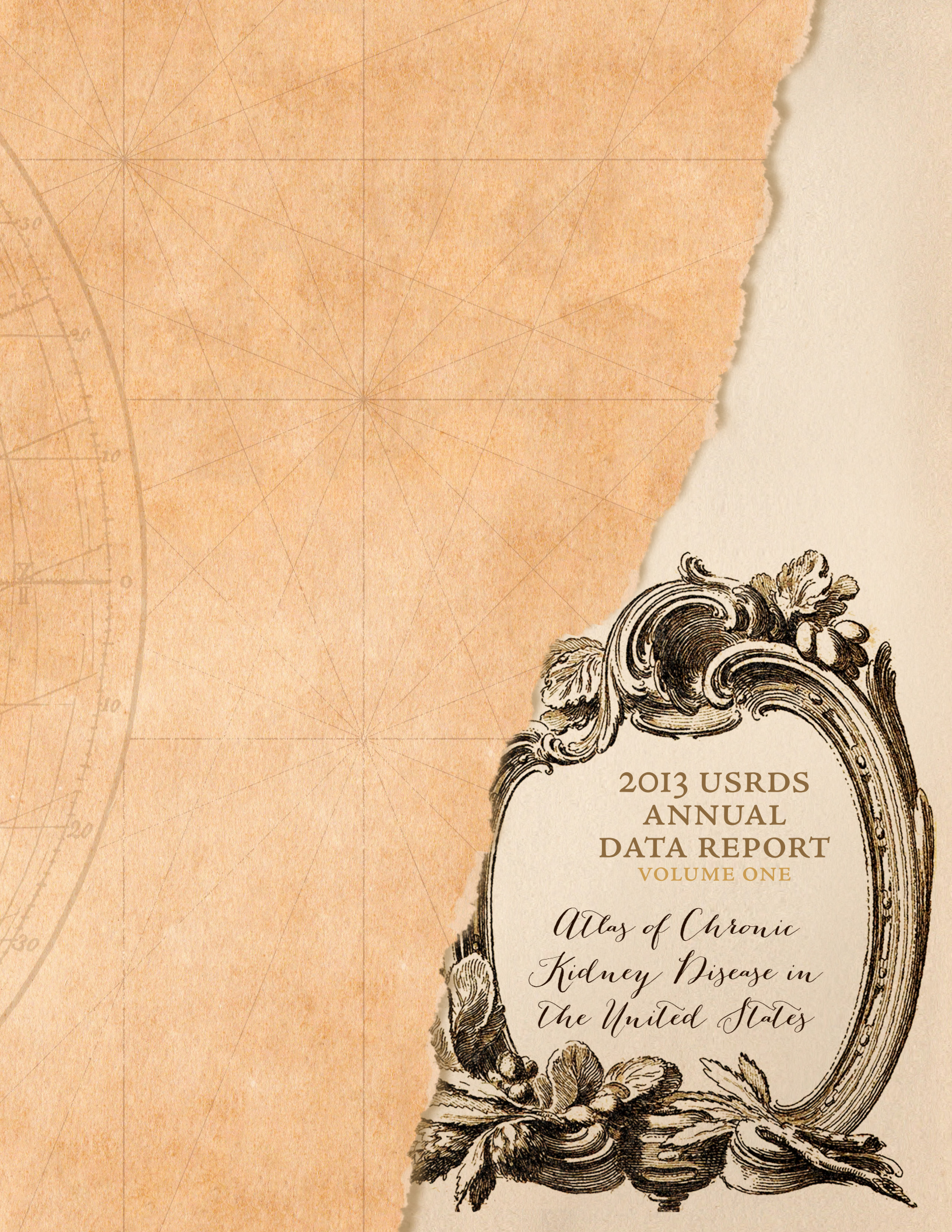
Admiral, there be whales here!

SCOTTY, STAR TREK IV: THE VOYAGE HOME

National Institutes of Health
National Institute of Diabetes & Digestive & Kidney Diseases
Division of Kidney, Urologic, & Hematologic Diseases


2013 USRDS
ANNUAL
DATA REPORT
VOLUME ONE
Atlas of Chronic
Kidney Disease in
The United States

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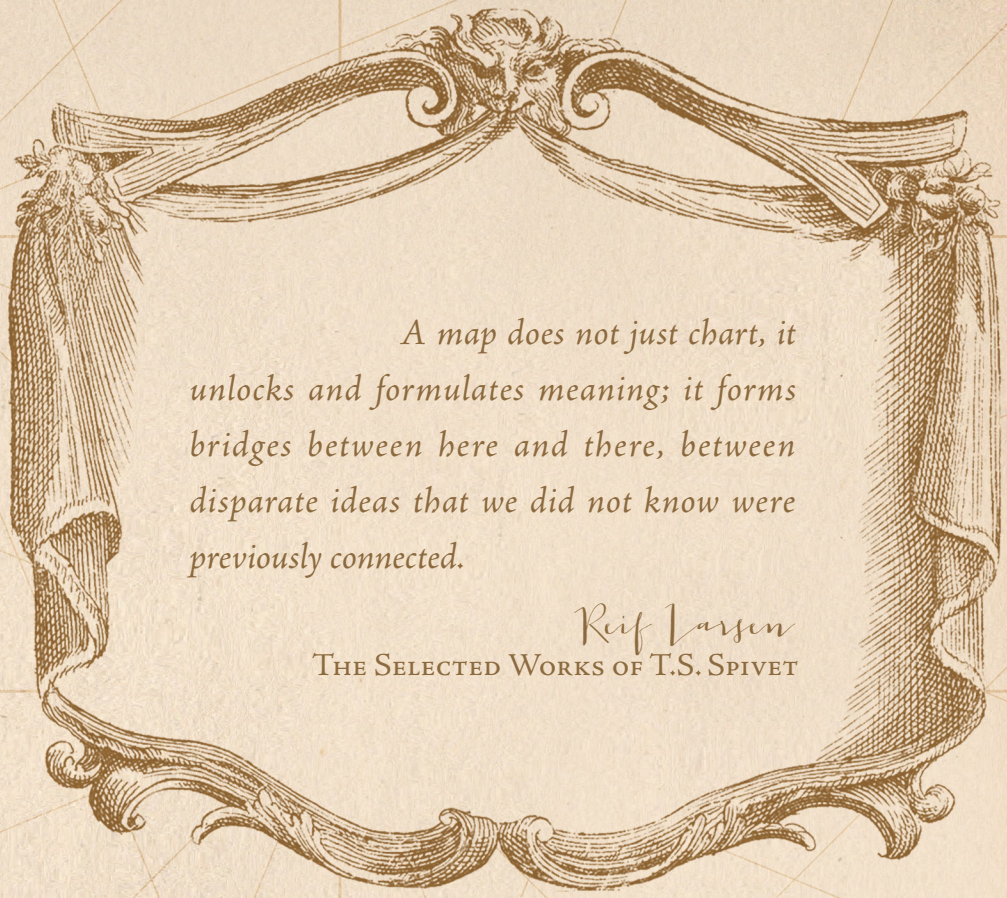


A map does not just chart, it unlocks and formulates meaning; it forms bridges between here and there, between disparate ideas that we did not know were previously connected.

Reif Larsen
The Selected Works of T.S. Spivet

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

populations

diseases

Treatment

outcomes

costs

data analysis

data on chronic kidney disease

APPEARING EACH YEAR IN THE ANNUAL DATA REPORT

chapter one

1.1 distribution of NHANES participants with diabetes, cardiovascular disease, & markers of CKD

1.a prevalence of CKD in NHANES participants, by age, gender, race/ethnicity, & risk factor

1.b awareness, treatment, & control of hypertension, hyperlipidemia, HDL, total cholesterol, & diabetes

chapter two

2.a descriptive parameters of CKD datasets, by age, gender, race/ethnicity, & coded comorbidity

2.b prevalence of recognized CKD, by dataset, year, & age

2.2 trends in CKD prevalence: Medicare patients age 65 & older, by race

2.5 probability of urine albumin & creatinine testing in Medicare patients at risk for CKD

2.c probability of laboratory testing in patients at risk for CKD, by demographic characteristics

2.d percent of patients with CKD, by demographic characteristics, comorbidity, & dataset

2.9 cumulative probability of a physician visit at month 12 following CKD diagnosis, by physician specialty & dataset

2.g cumulative probability of a physician visit at month 12 after CKD diagnosis

2.h cumulative probability of a physician visit at month 12 after a CKD diagnosis code of 585.3 or higher

chapter three

3.a adjusted hospitalization rates in Medicare patients, by CKD diagnosis code

3.5 adjusted rates of hospitalization for cardiovascular disease, by dataset & CKD diagnosis code

3.6 adjusted rates of hospitalization for infection, by dataset & CKD diagnosis code

3.14 all-cause mortality rates in Medicare CKD & non-CKD patients

3.c adjusted mortality rates in Medicare patients, by CKD diagnosis code

chapter five

chapter six

chapter seven

highlights OF VOLUME ONE

patients

6.7% prevalence of spot 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 spot 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%

10.0% prevalence of recognized CKD in Medicare patients age 65 & older, 2011 (Table 2.b & Figure 2.2)
white: 9.5% • black/African American: 14.7%
• Native American: 11.0% • Asian: 10.4%

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)

37% probability of urine albumin testing in Medicare patients with diabetes and hypertension (Figure 2.5)

0.57 cumulative probability of a nephrologist visit at month 12 after a CKD diagnosis of 585.3 or higher, 2011: Medicare patients age 65 & older (Table 2.h)

0.54 cumulative probability of a nephrologist visit at month 12 after a CKD diagnosis of 585.3 or higher, 2011: Truven Health MarketScan patients age 50–64 (Table 2.h)

52% percent of CKD patients with CHF receiving ACEIs/ARBs (Table 4.b)

outcomes

422 adjusted hospitalization rate in white Medicare CKD patients age 66 & older, 2011 (admissions per 1,000 patient years; Figure 3.3)
Stages 1–2: 362 • Stage 3: 417 • Stages 4–5: 577

467 adjusted hospitalization rate in black/African American Medicare CKD patients age 66 & older, 2011 (admissions per 1,000 patient years; Figure 3.3)
Stages 1–2: 424 • Stage 3: 439 • Stages 4–5: 576

74 adjusted mortality rate in white Medicare CKD patients age 66 & older, 2011 (deaths per 1,000 patient years; Table 3.c)
Stages 1–2: 63 • Stage 3: 65 • Stages 4–5: 101

73 adjusted mortality rate in black/African American Medicare CKD patients age 66 & older, 2011 (deaths per 1,000 patient years; Table 3.c)
Stages 1–2: 59 • Stage 3: 65 • Stages 4–5: 106

expenditures

$45.5 billion Medicare expenditures for patients with CKD, 2011 (Figure 7.5)
non-Part D: $41.6 billion • Part D: $3.9 billion

$24.6 billion Medicare expenditures for patients with CKD & diabetes, 2011 (Figure 7.6)
non-Part D: $22.2 billion • Part D: $2.4 billion

$21.2 billion Medicare expenditures for patients with CKD & congestive heart failure, 2011 (Figure 7.7)
non-Part D: $19.7 billion • Part D: $1.5 billion

$5.3 billion total net Part D payment for Medicare enrollees with CKD, 2011 (Figure 5.9)

$22,348 per person per year expenditures for CKD patients in the Medicare population, 2011 (includes Part D; Figure 7.8)
non-DM/non-CHF: $15,759 • CKD + DM: $18,611 • CKD + CHF: 30,619 • CKD + DM + CHF: $38,202

$3,949 per person per year Medicare Part D costs for enrollees with CKD, 2011 (Figure 5.10)

$613 per person per year out-of-pocket Part D costs for enrollees with CKD, 2011 (Figure 5.10)

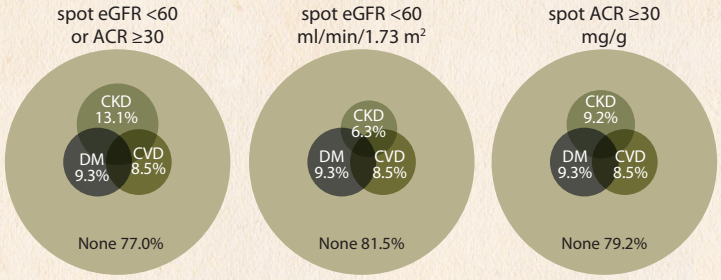
chronic kidney disease
IN THE UNITED STATES

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, cardiovascular disease (CVD), and CKD are three interrelated chronic diseases of clear public health relevance.

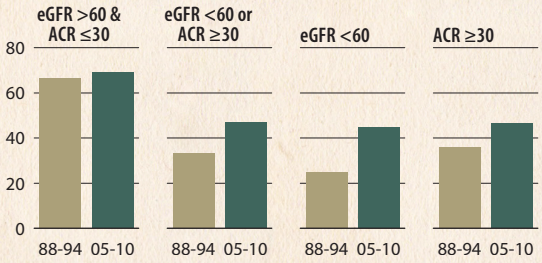


Single-sample eGFR <60 ml/min/1.73 m² and ACR ≥30 mg/g are associated with older age, diabetes, hypertension, and cardiovascular disease.

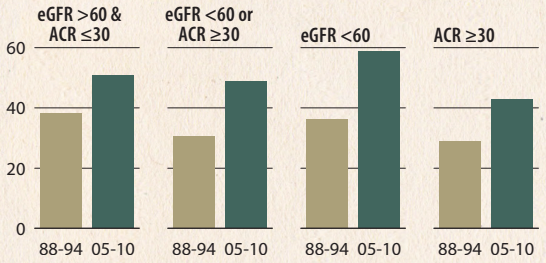
Percent	eGFR <60 (%)		ACR ≥30 mg/g (%)	
	1988–94	2005–10	1988–94	2005–10
Age: 60+	19.5	24.1	18.3	18.4
Diabetes	15.6	19.3	36.3	29.9
Self-reported diabetes	16.4	20.4	35.9	30.8
Hypertension	10.4	12.9	15.4	14.8
Self-reported hypertension	12.9	15.6	17.1	16.7
CVD	14.5	27.9	16.6	24.3
BMI ≥30	6.2	7.4	12.3	11.7

Control of risk factors for CKD

Percent of NHANES participants at target blood pressure (<130/<80 for those with single-sample eGFR <60 or ACR ≥30 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

75.3
MEDICARE

43.9
TRUVEN HEALTH MS

42.7
CDM

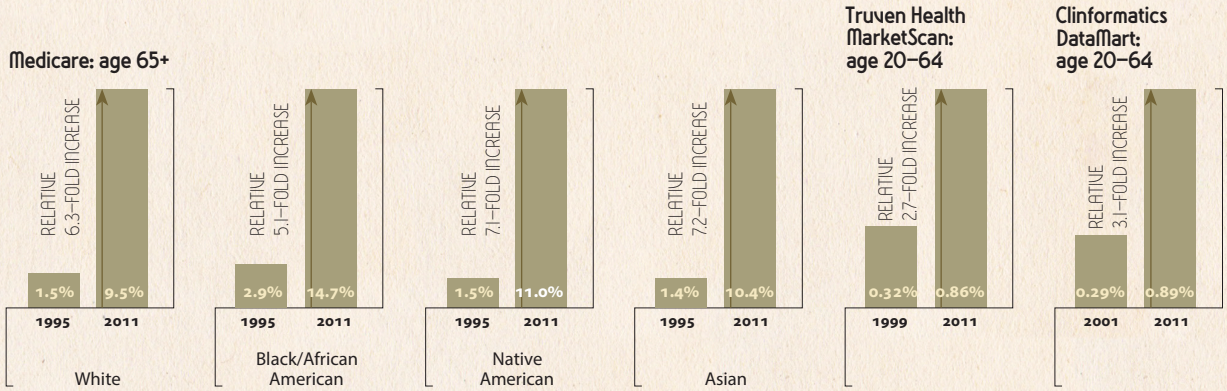
CKD is recognized more frequently in Medicare patients age 65 and older than in the Truven Health MarketScan and Clinformatics DataMart populations, age <65.

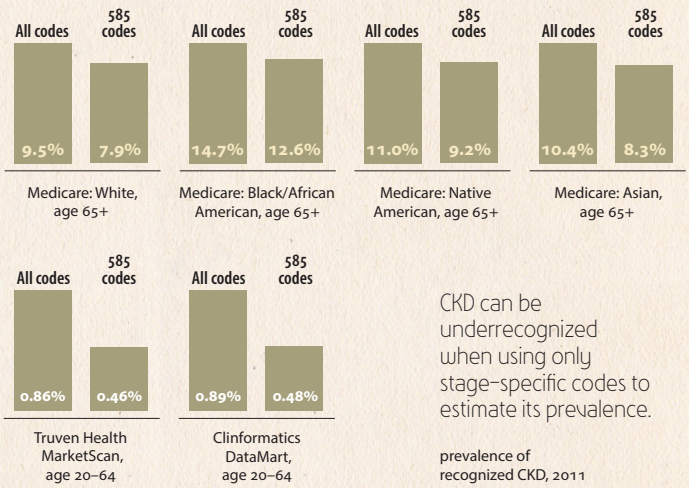
RECOGNIZED CKD

	Medicare	Truven Health MarketScan	Clinformatics DataMart (CDM)
20–44		0.4%	0.4%
45–54		0.8%	1.0%
55–64		1.9%	2.1%
65–74	6.9%		
75–84	12.2%		
85+	16.0%		

Circle diagrams: Figure 1.1
Disease burden: Table 1.a
Risk factors: Figures 1.12 & 1.15
Mean age: Table 2.a
Recognized CKD: Table 2.b
Note: eGFR calculated using the CKD-EPI equation

The prevalence of recognized CKD has increased significantly since 1995.





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

prevalence of recognized CKD, 2011

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

PROBABILITY OF TESTING IN 2011

11%
All patients

36%
Patients with diabetes (no hypertension)

5%
Patients with hypertension (no diabetes)

37%
Patients with both diabetes and hypertension

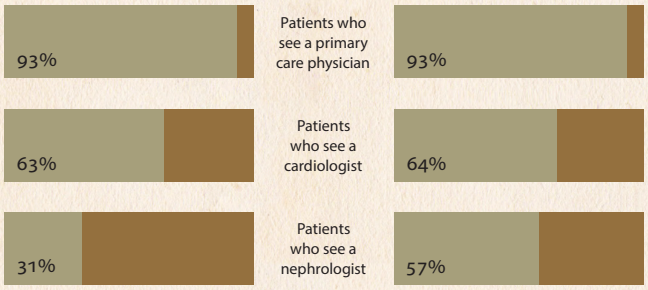
In patients with DIABETES, HYPERTENSION, OR CARDIOVASCULAR DISEASE, the odds of a CKD diagnosis code are 2–4 TIMES HIGHER than in patients without these conditions.

Medicare (age 65+)	Adjusted odds of a CKD diagnosis code	Truven Health MarketScan (50–64)
2.1	Diabetes	3.1
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
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** in the year following the diagnosis.

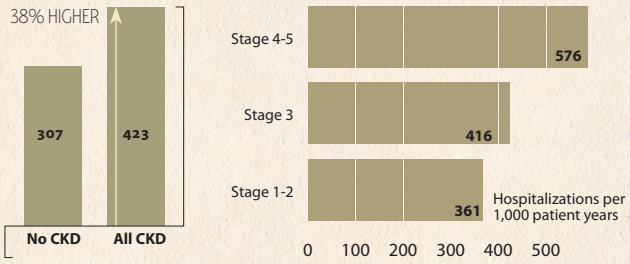


Acute kidney injury is highly associated with age, & rates of first AKI (per 1,000 patient years at risk) have increased

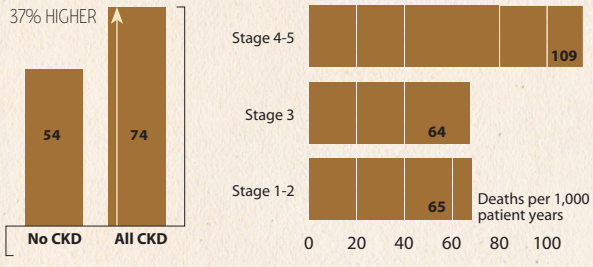
	Medicare		Truven Health MarketScan		Clinformatics DataMart	
	2001	2011	2001	2011	2001	2011
20–44			0.15	0.65	0.14	0.65
45–54			0.47	1.82	0.45	1.81
54–64			1.06	4.31	1.09	4.3
66–69	3.7	14.9				
70–74	4.9	18.8				
75–79	6.6	26.4				
80–84	8.0	35.9				
85+	9.6	49.6				
White	5.7	25.8				
Black/Af Am	11.9	45.3				

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

Hospitalization rates



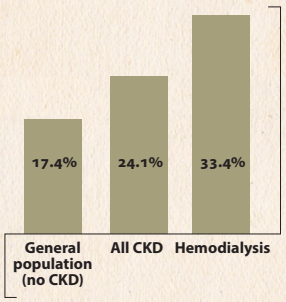
Mortality rates



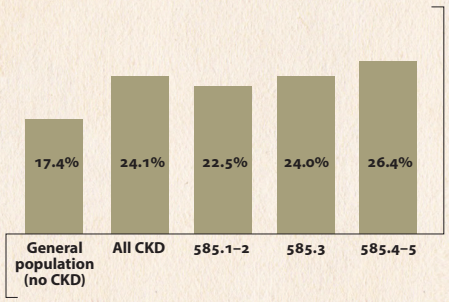
adjusted rates of REHOSPITALIZATION are also HIGHER IN CKD PATIENTS than in those without the disease

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

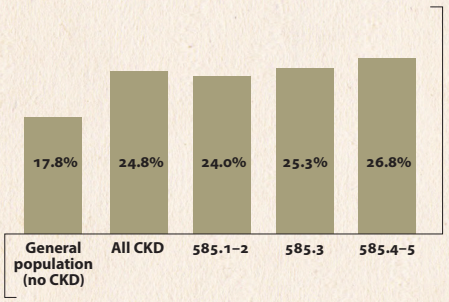
All-cause rehospitalization



Rehospitalization after all-cause index hospitalization

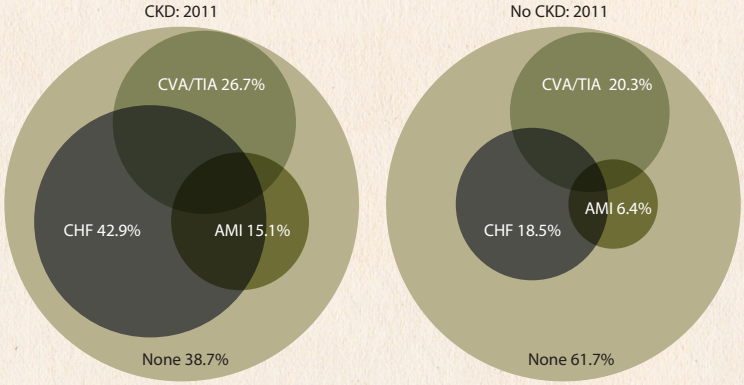


Rehospitalization after cardiovascular index hospitalization



Physician care: Tables 2.g–h
Acute kidney injury: Figures 6.3–4
Hospitalization: Table 3.a
Mortality: Table 3.c
Rehospitalization: Figures 3.1 & 3.9–10

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



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

67% of CKD patients with CHF receive a BETA BLOCKER

58% of CKD patients with a stroke receive a STATIN

76% 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

NET PART D COSTS FOR MEDICARE **CKD** PATIENTS IN 2011

$5.26 BILLION

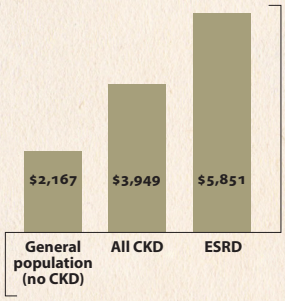
COSTS top three drug classes used by Part D enrollees with CKD

$394 million insulin — 8.3%

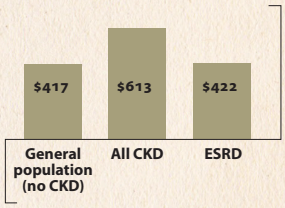
$302 million antiplatelet drugs — 6.3%

$264 million statins — 5.5%

20.0% of total Medicare Part D drug costs in 2011



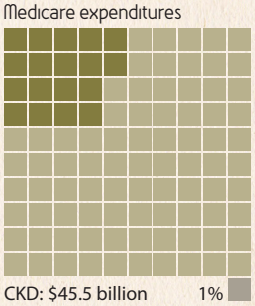
Per person per year Medicare Part D costs, 2011



Per person per year out-of-pocket Part D costs, 2011

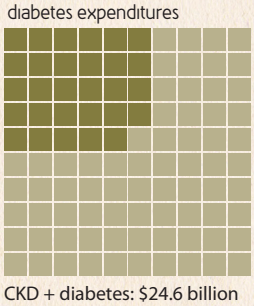
Costs of caring for patients with CKD in 2011
(fee-for-service Medicare patients age 65 & older)

Overall, **patients with CKD** account for 18% of total Medicare expenditures



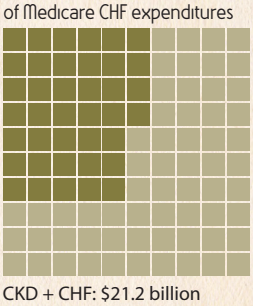
CKD: $45.5 billion — 1%
Medicare total: $249.8 billion

CKD patients with **diabetes** account for 29% of Medicare diabetes expenditures



CKD + diabetes: $24.6 billion
Medicare diabetes: $85.9 billion

CKD patients with **congestive heart failure** account for 39% of Medicare CHF expenditures



CKD + CHF: $21.2 billion
Medicare CHF: $54.7 billion

Circle diagram: Figure 4.1
Medication use: Table 4.b
Medication costs: Figure 7.18
Total Part D costs: Figure 5.9
PPPY & OOP costs: Figure 5.10
Costs of patient care: Figure 7.5–7

This is the twenty-fifth annual report of the United States Renal Data System, and the fourteenth in our atlas series. For the sixth 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 examine changes to patient care after the introduction of the bundled ESRD Prospective Payment System in January, 2011, showing data through July, 2012.

This year's ADR again 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 provide a framework for these issues, we draw on parallels between the growing understanding of CKD over the past decade and the knowledge gained over centuries in cartography and global navigation — knowledge which changed our views of the world. Throughout the book we show how, with the invention of more sophisticated mapping tools, views of the earth have altered and been clarified over time. Shorelines, for example, were first — and quite amazingly — drawn with such simple tools as a compass and the location of stars above the horizon. The ability to determine location by longitude was dramatically enhanced by John Harrison's advancement of the maritime chronometer to accurately keep time in all types of weather conditions at sea. Today, global positioning systems define, with extraordinary precision, our port of call.

Just as our knowledge of the earth changes with the advancement of analytical tools, so too does our understanding of kidney disease, as illustrated by the introduction of the new CKD classification system in February, 2002, which has helped further our understanding of the landscape of CKD.

In this ADR, as in prior volumes, we reflect on the widespread impact of kidney disease: 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 this volume enhances readers' ability to navigate the complexities of CKD and ESRD, just as mariners found safe passage to distant ports.

We approach Volume One from the perspective that the implications of CKD were under-appreciated prior to February, 2002, when the 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). This seminal guideline has been updated in the January, 2013 issue of Kidney International, which presents new information on prognosis, treatment, and refinement of the CKD stages.

The CKD-EPI estimating equation has been codified as a better measure of estimated GFR than the previous MDRD estimating equation. (The CKD-EPI equation is presented in the analytical methods, under "CKD in the general population.") In the 2013 ADR we exclusively use the CKD-EPI to calculate eGFR.

While the USRDS and others will continue to investigate the issues surrounding the use, in both the clinical and public health arenas, of estimating equations to identify kidney damage, 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 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 use a single point in time to show evidence of these abnormalities, recognizing that repeated measures may be required to establish real reductions in eGFR and/or increased levels of albuminuria. For example, using just a spot albumin-to-creatinine ratio of 30 mg/g or greater, 9.2 percent of the general U.S. population is identified as having CKD. We go on to 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 (EGHP) 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 Truven Health MarketScan (formally Thomson Rueters MarketScan) and Clinformatics DataMart (formally 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. The lack of improvement in rehospitalization rates over the past decade is a source of concern. Rates accelerate as patients progress toward more advanced stages of CKD, 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 medication classes used by CKD patients, reflecting the totality of their disease burden. We then look at enrollment patterns in the general Medicare, CKD, and ESRD populations with Part D coverage, highlighting the high percentage receiving the LIS, and present data on monthly premiums, deductibles, gap coverage, and copayments, or

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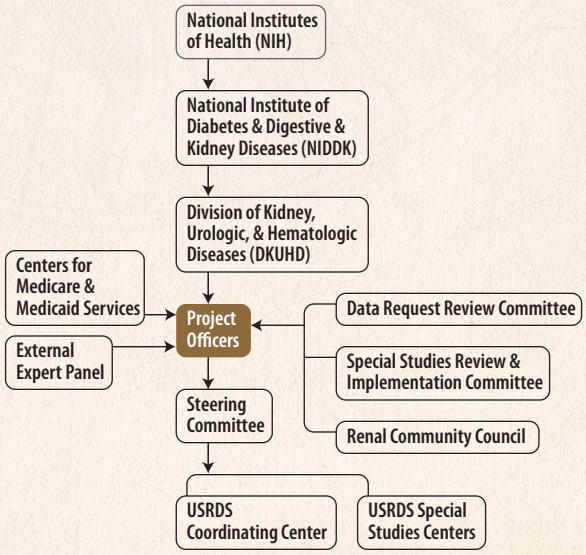
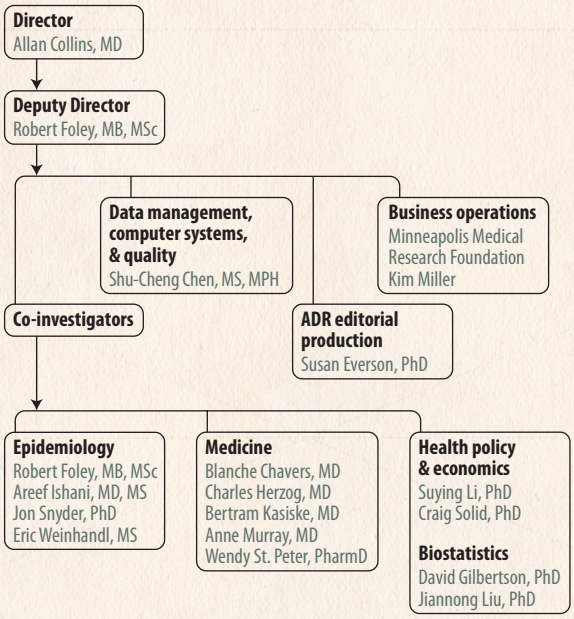


2 Departmental organization of the Coordinating Center



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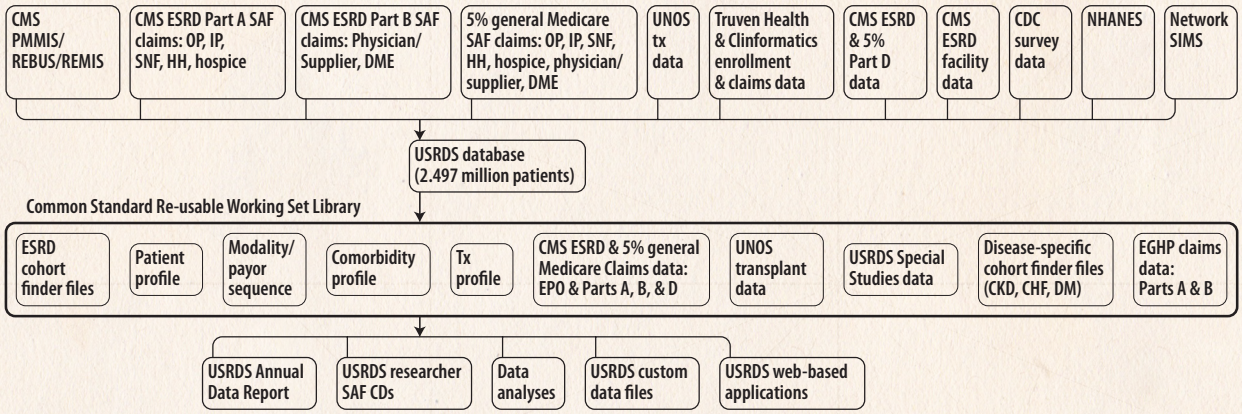
out-of-pocket expenditures. We conclude with data on the use of specific medications in CKD patients with Part D coverage, and look at use during the transition to ESRD.

Acute kidney injury is a condition with implications beyond the immediate event. In Chapter Six, our examination of recognized AKI during a hospitalization looks at trends 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

3 **Structure of the USRDS database**



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care after an event, at prescription drug therapy prior to, immediately after, and 12 months after the AKI event, and on changes in CKD stage.

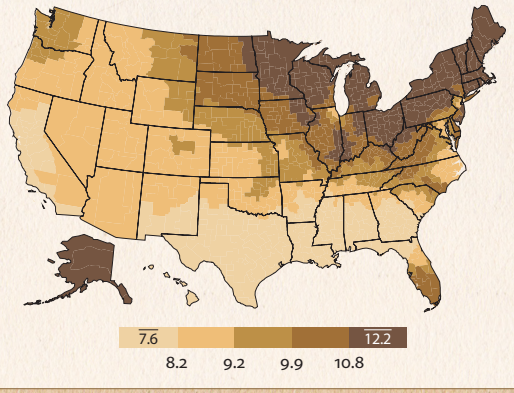
Chapter Seven addresses the costs associated with recognized CKD, based on Medicare data. We look at the relative burden of CKD versus other major chronic diseases such as diabetes and congestive heart failure, at per person per year costs, at costs by CKD stage and for Part D prescription drugs, and at the impact of the LIS.

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 needed based on clinical practice guidelines; both issues may contribute to the increased morbidity and mortality of this high-risk population.

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.