highest odds ratios (5.31 and 3.95) in both periods. » **Figures 1.4–6;** see page 140 for analytical methods. *NHANES III (1988–1994) & 2005–2010 participants age 20 & older. Adj: age/gender/race; for Figure 1.5, eGFR calculated using CKD-EPI equation.*

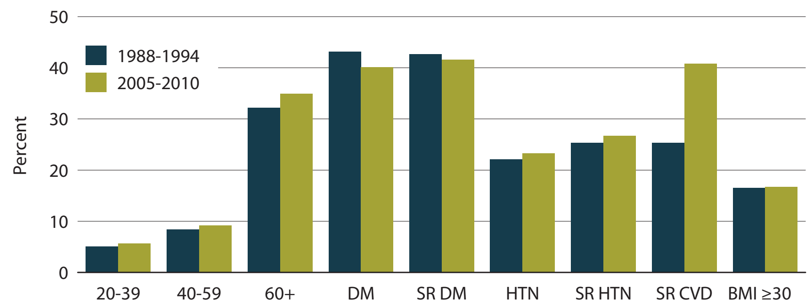
The percentage of NHANES participants with an ACR ≥30 mg/g increases with the severity of kidney disease. Among 2005–2010 NHANES participants with eGFRs <30 ml/min/1.73 m², for example, 68 percent had an elevated ACR. In those with eGFRs of 30–<45, 45–<60, or ≥60, 42, 21, and 8 percent, respectively, had elevated ACRs. » **Figure 1.7;** see page 140 for analytical methods. *NHANES III (1988–1994) & 2005–2010 participants age 20 & older; eGFR calculated using CKD-EPI equation.*

Many studies have shown that diabetes, hypertension, cardiovascular disease, higher body mass index, and advancing age are associated with the presence of CKD. Figure 1.8, showing the percentage of NHANES participants with either eGFR <60 ml/min/1.73 m² or ACR ≥30 mg/g, confirms a higher prevalence of CKD when each of these risk factors is present. While prevalence estimates are generally similar between time periods, the proportion with CKD among subjects with self-reported cardiovascular disease increased substantially, from 25.4 percent to 40.8 percent.

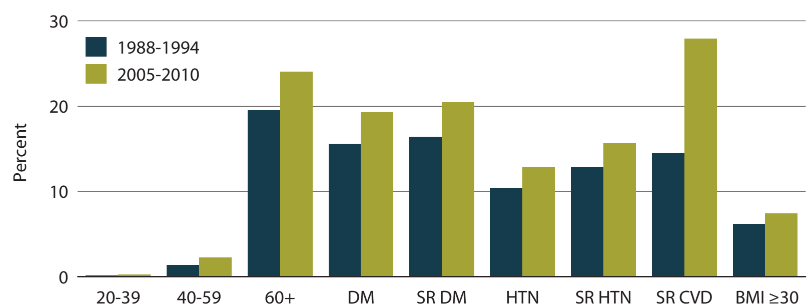
Figures 1.9–10 show similar analyses for eGFR <60 ml/min/1.73 m² and ACR ≥30 mg/g. For eGFR, prevalence estimates are higher in later years in all subgroups studied, especially age 60 and older (24.1 versus 19.5 percent), diabetes (19.3 versus 15.6 percent), and self-reported cardiovascular disease (14.5 versus 27.9 percent). For ACR ≥30 mg/g, a meaningful decline is seen in participants with diabetes (36.3 versus 29.9 percent), while a large increase is seen in those with self-reported cardiovascular disease (16.6 versus 24.3 percent).

While differences in categorization for cardiovascular disease may explain some of the disparities in prevalence estimates for markers of CKD, the differences appear large from a numerical standpoint. » **Figures 1.8–10;** see page 140 for analytical methods. *NHANES III (1988–1994) & 2005–2010 participants age 20 & older; for Figure 1.9, eGFR calculated using CKD-EPI equation. SR: self-reported.*

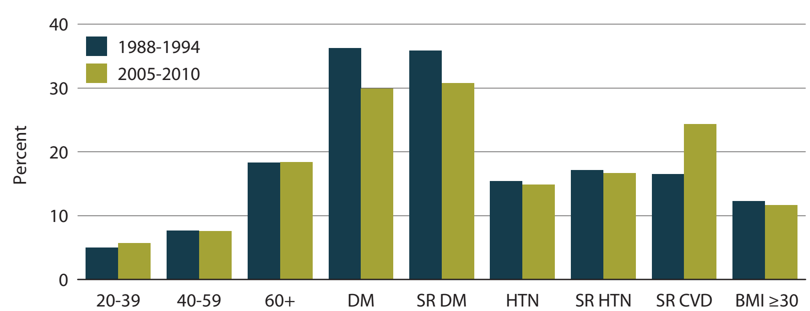
vol 1 **1.8** **NHANES participants with CKD, by age & risk factor**



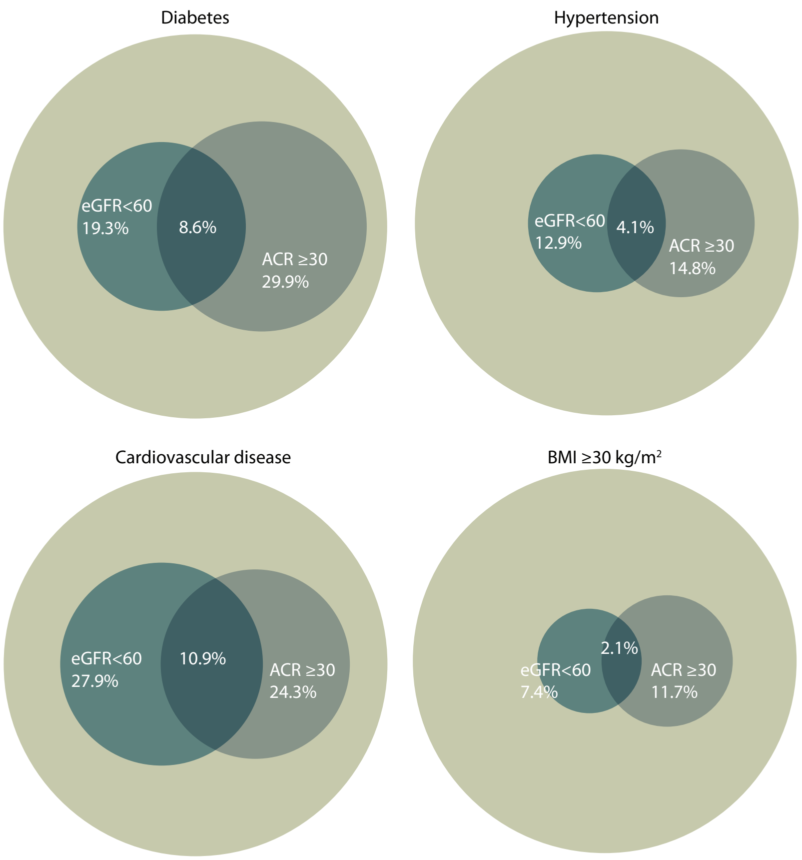
vol 1 **1.9** **NHANES participants with eGFR <60 ml/min/1.73 m², by age & risk factor**



vol 1 **1.10** **NHANES participants with urine albumin/creatinine ratio (ACR) ≥30 mg/g, by age & risk factor**



vol 1
1.11 **Distribution of markers of CKD in NHANES participants with diabetes, hypertension, cardiovascular disease, & obesity, 2005–2010**



Here we look at several subgroups of NHANES 2005–2010 participants, showing the percentage in each population with an eGFR <60 m/min/1.73 m^2 and an ACR ≥30 mg/g. Nearly 28 percent of participants with cardiovascular disease (CVD) had an eGFR less than 60, compared to 19.3, 12.9, and 7.4 percent of those with diabetes, hypertension, and a high body mass index, respectively. Participants with diabetes were the most likely to have an ACR ≥30 mg/g, at 29.9 percent, compared to 24.3, 14.8, and 11.7 percent among those with CVD, hypertension, and a high BMI.

Nearly 11 percent of participants with CVD had both an eGFR <60 and an ACR ≥30, compared to 8.6 percent of those with diabetes and 4.1 and 2.1 percent, respectively, of those with hypertension and a high BMI. **» Figure 1.11;** see page 140 for analytical methods. *NHANES III (1988–1994) & 2005–2010 participants age 20 & older; eGFR calculated using CKD-EPI equation; urine albumin/creatinine ratio (ACR).*

vol 1 **1.b** **Awareness, treatment, & control of hypertension, hyperlipidemia, HDL, total cholesterol, & diabetes**

	All CKD		eGFR <60 ml/min/1.73m²		ACR ≥30 mg/g	
	1988–1994	2005–2010	1988–1994	2005–2010	1988–1994	2005–2010
Hypertension, by current hypertensive status[1]						
Non- hypertensive status	27.3	26.2	16.1	15.5	31.2	30.4
Hypertensive (measured/treated)	72.7	73.8	83.9	84.5	68.8	69.6
Control of hypertension among hypertensive patients[2]						
Unaware	35.5	23.5	27.3	18.3	36.6	25.5
Aware, not treated	15.3	6.9	12.1	3.2	16.7	9.4
Aware, treated, uncontrolled	41.3	43.7	50.7	46.5	40.0	44.6
Aware, treated, controlled	7.9	25.9	9.9	32.0	6.7	20.5
Hyperlipidemia (LDL): LDL cholesterol[3]						
Within ATP-III target LDL range	24.8	32.6	8.3	18.6	31.2	40.3
Hyperlipidemia (measured or treated)	75.2	67.4	91.7	81.4	68.8	59.7
Control of hyperlipidemia (LDL) among participants with hyperlipidemia (LDL)[4]						
Unaware	62.1	33.8	61.2	35.6	64.4	31.7
Aware, not treated	24.3	10.8	27.4	12.2	20.7	8.1
Aware, treated, uncontrolled	11.5	24.2	11.2	25.0	11.8	24.4
Aware, treated & controlled	2.1	31.2	0.1	27.2	3.1	35.8
HDL cholesterol in ATP III target range[5]						
HDL <40 mg/dl (ATP III target)	27.8	19.6	30.8	18.0	25.2	21.6
HDL 40 mg/dl or higher (at/above ATP III target)	72.2	80.4	69.2	82.0	74.8	78.4
Total cholesterol[6]						
<200 (desirable)	35.0	57.6	27.6	62.1	36.5	56.4
200–239 (borderline high)	33.2	26.4	32.2	23.2	30.9	27.4
240+ (high)	31.7	16.1	40.1	14.7	32.6	16.2
Control of diabetes among patients with diabetes						
Glycohemoglobin <7% (controlled)	30.8	48.0	36.5	58.2	28.9	42.1
Glycohemoglobin 7% or higher (uncontrolled)	69.2	52.0	63.5	41.9	71.1	57.9

Here we examine awareness, treatment, and control of hypertension, hyperlipidemia, and diabetes in U.S. adults with CKD in 1988–1994 and 2005–2010. While the prevalence of hypertension was similar in both time frames, at 73 compared to 74 percent, the proportion unaware of their hypertension fell from 36 to 24 percent, while the proportion that was aware, treated, and controlled rose from 7.9 to 26 percent.

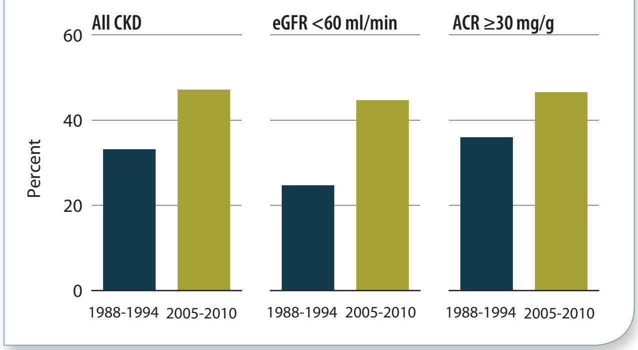
For hyperlipidemia, the overall prevalence declined from 75 to 67 percent, while the lack of awareness fell from 62 to 34 percent. The proportion categorized as aware, treated, and controlled increased almost 15-fold, from 2.1 to 31 percent. Among participants with diabetes, glycemic control improved from 31 to 48 percent. » **Table 1.b**; see page 140 for analytical methods. *NHANES III (1988–1994) & 2005–2010 participants age 20 & older; dialysis patients excluded from NHANES 2005–2010; eGFR calculated using CKD-EPI equation; urine albumin/creatinine ratio (ACR).*

Analysis definitions

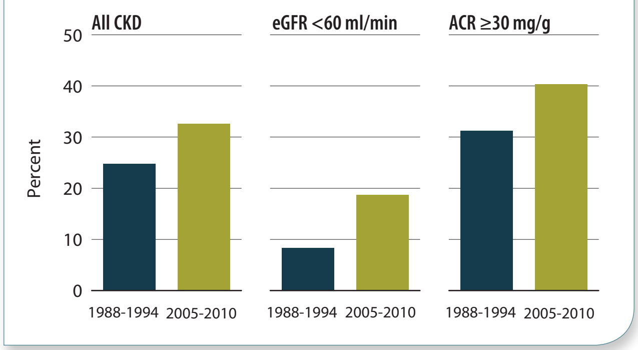
1. Hypertension defined as blood pressure ≥130/≥80 for those with CKD and diabetes; otherwise ≥140/≥90, or self-reported treatment for hypertension.
2. Awareness and treatment are self-reported. Control defined as <130/<80 for those with CKD and diabetes; otherwise <140/<90.
3. Hyperlipidemia based on elevated LDL following Adult Treatment Panel III (ATP III) guidelines, with CKD considered a risk equivalent for chronic heart disease, self-reported treatment, or self-reported dieting to lower cholesterol.
4. Awareness and treatment self-reported. Control defined as meeting the National Cholesterol Education Program (NCEP) ATP III LDL target: <100 mg/dl (high risk), <130 mg/dl (moderate risk), or <160 mg/dl (low risk).
5. HDL cholesterol classified according to ATP III guidelines.
6. Total cholesterol classified according to ATP III guidelines.
7. Glycohemoglobin classified according to American Diabetes Association guidelines.

Between 1988–1994 and 2005–2010, management of hypertension, hyperlipidemia, hyperglycemia, and diabetes in the NHANES cohorts improved, regardless of how CKD is defined — by eGFR or by ACR. » **Figures 1.12–15;** see page 140 for analytical methods. *NHANES III (1988–1994) & 2005–2010 participants age 20 & older; dialysis patients excluded from NHANES 2005–2010; eGFR calculated using CKD-EPI equation; urine albumin/creatinine ratio (ACR).*

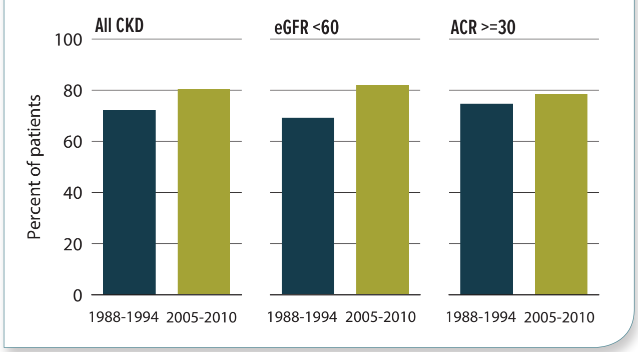
vol 1 **1.12** **NHANES participants at target blood pressure**



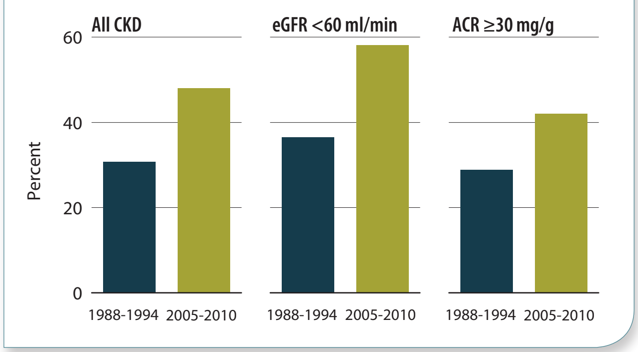
vol 1 **1.13** **NHANES participants within LDL cholesterol target range**



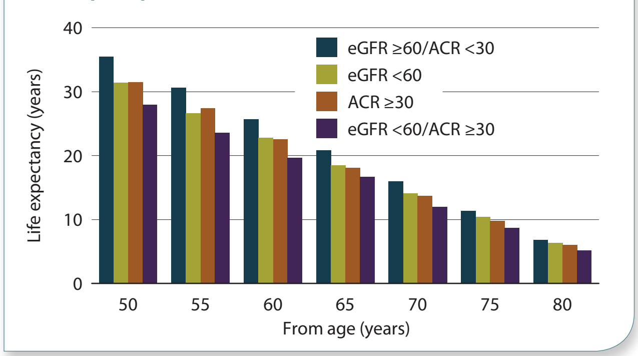
vol 1 **1.14** **NHANES participants within HDL cholesterol target range**



vol 1 **1.15** **NHANES participants with glycohemoglobin <7%**



vol 1 **1.16** **Life expectancy of NHANES participants with or without CKD, 1999–2004**



Many studies have shown that markers of CKD are associated with higher mortality rates, but few, if any, attempted to translate this mortality excess into easily understandable terms. Figure 1.16 shows life expectancy estimates for U.S. adults with CKD, using NHANES data from 1999–2004. At age 50, estimated life expectancy for subjects with eGFR ≥60 and ACR <30 is 35.5 years; the reductions in life expectancy associated with eGFR <60, ACR ≥30, and both conditions are 4.1 years (11.4 percent of 35.5 percent), 4.0 years (11.3 percent) and 7.5 years (21.2 percent), respectively. When life expectancy is calculated from successively older starting points, absolute reductions decline and percentage reductions remain broadly similar. » **Figure 1.16;** see page 140 for analytical methods. *NHANES participants, 1999–2004; eGFR calculated using CKD-EPI equation; urine albumin/creatinine ratio (ACR).*

PREVALENCE OF CKD

adjusted odds ratios of CKD in NHANES participants, by risk factor (Figure 1.4)

NHANES III » diabetes · 4.1 » self-reported diabetes · 3.7 » hypertension · 2.8
» self-reported hypertension · 2.4 » self-reported CVD · 1.8 » BMI ≥30 · 1.5

NHANES 2005–2010 » diabetes · 3.4 » self-reported diabetes · 3.4 » hypertension · 2.4
» self-reported hypertension · 2.3 » self-reported CVD · 1.7 » BMI ≥30 · 1.4

adjusted odds ratios of eGFR <60 in NHANES participants, by risk factor (Figure 1.5)

NHANES III » diabetes · 1.7 » self-reported diabetes · 1.8 » hypertension · 2.7
» self-reported hypertension · 2.7 » self-reported CVD · 2.2 » BMI ≥30 · 1.3

NHANES 2005–2010 » diabetes · 2.1 » self-reported diabetes · 2.2 » hypertension · 2.5
» self-reported hypertension · 2.5 » self-reported CVD · 2.8 » BMI ≥30 · 1.1

adjusted odds ratios of ACR ≥30 in NHANES participants, by risk factor (Figure 1.6)

NHANES III » diabetes · 5.3 » self-reported diabetes · 4.8 » hypertension · 2.9
» self-reported hypertension · 2.2 » self-reported CVD · 1.7 » BMI ≥30 · 1.5

NHANES 2005–2010 » diabetes · 4.0 » self-reported diabetes · 3.9 » hypertension · 2.4
» self-reported hypertension · 2.2 » self-reported CVD · 2.4 » BMI ≥30 · 1.5

COMORBIDITY

distribution of markers of CKD in NHANES participants with diabetes, HTN, CVD, & obesity, 2005–2010 (percent; Figure 1.11)

	diabetes	HTN	CVD	BMI ≥30
eGFR <60	19.3	12.9	27.9	7.4
ACR ≥30	29.9	14.8	24.3	11.7
eGFR <60 & ACR ≥30	8.6	4.1	10.9	2.1

AWARENESS, TREATMENT, AND CONTROL

NHANES participants at target blood pressure (percent; Figure 1.12)

	all CKD	eGFR <60	ACR ≥30
NHANES III	33.1	24.7	35.9
NHANES 2005–2010	47.2	44.6	46.5

NHANES participants within LDL cholesterol target range (percent; Figure 1.13)

	all CKD	eGFR <60	ACR ≥30
NHANES III	24.8	8.3	31.2
NHANES 2005–2010	32.6	18.6	40.3

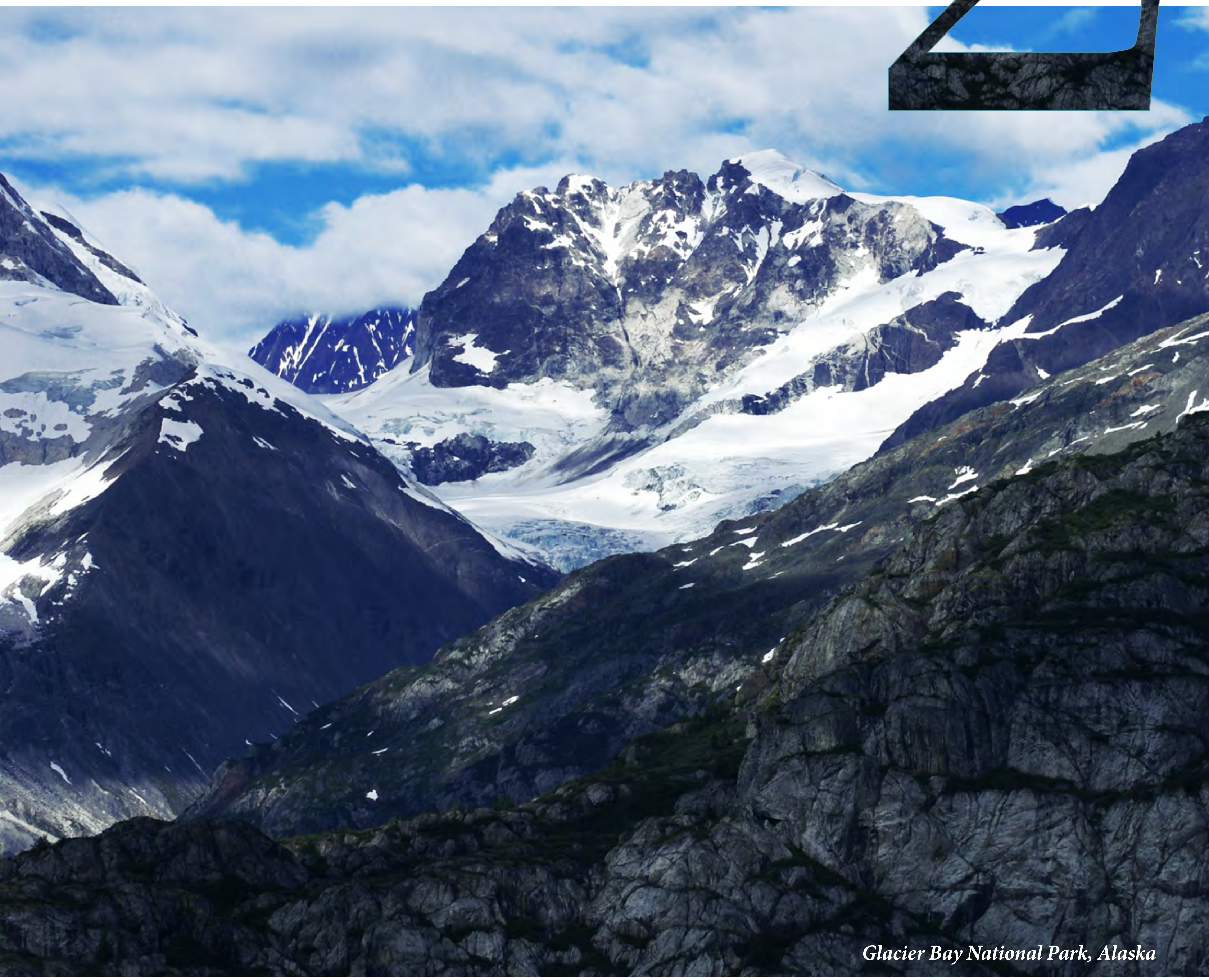
NHANES participants within HDL cholesterol target range (percent; Figure 1.14)

	all CKD	eGFR <60	ACR ≥30
NHANES III	27.8	30.8	25.2
NHANES 2005–2010	19.6	18.0	21.6

NHANES participants with glycohemoglobin <7% (percent; Figure 1.15)

	all CKD	eGFR <60	ACR ≥30
NHANES III	30.8	36.5	28.9
NHANES 2005–2010	48.0	58.2	42.1

2



Glacier Bay National Park, Alaska

IDENTIFICATION & CARE OF PATIENTS WITH CKD

The identification of CKD is a significant challenge, as most datasets lack the biochemical data that provide the greatest precision in identifying the disease. And while random samples such as the NHANES dataset contain biochemical information, as shown in Chapter One, they rarely include event rates or economic data, making it difficult to evaluate access to care for this high-risk population, or to examine adverse events in patients with CKD, diabetes, and cardiovascular disease.

The USRDS uses several datasets to assess the recognized CKD population based on reported diagnosis codes, including the general Medicare 5 percent sample, with an average of 1.2 million individuals each year, and several employer group health plan (EGHP) populations which together total 25 million enrollees. The Thomson Reuters MarketScan dataset (20 million enrolled lives) contains data from 40 Fortune 100 companies, 80 percent of which are self-insured, and has information on claims for services but no laboratory data. We also employ data from United Health Group's Ingenix i3 LabRx dataset, with information on 5.6 million lives per year from employers that are 20 percent self-insured. This dataset contains provider charges but no paid claims; it does, however, contain biochemical data provided by contract laboratories in the United Healthcare system on approximately 20 percent of the covered lives. Other ordered labs can be tracked, but results are not available.

The mean age of the period prevalent Medicare population age 65 and older is 75.3 overall, and 77.9 for those with CKD — a contrast to the EGHP population, at 44.3 and 52.5, respectively, for MarketScan patients, and 42.9 and 51.5 for those in the Ingenix i3 dataset. As expected, disease prevalence is lower for the younger EGHP patients. Interesting, however, is the similar disease burden in the MarketScan and Ingenix i3 populations, which, though associated with two very different sets of employers with different health plan payment systems, have similar degrees of diabetes, hypertension, congestive heart failure, and cancer. The 5–6 times greater burden of cancer among CKD patients in these younger populations has received little attention.

New stage-specific ICD-9-CM codes (585.x) were introduced in the fall of 2005, providing an opportunity to track populations with reported diagnosis codes over time. CKD is also defined through codes for diabetes (250.4x) and hypertension (403.9x), and through codes specific to kidney disease, such as glomerular disease (583.x). Definition of the total recognized CKD population must therefore take into consideration a variety of codes beyond the 585.x series.

The recognized prevalent CKD population has been growing rapidly since 2003, a year after the new CKD stage classification system was published. Stage-specific codes are now being used more frequently, and use of the 585.9 code — for unknown/unspecified stage — has been falling. CKD of Stages 3 and 4 continues to increase, particularly among black/African American patients. This growth represent greater recognition of the disease, as the true burden shown in the NHANES estimates has changed only slightly, and levels identified using claims data are far higher than those using only the combined 585 codes.

The testing of patients at high risk for kidney disease has long been a focus of the USRDS, and has been added as well to the Healthy People 2020 goals developed by the Department of Health and Human Services (see the HP2020 chapter in Volume Two). But while testing for urine albumin has been recommended by the American Diabetes Association for some time, there has been slow progress in its use. In 2010, for example, just one in three patients with diabetes alone, and one in 20 patients with hypertension alone, received a urine albumin test; for patients

VI
Sit and be still
until in the time
of no rain you hear
beneath the dry wind's
commotion in the trees
the sound of flowing
water among the rocks,
a stream unheard before,
and you are where
breathing is prayer.

WENDELL BERRY,
"Sabbaths 2001"

with both diabetes and hypertension, the rate was still less than 40 percent. Serum creatinine testing, in contrast, was used in 77–93 percent of patients. Serum creatinine tests, however, are frequently part of a panel of tests, so their use may not represent an active assessment of kidney function. Because urine albumin testing must be ordered separately, it may represent a true intent to assess kidney disease. Recent papers addressing the risk stratification of kidney disease use both the urine albumin/creatinine ratio and the estimated glomerular filtration rate, emphasizing that both tests are needed to fully assess kidney disease and its associated risks of death and progression to ESRD (Lancet 2010).

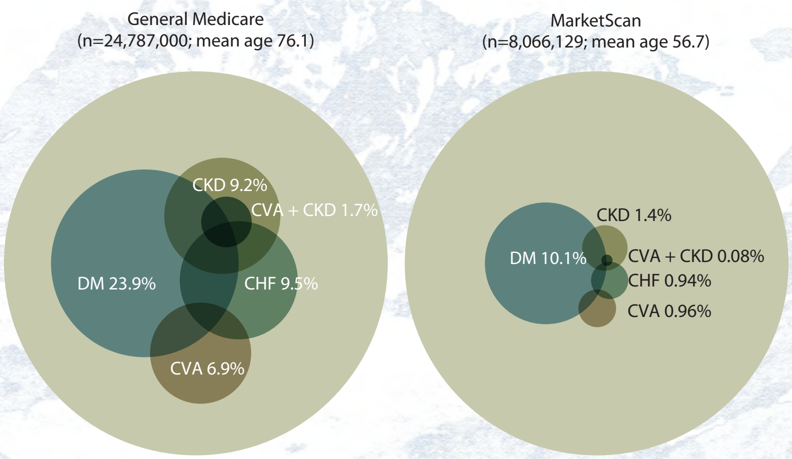
Data on physician care show that patients are far more likely to visit a primary care physician or cardiologist than a nephrologist after a CKD diagnosis. This may relate to concerns of primary care physicians that they will lose contact with patients as specialists assume aspects of care; it may also be difficult for patients to navigate what is for them a new dimension of care. Consultations within the hospital setting may present fewer barriers, an idea which should receive future assessment. Regardless of the possible reasons, nephrologists are seen by only one-third of patients with recognized CKD, a number similar within the Medicare system and the EGHPs. Among those with more advanced CKD (Stage 3 or higher), in contrast, 60 percent visit a nephrologist. It will be important to assess any differences in treatment among the referred and non-referred populations, and ways in which these differences might affect adverse outcomes.

Among both Medicare Part D enrollees and their younger MarketScan counterparts, approximately 60 percent of those with CKD and diagnosed diabetes receive an ACEI/ARB/renin inhibitor. Beta blocker use reaches 71–77 percent for patients with congestive heart failure and 59–73 percent in those with hypertension; the very high rates of cardiovascular events and of sudden death among CKD patients may provide a background for studies assessing the value of beta blockers across the board in the CKD population. Dihydropyridine calcium channel blockers are far more widely used to treat hypertension and cardiovascular disease in the MarketScan population than in Medicare Part D enrollees, and potassium-sparing diuretics or combination products are rarely used in CKD patients. Thiazide and loop diuretics, in contrast, receive much wider use in both populations.

Given the progressive clinical problems with fluid overload and hypertension in patients with Stage 4–5 CKD, it is puzzling to note in these patients the reduced use of ACEI/ARBs, drugs well known to help heart failure. Unfortunately, concerns about lower eGFRs and possible hyperkalemia have led physicians to reduce the use of these medications. More research is needed into the causes of lowered utilization of ACEIs/ARBs to determine the risks and benefits with advancing CKD.

The identification and care of CKD patients is very complex. Disparities do exist and should be addressed, as these patients have very high event rates and high rates of progression to ESRD, making them a costly and multifaceted population. » **Figure 2.1;** see page 141 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.*

vol 1 2.1 **Distribution of point prevalent general Medicare (age 65 & older) & MarketScan (age 50–64) patients with coded diabetes, CKD, CHF, & CVA, 2010**



This table presents descriptive data on patients in the three datasets used throughout Volume One of the ADR: the 1.2 million Medicare patients age 65 and older in the 5 percent sample, the 20.2 million patients age 20–64 in the MarketScan database, and the 5.6 million, also age 20–64, in the Ingenix i3 database. Information on race and ethnicity is not available in the MarketScan and Ingenix i3 data.

Data on comorbidity in part reflect the older age of the Medicare population. Ninety-two percent of Medicare CKD patients, for example, have hypertension, compared to 61.4 and 66.9 percent, respectively, of those in the MarketScan and Ingenix i3 databases. Thirty-two percent of Medicare CKD patients have congestive heart failure, compared to 8.6 and 7.4 percent in the MarketScan and Ingenix i3 populations. And the rate of cancer in Medicare CKD patients is 17.9 percent, compared to 13.7 and 12.4 percent, respectively, in MarketScan and Ingenix i3 patients. » **Table 2.a;** see page 141 for analytical methods. *Period prevalent patients 2010, without ESRD, age 65 & older (Medicare) & 20–64 (MarketScan & Ingenix i3).*

vol 1 **2.a** **Descriptive parameters of CKD datasets, by age, gender, race/ethnicity, & coded comorbidity, 2010**

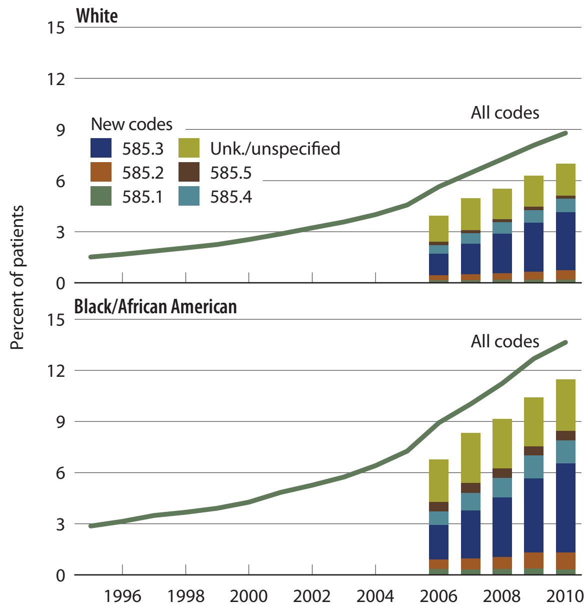
	Medicare 65+				MarketScan (20–64)				Ingenix i 3 (20–64)			
	All (mean age: 75.3)		CKD (77.9)		All (44.3)		CKD (52.5)		All (42.9)		CKD (51.5)	
	N	%	N	%	N	%	N	%	N	%	N	%
All	1,223,405	100.0	112,308	100.0	20,181,077	100.0	169,255	100.0	5,589,835	100.0	5,589,835	100.0
20-44					9,546,513	47.3	34,308	20.3	2,937,557	52.6	11,346	23.3
45-54					5,577,626	27.6	44,321	26.2	1,499,581	26.8	13,855	28.4
55-64					5,056,938	25.1	90,626	53.5	1,152,697	20.6	23,599	48.4
65-74	639,089	52.2	41,394	36.9								
75-84	414,580	33.9	46,272	41.2								
85+	169,736	13.9	24,642	21.9								
Male	515,109	42.1	52,716	46.9	9,606,282	47.6	90,216	53.3	2,711,710	48.5	26,424	54.1
Female	708,296	57.9	59,592	53.1	10,574,795	52.4	79,039	46.7	2,877,890	51.5	22,375	45.9
White	1,064,229	87.0	93,536	83.3								
Black/African American	92,315	7.5	12,605	11.2								
Other	17,718	1.4	1,380	1.2								
Hispanic	21,091	1.7	2,132	1.9								
Diabetes	291,751	23.8	53,441	47.6	1,171,149	5.8	63,817	37.7	304,598	5.4	17,931	36.7
Hypertension	742,753	60.7	103,523	92.2	2,630,713	13.0	103,859	61.4	772,345	13.8	32,636	66.9
CHF	116,019	9.5	35,697	31.8	102,952	0.5	14,560	8.6	26,191	0.5	3,613	7.4
Cancer	127,182	10.4	20,110	17.9	395,735	2.0	23,172	13.7	102,772	1.8	6,031	12.4

The prevalence of recognized CKD in the Medicare population increased by more than three-fold between 2000 and 2010, from 2.7 to 9.2 percent, and rose with age. Net increases in CKD prevalence are evident in the smaller EGHP populations as well — from 0.3 to 0.8 percent in the MarketScan population, and, in the Ingenix i3 population, from 0.4 percent in 2001 to 0.9 percent in 2010. » **Table 2.b;** see page 141 for analytical methods. *Prevalent patients surviving cohort year without ESRD, age 65 & older (Medicare) & 20–64 (MarketScan & Ingenix i3).*

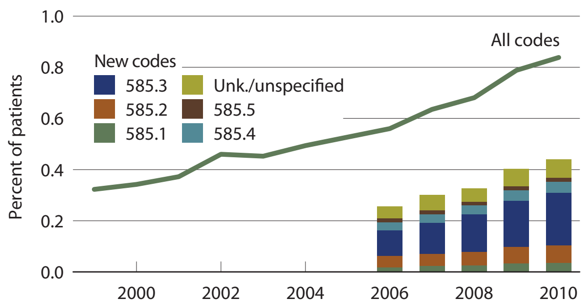
vol 1 **2.b** **Prevalence (%) of recognized CKD, by dataset & age**

	Medicare	MarketScan	Ingenix i3
2000	2.7	0.3	
2001	3.0	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	5.9	0.6	0.6
2007	6.7	0.6	0.7
2008	7.6	0.7	0.7
2009	8.5	0.8	0.8
2010	9.2	0.8	0.9
2010			
20-44		0.4	0.4
45-54		0.8	0.9
55-64		1.8	2.0
65-74	6.5		
75-74	11.2		
85+	14.5		

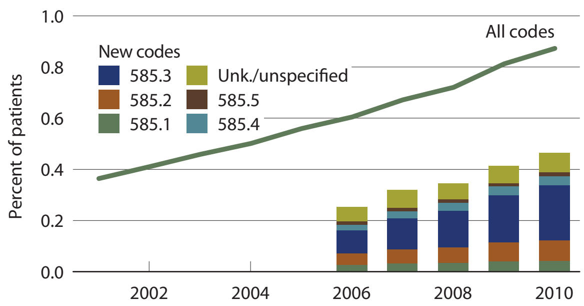
vol 1
2.2
Trends in CKD prevalence: Medicare patients age 65 & older, by race



vol 1
2.3
Trends in CKD prevalence: MarketScan patients age 20–64



vol 1
2.4
Trends in CKD prevalence: Ingenix i3 patients age 20–64



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

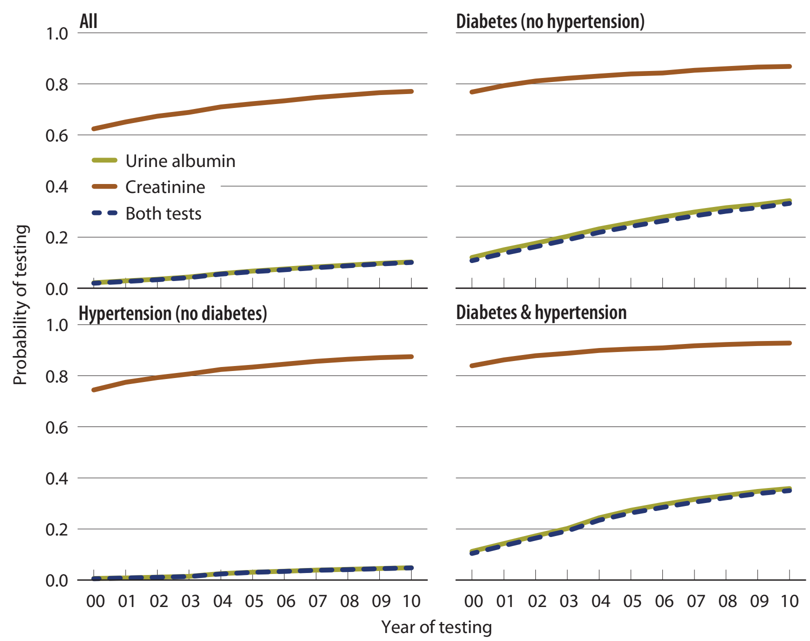
**In USRDS analyses, patients with ICD-9-CM code 585.6 & with no ESRD 2728 form or other indication of ESRD are considered to have code 585.5; see Appendix A for details.*

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

Among Medicare patients, claims data identify 13.7 percent of blacks/African Americans, and 8.8 percent of whites, as having prevalent CKD in 2010, compared to 11.5 and 7.0 percent identified using only the combined 585 codes. The difference is even more pronounced in the EGHP population, with claims data identifying prevalent CKD rates nearly twice as high as those found using solely the stage-specific codes.

The most commonly reported stage-specific code in the prevalent CKD population is 585.3 (Stage 3), at 3.4 and 5.2 percent for white and black/African American Medicare patients, respectively, and 0.21 and 0.22 percent among MarketScan and Ingenix i3 patients. **» Figures 2.2–4;** see page 141 for analytical methods. *Prevalent patients surviving cohort year, without ESRD, age 65 & older (Medicare) & 20–64 (MarketScan & Ingenix i3).*

vol 1 2.5 **Probability of urine albumin & creatinine testing in Medicare patients at risk for CKD**



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 2010, the probability of creatinine testing in Medicare patients at risk for CKD was 0.77; the probability of receiving a urine albumin test (which must be ordered separately), in contrast, was 0.10.

In patients with either diabetes or hypertension alone, the probablility of creatinine testing in 2010 was 0.87; the probability of urine albumin testing in those with diabetes alone was 0.34, compared to 0.05 in patients with hypertension alone.

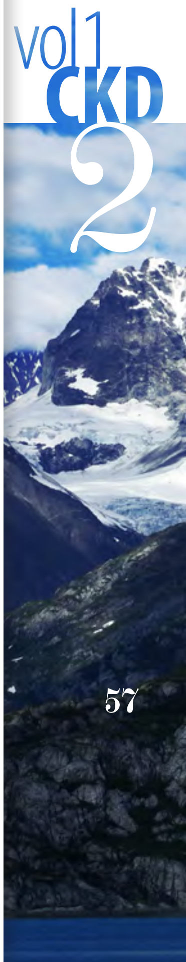
Having both diabetes and hypertension greatly increases the odds of developing CKD. The probability of creatinine testing in patients with both conditions was 0.93 in 2010, while the probability of a urine albumin test was 0.36; the probability of receiving both tests was 0.35. Because urine albumin testing must be ordered separately, it may represent a true intent to assess kidney disease. **» Figure 2.5;** see page 141 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.*

vol 1
2.c **Probability of laboratory testing in patients at risk for CKD, by demographic characteristics, 2010**

	Urine albumin Unadjusted	Adjusted	Creatinine Unadjusted	Adjusted	Both tests Unadjusted	Adjusted
All						
20-44	0.06	0.06	0.59	0.61	0.05	0.05
45-54	0.09	0.09	0.69	0.70	0.09	0.09
55-64	0.12	0.12	0.72	0.73	0.12	0.12
64-74	0.12	0.12	0.76	0.76	0.12	0.12
75-84	0.11	0.11	0.82	0.82	0.10	0.10
85+	0.06	0.06	0.82	0.82	0.06	0.06
Male	0.11	0.11	0.72	0.73	0.10	0.10
Female	0.10	0.10	0.81	0.81	0.10	0.10
White	0.10	0.10	0.78	0.78	0.10	0.10
Black/Af. American	0.13	0.14	0.73	0.75	0.13	0.13
Other	0.13	0.13	0.71	0.71	0.13	0.13
Hispanic	0.15	0.16	0.71	0.72	0.14	0.15
Diabetes						
20-44	0.35	0.35	0.87	0.88	0.34	0.34
45-54	0.35	0.36	0.88	0.89	0.34	0.35
55-64	0.37	0.37	0.89	0.89	0.35	0.36
64-74	0.40	0.41	0.92	0.92	0.40	0.40
75-84	0.34	0.34	0.93	0.93	0.33	0.33
85+	0.22	0.22	0.93	0.92	0.21	0.21
Male	0.36	0.36	0.90	0.90	0.35	0.34
Female	0.35	0.36	0.93	0.93	0.34	0.35
White	0.36	0.36	0.92	0.92	0.35	0.35
Black/Af. American	0.34	0.33	0.90	0.90	0.33	0.32
Other	0.37	0.36	0.87	0.87	0.36	0.35
Hispanic	0.38	0.39	0.90	0.90	0.37	0.37
Hypertension						
20-44	0.14	0.15	0.83	0.84	0.14	0.15
45-54	0.16	0.16	0.85	0.86	0.16	0.16
55-64	0.19	0.19	0.86	0.87	0.19	0.19
64-74	0.17	0.17	0.89	0.89	0.17	0.17
75-84	0.13	0.14	0.91	0.91	0.13	0.13
85+	0.07	0.08	0.90	0.90	0.07	0.08
Male	0.16	0.15	0.87	0.88	0.15	0.15
Female	0.14	0.14	0.90	0.90	0.13	0.14
White	0.14	0.14	0.90	0.90	0.13	0.14
Black/Af. American	0.18	0.17	0.87	0.88	0.18	0.17
Other	0.18	0.18	0.85	0.85	0.18	0.18
Hispanic	0.22	0.22	0.88	0.88	0.21	0.21
Cardiovascular disease						
20-44	0.10	0.10	0.83	0.83	0.10	0.10
45-54	0.14	0.14	0.86	0.86	0.13	0.13
55-64	0.17	0.17	0.87	0.87	0.17	0.16
64-74	0.16	0.16	0.88	0.89	0.15	0.15
75-84	0.12	0.12	0.90	0.90	0.12	0.12
85+	0.06	0.07	0.89	0.89	0.06	0.06
Male	0.13	0.13	0.87	0.87	0.13	0.13
Female	0.12	0.12	0.90	0.91	0.11	0.12
White	0.12	0.12	0.89	0.89	0.12	0.12
Black/Af. American	0.16	0.15	0.88	0.88	0.16	0.15
Other	0.17	0.16	0.86	0.86	0.16	0.16
Hispanic	0.19	0.20	0.90	0.90	0.19	0.19

Across all age, gender, and racial/ethnic categories, the adjusted probability of receiving a creatinine test is considerably higher — 5 to 13 times — than the probability of receiving a urine albumin test.

By disease category, the large disparity in the type of test performed is less evident in patients with diabetes, where differences favor creatinine testing over urine albumin testing by a margin of approximately three to one. In patients with hypertension or cardiovascular disease, the probability of creatinine testing is generally 6–7 times greater than that of urine albumin testing. » **Table 2.c**; see page 141 for analytical methods. *Medicare patients from the 5 percent sample, age 20 & older, with Parts A & B coverage in 2010; patients diagnosed with CKD or ESRD during 2010 are excluded.*



In the NHANES population, 14 percent of participants have CKD. The likelihood of CKD increases with age, is highest in those age 80 and older, and is recognized in women more often than in men, at 15.8 and 12.1 percent, respectively. By race, 14.3 percent of whites and 16 percent of blacks/African Americans in the NHANES population have CKD. Fifty-one percent of participants age 80 and older have CKD of Stage 3 or higher.

Among Medicare patients age 65 and older, a CKD diagnosis code is more likely in older patients, men, and blacks/African Americans, and in patients with cardiovascular disease, at 23.1 percent compared to 10.3 and 15.8 percent in patients with diabetes or hypertension.

In the MarketScan population age 55–59 and 60–64, the odds of a CKD diagnosis code are 18 and 42 percent higher compared to patients age 50–64, are lower in women compared to men, and are three times higher in patients with diabetes, hypertension, or cardiovascular disease than in patients without these conditions. » **Tables 2.d–f;** see page 141 for analytical methods. *Medicare patients age 65 & older & MarketScan patients age 50–64, alive & eligible for all of 2010. CKD claims as well as other diseases identified in 2010. NHANES 2005–2010 participants, age 20 & older; eGFR estimated by CKD-EPI equation.*

vol 1
2.d **Percent of patients with CKD, by demographic characteristics, comorbidity, & dataset, 2010**

	NHANES	Medicare (65+)			MarketScan (50–64)		
	Any CKD	DM (no HTN)	HTN (no DM)	CVD	DM (no HTN)	HTN (no DM)	CVD
All	14.0	10.3	15.8	23.1	6.1	5.4	10.0
20-49	6.5						
50-54	8.4				5.1	4.4	7.9
55-59	13.3				5.8	5.1	9.7
60-64	17.2				7.1	6.4	11.5
65-74	29.1	8.5	11.3	19.4			
75-79	49.5	11.1	16.1	23.3			
80+	65.5	14.1	21.5	26.8			
Male	12.1	11.5	18.3	24.4	6.6	6.1	10.6
Female	15.8	9.1	14.3	22.0	5.5	4.7	9.3
White	14.3	10.3	15.6	22.3			
Black/Af Am	16.0	11.2	19.6	32.3			
Other	11.9	10.2	14.3	24.9			

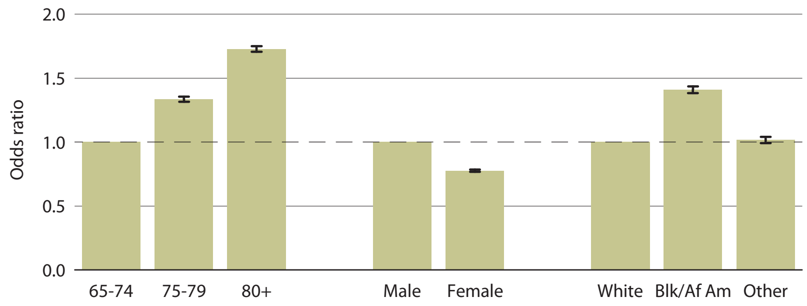
vol 1
2.e **Percent of patients with a CKD diagnosis code of 585.3 or higher, by demographic characteristics, comorbidity, & dataset, 2010**

	NHANES	Medicare (65+)			MarketScan (50–64)		
	eGFR <60	DM (no HTN)	HTN (no DM)	CVD	DM (no HTN)	HTN (no DM)	CVD
All	6.7	2.8	6.2	9.3	1.5	1.6	3.3
20-49	0.5						
50-54	2.5				0.9	1.2	2.2
55-59	5.3				1.3	1.5	3.0
60-64	8.5				2.1	2.1	4.0
65-74	18.7	2.2	4.1	7.5			
75-79	35.9	3.2	6.5	9.7			
80+	51.3	3.9	8.7	10.8			
Male	5.6	3.2	7.2	10.0	1.7	1.8	3.5
Female	7.7	2.4	5.6	8.7	1.3	1.4	3.0
White	7.9	2.8	6.1	8.9			
Black/Af Am	6.2	3.1	8.2	13.9			
Other	2.6	3.0	5.4	10.0			

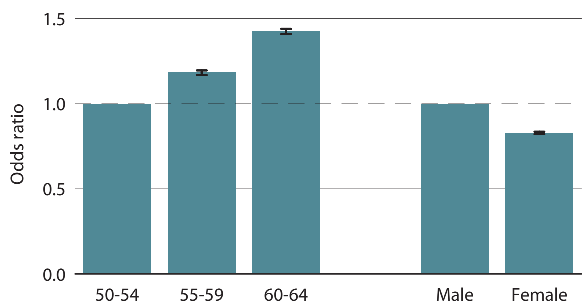
vol 1
2.f **Adjusted odds ratio of a CKD diagnosis code, by demographic characteristics, comorbidity, & dataset, 2010**

	Medicare (65+)		MarketScan (50-64)	
	Odds ratio	p-value	Odds ratio	p-value
50-54			ref	
55-59			1.18	< .0001
60-64			1.42	< .0001
64-74	reference		-	
75-84	1.44	< .0001	-	
85+	1.90	< .0001	-	
Male	reference		ref	
Female	0.78	< .0001	0.83	< .0001
White	reference		-	
Black/Af Am	1.41	< .0001	-	
Other	1.02	0.1813	-	
Diabetes	2.09	< .0001	3.16	< .0001
Hypertension	3.66	< .0001	3.30	< .0001
Cardiovascular disease	2.43	< .0001	2.74	< .0001

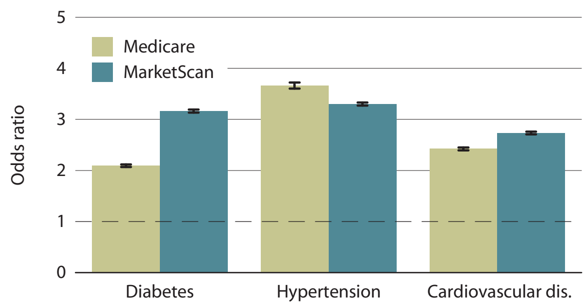
vol 1 2.6 **Odds ratio of a CKD diagnosis code in Medicare patients, by age, gender, & race, 2010**



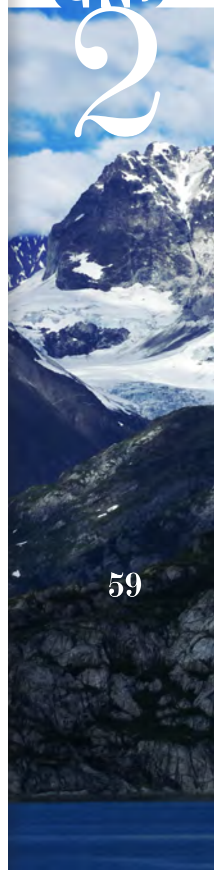
vol 1 2.7 **Odds ratio of a CKD diagnosis code in MarketScan patients, by age & gender, 2010**



vol 1 2.8 **Odds ratio of a CKD diagnosis code, by comorbidity, 2010**

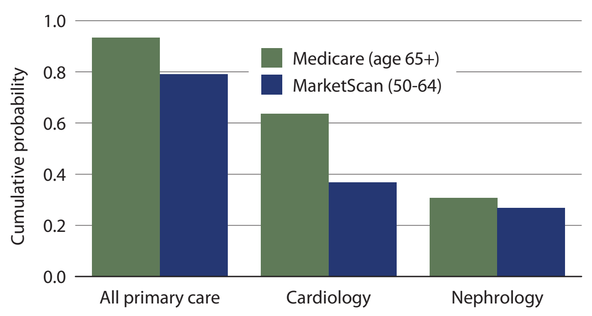


The odds of a CKD diagnosis code in Medicare patients age 65 and older, and in MarketScan patients age 50–64, are higher in older patients and males compared to their respective reference populations; for Medicare patients, the odds are greater for blacks/African Americans than for whites. And in both Medicare and MarketScan populations, patients with diabetes, hypertension, or cardiovascular disease are 2–3 times more likely to have a CKD diagnosis code compared to patients without these diseases. **» Figures 2.6–8;** see page 141 for analytical methods. *Medicare patients age 65 & older & MarketScan patients age 50–64, alive & eligible for all of 2010. CKD claims as well as other diseases identified in 2010.*



In the year after being diagnosed with CKD, the cumulative probability of seeing a primary care physician is much higher than the probability of seeing a cardiologist or nephrologist, at 0.79 in the MarketScan population, and 0.93 in patients with Medicare coverage. And in both populations, the cumulative probability of a cardiology visit is much higher than that of a nephrologist visit, at 0.64 versus 0.31, respectively, in Medicare patients and 0.37 versus 0.27 in the MarketScan population. » **Figure 2.9;** see page 141 for analytical methods. *Patients alive & eligible all of 2009. CKD diagnosis represents date of first CKD claim during 2009; physician claims searched during the 12 months following that date.*

vol 1
2.9 **Cumulative probability of a physician visit at month 12 after CKD diagnosis, by dataset & physician specialty, 2010**



The type of physician seen by month 12 following a CKD diagnosis changes dramatically with the severity of CKD. In Medicare patients with any CKD, for example, the probability of seeing a nephrologist is 0.24–0.35 across demographic groups; in those with a diagnosis code of 585.3 or higher, the probability is 0.44–0.62. In the MarketScan CKD population, the probability of seeing a nephrologist is 0.27 overall, increasing to 0.56 in patients with a diagnosis code of 585.3 or higher. » **Tables 2.g–h;** see page 141 for analytical methods. *Patients alive & eligible all of 2009. CKD diagnosis represents date of first CKD claim during 2009; physician claims searched during the 12 months following that date.*

vol 1
2.g **Cumulative probability of a physician visit at month 12 after CKD diagnosis in 2009, by demographic characteristics, physician specialty, & dataset, 2010**

	Medicare (65+)			MarketScan (50–64)		
	Primary care	Cardiologist	Nephrologist	Primary care	Cardiologist	Nephrologist
50-54				0.74	0.31	0.23
55-59				0.77	0.35	0.26
60-64				0.79	0.40	0.28
65-74	0.91	0.60	0.33			
75-84	0.93	0.66	0.31			
85+	0.93	0.66	0.24			
Male	0.93	0.61	0.29	0.76	0.38	0.26
Female	0.92	0.67	0.31	0.78	0.35	0.26
White	0.93	0.65	0.29			
Black/Af Am	0.91	0.61	0.35			
Other	0.90	0.59	0.31			
All	0.93	0.64	0.31	0.79	0.37	0.27

vol 1
2.h **Cumulative probability of a physician visit at month 12 after a CKD diagnosis code of 585.3 or higher in 2009, by demographic characteristics, physician specialty, & dataset, 2010**

	Medicare (65+)			MarketScan (50–64)		
	Primary care	Cardiologist	Nephrologist	Primary care	Cardiologist	Nephrologist
50-54				0.75	0.37	0.53
55-59				0.78	0.39	0.52
60-64				0.80	0.43	0.52
65-74	0.92	0.61	0.62			
75-84	0.93	0.67	0.57			
85+	0.93	0.66	0.44			
Male	0.93	0.61	0.54	0.77	0.42	0.52
Female	0.92	0.69	0.59	0.79	0.38	0.52
White	0.93	0.65	0.56			
Black/Af Am	0.92	0.61	0.61			
Other	0.90	0.60	0.55			
All	0.93	0.65	0.60	0.79	0.41	0.56

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 & 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.

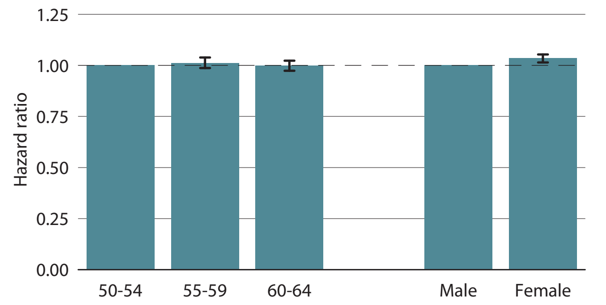
vol 1
2.i **Hazard ratio of seeing a nephrologist 12 months after CKD diagnosis, by demographics, comorbidity, CKD stage, & dataset, 2010**

	Medicare (65+) Hazard ratio	Medicare (65+) p-value	MarketScan (50-64) Hazard ratio	MarketScan (50-64) p-value
50-54			reference	
55-59			1.01	0.3538
60-64			1.00	0.9000
65-74	reference		-	
75-84	0.88	<.0001	-	
85+	0.63	<.0001	-	
Male	reference		reference	
Female	0.88	<.0001	1.03	0.0004
White	reference		-	
Black/Af Am	1.19	<.0001	-	
Other	1.01	0.63	-	
Diabetes	1.23	<.0001	1.16	<.0001
Hypertension	2.13	<.0001	1.41	<.0001
Cardiovascular disease	1.16	<.0001	1.14	<.0001
Stgs 3–5 vs Stg 1–2 or unk	3.41	<.0001	3.75	<.0001

Among Medicare patients age 65 and older, blacks/African Americans are 19 percent more likely than their white counterparts to have seen a nephrologist 12 months after CKD diagnosis, and men are more likely to see a nephrologist after diagnosis than women. For CKD patients with diabetes or cardiovascular disease, the likelihood of seeing a nephrologist is 23 and 16 percent higher, respectively, than in CKD patients without these conditions. Among patients with a CKD diagnosis code of Stage 3 or higher, the likelihood of seeing a nephrologist is more than three times that found in patients with CKD of an unknown stage or CKD of Stages 1–2. » **Table 2.i;** see page 141 for analytical methods. *Patients alive & eligible all of 2009. CKD diagnosis represents date of first CKD claim during 2009; physician claims searched during the 12 months following that date.*

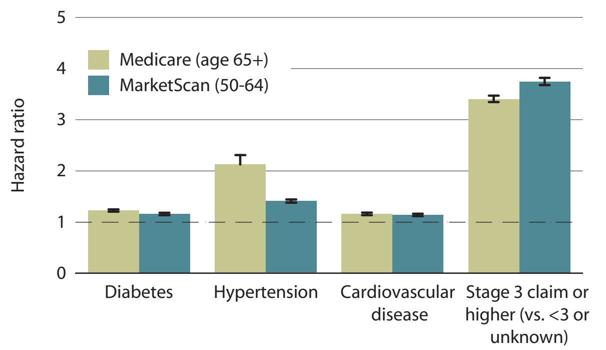
vol 1
2.10 **Hazard ratio of Medicare patients seeing a nephrologist 12 months after CKD diagnosis, by age, gender, & race, 2010**

vol 1
2.11 **Hazard ratio of MarketScan patients (age 50–64) seeing a nephrologist 12 months after CKD diagnosis, by age & gender, 2010**



Factors associated with a higher likelihood of seeing a nephrologist 12 months after a CKD diagnosis include black/African American race (Medicare population), diabetes, hypertension, cardiovascular disease, and a CKD diagnosis code of 585.3 or higher. » **Figures 2.10–12;** see page 141 for analytical methods. *Patients alive & eligible all of 2009. CKD diagnosis represents date of first CKD claim during 2009; physician claims searched during the 12 months following that date.*

vol 1
2.12 **Hazard ratio of patients seeing a nephrologist 12 months after CKD diagnosis, by comorbidity, CKD stage, & dataset, 2010**



These figures compare medication use in identified older CKD patients enrolled in Part D to that of younger, commercially-insured CKD patients in the MarketScan database. Among Part D patients with a diagnosis of diabetes or hypertension, 59 and 54 percent use a renin-angiotensin system agent, compared to 61 and 54 percent in the MarketScan population.

Beta blocker use in Part D patients with CHF or hypertension is 71 and 59 percent, compared to 77 and 73 percent for MarketScan patients. Use of this medication class tends to be more common in Part D patients with later-stage CKD, and in MarketScan patients in the earlier stages of CKD.

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

Potassium-sparing diuretics or combination diuretic products are rarely used in CKD patients. Thiazide and loop diuretics, in contrast, receive much wider use, with 30 and 31 percent, respectively, of Medicare and Marketscan patients receiving a thiazide diuretic, and 44 and 21 percent a loop diuretic. Across all stages of CKD, loop diuretic use is more common in Medicare patients. » Figures 2.13–16; see page 141 for analytical methods. *Point prevalent Medicare CKD patients age 65 & older, & MarketScan CKD patients age 50–64.*

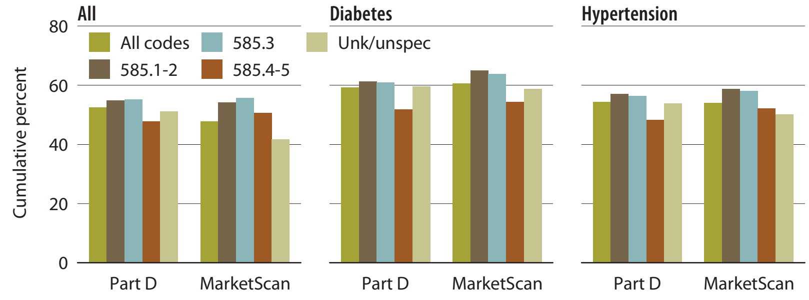
ICD-9-CM codes

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

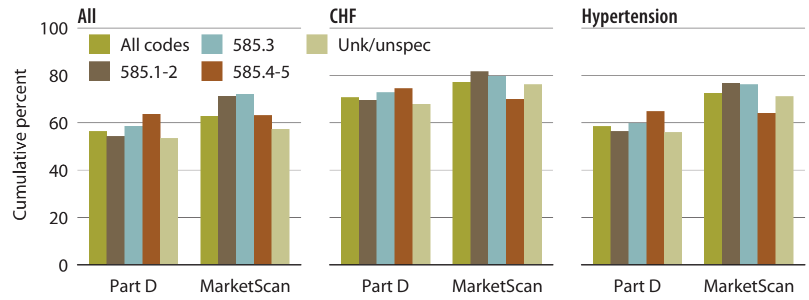
In USRDS analyses, patients with ICD-9-CM code 585.6 & with no ESRD 2728 form or other indication of ESRD are considered to have code 585.5; see Appendix A for details.

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

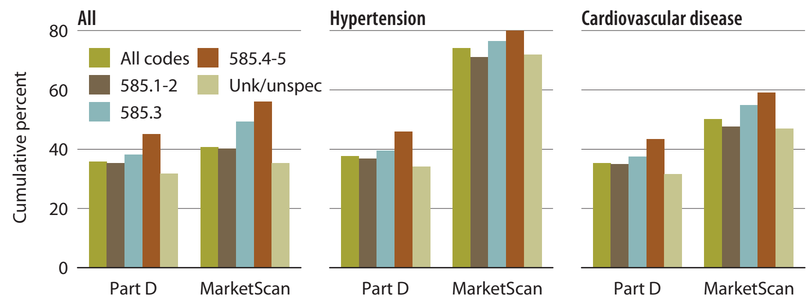
vol 1 **2.13** **Medicare Part D & MarketScan CKD patients with at least one claim for an ACEI/ARB/renin inhibitor in the 12 months following the disease defining entry period, by CKD diagnosis code, 2010**



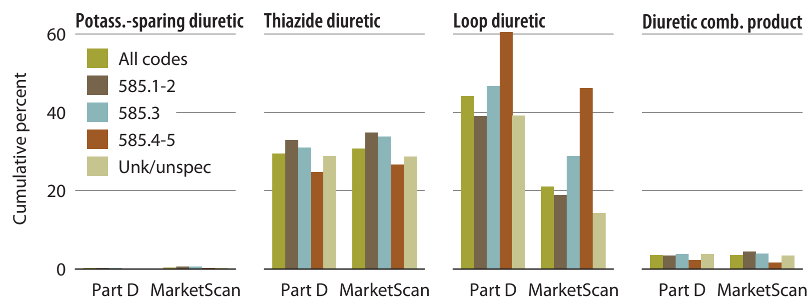
vol 1 **2.14** **Medicare Part D & MarketScan CKD patients with at least one claim for a beta blocker in the 12 months following the disease defining entry period, by CKD diagnosis code, 2010**



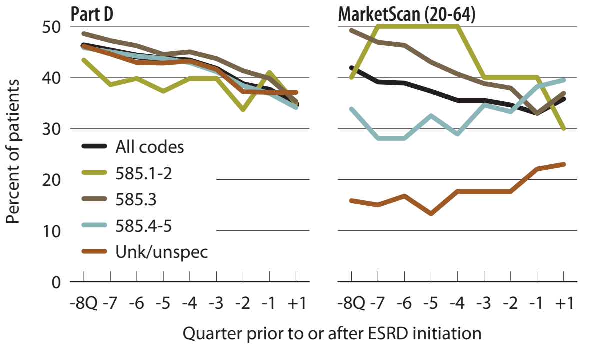
vol 1 **2.15** **Medicare Part D & MarketScan CKD patients with at least one claim for a DHP calcium channel blocker in the 12 months following the disease-defining entry period, by CKD diagnosis code, 2010**



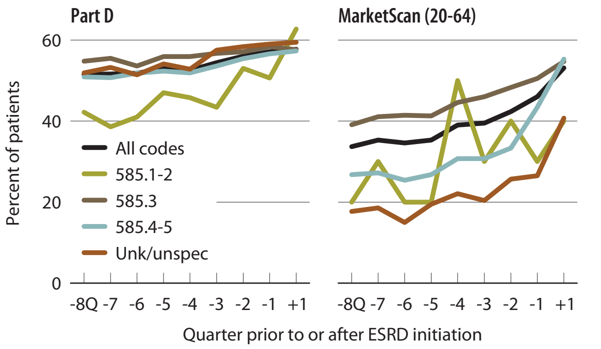
vol 1 **2.16** **CKD patients with at least one claim for a diuretic in the 12 months following the disease-defining entry period, by dataset & CKD diagnosis code, 2010**



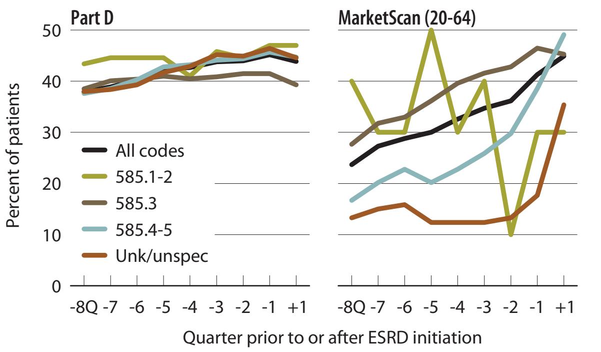
vol 1 **2.17** **ACEI/ARB/renin inhibitor use during the transition to ESRD, by dataset & CKD stage, 2010**



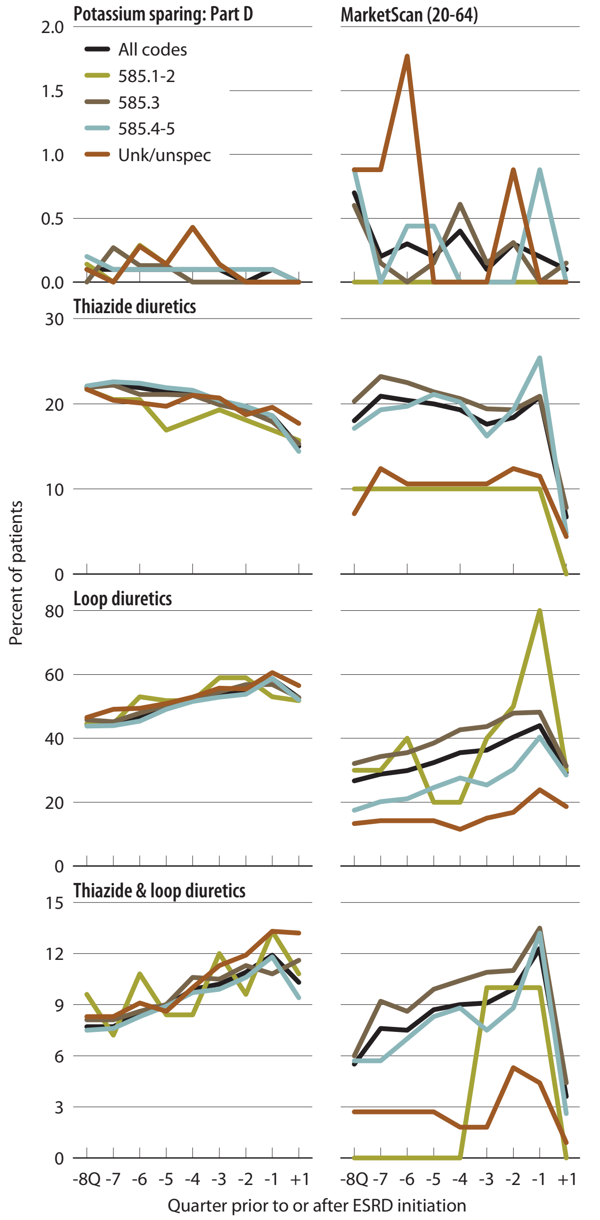
vol 1 **2.18** **Beta blocker use during the transition to ESRD, by dataset & CKD stage, 2010**



vol 1 **2.19** **Dihydropyridine calcium channel blocker use during the transition to ESRD, by dataset & CKD stage, 2010**



vol 1 **2.20** **Use of diuretics during the transition to ESRD, by dataset & CKD stage, 2010**



These figures illustrate patterns of medication use during the transition to ESRD. Among Medicare patients with recognized CKD, ACEI/ARB/renin inhibitor use falls from 38–46 percent at eight quarters before ESRD diagnosis to 35 percent in the quarter following; use of beta blockers, in contrast, increases from 52 to 58 percent. The pattern of use of dihydropyridine calcium channel blockers is similar to that of beta blockers, although overall use is lower. » **Figures 2.17–20;** see page 141 for analytical methods. *Point prevalent Medicare CKD patients age 67 & older, & MarketScan CKD patients age 20–64.*

PREVALENCE OF RECOGNIZED CKD

patients with coded diabetes, CKD, CHF, & CVA, 2010 (Figure 2.1)

	CKD	diabetes	CHF	CVA	CVA + CKD
Medicare (age 65+)	9.2%	23.9%	9.5%	6.9%	1.7%
MarketScan (age 50–64)	1.4%	10.1%	0.94%	0.97%	0.1%

LABORATORY TESTING IN PATIENTS AT RISK FOR CKD

probability of urine albumin & creatinine testing in Medicare patients age 65 & older at risk for CKD, 2010 (Figure 2.5)

	urine albumin	creatinine	both
overall	0.10	0.77	0.10
diabetes, no hypertension	0.34	0.87	0.33
hypertension, no diabetes	0.05	0.87	0.05
diabetes & hypertension	0.36	0.93	0.35

PROBABILITY & ODDS OF A CKD DIAGNOSIS CODE

adjusted odds ratio of a CKD diagnosis code, 2010 (Table 2.f)

Medicare (age 65+) » white · reference » blacks/African American · 1.41
» diabetes · 2.09 » hypertension · 3.66 » CVD · 2.43
MarketScan (age 50–64) » diabetes · 3.16 » hypertension · 3.30 » cardiovascular disease · 2.74

PROBABILITY & ODDS OF SEEING A PHYSICIAN AFTER CKD DIAGNOSIS

cumulative probability of a physician visit at month 12 following a CKD diagnosis, 2009 (Figure 2.9)

	all primary care	cardiologist	nephrologist
Medicare (age 65+)	0.93	0.64	0.31
MarketScan (age 50–54)	0.79	0.37	0.27

PRESCRIPTION DRUG THERAPY

CKD patients with at least one claim for an ACEI/ARB/renin inhibitor, 2010 (Figure 2.13)

	all	with diabetes	with hypertension
Medicare Part D (age 65+)	52%	59%	54%
Marketscan (age 50–64)	48%	61%	54%

CKD patients with at least one claim for a beta blocker, 2010 (Figure 2.14)

	all	with CHF	with hypertension
Medicare Part D (age 65+)	57%	71%	59%
Marketscan (age 50–64)	63%		73%

CKD patients with at least one claim for a DHP calcium channel blocker, 2010 (Figure 2.15)

	all	with hypertension	with CVD
Medicare Part D (age 65+)	36%	38%	35%
Marketscan (age 50–64)	41%	74%	50%

3

Arches National Park, Utah

MORBIDITY & MORTALITY IN PATIENTS WITH CKD

Assessing morbidity in patients with chronic kidney disease requires longitudinal data from a defined population, with relatively complete information on all-cause and cause-specific hospitalization. Such data are rarely available on a random sample of the U.S. population, since it is very difficult to track patients across multiple insurers. Health plan datasets from Medicare and from employer group health plans (EGHPs), however, can capture information well, particularly over a one-year period, and they provide a unique opportunity to assess morbidity.

In this chapter we use data from three insurers which represent large populations. Medicare data, for instance, cover 95 percent of individuals age 65 and older. We also employ the Thomson Rueters MarketScan dataset and the United Healthcare Ingenix i3 LabRx dataset, both from large EGHPs. MarketScan data cover health plan expenditure claims for employers that are approximately 80 percent self-insured, compared to just 20 percent in the Ingenix i3 data. For each dataset we use diagnosis codes to define CKD during a one-year entry period, noting hospitalizations and services in the one-year follow-up period.

We begin by examining rehospitalization rates in the CKD, hemodialysis, and general Medicare populations. Thirty-four percent of hemodialysis patients are rehospitalized within 30 days, compared to 24 percent of patients with CKD and 18 percent in the general Medicare population. Rehospitalization rates have not changed in the past decade, a major concern. Detailed causes of rehospitalizations need to be addressed and to be matched up with the changes in medication use (reported in Chapter Two), with particular reference to the decreased use of ACE/ARBs and diuretics.

Overall, the rate of hospitalizations approaches 0.6 per patient year, a rate less than half of that noted for hemodialysis patients (see Chapter Three of Volume Two). Rates of hospitalization for cardiovascular disease and infection continue to rise with CKD stage, an observation reported by other investigators more than seven years ago.

On no subject are our ideas more warped and pitiable than on death... Let children walk with nature, let them see the beautiful blendings and communions of death and life, their joyous inseparable unity, as taught in woods and meadows, plains and mountains and streams of our blessed star, and they will learn that death is stingless indeed, and as beautiful as life, and that the grave has no victory, for it never fights. All is divine harmony.

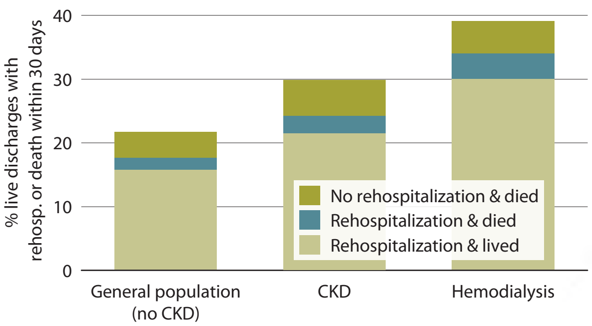
JOHN MUIR
A Thousand-Mile Walk to the Gulf

MORBIDITY & MORTALITY IN PATIENTS WITH CKD
introduction

Data on mortality in CKD and non-CKD patients illustrate the impact of adjustments for comorbidity and disease severity on absolute death rates. Adjusting for age, gender, race, comorbidity, and prior hospitalizations, mortality among CKD patients in 2010 is 59 percent greater than among non-CKD patients. As with hospitalization, CKD is thus a risk multiplier for mortality. The decline in rates since 1995 may partially reflect increased recognition of CKD, as illustrated by the increasing percentage of patients carrying the diagnosis; it may also indicate classification bias rather than a true reduction. Adjustments over time, however, appear to mitigate some of these issues, as the drop in mortality rates since 1995 is greater than that seen among patients without CKD.

Patterns in mortality by CKD stage parallel those seen with hospitalization; the adjusted rate in patients with CKD of Stages 4–5, for example, is 53 percent greater than that in non-CKD patients. The impact of diabetes and congestive heart failure as risk multipliers is also important, particularly given that cardiovascular risk factors are relatively under-treated in U.S. patients with CKD. » **Figure 3.1;** see page 142 for analytical methods. *January 1, 2010 point prevalent Medicare patients, age 66 & older on December 31, 2009, unadjusted. Includes live hospital discharges from January 1 to December 1, 2010.*

vol 1 **3.1** **All-cause rehospitalization or death within 30 days after live hospital discharge in the general Medicare (no CKD), CKD, & hemodialysis populations, age 66+, 2010**



In both CKD and non-CKD populations age 66 and older, adjusted rates of hospitalization increase with greater comorbidity. In 2010, for example, admissions for Stage 4–5 CKD patients with both diabetes and cardiovascular disease reached 882 per 1,000 patient years — more than twice the rate among patients with neither diagnosis.

By race, hospitalization rates are generally higher among blacks/African Americans compared to whites, but differences are negligible in those with Stage 4–5 CKD, at 598 and 596 per 1,000 patient years, respectively. » **Figures 3.2–3;** see page 142 for analytical methods. *January 1, 2010 point prevalent Medicare patients, age 66 & older on December 31, 2009. Adj: age/gender/race/prior hospitalization/comorbidity; rates by one factor are adjusted for the others. Ref: Medicare patients age 66 & older, 2010.*

ICD-9-CM codes

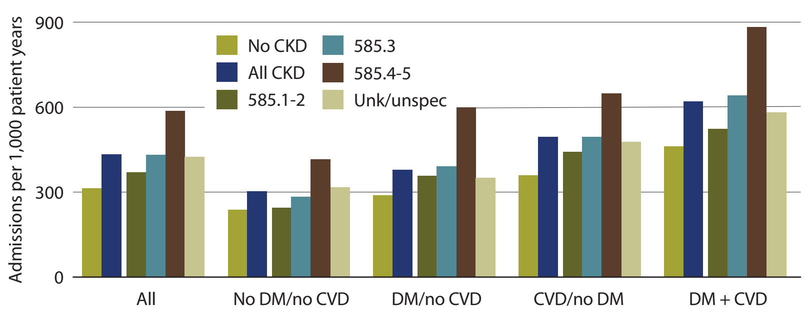
- 585.1 Chronic kidney disease, Stage 1
- 585.2 Chronic kidney disease, Stage 2 (mild)
- 585.3 Chronic kidney disease, Stage 3 (moderate)
- 585.4 Chronic kidney disease, Stage 4 (severe)
- 585.5 Chronic kidney disease, Stage 5 (excludes 585.6: Stage 5, requiring chronic dialysis.*)

Chronic kidney disease, unknown/unspecified

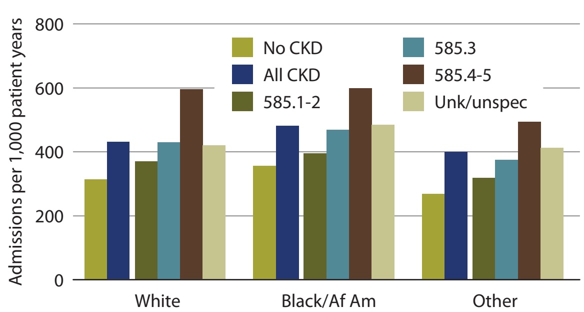
In USRDS analyses, patients with ICD-9-CM code 585.6 & with no ESRD 2728 form or other indication of ESRD are considered to have code 585.5; see Appendix A for details.

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

vol 1 **3.2** **Adjusted hospitalization rates in Medicare patients, by comorbidity & CKD diagnosis code, 2010**



vol 1 **3.3** **Adjusted hospitalization rates in Medicare patients, by race & CKD diagnosis code, 2010**

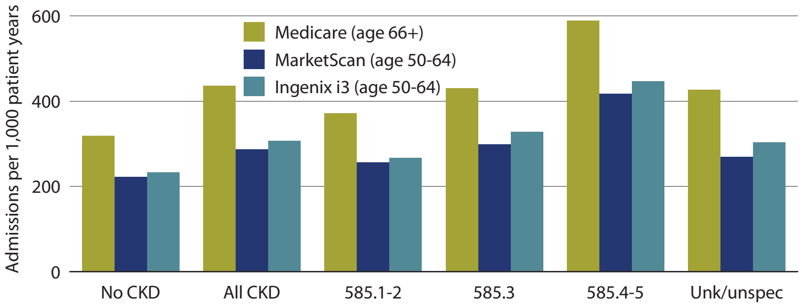


vol 1 **3.a** **Adjusted hospitalization rates (per 1,000 patient years) in Medicare patients, by CKD diagnosis code, 2010**

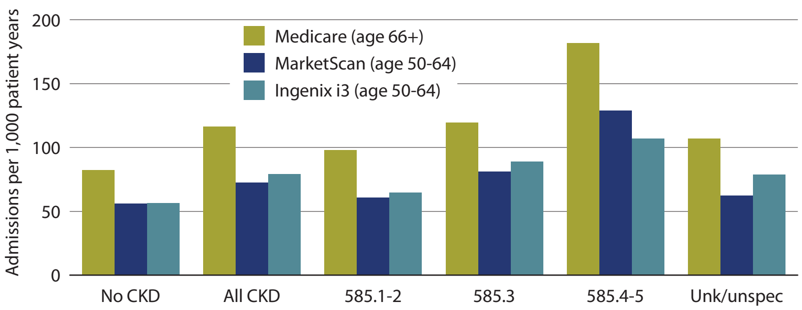
	No CKD	All CKD	585.1–2	585.3	585.4–5	Unk/unspec
All	314.5	433.6	370.4	431.2	587.1	424.3
Age: 66–69	246.3	365.0	294.4	394.2	539.1	338.9
70–74	266.2	384.2	330.3	360.0	599.4	378.8
75–84	327.8	441.5	379.6	441.5	577.9	433.2
85+	449.5	539.6	475.5	526.0	637.5	539.0
Male	317.1	425.7	368.5	424.2	587.8	413.8
Female	313.1	441.4	373.5	437.2	589.0	434.7
White	314.1	431.7	370.8	430.1	595.7	420.7
Black/Af Am	355.6	481.4	394.9	469.6	598.4	483.7
Other	268.5	400.4	319.0	374.9	494.5	412.9

Among Medicare patients age 66 and older, adjusted admission rates are greater for patients with CKD compared to those without, and for patients with Stage 4–5 CKD compared to those in an earlier stage. The highest rates by race occur among blacks/African Americans; by gender, admissions for women with CKD are consistently higher than those found in their male counterparts. » **Table 3.a;** see page 142 for analytical methods. *January 1, 2010 point prevalent Medicare patients, age 66 & older on December 31, 2009. Adj: age/gender/race/prior hospitalization/comorbidity; rates by one factor are adjusted for the others. Ref: Medicare patients age 66 & older, 2010.*

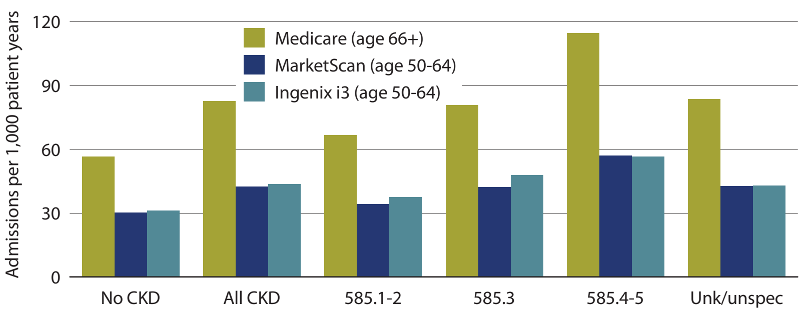
vol 1
3.4 **Adjusted all-cause hospitalization rates, by dataset & CKD diagnosis code, 2010**



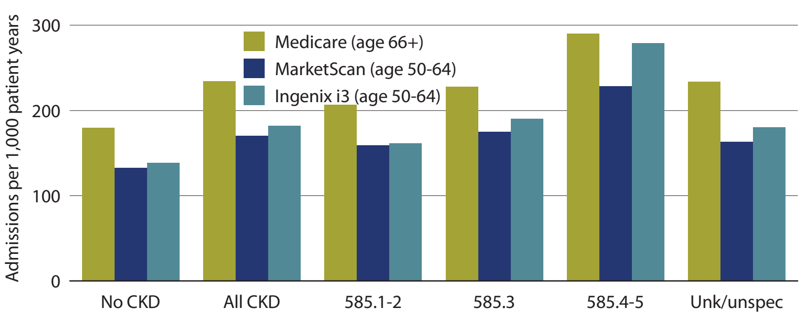
vol 1
3.5 **Adjusted rates of hospitalization for cardiovascular disease, by dataset & CKD diagnosis code, 2010**



vol 1
3.6 **Adjusted rates of hospitalization for infection, by dataset & CKD diagnosis code, 2010**



vol 1
3.7 **Adjusted rates of hospitalization for other causes, by dataset & CKD diagnosis code, 2010**



Adjusted all-cause hospitalization rates, and rates of hospitalization for cardiovascular disease, infection, and other causes, are each higher among Medicare patients age 66 and older than in the younger MarketScan and Ingenix i3 populations. Rates are also greatest for patients with CKD compared to those without, and are generally higher in the later stages of the disease.

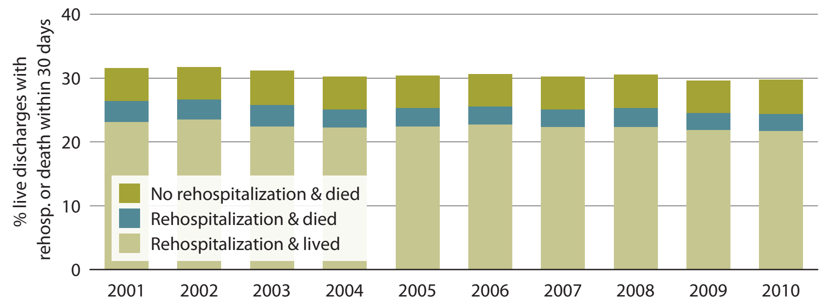
All-cause hospitalization rates, for example, are 58 percent higher among Medicare patients with Stage 4–5 CKD than among their counterparts with Stages 1–2, reaching 589 admissions per 1,000 patient years; in the MarketScan and Ingenix i3 populations, rates are 63 and 67 percent higher in those with later-stage CKD.

Among Medicare patients, the rate of 182 cardiovascular admissions per 1,000 patient years in those with Stage 4–5 CKD is 86 percent higher than the rate of 98 reported for those with CKD of Stages 1–2. And rates of 129 and 107 reported for MarketScan and Ingenix i3 patients with later-stage CKD are 112 and 65 percent greater, respectively, than those for patients in the earliest stages of the disease.

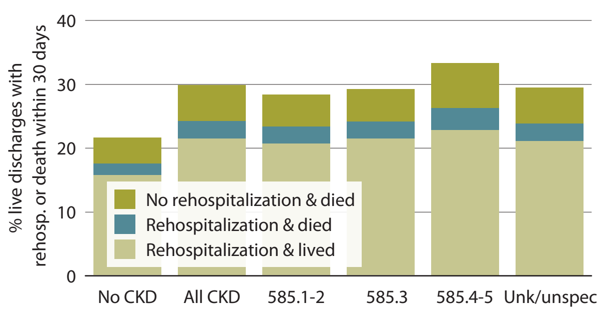
Compared to those of patients in the early stages of CKD, rates of admission for infection among patients with CKD of Stages 4–5 are 72, 66, and 50 percent greater, respectively, among Medicare, MarketScan, and Ingenix i3 patients. » **Figures 3.4–7;** see page 142 for analytical methods. *Medicare: point prevalent patients on January 1, 2010, age 66 & older on December 31, 2009. MarketScan & Ingenix i3: point prevalent patients on January 1, 2010, age 50–64 on December 31, 2009. Adj: gender/prior hospitalization/comorbidity; ref: Medicare patients age 66 & older, 2010.*

Adjusted all-cause rehospitalization rates in Medicare CKD patients have slowly decreased during the last decade, from 27 percent in 2002 to 24 percent in 2010. » **Figure 3.8;** see page 142 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 2005. Includes discharges from January 1 to December 1 of each year.*

vol 1 **3.8** **Adjusted all-cause rehospitalization or death 30 days after live hospital discharge in CKD patients**



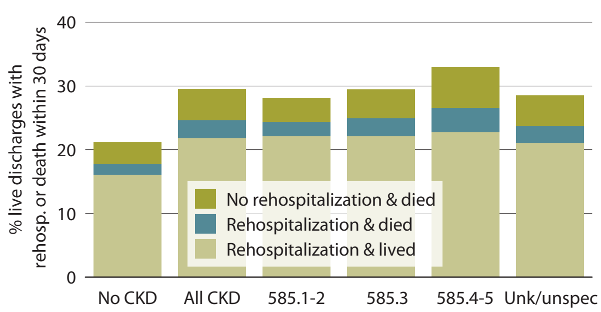
vol 1 **3.9** **All-cause rehospitalization or death within 30 days after discharge from all-cause index hospitalization, by CKD stage, 2010**



vol 1 **3.b** **Percent live hospital discharges in CKD patients with an all-cause rehospitalization within 30 days, 2010**

	No CKD	All CKD	585.1–2	585.3	585.4–5	Unk/unspec
All	17.7	24.3	23.4	24.2	26.3	23.9
Age: 66–69	17.0	26.2	22.6	26.4	29.8	25.8
70–74	17.0	25.4	21.7	24.2	28.6	26.0
75–84	18.1	24.3	26.0	24.3	26.0	23.5
85+	18.0	22.8	20.4	23.0	24.4	22.4
Male	18.5	24.6	24.0	24.3	26.3	24.5
Female	17.1	24.0	22.9	24.0	26.4	23.4
White	17.4	23.6	22.3	23.7	25.3	23.3
Black/Af Am	20.4	27.6	27.5	26.7	30.0	27.5
Other	17.6	26.8	26.9	26.4	31.6	25.2
No rehosp & died	4.0	5.6	5.0	5.1	7.0	5.6
Rehosp & died	1.8	2.8	2.7	2.6	3.5	2.7
Rehosp & lived	15.9	21.5	20.8	21.6	22.8	21.2

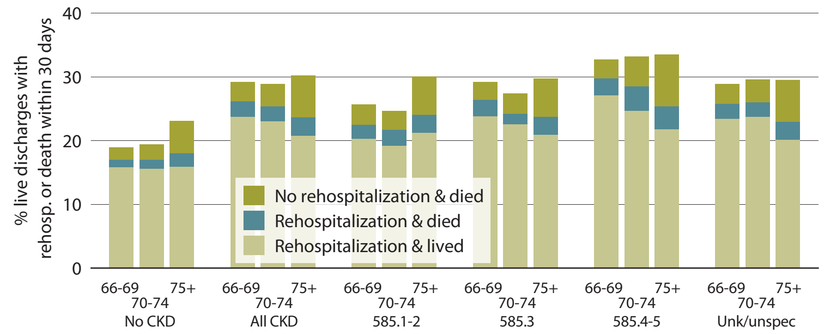
vol 1 **3.10** **All-cause rehospitalization or death within 30 days after discharge from cardiovascular index hospitalization, by CKD stage, 2010**



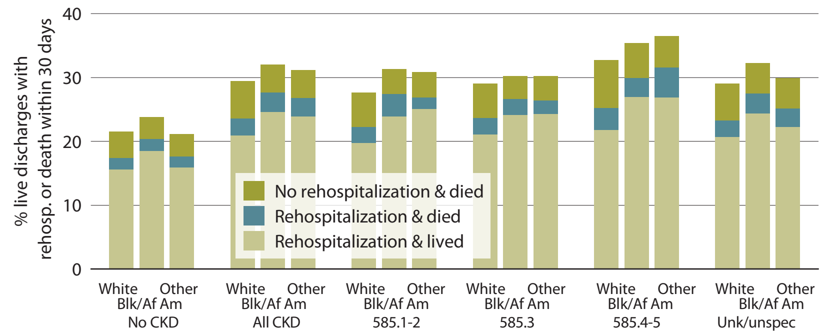
The thirty-day all-cause rehospitalization rate among patients with CKD of Stages 4–5 was 26 percent in 2010, compared to 23 percent in those with Stage 1–2 CKD; rates for death or rehospitalization were 33 and 28 percent, respectively. The rehospitalization rate among CKD patients (24 percent) exceeded the rate of the combined end-point of death or rehospitalization in non-CKD patients, at 22 percent.

Rates of rehospitalization increase with the severity of CKD, and are highest among males and blacks/African Americans within all groups except patients with CKD of Stages 4–5; rates in these patients are similar by gender and highest in races other than white or black/African American.

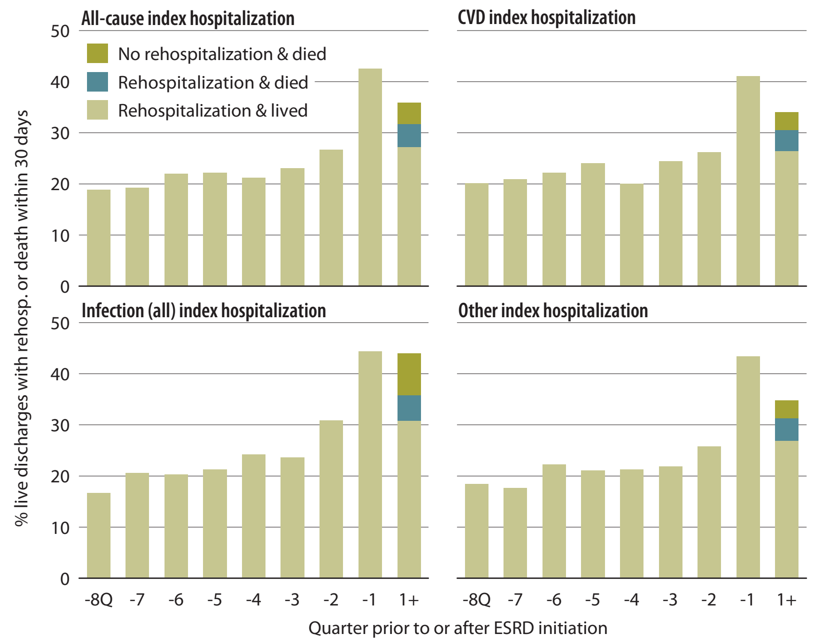
Following discharge from a cardiovascular hospitalizations, rehospitalization rates in 2010 were 18 and 25 percent, respectively, for non-CKD and CKD patients; rates for rehospitalization or death were 21 and 30 percent. » **Table 3.b & Figures 3.9–10;** see page 142 for analytical methods. *January 1, 2010 point prevalent Medicare patients, age 66 & older on December 31, 2009; unadjusted. Includes live hospital discharges from January 1 to December 1, 2010* vol 1 **3.11** **All-cause rehospitalization or death 30 days after live hospital discharge in Medicare patients, by age & CKD diagnosis code, 2010**



vol 1 **3.12** **All-cause rehospitalization or death 30 days after live hospital discharge in Medicare patients, by race & CKD diagnosis code, 2010**



vol 1 **3.13** **All-cause rehospitalization or death 30 days after live hospital discharge during the transition to ESRD, by cause-specific index hospitalization, 2010**



Here we highlight the issue of competing risks of mortality and rehospitalization. Rates of rehospitalization rates tend to be lower for older patients, as death precludes the opportunity for readmission. Figure 3.11 demonstrates a pattern of increasing mortality and decreasing rehospitalization rates in older patients with CKD overall and by CKD stage.

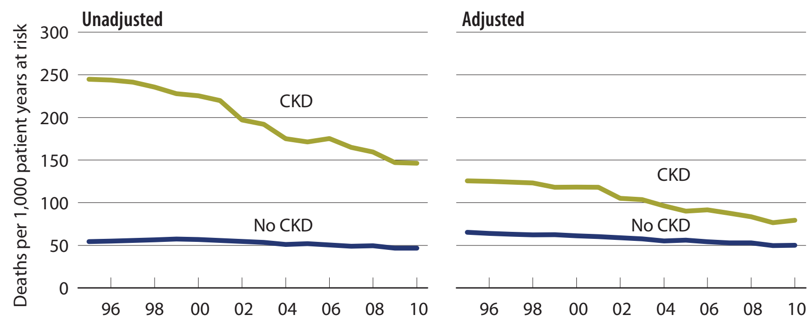
Rates by race show lower rehospitalization rates among whites compared to blacks/African Americans patients of other races within all stages of CKD. Mortality, however, is also higher in whites, indicating a need for caution when interpreting trends in rehospitalization by race. **» Figures 3.11–12;** see page 142 for analytical methods. *January 1, 2010 point prevalent Medicare patients, age 66 & older on December 31, 2009; unadjusted.*

The highest rehospitalization rates during the transition to ESRD are observed following an index hospitalization for infection, with 44 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 or rehospitalization within 30 days. **» Figure 3.13;** see page 142 for analytical methods. *Incident ESRD patients, January 1 to October 1, 2010; age 67 or older, unadjusted.*

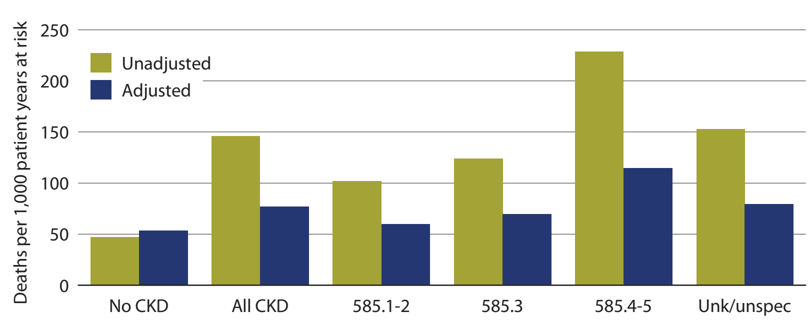
The unadjusted mortality rate in Medicare CKD patients age 66 and older has decreased 40.3 percent since 1995, to 146.2 deaths per 1,000 patient years in 2010. When adjusted for patient characteristics and complexity, however, the rate is lowered considerably, reaching 79.5 in 2010. » **Figure 3.14;** see page 142 for analytical methods. *January 1 point prevalent Medicare patients age 66 & older. Adj: age/gender/race/prior hospitalization/comorbidities. Ref: 2005 patients.*

Among non-CKD patients age 66 and older, adjusted mortality rates are 15 percent higher than unadjusted rates. For CKD patients, in contrast, rates adjusted for patient characteristics, hospitalizations, and comorbidities are 41–50 percent lower. Adjusted mortality reaches 115 deaths per 1,000 patient years for patients with Stage 4–5 CKD. » **Figure 3.15;** see page 142 for analytical methods. *January 1, 2010 point prevalent patients age 66 & older. Adj: age/gender/race/prior hospitalization/comorbidities. Ref: 2010 patients.*

vol 1 3.14 **All-cause mortality rates in Medicare CKD & non-CKD patients**



vol 1 3.15 **All-cause mortality rates in Medicare CKD & non-CKD patients, by CKD diagnosis code, 2010**



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 & with no ESRD 2728 form or other indication of ESRD are considered to have code 585.5; see Appendix A for details.*

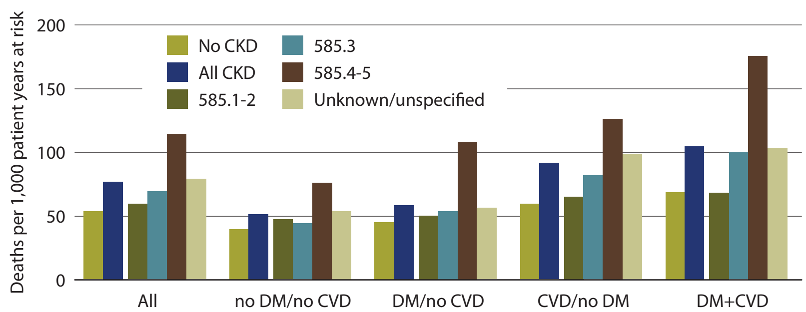
CKD stage estimates are from a single measurement. For clinical case definition, abnormalities should be present ≥ 3 months.

vol 1
3.c **Adjusted mortality rates (per 1,000 patient years at risk) in Medicare patients, by CKD diagnosis code, 2010**

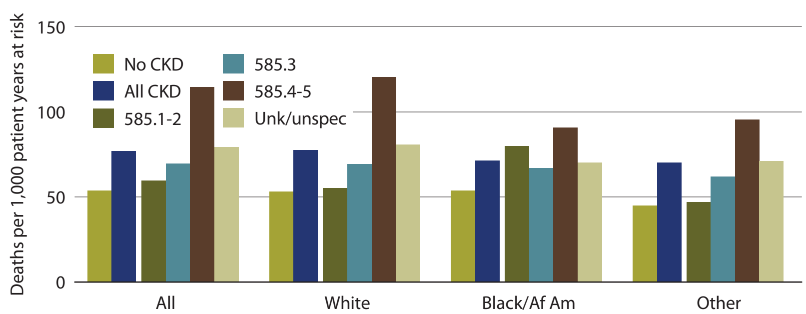
	No CKD	All CKD	585.1–2	585.3	585.4–5	Unk/unspec
All	53.7	77.0	59.7	69.5	114.7	79.3
Age: 66–69	23.3	37.2	20.7	41.4	44.2	37.1
70–74	27.5	42.4	26.7	35.6	79.2	42.1
75–84	48.3	72.7	48.4	64.6	137.5	72.4
85+	127.5	166.7	152.1	143.5	198.8	183.1
Male	58.0	81.4	67.1	77.2	122.1	80.5
Female	49.2	75.0	50.6	63.2	112.7	81.2
White	53.0	77.6	55.1	69.5	120.5	80.7
Black/Af Am	53.8	71.4	79.9	67.1	90.7	70.2
Other	44.9	70.1	46.9	61.8	95.6	71.3

Adjusted mortality per 1,000 patient years among Medicare CKD patients age 66 and older is lowest for those with CKD of Stages 1–2, at 20.7; the rate rises to 115 in those with Stage 4–5 CKD. Mortality is consistently higher for men than women, and in patients with Stage 4–5 CKD is 32 percent higher for whites compared to black/African American patients. » **Table 3.c;** see page 142 for analytical methods. *January 1, 2010 point prevalent patients age 66 & older. Adj: age/gender/race/prior hospitalization/comorbidities. Ref: 2010 patients.*

vol 1
3.16 **Adjusted mortality rates in Medicare patients, by comorbidity & CKD diagnosis code, 2010**



vol 1
3.17 **Adjusted mortality rates in Medicare patients, by race & CKD diagnosis code, 2010**



Adjusted rates of mortality generally increase with patient complexity. Among Stage 4–5 CKD patients without diabetes or cardiovascular disease, for example, the rate is 76 per 1,000 patient years at risk; among those with both diagnoses, it rises to 176.

By race, adjusted mortality is highest in patients with Stage 4–5, and is highest in whites than in blacks/African Americans. Overall, the rate among blacks/African Americans with CKD is 71 per 1,000 patient years, compared to 78 and 70 among whites and patients of other races. » **Figures 3.16–17;** see page 142 for analytical methods. *January 1, 2010 point prevalent patients age 66 & older. Adj: age/gender/race/prior hospitalization/comorbidities. Ref: 2010 patients.*

HOSPITALIZATION RATES IN CKD & NON-CKD PATIENTS

adjusted admissions in Medicare CKD patients age 66 & older, 2010 (per 1,000 patient years; Figures 3.2–3)

	no CKD	all CKD	Stages 1–2	Stage 3	Stages 4–5
no diabetes, no CVD	238	302	244	284	416
diabetes, cardiovascular disease	462	621	523	642	882
white	314	432	371	430	596
black/African American	356	481	395	470	598

adjusted all-cause hospitalization rates in CKD patients (per 1,000 patient years; Figure 3.4)

	Stages 1–2	Stage 3	Stages 4–5
Medicare, age 66+	372	430	589
MarketScan, age 50–64	256	299	417
Ingenix i3, age 50–64	267	328	447

MORTALITY

all-cause mortality rates in Medicare patients age 66 & older, 2010 (per 1,000 patient years; Figure 3.15)

	all CKD	Stages 1–2	Stage 3	Stages 4–5
unadjusted	146	102	124	228
adjusted	77	60	69	115

adjusted mortality rates in Medicare patients age 66 & older, by patient comorbidity, 2010 (per 1,000 patient years; Figure 3.16)

	all CKD	Stages 1–2	Stage 3	Stages 4–5
no diabetes, no cardiovascular disease	52	48	44	76
diabetes, no cardiovascular disease	59	50	54	109
no diabetes, cardiovascular disease	92	65	82	126
diabetes & cardiovascular disease	105	68	100	176

adjusted mortality rates in Medicare CKD patients age 66 & older, by race, 2010 (per 1,000 patient years; Figure 3.17)

	all CKD	Stages 1–2	Stage 3	Stages 4–5
white	78	55	70	121
black/African American	71	80	67	91

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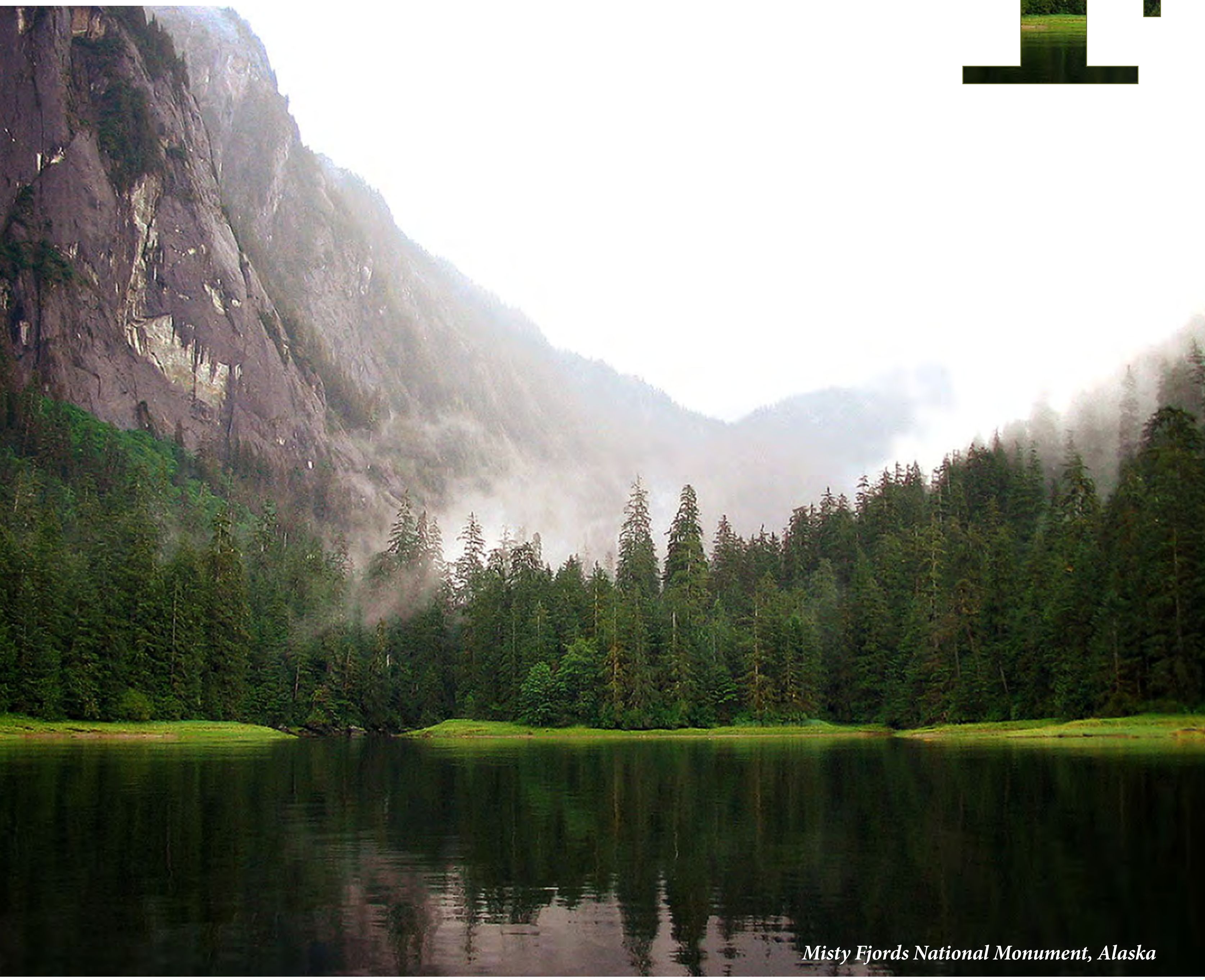


Misty Fjords National Monument, Alaska

CARDIOVASCULAR DISEASE IN PATIENTS WITH CKD

This chapter highlights the epidemiology of the relationship between CKD and cardiovascular disease, and documents the impressive graded risk of mortality associated with advanced CKD. Additionally, we present a temporal analysis of the changing approach to diagnostic evaluation in patients with CKD and CHF, include a new investigation on the distribution of fatal and nonfatal myocardial infarction by CKD stage, and look at medication use and associated outcomes by CKD stage.

We begin with a Venn diagram detailing the prevalence of cardiovascular disease with respect to CKD; this figure also provides a rough temporal analysis, as data are presented for 2005 and 2010. In both years there is an increased prevalence of associated cardiovascular disease in patients with CKD compared to those without. In 2005, for example, nearly half of elderly CKD patients had a concomitant diagnosis of CHF, and 15 percent had an AMI; among their non-CKD counterparts, these numbers fell to 22 and 7 percent. Similar clustering occurs in 2010, but data suggest there may have been a reduction in certain types of associated cardiovascular comorbidity (e.g., an absolute 6 percent reduction in CHF).

Later in the chapter, in Table 4.b, we provide data on medication use with respect to cardiovascular condition and CKD stage. In patients with CHF, for example, one notable finding is the increased use of beta blockers. In elderly non-CKD patients, 52 percent of those with CHF received a beta blocker in 2007; this rose to 60 percent in 2010; in the CKD population, use rose from 56 to 66 percent. There was a more modest increase in the use of ACEIs/ARBs, from 54 to 57 percent in the non-CKD population, and from 47 to 52 percent in those with CKD. One conclusion derived from these data is that, in 2010, there is really no discernible impact of "therapeutic nihilism" related to the use of beta blockers in patients with advanced CKD. The proportion of patients receiving a beta blocker was actually higher, at about 70 percent, than the 60 percent seen in patients without CKD. One can speculate that this may reflect both a change in practice patterns and the availability of Part D coverage, facilitating the administration of these evidence-based therapies. In patients with AMI, there was a high penetration in the use of beta blockers, similar across CKD stages, and reaching 77–78 percent in both CKD and non-CKD patients.

For ACEIs/ARBs, in contrast, there appears to be an inverse relationship between CKD stage and the use of these agents following AMI, with the medications prescribed to 66 percent of non-CKD patients, compared to 57 percent of those with CKD. Importantly, only 46 percent of patients with Stage 4–5 CKD receive an ACEI/ARB. There also appears to be an inverse relationship between CKD stage and warfarin use in patients with AFIB. In 2010, 56 percent of non-CKD patients, and 49 percent of those with CKD, were identified as receiving warfarin, numbers higher than the 48 and 40 percent seen in 2007, and suggesting the

Man's heart away from nature becomes hard.
LUTHER STANDING BEAR

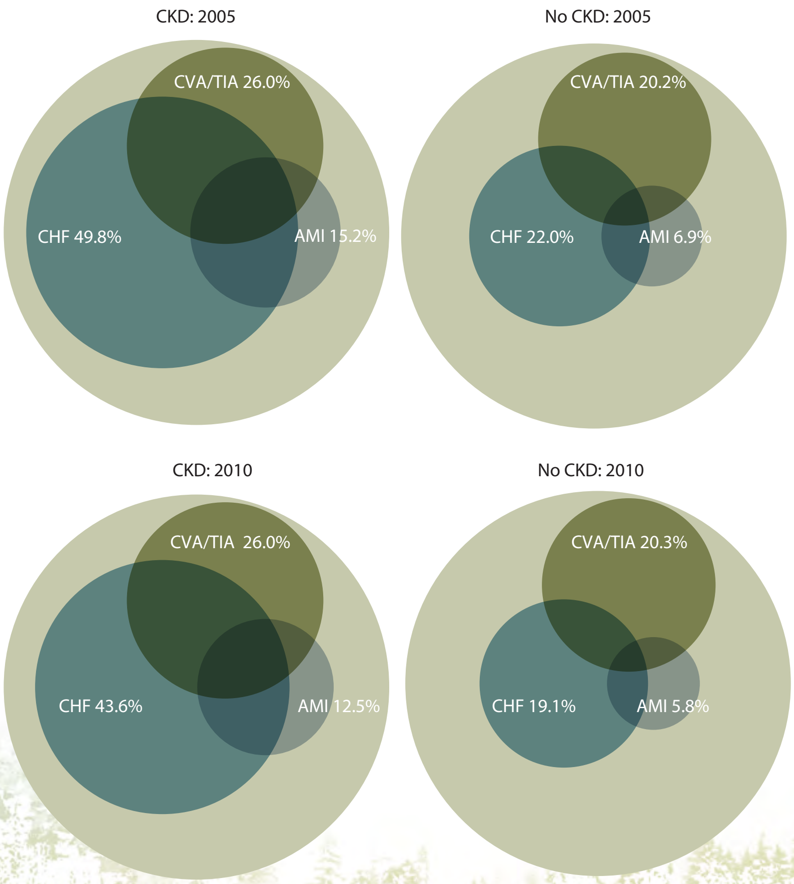
CARDIOVASCULAR DISEASE IN PATIENTS WITH CHRONIC KIDNEY DISEASE

introduction

progressive dissemination of this particular evidence-based therapy over time in the Medicare population (Shroff et al., Arch Internal Med, in press 2012, and Lakshminarayan et al.).

Finally, statins are widely used for secondary prevention in patients with known coronary artery disease, irrespective of CKD stage, a finding borne out in these data. In patients without identified cardiovascular events, the percentage receiving statins increased from 37 to 44 percent in the non-CKD population, and from 45 to 54 percent in those with CKD. » **Figure 4.1;** see page 143 for analytical methods. *December 31, 2005 & 2010 point prevalent Medicare enrollees, age 66 & older, with fee-for-service coverage for the entire calendar year.*

vol 1
4.1 **Cardiovascular disease in patients with or without CKD**



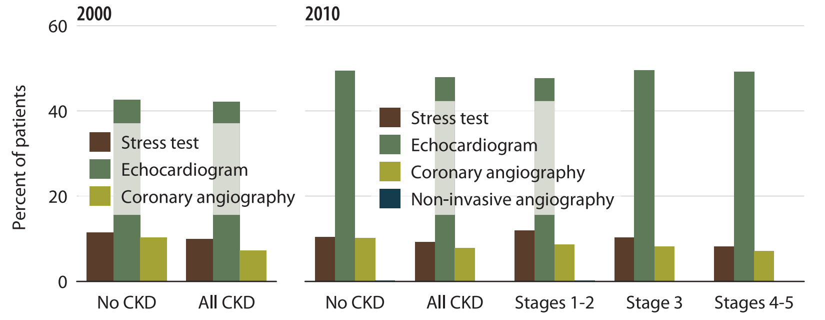
This table provides a snapshot of cardiovascular disease prevalence related to demography and CKD stage. One uniform finding is the progressively increased representation for each cardiovascular condition with respect to advanced CKD stage and age. In the non-CKD population, for example, only 3.6 percent of patients age 66–69 have CHF, compared to 15 percent of those age 85 and older. Among patients with Stage 4–5 CKD, these numbers reach 34 and 48 percent. CHF is a common comorbid condition in elderly patients, particularly among those with advanced CKD.

After CHF, the next most common condition is atrial fibrillation. Four percent of patients age 66–69 and without identified CKD have atrial fibrillation, compared to 17 percent of those age 85 or older. Among patients with Stage 4–5 CKD, in contrast, these numbers rise to 16 and 32 percent. Surprisingly, percentages are lower for black/African American patients compared to whites. **» Table 4.a;** see page 143 for analytical methods. *December 31, 2010 point prevalent Medicare enrollees, age 66 & older.*

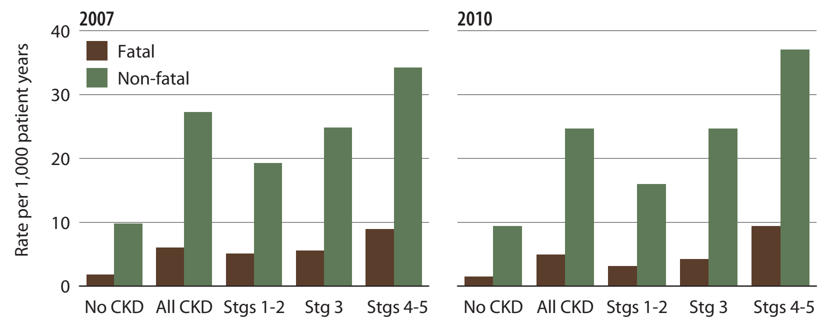
vol 1 **4.a** **Cardiovascular disease & intervention (percent), by CKD stage, age, & race, 2010**

	Overall	60–69	70–74	75–84	85+	White	Blk/Af Am	Other
CHF								
No CKD	7.3	3.6	4.8	8.1	15.0	7.2	8.8	6.0
All CKD	31.8	22.8	25.2	31.5	41.8	31.8	33.2	28.1
Stages 1–2	26.9	20.5	21.1	26.9	38.2	27.1	26.7	25.5
Stage 3	30.7	23.2	24.6	30.3	40.3	30.8	31.7	26.8
Stage 4–5	41.7	33.6	35.9	41.4	48.1	42.1	40.1	39.1
AMI								
No CKD	2.2	1.6	1.9	2.5	3.0	2.3	1.8	1.5
All CKD	9.1	7.9	8.8	9.2	9.9	9.4	8.1	7.7
Stages 1–2	7.8	6.8	7.3	8.2	8.4	8.1	6.1	6.6
Stage 3	8.7	7.7	8.1	8.7	9.9	9.0	7.6	7.1
Stage 4–5	10.4	8.3	11.7	10.4	10.6	10.7	9.6	8.9
PAD								
No CKD	9.3	4.7	6.5	10.6	17.9	9.3	10.4	7.8
All CKD	26.3	20.0	22.8	26.7	31.5	26.6	25.1	22.7
Stages 1–2	22.7	16.2	20.0	23.5	29.5	23.2	21.2	20.6
Stage 3	24.7	18.6	21.7	25.2	29.6	25.2	22.4	21.5
Stage 4–5	28.7	22.2	24.8	29.0	32.8	28.9	29.0	24.9
CVA/TIA								
No CKD	7.7	4.4	6.0	9.3	12.4	7.7	8.8	6.7
All CKD	19.0	14.5	16.2	20.0	21.7	18.8	21.1	17.6
Stages 1–2	17.5	12.5	14.5	18.6	22.8	17.3	19.2	17.7
Stage 3	17.9	14.0	15.0	19.0	20.4	17.9	19.2	16.2
Stage 4–5	19.2	17.1	16.5	19.9	20.5	18.8	22.6	17.3
Atrial fibrillation (AFIB)								
No CKD	9.3	4.1	6.5	11.5	16.9	10.0	4.5	5.1
All CKD	23.0	13.3	17.4	24.1	30.6	24.8	13.3	15.1
Stages 1–2	20.1	12.4	15.7	21.7	27.9	22.0	11.2	12.9
Stage 3	22.7	13.9	17.6	23.3	30.2	24.5	12.5	14.5
Stage 4–5	25.7	15.7	19.5	26.3	31.8	28.2	14.2	18.6
ICDs/CRT-D								
No CKD	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
All CKD	0.6	0.6	0.7	0.7	0.3	0.6	0.5	0.3
Stages 1–2	0.5	0.4	0.6	0.7	0.2	0.5	0.4	0.5
Stage 3	0.6	0.7	0.7	0.7	0.3	0.6	0.6	0.3
Stage 4–5	0.8	1.0	1.0	0.8	0.5	0.8	0.6	0.5
Revascularization (PCI)								
No CKD	0.9	0.9	1.0	0.9	0.5	0.9	0.6	0.6
All CKD	2.5	3.1	3.0	2.8	1.5	2.7	1.8	2.1
Stages 1–2	2.4	3.0	2.8	2.6	1.2	2.5	1.8	2.3
Stage 3	2.5	2.8	2.9	2.7	1.5	2.6	1.6	1.8
Stage 4–5	2.3	3.3	3.0	2.4	1.4	2.4	1.8	2.1
Revascularization CABG)								
No CKD	0.2	0.3	0.3	0.3	0.1	0.3	0.1	0.2
All CKD	0.9	1.3	1.3	1.0	0.4	1.0	0.5	0.8
Stages 1–2	0.9	1.0	1.5	0.9	0.3	1.0	0.7	0.9
Stage 3	1.0	1.3	1.3	1.0	0.4	1.0	0.6	0.8
Stage 4–5	0.6	0.6	1.0	0.7	0.3	0.7	0.2	0.4

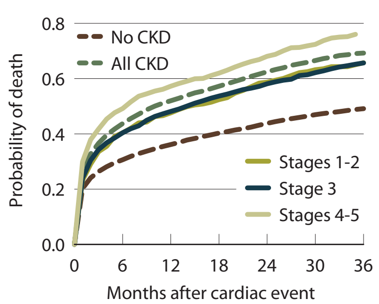
vol 1 **4.2** **Patients with CHF who receive diagnostic testing within 90 days of diagnosis, by CKD status**



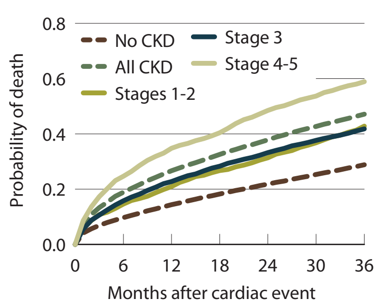
vol 1 **4.3** **Rates of fatal & non-fatal AMI, by CKD status**



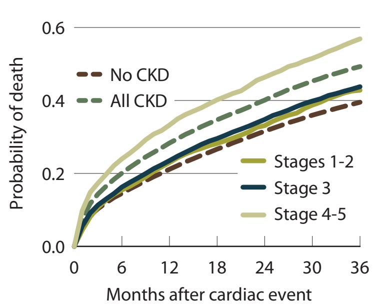
vol 1 **4.4** **Probability of death following an AMI, by CKD status, 2007–2008**



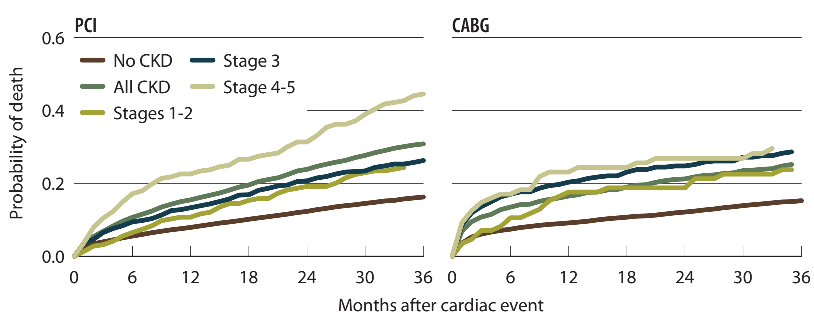
vol 1 **4.5** **Probability of death following a CVA/TIA, by CKD status, 2007–2008**



vol 1 **4.6** **Probability of death following a CHF diagnosis, by CKD status, 2007–2008**



vol 1 **4.7** **Probability of death following a cardiovascular procedure (PCI/CABG), by CKD status, 2007–2008**



There has been little change by CKD status in the percentage of patients receiving stress tests, nor has the use of coronary angiography changed appreciably, despite the recognition of CKD as a risk factor for both coronary events and increased mortality. Data suggest that clinicians have not become materially more aggressive in using angiography to evaluate elderly CKD patients for coronary disease. The use of echocardiography in CKD patients with CHF, in contrast, has grown, from 42 percent in 2000 to 48 percent in 2010.

There is no clear temporal trend in the distribution of fatal and non-fatal myocardial infarctions (MIs), with the possible exception of a small increased rate of non-fatal MIs in patients with advanced CKD (this might reflect the dissemination of more sensitive cardiac biomarkers; most identified MIs are non-fatal). Mortality following MI in patients with advanced CKD, however, remains high, with long-term mortality approaching that reported in dialysis patients.

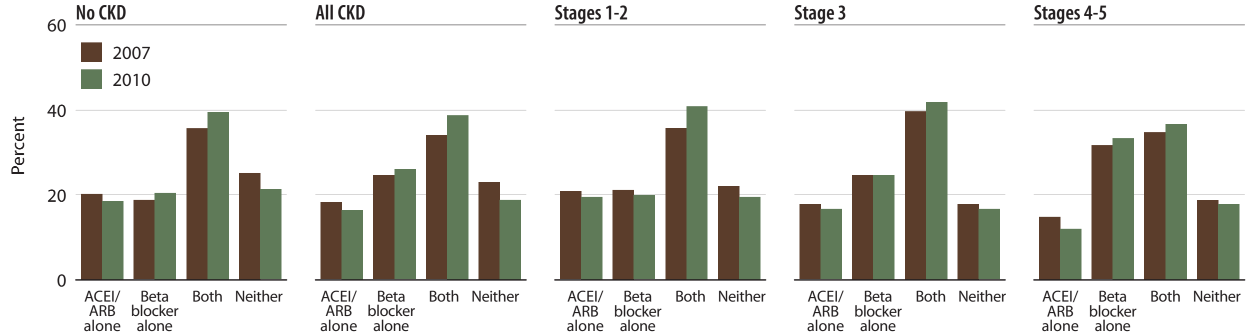
There is a graded increased risk of mortality with advancing CKD; the two-year mortality rate after MI, for example, at 44 percent in patients with no CKD, rises to 58 and 68 percent for those with Stage 3 and 4–5 CKD. Similar trends occur for death following CVA/TIA, CHF diagnosis, and coronary revascularization. Although the probability of death is lower in patients with advanced CKD who have CABG surgery compared to PCI, these are observational data and there may be confounding by indication. » **Figures 4.2–7;** see page 143 for analytical methods. *Jan. 1 pt. prev. Medicare pts. age 66 & older; first CHF diag. in 2000 or 2010 (4.2); first CVD diagnosis or procedure in 2007–2008 (4.4–7).*

vol 1 **4.b** **Cardiovascular disease & pharmacological interventions (row percent), by diagnosis & CKD stage**

	2007 N	ACEI/ARB	Beta blocker	Clopidogrel	Warfarin	Statin	Amiodarone	2010 N	ACEI/ARB	Beta blocker	Clopidogrel	Warfarin	Statin	Amiodarone
CHF														
No CKD	59,922	53.8	52.2	14.2	21.2	36.9	4.6	50,894	57.2	60.3	16.0	24.3	46.6	5.2
All CKD	12,611	47.4	56.4	18.3	19.0	38.9	5.7	16,348	52.2	66.4	20.3	23.2	50.8	7.7
Stages 1–2	650	50.5	54.2	19.2	18.9	39.5	3.8	666	57.1	64.3	21.3	19.2	50.6	7.5
Stage 3	2,274	52.6	60.6	19.6	19.7	45.8	5.9	4,505	55.0	68.2	21.4	24.8	55.0	8.0
Stages 4–5	2,129	42.4	62.0	19.7	16.8	41.2	6.1	3,316	44.4	69.9	21.4	21.3	52.8	8.8
AMI														
No CKD	4,078	64.7	74.5	49.4	13.7	59.5	6.5	3,491	65.5	77.4	50.5	14.4	66.8	6.7
All CKD	800	55.5	74.3	44.1	14.5	57.6	4.4	964	57.3	78.0	46.2	17.0	63.7	7.5
Stages 1–2	38	65.8	86.8	44.7	21.1	65.8	2.6	37	54.1	83.8	40.5	10.8	62.2	5.4
Stage 3	144	56.3	76.4	48.6	14.6	63.2	4.9	268	56.7	77.2	48.9	17.9	65.3	6.0
Stages 4–5	149	42.3	80.5	40.9	15.4	52.3	3.4	189	46.0	78.8	51.3	13.2	69.8	5.8
PAD														
No CKD	65,809	44.8	39.3	15.1	11.7	36.6	1.9	60,263	48.4	44.2	16.9	12.4	46.3	2.0
All CKD	9,938	47.3	52.2	20.9	15.1	40.8	4.3	12,988	51.1	57.8	22.8	16.8	51.9	4.7
Stages 1–2	538	52.0	51.9	22.1	14.7	41.3	4.1	625	55.4	56.6	24.6	14.9	55.0	4.3
Stage 3	1,855	53.1	54.3	22.8	15.0	49.7	4.6	3,646	54.9	60.6	25.0	17.6	56.6	4.8
Stages 4–5	1,555	44.8	59.0	21.0	13.0	45.2	5.0	2,289	45.0	64.1	23.9	16.0	56.5	6.2
CVA/TIA														
No CKD	48,437	46.9	40.8	21.4	14.0	41.8	1.9	40,372	51.2	45.4	23.1	14.8	53.5	2.1
All CKD	6,378	49.4	53.0	26.5	15.9	43.3	3.9	7,671	52.7	58.3	26.3	19.3	54.6	4.3
Stages 1–2	317	50.5	53.6	28.1	13.9	42.6	3.8	361	58.2	59.8	26.0	15.5	54.8	3.3
Stage 3	1,164	51.7	56.6	26.7	17.1	50.2	4.9	2,207	54.6	59.6	28.0	20.2	58.4	4.3
Stages 4–5	912	46.7	59.4	28.3	14.0	47.4	4.2	1,232	46.3	64.6	26.7	18.7	57.2	6.2
AFIB														
No CKD	53,590	44.7	50.4	9.0	47.5	33.1	7.8	54,002	50.2	60.4	9.6	56.2	46.1	8.5
All CKD	7,245	45.0	54.9	13.9	40.2	35.5	10.5	10,917	50.6	66.5	14.2	49.4	50.4	12.9
Stages 1–2	372	50.5	55.1	13.2	43.0	34.1	8.1	498	54.2	66.1	16.5	45.6	52.6	12.4
Stage 3	1,269	48.7	55.9	14.3	44.6	40.3	12.4	3,117	52.8	67.3	14.2	52.6	54.1	14.3
Stages 4–5	1,094	43.2	59.0	14.3	38.4	37.8	12.7	1,888	44.2	68.9	15.7	48.0	53.0	15.5
ICD/CRT-D														
No CKD	654	74.8	80.3	25.1	30.9	57.2	15.9	455	79.8	84.6	31.9	36.0	65.1	20.2
All CKD	241	65.1	82.2	28.2	32.8	53.5	18.7	179	64.8	88.3	31.3	43.6	60.9	21.2
Stages 1–2	7	42.9	71.4	42.9	57.1	42.9	14.3	5	100.0	100.0	40.0	20.0	40.0	0.0
Stage 3	54	66.7	83.3	29.6	38.9	51.9	18.5	61	59.0	93.4	31.1	39.3	59.0	16.4
Stages 4–5	41	53.7	73.2	31.7	29.3	58.5	17.1	36	47.2	86.1	33.3	44.4	63.9	19.4
Revascularization: PCI														
No CKD	4,695	64.7	73.5	89.3	10.3	72.2	4.0	4,319	66.1	75.3	87.0	10.7	76.1	3.7
All CKD	530	59.1	77.7	87.2	12.5	66.6	5.1	728	67.2	80.2	84.1	14.3	71.0	6.0
Stages 1–2	32	53.1	78.1	93.8	9.4	81.3	0.0	33	75.8	81.8	90.9	6.1	81.8	0.0
Stage 3	127	57.5	74.0	85.0	15.0	62.2	3.1	229	65.5	76.9	83.4	13.5	67.7	5.2
Stages 4–5	71	60.6	76.1	88.7	12.7	59.2	8.5	107	50.5	77.6	88.8	13.1	76.6	4.7
Revascularization: CABG														
No CKD	1,299	62.2	83.4	31.6	18.2	72.6	26.8	1,000	64.0	86.6	32.4	21.2	82.6	33.6
All CKD	129	63.6	82.9	32.6	27.9	67.4	29.5	139	56.8	85.6	36.7	17.3	77.7	23.7
Stages 1–2	12	75.0	91.7	41.7	33.3	66.7	33.3	8	37.5	62.5	25.0	0.0	87.5	37.5
Stage 3	29	79.3	82.8	44.8	24.1	69.0	27.6	51	56.9	88.2	41.2	17.6	80.4	25.5
Stages 4–5	15	53.3	80.0	20.0	33.3	86.7	33.3	18	33.3	88.9	38.9	11.1	83.3	16.7
No cardiac event														
No CKD	360,270	41.1	27.7	4.3	2.3	37.0	0.2	377,558	44.5	30.0	5.3	2.4	44.1	0.2
All CKD	13,360	59.5	43.8	7.5	4.5	45.4	0.5	22,513	62.5	47.3	8.8	5.0	53.9	0.6
Stage 1-2	791	65.5	45.3	8.1	3.3	52.1	0.3	1,254	65.9	45.1	8.1	4.6	58.0	0.2
Stage 3	3,133	69.3	48.1	8.1	3.8	53.6	0.5	7,572	69.2	49.9	9.2	4.3	60.1	0.6
Stage 4-5	2,253	60.1	53.5	8.4	3.8	48.3	1.0	3,555	60.6	57.8	10.1	5.1	55.6	1.0

» **Table 4.b;** see page 143 for analytical methods. *January 1 point prevalent Medicare patients with Medicare Parts A, B, & D enrollment.*

vol 1
4.8
Utilization of cardiac drugs, by drug class & CKD status, 2010



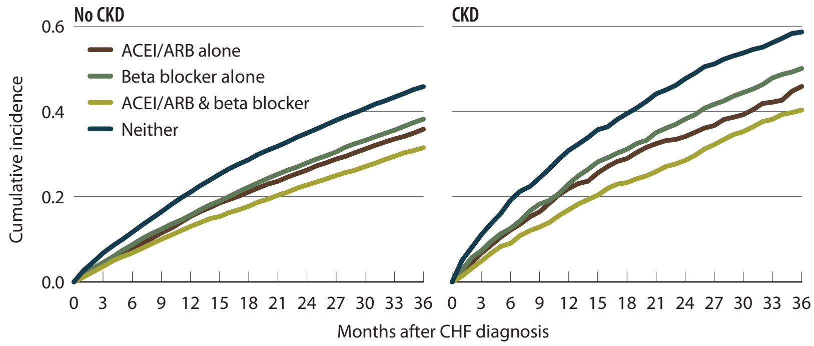
Even in a short, three-year time period, the use of beta blockers has increased. Importantly, the number of patients receiving neither an ACEI/ARB nor a beta-blocker fell between 2007 and 2010.

Figures 4.9–10 demonstrate the apparent protective association, with respect to CKD, of combined ACEI/ARB therapy in patients with CHF and following MI. Although these are observational data (which should be interpreted with caution), it is interesting that results are concordant with clinical trial data on the use of ACEIs/ARBs and beta blockers in CHF and post-MI populations.

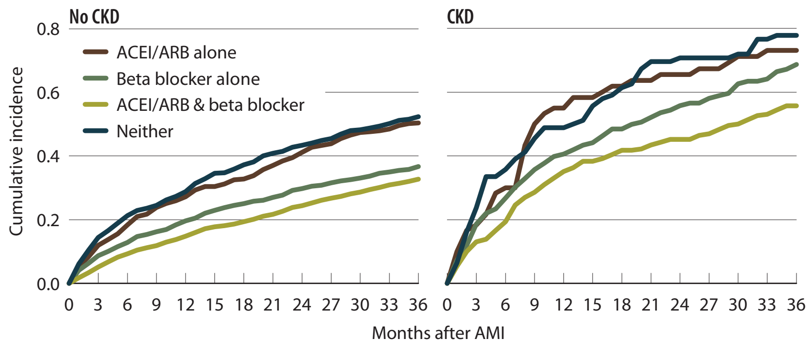
The cumulative incidence of death reported in these figures, and the relationship to the use of ACEIs/ARBs and beta blockers, are remarkably similar to what is shown in parallel figures in Chapter Four of Volume Two, with the main difference being the higher overall mortality in ESRD patients with these conditions and the smaller absolute difference in survival related to the individual therapies. The overall patterns, however, are similar, suggesting therapeutic benefit across all stages of CKD, including ESRD.

Although the figures in Volume Two pertain to ESRD rather than dialysis, their data are indicative of dialysis outcomes, as 92 and 94 percent of CHF and MI events, respectively, are among dialysis patients. The relative contribution of renal transplant recipients to these data is actually very small. **» Figures 4.8–10;** see page 143 for analytical methods. *January 1 point prevalent patients with Medicare Parts A, B, & D enrollment, with a first diagnosis of CHF or MI in the year; patients with baseline disease are excluded.*

vol 1
4.9
Cumulative incidence of death following a diagnosis of CHF, by CKD stage & medication use, 2007



vol 1
4.10
Cumulative incidence of death following a diagnosis of AMI, by CKD stage & medication use, 2007



PRESENCE OF CARDIOVASCULAR DISEASE

patients with cardiovascular disease (percent; Figure 4.1)

	CHF	CVA/TIA	AMI
CKD: 2005	49.8	26.0	15.2
CKD: 2010	43.6	26.0	12.5
no CKD: 2005	22.0	20.2	6.9
no CKD: 2010	19.1	20.3	5.8

CARDIOVASCULAR MORTALITY

probability of death at two years following AMI, 2007–2008 (Figure 4.4)

» no CKD · 0.44 » all CKD · 0.63 » Stages 1–2 · 0.59 » Stage 3 · 0.58 » Stages 4–5 · 0.68

probability of death at two years following CVA/TIA, 2007–2008 (Figure 4.5)

» no CKD · 0.22 » all CKD · 0.38 » Stages 1–2 · 0.31 » Stage 3 · 0.33 » Stages 4–5 · 0.49

probability of death at two years following a CHF diagnosis, 2007–2008 (Figure 4.6)

» no CKD · 0.32 » all CKD · 0.40 » Stages 1–2 · 0.33 » Stage 3 · 0.35 » Stages 4–5 · 0.46

probability of death at two years following PCI, 2007–2008 (Figure 4.7)

» no CKD · 0.12 » all CKD · 0.24 » Stages 1–2 · 0.19 » Stage 3 · 0.21 » Stages 4–5 · 0.31

probability of death at two years following CABG, 2007–2008 (Figure 4.7)

» no CKD · 0.12 » all CKD · 0.21 » Stages 1–2 · 0.19 » Stage 3 · 0.25 » Stages 4–5 · 0.27

MEDICATION USE & SURVIVAL IN PATIENTS WITH CVD

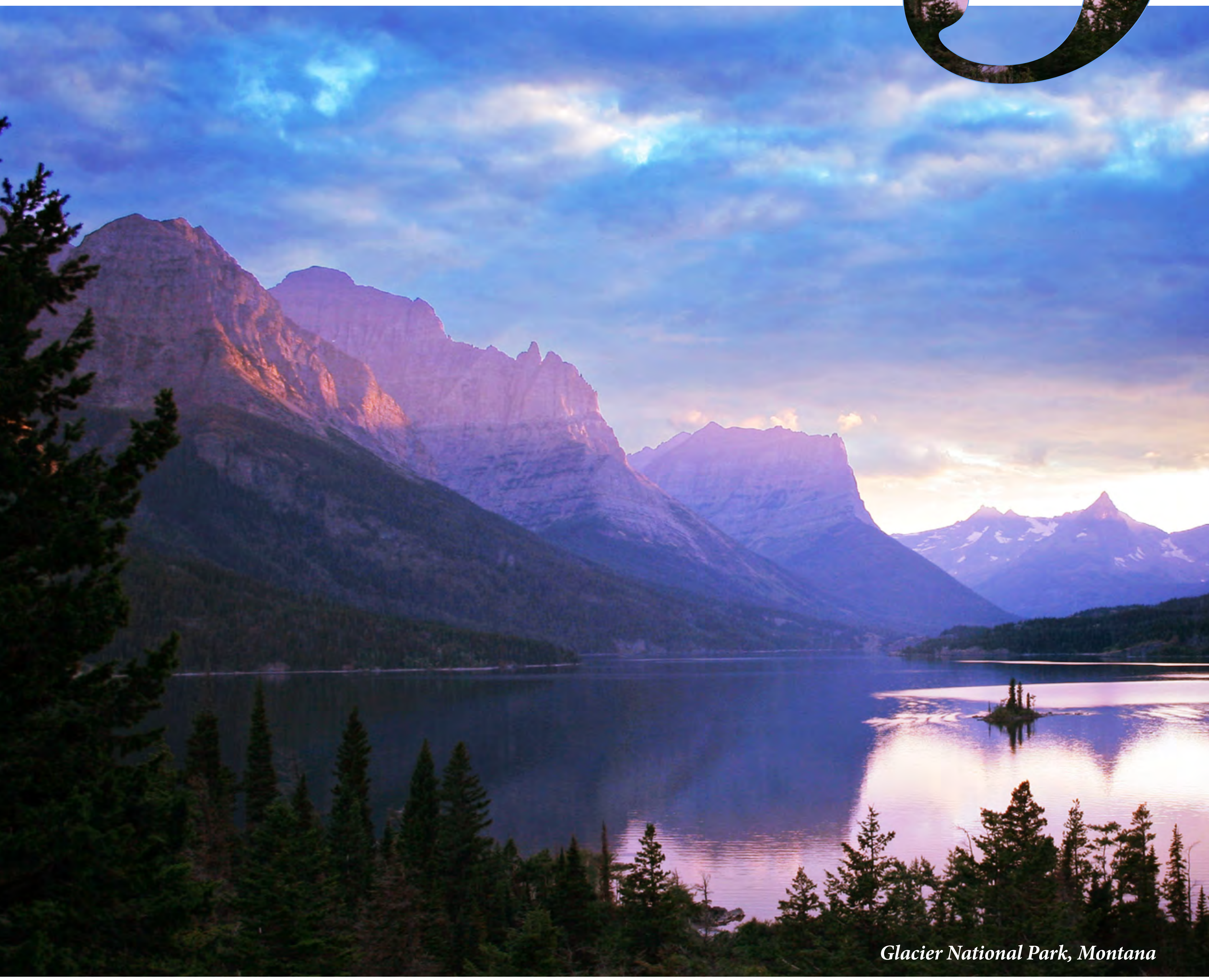
cumulative incidence of death at two years following a diagnosis of CHF (Figure 4.9)

	ACE/ARB	beta blocker	both	neither
no CKD	0.26	0.28	0.23	0.35
CKD	0.34	0.38	0.29	0.48

cumulative incidence of death at two years following a diagnosis of AMI (Figure 4.10)

	ACE/ARB	beta blocker	both	neither
no CKD	0.41	0.30	0.24	0.43
CKD	0.66	0.56	0.45	0.71

5



Glacier National Park, Montana

PART D PRESCRIPTION DRUG COVERAGE IN PATIENTS WITH CKD

Of all the questions which can come before this nation, short of the actual preservation of its existence in a great war, there is none which compares in importance with the great central task of leaving this land even a better land for our descendants than it is for us, and training them into a better race to inhabit the land and pass it on. Conservation is a great moral issue, for it involves the patriotic duty of insuring the safety and continuance of the nation.

THEODORE ROOSEVELT,
"The New Nationalism" speech

In December 2010, over 28 million Medicare-enrolled elderly and disabled people, as well as individuals with ESRD, were enrolled in a Medicare Part D prescription drug plan (PDP). Before 2006, these patients obtained drug coverage through various insurance plans, state Medicaid programs, or pharmaceutical assistance programs, received samples from physicians, or paid out-of-pocket. After 2006, however, the majority obtained Part D coverage. Sixty percent of general Medicare patients, and 58 and 69 percent of CKD and ESRD patients, were enrolled in Part D in 2010.

Part D benefits can be managed through a stand-alone PDP or through a Medicare Advantage (MA) plan, which provides medical as well as prescription benefits. CKD patients can choose to enroll in an MA plan; ESRD patients, in contrast, are precluded from entering an MA plan if they are not already enrolled in one when they reach ESRD. Most data presented in this chapter encompass both types of plans.

Medicare-enrolled CKD patients obtain outpatient medication benefits through Part B, Part D, retiree drug subsidy plans, or other creditable coverage (equivalent to or better than Part D), including employer group health plans, Veterans Administration benefits, Medicaid wrap-around programs, and state kidney programs. Some also pay out-of-pocket for plan expenses and copayments, over-the-counter medications, and low-cost generic agents at retailers.

The percentage of CKD patients with creditable coverage increased from 12.5 to 13.2 percent between 2008 and 2010. The proportion of patients with other creditable coverage is slightly higher among CKD than general Medicare patients (at 13.2 versus 12.6 percent), but a higher proportion of CKD patients have retiree drug subsidy coverage, at 21 compared to 14 percent. The percentage of CKD patients with no known coverage fell from 8.8 to 7.8 between 2008 and 2010, reaching a level lower than the 12.6 percent seen in the general Medicare population.

Part D does not cover every medication prescribed to Medicare enrollees. Several drug categories — including over-the-counter medications, barbiturates, benzodiazepines, anorexia and weight loss or gain medications, prescription vitamins (except for prenatal vitamins), and cough and cold medications — are excluded from the Part D program by law. This means that some drugs commonly used in CKD patients (oral iron, ergocalciferol, cholecalciferol) are not currently covered through Medicare Part D. Oral calcitriol, doxercalciferol, and paricalcitol, however, are not considered prescription vitamins, and are thus covered.

Prior to the start of the Medicare Part D program in 2006, patients dually-enrolled in Medicare and Medicaid received prescription benefits under state Medicaid programs. The Part D program, however, offers a substantial low-income subsidy (LIS) benefit to enrollees with limited assets and income, including those who are dually-enrolled. The LIS provides full or partial waivers for many out-of-pocket cost-sharing requirements, including premiums, deductibles, and copayments, and provides full or partial coverage during the coverage gap ("donut hole"). Fifty percent of CKD patients enrolled in Part D have LIS, compared with only 37 percent of general Medicare patients and 70 percent of ESRD patients. Eighty-six percent of Asian patients with CKD have LIS, compared to

Terms used in the Part D analyses can be found at the end of this chapter, on page 96.

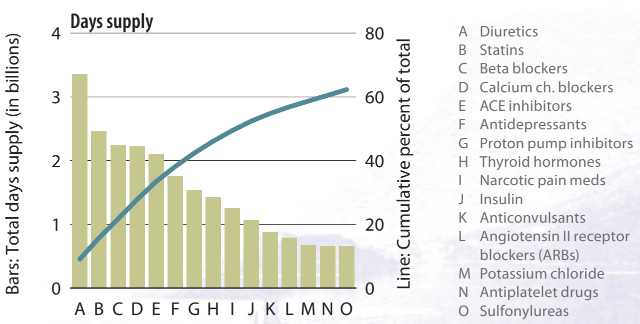
79 percent of blacks/African Americans and 41 percent of whites. In general, CKD patients thus pay proportionally lower out-of-pocket costs than general Medicare patients for their Part D prescriptions. CKD patients enrolled in Part D and without LIS, however, pay higher premiums for their plans than do general Medicare or ESRD patients.

The net Part D payment for identified CKD patients rose from $2.9 billion in 2007 to $4.5 billion in 2010 — a 56 percent growth, as compared to a 25 percent increase for general Medicare patients. This can be at least partially explained by increased identification of CKD; recognized CKD prevalence has increased 37 percent since 2007.

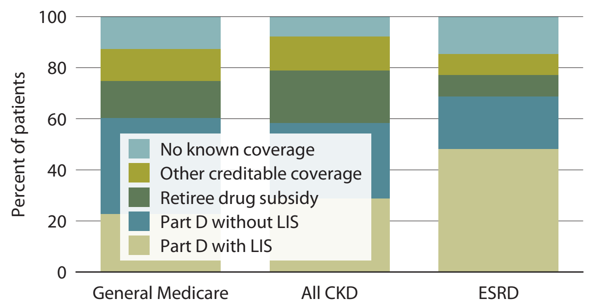
Out-of-pocket (OOP) Part D costs for CKD patients are higher than for general Medicare patients, at $738 versus $478 per person per year (PPPY). This reflects a greater mean number of Part D prescriptions for CKD patients. CKD patient OOP costs relative to total Part D costs, however, are proportionally lower than those in the general Medicare population; a higher percentage of CKD patients enrolled in Part D have the LIS, which lessens their OOP costs. Non-LIS CKD patients pay over $700 more per year for Part D prescriptions than do their non-LIS counterparts in the general Medicare population. Accordingly, a higher percentage of non-LIS CKD patients reach the coverage gap (37 versus 19 percent) and the catastrophic coverage phase (7 versus 2 percent).

As measured by total days supply, statins represented 7.3% of Part D drug use among CKD patients but 4.9% of their Part D costs- the same relative proportion seen in general Medicare patients, where represented 9.1% of Part D drug use and 5.7% of the costs. Of the top 15 drug classes used by CKD patients, cardiovascular therapies (statins, angiotensin-converting enzyme inhibitors, angiotensin II receptor blockers, diuretics, calcium channel blockers and beta blockers) are the most common both by frequency of use. **» Figure 5.1;** see page 145 for analytical methods. *Part D claims for all patients in the Medicare 5 percent sample; claims & costs scaled up by a factor of 20 to estimate totals. Costs are the sum of Medicare payment & low income subsidy. Therapeutic classifications based on Medi-span's generic product identifier (GPI) therapeutic classification system.*

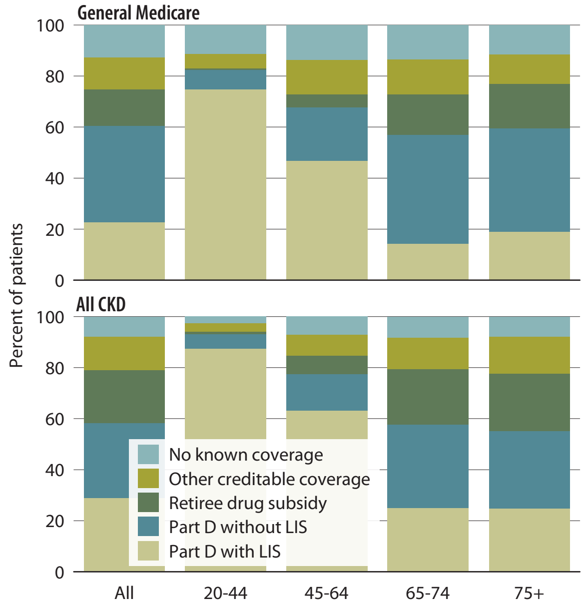
vol 1 5.1 **Top 15 drug classes used by general Medicare Part D enrollees with CKD, by days supply, 2010**



vol 1 **5.2** **Sources of prescription drug coverage in Medicare enrollees, by population, 2010**



vol 1 **5.3** **Sources of prescription drug coverage in Medicare enrollees, by age, 2010**



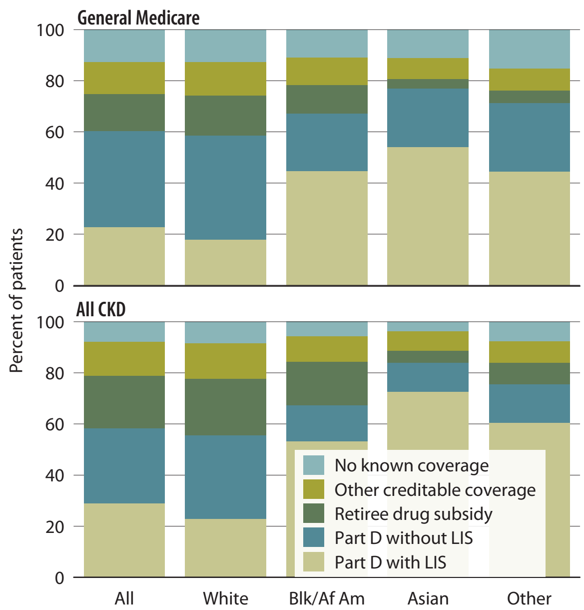
Sixty percent of general Medicare patients, and 58 percent of patients with CKD, were enrolled in Part D in 2010, as were 69 percent of patients with ESRD. The proportion of patients with other creditable coverage is similar among CKD and Medicare patients, at about 13 percent, but a higher proportion of CKD patients have retiree drug subsidy coverage, at 21 compared to 14 percent. Eight percent of CKD patients have no known source of drug coverage — a level lower than the 13 percent seen in the general Medicare population.

Among both general Medicare beneficiaries and those with CKD, the percentage enrolled in Part D generally declines with age, although, in the general Medicare population, it is higher among those age 75 and older than for those age 65–75.

Nearly 75 percent of general Medicare patients age 20–44 receive the low income subsidy (LIS). It is important to note that most patients in the younger two age groups are disabled. In the two older age groups, similar proportions of general Medicare and CKD patients are enrolled in Part D, at 55–60 percent. The proportion of patients with LIS declines with age in both populations (with the exception of those age 75 and older in the general Medicare population), but CKD patients in each age category are more likely to receive this subsidy.

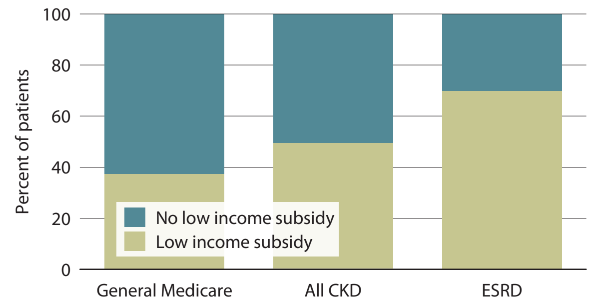
Patterns of coverage by race are similar in the general Medicare and CKD populations, with both Part D enrollment overall and Part D coverage with LIS highest in Asian patients, and lowest in whites. LIS coverage is higher across races for CKD patients than among their general Medicare counterparts **» Figures 5.2–4;** see page 145 for analytical methods. *Point prevalent Medicare enrollees alive on January 1, 2010.*

vol 1 **5.4** **Sources of prescription drug coverage in Medicare enrollees, by race, 2010**



Part D enrollment patterns in patients with CKD

vol 1
5.5 **Part D enrollees, by low income subsidy (LIS) status & population, 2010**

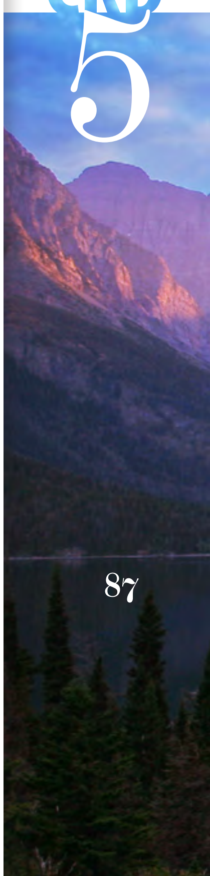


vol 2
5.a **Percent of Part D enrollees with low income subsidy (LIS), by age & race, 2010**

	General Medicare		All CKD	
	Part D w/LIS	Part D wo/LIS	Part D w/LIS	Part D wo/LIS
White				
All ages	30.6	69.4	41.2	58.8
20-44	90.0	10.0	93.5	6.5
45-64	65.3	34.7	78.4	21.7
65-74	18.8	81.3	34.7	65.3
75+	25.4	74.6	36.8	63.2
Black/Af Am				
All ages	66.6	33.4	78.9	21.1
20-44	93.7	6.4	95.5	4.5
45-64	81.6	18.4	87.7	12.3
65-74	51.8	48.2	72.7	27.4
75+	61.4	38.6	77.5	22.5
Asian				
All ages	70.5	29.6	86.5	13.5
20-44	91.6	8.4	93.8	6.3
45-64	74.9	25.1	85.7	14.3
65-74	65.3	34.8	86.7	13.3
75+	73.4	26.6	86.3	13.7
Other				
All ages	62.4	37.6	79.9	20.1
20-44	87.3	12.7	93.2	6.8
45-64	71.4	28.6	86.0	14.0
65-74	54.7	45.3	75.3	24.7
75+	61.0	39.0	80.0	20.0

Fifty percent of CKD patients with Part D coverage had LIS benefits in 2010, compared to 70 percent of dialysis patients. A higher proportion of CKD patients are thus at risk to experience the coverage gap and to have higher premiums, deductibles, and drug copayments, on average, than dialysis patients. **» Figure 5.5;** see page 145 for analytical methods. *Point prevalent Medicare enrollees alive on January 1, 2010.*

Among both general Medicare beneficiaries and those with CKD, and in each race category, the proportion of patients with LIS generally declines with age, though it is greater for patients age 75 and older than for those age 65–74. In each age group within each race category, patients with known CKD are more likely to have LIS than their general Medicare counterparts. And in both the general Medicare and CKD populations, Asians are the most likely by race to have LIS, and whites the least. **» Table 5.a;** see page 145 for analytical methods. *Point prevalent Medicare enrollees alive on January 1, 2010.*



CMS provides prescription drug plans (PDPs) with guidance on structuring a “standard” Part D PDP. The upper portion of Table 5.b shows the standard benefit design for PDPs in the years 2006 through 2010. In 2010, for example, beneficiaries shared costs with the PDP (as co-insurance or copayments) until the combined total reached $2,830 during the initial coverage period. After reaching this level, beneficiaries went into the coverage gap, or “donut hole,” where they paid 100 percent of costs. Since 2010, the government has been providing those reaching the coverage gap with more assistance each year; they received a $250 rebate in 2010 and a 50 percent brand discount in both 2011 and 2012.

In 2010, beneficiaries who obtained a yearly out-of pocket drug cost of $4,550 reached the catastrophic coverage phase, in which they paid only a small copayment for their drugs until the end of the year.

PDPs have the latitude to structure their plans differently from what is presented here; companies offering non-standard plans must show that their coverage is at least actuarially equivalent to the standard plan. Many have developed plans with no deductibles or with drug copayments instead of the 25 percent co-insurance, and some plans provide generic and/or brand name drug coverage during the coverage gap. » **Table 5.b**. *http://www.q1medicare.com/PartD-The-2010-Medicare-Part-D-Outlook.php.*

vol 1 **5.b** **Medicare Part D benefit parameters for defined standard benefit, 2006–2010**

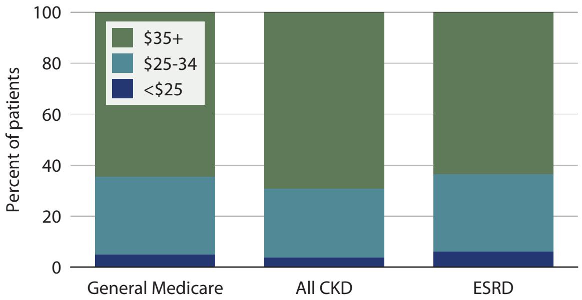
	2006	2007	2008	2009	2010
Deductible After the deductible is met, beneficiary pays 25% of covered costs up to total prescription costs meeting the initial coverage limit.	$250	$265	$275	$295	$310
Initial coverage limit Coverage gap (donut hole) begins at this point. (The beneficiary pays 100% of prescription costs up to the out-of-pocket threshold.)	$2,250	$2,400	$2,510	$2,700	$2,830
Total covered Part D drug out-of-pocket spending including the coverage gap Catastrophic coverage starts after this point.	$5,100.00	$5,451,25	$5,726.25	$6,153.75	$6,440.00 plus a $250 rebate
Out-of-pocket threshold This is the total out-of-pocket costs including the donut hole.	$3,600	$3,850	$4,050	$4,350	$4,550
2010 example					
$310 (deductible)	$250.00	$265.00	$275.00	$295.00	$310.00
+ (($2,830 – $310) * 25%) (initial coverage)	$500.00	$533.75	$558.75	$601.25	$630.00
+ (($6,440 – $2,830) * 100%) (coverage gap)	$2,850.00	$3,051.25	$3,216.25	$3,453.75	$3,610.00
= $4,500 (maximum out-of-pocket costs prior to catastrophic coverage, excluding plan premium)	$3,600.00	$3,850.00	$4,050.00	$4,350.00	$4,550.00
Catastrophic coverage benefit					
Generic/preferred multi-source drug	$2.00	$2.15	$2.25	$2.40	$2.50
Other drugs	$5.00	$5.35	$5.60	$6.00	$6.30

Among general Medicare beneficiaries, those with CKD, and those with ESRD, enrollment in Medicare Part D rose between 2006 and 2010. In each of the first two years of Part D, enrollment was slightly higher for those with CKD than in the general Medicare population. In 2008–2010, however, the reverse was true. And in each year since the inception of Part D, enrollment has been greatest for patients with ESRD. » **Table 5.c;** see page 145 for analytical methods. *Point prevalent Medicare enrollees alive on January 1, excluding those in Medicare Advantage Part D plans.*

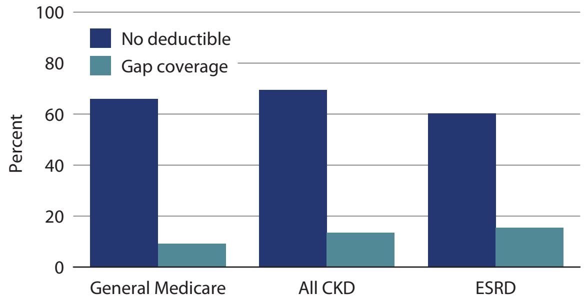
vol 2 **5.c** **Prevalent general Medicare, CKD, & ESRD patients enrolled in Part D (%)**

	General Medicare	All CKD	ESRD
2006	54.6	55.1	62.6
2007	57.0	57.2	65.5
2008	58.6	57.7	67.0
2009	59.8	58.2	68.0
2010	60.4	58.4	68.9

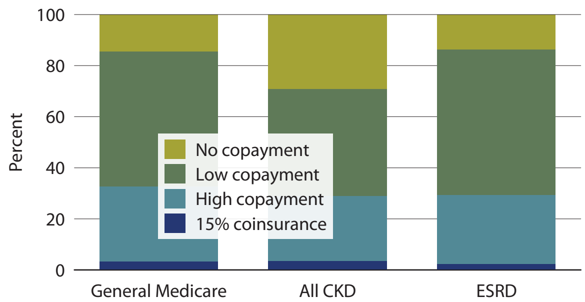
vol 1 5.6 **Part D non-LIS enrollees with specified monthly premium, 2010**



vol 1 5.7 **Part D non-LIS enrollees with gap coverage or no deductible, 2010**



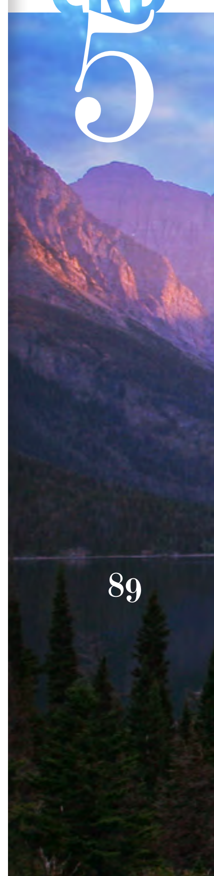
vol 1 5.8 **Part D LIS enrollees with specified co-insurance/copayment, 2010**



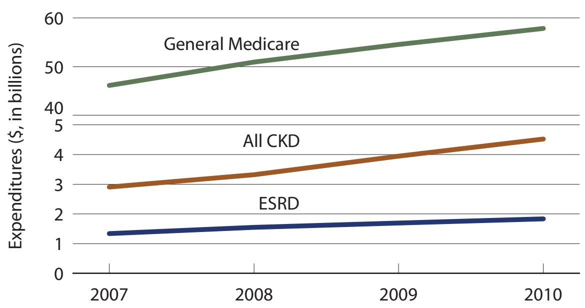
Patients without the low income subsidy (LIS) pay full monthly premiums. Between 2006 and 2010, the weighted average premium for Medicare Part D stand-alone prescription drug plans (PDPs) increased from $25.93 to $37.25 (facts.kff.org). In 2010, 69 percent of CKD patients were enrolled in plans with premiums greater than $35 per month, compared to 65 percent of Medicare patients.

The percentage of Part D non-LIS enrollees with no deductible is similar in the general Medicare and CKD populations, at 66–69, and has declined since 2008 (2011 USRDS ADR). Gap ("donut hole") coverage, in contrast, is more common in CKD patients, at 13 compared to 9 percent. Sixteen percent of ESRD patients in 2010 were enrolled in plans with gap coverage. In 2010, most PDPs (80 percent) did not offer gap coverage (http://www.kff.org/medicare/8008.cfm).

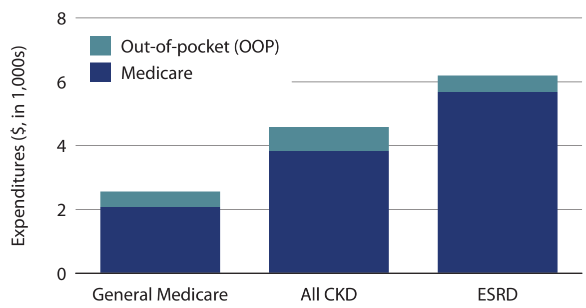
Most Part D LIS enrollees (full-benefit dual-eligible patients) pay no monthly premium, but non-institutionalized LIS patients do pay drug copayments or co-insurance based on income and assets. Seventy one percent of CKD patients with LIS have low or no copayments for their Part D medications, compared to 67 percent of general Medicare patients. Only 3–4 percent pay 15 percent co-insurance for their medications. And even CKD patients with high copayments (25 percent, on average, in 2010) paid a maximum of just $2.50 per generic and $6.30 for branded medications. » **Figures 5.6–8;** see page 145 for analytical methods. *Point prevalent Medicare enrollees alive on January 1, excluding those in Medicare Advantage Part D plans.*



vol 1 **5.9** **Net Part D payment for Medicare enrollees**



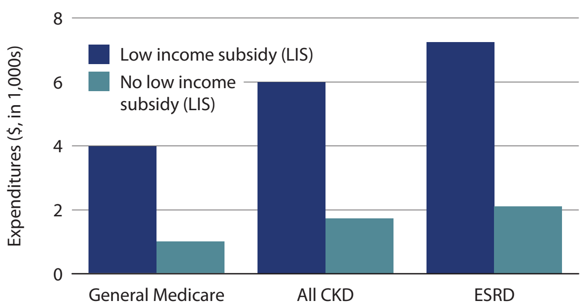
vol 1 **5.10** **Per person per year Medicare & out-of-pocket Part D costs for enrollees, 2010**



In 2010, total net Part D payment for patients with identified kidney disease (CKD patients not on dialysis, and ESRD patients) was $6.4 billion — about 10 percent of total Part D prescription drug costs. These costs do not include costs of drugs billed to Part B, including intradialytic medications (ESAs, IV vitamin D, iron) and immunosuppressants. **» Figure 5.9;** see page 145 for analytical methods. *General Medicare totals include Part D claims for all patients in the Medicare 5 percent sample enrolled in Part D. CKD total includes Medicare CKD patients, as determined from claims. ESRD totals include all Part D claims for Medicare ESRD patients enrolled in Part D.*

At $4,580, the per person per year (PPPY) total cost of medications covered by Medicare Part D in 2010 was 1.8 times higher in CKD patients than in the general Medicare population. Proportional to total Part D costs, however, out-of-pocket costs were lower in CKD patients, representing 16 percent of their PPPY costs compared to 19 percent for the general Medicare population. **» Figure 5.10;** see page 145 for analytical methods. *General Medicare totals include Part D claims for all patients in the Medicare 5 percent sample enrolled in Part D. CKD totals includes Medicare CKD patients, as determined from claims. ESRD totals include all Part D claims for Medicare ESRD patients enrolled in Part D. Medicare total is the sum of Medicare net payment plus LIS amount.*

vol 1
5.11
Per person per year Part D costs for enrollees, by low income subsidy (LIS) status, 2010

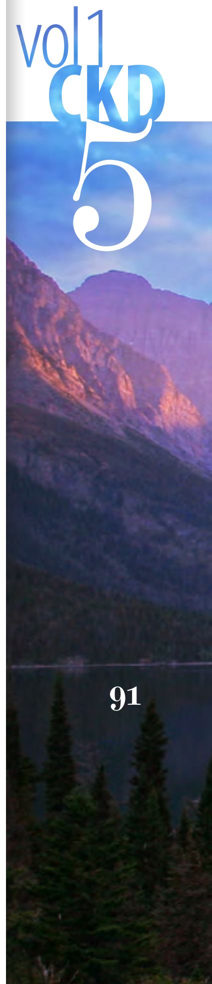


vol 1
5.d
Total per person per year (PPPY) costs ($) for Part D enrollees, by LIS status, 2010

	General Medicare		All CKD		ESRD	
	LIS	No LIS	LIS	No LIS	LIS	No LIS
All	3,985	1,010	5,997	1,733	7,243	2,114
20-44	4,296	1,284	8,182	1,324	7,153	1,634
45-64	5,148	1,292	8,069	2,652	7,782	2,148
65-74	3,301	924	6,033	1,830	6,909	2,267
75+	3,392	1,046	4,990	1,620	6,019	1,978
Male	3,956	1,001	6,146	1,757	7,277	2,210
Female	4,003	1,016	5,912	1,711	7,211	2,050
White	3,375	864	6,234	1,746	7,248	2,203
Black/Af Am	4,236	1,026	5,395	1,514	7,270	1,853
Other race	3,625	879	5,884	1,753	7,057	2,001

Per person per year (PPPY) total costs for Part D-covered medications in 2010 were 3.3–3.9 times greater for patients with the LIS than for those without. Costs in LIS and non-LIS patients vary from $3,985 and $1,010 PPPY, respectively, in the general Medicare population to $5,997 and $1,733 among patients with CKD, and to $7,243 and $2,114 among those with ESRD. » **Figure 5.11;** see page 145 for analytical methods. *Medicare patients surviving 2010. General Medicare totals include Part D claims for all patients in the Medicare 5 percent sample enrolled in Part D. CKD total includes Medicare CKD patients, as determined from claims. ESRD totals include all Part D claims for Medicare ESRD patients enrolled in Part D.*

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, at $7,243 and $2,114, respectively, followed by CKD ($5,997 and $1,733) and general Medicare ($3,985 and $1,010) patients. By race, and regardless of LIS status, PPPY costs in the general Medicare population are highest for blacks/African Americans, and in the CKD population are highest for whites. » **Table 5.d;** see page 145 for analytical methods. *All Medicare patients enrolled in Part D in 2010. CKD determined from claims. ESRD patients are period prevalent ESRD in 2010.*

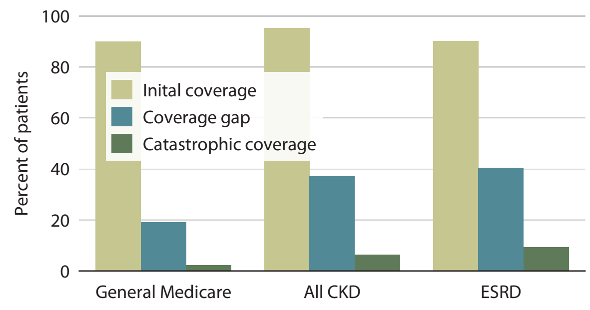


Part D enrollees without the low income subsidy (LIS) may encounter three coverage phases, depending on total and out-of-pocket costs per year. In 2010, patients with total Part D drug costs up to $2,830 fell into the initial coverage phase, while those with costs over that amount entered the coverage gap ("donut hole"), in which they were responsible for 100 percent of drug costs minus the $250 rebate given in 2010. Patients whose out-of-pocket total reached $4,550 then entered the catastrophic coverage phase, in which they paid only a fraction of overall drug costs.

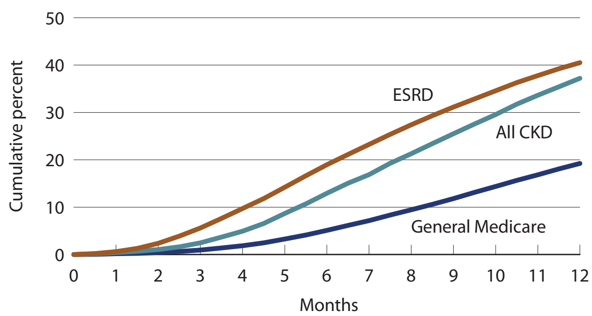
In 2010, 37 percent of all CKD patients (those not on dialysis) reached the coverage gap, compared to 19 percent in the general Medicare population and 41 percent of ESRD patients. Seven percent of CKD patients reached catastrophic coverage, compared to 2 percent of general Medicare and 9.3 percent of ESRD patients.

Patients with ESRD generally reach the coverage gap slightly sooner than those with CKD, while general Medicare patients on average take much longer. And 18 percent of CKD patients who reach the coverage gap subsequently attain catastrophic coverage, compared to 13 percent of general Medicare and 23 percent of ESRD patients. Patients with ESRD reach catastrophic coverage faster than do patients with CKD, and patients with CKD reach this coverage faster than general Medicare patients. » Figures 5.12–14; see page 145 for analytical methods. *Point prevalent Medicare enrollees alive on January 1, excluding those in employer-sponsored & national PACE Part D plans.*

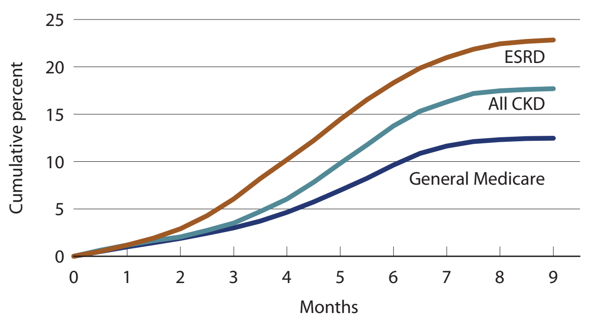
vol 1 5.12 **Part D non-LIS enrollees who reach each coverage phase, 2010**



vol 1 5.13 **Cumulative percent of Part D non-LIS enrollees who reach the coverage gap, 2010**



vol 1 5.14 **Cumulative percent of Part D non-LIS enrollees who reach catastrophic coverage after reaching the coverage gap, 2010**



vol 1
5.e
Twelve-month probability (percent) of reaching the coverage gap in Part D non-LIS enrollees, 2010

	General Medicare	All CKD	ESRD
All	19.2	37.2	40.5
45-64	23.7	41.0	39.3
65-74	16.7	38.4	45.7
75+	21.6	36.4	39.7
Male	18.6	36.2	38.2
Female	19.7	38.1	44.1
White	19.8	38.0	42.3
Black/African American	14.2	26.4	34.8
Asian	12.9	31.9	40.3
Other	15.1	33.9	34.2
Hypertension	27.9	38.3	41.0
CVD	32.1	40.2	42.2
Diabetes	36.3	46.3	44.9
Cancer	28.1	35.1	42.7

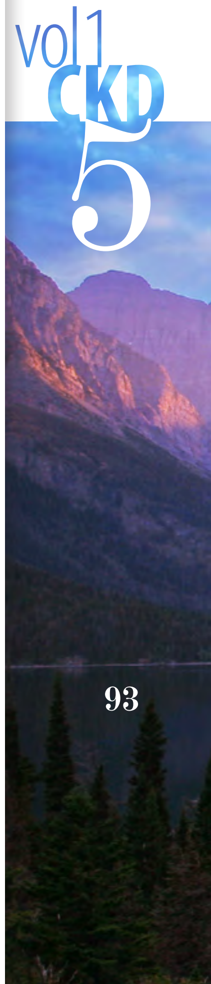
vol 1
5.f
Rate of Part D-covered prescription fills (PPPM) in Part D non-LIS enrollees, 2010

	Gen Med.	All CKD	ESRD
Patients who do not reach the coverage gap	2.0	3.1	2.7
Patients who reach coverage gap, but not catastrophic coverage			
During initial coverage period	4.5	5.3	5.0
During coverage gap	4.4	5.1	4.6
Patients who reach catastrophic coverage			
During initial coverage period	6.6	7.5	6.4
During coverage gap	7.1	7.9	6.7
During catastrophic coverage	7.1	8.5	7.2

Thirty-seven percent of non-LIS Part D enrollees with CKD reach the coverage gap within 12 months; this varies little by age or gender. Among all three populations — general Medicare, CKD, and ESRD — white patients are most likely, by race, to reach the gap. By diagnosis, patients with diabetes reach the gap at the highest rate. » **Table 5.e;** see page 145 for analytical methods. *Point prevalent Medicare enrollees alive on January 1, excluding those in employer-sponsored & national PACE Part D plans.*

Number, fill rate, and prescription cost influence whether patients stay in the initial coverage phase or progress to the coverage gap and then to catastrophic coverage. Among patients who reach either the coverage gap or catastrophic coverage, CKD patients have a higher fill rate than patients in the general Medicare population.

Among patients who reach the coverage gap but do not get to catastrophic coverage, the fill rate consistently declines from that of the initial coverage period. This could be due either to a reduction in medication adherence or to a decision to obtain medications outside the Part D plan, and it is a pattern not seen in patients who reach catastrophic coverage. In these patients, the fill rate generally rises as patients move from initial coverage to the gap, and then again as they reach catastrophic coverage. Patients with a higher number of Part D medications could be incentivized to fill prescriptions in order to reach this phase more quickly, as their out-of-pocket expenses then decrease dramatically. » **Table 5.f;** see page 145 for analytical methods. *Point prevalent Medicare enrollees alive on January 1, excluding those in employer-sponsored & national PACE Part D plans.*



In terms of frequency of use, the top 15 drugs covered by Medicare Part D are similar in the general Medicare and CKD populations. Simvastatin, for example, is the most frequently used drug in the general Medicare population, and second on the list for CKD patients. Three drugs — atenolol, metformin and hydrochlorothiazide — appear in the top 15 for general Medicare patients, but not for CKD patients, in whom furosemide (a loop diuretic) has a more potent diuretic effect, and metformin is contraindicated secondary to the increased risk of lactic acidosis. Carvedilol, allopurinol, and hydrocodone, in contrast, make the list only for CKD patients. Interestingly, potassium chloride is one of the most frequently used medications in the CKD population, which may indicate a more aggressive use of diuretics in these patients.

When ranked by net cost, the list of medications used in the general Medicare population contains more psychiatric and Alzheimer-related drugs than do the lists for CKD patients. Sitagliptin, in contrast, appear only in the CKD lists. The highest net costs in the CKD population are for insulin, reflecting both the high prevalence of diabetes in these patients and the fact that many new insulin therapies are still under patent and not available as generics. » **Tables 5.g–i;** see page 145 for analytical methods. *Part D claims for all patients in the Medicare 5 percent sample (5.g & 5.h); claims & costs scaled up by a factor of 20 to estimate totals. Costs are the sum of Medicare payment & low income subsidy. All patients in the Medicare 5 percent sample. CKD Medicare patients (5.h), with Medicare as primary payor for calendar year 2009; all Part D claims for calendar year 2010 are included. ESRD patients (5.i); all Part D claims regardless of payor status.*

vol 1 **5.g** **Top 15 drugs used by general Medicare Part D enrollees, by days supply & net cost, 2010**

By days supply Generic name	Total days supply	By net cost Generic name	Total days supply	Total cost (dollars)
Simvastatin	1,702,375,780	Insulin	511,312,380	2,204,924,900
Levothyroxine	1,408,144,720	Clopidogrel bisulfate	560,273,580	2,202,262,860
Lisinopril	1,310,638,440	Quetiapine	193,120,900	1,819,768,660
Metoprolol	1,248,935,160	Atorvastatin	589,820,100	1,578,663,040
Amlodipine	1,050,487,820	Esomeprazole	298,881,780	1,486,140,140
Omeprazole	954,590,700	Olanzapine	82,157,060	1,464,146,720
Furosemide	880,613,700	Donepezil	231,598,180	1,311,955,200
Metformin	790,663,320	Fluticasone/salmeterol	212,550,980	1,189,165,040
Hydrochlorothiazide	741,156,420	Aripiprazole	66,393,740	960,720,360
Atenolol	682,587,600	Pioglitazone	188,729,080	960,720,360
Potassium chloride	648,922,600	Rosuvastatin	273,186,300	770,944,720
Atorvastatin	589,820,100	Tiotropium	151,008,040	738,255,540
Warfarin	570,131,360	Oxycodone	100,246,640	711,985,100
Clopidogrel bisulfate	560,273,580	Memantine	160,681,280	659,503,080
Insulin	511,312,380	Duloxetine	136,667,420	617,850,360

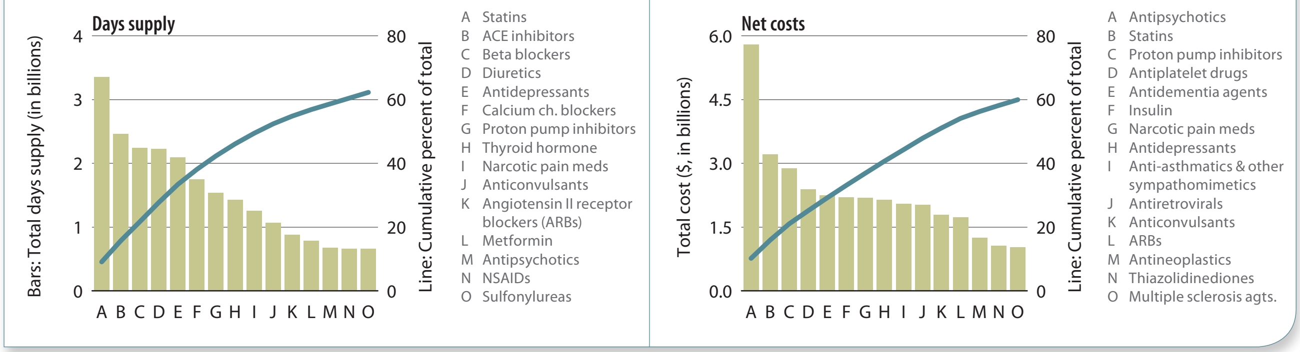
vol 1 **5.h** **Top 15 drugs used by general Medicare Part D enrollees with CKD, by days supply & net cost, 2010**

By days supply Generic name	Total days supply	By net cost Generic name	Total days supply	Total cost (dollars)
Furosemide	116,549,920	Insulin	74,735,540	359,843,460
Simvastatin	96,025,260	Clopidogrel bisulfate	53,989,880	227,155,480
Metoprolol	95,041,300	Donepezil	19,567,440	122,565,260
Levothyroxine	88,402,280	Esomeprazole	21,754,600	114,521,000
Amlodipine	84,617,740	Atorvastatin	38,651,260	113,114,980
Lisinopril	76,513,600	Quetiapine	13,461,420	108,079,420
Insulin	74,735,540	Pioglitazone	17,299,760	93,359,820
Omeprazole	64,962,340	Fluticasone/salmeterol	14,054,300	86,148,580
Potassium chloride	58,766,760	Olanzapine	4,762,140	78,968,440
Clopidogrel bisulfate	53,989,880	Memantine	13,856,500	63,059,380
Warfarin	50,785,740	Epoetin alfa	1,938,100	61,496,720
Carvedilol	47,520,840	Tiotropium	11,196,580	58,903,920
Atorvastatin	38,651,260	Sitagliptin	11,133,600	56,650,900
Allopurinol	37,697,680	Valsartan	24,878,640	55,643,200
Hydrocodone/acetaminophen	31,742,560	Rosuvastatin	18,313,300	54,392,300

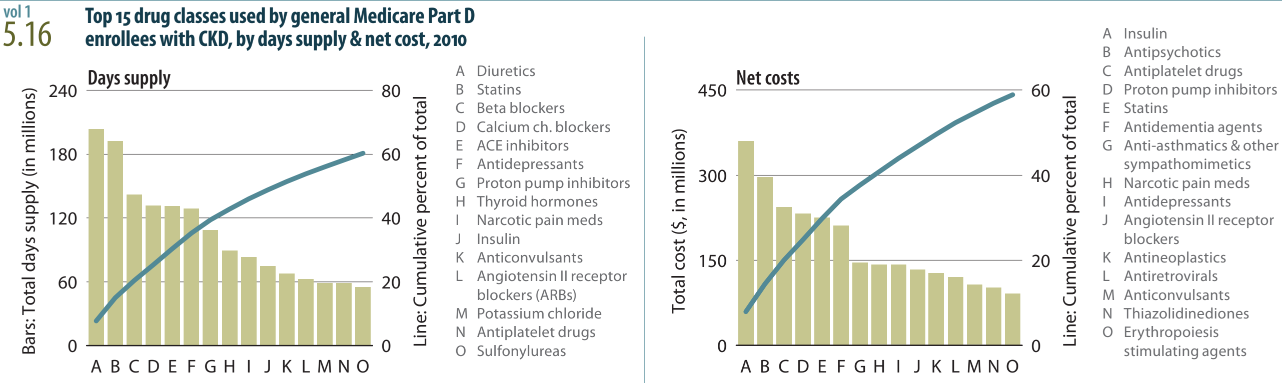
vol 1 **5.i** **Top 15 drugs used by Part D enrollees with ESRD, by days supply & net cost, 2010**

By days supply Generic name	Total days supply	By net cost Generic name	Total days supply	Total cost (dollars)
Insulin	25,682,414	Cinacalcet	13,811,538	275,814,134
Metoprolol	25,587,800	Sevelamer carbonate	15,808,229	236,471,065
Amlodipine	24,678,440	Insulin	25,682,414	104,947,191
Simvastatin	19,554,349	Sevelamer HCL	5,621,239	97,133,405
Lisinopril	17,370,355	Lanthanum carbonate	2,802,068	64,195,302
Omeprazole	16,345,094	Clopidogrel bisulfate	11,906,189	54,664,026
Sevelamer carbonate	15,808,229	Calcium acetate	14,909,212	52,169,404
Calcium acetate	14,909,212	Valganciclovir	1,004,129	46,174,583
Furosemide	14,073,278	Esomeprazole	6,582,989	37,187,989
Cinacalcet	13,811,538	Atorvastatin	8,932,963	29,344,213
Clonidine	13,755,734	Pantoprazole	5,183,660	18,592,221
Carvedilol	13,572,585	Tacrolimus	1,323,415	17,419,846
Levothyroxine	12,879,923	Doxercalciferol	1,021,253	15,982,039
Clopidogrel bisulfate	11,906,189	Pioglitazone	2,706,705	15,654,163
Prednisone	9,887,450	Valsartan	5,502,069	15,163,109

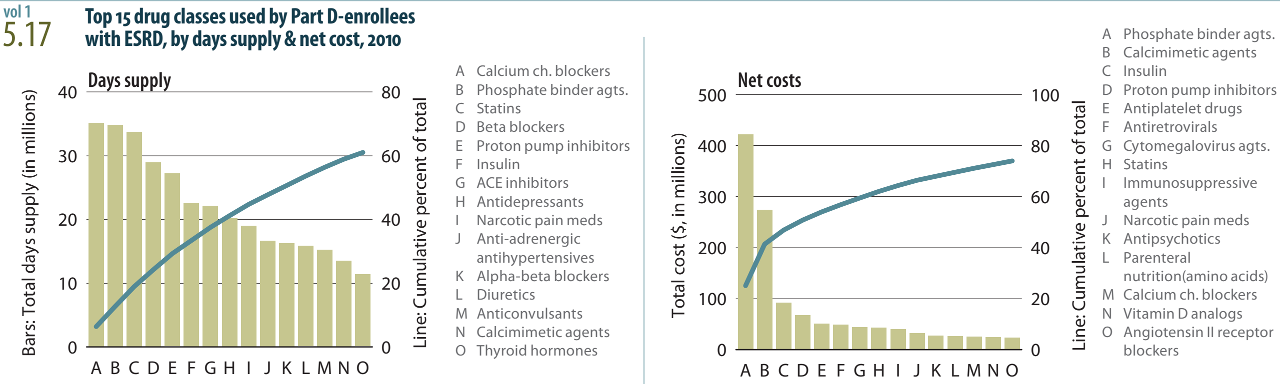
vol 1 **5.15** **Top 15 drug classes used by general Medicare Part D enrollees, by days supply & net cost, 2010**



vol 1 **5.16** **Top 15 drug classes used by general Medicare Part D enrollees with CKD, by days supply & net cost, 2010**



vol 1 **5.17** **Top 15 drug classes used by Part D-enrollees with ESRD, by days supply & net cost, 2010**



Statins and beta-blockers are two of the top three most frequently used drug classes in both the CKD and the general Medicare populations. Three drug classes,—metformin, antipsychotics, and non-steroidal anti-inflammatory agents—appear in the top 15 for general Medicare patients, but not for CKD patients. Potassium chloride, insulin and antiplatelet drugs in contrast, make the list only for patients with CKD.

When ranked by net cost, the lists of medication classes used in the general Medicare population are similar in the general Medicare and CKD populations. Multiple sclerosis agents appears only in the general Medicare list while erythropoiesis stimulating agents appears only in the CKD list. The highest net costs in the CKD population are for insulin, reflecting both the high prevalence of diabetes in these patients and the fact that many new insulin therapies are still under patent and not available as generics. For CKD patients, eight drug classes are among the top 15 based both on frequency of use and net costs.

» **Figures 5.15–17;** see page 145 for analytical methods. *Part D claims for all patients in the Medicare 5 percent sample (5.15 & 5.16); claims & costs scaled up by a factor of 20 to estimate totals. Costs are the sum of Medicare payment & low income subsidy. All patients in the Medicare 5 percent sample. CKD Medicare patients (5.16), with Medicare as primary payor for calendar year 2009; all Part D claims for calendar year 2010 are included. ESRD patients (5.17); all Part D claims regardless of payor status. Therapeutic classification based on Medi-Span's generic product identifier (GPI) therapeutic classification system.*

PART D ENROLLMENT PATTERNS

sources of prescription drug coverage among Medicare enrollees, 2010 (Figure 5.2)

	general Medicare	CKD	ESRD
Part D with low income subsidy	23%	29%	48%
Part D without low income subsidy	38%	29%	21%
retiree drug subsidy	14%	21%	8%

Medicare Part D enrollees with low income subsidy, 2010 (Figure 5.5)

» general Medicare · 38% » CKD · 50% » ESRD · 70%

OVERALL COSTS OF PART D ENROLLMENT

per person per year Medicare & out-of-pocket Part D costs for enrollees, 2010 (Figure 5.10)

	Medicare	out-of-pocket
general Medicare	$2,089	$478
all CKD	$3,843	$738
ESRD	$5,684	$506

per person per year Part D costs for enrollees, 2010 (Figure 5.11)

	general Medicare	CKD	ESRD
patients with low income subsidy	$3,985	$5,997	$7,243
patients with no low income subsidy	$1,010	$1,733	$2,114

COVERAGE PHASE ANALYSES FOR PART D ENROLLEES

Part D non-LIS enrollees who reach the coverage gap, 2010 (Figure 5.13)

at 12 months » general Medicare 19% » all CKD 37% » ESRD 41%

Part D non-LIS enrollees who reach catastrophic coverage after reaching the coverage gap, 2010 (Figure 5.14)

at 9 months » general Medicare 12% » all CKD 18% » ESRD 23%

terms used in the Part D analyses

Low income subsidy (LIS) For Medicare beneficiaries with limited income and/or assets, the costs of participation in Medicare Part D may be reduced by the LIS. Beneficiaries who are dually eligible for Medicare and Medicaid are automatically granted the LIS, while beneficiaries who are not dually eligible may apply for it. While the LIS may take eight different levels, with monthly premiums and copayments either eliminated or reduced, all dually eligible beneficiaries pay no monthly premiums.

Creditable coverage Prescription drug coverage that is actuarially equivalent to the standard Part D benefit, as defined annually by CMS. Beneficiaries with creditable coverage may forgo participation in Medicare Part D without having to pay increased monthly premiums upon future enrollment. Examples of creditable coverage include the Federal Employee Health Benefits Program, TRICARE, VA Health Care Benefits, State Pharmacy Assistance Programs (SPAPs), and private insurance that is eligible for the retiree drug subsidy. Private insurance for the working aged may or may not be creditable.

Retiree drug subsidy (RDS) A program designed to encourage employers to continue to provide prescription drug coverage to retirees eligible for Medicare Part D. Under the program, employers receive a tax-free rebate equal to 28 percent of covered prescription drug costs incurred by their retirees. The program is relatively simple to administer, but may ultimately be more costly than providing employees a type of Part D plan known as an "employer group waiver plan." Following passage of the Patient Protection and Affordable Care Act, the tax-free status of the subsidy is due to expire on December 31, 2012.

Fills per person Each prescription drug purchase constitutes a fill. Fills per person are calculated from the quotient of cumulative fills in a population and the number of people in that population.

Total days supply Each prescription drug is disbursed with sufficient quantity to administer for a set number of days, so long as instructions are followed (i.e., so long as adherence is perfect). Total days supplied equals the cumulative number of days supplied through all fills of a particular medication in a population.

Deductible At the beginning of each calendar year, each non-LIS Part D enrollee is responsible for 100 percent of gross drug costs up to a set amount (i.e., the deductible), at which point cost sharing begins. In the standard benefit, the deductible was $250, $265, and $275 in 2006, 2007, and 2008, respectively.

Initial coverage period The interval following the deductible phase, but preceding the coverage gap. During this time, the Part D enrollee without the LIS is normally responsible for 25 percent of gross drug costs (in the standard benefit).

Coverage gap The interval following the initial coverage period, but preceding catastrophic coverage. During this time, non-LIS Part D enrollees are normally responsible for 100 percent of gross drug costs (in the standard benefit). In 2010, the Affordabl e Health Care Act made several changes to Medicare Part D to reduce the effect of the coverage gap, so that it phases out by 2020. In 2010, non-LIS enrollees received a $250 rebate from Medicare to partially cover costs during the coverage gap. In 2011, non-LIS enrollees were given a 50 percent discount on the total price of brand name drugs and a 7 percent reduction in cost of generic medications while in the gap.

Catastrophic coverage The interval following the coverage gap. During this time, the Part D enrollee without the LIS is normally responsible for 5 percent of gross drug costs (in the standard benefit).

Medicare Advantage Part D plans (MA-PDs) Medicare Part D plans that are offered only to participants in Medicare Part C.

6

Glacier National Park, Montana

ACUTE KIDNEY INJURY

In this chapter we examine antecedents and outcomes associated with acute kidney injury (AKI) in three nationally representative datasets. The first and largest is the 5 percent Medicare sample, in which we can identify individuals hospitalized with AKI or AKI requiring dialysis. We also use the MarketScan dataset, a compilation of claims submitted voluntarily by large self-insured firms, and the Ingenix i3 dataset, with individuals covered by traditional health insurance. We establish a cohort of patients for each dataset and follow them to identify AKI episodes with and without the need for dialysis.

Available datasets do not commonly contain biochemical data with which to definitively identify an AKI episode. We thus use administrative billing data to identify episodes of AKI alone and those requiring dialysis. This indirect method has a number of limitations, including poor sensitivity and the possibility of a phenomenon described as "code creep." This occurs over a period of time when billing thresholds are changed by physicians and/or hospital coders, and can increase the likelihood of an administrative code for AKI being generated by a less severe episode, potentially skewing analyses that demonstrate temporal changes in AKI incidence. As less severe AKI is identified and coded, the incidence of associated adverse outcomes is also likely to fall.

Figure 6.1 captures this problem by showing the rising incidence of AKI. While in isolation there appears to be an epidemic, it is likely that a proportion of this change is the result of code creep. Superimposed on this figure is the proportion of reported AKI patients requiring dialysis. While the threshold for defining AKI has changed over time, the threshold for when to initiate dialysis has likely remained fairly stable. In contrast to the incidence of AKI, the incidence of AKI requiring dialysis has been declining, further supporting the notion of code creep for AKI diagnoses.

We next examine patient characteristics. The rate of AKI is significantly associated with older age and black/African American race — a disparity rising since 1995. Of note, the difference in AKI incidence between whites and both blacks/African Americans and patients of other races has changed dramatically. There has been a fairly stable use of daily hemodialysis in AKI patients, a slight decrease in the use of continuous hemodialysis, and significant growth in the number of patients whose dialysis modality is unknown, largely a result of changing reimbursement payments.

Data on the causes of hospitalization show that, while AKI remains the primary reported code, use of this code has been declining, and there has been a significant increase in the number of patients with septicemia and concurrent AKI. Again, this is likely due in part to the changing reimbursement for various diagnoses. We also show that increasing age and black/African American race both appear to be significant risk factors for AKI, with or without dialysis.

The next few spreads outline patient outcomes and care patterns after AKI hospitalizations. A significant number (58 percent) of patients with an AKI hospitalization will have a recurrent AKI hospitalization within one year, while numerous

The Utah deserts and plateaus and canyons are not a country of big returns, but a country of spiritual healing, incomparable for contemplation, meditation, solitude, quiet, awe, peace of mind and body. We were born of wilderness, and we respond to it more than we sometimes realize. We depend upon it increasingly for relief from the termite life we have created. Factories, power plants, resorts, we can make anywhere. Wilderness, once we have given it up, is beyond our reconstruction.

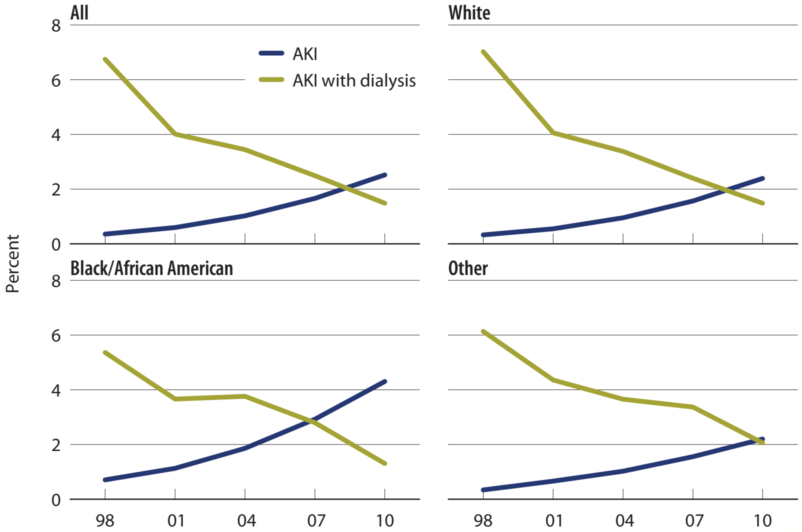
WALLACE STEGNER, *Wilderness at the Edge* individuals have multiple recurrent AKI hospitalizations. The risk of recurrent hospitalizations is magnified by the presence of CKD at base, but does not appear to be influenced by race. As we have demonstrated in previous ADRs, the risk of either ESRD or death in the year following an AKI hospitalization is quite high, at 5 and 25 percent, respectively, for those with both AKI and CKD (2010 ADR, Volume One, Figure 8.18). Blacks/African Americans are more likely than whites to experience an ESRD event after an AKI episode, but less likely to die.

Renal care after an AKI episode remains poor, with very few patients seeing a nephrologist within one year of their AKI hospitalization. This lack of follow-up holds true even in patients with multiple hospitalizations for AKI. And while serum creatinine testing following an AKI episode occurs in the majority of patients, black/African American patients who do not see a nephrologist are far less likely to be tested than whites.

The use of cardioprotective drugs surrounding an AKI episode varies depending on the class of agents. In general, an AKI episode does not appear to modify the use of beta blockers, calcium channel blockers, or loop diuretics. An AKI episode does result in a decrease in the use of both thiazide diurietcs as well as ACEI/ARB/renin inhibitors; this decrease, however, is transient, and many patients resume these medications within one year of AKI discharge.

Patients who experience an AKI hospitalization have modifications in their reported stage of CKD. Many individuals without CKD prior to their AKI hospitalization are later reclassified as having moderate to advanced CKD. In general, patients appear to have an increase in CKD stage following an AKI hospitalization. **» Figure 6.1;** see page 145 for analytical methods. *Medicare patients age 66 & older.*

vol 1
6.1
Hospitalizations for acute kidney injury, with or without dialysis, by race

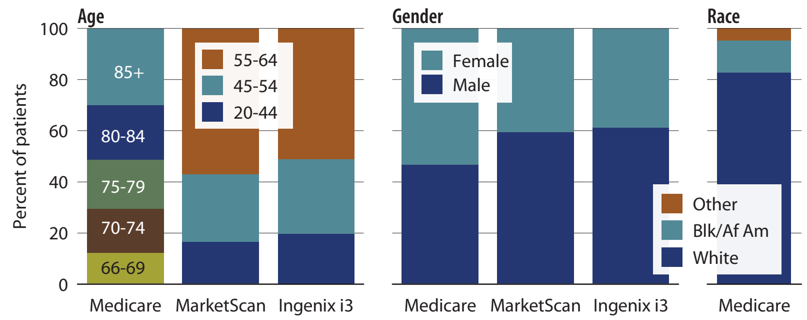


In the Medicare, MarketScan, and Ingenix i3 populations with AKI, the proportion of males to females in 2010 was 47 to 53, 60 to 40, and 61 to 39 percent, respectively. By race, 82.7 percent of Medicare AKI patients were white, and 12.6 and 4.7 percent, respectively, were black/African American or individuals of other races » **Figure 6.2;** see page 145 for analytical methods. *Medicare AKI patients age 66 & older, & MarketScan & Ingenix i3 patients AKI age 20–64.*

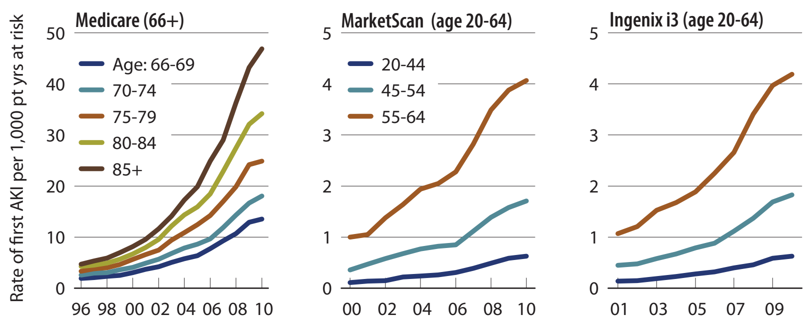
Acute kidney injury is highly associated with age. Among Medicare patients age 66–69, for example, the rate of AKI in 2010 was 13.6 per 1,000 patient years, and increased to 18.1, 24.9, 34.2, and 46.9, respectively, with increasing ages of 70–74, 75–79, 80–84, and 85 and older. Similar patterns are seen in both the MarketScan and Ingenix i3 populations. » **Figure 6.3;** see page 145 for analytical methods. *Medicare AKI patients age 66 & older, & MarketScan & Ingenix i3 AKI patients age 20–64.*

The incidence of AKI among Medicare patients age 66 and older varies considerably by race, in 2010 reaching 44.2 per 1,000 patient years in blacks/African Americans compared to 24.3 and 22.5, respectively, in whites and individuals of other races. » **Figure 6.4;** see page 145 for analytical methods. *Medicare AKI patients age 66 & older.*

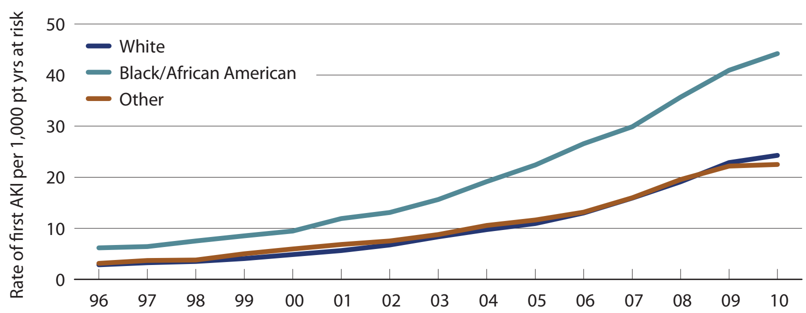
vol 1 **6.2** **Characteristics of patients with acute kidney injury, by age, gender, & race, 2010**



vol 1 **6.3** **Rates of first AKI, by age & dataset**



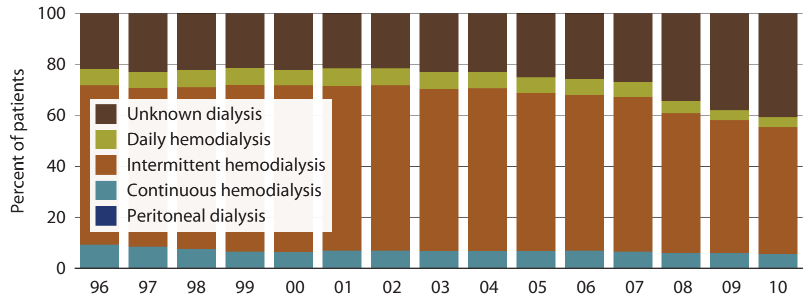
vol 1 **6.4** **Rates of AKI in Medicare patients age 66 & older, by race**



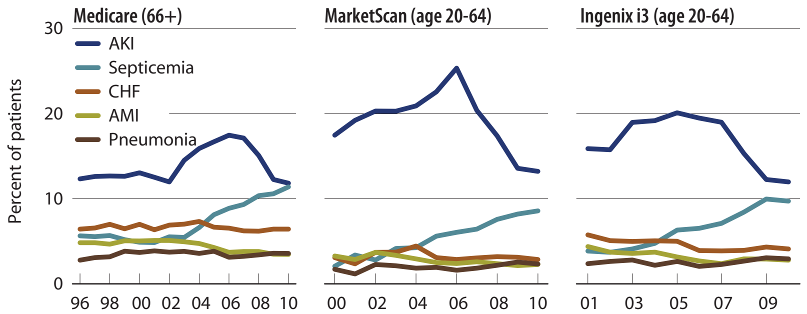
Among hospitalized patients with AKI who require dialysis, there has been a noticeable increase in the number of patients for whom dialysis type is categorized as unknown, to 40.7 percent in 2010. The type of dialysis received during an AKI hospitalization has historically been obtained from physician claims. Changes in reimbursement protocols have led providers to claim dialysis events independent of dialysis type, making it difficult to determine the mode of dialysis used during the AKI hospitalization.

Acute peritoneal dialysis is now seldom used with AKI, with the percentage of patients falling from 0.33 percent in 1996 to just 0.05 percent in 2010. Use of other modes of dialysis has also fallen, from 8.9 to 5.7 percent for continuous hemodialysis, 62.6 to 49.7 percent for intermittent hemodialysis, and 6.5 to 3.9 percent for daily dialysis. **» Figure 6.5;** see page 145 for analytical methods. *Medicare AKI patients age 66 & older.*

vol 1 **6.5** **Type of dialysis in hospitalized Medicare AKI patients age 66 & older who require dialysis**



vol 1 **6.6** **Primary diagnosis code for patients with AKI, by dataset**



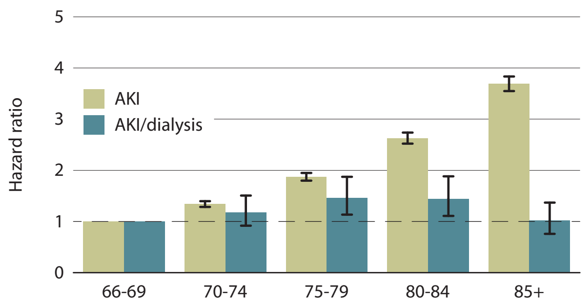
While the AKI event itself remains a major reason for AKI hospitalization, the percentage of patients with this diagnosis has been steadily declining overall, falling from a high of 17.5 percent in 2006 to 11.8 percent in 2010 in Medicare patients, from 25.3 to 13.2 percent in the MarketScan population during the same period, and from 20.1 percent in 2005 to 12 percent in 2010 for the Ingenix i3 cohort.

Admissions for septicemia, in contrast, have steadily increased, to 11.4, 8.6, and 9.7 percent, respectively. **» Figure 6.6;** see page 145 for analytical methods. *Medicare AKI patients age 66 & older, & MarketScan & Ingenix i3 patients age 20–64.*

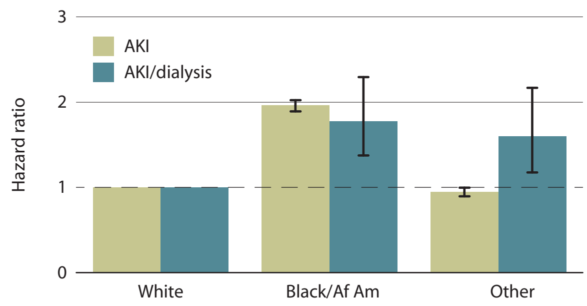
Acute kidney injury is highly associated with age in patients who do not require dialysis, even after adjusting for other factors. The adjusted hazard ratio for an AKI hospitalization increases in a graded manner with each increase in age. Among those age 70–74, for example, the hazard ratio for AKI with no dialysis is 1.3, while in those age 85 and older it reaches 3.7. » Figure 6.7; see page 145 for analytical methods. *Medicare patients age 66 & older; adj: gender/race; ref: patients age 66–69, 2010.*

The adjusted hazard ratio for an AKI hospitalization is significantly higher in blacks/African Americans than among their white counterparts: two times higher for AKI alone, and 1.8 times higher for AKI requiring dialysis. Compared to whites, patients of other races have an equivalent risk of an AKI hospitalization alone, but a risk of 1.6 for an AKI hospitalization requiring dialysis. » Figure 6.8; see page 145 for analytical methods. *Medicare patients age 66 & older; adj: age, & gender; ref: whites, 2010.*

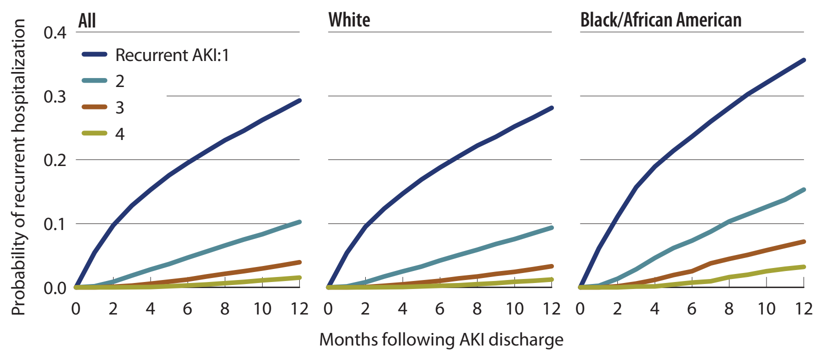
vol 1 6.7 **Adjusted hazard of an AKI hospitalization in Medicare patients, by age, 2010**



vol 1 6.8 **Adjusted hazard of an AKI hospitalization in Medicare patients, by race, 2010**



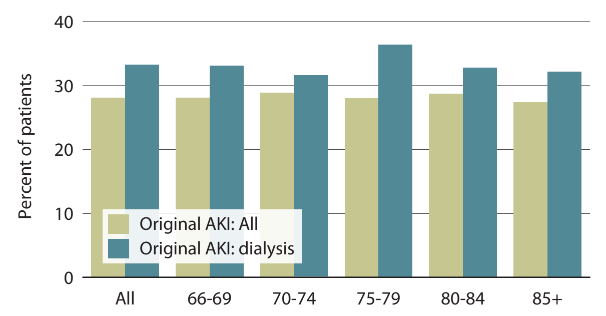
vol 1 6.9 **Probability of a recurrent AKI hospitalization in Medicare patients, by number of recurrent events & race, 2009–2010**



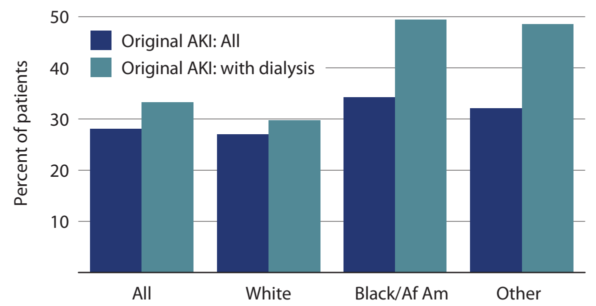
Following discharge after an AKI hospitalization, the probability of one recurrent hospitalization event is 0.29 overall and 0.28 and 0.36, respectively, in whites and blacks/African Americans. The probability of having more than one AKI event is highest in blacks/African Americans compard to whites — at 0.15 versus 0.09 for two events and 0.07 versus 0.03 for three. » Figure 6.9; see page 145 for analytical methods. *Medicare AKI patients age 66 & older, 2009–2010.*

In contrast to the association of AKI with increasing age, the incidence of recurrent AKI hospitalization alone or with dialysis does not vary greatly by age. It is apparent, however, that recurrent AKI hospitalization is more common in patients needing dialysis during their hospital stay compared to those who do not, at 33.3 and 28.1 percent overall. This is particularly evident in blacks/African Americans and patients of other races, at 49.4 versus 34.3 percent and 48.6 versus 32.1 percent, respectively. » **Figures 6.10–11;** see page 145 for analytical methods. *Medicare patients age 66 & older; original AKI in 2009, recurrent AKI within one year.*

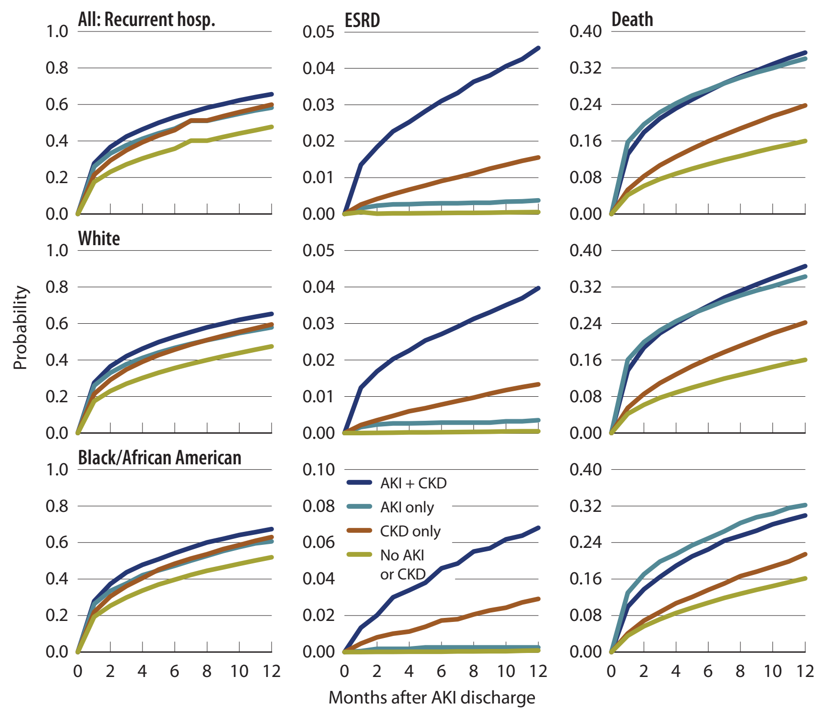
vol 1 **6.10** **Patients with a recurrent AKI, by age, 2009–2010**



vol 1 **6.11** **Patients with a recurrent AKI, by race, 2009–2010**



vol 1 **6.12** **Probability of a recurrent hospitalization, ESRD, or death following hospitalization for AKI, by race, 2009–2010**



Individuals who survive an AKI hospitalization have a greater likelihood of a recurrent hospital admission compared to those with no evidence of kidney disease (AKI or CKD), at 0.58 versus 0.48; the presence of CKD in addition to AKI raises the probability to 0.66.

Those surviving an AKI episode are at risk of developing ESRD, a risk magnified by the presence of CKD prior to AKI. By race, the probability of ESRD is higher in blacks/African Americans than in whites, at 0.07 compared to 0.04 among those with a prior diagnosis of CKD.

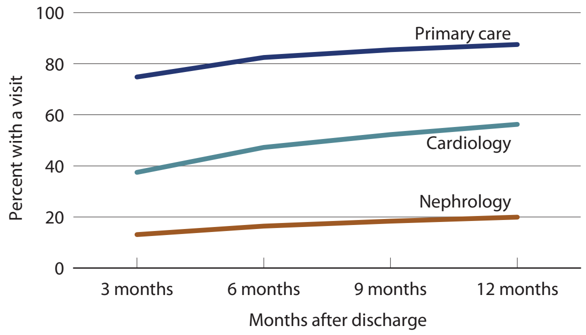
In patients who survive the AKI event, the probability of dying within a year is elevated regardless of whether patients have pre-existing CKD, and is slightly higher in whites compared to blacks/African Americans. » **Figure 6.12;** see page 145 for analytical methods. *Medicare patients age 66 & older, 2009–2010.*

Following an AKI hospitalization, 75 percent of patients see a primary physician within three months of discharge, while 38 and 13.2 percent, respectively, see a cardiologist or nephrologist.

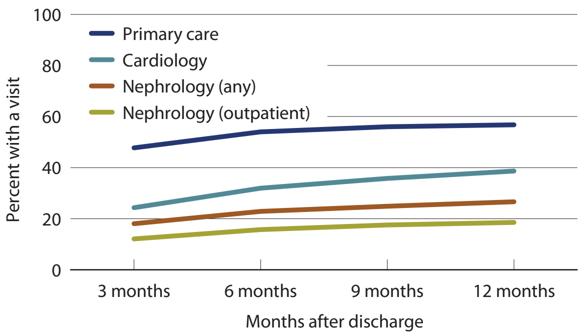
Surprisingly, fewer than half of the patients with a recurrent AKI see a primary care physician within three months of their second discharge, while 24.4 percent see a cardiologist and 18.1 and 12.2 percent, respectively, see a nephrologist (any or outpatient).

Outpatient visits to a nephrologist following an initial or recurrent AKI event are more likely in patients with CKD than in those without. » **Figures 6.13–15;** see page 145 for analytical methods. *Medicare AKI patients age 66 & older, 2009–2010.*

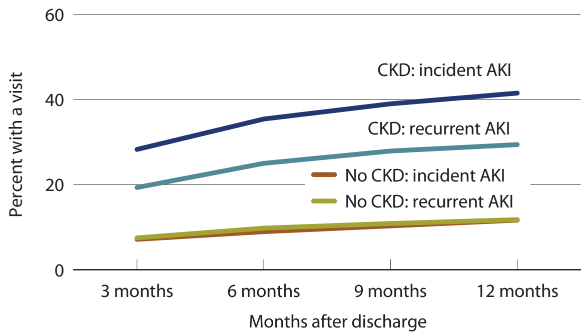
vol 1 6.13 **Outpatient physician visits following initial AKI discharge, 2009–2010**



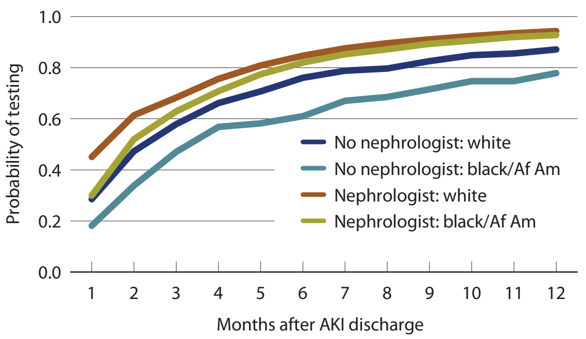
vol 1 6.14 **Physician visits in the year following a recurrent AKI discharge, 2009–2010**



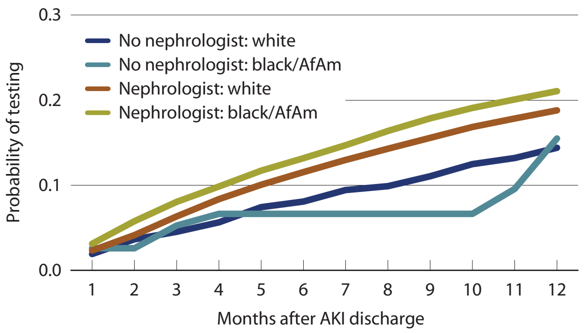
vol 1 6.15 **Outpatient nephrology visits in the year following a recurrent AKI discharge, 2009–2010**



vol 1 6.16 **Probability of serum creatinine testing after hospitalization for acute kidney injury, 2009–2010**

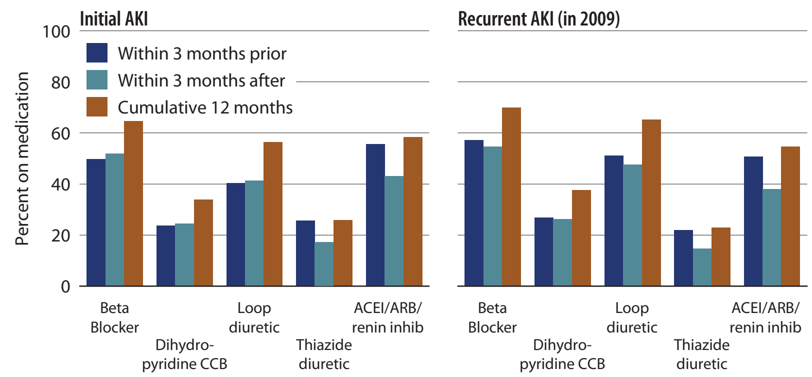


vol 1 6.17 **Probability of urine albumin testing after hospitalization for acute kidney injury, 2009–2010**

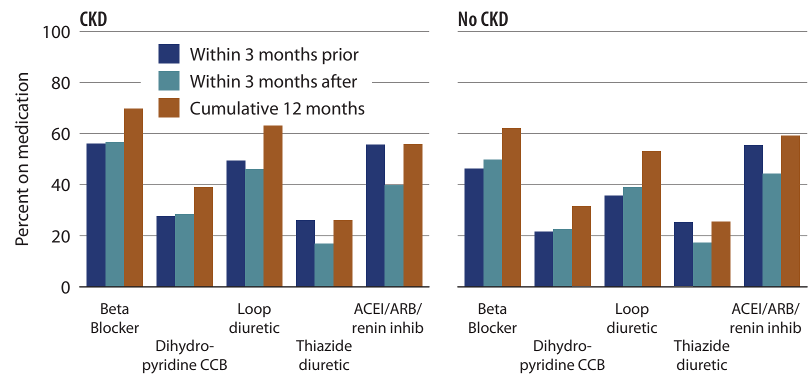


Among individuals suffering an AKI event, the probability of serum creatinine and urine albumin testing is higher, regardless of race, in those seeing a nephrologist than in those who do not. » **Figures 6.16–17;** see page 145 for analytical methods. *Medicare AKI patients, age 66 & older, 2009.*

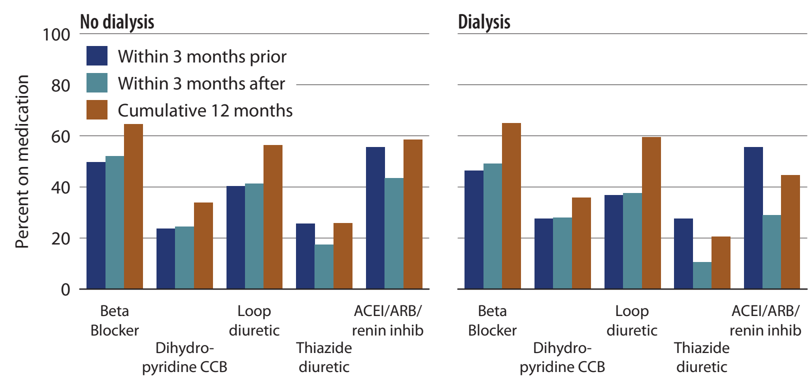
vol 1
6.18 **Drug therapy prior to & after hospitalization for AKI in patients with Medicare Part D coverage, for initial & recurrent AKI**



vol 1
6.19 **Drug therapy prior to & after hospitalization for AKI in patients with Medicare Part D coverage, by CKD status**



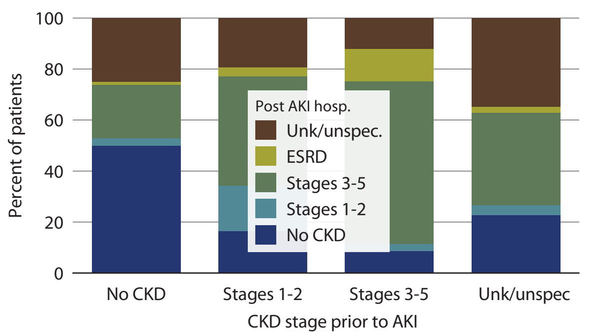
vol 1
6.20 **Drug therapy prior to & after AKI hospitalization in patients with Medicare Part D coverage, with or without dialysis**



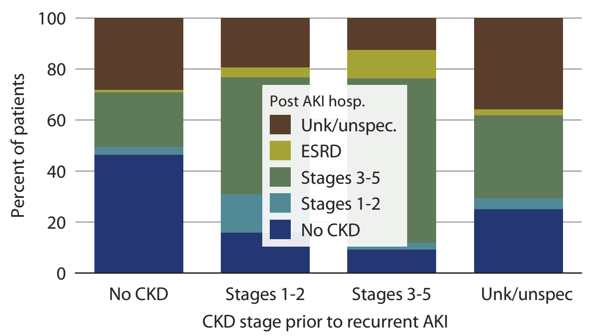
When comparing cardiovascular medication use in patients prior to, in the first three months after, and at one year following an AKI or recurrent AKI event, the greatest increases in medication use occur in patients who had dihydropyridine calcium channel blockers, loop diuretics, or beta blockers prescribed within the three months prior to their AKI event. Patients using thiazide diuretics or an ACEI/ARB/renin inhibitor, in contrast, are likely to use less of these medications at three months post-AKI, but generally return to their pre-AKI use levels by twelve months.

The same patterns of medication use persist in AKI patients with or without CKD, and in patients with or without dialysis during their AKI hospital stay. In patients requiring dialysis, for example, the use of thiazide diuretics falls from 28 to 11 percent at month three post-AKI, while use of ACEIs/ARBs/renin inhibitors falls from 56 to 29 percent. **» Figures 6.18–20;** see page 145 for analytical methods. *AKI patients with Part D coverage, 2009. For Figure 6.19, CKD identified as any CKD claim during the three months prior to AKI. Presence of medication represents a Part D claim during 2009, where the timing is based on the service date of the medication in the Part D data. Data on medication "prior to AKI" includes only those patients whose AKI occurs in April or later in the year; "after AKI" includes only those whose AKI occurs in September or earlier in the year, & who survive without developing ESRD for the entire follow-up period (three or 12 months).*

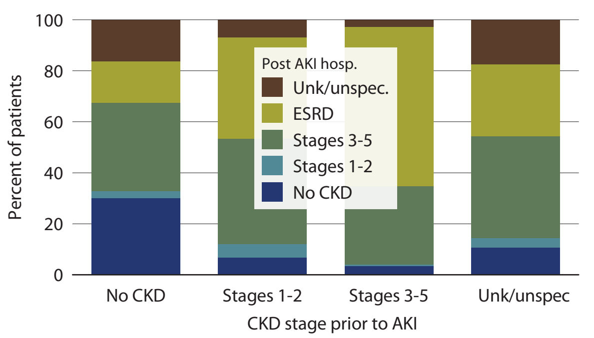
vol 1
6.21 **Changes to CKD status following hospitalization for AKI in Medicare patients, 2010**



vol 1
6.22 **Changes to CKD status following a recurrent rehospitalization for AKI in Medicare patients, 2010**



vol 1
6.23 **Changes to CKD status following a hospitalization for AKI with dialysis in Medicare patients, 2010**

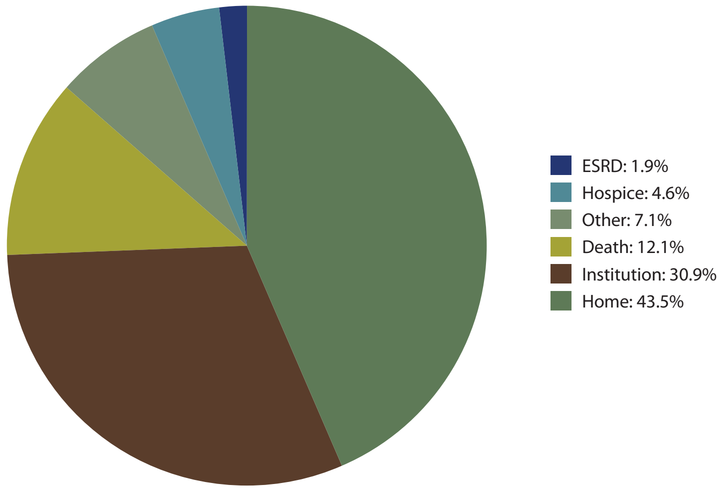


CKD status changes significantly following an AKI hospitalization. Among those with CKD of Stages 1–2 prior to the hospitalization, for example, 43 percent are later classified as having Stage 3–5 CKD. And of those with Stage 3–5 CKD pre-hospitalization, 12.6 percent reach ESRD.

Similar patterns exist in patients with a recurrent AKI hospitalization. Among those with CKD of Stages 1–2 prior to the AKI hospitalization, 46 percent are later classified as having Stage 3–5 CKD, and in patients with Stage 3–5 pre-hospitalization, 11.3 percent reach ESRD.

Among patients with an AKI hospitalization requiring dialysis, of those classified as Stage 1–2 CKD, 41.4 percent are reclassified as having CKD of Stages 3–5 after their hospitalization; among patients with Stage 3–5 CKD pre-hospitalization, 62 percent reach ESRD. **» Figures 6.21–23;** see page 145 for analytical methods. *Medicare AKI patients age 66 & older, 2010. For Figure 6.22, recurrent hospitalization occurred in 2009; for Figure 6.23, data limited to AKI events with dialysis.*

vol 1
6.24 **Outcomes following an AKI hospitalization, 2010**



Here we demonstrate trajectories for patients once they are discharged from the hospital. Among 2010 AKI patients age 66 and older, approximately 2 percent were enrolled in an ESRD program, while 4.6 and 12.1 percent, respectively, went to hospice or died during their hospitalization. Nearly one-third were institutionalized in a skilled nursing facility, and 44 percent were discharged to their home. **» Figure 6.24;** see page 145 for analytical methods. *Medicare AKI patients age 66 & older, 2010.*

CHARACTERISTICS OF PATIENTS WITH AKI

rates of AKI in Medicare patients age 66 & older, by race (per 1,000 patient years; Figure 6.4)

	» white	» black/African American	» other
1996	2.9	6.2	3.1
2000	4.9	9.5	5.9
2005	10.9	22.4	11.6
2010	24.3	44.2	22.5

primary diagnosis for patients with AKI, 2010 (percent; Figure 6.6)

	» AKI	» septicemia	» CHF	» acute MI	» pneumonia
Medicare	11.8	11.4	6.4	3.5	3.6
MarketScan	13.2	8.6	2.9	2.3	2.3
Ingenix i3	11.9	9.7	4.1	2.8	2.9

AKI HOSPITALIZATION

probability of a recurrent AKI hospitalization in Medicare patients, by number of events & race, 2009–2010 (Figure 6.9)

	» one event	» two events	» three events	» four events
all	0.29	0.10	0.04	0.02
white	0.28	0.09	0.03	0.01
black/African American	0.36	0.15	0.07	0.03

PATIENT CARE & OUTCOMES FOLLOWING AKI HOSPITALIZATION

outpatient physician visits following initial AKI discharge, 2009–2010 (percent; Figure 6.13)

	» primary care	» cardiology	» nephrology
within 3 months	74.9	37.5	13.2
within 6 months	82.5	47.2	16.4
within 9 months	85.5	52.3	18.4
within 12 months	87.6	56.3	20.0

physician visits in the year following a recurrent AKI discharge, 2009–2010 (percent; Figure 6.14)

	» primary care	» cardiology	» nephrology (any)	» nephrology (OP)
within 3 months	47.8	24.4	18.1	12.2
within 6 months	54.0	32.0	22.9	15.8
within 9 months	56.0	35.8	25.0	17.5
within 12 months	56.8	38.7	26.7	18.6

7

COSTS OF CHRONIC KIDNEY DISEASE

How hard to realize that every camp of men or beast has this glorious starry firmament for a roof! In such places standing alone on the mountaintop it is easy to realize that whatever special nests we make — leaves and moss like the marmots and birds, or tents or piled stone — we all dwell in a house of one room — the world with the firmament for its roof — and are sailing the celestial spaces without leaving any track.

JOHN MUIR,
John of the Mountains

Determining the economic impact of CKD on the healthcare system is challenging on several levels. There is, for instance, considerable under-recognition of CKD, as noted in Chapter One. A biochemical definition would be the most quantitative, but health plan datasets rarely contain this information on a large scale. A definition of the CKD cohort using diagnosis codes, however, may represent only the more advanced — and thus most expensive — cases. In addition, CKD is a highly interactive disease, associated with cardiovascular disease, diabetes, stroke, and infectious complications.

Given these limitations, we have developed a method using diagnosis codes to create a point prevalent CKD cohort. In the 2009 and 2010 ADRs, "new" CKD patients were included in order to produce a period prevalent cohort parallel to that created for the ESRD population. These patients, however, accounted for a disproportionate percentage of overall costs, which could not be directly attributed to their CKD status. The reasons for this are numerous, but may include a high rate of acute kidney injury (AKI). This year, we thus continue with the method discussed in the 2011 ADR, including only those patients classified as having CKD on January 1 of a given year. This creates a true point prevalent cohort and reduces the impact of AKI patients, thereby allowing us a more accurate assessment of the chronic disease condition and its associated costs.

When compared to those in the 2009 ADR, costs reported here for CKD patients are thus significantly lower, while those for non-CKD patients are higher. It is unclear which method most accurately depicts true CKD costs. Each has its strengths and weaknesses, and the differences reflect the uncertainty involved in using claims to classify CKD. Additionally, there is emerging data to indicate that AKI patients have a high probability of CKD. These areas will be the subject of ongoing research to be sure the CKD population's impact on the health care system is addressed.

We begin the chapter by presenting Medicare data on the chronic diseases associated with the greatest population-level expenditures. Congestive heart failure (CHF), for example, affects 9.5 percent of patients in the fee-for-service Medicare population, and accounts for nearly 22 percent of expenditures. Nearly 34 percent of expenditures go toward the 23.4 percent of patients with diabetes. And patients with CKD, who represent 8.4 percent of the point prevalent population, account for 17.0 percent of total expenditures. These assessments do not include ESRD patients on dialysis or with a kidney transplant, who account for another 6.4 percent of fee-for-service expenditures. The combined CKD and ESRD populations thus account for 24 percent of the budget, a number greater than that associated with CHF.

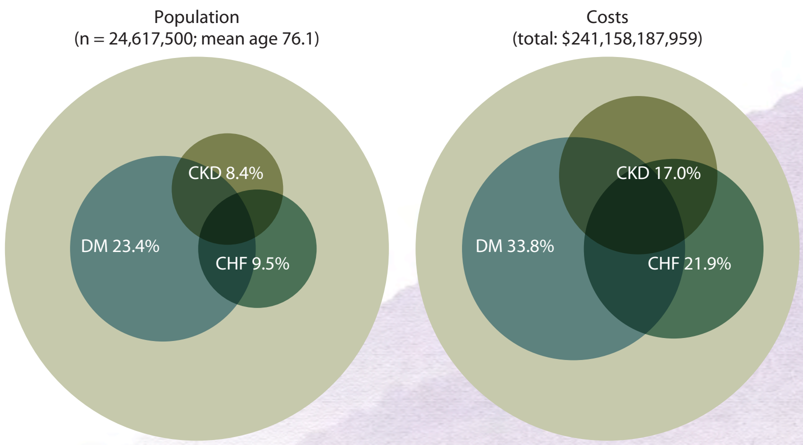
While patients in each of these populations may carry other major diagnoses such as arthritis, cataracts, hip fractures, cancer, and chronic lung disease, on a population level these three groups consume very large portions of the Medicare budget. On this basis alone, targeting the CKD population would have a large impact if improvements in care led to reduced comorbidities and hospitalizations. Overall, CKD patients incur per person per year (PPPY) costs of just over $23,000, compared to $8,000 for patients without ESRD, CKD, diabetes, or CHF (see Reference Table K.5 in this volume). Patients with CKD of Stages 4–5 have yearly expenditures of $28,508, demonstrating the impact of more advanced disease and its increasing complications. In patients with both Stage 4–5 CKD and CHF, costs are slightly more than $38,000 for whites, and approach $48,000 for blacks/African Americans.

These costs approach 50 percent of the $88,000 PPPY incurred by a hemodialysis patient (Figure 11.7, Volume Two). In addition, Part D expenditures account for $3,300 per year. CKD patients overall thus incur nearly half the costs of the hemodialysis population — a group which, with the exception of some populations with rare diseases, is the most expensive in the Medicare system.

We conclude this chapter with data on the Medicare Part D benefit, a program which began in 2006. In 2010, Part D costs accounted for 8 percent of total Medicare expenditures in the CKD population. Costs vary considerably in relation to the low income subsidy (LIS); net Part D costs for CKD patients with the LIS are more than twice those for their non-LIS counterparts, while out-of-pocket Part D costs range from $133–$159 in LIS patients to $1,244–$1,443 in patients without the LIS.

Part D costs for CKD patients are 74 percent of those for ESRD patients with LIS, and 86 percent of those for non-LIS patients. Given the large costs of Part D covered medications in CKD patients, and the observation that ACEI/ARB use is reduced in patients with advancing CKD despite complications from congestive heart failure, we need to strive for greater understanding of the risk benefit of treatment in patients with CKD. **» Figure 7.1;** see page 146 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 2010.*

vol 1 **7.1** **Point prevalent distribution & annual costs of Medicare (fee-for-service) patients, age 65 & older, with diagnosed diabetes, CHF, & CKD, 2010**



In 2010, overall per person per year (PPPY) costs for patients with CKD reached $22,323 for Medicare patients age 65 and older, and $13,395 for patients age 50–64 in the MarketScan 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 50 percent greater in the Medicare population and 81 percent higher among MarketScan patients.

Among Medicare patients with both CKD and diabetes, PPPY costs for blacks/African Americans reached $28,651 in 2010, 16.5 percent higher than the $24,593 incurred by whites. Costs for those with Stage 4–5 CKD were 42 and 50 percent greater, respectively, for blacks/African Americans and whites than costs for their counterparts with CKD of Stages 1–2.

In 2010, costs for black/African American Medicare patients with both CKD and congestive heart failure were 21.3 percent higher than costs for whites with both diagnoses, at $40,487 and $33,374, respectively. And for patients with Stage 4–5 CKD, costs were 23 and 21 percent higher among blacks/African Americans and whites, respectively, than costs in those with CKD of Stages 1–2. » **Figures 7.2–4;** see page 146 for analytical methods. *Point prevalent Medicare patients age 65 & older (5 percent Medicare sample, 7.2–4) & MarketScan patients age 50–64 (7.2). Includes Part D.*

ICD-9-CM codes

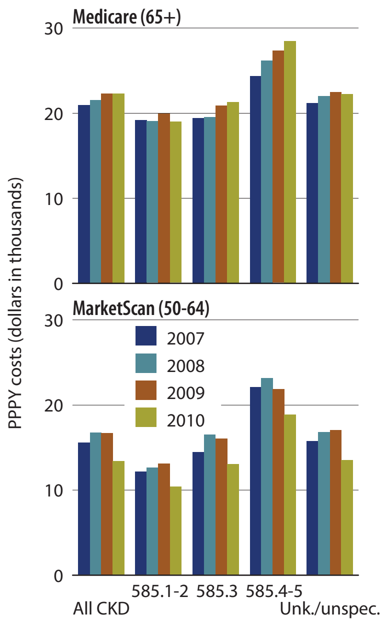
585.1	Chronic kidney disease, Stage 1
585.2	Chronic kidney disease, Stage 2 (mild)
585.3	Chronic kidney disease, Stage 3 (moderate)
585.4	Chronic kidney disease, Stage 4 (severe)
585.5	Chronic kidney disease, Stage 5 (excludes 585.6: Stage 5, requiring chronic dialysis.*)

Chronic kidney disease, unknown/unspecified

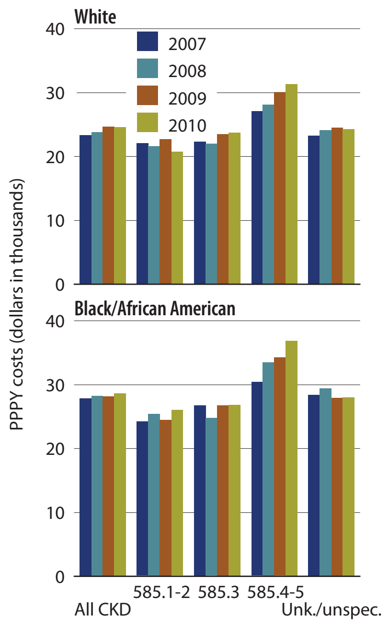
**In USRDS analyses, patients with ICD-9-CM code 585.6 & with no ESRD 2728 form or other indication of ESRD are considered to have code 585.5; see Appendix A for details.*

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

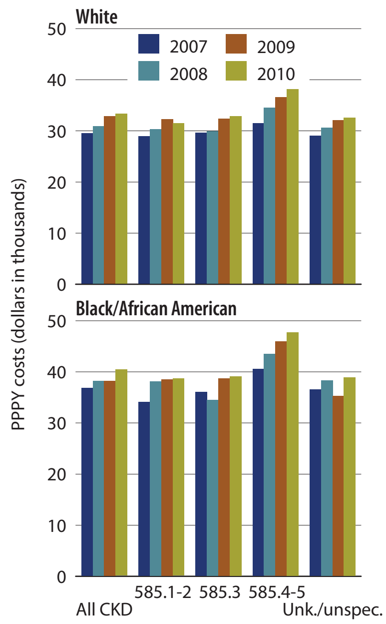
vol 1 **7.2** **Overall PPPY costs in CKD patients, by CKD diagnosis code, dataset, & year**



vol 1 **7.3** **PPPY costs in Medicare CKD pts with DM, by CKD diagnosis code, race, & year**



vol 1 **7.4** **PPPY costs in Medicare CKD pts with CHF, by CKD diagnosis code, race, & year**

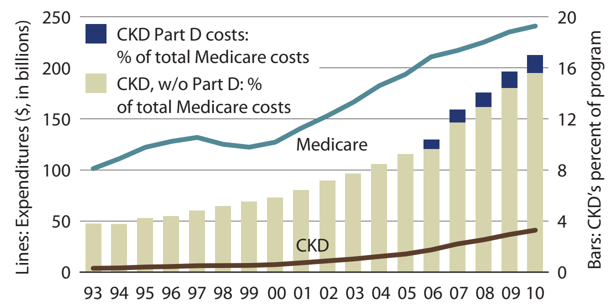


In 1993, total costs for Medicare patients age 65 and older with CKD accounted for just 3.9 percent of overall Medicare expenditures. In 2010, non-Part D costs for these patients reached $41 billion, 17 percent of total Medicare dollars, while their Part D expenditures accounted for 1.4 percent of Medicare dollars, up from 0.7 percent in 2006.

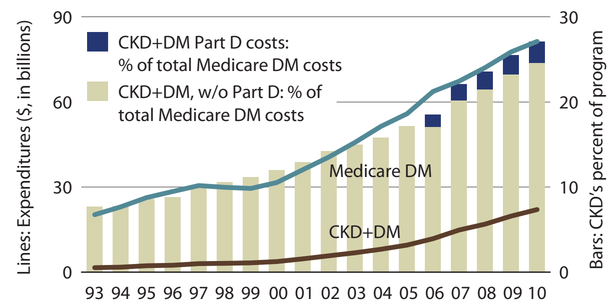
Non-Part D expenditures for CKD patients with diabetes accounted for 24.6 percent of total Medicare diabetes costs in 2010, totaling $22 billion — a fourteen-fold increase since 1993, and one that demonstrates the enormous economic burden that diabetes imposes on the healthcare system. The percentage of total Medicare diabetes costs attributed to Part D has increased from 1.4 in 2006 to 2.5 in 2010.

Costs for CKD patients with congestive heart failure accounted for 36.8 percent of total Medicare CHF dollars in 2010 — $19.4 billion of the nearly $53 billion spent by Medicare on patients with CHF. Part D costs for CKD patients with CHF rose to $1.4 billion, accounting for 2.7 percent of Medicare CHF costs. » **Figures 7.5–7;** see page 146 for analytical methods. *Point prevalent Medicare CKD patients age 65 & older.*

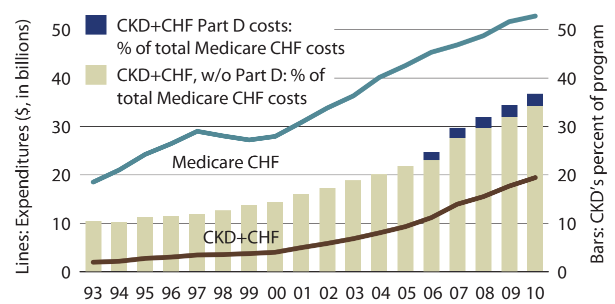
vol 1 **7.5** **Overall expenditures for CKD in the Medicare population**



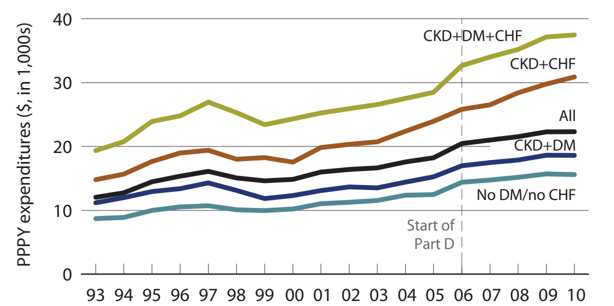
vol 1 **7.6** **Overall expenditures for CKD & diabetes in the Medicare population**



vol 1 **7.7** **Overall expenditures for CKD & congestive heart failure in the Medicare population**



vol 1 **7.8** **Per person per year expenditures for CKD in the Medicare population, by at-risk group**



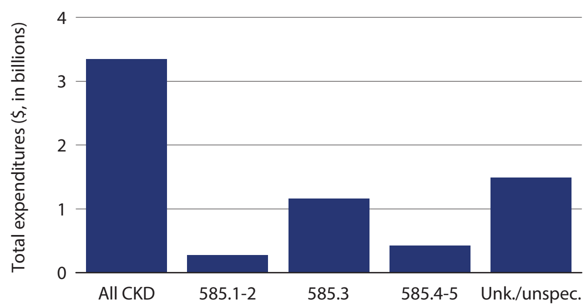
In 2010, per person per year costs (including Part D) for patients with CKD totaled $22,323 overall, and were highest in those with diabetes and CHF as well, at $37,490. Costs for CKD patients with no diabetes or CHF, in contrast, totaled $15,607. » **Figure 7.8;** see page 146 for analytical methods. *Point prevalent Medicare CKD patients age 65 & older. Includes Part D.*

In 2010, total Part D costs for CKD patients reached $3.35 billion. Eight percent of these costs were incurred by patients with Stage 1–2 CKD, 35 percent by those with CKD of Stage 3, and 13 percent by those in Stages 4–5.

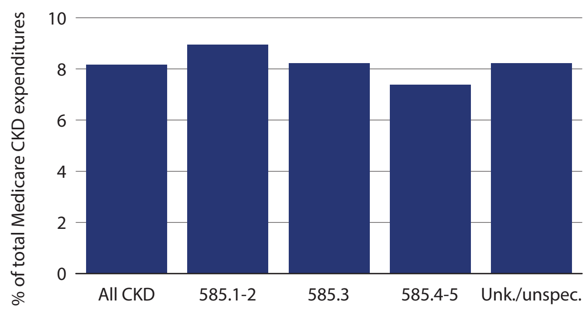
Part D costs account for 8.2 percent of total Medicare costs for the CKD population as a whole, 9.0 percent of costs in Stage 1–2 patients, 8.2 percent in patients with Stage 3 CKD, and 7.4 percent in those with CKD of the most advanced stages.

Total overall Part D net CKD costs in 2010 were dominated by cost for patients with the low income subsidy (LIS), at $119 million compared to $48 million is those with no LIS. Costs e highest in LIS patients with Stage 3 CKD, at $39 million compared to $10 and $16 million, respectively, in patients with CKD of Stages 1–2 and 4–5. » Figures 7.9–11; see page 146 for analytical methods. *Includes Part D claims for all CKD patients, defined from claims on a point prevalent basis, for calendar year 2010. Costs are estimated net pay: sum of plan covered payments & low income subsidy amounts. Counts & costs obtained from 5 percent Medicare sample, & scaled up by a factor of 20 to estimate total Medicare CKD costs.*

vol 1 7.9 **Total Part D costs, by CKD diagnosis code, 2010**



vol 1 7.10 **Part D costs in patients with CKD as a proportion of total Medicare CKD expenditures, by CKD diagnosis code, 2010**



ICD-9-CM codes

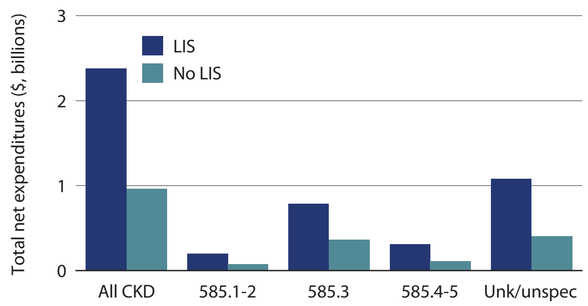
585.1	Chronic kidney disease, Stage 1
585.2	Chronic kidney disease, Stage 2 (mild)
585.3	Chronic kidney disease, Stage 3 (moderate)
585.4	Chronic kidney disease, Stage 4 (severe)
585.5	Chronic kidney disease, Stage 5 (excludes 585.6: Stage 5, requiring chronic dialysis.*)

Chronic kidney disease, unknown/unspecified

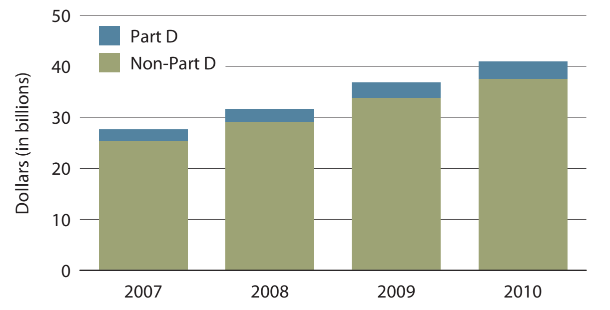
**In USRDS analyses, patients with ICD-9-CM code 585.6 & with no ESRD 2728 form or other indication of ESRD are considered to have code 585.5; see Appendix A for details.*

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

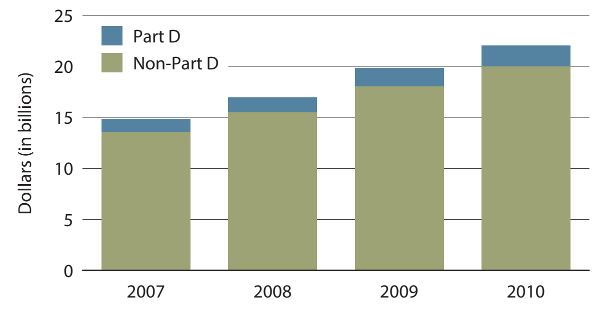
vol 1 7.11 **Total Part D CKD net costs in patients with CKD, by low income subsidy (LIS) status & CKD diagnosis code, 2010**



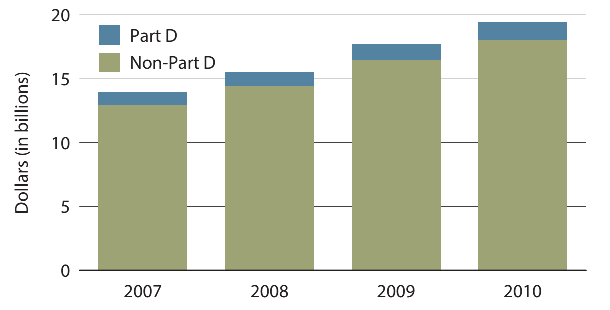
vol 1
7.12
Overall Medicare Part D & non-Part D costs in patients with CKD, by year



vol 1
7.13
Overall Medicare Part D & non-Part D costs in patients with CKD & diabetes, by year



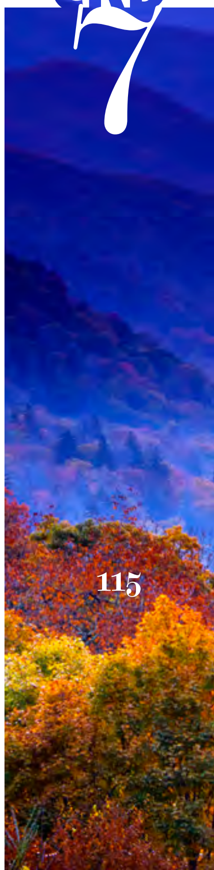
vol 1
7.14
Overall Medicare Part D & non-Part D costs in patients with CKD & CHF, by year



For prevalent Medicare CKD patients age 65 and older, overall non-Part D costs increased 48 percent between 2007 and 2010, from $25.5 billion to $37.7 billion. Part D costs in this population rose 53 percent, from $2.2 billion to $3.3 billion, accounting for 8.2 percent of total costs in 2010, up slightly from 7.9 percent in 2007.

Costs for patients with diabetes in addition to CKD show similar trends. Non-Part D expenditures rose 47 percent, reaching $20 billion in 2010, while Part D costs, at $2.1 billion, were nearly 59 percent greater than in 2007, and accounted for 9.3 percent of total costs for the population.

Expenditures for patients with CKD and congestive heart failure have increased at a slower rate. Non-Part D costs reached $18.1 billion in 2010, 40 percent higher than the $12.9 billion incurred in 2007. Part D costs rose 36 percent to reach $1.4 billion — 7.0 percent of overall costs, just under the 7.2 percent seen in 2007. **» Figures 7.12–14;** see page 146 for analytical methods. *Point prevalent Medicare CKD patients age 65 & older.*



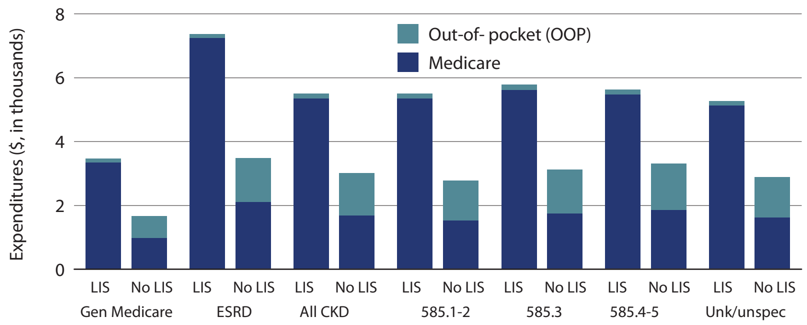
Medicare patients with CKD have higher per person per year (PPPY) Part D costs than general Medicare enrollees regardless of low income subsidy (LIS) status. Overall PPPY costs in 2010 were $5,350 and $3,349, respectively, for CKD and general Medicare patients with LIS and $1,694 and $979 for those with no LIS. » **Table 7.a;** see page 146 for analytical methods. *Point prevalent Medicare CKD patients age 65 & older, 2010.*

vol 1 **7.a** **Total PPPY Part D costs ($) for Part D enrollees, 2010**

	Gen. Medicare		All CKD	
	LIS	No LIS	LIS	No LIS
All	3,349	979	5,350	1,694
65-74	3,301	924	6,033	1,830
75+	3,392	1,047	4,990	1,620
Male	3,119	969	5,243	1,707
Female	3,454	986	5,402	1,682
White	3,544	994	5,521	1,711
Black/Af Am	3,021	863	4,685	1,475
Other race	3,003	822	5,576	1,530

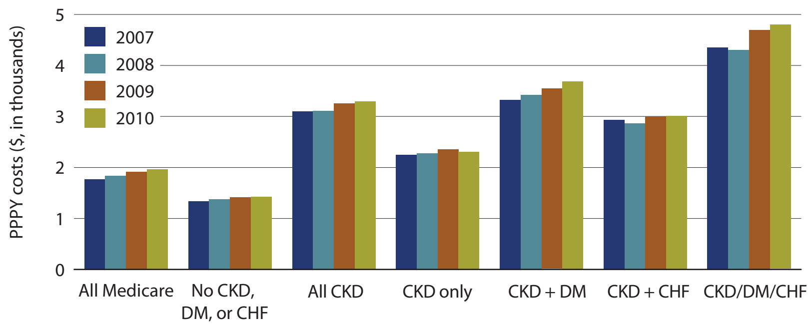
In 2010, ESRD patients with the low income subsidy (LIS) had the highest per person per year (PPPY) costs, at $7,243 compared to $3,349 and $5,350, respectively, for the general Medicare and CKD populations. Out-of-pocket costs were lowest for general Medicare and ESRD patients with the LIS, at $118 and $125 compared to $145 in CKD patients. In those without the LIS, out-of-pocket costs were $686, $1,376, and $1,316, respectively, for general Medicare, ESRD, and CKD patients. » **Figure 7.15;** see page 146 for analytical methods. *Point prevalent Medicare CKD patients age 65 & older, 2010.*

vol 1 **7.15** **Per person per year (PPPY) Part D costs for Part D enrollees, by low income subsidy (LIS) status, 2010**

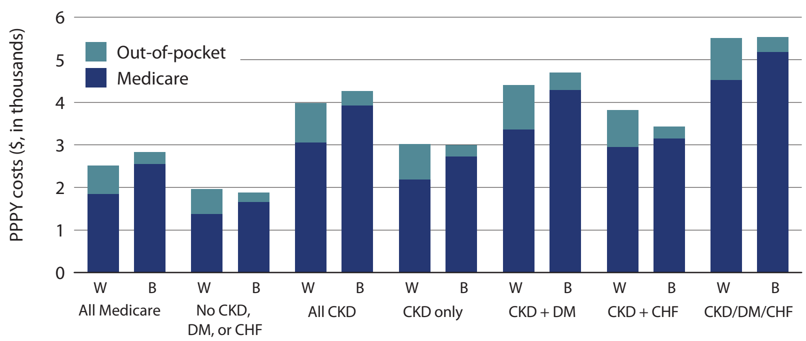


Between 2009 and 2010, Medicare Part D expenditures per person per year (PPPY) rose 2.4 percent overall and 4.7 percent for patients with CKD, to $1,965 and $3,298, respectively. Costs rise with patient complexity, reaching $3,688 for those with CKD and diabetes, and $4,802 for those with an additional diagnosis of congestive heart failure (CHF). » **Figure 7.16;** see page 146 for analytical methods. *Point prevalent Medicare CKD patients age 65 & older, 2010.*

vol 1 **7.16** **Overall per person per year (PPPY) Part D costs for Part D enrollees, by year & at-risk group, 2010**



vol 1
7.17 **Overall per person per year (PPPY) Part D costs for Part D enrollees, by race & at-risk group, 2010**



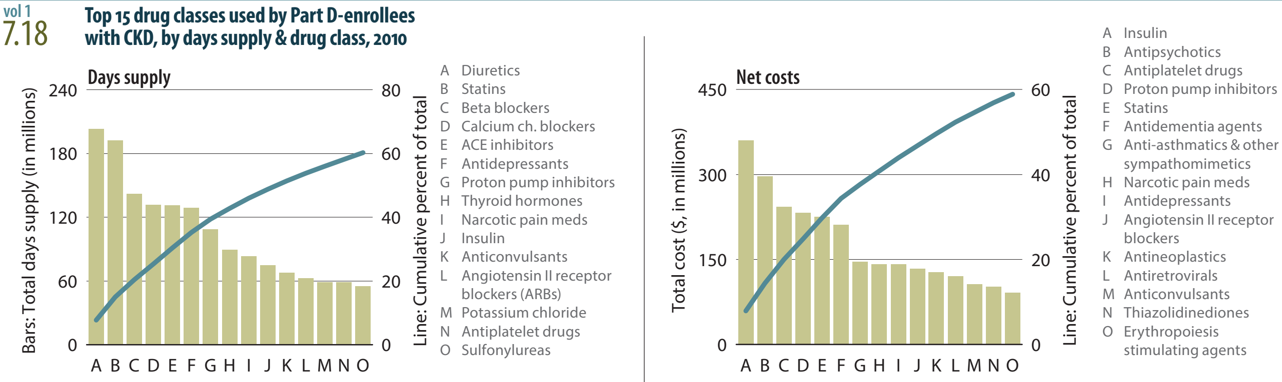
In general, out-of-pocket costs (OOP) for whites in 2010 were 2.5 to 3 times higher than those for blacks/African Americans. And while per person per year costs are higher for patients with CKD compared to those without the condition, the proportion of OOP costs to total costs is actually higher in patients with no CKD. » **Figure 7.17;** see page 146 for analytical methods. *Point prevalent Medicare CKD patients age 65 & older, 2010.*

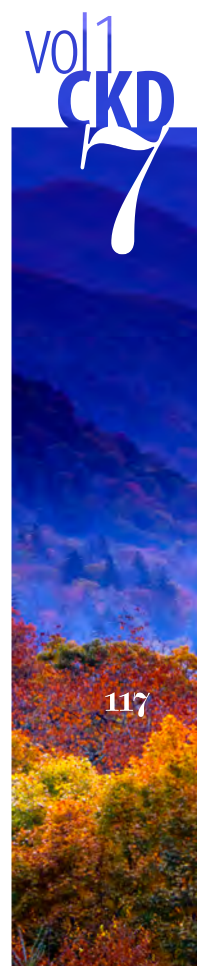
vol 1
7.b **Top 15 drugs used in Part D enrollees with CKD, by days supply & net cost, 2010**

By days supply Generic name	Total days supply	By net cost Generic name	Total days supply	Total cost (dollars)
Furosemide	116,549,920	Insulin	74,735,540	359,843,460
Simvastatin	96,025,260	Clopidogrel bisulfate	53,989,880	227,155,480
Metoprolol	95,041,300	Donepezil	19,567,440	122,565,260
Levothyroxine	88,402,280	Esomeprazole	21,754,600	114,521,000
Amlodipine	84,617,740	Atorvastatin	38,651,260	113,114,980
Lisinopril	76,513,600	Quetiapine	13,461,420	108,079,420
Insulin	74,735,540	Pioglitazone	17,299,760	93,359,820
Omeprazole	64,962,340	Fluticasone/salmeterol	14,054,300	86,148,580
Potassium chloride	58,766,760	Olanzapine	4,762,140	78,968,440
Clopidogrel bisulfate	53,989,880	Memantine	13,856,500	63,059,380
Warfarin	50,785,740	Epoetin alfa	1,938,100	61,496,720
Carvedilol	47,520,840	Tiotropium	11,196,580	58,903,920
Atorvastatin	38,651,260	Sitagliptin	11,133,600	56,650,900
Allopurinol	37,697,680	Valsartan	24,878,640	55,643,200
Hydrocodone/acetaminophen	31,742,560	Rosuvastatin	18,313,300	54,392,300

Furosemide is the most frequently used drug in CKD patients. Simvastatin, the most frequently used drug in the general Medicare population, is also widely used by Part D enrollees with CKD. Drugs such as carvedilol, allopurinol, and hydrocodone are not widely used in the general Medicare population but are frequently used in CKD patients. And potassium chloride is one of the most frequently used medications in the CKD population, which may indicate a more aggressive use of diuretics in these patients. » **Table 7.b & Figure 7.18;** see page 146 for analytical methods. *Point prevalent Medicare CKD patients age 65 & older. Therapeutic classification based on Medi-Span's generic product identifier (GPI) therapeutic classification system.*

vol 1
7.18 **Top 15 drug classes used by Part D-enrollees with CKD, by days supply & drug class, 2010**





OVERALL COSTS OF CKD

per person per year costs in Medicare CKD patients with diabetes, 2010 (Figure 7.3)

» white · $24,593 » black/African American · $28,651

per person per year costs in Medicare CKD patients with congestive heart failure, 2010 (Figure 7.4)

» white · $33,374 » black/African American · $40,487

overall Medicare expenditures for CKD, 2010 (Figure 7.5)

» $41.0 billion (includes Part D)

» 17.0% of total Medicare dollars, up from 5.8% in 2000

Medicare expenditures for patients with CKD & diabetes, 2010 (Figure 7.6)

» $22.1 billion (includes Part D)

» 27.1% of Medicare diabetes dollars, up from 12.0% in 2000

Medicare expenditures for patients with CKD & congestive heart failure, 2010 (Figure 7.7)

» $19.4 billion (includes Part D)

» 36.8% of Medicare CHF dollars, up from 14.4% in 2000

per person per year expenditures for CKD in the Medicare population, 2010 (Figure 7.8)

» all CKD · $22,323 (includes Part D)

» no DM or CHF · $15,607 » CKD + DM · $18,614 » CKD + CHF · $30,903 » CKD + DM + CHF · $37,490

MEDICARE PART D COSTS

total Part D costs, by CKD stage, 2010 (Figure 7.9)

» all CKD · $3.35 billion » Stages 1–2 · $275 million » Stage 3 · $1.16 billion » Stages 4–5 · $426 million

total Part D net costs in CKD patients, by low income subsidy (LIS) status & CKD stage, 2010 (Figure 7.11)

	all CKD	Stages 1–2	Stage 3	Stages 4–5
LIS	» all CKD · $2.4 billion	» Stages 1–2 · $200 million	» Stage 3 · $789 million	» Stages 4–5 · $311 million
no LIS	· $965 million	· $75 million	· $368 million	· $114 million

PER PERSON PER YEAR MEDICARE PART D COSTS

PPPY Part D costs for Part D enrollees, by at-risk group, 2010 (Figure 7.16)

» All Medicare · $1,965 » no CKD, DM, or CHF · $1,431 » all CKD · $3,298 » CKD only · $2,308

» CKD + DM · $3,688 » CKD + CHF · $3,013 » CKD + DM + CHF · $4,802

Tables

Antelope Canyon, Lake Powell Navajo Tribal Park, Arizona

Wherever modern Science has exploded a superstitious fable or even a picturesque error, she has replaced it with a grander and even more poetical truth.

GEORGE PERKINS MARSH,
"The Study of Nature"

REFERENCE TABLES » CKD

Both the CKD and ESRD volumes now include only selected tables of particular interest, and data for some early years are omitted from the printed tables. Excel files of the complete tables are available on our website, www.usrds.org, and on the CD included with this book.

The following symbols are used throughout these tables
* Values for cells with ten or fewer patients are suppressed. " . " Zero values in this cell. †Hispanic is classified as "race" in the Medicare enrollment files.

Table B.1

Point prevalent (December 31) estimated counts: all non-ESRD Medicare patients

Medicare patients (5 percent sample), primary payor only, by age, gender, race, & at-risk group

	1993	1994	1995	1996	1997	1998	1999	2000	2001
20 - 29	171,260	180,540	183,580	182,200	175,180	169,100	162,420	154,640	157,520
30 - 39	519,800	553,940	573,360	583,040	568,840	559,960	548,520	536,580	534,940
40 - 49	693,600	765,260	827,060	876,640	893,600	924,140	962,820	1,005,240	1,050,920
50 - 59	845,980	911,220	965,120	1,023,800	1,077,340	1,122,080	1,180,260	1,254,720	1,352,060
60 - 64	634,240	662,740	678,380	681,440	683,740	697,360	717,000	747,820	803,500
65 - 69	6,599,760	6,442,620	6,177,480	5,885,820	5,511,360	5,212,720	5,087,180	5,104,040	5,357,500
70 - 74	7,311,840	7,380,380	7,207,080	6,915,940	6,666,980	6,421,860	6,246,860	6,218,580	6,304,220
75 - 79	5,601,080	5,560,460	5,562,820	5,570,960	5,491,920	5,400,300	5,471,540	5,501,260	5,577,280
80 - 84	3,785,300	3,856,660	3,856,660	3,829,120	3,759,500	3,733,760	3,704,540	3,799,760	3,996,640
85+	3,188,160	3,236,840	3,266,360	3,269,860	3,272,800	3,284,040	3,319,780	3,371,780	3,463,920
20 - 44	1,028,140	1,104,960	1,156,500	1,185,620	1,172,660	1,172,060	1,166,920	1,159,800	1,175,820
45 - 54	740,400	814,120	876,340	936,120	969,080	1,005,620	1,061,960	1,132,820	1,205,160
55 - 64	1,096,340	1,154,620	1,194,660	1,225,380	1,256,960	1,294,960	1,342,140	1,406,380	1,517,960
65 - 74	13,911,600	13,823,000	13,384,560	12,801,760	12,178,340	11,634,580	11,334,040	11,322,620	11,661,720
75+	12,574,540	12,653,960	12,685,840	12,669,940	12,524,220	12,418,100	12,495,860	12,672,800	13,037,840
Male	12,178,060	12,290,220	12,203,500	12,033,920	11,733,080	11,511,320	11,498,920	11,667,140	12,110,860
Female	17,172,960	17,260,440	17,094,400	16,784,900	16,368,180	16,014,000	15,902,000	16,027,280	16,487,640
White	25,571,240	25,856,400	25,581,280	25,121,260	24,452,520	23,908,240	23,765,420	23,980,520	24,697,660
Black/Af Am	2,499,840	2,572,420	2,556,040	2,515,920	2,444,640	2,412,020	2,422,520	2,471,820	2,596,040
Native American	68,060	75,300	81,060	86,940	90,720	94,980	99,820	105,020	112,500
Asian	179,000	203,760	219,520	238,020	246,700	255,760	268,320	285,840	305,700
†Hispanic	480,660	540,540	571,340	590,500	597,940	586,600	578,340	581,480	597,820
Other/unknown	552,220	302,240	288,660	266,180	268,740	267,720	266,500	269,740	288,780
Diabetes	3,432,100	3,628,560	3,725,740	3,844,840	3,972,340	4,088,720	4,256,460	4,517,360	4,908,920
CHF	2,196,000	2,317,520	2,388,580	2,480,880	2,546,380	2,547,000	2,536,700	2,579,280	2,646,000
CKD	421,800	460,400	477,400	518,700	559,860	598,800	644,980	729,980	845,040
All	29,351,020	29,550,660	29,297,900	28,818,820	28,101,260	27,525,320	27,400,920	27,694,420	28,598,500

	2002	2003	2004	2005	2006	2007	2008	2009	2010
20 - 29	164,760	181,540	197,540	208,120	208,140	217,620	223,620	229,100	236,480
30 - 39	527,820	523,240	524,420	524,340	503,560	512,820	515,940	520,660	532,780
40 - 49	1,098,700	1,148,680	1,191,400	1,203,040	1,152,360	1,133,980	1,112,420	1,099,240	1,104,140
50 - 59	1,450,420	1,538,380	1,644,460	1,730,020	1,715,900	1,742,520	1,762,040	1,803,560	1,879,560
60 - 64	865,900	930,400	990,700	1,016,100	1,012,900	1,043,520	1,061,680	1,094,400	1,156,980
65 - 69	5,655,620	5,909,100	6,041,080	5,982,940	5,777,520	5,672,920	5,643,940	5,715,700	5,848,900
70 - 74	6,379,520	6,364,720	6,355,400	6,247,420	6,034,120	5,926,820	5,902,320	5,849,540	5,891,060
75 - 79	5,724,280	5,762,340	5,682,540	5,570,500	5,306,360	5,072,600	4,847,400	4,761,860	4,732,900
80 - 84	4,163,520	4,270,520	4,375,820	4,321,640	4,163,020	4,082,360	3,966,120	3,879,260	3,868,700
85+	3,565,860	3,662,840	3,725,020	3,774,760	3,790,540	3,818,300	3,824,620	3,904,040	3,978,300
20 - 44	1,189,200	1,212,340	1,239,600	1,249,300	1,194,180	1,200,180	1,188,860	1,190,520	1,207,880
45 - 54	1,274,780	1,349,680	1,428,900	1,477,540	1,451,740	1,470,280	1,481,140	1,493,480	1,530,540
55 - 64	1,643,620	1,760,220	1,880,020	1,954,780	1,946,940	1,980,000	2,005,700	2,062,960	2,171,520
65 - 74	12,035,140	12,273,820	12,396,480	12,230,360	11,811,640	11,599,740	11,546,260	11,565,240	11,739,960
75+	13,453,660	13,695,700	13,783,380	13,666,900	13,259,920	12,973,260	12,638,140	12,545,160	12,579,900
Male	12,617,460	12,974,980	13,217,020	13,186,540	12,839,240	12,689,380	12,578,120	12,601,820	12,802,480
Female	16,978,940	17,316,780	17,511,360	17,392,340	16,825,180	16,534,080	16,281,980	16,255,540	16,427,320
White	25,512,720	26,053,940	26,378,820	26,220,260	25,474,600	25,062,320	24,704,280	24,594,200	24,801,900
Black/Af Am	2,707,840	2,798,500	2,864,800	2,835,840	2,721,500	2,650,700	2,620,400	2,677,100	2,765,260
Native American	118,380	123,000	127,740	129,980	130,000	132,940	135,580	137,020	140,260
Asian	331,800	359,140	379,220	406,180	404,900	427,340	441,420	456,020	477,260
†Hispanic	609,660	618,760	617,140	604,160	548,880	549,360	540,300	554,860	577,420
Other/unknown	316,000	338,420	360,660	382,460	384,540	400,800	418,120	438,160	467,700
Diabetes	5,337,300	5,690,840	6,053,320	6,202,000	6,246,200	6,401,760	6,488,300	6,689,620	6,920,620
CHF	2,724,440	2,799,720	2,844,480	2,764,280	2,657,520	2,599,660	2,556,100	2,569,600	2,584,480
CKD	974,860	1,100,720	1,241,840	1,378,620	1,675,800	1,855,040	2,048,100	2,274,520	2,492,240
All	29,596,400	30,291,760	30,728,380	30,578,880	29,664,420	29,223,460	28,860,100	28,857,360	29,229,800

Table B.2

Point prevalent (December 31) estimated counts: Medicare CKD patients

Medicare patients (5 percent sample), primary payor only, by age, gender, race, & at-risk group

	1993	1994	1995	1996	1997	1998	1999	2000	2001
20 - 29	1,300	1,120	1,220	1,280	1,340	1,160	1,240	1,060	1,380
30 - 39	3,600	4,300	4,640	5,480	5,160	5,240	5,840	5,680	6,000
40 - 49	6,160	7,620	8,700	9,660	10,660	12,800	13,580	15,060	16,300
50 - 59	12,520	14,700	15,840	17,880	19,520	23,020	25,740	30,080	35,460
60 - 64	12,020	13,660	14,560	16,200	17,000	18,220	20,920	24,060	28,560
65 - 69	64,520	69,120	72,300	75,340	77,040	80,280	83,520	97,200	112,240
70 - 74	89,200	98,340	98,960	107,620	115,140	123,360	129,960	143,820	163,720
75 - 79	87,920	93,520	97,120	108,380	120,620	126,880	140,400	159,920	185,840
80 - 84	73,140	77,960	82,900	90,020	95,480	102,160	110,420	124,620	151,060
85+	71,420	80,060	81,160	86,840	97,900	105,680	113,360	128,480	144,480
20 - 44	7,920	8,680	9,700	10,720	11,300	12,020	12,920	13,320	14,080
45 - 54	7,900	10,080	11,400	13,360	14,000	16,540	17,940	21,160	24,800
55 - 64	19,780	22,640	23,860	26,420	28,380	31,880	36,460	41,460	48,820
65 - 74	153,720	167,460	171,260	182,960	192,180	203,640	213,480	241,020	275,960
75+	232,480	251,540	261,180	285,240	314,000	334,720	364,180	413,020	481,380
Male	210,220	224,100	232,240	253,640	273,280	293,940	317,920	359,720	416,520
Female	211,580	236,300	245,160	265,060	286,580	304,860	327,060	370,260	428,520
White	343,280	373,260	387,300	421,020	455,100	485,380	523,920	594,320	687,560
Black/Af Am	62,980	66,720	68,600	73,300	77,900	81,980	86,820	96,260	113,540
Native American	860	1,280	1,300	1,320	1,680	2,280	2,940	3,760	4,400
Asian	2,060	2,780	3,080	4,300	4,780	6,360	6,900	8,600	10,460
†Hispanic	6,540	9,180	11,020	12,580	14,340	15,900	16,980	19,480	21,020
Other/unknown	6,080	7,180	6,100	6,180	6,060	6,900	7,420	7,560	8,060
No DM, no CHF	181,720	191,940	192,760	205,160	216,060	222,480	237,600	260,640	301,440
CHF only	149,760	169,040	182,400	205,440	229,480	257,440	285,100	333,100	395,820
DM only	164,380	184,640	193,500	209,940	227,720	243,660	259,580	297,220	335,760
DM & CHF	74,060	85,220	91,260	101,840	113,400	124,780	137,300	160,980	187,980
All	421,800	460,400	477,400	518,700	559,860	598,800	644,980	729,980	845,040

	2002	2003	2004	2005	2006	2007	2008	2009	2010
20 - 29	1,440	1,460	1,640	1,940	2,480	2,900	2,900	3,520	3,460
30 - 39	7,380	7,420	7,060	7,560	8,780	9,340	9,920	10,840	11,420
40 - 49	19,180	22,480	24,420	25,240	28,000	29,880	34,420	36,640	39,080
50 - 59	40,740	46,440	53,160	59,760	70,740	78,780	84,480	95,500	105,320
60 - 64	33,820	39,140	45,660	49,400	59,620	66,240	70,840	80,300	89,320
65 - 69	129,320	149,700	166,240	179,860	214,240	236,500	258,780	291,240	319,660
70 - 74	184,720	203,500	228,900	243,200	287,640	319,620	357,080	393,280	426,360
75 - 79	211,400	233,800	258,820	287,300	336,820	365,700	388,740	424,920	460,460
80 - 84	179,000	207,680	236,560	264,980	323,680	357,700	394,520	426,980	466,360
85+	167,860	189,100	219,380	259,380	343,800	388,380	446,420	511,300	570,800
20 - 44	16,400	18,020	18,460	19,200	21,620	22,840	24,820	27,300	28,540
45 - 54	28,160	31,820	36,540	39,200	45,220	50,600	56,400	61,960	67,580
55 - 64	58,000	67,100	76,940	85,500	102,780	113,700	121,340	137,540	152,480
65 - 74	314,040	353,200	395,140	423,060	501,880	556,120	615,860	684,520	746,020
75+	558,260	630,580	714,760	811,660	1,004,300	1,111,780	1,229,680	1,363,200	1,497,620
Male	479,500	546,120	608,560	684,120	830,480	915,300	997,920	1,093,560	1,186,320
Female	495,360	554,600	633,280	694,500	845,320	939,740	1,050,180	1,180,960	1,305,920
White	796,400	900,400	1,015,240	1,130,660	1,380,100	1,535,020	1,690,240	1,865,840	2,036,200
Black/Af Am	128,960	144,240	162,040	177,260	213,480	225,860	248,260	284,160	316,300
Native American	4,700	5,160	6,120	5,960	7,620	9,060	10,860	11,700	12,720
Asian	11,580	13,220	16,440	19,240	23,220	27,840	33,240	38,920	42,640
†Hispanic	23,000	25,700	28,940	30,100	33,340	35,840	39,760	44,700	50,360
Other/unknown	10,220	12,000	13,060	15,400	18,040	21,420	25,740	29,200	34,020
No DM, no CHF	346,300	395,420	437,780	487,960	601,860	677,920	759,020	848,460	937,540
DM only	464,840	524,880	605,220	672,740	809,000	901,700	992,800	1,109,160	1,214,960
CHF only	378,060	419,440	471,300	510,540	606,440	641,360	676,660	730,140	779,660
DM & CHF	214,340	239,020	272,460	292,620	341,500	365,940	380,380	413,240	439,920
All	974,860	1,100,720	1,241,840	1,378,620	1,675,800	1,855,040	2,048,100	2,274,520	2,492,240

Table B.3

Point prevalent (December 31) estimated counts: Medicare patients with diabetes

Medicare patients (5 percent sample), primary payor only, by age, gender, race, & at-risk group

	1993	1994	1995	1996	1997	1998	1999	2000	2001
20 - 29	3,500	4,080	4,440	4,420	4,880	4,660	5,020	5,320	5,840
30 - 39	18,400	20,020	22,580	25,040	26,540	28,860	30,880	33,800	36,420
40 - 49	49,900	57,520	65,000	72,600	78,580	87,280	95,140	105,440	117,220
50 - 59	117,100	131,280	143,660	162,340	179,820	194,520	213,580	235,400	268,020
60 - 64	111,020	121,200	129,100	136,040	144,560	154,600	164,120	180,400	204,260
65 - 69	730,920	751,440	746,700	748,240	742,580	743,360	765,720	809,300	891,040
70 - 74	896,380	950,040	962,060	972,200	992,760	1,004,720	1,019,380	1,064,540	1,136,080
75 - 79	714,520	739,540	769,340	804,940	840,580	871,040	928,580	982,000	1,042,000
80 - 84	463,740	501,680	517,360	537,000	555,460	575,740	593,440	634,080	702,400
85+	326,620	351,760	365,500	382,020	406,580	423,940	440,600	467,080	505,640
20 - 44	41,680	46,860	52,300	57,280	62,840	69,140	74,040	80,740	87,820
45 - 54	75,500	86,580	98,180	111,160	120,780	130,320	142,760	159,520	182,420
55 - 64	182,740	200,660	214,300	232,000	250,760	270,460	291,940	320,100	361,520
65 - 74	1,627,300	1,701,480	1,708,760	1,720,440	1,735,340	1,748,080	1,785,100	1,873,840	2,027,120
75+	1,504,880	1,592,980	1,652,200	1,723,960	1,802,620	1,870,720	1,962,620	2,083,160	2,250,040
Male	1,419,480	1,490,660	1,543,240	1,605,620	1,671,760	1,725,560	1,810,420	1,935,180	2,123,040
Female	2,012,620	2,137,900	2,182,500	2,239,220	2,300,580	2,363,160	2,446,040	2,582,180	2,785,880
White	2,815,300	2,952,180	3,024,540	3,116,220	3,216,780	3,304,380	3,434,040	3,645,480	3,955,360
Black/Af Am	456,240	488,760	499,900	511,880	518,200	532,260	556,400	588,320	646,320
Native American	10,240	12,260	13,860	15,220	17,380	19,560	21,940	24,440	27,480
Asian	21,560	26,640	30,700	35,740	40,200	43,680	50,240	56,120	63,420
†Hispanic	86,440	102,780	112,500	123,840	135,600	142,080	145,480	153,080	160,200
Other/unknown	42,320	45,940	44,240	41,940	44,180	46,760	48,360	49,920	56,140
No CKD, no CHF	2,765,100	2,900,260	2,952,460	3,011,440	3,079,780	3,150,600	3,279,640	3,463,280	3,756,480
CHF only	591,300	644,480	682,140	729,800	776,480	805,460	829,020	881,960	944,600
CKD only	149,760	169,040	182,400	205,440	229,480	257,440	285,100	333,100	395,820
CKD & CHF	74,060	85,220	91,260	101,840	113,400	124,780	137,300	160,980	187,980
All	3,432,100	3,628,560	3,725,740	3,844,840	3,972,340	4,088,720	4,256,460	4,517,360	4,908,920

	2002	2003	2004	2005	2006	2007	2008	2009	2010
20 - 29	6,020	6,940	8,180	9,540	9,360	10,820	10,480	11,540	12,140
30 - 39	39,860	42,920	45,760	47,480	47,060	50,980	52,400	53,760	55,820
40 - 49	135,320	150,020	163,700	168,000	169,040	172,020	177,300	183,840	191,860
50 - 59	298,340	327,580	360,980	384,760	390,440	408,740	423,020	444,320	468,380
60 - 64	232,680	257,760	287,300	295,440	299,140	313,740	320,740	336,680	359,720
65 - 69	987,300	1,074,820	1,152,780	1,180,820	1,189,100	1,207,240	1,215,520	1,258,140	1,308,360
70 - 74	1,205,240	1,247,800	1,305,800	1,322,900	1,326,640	1,358,440	1,396,420	1,423,280	1,463,180
75 - 79	1,118,820	1,177,400	1,211,520	1,224,620	1,209,200	1,209,020	1,183,780	1,201,600	1,223,580
80 - 84	771,420	826,700	896,100	914,180	918,500	940,860	945,280	961,640	982,860
85+	542,300	578,900	621,200	654,260	687,720	729,900	763,360	814,820	854,720
20 - 44	98,080	106,760	115,120	121,180	119,980	125,520	127,600	131,580	134,800
45 - 54	203,440	224,000	247,440	260,080	261,800	276,780	287,700	300,280	316,160
55 - 64	410,700	454,460	503,360	523,960	533,260	554,000	568,640	598,280	636,960
65 - 74	2,192,540	2,322,620	2,458,580	2,503,720	2,515,740	2,565,680	2,611,940	2,681,420	2,771,540
75+	2,432,540	2,583,000	2,728,820	2,793,060	2,815,420	2,879,780	2,892,420	2,978,060	3,061,160
Male	2,333,860	2,509,260	2,676,420	2,745,960	2,790,460	2,879,960	2,942,440	3,041,340	3,158,680
Female	3,003,440	3,181,580	3,376,900	3,456,040	3,455,740	3,521,800	3,545,860	3,648,280	3,761,940
White	4,295,920	4,572,840	4,861,560	4,985,900	5,045,760	5,174,680	5,230,220	5,361,920	5,512,300
Black/Af Am	705,140	753,940	801,920	809,260	802,720	803,540	811,340	854,400	898,040
Native American	30,960	33,260	35,980	36,560	37,080	40,000	42,700	43,620	45,160
Asian	72,160	82,540	91,760	102,260	104,500	116,260	126,760	135,360	147,240
†Hispanic	168,780	175,900	181,140	178,180	163,680	168,440	168,960	178,300	189,820
Other/unknown	64,340	72,360	80,960	89,840	92,460	98,840	108,320	116,020	128,060
No CKD, no CHF	4,078,500	4,335,680	4,600,900	4,718,700	4,699,220	4,781,080	4,796,320	4,885,840	5,018,340
CKD only	1,008,300	1,069,300	1,119,660	1,103,180	1,079,480	1,084,920	1,079,560	1,107,860	1,127,240
CHF only	464,840	524,880	605,220	672,740	809,000	901,700	992,800	1,109,160	1,214,960
CKD & CHF	214,340	239,020	272,460	292,620	341,500	365,940	380,380	413,240	439,920
All	5,337,300	5,690,840	6,053,320	6,202,000	6,246,200	6,401,760	6,488,300	6,689,620	6,920,620

Table B.4

Point prevalent (December 31) estimated counts: Medicare patients with CHF

Medicare patients (5 percent sample), primary payor only, by age, gender, race, & at-risk group

	1993	1994	1995	1996	1997	1998	1999	2000	2001
20 - 29	900	1,080	1,120	1,180	1,220	1,240	1,260	1,100	1,360
30 - 39	4,540	5,140	5,680	5,820	6,120	6,200	6,420	6,960	7,740
40 - 49	14,080	15,500	17,940	20,640	21,940	24,160	25,100	28,380	29,520
50 - 59	43,160	46,980	51,080	56,140	61,180	65,600	70,780	78,440	86,280
60 - 64	47,820	52,340	55,600	59,100	61,280	64,060	65,100	70,520	76,540
65 - 69	243,480	249,540	247,700	253,900	249,300	241,800	242,800	248,140	262,100
70 - 74	382,080	403,000	407,880	406,620	421,340	421,300	411,480	410,960	416,280
75 - 79	440,400	455,220	466,460	492,800	508,400	506,240	514,200	526,420	536,660
80 - 84	440,200	469,260	491,260	507,840	513,280	509,320	498,440	508,980	527,460
85+	579,340	619,460	643,860	676,840	702,320	707,080	701,120	699,380	702,060
20 - 44	10,520	11,440	13,080	14,120	15,980	16,480	16,700	17,700	19,280
45 - 54	24,540	27,580	30,580	34,600	36,640	40,820	43,480	49,900	53,980
55 - 64	75,440	82,020	87,760	94,160	99,120	103,960	108,480	117,800	128,180
65 - 74	625,560	652,540	655,580	660,520	670,640	663,100	654,280	659,100	678,380
75+	1,459,940	1,543,940	1,601,580	1,677,480	1,724,000	1,722,640	1,713,760	1,734,780	1,766,180
Male	869,120	910,080	935,400	976,900	1,012,340	1,021,600	1,032,220	1,062,940	1,104,620
Female	1,326,880	1,407,440	1,453,180	1,503,980	1,534,040	1,525,400	1,504,480	1,516,340	1,541,380
White	1,915,700	2,012,160	2,072,100	2,147,060	2,203,740	2,199,040	2,185,780	2,221,080	2,264,780
Black/Af Am	217,420	232,920	239,900	251,020	252,080	252,320	253,480	259,440	274,340
Native American	2,460	3,500	3,800	4,420	5,200	6,220	7,080	7,760	9,700
Asian	7,700	9,300	10,940	13,440	15,200	17,100	17,300	19,020	22,080
†Hispanic	26,480	30,340	33,820	40,120	45,100	47,340	48,580	49,180	53,200
Other/unknown	26,240	29,300	28,020	24,820	25,060	24,980	24,480	22,800	21,900
No DM, no CKD	1,514,380	1,573,620	1,604,200	1,642,980	1,655,580	1,622,660	1,585,400	1,561,080	1,553,620
CKD only	164,380	184,640	193,500	209,940	227,720	243,660	259,580	297,220	335,760
DM only	591,300	644,480	682,140	729,800	776,480	805,460	829,020	881,960	944,600
CKD & DM	74,060	85,220	91,260	101,840	113,400	124,780	137,300	160,980	187,980
All	2,196,000	2,317,520	2,388,580	2,480,880	2,546,380	2,547,000	2,536,700	2,579,280	2,646,000

	2002	2003	2004	2005	2006	2007	2008	2009	2010
20 - 29	1,380	1,720	1,780	1,540	1,640	1,660	1,600	1,880	1,820
30 - 39	8,220	8,640	8,900	8,960	8,480	8,580	8,660	8,920	9,560
40 - 49	33,160	36,840	38,720	37,060	36,880	36,640	35,520	37,400	37,800
50 - 59	93,900	100,560	105,740	110,840	106,780	105,600	107,260	111,720	118,120
60 - 64	84,140	89,440	95,580	95,040	93,800	95,100	92,400	97,800	101,780
65 - 69	276,000	292,040	301,200	286,200	276,260	270,420	266,540	270,500	279,460
70 - 74	421,180	424,820	427,420	407,220	384,200	370,900	371,980	367,120	371,800
75 - 79	538,680	547,980	536,960	516,760	487,480	463,540	443,440	437,160	425,380
80 - 84	548,420	566,300	585,100	561,560	532,520	521,600	501,700	492,060	488,520
85+	719,360	731,380	743,080	739,100	729,480	725,620	727,000	745,040	750,240
20 - 44	21,440	23,180	24,600	23,960	22,900	21,940	22,100	22,480	23,600
45 - 54	57,480	61,820	65,700	66,520	66,180	65,880	66,300	70,280	72,200
55 - 64	141,880	152,200	160,420	162,960	158,500	159,760	157,040	164,960	173,280
65 - 74	697,180	716,860	728,620	693,420	660,460	641,320	638,520	637,620	651,260
75+	1,806,460	1,845,660	1,865,140	1,817,420	1,749,480	1,710,760	1,672,140	1,674,260	1,664,140
Male	1,149,100	1,193,540	1,229,120	1,200,300	1,162,360	1,147,280	1,142,980	1,147,800	1,167,160
Female	1,575,340	1,606,180	1,615,360	1,563,980	1,495,160	1,452,380	1,413,120	1,421,800	1,417,320
White	2,328,420	2,390,520	2,424,560	2,353,620	2,271,360	2,219,820	2,176,600	2,172,560	2,171,060
Black/Af Am	285,440	292,580	301,800	293,140	276,240	265,600	266,260	281,920	293,760
Native American	9,800	10,420	10,500	10,560	10,820	11,440	11,760	11,500	11,620
Asian	23,640	24,580	26,300	27,500	25,740	28,760	28,960	28,180	29,740
†Hispanic	54,380	58,460	57,400	55,180	49,340	49,340	47,560	49,160	50,820
Other/unknown	22,760	23,160	23,920	24,280	24,020	24,700	24,960	26,280	27,480
No DM, no CKD	1,552,420	1,550,000	1,525,980	1,443,180	1,313,100	1,239,320	1,180,260	1,144,840	1,117,500
DM only	378,060	419,440	471,300	510,540	606,440	641,360	676,660	730,140	779,660
CHF only	1,008,300	1,069,300	1,119,660	1,103,180	1,079,480	1,084,920	1,079,560	1,107,860	1,127,240
CKD & DM	214,340	239,020	272,460	292,620	341,500	365,940	380,380	413,240	439,920
All	2,724,440	2,799,720	2,844,480	2,764,280	2,657,520	2,599,660	2,556,100	2,569,600	2,584,480

Table B.5

Point prevalent (December 31) estimated counts: Medicare patients without ESRD, CKD, diabetes, or CHF

Medicare patients (5 percent sample), primary payor only, by age, gender, & race

	1993	1994	1995	1996	1997	1998	1999	2000	2001
20 - 29	166,120	174,780	177,460	175,820	168,280	162,720	155,620	147,820	149,640
30 - 39	495,520	526,940	543,420	549,740	534,460	523,200	509,460	494,560	489,880
40 - 49	630,440	692,860	745,640	785,000	794,740	814,760	844,600	874,700	907,780
50 - 59	698,560	746,360	784,860	823,240	856,540	884,140	921,720	969,800	1,032,220
60 - 64	490,680	507,180	513,420	507,880	500,820	504,340	514,000	526,860	556,360
65 - 69	5,679,820	5,502,480	5,244,160	4,948,660	4,585,820	4,295,340	4,152,180	4,123,360	4,286,240
70 - 74	6,122,660	6,125,060	5,940,360	5,642,020	5,367,800	5,112,480	4,929,100	4,858,460	4,870,100
75 - 79	4,539,320	4,464,460	4,433,880	4,389,840	4,267,620	4,155,300	4,165,040	4,135,380	4,138,720
80 - 84	2,957,300	2,972,820	2,945,900	2,887,460	2,798,000	2,758,200	2,719,820	2,769,140	2,885,480
85+	2,352,080	2,344,180	2,343,860	2,308,080	2,268,880	2,262,100	2,287,640	2,319,020	2,370,320
20 - 44	973,540	1,043,620	1,088,540	1,110,580	1,090,820	1,083,860	1,073,680	1,059,240	1,067,120
45 - 54	645,460	705,160	753,720	798,240	820,720	844,480	886,540	936,560	985,140
55 - 64	862,320	899,340	922,540	932,860	943,300	960,820	985,180	1,017,940	1,083,620
65 - 74	11,802,480	11,627,540	11,184,520	10,590,680	9,953,620	9,407,820	9,081,280	8,981,820	9,156,340
75+	9,848,700	9,781,460	9,723,640	9,585,380	9,334,500	9,175,600	9,172,500	9,223,540	9,394,520
Male	10,023,260	10,042,560	9,892,980	9,636,980	9,251,460	8,979,660	8,882,260	8,905,720	9,135,240
Female	14,109,240	14,014,560	13,779,980	13,380,760	12,891,500	12,492,920	12,316,920	12,313,380	12,551,500
White	21,179,900	21,265,660	20,886,940	20,284,140	19,486,800	18,877,500	18,621,680	18,613,080	18,987,940
Black/Af Am	1,880,400	1,911,100	1,882,500	1,827,340	1,751,780	1,706,480	1,694,380	1,711,040	1,769,420
Native American	56,220	60,700	64,800	68,820	69,900	71,340	73,320	75,920	79,180
Asian	150,880	169,140	179,900	191,240	194,560	198,660	205,080	215,540	226,180
†Hispanic	375,260	416,740	435,400	440,620	434,040	416,000	404,340	400,180	406,960
Other/unknown	489,840	233,780	223,420	205,580	205,880	202,600	200,380	203,340	217,060
All	24,132,500	24,057,120	23,672,960	23,017,740	22,142,960	21,472,580	21,199,180	21,219,100	21,686,740

	2002	2003	2004	2005	2006	2007	2008	2009	2010
20 - 29	156,680	172,280	186,960	196,060	195,780	203,620	210,100	213,840	220,540
30 - 39	478,120	469,920	468,800	466,720	445,800	451,420	452,940	455,840	464,680
40 - 49	935,120	968,200	994,600	1,002,820	949,960	928,720	901,320	879,880	876,580
50 - 59	1,095,280	1,149,760	1,219,960	1,275,240	1,253,740	1,262,520	1,263,860	1,277,920	1,321,100
60 - 64	587,120	622,540	650,860	667,400	658,920	674,000	683,380	696,580	731,620
65 - 69	4,477,300	4,631,440	4,678,200	4,595,020	4,378,200	4,247,320	4,206,880	4,222,360	4,289,900
70 - 74	4,876,420	4,809,040	4,740,140	4,620,780	4,402,920	4,261,900	4,187,440	4,099,700	4,087,540
75 - 79	4,206,900	4,180,940	4,067,780	3,948,280	3,701,900	3,476,180	3,276,460	3,166,820	3,110,400
80 - 84	2,964,600	3,002,140	3,026,800	2,962,860	2,799,380	2,693,780	2,572,700	2,466,360	2,425,200
85+	2,419,120	2,468,820	2,478,360	2,492,640	2,451,720	2,429,580	2,381,160	2,378,240	2,386,840
20 - 44	1,067,860	1,080,580	1,099,200	1,102,740	1,048,280	1,049,160	1,036,160	1,031,660	1,044,440
45 - 54	1,031,200	1,081,840	1,133,880	1,168,500	1,138,680	1,142,360	1,139,260	1,135,380	1,154,280
55 - 64	1,153,260	1,220,280	1,288,100	1,337,000	1,317,240	1,328,760	1,336,180	1,357,020	1,415,800
65 - 74	9,353,720	9,440,480	9,418,340	9,215,800	8,781,120	8,509,220	8,394,320	8,322,060	8,377,440
75+	9,590,620	9,651,900	9,572,940	9,403,780	8,953,000	8,599,540	8,230,320	8,011,420	7,922,440
Male	9,396,840	9,543,740	9,594,400	9,487,900	9,075,820	8,825,560	8,636,720	8,530,140	8,579,680
Female	12,799,820	12,931,340	12,918,060	12,739,920	12,162,500	11,803,480	11,499,520	11,327,400	11,334,720
White	19,409,340	19,618,900	19,627,060	19,353,540	18,516,400	17,963,780	17,515,820	17,219,320	17,212,020
Black/Af Am	1,817,140	1,854,660	1,866,200	1,833,660	1,725,080	1,656,300	1,612,740	1,611,120	1,643,280
Native American	81,640	83,660	85,540	87,380	86,040	86,300	85,160	85,500	86,360
Asian	242,860	258,600	268,100	283,540	280,120	288,080	290,460	295,020	302,320
†Hispanic	409,720	409,380	402,260	394,320	356,080	351,800	342,260	345,920	354,640
Other/unknown	235,960	249,880	263,300	275,380	274,600	282,780	289,800	300,660	315,780
All	22,196,660	22,475,080	22,512,460	22,227,820	21,238,320	20,629,040	20,136,240	19,857,540	19,914,400

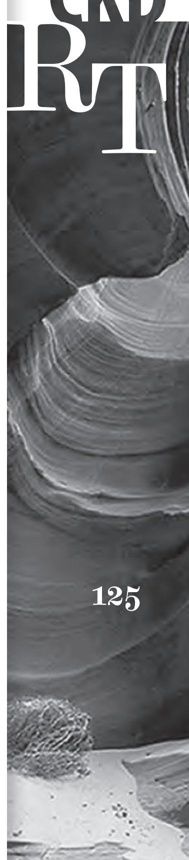


Table B.6

Point prevalent (December 31) estimated counts: Medicare CKD patients, by coded CKD stage

Medicare patients (5 percent sample), primary payor only, by age, gender, & race

	2007			Unknown/		2008			Unknown/	
	Stages 1-2	Stage 3	Stages 4-5	unspecified	Total	Stages 1-2	Stage 3	Stages 4-5	unspecified	Total
20 - 29	560	320	200	1,820	2,900	380	480	320	1,720	2,900
30 - 39	1,320	1,480	1,120	5,420	9,340	1,360	1,840	1,180	5,540	9,920
40 - 49	3,460	5,200	3,200	18,020	29,880	4,040	6,600	3,680	20,100	34,420
50 - 59	8,140	18,680	10,700	41,260	78,780	8,800	22,460	10,500	42,720	84,480
60 - 64	7,120	17,140	8,700	33,280	66,240	7,560	20,840	8,640	33,800	70,840
65 - 69	24,800	66,860	25,880	118,960	236,500	26,720	79,760	26,640	125,660	258,780
70 - 74	30,200	95,380	36,120	157,920	319,620	33,580	118,460	38,200	166,840	357,080
75 - 79	31,740	107,840	46,820	179,300	365,700	32,520	132,620	45,860	177,740	388,740
80 - 84	27,200	102,220	47,800	180,480	357,700	29,900	126,580	52,160	185,880	394,520
85+	27,740	90,320	53,920	216,400	388,380	30,500	124,960	63,140	227,820	446,420
20 - 44	2,900	3,660	2,280	14,000	22,840	3,240	4,400	2,760	14,420	24,820
45 - 54	5,680	10,100	6,760	28,060	50,600	6,160	13,080	6,620	30,540	56,400
55 - 64	12,020	29,060	14,880	57,740	113,700	12,740	34,740	14,940	58,920	121,340
65 - 74	55,000	162,240	62,000	276,880	556,120	60,300	198,220	64,840	292,500	615,860
75+	86,680	300,380	148,540	576,180	1,111,780	92,920	384,160	161,160	591,440	1,229,680
Male	83,400	257,240	110,140	464,520	915,300	89,300	316,700	117,540	474,380	997,920
Female	78,880	248,200	124,320	488,340	939,740	86,060	317,900	132,780	513,440	1,050,180
White	128,920	420,160	184,300	801,640	1,535,020	140,140	528,500	197,660	823,940	1,690,240
Black/Af Am	23,740	61,200	36,700	104,220	225,860	24,600	75,520	37,080	111,060	248,260
Native American	880	2,240	1,420	4,520	9,060	920	2,840	1,560	5,540	10,860
Asian	2,640	7,460	3,880	13,860	27,840	2,840	9,360	4,720	16,320	33,240
†Hispanic	4,000	8,840	5,020	17,980	35,840	4,260	10,880	5,820	18,800	39,760
Other/unknown	2,100	5,540	3,140	10,640	21,420	2,600	7,500	3,480	12,160	25,740
All	162,280	505,440	234,460	952,860	1,855,040	175,360	634,600	250,320	987,820	2,048,100

	2009			Unknown/		2010			Unknown/	
	Stages 1-2	Stage 3	Stages 4-5	unspecified	Total	Stages 1-2	Stage 3	Stages 4-5	unspecified	Total
20 - 29	420	700	340	2,060	3,520	460	520	240	2,240	3,460
30 - 39	1,060	2,180	1,200	6,400	10,840	1,680	2,200	1,200	6,340	11,420
40 - 49	3,880	8,680	3,920	20,160	36,640	4,340	9,920	4,080	20,740	39,080
50 - 59	10,060	27,840	11,180	46,420	95,500	12,500	32,100	12,000	48,720	105,320
60 - 64	9,020	24,640	10,900	35,740	80,300	9,380	30,500	11,380	38,060	89,320
65 - 69	30,960	100,880	28,000	131,400	291,240	34,920	117,560	29,740	137,440	319,660
70 - 74	37,760	143,880	41,160	170,480	393,280	43,600	166,540	42,120	174,100	426,360
75 - 79	38,040	160,140	48,980	177,760	424,920	40,560	188,720	50,020	181,160	460,460
80 - 84	33,360	155,640	54,140	183,840	426,980	35,400	185,560	56,960	188,440	466,360
85+	35,180	165,720	70,400	240,000	511,300	40,700	208,300	76,580	245,220	570,800
20 - 44	3,000	5,880	2,760	15,660	27,300	3,680	6,140	2,700	16,020	28,540
45 - 54	6,660	15,800	7,300	32,200	61,960	8,000	18,440	7,340	33,800	67,580
55 - 64	14,780	42,360	17,480	62,920	137,540	16,680	50,660	18,860	66,280	152,480
65 - 74	68,720	244,760	69,160	301,880	684,520	78,520	284,100	71,860	311,540	746,020
75+	106,580	481,500	173,520	601,600	1,363,200	116,660	582,580	183,560	614,820	1,497,620
Male	99,240	387,740	125,100	481,480	1,093,560	110,300	452,980	129,340	493,700	1,186,320
Female	100,500	402,560	145,120	532,780	1,180,960	113,240	488,940	154,980	548,760	1,305,920
White	155,440	655,540	212,380	842,480	1,865,840	175,640	776,220	222,500	861,840	2,036,200
Black/Af Am	30,660	94,400	41,740	117,360	284,160	32,440	116,840	43,640	123,380	316,300
Native American	960	3,940	1,840	4,960	11,700	940	4,340	1,920	5,520	12,720
Asian	3,960	12,820	4,780	17,360	38,920	4,420	15,740	5,520	16,960	42,640
†Hispanic	5,540	14,080	6,400	18,680	44,700	6,220	16,780	6,460	20,900	50,360
Other/unknown	3,180	9,520	3,080	13,420	29,200	3,880	12,000	4,280	13,860	34,020
All	199,740	790,300	270,220	1,014,260	2,274,520	223,540	941,920	284,320	1,042,460	2,492,240

Table B.7

Percentage of non-institutionalized NHANES participants age 20 & older in the United States

by age, gender, race, & at-risk group

	NHANES 1999-2002	NHANES 2003-2006	NHANES 2007-2010
20 - 44	51.1	49.2	47.1
45 - 54	19.8	21.0	20.6
55 - 64	12.2	12.6	15.1
65 - 74	9.3	9.5	9.5
75+	7.6	7.7	7.7
Male	47.8	48.0	48.2
Female	52.2	52.0	51.8
Non-Hispanic white	71.5	72.3	68.7
Non-Hisp black/Af Am	10.9	11.4	11.3
Mexican American	7.1	7.9	8.5
Other	10.5	8.4	11.5
Diabetes	8.0	8.9	10.2
Self-reported diabetes	6.7	7.8	8.5
Hypertension	46.1	46.0	44.6
Self-reported hyptertension	25.8	29.9	30.3
CVD	8.5	9.3	8.3
BMI>=30	30.6	33.6	34.9
ALL	100.0	100.0	100.0

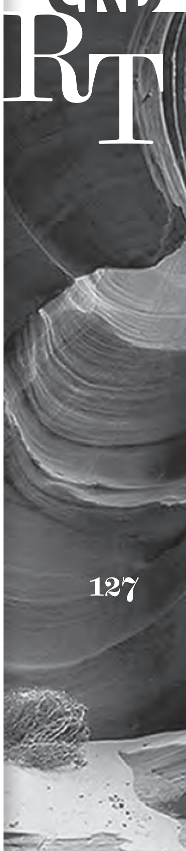


Table B.8

Percentage of non-institutionalized NHANES participants age 20 & older with CKD (Stages 1-4)

by age, gender, race, & at-risk group

CKD: CKD-EPI equation	NHANES 1999-2002	NHANES 2003-2006	NHANES 2007-2010
20 - 44	21.3	20.2	19.2
45 - 54	14.5	13.2	12.8
55 - 64	13.0	15.4	15.9
65 - 74	20.4	20.8	20.8
75+	30.8	30.3	31.4
Male	41.4	42.3	41.7
Female	58.6	57.7	58.3
Non-Hispanic white	73.3	73.1	72.1
Non-Hisp black/Af Am	10.9	11.9	11.4
Mexican American	5.4	6.3	7.4
Other	10.4	8.7	9.0
Diabetes	21.4	24.5	27.8
Self-reported diabetes	18.5	22.9	25.0
Hypertension	74.4	74.3	73.5
Self-reported hyptertension	49.3	56.0	57.9
CVD	22.2	27.6	23.0
BMI>=30	38.6	39.0	42.3
All	100.0	100.0	100.0

Table B.9

Percentage of non-institutionalized NHANES participants age 20 & older with diabetes

by age, gender, race, & at-risk group

	NHANES 1999-2002	NHANES 2003-2006	NHANES 2007-2010
20 - 44	17.7	17.3	13.6
45 - 54	21.3	22.0	22.7
55 - 64	23.5	22.7	23.8
65 - 74	22.4	23.8	23.2
75+	15.2	14.2	16.7
Male	50.6	47.1	50.4
Female	49.5	52.9	49.6
Non-Hispanic white	60.5	63.9	60.4
Non-Hisp black/Af Am	16.3	17.0	17.3
Mexican American	7.2	9.2	9.5
Other	15.9	10.0	12.8
eGFR <60 ml/min/1.73 m^2	16.7	20.0	19.4
ACR >=30 mg/g	36.2	31.0	29.4
eGFR < 60 & ACR >=30	9.0	8.5	8.3
All	100.0	100.0	100.0

eGFR is estimated using the CKD-EPI equation

Table B.10

Percentage of non-institutionalized NHANES participants age 20 & older with CHF

by age, gender, race, & at-risk group

	NHANES 1999-2002	NHANES 2003-2006	NHANES 2007-2010
20 - 44	8.8	6.1	7.6
45 - 54	14.3	12.2	10.9
55 - 64	20.7	17.7	20.3
65 - 74	19.2	30.2	26.8
75+	37.0	33.8	34.4
Male	50.6	54.8	53.4
Female	49.4	45.2	46.6
Non-Hispanic white	73.0	82.0	69.0
Non-Hisp black/Af Am	13.3	12.8	17.1
Mexican American	3.7	3.0	3.3
Other	10.0	2.2	10.6
eGFR <60 ml/min/1.73 m^2	37.0	41.6	35.0
ACR >=30 mg/g	32.1	31.2	30.4
eGFR < 60 & ACR >=30	17.0	14.9	16.2
All	100.0	100.0	100.0

eGFR is estimated using the CKD-EPI equation

Table K.1

Per person per year estimated costs ($): all non-ESRD Medicare patients

general Medicare patients (5 percent sample), primary payor only, by age, gender, race, & at-risk group

	1993	1994	1995	1996	1997	1998	1999	2000	2001
20 - 29	2,979	3,124	3,097	3,065	3,106	3,292	2,987	3,004	3,674
30 - 39	3,286	3,606	3,777	3,874	3,932	3,762	3,661	3,717	4,121
40 - 49	3,161	3,525	3,704	3,953	4,075	4,024	3,980	4,136	4,538
50 - 59	3,852	4,122	4,478	4,749	4,905	4,738	4,771	4,905	5,380
60 - 64	4,626	4,927	5,430	5,887	5,983	5,834	5,640	5,756	6,395
65 - 69	2,891	3,141	3,394	3,579	3,779	3,755	3,741	3,879	4,264
70 - 74	3,528	3,839	4,152	4,389	4,658	4,580	4,623	4,775	5,205
75 - 79	4,357	4,762	5,128	5,466	5,789	5,626	5,622	5,846	6,411
80 - 84	5,037	5,639	6,193	6,583	6,974	6,623	6,547	6,790	7,516
85+	5,701	6,527	7,244	7,713	8,285	7,806	7,597	7,830	8,679
20 - 44	3,197	3,486	3,622	3,737	3,824	3,767	3,646	3,771	4,168
45 - 54	3,454	3,676	3,977	4,265	4,436	4,249	4,269	4,423	4,821
55 - 64	4,343	4,707	5,131	5,499	5,582	5,464	5,370	5,462	6,099
65 - 74	3,224	3,507	3,798	4,015	4,253	4,207	4,228	4,373	4,781
75+	4,888	5,456	5,976	6,366	6,773	6,477	6,404	6,634	7,324
Male	4,185	4,507	4,855	5,176	5,464	5,345	5,374	5,522	6,064
Female	3,820	4,281	4,708	5,007	5,342	5,172	5,120	5,345	5,903
White	3,952	4,312	4,692	4,986	5,295	5,168	5,157	5,370	5,906
Black/Af Am	4,579	5,137	5,649	6,078	6,471	6,139	5,972	6,054	6,689
Native American	2,600	3,161	3,887	4,114	4,250	4,525	4,169	4,748	5,463
Asian	2,634	2,995	3,208	3,601	4,291	4,029	4,430	4,625	5,559
†Hispanic	3,267	4,041	4,420	4,832	5,510	5,273	5,361	5,377	6,147
Other/unknown	3,243	5,135	5,846	6,250	5,672	5,441	5,598	5,252	5,344
Diabetes	7,098	7,817	8,497	9,053	9,541	9,044	8,689	8,901	9,611
CHF	10,448	11,448	12,529	13,342	14,224	13,408	12,995	13,370	14,568
CKD	12,202	12,930	14,667	15,635	16,259	15,150	14,753	14,995	16,125
All	3,970	4,375	4,769	5,077	5,393	5,244	5,226	5,419	5,970

	2002	2003	2004	2005	2006	2007	2008	2009	2010
20 - 29	3,480	3,726	3,959	4,323	6,488	6,898	7,436	8,194	8,181
30 - 39	4,326	4,699	5,060	5,254	8,329	8,948	9,416	9,850	10,167
40 - 49	4,791	5,261	5,766	6,178	9,360	10,160	11,043	11,682	11,862
50 - 59	5,735	6,149	6,528	6,910	9,437	10,337	11,003	11,824	12,504
60 - 64	6,796	7,278	7,908	8,315	10,145	10,730	11,418	12,134	12,540
65 - 69	4,487	4,753	5,115	5,411	6,187	6,597	6,978	7,358	7,551
70 - 74	5,481	5,803	6,221	6,592	7,380	7,757	8,083	8,538	8,876
75 - 79	6,769	7,141	7,685	8,139	9,043	9,485	10,016	10,464	10,708
80 - 84	7,855	8,238	8,874	9,459	10,626	11,216	11,829	12,519	12,816
85+	9,182	9,626	10,370	11,128	12,602	13,531	14,436	15,201	15,553
20 - 44	4,345	4,730	5,125	5,406	8,397	8,965	9,580	10,125	10,224
45 - 54	5,215	5,654	6,031	6,536	9,469	10,339	11,202	11,831	12,419
55 - 64	6,404	6,852	7,405	7,727	9,786	10,549	11,154	11,999	12,488
65 - 74	5,025	5,309	5,689	6,017	6,798	7,191	7,544	7,963	8,223
75+	7,720	8,116	8,750	9,339	10,498	11,154	11,851	12,507	12,832
Male	6,348	6,710	7,173	7,614	8,640	9,126	9,647	10,147	10,442
Female	6,246	6,598	7,128	7,576	8,963	9,602	10,188	10,787	11,111
White	6,215	6,581	7,082	7,533	8,676	9,247	9,800	10,340	10,650
Black/Af Am	7,079	7,355	7,942	8,427	10,089	10,695	11,271	11,998	12,461
Native American	5,924	6,868	7,028	7,393	8,963	9,806	10,499	10,970	11,656
Asian	5,956	6,036	6,452	6,386	8,178	8,780	9,365	10,106	9,998
†Hispanic	6,667	7,094	7,563	8,111	11,012	11,795	12,465	12,902	12,895
Other/unknown	5,283	5,508	5,642	5,853	7,251	7,519	8,052	8,429	8,433
Diabetes	9,965	10,402	11,036	11,518	13,476	14,112	14,806	15,633	15,974
CHF	15,601	16,342	17,557	18,809	21,149	22,708	24,222	25,698	26,421
CKD	16,629	16,858	17,850	18,549	20,967	21,546	22,121	23,005	23,140
All	6,289	6,645	7,147	7,592	8,824	9,396	9,953	10,509	10,819

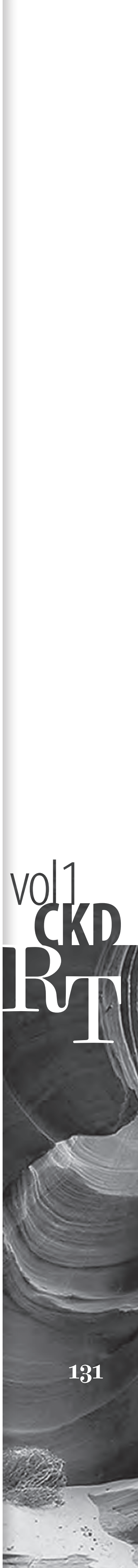


Table K.2

Per person per year estimated costs ($): Medicare CKD patients

general Medicare patients (5 percent sample), primary payor only, by age, gender, race, & at-risk group

	1993	1994	1995	1996	1997	1998	1999	2000	2001
20 - 29	10,461	10,541	11,673	18,158	17,611	16,691	14,061	13,338	17,559
30 - 39	12,675	15,112	19,086	18,785	15,578	13,922	13,207	16,054	16,490
40 - 49	12,339	13,997	15,000	17,716	17,777	14,771	15,097	14,541	15,715
50 - 59	13,433	15,570	16,884	17,072	16,595	14,713	16,153	16,872	17,922
60 - 64	15,701	15,025	16,556	20,154	19,697	17,797	16,927	17,221	16,634
65 - 69	12,115	11,480	13,480	13,640	14,776	13,788	13,112	13,528	14,114
70 - 74	11,753	12,256	14,612	15,108	15,011	14,621	14,333	13,963	14,945
75 - 79	12,487	12,810	14,846	15,045	16,747	15,912	14,977	15,701	16,578
80 - 84	11,551	13,757	14,670	16,666	17,017	15,142	15,008	15,349	16,917
85+	12,384	13,519	14,586	16,315	16,989	15,726	15,448	15,303	17,348
20 - 44	12,312	14,152	16,379	17,485	16,381	13,934	14,412	14,987	16,571
45 - 54	11,723	14,771	16,024	17,203	17,493	15,985	15,703	16,507	15,822
55 - 64	15,265	15,228	16,771	19,335	18,393	16,181	16,498	16,793	17,684
65 - 74	11,908	11,927	14,140	14,479	14,914	14,285	13,848	13,792	14,608
75+	12,163	13,316	14,712	15,937	16,903	15,621	15,127	15,477	16,906
Male	12,055	12,577	14,290	15,346	15,712	14,691	14,647	14,953	15,736
Female	12,345	13,276	15,019	15,904	16,779	15,582	14,854	15,036	16,501
White	11,756	12,476	14,106	14,832	15,475	14,496	14,222	14,541	15,607
Black/Af Am	14,335	15,307	16,955	19,762	20,131	18,851	17,554	17,825	19,299
Native American	11,386	10,712	18,056	13,121	14,970	12,705	11,511	13,704	14,779
Asian	9,674	12,164	7,309	11,942	12,555	11,828	15,009	14,545	15,506
†Hispanic	10,335	12,444	18,909	17,810	20,190	16,458	16,030	15,367	16,185
Other/unknown	18,789	15,530	20,303	20,142	20,120	17,785	17,537	14,813	18,486
NDM, non-CHF	8,836	9,107	10,189	10,821	10,922	10,205	10,224	10,348	11,161
CHF only	17,009	18,085	20,709	22,065	23,304	21,737	21,116	21,355	22,908
DM only	15,238	16,303	18,435	19,207	20,306	18,761	17,305	18,008	18,811
DM & CHF	19,721	20,937	24,224	25,354	27,104	25,456	23,644	24,576	25,410
All	12,202	12,930	14,667	15,635	16,259	15,150	14,753	14,995	16,125

	2002	2003	2004	2005	2006	2007	2008	2009	2010
20 - 29	14,384	12,873	14,634	20,603	19,622	26,690	28,207	38,126	35,200
30 - 39	16,784	14,561	18,329	20,000	25,351	26,797	29,175	29,303	30,649
40 - 49	17,088	18,588	21,466	21,331	29,104	26,545	29,134	32,792	31,344
50 - 59	19,163	19,254	19,933	21,785	24,844	27,145	27,106	27,942	30,831
60 - 64	18,671	19,152	20,041	20,049	23,876	25,060	26,110	28,666	29,163
65 - 69	14,713	15,061	15,739	16,441	18,522	19,624	20,242	20,781	20,257
70 - 74	15,643	15,899	16,323	17,013	18,804	19,377	19,503	20,385	20,541
75 - 79	16,916	16,954	18,009	18,169	20,556	20,576	21,151	21,392	21,813
80 - 84	17,044	17,168	18,580	19,366	21,214	21,805	22,201	23,417	23,327
85+	17,500	17,895	18,943	20,026	22,774	23,046	23,991	24,746	24,615
20 - 44	17,147	16,593	19,409	21,226	26,231	26,839	29,499	33,968	31,212
45 - 54	17,677	18,874	20,820	22,071	25,998	26,978	28,332	29,007	32,031
55 - 64	19,089	19,150	19,940	20,413	24,617	25,875	26,226	28,361	29,474
65 - 74	15,263	15,553	16,075	16,773	18,684	19,482	19,816	20,551	20,421
75+	17,122	17,288	18,465	19,109	21,446	21,785	22,442	23,223	23,308
Male	16,624	16,890	17,723	18,617	20,479	20,834	21,491	22,409	22,512
Female	16,634	16,827	17,974	18,485	21,450	22,245	22,735	23,566	23,717
White	16,144	16,351	17,409	18,096	20,305	20,858	21,376	22,345	22,335
African American	18,830	19,494	20,451	21,594	24,236	25,381	26,109	25,994	27,472
Native American	15,874	18,943	18,471	17,380	19,904	22,349	21,685	24,084	27,225
Asian	20,026	15,951	16,915	16,571	21,398	20,690	24,428	23,914	23,237
†Hispanic	19,114	20,026	20,176	20,254	28,632	27,956	28,286	31,622	29,677
Other/unknown	17,111	16,507	15,983	16,340	19,047	20,024	21,629	22,938	21,229
NDM, non-CHF	11,398	11,781	12,581	12,791	14,809	15,239	15,677	16,307	16,236
DM only	23,772	24,430	25,675	27,060	30,222	31,352	32,907	34,632	35,520
CHF only	19,430	19,517	20,529	21,219	24,083	24,776	25,238	26,292	26,373
DM & CHF	26,241	27,161	28,096	29,101	33,252	34,744	35,991	38,120	38,657
All	16,629	16,858	17,850	18,549	20,967	21,546	22,121	23,005	23,140

Table K.3

Per person per year estimated costs ($): Medicare patients with diabetes

general Medicare patients (5 percent sample), primary payor only, by age, gender, race, & at-risk group

	1993	1994	1995	1996	1997	1998	1999	2000	2001
20 - 29	7,657	8,252	8,393	8,337	8,660	10,108	10,320	8,666	10,952
30 - 39	8,029	7,813	9,032	8,382	8,885	7,211	7,106	8,386	8,815
40 - 49	6,495	7,495	7,896	8,262	8,376	7,959	8,156	8,484	8,684
50 - 59	7,430	7,954	8,381	9,023	8,949	8,544	8,681	9,061	9,680
60 - 64	8,067	8,585	9,058	10,127	10,190	9,745	9,119	9,194	9,925
65 - 69	5,864	6,335	6,881	7,270	7,661	7,254	6,983	7,126	7,775
70 - 74	6,627	7,287	7,826	8,226	8,584	8,362	7,995	8,116	8,633
75 - 79	7,546	8,297	8,905	9,441	10,131	9,625	9,220	9,342	10,146
80 - 84	8,082	9,045	10,120	10,829	11,404	10,392	9,920	10,234	11,166
85+	8,620	9,768	10,759	11,636	12,390	11,493	10,864	11,301	12,194
20 - 44	7,518	7,769	8,069	7,971	8,227	7,581	7,827	8,397	8,644
45 - 54	7,056	7,482	7,970	8,690	8,962	8,260	8,514	8,968	9,253
55 - 64	7,761	8,440	8,967	9,784	9,652	9,317	8,919	9,083	9,893
65 - 74	6,280	6,857	7,408	7,807	8,182	7,887	7,564	7,690	8,262
75+	7,933	8,834	9,680	10,342	11,009	10,264	9,791	10,030	10,893
Male	7,163	7,818	8,432	9,006	9,480	9,052	8,801	8,893	9,598
Female	7,053	7,817	8,542	9,086	9,585	9,038	8,608	8,907	9,621
White	7,035	7,699	8,376	8,876	9,327	8,879	8,537	8,809	9,463
Black/Af Am	7,560	8,668	9,343	10,239	10,815	10,212	9,671	9,689	10,627
Native American	4,501	6,352	7,672	7,710	8,242	8,156	7,094	8,072	8,879
Asian	4,924	5,464	5,726	6,441	7,337	7,301	7,357	7,675	8,792
†Hispanic	5,529	7,378	8,048	8,595	10,133	9,047	9,013	8,641	9,758
Other/unknown	10,480	9,064	10,293	11,301	10,570	9,303	9,277	8,782	9,316
Non-CKD, non-CHF	5,781	6,343	6,792	7,205	7,443	7,056	6,803	6,938	7,522
CHF only	13,456	14,775	16,240	17,104	18,252	17,011	16,171	16,710	17,814
CKD only	15,238	16,303	18,435	19,207	20,306	18,761	17,305	18,008	18,811
CKD & CHF	19,721	20,937	24,224	25,354	27,104	25,456	23,644	24,576	25,410
All	7,098	7,817	8,497	9,053	9,541	9,044	8,689	8,901	9,611

	2002	2003	2004	2005	2006	2007	2008	2009	2010
20 - 29	9,487	9,188	9,040	8,826	14,351	15,001	16,507	21,002	19,426
30 - 39	9,369	9,268	9,907	10,420	15,616	17,529	17,936	18,837	18,310
40 - 49	9,445	10,545	11,493	11,251	16,722	17,343	18,509	19,758	19,906
50 - 59	9,686	10,179	11,009	11,473	15,042	16,458	17,267	18,290	19,433
60 - 64	10,287	10,911	11,650	12,066	15,144	15,629	16,638	17,831	18,349
65 - 69	8,017	8,447	8,763	9,099	10,566	11,137	11,610	12,353	12,557
70 - 74	8,933	9,348	9,959	10,291	11,775	12,035	12,568	13,290	13,673
75 - 79	10,475	10,884	11,547	12,043	13,510	13,994	14,682	15,333	15,487
80 - 84	11,577	11,980	12,727	13,479	15,301	15,922	16,591	17,470	17,651
85+	12,952	13,355	14,181	15,052	17,180	18,266	19,140	19,912	20,262
20 - 44	9,456	9,862	10,935	11,040	16,194	17,154	18,071	19,621	18,868
45 - 54	9,789	10,380	10,960	11,312	15,906	17,015	18,321	19,184	20,225
55 - 64	9,915	10,586	11,440	11,776	14,980	15,914	16,633	17,839	18,593
65 - 74	8,529	8,942	9,405	9,732	11,206	11,611	12,119	12,856	13,151
75+	11,349	11,756	12,489	13,169	14,925	15,631	16,399	17,206	17,457
Male	9,972	10,413	10,966	11,536	13,066	13,599	14,227	14,952	15,349
Female	9,959	10,395	11,092	11,504	13,803	14,526	15,280	16,196	16,494
White	9,801	10,256	10,903	11,364	13,165	13,748	14,456	15,233	15,613
Black/Af Am	10,953	11,384	12,003	12,676	15,060	15,910	16,388	17,526	18,035
Native American	8,733	10,631	10,161	10,514	12,875	13,756	14,946	15,194	15,651
Asian	10,259	9,531	9,768	9,724	12,414	13,265	14,396	15,451	14,933
†Hispanic	10,548	10,969	11,919	12,725	16,996	18,642	19,918	20,713	19,850
Other/unknown	8,770	8,832	9,138	9,366	11,869	12,102	12,579	13,446	13,156
Non-CKD, non-CHF	7,687	8,091	8,546	8,880	10,556	10,941	11,490	12,064	12,306
CKD only	18,897	19,697	20,933	22,142	25,476	27,182	28,622	30,285	30,891
CHF only	19,430	19,517	20,529	21,219	24,083	24,776	25,238	26,292	26,373
CKD & CHF	26,241	27,161	28,096	29,101	33,252	34,744	35,991	38,120	38,657
All	9,965	10,402	11,036	11,518	13,476	14,112	14,806	15,633	15,974

Table K.4

Per person per year estimated costs ($): Medicare patients with CHF

general Medicare patients (5 percent sample), primary payor only, by age, gender, race, & at-risk group

	1993	1994	1995	1996	1997	1998	1999	2000	2001
20 - 29	13,793	17,859	13,768	18,395	17,293	28,526	15,767	21,696	23,214
30 - 39	13,115	17,075	16,010	19,449	15,975	16,744	14,063	13,309	15,905
40 - 49	10,493	12,247	13,728	14,620	15,238	14,592	14,089	15,179	15,282
50 - 59	12,653	13,021	14,582	14,680	15,350	14,419	14,874	15,803	15,955
60 - 64	13,096	13,214	14,180	16,330	16,291	15,633	14,629	14,730	16,513
65 - 69	10,654	11,327	12,283	13,068	14,146	13,623	12,715	13,042	14,141
70 - 74	10,685	11,642	12,787	13,415	14,181	13,404	13,274	13,360	14,084
75 - 79	10,651	11,632	12,548	13,240	14,442	13,796	13,460	13,798	14,848
80 - 84	10,284	11,557	12,860	13,643	14,443	13,377	12,937	13,324	15,032
85+	9,718	10,768	11,799	12,742	13,595	12,647	12,199	12,700	14,016
20 - 44	12,903	14,955	15,457	16,648	15,274	16,094	15,065	15,759	16,014
45 - 54	11,491	12,247	13,354	14,306	15,538	14,370	14,556	15,682	15,167
55 - 64	12,916	13,291	14,537	15,903	15,918	15,269	14,593	14,985	16,514
65 - 74	10,673	11,519	12,593	13,284	14,168	13,485	13,070	13,242	14,105
75+	10,185	11,276	12,352	13,171	14,110	13,216	12,803	13,226	14,581
Male	10,920	11,729	12,723	13,585	14,498	13,705	13,441	13,649	14,847
Female	10,148	11,268	12,407	13,188	14,049	13,215	12,698	13,180	14,374
White	10,190	11,157	12,176	12,942	13,780	13,049	12,647	13,009	14,152
Black/Af Am	12,213	13,658	15,184	16,309	17,204	16,120	15,276	15,943	17,465
Native American	8,815	9,403	15,292	12,709	12,603	11,791	12,241	12,769	13,549
Asian	7,731	10,295	9,049	9,338	12,106	12,056	13,325	14,343	16,596
†Hispanic	9,845	12,793	14,264	15,017	18,158	16,333	16,431	14,843	17,180
Other/unknown	15,170	13,333	14,676	17,379	17,342	13,357	13,896	15,244	14,755
NDM, non-CKD	9,095	9,951	10,758	11,451	12,162	11,472	11,104	11,362	12,365
CKD only	17,009	18,085	20,709	22,065	23,304	21,737	21,116	21,355	22,908
DM only	13,456	14,775	16,240	17,104	18,252	17,011	16,171	16,710	17,814
CKD & DM	19,721	20,937	24,224	25,354	27,104	25,456	23,644	24,576	25,410
All	10,448	11,448	12,529	13,342	14,224	13,408	12,995	13,370	14,568

	2002	2003	2004	2005	2006	2007	2008	2009	2010
20 - 29	26,789	25,675	11,924	24,073	24,008	27,898	37,783	47,710	29,839
30 - 39	19,136	16,698	18,847	23,549	25,972	27,620	29,030	30,214	34,536
40 - 49	16,648	18,642	19,138	20,251	26,784	28,846	31,477	32,959	32,901
50 - 59	16,950	17,826	18,589	20,045	23,784	26,493	28,330	29,835	31,787
60 - 64	17,651	18,263	19,088	21,138	23,855	26,233	26,859	29,038	30,510
65 - 69	15,246	15,785	17,000	18,004	20,066	21,719	23,228	24,622	24,952
70 - 74	15,374	16,072	17,026	18,393	20,271	21,498	22,504	24,244	24,925
75 - 79	15,942	16,743	18,041	19,033	21,044	22,361	23,914	24,979	25,963
80 - 84	15,760	16,592	17,763	18,864	21,240	22,695	24,093	26,035	26,286
85+	14,943	15,620	17,130	18,530	20,965	22,553	24,360	25,538	26,244
20 - 44	19,117	18,526	18,135	21,159	26,749	28,769	32,036	32,984	32,411
45 - 54	16,268	18,231	18,853	20,615	25,059	27,333	30,017	31,508	33,240
55 - 64	17,499	18,018	18,915	20,573	23,674	26,283	27,106	29,128	30,703
65 - 74	15,324	15,958	17,015	18,232	20,187	21,590	22,808	24,401	24,937
75+	15,505	16,268	17,608	18,787	21,075	22,541	24,152	25,536	26,181
Male	15,908	16,763	17,814	19,103	20,649	22,177	23,506	24,944	25,557
Female	15,382	16,037	17,367	18,587	21,535	23,118	24,790	26,306	27,118
White	15,098	15,914	17,175	18,416	20,544	22,030	23,481	24,983	25,619
Black/Af Am	18,681	19,089	20,047	21,969	24,965	26,946	28,781	29,672	31,108
Native American	15,811	19,098	20,147	18,199	21,260	22,542	25,160	26,738	27,383
Asian	20,108	16,870	19,033	16,075	20,141	23,392	25,692	27,910	28,362
†Hispanic	19,056	19,260	19,945	20,995	27,668	30,884	31,870	34,441	33,597
Other/unknown	15,651	16,642	16,565	17,100	22,026	21,822	25,344	25,799	26,180
NDM, non-CKD	13,207	13,777	14,748	15,788	17,247	18,343	19,533	20,560	20,904
DM only	23,772	24,430	25,675	27,060	30,222	31,352	32,907	34,632	35,520
CHF only	18,897	19,697	20,933	22,142	25,476	27,182	28,622	30,285	30,891
CKD & DM	26,241	27,161	28,096	29,101	33,252	34,744	35,991	38,120	38,657
All	15,601	16,342	17,557	18,809	21,149	22,708	24,222	25,698	26,421

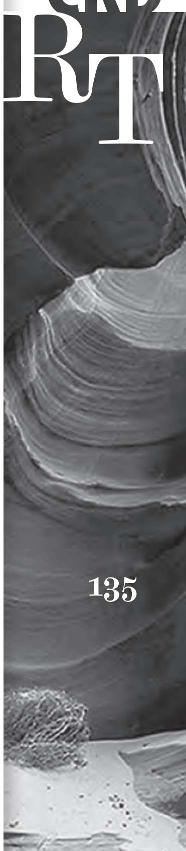
Table K.5

Per person per year estimated costs ($): Medicare patients without ESRD, CKD, diabetes, or CHF

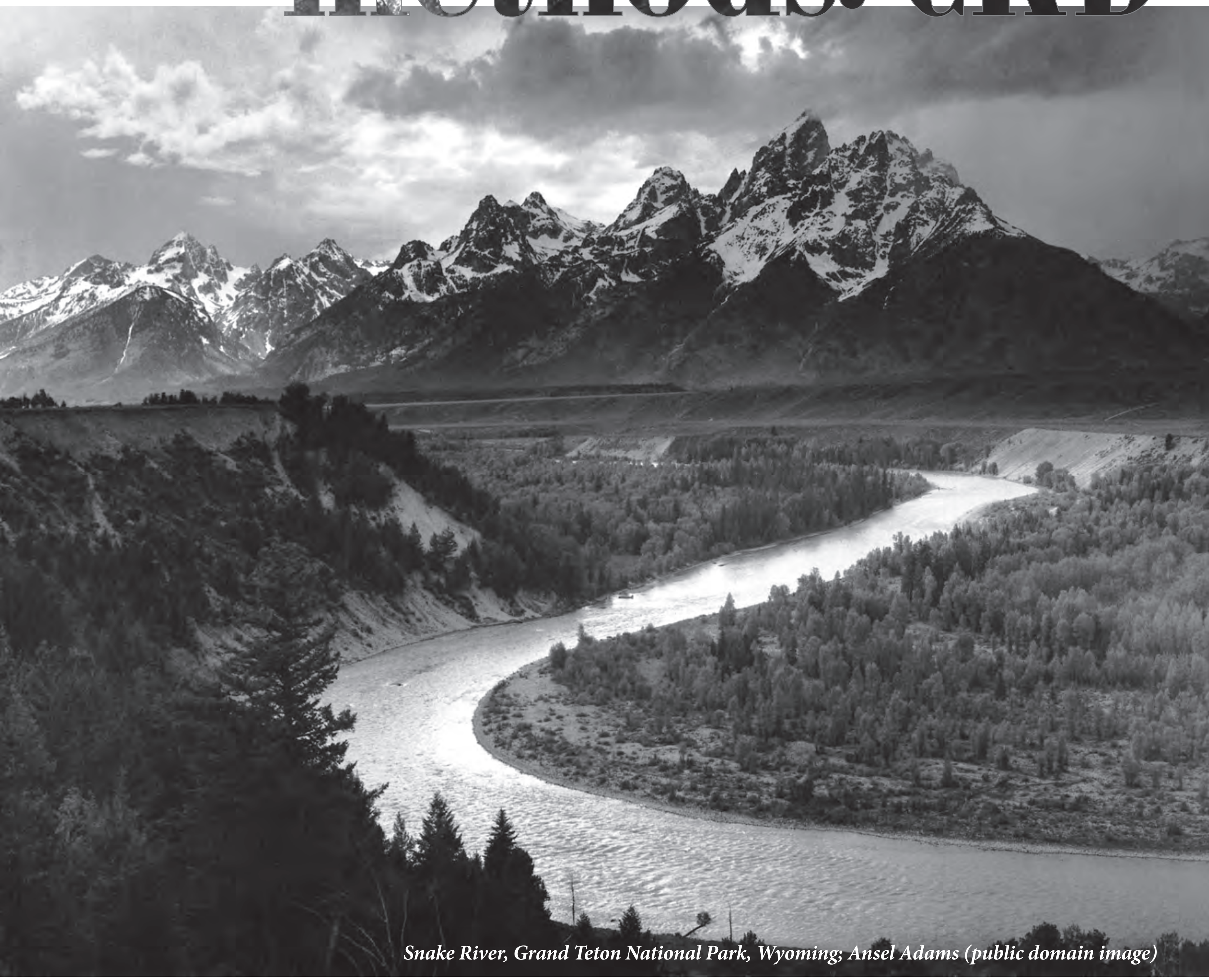
general Medicare patients (5 percent sample), primary payor only, by age, gender, & race

	1993	1994	1995	1996	1997	1998	1999	2000	2001
20 - 29	2,832	2,920	2,917	2,823	2,831	2,901	2,672	2,671	3,268
30 - 39	3,032	3,313	3,424	3,510	3,562	3,438	3,330	3,286	3,647
40 - 49	2,786	3,062	3,191	3,396	3,451	3,415	3,325	3,437	3,803
50 - 59	2,989	3,185	3,454	3,633	3,765	3,624	3,582	3,599	3,973
60 - 64	3,506	3,742	4,173	4,323	4,334	4,219	4,136	4,194	4,681
65 - 69	2,346	2,533	2,713	2,817	2,933	2,920	2,934	3,031	3,314
70 - 74	2,849	3,078	3,285	3,451	3,637	3,552	3,606	3,748	4,095
75 - 79	3,516	3,821	4,084	4,328	4,490	4,336	4,387	4,576	5,008
80 - 84	4,096	4,538	4,912	5,172	5,411	5,182	5,164	5,383	5,925
85+	4,653	5,338	5,911	6,196	6,608	6,210	6,087	6,263	6,978
20 - 44	2,929	3,176	3,281	3,373	3,437	3,368	3,218	3,286	3,641
45 - 54	2,874	3,012	3,238	3,450	3,537	3,406	3,345	3,419	3,797
55 - 64	3,287	3,574	3,904	4,053	4,100	4,014	3,984	3,967	4,441
65 - 74	2,606	2,815	3,015	3,154	3,308	3,262	3,300	3,421	3,737
75+	3,952	4,385	4,762	5,023	5,266	5,034	5,028	5,224	5,765
Male	3,418	3,646	3,889	4,103	4,258	4,151	4,195	4,313	4,707
Female	3,031	3,382	3,685	3,875	4,096	3,969	3,963	4,140	4,594
White	3,217	3,486	3,759	3,957	4,153	4,047	4,069	4,239	4,667
Black/Af Am	3,402	3,753	4,081	4,302	4,539	4,264	4,170	4,195	4,614
Native American	2,190	2,465	2,792	3,134	3,119	3,346	3,123	3,493	4,115
Asian	2,175	2,403	2,619	2,892	3,394	3,011	3,294	3,428	4,243
†Hispanic	2,501	2,986	3,196	3,471	3,702	3,641	3,662	3,795	4,296
Other/unknown	2,162	3,831	4,404	4,519	3,937	4,097	4,252	3,784	3,815
All	3,191	3,493	3,770	3,970	4,163	4,045	4,060	4,213	4,641

	2002	2003	2004	2005	2006	2007	2008	2009	2010
20 - 29	3,022	3,327	3,640	3,917	5,954	6,225	6,649	7,129	7,235
30 - 39	3,740	4,117	4,355	4,472	7,295	7,737	8,105	8,454	8,754
40 - 49	3,946	4,228	4,596	4,995	7,745	8,431	9,139	9,556	9,646
50 - 59	4,336	4,611	4,837	5,121	7,268	7,877	8,454	9,020	9,384
60 - 64	4,920	5,246	5,781	6,019	7,286	7,692	8,242	8,575	8,794
65 - 69	3,473	3,643	3,935	4,149	4,710	4,947	5,192	5,432	5,573
70 - 74	4,267	4,535	4,814	5,091	5,634	5,929	6,113	6,334	6,570
75 - 79	5,249	5,533	5,960	6,326	6,956	7,236	7,543	7,812	7,929
80 - 84	6,192	6,460	6,935	7,386	8,196	8,611	9,015	9,364	9,581
85+	7,363	7,756	8,281	8,868	10,002	10,679	11,302	11,834	12,042
20 - 44	3,708	4,039	4,308	4,535	7,242	7,684	8,152	8,538	8,692
45 - 54	4,079	4,375	4,669	5,082	7,623	8,306	8,973	9,391	9,715
55 - 64	4,712	4,986	5,390	5,601	7,164	7,676	8,222	8,724	8,952
65 - 74	3,896	4,109	4,384	4,624	5,175	5,441	5,655	5,884	6,066
75+	6,057	6,365	6,842	7,303	8,136	8,591	9,044	9,440	9,637
Male	4,874	5,135	5,464	5,762	6,574	6,878	7,224	7,490	7,642
Female	4,855	5,126	5,519	5,879	6,921	7,384	7,774	8,133	8,351
White	4,889	5,166	5,528	5,882	6,769	7,178	7,555	7,874	8,078
Black/Af Am	4,891	5,034	5,525	5,722	6,990	7,277	7,672	8,092	8,234
Native American	4,436	4,900	5,069	5,648	6,740	7,538	7,801	8,026	8,588
Asian	4,142	4,420	4,861	4,756	6,059	6,501	6,661	7,114	6,876
†Hispanic	4,523	4,915	5,073	5,440	7,568	7,872	8,198	8,141	8,360
Other/unknown	3,854	4,085	4,175	4,381	5,268	5,473	5,756	5,893	5,935
All	4,863	5,130	5,496	5,829	6,773	7,168	7,539	7,858	8,047



methods: CKD



Snake River, Grand Teton National Park, Wyoming; Ansel Adams (public domain image)

Science kills credulity and superstition, but to the well-balanced mind it enhances the feeling of wonder, of veneration, and of kinship which we feel in the presence of the miraculous universe.

JOHN BURROUGHS,
Accepting the Universe

In this appendix we describe the datasets and methods used for ckd analyses. Data management and preparation, database definitions, and the data sources used for esrd analyses are described in the appendix of Volume Two.

data sources

The USRDS maintains a stand-alone database with data on diagnoses and demographic characteristics of CKD and ESRD patients, along with biochemical data, dialysis claims, and information on treatment and payor histories, hospitalization events, deaths, physician/supplier services, and providers.

CMS MEDICARE ENROLLMENT DATABASE

The Enrollment Database (EDB) of the Centers for Medicare and Medicaid Services (CMS) is the designated repository of all Medicare beneficiary enrollment and entitlement data, and provides current and historical information on residence, Medicare as secondary payor (MSP) and employer group health plan (EGHP) status, and Health Insurance Claim/Beneficiary Identification Code (HIC/BIC) cross-referencing.

ESRD MEDICAL EVIDENCE FORM (CMS 2728)

The ESRD Medical Evidence (ME) form is the official form for registering ESRD patients, and must be submitted by dialysis or transplant providers within 45 days of ESRD initiation. The CMS, USRDS, and renal research communities rely on the ME form to ascertain basic patient demographic attributes, the primary cause of renal failure, major comorbidities, and biochemical test results at the time of ESRD initiation.

The third key revision of the ME form, released in May, 2005, was meant to remedy several shortcomings found in the 1995 form and its earlier version. Key additions target pre-ESRD care and vascular access use, and additional new fields collect information on glycosylated hemoglobin and lipid testing, on the frequency of hemodialysis sessions, and on whether patients are informed of transplant options.

ESRD DEATH NOTIFICATION FORM (CMS 2746)

The ESRD Death Notification form is used as the official form for reporting the death of individual patients with ESRD. According to CMS policy, this form must be submitted by dialysis or transplant providers within 30 days of a patient's death, and provides the date and causes of death (primary and secondary), reasons for discontinuation of renal replacement therapy, if applicable, and evidence of hospice care prior to death. It is the primary source of death information for CMS and the USRDS, identifying more than 99 percent of deaths. The USRDS also utilizes the Social Security Administration's (SSA) Death Master File as a supplemental data source for ascertaining death in a small group of lost-to-follow-up ESRD patients; this file, however, identifies only all-cause deaths.

CMS 5 PERCENT STANDARD ANALYTICAL FILES (SAFS)

These files contain billing data from final action claims, submitted by Medicare beneficiaries, in which all adjustments have been resolved. The claims data are selected randomly from general Medicare claims (i.e. final action claims) using five combinations of the last two digits of the CMS Health Insurance Claims (HIC) number: 05, 20, 45, 70, and 95. Since the same two-digit numbers are used each year to create the 5 percent general Medicare SAFS, one should expect to see the same beneficiaries in these annual datasets. These claims are categorized into the inpatient (IP), outpatient (OP), home health agency (HHA), hospice (HS), skilled nursing facility (SNF), physician/supplier (PB), and durable medical equipment (DME) SAFS.

Files are updated each quarter through June of the next year, when annual files are finalized. Datasets for the current year are created six months into the year and updated quarterly until finalized at 18 months, after which they are not updated to include late arriving claims. Annual files are thus approximately 98 percent complete. The USRDS 2012 ADR includes all claims up to December 31, 2010.

MEDICARE CURRENT BENEFICIARY SURVEY (MCBS)

The MCBS is a longitudinal survey of a nationally representative sample of aged, disabled, and institutionalized Medicare beneficiaries. It contains information on the health status, health care use and expenditures, drug prescriptions, health insurance coverage, and socioeconomic and demographic characteristics of the entire spectrum of Medicare beneficiaries. Data are made available by CMS in two datasets: Access to Care (1992–2009), and Cost and Use (1992–2008), with the 2009 and 2008 files, respectively, the latest updates for the 2012 ADR.

In the fall of 1991, the MCBS began to be conducted three times per calendar year (winter, summer, and fall), and in 1994 a sample rotation scheme was introduced. Survey participants are kept in the sample for four years, with approximately one-third rolling off, and new participants added each fall to keep the overall sample size at approximately 12,000 each calendar year.

CMS PRESCRIPTION DRUG EVENT (PDE) FILE

In December 2003, Congress passed the Medicare Prescription Drug, Improvement, and Modernization Act (MMA), amending the Social Security Act by adding Part D under Title XVIII. With this new Part D coverage, health plans must submit a summary record called the prescription drug event (PDE) record to CMS whenever a Medicare beneficiary fills a prescription. The PDE record contains 37 data elements; the USRDS receives PDE records with 30 elements, excluding a few non-critical fields. Each drug is identified by a National Drug Index (NDC) code; the record also contains prescription dosing information, drug costs above and below the out-of-pocket threshold, other true out-of-pocket (TrOOP) amounts, plan paid amounts, and low-income cost-sharing subsidy amounts.

Due to delays in the availability of the data, only the 2006 and 2007 PDE files were available for the 2010 ADR. PDE data from 2008 were included in the 2011 ADR. Starting with the 2012 ADR, however, PDE data are in-sync with ESRD claims, so 2009 and 2010 PDE data are both included in this ADR.

THOMSON REUTERS MARKETSCAN DATA

The Thomson Reuters MarketScan Commercial Claims and Encounters Database includes specific health services records for employees and their dependents in a selection of large employers, health plans, and government and public organizations. The database includes nine files: Annual Enrollment Summary Table, Enrollment Detail Table, Inpatient Admissions Table, Inpatient Services Table, Outpatient Services Table, Outpatient Pharmaceutical Claims Table, Facility (Inpatient and Outpatient) Header Table, Aggregated Populations Table, and the Red Book (prescription drug information by National Drug Code). The strength of this database lies in the quality of its cost information, where claims data include actual paid dollars and net payments by the insurer.

The MarketScan database links billing and encounter data to detailed patient demographic and enrollment information across sites and types of providers, and over time from 1999 to 2010, and includes commercial health data from approximately 100 payors; about 80 percent of those covered are self-insured. Each year the database contains health data for about 10.5 million people. For details about the MarketScan data, please visit www.usrds.org.

INGENIX I3 DATA

The Ingenix i3 database is a commercial, non-capitated health plan database covering employees from multiple employers within a single insurer. In addition to the usual service encounter and drug data, it also includes laboratory data, allowing for comparisons between claims-based and lab-based definitions of diseases. To protect the discount structure of its business, the billing data of this single insurer discloses only charged dollars without actual paid amounts or the portion paid by the insurer.

The Ingenix i3 database links billing and encounter data to detailed demographic and enrollment information of individual employees from 2000 to 2010, and contains health data for about 14 million people annually. For details about what is contained in the Ingenix i3 data, please visit our website at www.usrds.org.

NATIONAL HEALTH AND NUTRITION EXAMINATION SURVEY (NHANES)

NHANES is a series of health examination surveys conducted by the National Center for Health Statistics (NCHS) of the Centers for Disease Control and Prevention (CDC). Begun in 1959, NHANES is designed to monitor the health and nutritional status of the non-institutionalized civilian population in the United States. NHANES III was conducted in two phases between 1988 and 1994. In 1999, NHANES became a continuous annual survey to allow annual estimates, with release of public-use data files every two years. Both NHANES III and NHANES 1999–2010 were nationally representative cross-sectional surveys and used a complex, stratified, multi-stage probability cluster sampling design that included selection of primary sampling units (counties), household segments within the counties, and sample persons from selected households. Survey

participants were interviewed in their homes and/or received standardized medical examinations in mobile examination centers. Both surveys over-sampled African Americans, Mexican Americans, and individuals age 60 or older to improve the estimates for these subgroups.

PAYORS

Information on payors is obtained from the CMS EDB. We also examine Medicare outpatient claims to identify patients for whom the EDB does not indicate Medicare as primary payor (MPP), but who have at least three consecutive months of dialysis treatment covered by Medicare; these patients are also designated as having MPP coverage. From these two data sources we construct a payor sequence file to define payor history, and, starting with the 2003 ADR, we use this file to identify Medicare eligibility status and other payors.

The construction of this file is similar to that of the treatment history file. Payor status is maintained for each ESRD patient from the first ESRD service date until death or the end of the study period. Payor data are used to categorize a patient as MPP, Medicare as secondary payer (MSP) with EGHP, MSP non-EGHP, Medicare Advantage (Medicare + Choice), Medicaid, or a combination of payors. With this approach, the USRDS is now able to apply payor status information in all outcome analyses using the "as-treated" model (see the discussion of Chapter Eleven in Volume Two).

UNITED STATES CENSUS

In rate calculations throughout this year's ADR we use data from the 2000 and 2010 U.S. Census, and incorporate CDC population estimates by race.

database definitions

EGHP DATA

To examine the demographic segment represented by the EGHP data, we use enrollment information to construct yearly cohorts of enrollees younger than 65. To ensure that we select enrollees with the potential to generate claims evidence appropriate to the demands of analytical methods, rules for inclusion also include 12 months of continuous coverage in a commercial fee-for-service plan, and, for medication analyses, continuous prescription drug coverage. Comorbidities are identified using claims. Patients with at least one inpatient claim or at least two outpatient claims during the period of interest and with a diagnosis code of a particular comorbidity are identified as having that comorbidity.

ESRD COHORT IN THE EGHP POPULATION

Because the MarketScan and Ingenix i3 databases do not provide identifiable data elements, we are unable to link them directly to the USRDS ESRD registry. To identify ESRD patients, we therefore use a process similar to that used in the registry. Transplant patients are identified by evidence of a kidney transplant procedure or an adverse graft event, and chronic dialysis patients by evidence of continuous history of dialysis therapy, with at least three consecutive months of dialysis service and with dialysis service claims in at least 70 percent of treatment months. Treatment months are defined by the period from the first dialysis claim to the earliest of kidney transplant, death, or end of enrollment. Both inpatient and outpatient claims are evaluated for evidence of dialysis service history.

The first ESRD service date is set to the earliest of the first dialysis service date or the transplant date. If neither is available, the start of enrollment is used. Incidence is defined by a first ESRD service date at least 60 days after the start of enrollment.

identification of major comorbidities

According to a previously validated method for using Medicare claims to identify diabetic patients, a patient is diabetic if, within a one-year observation period, he or she has a qualifying ICD-9-CM diagnosis code of diabetes on one or more Part A institutional claims (inpatient, skilled nursing facility, or home health agency), or two or more institutional outpatient claims and/or physician/supplier claims. We employ this method to identify major comorbidities: diabetes, 250.xx, 357.2, 362.0x, and 366.41; hypertension, 362.11, 401.x–405.x, 437.2; CKD, 016.0, 095.4, 189.0, 189.9, 223.0, 236.91, 250.4, 271.4, 274.1, 283.11, 403.x1, 403.x0 (after October 1, 2006), 404.x2, 404.x3, 404.x0 and 404.x1 (after October 1, 2006), 440.1, 442.1, 447.3, 572.4, 580–588, 591, 642.1, 646.2, 753.12–753.17, 753.19, 753.2, and 794.4; congestive heart failure, 398.91, 402.x1, 404.x3, 422.xx, 425.xx 428.xx, V42.1; and CVD (other than CHF), 404.x1, 410–414, 420–421, 423–424, 426–427, 429, 430–438, 440–444, 447, 451–453, 557, 785.0–785.3, V42.2, V43.3, V45.0, V45.81, V45.82, and V53.3.

CKD in the general population

chapter one

The National Health and Nutrition Examination Survey (NHANES) is a nationally representative survey which combines interviews and medical examinations to assess the health of the United States non-institutionalized population (http://www.cdc.gov/nchs/nhanes.htm). The first NHANES data was collected in the early 1970s, followed by two more NHANES cycles in the late 1970s and late 1980s/early 1990s. Starting in 1999, NHANES has been collecting data continuously in two-year cycles. Data for this chapter comes from participants 20 years old and older in NHANES III (1988–1994) and in the NHANES continuous cycle years 2005–2006, 2007–2008, and 2009–2010.

The statistical software package SUDAAN, version 10.0, was used to analyze all NHANES data, incorporating the sampling weights and survey design through Taylor Series Linearization.

In this chapter, age is defined as the participant's age at the time of the household interview, categorized into the following age groups: 20–39, 40–59, or 60 and older. Race/ethnicity is self-reported and is categorized as non-Hispanic white, non-Hispanic African American, or other.

The estimated glomerular filtration rate (eGFR, measured in ml/min/1.73 m^2) is calculated using the CKD-EPI equation, based on the National Center for Health Statistics recommended standardized creatinine values. The CKD-EPI equation is: eGFR = 141 × min(Scr/κ, 1) α × max(Scr/κ, 1) (-1.209) × 0.993age × 1.018 [if female] × 1.159 [if black/African American], where Scr is standardized serum creatinine in mg/dl, κ is 0.7 for females and 0.9 for males, α is -0.329 for females and -0.411 for males, min(Scr/κ, 1) indicates the minimum of Scr/ κ or 1, and max(Scr/κ, 1) indicates the maximum of Scr/κ or 1 (Levey et al.).

Albumin/creatinine ratio (ACR) is the ratio of urinary albumin (mg/l) to urinary creatinine (mg/dl). Based on an NCHS suggestion, urine creatinine value is adjusted to NHANES 2007–2008.

The identification of CKD is based on both eGFR and ACR, and is defined as an eGFR less than 60 ml/min/1.73 m^2 or an ACR ≥ 30 mg/g. CKD includes stages 1–5, which are classified using the standard CKD definitions:

» Stage 1: ACR ≥ 30 and eGFR ≥ 90
» Stage 2: ACR ≥ 30 and 60 ≤ eGFR < 90
» Stage 3: 30 ≤ eGFR < 60
» Stage 4: 15 ≤ eGFR < 60
» Stage 5: eGFR < 15

Participants with diabetes are those with any of the following: 1) an affirmative answer to the question "Have you ever been told by a doctor or other health professional that you have diabetes or sugar diabetes (other than during pregnancy)" 2) an affirmative response to either "are you now taking insulin?" or "are you now taking diabetic pills to lower your blood sugar?" or 3) glycohemoglobin ≥ 7 percent. Participants with self-reported diabetes are those who report having been told by a doctor that they have diabetes or sugar diabetes (other than during pregnancy). In NHANES 2005–2010, participants answering "borderline" are classified as non-diabetic to agree with NHANES III coding. Control of diabetes is assessed as a glycohemoglobin of < 7 percent.

Patients with hypertension are those with either 1) high blood pressure, defined as systolic blood pressure above 140 mmHg (> 130 mmHg for those with CKD or self-reported diabetes) or diastolic blood pressure above 90 mmHg (>80 mmHg for those with CKD or self-reported diabetes), or 2) an affirmative answer to the question "Are you now taking prescribed medicine for high blood pressure?" Self-reported hypertension is identified through an affirmative answer to the question "Have you ever been told by a doctor or other health professional that you had hypertension, also called high blood pressure?" Patients are classified as being aware of hypertension if they report having been told they have high blood pressure, are classified as being treated for hypertension if they report currently taking a prescription to control hypertension, and are considered in control of hypertension if current blood pressure is < 140/<90 (< 130/<80 for CKD or diabetic patients).

Participants who self-report any of the following diseases are considered to have cardiovascular disease: angina, myocardial infarction, stroke, coronary heart disease, or congestive heart failure.

Hyperholesterolemia (LDL cholesterol) is measured in the medical examination. We assess whether LDL falls within the ATP III target range (≤100 mg/dl for patients with coronary heart disease (CHD) and CHD risk equivalents, including CKD, ≤130 mg/dl for patients with two or more risk factors, and ≤160 mg/dl for patients with 0–1 risk factors) based on measured LDL level and associated risk factors (http://www.nhlbi.nih.gov/guidelines/cholesterol/atglance.pdf). Similar to hypertension, awareness of hypercholesterolemia is assessed by self-report of being told by a doctor that blood cholesterol level is high, and a patient is classified as being treated for hyperlipidemia if he or she reports currently taking a cholesterol medication to control cholesterol. Control is defined as meeting the ATP III LDL target for the appropriate risk category. HDL cholesterol is within ATP III target if it is less than 40 mg/dl. There are three categories of total cholesterol: <200 (desirable), 200–239 (borderline high), and ≥240 (high).

identification & care of patients with CKD

chapter two

Figure 2.1 illustrates the extent of point prevalent diabetes, cerebrovascular accident/transient ischemic attack, congestive heart failure, and CKD in the general Medicare population. Methods are the same as those described at the beginning of Chapter Six.

Table 2.a compares the characteristics of prevalent general Medicare, MarketScan, and Ingenix Ingenix CKD patients by age, gender, race, ethnicity, and comorbidity in 2010. Table 2.b includes prevalent non-ESRD Medicare patients age 65 and older, alive at the end of 2010, and prevalent MarketScan and Ingenix i3 patients age 20–64. Each comorbidity is defined by medical claims (one inpatient or two outpatient claims) during each calendar year.

Figures 2.2–4 illustrate the prevalence of CKD in the Medicare, MarketScan, and Ingenix i3 populations. The 5 percent Medicare sample includes patients age 65 and older, without ESRD, who survive throughout the cohort year with Medicare as primary payor, and who are not enrolled in Medicare Advantage. The MarketScan and Ingenix i3 cohorts are constructed in a similar fashion, but are restricted to patients age 20–64, enrolled in a fee-for-service plan, and without ESRD.

Figure 2.5 shows the cumulative probability of non-CKD patients receiving a first urinary microalbumin or creatinine measurement, or both measurements, by month 12 of the second year of each two-year period. The general Medicare population includes patients continuously enrolled in the Medicare inpatient/outpatient and physician/supplier program during the first year. Patients are excluded if they are younger than 20 at the beginning at the second year, are enrolled in a managed care program (HMO), acquire Medicare as secondary payor, die, are diagnosed with CKD or ESRD during the first year, have a missing date of birth, or do not live in the 50 states, the District of Columbia, Puerto Rico, or the Territories. Patients are followed from January 1 to December 31 of the second year. The Kaplan-Meier method is used to calculate the cumulative probability, and patients are censored at death, development of ESRD, and change in payor status.

CPT codes used to define urinary microalbumin measurement are 82042, 82043, 82044, and 84156, while codes for creatinine measurement are 80047, 80048, 80049, 80050, 80053, 80054, 80069, and 82565. Diabetes and hypertension are defined in the first year. Methods of defining CKD, diabetes, and hypertension are the same as those described above in the section on identification of major comorbidities.

Table 2.c shows unadjusted and adjusted cumulative probabilities of non-CKD patients receiving a first urinary microalbumin or creatinine measurement, or both measurements, by month 12 of 2010. The cohort is the same as that described for 2009–2010 in Figure 2.5. Cardiovascular disease is defined as any combination of ASHD, CHF, CVD, PVD, dysrhythmia, or other cardiovascular disease, as described in the section on identification of major comorbidities. The Kaplan-Meier method is used to calculate the unadjusted cumulative probability, and the corrected groups prognosis methodology is used to calculate the adjusted cumulative probability for each patient characteristic category.

The Medicare and MarketScan columns of Tables 2.d–e include patients who are alive with full coverage for all of 2010. The CKD diagnosis code (all or 585.3–585.6), as well as the disease burden, are determined from claims in 2010. Table 2.f and Figures 2.6–8 reflect the results of adjusted logistic regression on the Medicare and MarketScan cohorts from Tables 2.d–e.

Figures 2.9–12 and Tables 2.g–i include patients who are alive with full coverage for all of 2009, to allow for up to one year of follow-up for physician claims. The date on the earliest CKD claim (all or 585.3–585.6) of 2009 is used as the date of CKD diagnosis, and physician claims are searched for 365 days following that date. The cumulative probability in Figure 2.9 represents unadjusted Kaplan-Meier estimates, while in Tables 2.g–h the adjusted cumulative probability is obtained from the corrected group prognosis method, implementing proportional hazards regression. Adjusted hazard ratios in Table 2.i and Figures 2.10–12 are obtained from proportional hazards regression.Figures 2.13–16 include CKD patients in the 2009 entry period, and show the cumulative probability of medication use during the twelve-month study period in 2010. The study cohort includes MarketScan patients (age 50–64) and patients from

the Medicare 5 percent sample (age 65 and above); MarketScan patients have fee-for-service coverage during the entry period and medical coverage and drug insurance during the study period. All comorbidities are defined by medical claims (one inpatient or two outpatient) during the entry period.

Figures 2.17–20 show the percentage of patients on specific drugs during the eight quarters prior to and one quarter after ESRD initiation, based on CKD diagnosis codes. The cohort includes 2010 incident Medicare ESRD patients age 67 and older at the initiation of ESRD, and Marketscan patients age 20-64. Medicare ESRD patients have two years of prior coverage with Parts A and B, and have Part D coverage during the nine quarters, while Marketscan patients have fee-for-service coverage and drug insurance during the nine quarters.

hospitalization & mortality

chapter three

hospitalization

Adjusted admission rates in this chapter include adjustment for baseline comorbidities and prior hospitalization in addition to patient demographics. A model-based adjustment method is used with a Poisson assumption, and includes data from the current and previous two years, with respective weights of 1, ¼, and ⅛. Adjusted rates reflect the distribution of a reference cohort, specified below in the discussion of the respective figures. With this method, the parameter estimates from the model are used to calculate an estimated admission rate for each patient in the reference cohort. Adjusted rates are then computed as the weighted average of these individual rates, using as the weight the time at risk of each patient in the reference cohort.

Figure 3.1 shows rates of rehospitalization and/or death 30 days after live hospital discharge among general Medicare patients without CKD, with CKD, and on hemodialysis. Data include point prevalent Medicare patients on January 1, 2010, who are age 66 and older on December 31, 2009. For the CKD and non-CKD cohorts, during 2009 CKD is defined and patients are continuously enrolled in Medicare Parts A and B without HMO coverage and without ESRD. Live hospital discharges from January 1 to December 1, 2010 are identified as index hospitalizations; the latter date provides a 30-day period following the latest discharge to evaluate rehospitalization. The units of analyses include hospital discharges rather than patients. Hospitalization data exclude rehabilitation claims and transfers. Discharges with a same-day admission to long-term care or a critical access hospital are excluded. For hemodialysis patients, discharges are excluded with a transplant, loss to follow-up, or end of payor status before day 30 after discharge. For general Medicare patients, discharges are excluded with a first ESRD service date or end of payor status (not due to death) before day 30. Rates reflect the percentage of live discharges followed by a rehospitalization and/or death within 30 days.

Table 3.a and Figures 3.2–3 show adjusted all-cause admission rates in Medicare patients age 66 and older. The study design consists of a one-year period (2009) during which CKD, comorbidities, and prior hospitalization are defined from claims, followed by the cohort year (2010) when follow-up for admissions begins on January 1. The Medicare cohort includes patients who are age 66 and older on December 31, 2009, are residents of the 50 states, the District of Columbia, Puerto Rico, or the Territories, are continuously enrolled in Medicare inpatient/outpatient and physician/supplier coverage, are without HMO coverage, are without ESRD, and who survive the complete year prior to follow-up. Patients are followed for admissions from January 1, 2010, and are censored at the earliest of death, ESRD initiation, end of plan coverage, or December 31, 2010. Rates are adjusted for age, gender, race, prior hospitalization, COPD, hypertension, liver disease, gastrointestinal disease, cancer, anemia, and with diabetes and cardiovascular disease combinations rather than as separate factors. Groups for diabetes and cardiovascular disease are mutually exclusive. Rates presented by one factor are adjusted for the others. The reference cohort includes Medicare patients in 2010, age 66 and older.

Figures 3.4–7 show adjusted all-cause and cause-specific admission rates by CKD diagnosis code and dataset. Study design, censoring, and inclusion criteria generally follow the description for the Medicare cohort in Table 3.a and Figures 3.2–3. Additionally, Ingenix i3 and MarketScan data include point prevalent patients on January 1, 2010, continuously enrolled in a fee-for-service or commercial health plan and without ESRD during 2009, and age 50–64 on December 31, 2009. The group labeled "CKD" includes those with claims-based evidence of CKD in 2009, while "non-CKD" is defined as patients without claims-based evidence of CKD. Rates are adjusted for gender, prior hospitalization, ASHD, CHF, CVA, PVD, dysrhythmia, other cardiac disease, diabetes, COPD, hypertension, liver disease, gastrointestinal disease, cancer, and anemia. Cause-specific rates reflect hospital admissions for the purpose of the stated condition, and are identified by the principal ICD-9-CM diagnosis codes for cardiovascular and infectious admissions listed in the description of Figure 3.1 in Volume Two. The reference cohort includes Medicare patients in 2010, age 66 and older.

Figure 3.8 displays annual trends in rates of rehospitalization and/or death within 30 days after hospital discharge among CKD patients. Methods follow those described in Figure 3.1 for CKD patients in 2010. Here, however, point prevalent Medicare CKD patients are included on January 1 of each year, including those age 66 and older on December 31 of the prior year. Also, during each prior year, CKD is defined, and patients are continuously enrolled in Medicare Parts A and B without HMO coverage and without ESRD. Live hospital discharges from January 1 to December 1 of each year are included. Rates are adjusted for age, gender, and race using direct adjustment, and the reference group includes discharges in 2005.

Table 3.b and Figures 3.9–12 show unadjusted rates of rehospitalization and/or death within 30 days after live hospital discharge. Methods follow those described for the CKD and non-CKD cohorts in Figure 3.1. Data include point prevalent Medicare patients on January 1, 2010, age 66 and older on December 31, 2009. Additionally, CKD stage is defined during 2009. While Table 3.b and Figures 3.9 and 3.11–12 include discharges from all-cause index hospitalizations, Figure 3.10 illustrates rehospitalization rates among discharges from cardiovascular index hospitalizations. Cardiovascular index hospitalizations are identified by principal ICD-9-CM diagnosis codes listed for Figure 3.1 in the Analytical Methods section for Volume Two.

Figure 3.13 illustrates unadjusted rehospitalization rates during the transition to ESRD. The analysis includes incident ESRD patients with a first ESRD service date between January 1 and October 1, 2010, who are age 67 and older, and who are residents of the 50 states, the District of Columbia, Puerto Rico, or the Territories. During the complete two years prior to ESRD initiation, patients are alive and have Medicare as a primary payer with continuous Parts A and B coverage. Hospitalization data exclude rehabilitation claims and transfers. Discharges with a same-day admission to long-term care or a critical access hospital are excluded. During the first quarter after initiation, discharges are included with Medicare PA and B coverage during the 30 days after discharge. Quarterly rates are displayed during the two years prior and first quarter after initiation. To allow 30 days of follow-up for rehospitalization after discharge, live hospital discharges are included in only the first two months of each quarter. Cardiovascular and infectious index hospitalizations are identified by principal ICD-9-CM diagnosis codes listed for Figure 3.1 in the Analytical Methods section in the appendix for Volume Two.

mortality

Figure 3.14 illustrates trends, by CKD status, in unadjusted and adjusted all-cause mortality. The study cohort for 1995 includes point prevalent Medicare patients on January 1, 1995, age 66 or older. CKD status is identified from 1994 Medicare claims, and the cohort excludes patients enrolled in an HMO, with Medicare as secondary payor, or diagnosed with ESRD in 1994. Follow-up extends from January 1, 1995, to December 31, 1995, and is censored at ESRD and the end of Medicare entitlement. Patients not living in the 50 states or the District of Columbia are excluded. Cohorts for 1996–2010 are constructed in a similar manner. Adjusted mortality is based on a Cox regression model and adjusted for demographics, hospitalization in the prior year, and comorbidities and sources of comorbidities defined in the prior year. Medicare patients from 2005 are used as the reference cohort.

For Figures 3.15–17 and Table 3.c, the cohort definitions are same as those defined in Figure 3.14. Adjusted mortality is based on a Cox regression model; rates by age are adjusted for gender, race, and comorbidities; rates by gender are adjusted for age, race, and comorbidities; and rates by race are adjusted for age, gender, and comorbidities. All 2010 patients are used as the reference cohort.

cardiovascular disease in patients with CKD

chapter four

Table 4.a describes the prevalence of cardiovascular disease and treatment in Medicare enrollees. Cardiovascular disease include acute myocardial infarction (AMI), atrial fibrillation (AF), cerebrovascular accident/transient ischemic attack (CVA/TIA), congestive heart failure (CHF), and peripheral arterial disease (PAD), while treatment include percutaneous coronary interventions (PCI), coronary artery bypass graft surgery (CABG), and use of implantable cardioverter defibrillators and cardiac resynchronization therapy with defibrillator (ICD/CRT-D). The study cohort includes point prevalent Medicare enrollees on December 31, 2010 who are age 66 and older, residing in the 50 states, the District of Columbia, Puerto Rico, or the Territories, continuously enrolled in Medicare inpatient/outpatient and physician/supplier coverage, and not enrolled in an HMO in 2010. Patients with ESRD on or before December 31, 2010 are excluded.

Patients with CKD are identified using the same methodology described above in the section on data sources (referred to in this chapter as the claims-based method). CKD stage is defined based on the fourth digit of ICD-9-CM diagnosis code 585.x. Using the claims-based method, we identify those with AMI, AF, CVA/TIA, or CHF in 2010. Various sources of claims and types of codes are used to identify cardiovascular treatments. CABG is defined through ICD-9-CM procedure codes in inpatient claims only, ICD/CRT-D is defined through ICD-9-CM procedure codes in inpatient/outpatient claims, and PCI is identified through ICD-9-CM procedure codes in inpatient/outpatient claims or CPT codes in outpatient revenue claims or physician/supplier claims. PAD is defined through either diagnosis codes or procedure codes; if defined through diagnosis codes, we use the claims-based method; if defined through procedure codes, we employ the method used for PCI. The codes used to identify cardiovascular diseases and procedures are as follows:

- AF: 427.3 (ICD-9-CM diagnosis codes)
- AMI: 410 and 412 (ICD-9-CM diagnosis codes)
- CHF: 398.91, 422, 425, 428, 402.X1, 404.X1, 404.X3, and V42.1 (ICD-9-CM diagnosis codes)
- CVA/TIA: 430–438 (ICD-9-CM diagnosis codes)

PAD: 440–444, 447, and 557 (ICD-9-CM diagnosis codes); 84.0, 84.1, 84.91, 39.25, 39.26, and 39.29 (ICD-9-CM procedure codes); 24900, 24920, 25900, 25905, 25920, 25927, 27295, 27590, 27591, 27592, 27598, 27880, 27881, 27882, 27888, 27889, 28800, 28805, 34900, 35131, 35132, 35141, 35142, 35151, 35152, 34051, 34151, 34201, 34203, 34800–34834, 35081–35103, 35331, 35341, 35351, 35355, 35361, 35363, 35371, 35372, 35381, 35450, 35452, 35454, 35456, 35459, 35470, 35471, 35472, 35473, 35474, 35480, 35481, 35482,35483, 35485, 35490, 35491, 35492, 35493, 35495, 35521, 35531, 35533, 35541, 35546, 35548, 35549, 35551, 35556, 35558, 35563, 35565, 35566, 35571, 35583, 35585, 35587, 35621, 35623, 35646, 35647, 35651, 35654, 35656, 35661, 35663, 35665, 35666, and 35671 (CPT codes)

- CABG surgery: 36.1X (ICD-9-CM procedure codes)
- PCI: 00.66, 36.01, 36.02, 36.05, 36.06, and 36.07 (ICD-9-CM procedure codes); 92980–92982, 92984, 92995–92996, G0290, and G0291 (CPT/HCPCS codes)
- ICD/CRT-D: 37.94 and 00.51 (ICD-9-CM procedure codes)

The overall prevalence and age- and race-specific prevalence of each cardiovascular disease and treatment in 2010 are calculated for patients with CKD (overall and by CKD stage) and without CKD, respectively. Prevalence is represented per 100 patients.

Figure 4.1 presents the burden of prevalent AMI, CHF, and CVA/TIA in the Medicare CKD and non-CKD population with cardiovascular disease in 2005 and 2010. Methods of cohort construction and identification of AMI, CHF, and CVA/TIA are the same as those described for Table 4.a. Patients with cardiovascular disease are identified if they have ASHD, CHF, CVA/TIA, dysrhythmia, PVD, or other cardiac disease. ICD-9-CM diagnosis codes used to identify ASHD, dysrhythmia, PVD, and other cardiac disease are as follows:

- ASHD: 410–414, V45.81, and V45.82
- Dysrhythmia: 426–427, V45.0, and V53.3
- PVD: 440–444, 447, 451–453, and 557
- Other cardiac disease: 420–421, 423–424, 429, 785.0–785.3, V42.2, and V43.3

Figure 4.2 describes the percentage of patients with incident CHF receiving diagnostic testing at or up to 90 days after CHF diagnosis in 2000 and 2010. The cohort of incident CHF patients in 2010 includes point prevalent Medicare enrollees on January 1, 2010, with their first CHF diagnosis (index event) during 2010, continuously enrolled in Medicare inpatient/outpatient and physician/supplier coverage, not enrolled in an HMO during the one-year period before the index event, age 66 or older on the date of the index event, and residing in the 50 states, the District of Columbia, Puerto Rico, or the Territories. Patients with incident CHF are identified through ICD-9-CM diagnosis codes 398.91, 425.X, 428.XX, 402.X1, 404.X1, and 404.X3 using the claims-based method, and the index date is defined on the date of the first appearance of a claim with the qualifying diagnosis codes. The twelve-month period prior to the index event

is the baseline period. Patients with CKD and pre-existing CHF are identified during the baseline period using the method described for Table 4.a. We exclude patients who are diagnosed with ESRD prior to the index event and those with pre-existing CHF. Follow-up for testing begins on the CHF diagnosis date and ends on the earliest of death, ESRD diagnosis, change of enrollment status, 90 days after CHF diagnosis, or December 31, 2010. The same methods are used to construct the cohort of incident CHF patients in 2000.

Diagnostic testing for patients with CHF includes resting echocardiogram, coronary angiography, non-invasive coronary angiography, or any stress test including stress echocardiograms, stress nuclear imaging, stress test, and stress electrocardiograms (ECGs). Patients received these tests are identified through ICD-9-CM procedure codes in inpatient/outpatient claims or CPT/HCPCS codes in outpatient revenue claims or physician/supplier claims. Codes used to define these tests are as follows:

- resting echocardiogram: 93303, 93304, 93306–93308, 93312-93318, 93320, 93321, and 93325 (CPT codes)
- coronary angiography and/or catheterization: 37.22–37.23 and 88.53–88.57 (ICD-9-CM procedure codes); 93508, 93510, 93511, 93524, 93526, 93527, 93529, 93531–93533, 93539, 93540, 93543, 93545, and 93555 (CPT codes)
- non-invasive coronary angiography: 75571–75574 (CPT codes; available in 2010)
- stress echocardiograms: 93350 (CPT code)
- stress nuclear imaging: 78459–78461, 78464, 78465, 78469, 78472, 78473, 78478, 78480, 78481, 78483, 78491, and 78492 (CPT codes)
- stress test: 89.41–89.44 (ICD-9-CM procedure codes)
- stress ECGs: 93015–93018 (CPT codes)

The percentage of patients receiving each test is calculated as the number of patients tested during the follow-up period divided by the total number of patients at the beginning of follow-up; this is presented by CKD status for the 2000 cohort and by CKD status/stages for the 2010 cohort.

Figure 4.3 illustrates rates of fatal and non-fatal AMI by CKD status. The study cohorts include point prevalent Medicare enrollees on January 1 of 2007 or 2010, who are age 66 and older, residing in the 50 states, the District of Columbia, Puerto Rico, or the Territories, continuously enrolled in Medicare inpatient/outpatient and physician/supplier coverage, and not enrolled in an HMO in the prior year. Patients with ESRD on or before December 31 of the prior year are excluded. AMI is identified through ICD-9-CM diagnosis codes 410, 410.X0, and 410.X1 on inpatient claims. Fatal AMI is defined if a patient died on the same day of admission for AMI or one day later regardless of discharge status recorded on the inpatient claims, or if the patient died in the hospital. Follow-up for AMI event begins on January 1 and ends on the earliest of AMI hospitalization, death, ESRD diagnosis, change of enrollment status, or December 31 of 2007 or 2010. Rates are unadjusted and estimated as the number of patients who have an AMI event per 1,000 patient years at risk.

Figures 4.4–7 describe the three-year cumulative probability of death in Medicare patients with a first diagnosis of AMI, CVA/TIA, CHF, or a CV procedure (PCI or CABG) (index event) in 2007–2008. The study cohorts are constructed as for Figure 4.2, except that the period searched for the index event is 2007–2008. As with Figure 4.2, patients with a pre-existing condition of interest in the year before the index event are excluded. Pre-existing conditions of AMI, CVA/TIA, and CHF are identified using the same method described for Table 4.a. CHF and AMI events are defined using the methods described for Figures 4.2 and 4.3, respectively. A CVA/TIA event is defined using the method described for Table 4.a and diagnosis codes 430–437. The same method is used to define pre-existing conditions and events of PCI or CABG. Follow-up begins on the index event date and ends at the earliest of death, ESRD diagnosis, three years after the index event, or December 31, 2010. The Kaplan-Meier method is used to estimate all-cause survival. Cumulative probabilities of death are obtained by subtracting the cumulative survival probabilities from one. Table 4.b describes pharmacological interventions for cardiovascular disease in Medicare enrollees. For each year (2007 and 2010), the cohort includes Medicare enrollees (in both Parts A and B) on January 1, age 66 and without ESRD, followed until the earliest of death, ESRD onset, cessation of Medicare coverage (with either Part A or B), or December 31. First cardiovascular disease events in the follow-up interval are identified with the claims-based method, as described for Figure 4.2. For CHF, events are identified by ICD-9-CM codes 398.91, 402.X1, 404.X1, 404.X3, 425.X, and 428.X. For AMI, events are identified by codes 410, 410.X0, and 410.X1 on inpatient claims. For CVA/TIA, events are identified by codes 430–437. And for all other diagnoses and procedures, events are identified with the codes used in Table 4.a. The index date of each event is defined as the admission or service date of the first claim in the follow-up interval with a qualifying diagnosis code. CKD status/stage and baseline cardiovascular disease re ascertained from claims during the one year preceding the index date, and, in the case of ascertainment of baseline cardiovascular disease, algorithms and codes are the same as those used in Table 4.a.

Because Table 4.b and Figures 4.8–10 describe pharmacological interventions, only a subset of cardiovascular disease events was retained for analysis. Specifically, each patient is required to be discharged within two weeks of the index date of the event (if the patient was hospitalized on the index date), to not be hospitalized at one month after the index date, and to carry continuous Medicare Part D coverage during the interval from one month before to one month after the index date. This set of requirements establishes prescription drug coverage during an interval of time around the index date of the event, and admits sufficient cumulative time outside the hospital for the patient to fill a prescription at an outpatient pharmacy. Use of a medication is defined by at least one prescription fill between one month before and one month after the index date. Drugs are identified from National Drug Codes linked to Generic Product Identifiers, using the Medi-Span Master Drug Data Base.

In Table 4.b, all cardiovascular disease events that satisfy inclusion criteria regarding Medicare Part D coverage and hospitalization are retained for analysis, regardless of baseline cardiovascular disease status. For 2007, events with an index date between January 1 and December 31 are analyzed, whereas for 2010, events with an index date between January 1 and November 30 are analyzed (as Part D data after December 31, 2010, were unavailable). Patients with no cardiac event include those whose entire follow-up interval is marked by no cardiovascular disease events. In Figures 4.8–10, only the subset of cardiovascular disease events not accompanied by baseline disease are retained for analysis. In Figures 4.9–10, patients are followed from one month after the index date to the earliest of earliest of death, ESRD onset, cessation of Medicare coverage (with either Part A or B), or December 31, 2010.

prescription drug coverage in CKD patients

chapter five

In figures and tables regarding enrollment and utilization of Medicare Part D, we analyze cohorts of Medicare enrollees in 2006–2010 based on the 5 percent sample (general Medicare enrollees), and with non-dialysis-dependent chronic kidney diseases (CKD). We also analyze cohorts of Medicare enrollees receiving dialysis or with a functioning kidney transplant (based on the 100 percent ESRD population). For general Medicare enrollees or enrollees with non-dialysis-dependent CKD, we require continuous enrollment in Medicare Parts A and B during the previous calendar year, no participation in Medicare Advantage during the previous year, and Medicare enrollment in January of the index year. CKD is identified from diagnosis codes on claims during the previous calendar year. For the dialysis and kidney transplant cohorts we retain all patients who were alive and enrolled in Medicare on January 1 of the index year and whose ESRD onset was at least 90 days earlier; treatment modality is identified on January 1.

In Figures 5.2–4, the type of prescription drug coverage is defined sequentially. That is, we first classify patients as "Part D with LIS" if there exists at least one calendar month in 2010 with Part D enrollment and receipt of low-income subsidy (LIS). In patients without one such month, we classify remaining patients as "Part D without LIS" if there exists at least one calendar month with Part D enrollment. In patients without one such month, we classify remaining patients as "retiree drug subsidy" if there exists at least one calendar month with employer receipt of the subsidy. In patients without one such month, we classify remaining patients as "other creditable coverage" if there exists at least one calendar month with enrollment in military, government employee, or employer group health plans.

In Figures 5.5 and Table 5.a, we classify Part D enrollees as LIS recipients if there exists at least one calendar month in 2010 with receipt of the LIS. In Figures 5.6–8, we consider only those Part D enrollees who were not LIS recipients during any calendar month of the index year. In all figures, patients enrolled in Medicare Advantage Part D (MA-PD) plans are excluded.

In Figures 5.12–14 and Tables 5.e–f, we consider only those Part D enrollees who were not LIS recipients during any calendar month of 2010. In all figures, patients enrolled in employer group waiver plans or national Programs of All-inclusive Care for the Elderly (PACE) are excluded, as these types of plans do not report data concerning coverage phase progression of enrollees. In Figure 5.13, follow-up begins on January 1, 2010, and in Figure 5.14, follow-up begins on the date of entry into the coverage gap. In Table 5.e, diagnoses of hypertension, cardiovascular disease, diabetes, and cancer are ascertained from claims during 2009. In Table 5.f, a fill is simply defined as a transaction billed to Part D.

Part D costs for several different populations are presented in this chapter. The general Medicare population includes all Part D enrollees (estimated from the 5 percent Medicare sample), while the CKD population includes only persons who survive all of year one, are continuously enrolled in Medicare inpatient/outpatient and physician/supplier coverage for this period, are not enrolled in a Medicare Advantage Part D (MA-PD) plan, and have a qualifying CKD diagnosis (but do not have ESRD) during year one; this cohort is also drawn from the 5 percent Medicare sample. CKD stage is defined from claims. Costs are aggregated for year two for all Part D enrollees with CKD, with censoring at the earliest of death, development of ESRD, or the end of year two. The ESRD population (Figures 5.9–11 and Table 5.d) are drawn from the 100 percent ESRD population. ESRD includes all ESRD patients enrolled in Part D. Costs are presented as total Part D expenditures, which are estimated as the sum of the Medicare covered amount and the low income subsidy (LIS) amount (Figure 5.9), or as per person per year expenditures (Figures 5.10–11), also estimated as above. Figure 5.10 also presents out-of-pocket expenditures obtained from the prescription drug event record.

Tables 5.g–i show the top Part D drugs by frequency, as judged from the total days supply (obtained from the prescription drug event record), as well as by cost. Figures 5.15 (general Medicare), 5.16 (CKD) and 5.17 (ESRD) show the frequency of prescriptions for Part D drugs, by class (based on Medi-Span's generic product identifier therapeutic classification system) as well as costs.

acute kidney injury

chapter six

In this chapter, patients with a hospitalization for acute kidney injury (AKI), or for AKI requiring dialysis (AKI-D) are identified from inpatient claims by the presence of ICD-9-CM code 584.x or by indication of dialysis through any of the following: ICD-9-CM procedure codes 39.95 and 54.98; ICD-9-CM diagnosis codes V45.1, V56.0, and V56.1; CPT codes 90935, 90937, 90945, and 90947; and revenue codes 0800–0809. Patients with ESRD diagnosed before the AKI hospitalization discharge are omitted, except as indicated. For patients with multiple AKI hospitalizations through the years, the first one in the time frame is counted. The event rate is estimated as the number of events per 1,000 patient years at risk.

Figure 6.1 displays the percentage of patients hospitalized for AKI or AKI-D in a given year. The cohort includes general Medicare patients age 66 or older on December 31 of the cohort year, continuously enrolled in Medicare inpatient/outpatient and physician/supplier coverage, with no HMO coverage, and who survive and are without ESRD in the cohort year.

Figure 6.2 shows the demographic characteristics of patients suffering AKI. The study cohort includes the general Medicare patients described for Figure 6.1 (Figure 6.2 uses the 2010 cohort), along with MarketScan and Ingenix i3 patients age 20–64 on December 31 of the cohort year who are enrolled in a fee-for-service plan.

Figures 6.3–4 show rates per time at risk, while Figure 6.5 shows the type of dialysis used by hospitalized AKI-D patients. Modality is defined as follows: peritoneal dialysis, CPT codes 90945 or 90947 and 49420; continuous venous-to-venous hemodialysis (CVVHD), dialysis with CPT codes 90945 or 90947 but without 49420; intermittent hemodialysis (IHD), dialysis with CPT codes 90935 or 90937 and intermittent in the first three days; and daily hemodialysis (DHD), dialysis with CPT codes 90935 or 90937 and with three consecutive dialysis sessions in the first three days. To define modality, we first determine if there is any peritoneal dialysis during the period of the AKI event, and then look for continuous dialysis to identify hemodialysis or DHD. Those who are not identified by the above methods are categorized as having an unknown dialysis type. Figure 6.6 illustrates the principle diagnosis that appears on AKI claims.

Figures 6.7–8 present hazard ratios for AKI hospitalization, adjusted for age, gender, and race. The study cohort includes 2010 general Medicare patients age 66 and older, along with 2010 MarketScan and Ingenix i3 patients age 20–64. Patients with ESRD before January 1, 2011, are excluded. Each patient is followed from this date to the earliest of death (Medicare patients only), ESRD diagnosis, change of enrollment, or December 31, 2010.

Figures 6.9–13 are limited to patients with an AKI in 2009, who are followed for one year to look for a recurrent AKI (6.9–11), ESRD or death (6.12), or an outpatient visit to a nephrologist (6.13). Figure 6.14 is limited to patients with a recurrent AKI in 2009, and they are followed for one year to look for an outpatient nephrologist

visit. In Figure 6.15, CKD status includes those with both the index and recurrent AKI in 2009, and CKD claims during the six months before each event are used to identify those with CKD.

Testing in Figures 6.16–17 is identified as follows: creatinine testing, HCPCS codes 80048, 80050, 80053, 80069, and 82565; urine protein testing: CPT codes 82042, 82043, 82044, and 84156.

Figures 6.18–20 examine the use of several prescription medications before and after AKI hospitalization, and include 2009 Medicare patients with Part D coverage.

Figures 6.21–23 display changes in CKD status following an AKI or recurrent AKI hospitalization in 2009, based on CKD claims before and after the hospitalization. The cohort includes all Medicare patients age 66 or older on December 31, 2009. CKD claims are identified in the one year prior and one year following the AKI admission date, and CKD stage is defined with the method described above, under "identification of major comorbidities." ESRD is defined by the ESRD date.

Figure 6.24 shows the distribution of patients by CKD stage prior to an AKI hospitalization in 2009, along with discharge status and outcomes. Patients with a discharge status of "home" or "home health" are identified as being discharged home, while those identified as institutionalized are those whose discharge status included "Skilled Nursing Facility", "Long-term Care Hospital" or "Rehabilitation." CKD stage is obtained from 2009 claims prior to the admission date, and nephrologist care is determined from claims in the year following discharge. Creatinine testing is tracked during the three months after discharge, and albumin in the one year following discharge.

costs of CKD

chapter seven

The general Medicare point prevalent cohort used in Figures 7.1–17 includes persons age 65 and older who survive all of year one, are continuously enrolled in Medicare inpatient/outpatient and physician/supplier coverage for this period, are not enrolled in an HMO, and do not have ESRD during year one. Costs are aggregated for year two, with censoring at the earliest of death, development of ESRD, change in payor status, or the end of year two. Figure 7.2 also features the MarketScan point prevalent CKD population, constructed in a similar fashion, but limited to patients age 50–64.

Costs are categorized in several ways throughout this chapter. For Figures 7.1, 7.5–7, 7.9, 7.11, and 7.12–14, costs are simply total claims-based expenditures, while those in 7.2–4, 7.8, 7.15–16, and Table 7.a are claims-based expenditures on a per person per year (PPPY) basis.

Important comorbidities (diabetes, CKD, and CHF) are determined for these cohorts from Medicare claims using a previously validated method, as described earlier in the section on identification of major comorbidities. Costs in Figures 7.5–8 are presented for the 1992–2009 cohorts; the cost year is always the year after the cohort year.

The MarketScan population used in Figure 7.2 includes patients age 50–64, and is constructed in the same fashion as that described for the Medicare population, requiring continuous enrollment in a fee-for-service health plan. Patients identified as having ESRD are excluded, and the cohorts are from 2006 to 2009 (cost years 2007–2010).

Figures 7.9, 7.11, 7.15–17, and Table 7.a present Medicare Part D costs. Populations used in these figures are derived from the point prevalent Medicare population (described above), with the further restriction that each individual included in the population is enrolled in Part D for the full 12 months of the analysis year and has a qualifying diagnosis of CKD. Costs are estimated Medicare net pay, which is the sum of plan covered payments and low income subsidy payments. Costs do not include out-of-pocket expenditures, which are displayed separately in Figures 7.15 and 7.17. Figures 7.9 and 7.11–14 show total Part D expenditures, while other figures use PPPY expenditures.

reference tables: CKD

Tables B.1–6 present estimated point prevalent (December 31) counts of the general Medicare non-ESRD population, based on the 5 percent Medicare sample.

Tables K.1–5 present estimates of per person per year costs for general Medicare patients, also derived from the 5 percent Medicare sample. The cohorts include those who survive all of year one, are continuously enrolled with Medicare inpatient/outpatient and physician/supplier coverage, are not enrolled in Medicare Advantage, and do not have ESRD during year one. Costs are aggregated for year two, with censoring at the earliest of death, development of ESRD, change in payor status, or the end of year two. Important comorbidities are determined for these cohorts from Medicare claims using a previously validated method, as described earlier in the section on identification of major comorbidities. Expenditures are presented for the 1993–2010 cohorts, and the cost year is always the calendar year after the cohort year.