
Introduction to Volume 1: CKD in the United States

Introduction

Chronic kidney disease (CKD) has continued to receive more attention, primarily since the consensus definition and staging classification of CKD was first published by the National Kidney Foundation (NKF) Kidney Disease Outcomes Quality Initiative (KDOQI) (NKF, 2002). Federal agencies have also done much to raise awareness of CKD as a significant public health problem. The USRDS Annual Data Report (ADR) first included a chapter addressing CKD in 2002, and expanded this to a multi-chapter CKD volume in 2008. In 2002, the National Institute of Diabetes and Digestive and Kidney Diseases (NIDDK) launched a National Kidney Disease Education Program (NKDEP; NIDDK, 2002). NKDEP provides information for patients and providers regarding the detection of CKD and care of people with the disease.

The Centers for Disease Control and Prevention (CDC) supports a CKD initiative (CDC, 2015) with the CKD Surveillance Program as its major component; since 2007, this project has reported on many aspects of this important chronic condition.

A nexus between the common non-communicable diseases (NCDs), such as diabetes mellitus, hypertension, obesity, and CKD is well recognized. Over the last decade, the relationship between acute kidney injury (AKI) and CKD has received greater attention (Chawla et al., 2014). During the 2011 High-Level Meeting of the United Nations General Assembly on Prevention and Control of NCDs, it was recognized that, similar to other chronic NCDs, renal diseases “...pose a major health burden for many countries and that these diseases share common risk factors and can benefit from common responses to non-communicable diseases” (United Nations, 2011). The Meeting concluded, however, that CKD could be addressed as a complication of the four main NCDs highlighted by the World Health Organization: cardiovascular disease, cancer, chronic lung diseases,

and diabetes mellitus. At present, the national NCD public health programs of many countries do not specifically include CKD as a public health priority. It is imperative that CKD be recognized as an NCD in its own right, and directly addressed in national programs to combat NCDs around the world. CKD is common, and is associated with high morbidity, mortality, and cost, yet is readily identifiable by simple testing of blood and urine. Timely recognition and treatment has the potential to delay progression of the disease and reduce complications.

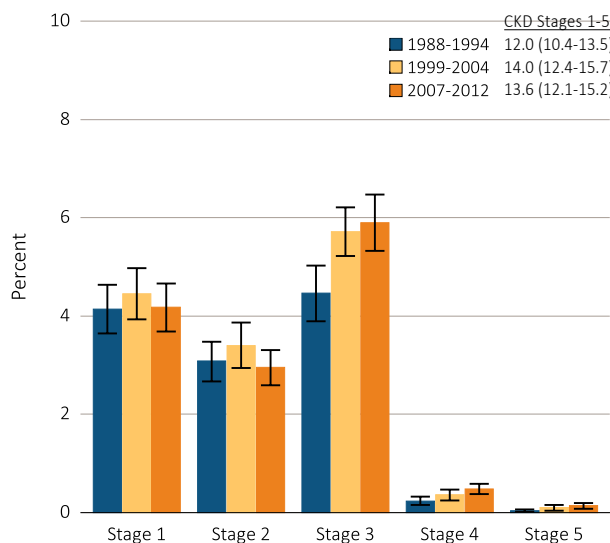
While the number of new patients with end-stage renal disease (ESRD) appears to be stabilizing in the United States, the need to further reduce both the incidence and prevalence of this devastating complication of kidney disease cannot be overemphasized. The key to success is undoubtedly in the realm of prevention and optimal management of CKD in order to slow progression with the goal of completely avoiding ESRD. Large observational studies have shown that even mild to moderate reductions in kidney function and small quantities of albumin in the urine are associated with high rates of all-cause mortality and cardiovascular mortality in particular (Chronic Kidney Disease Prognosis Consortium, 2010; Astor et al., 2011). CKD has therefore been appropriately recognized as a cardiovascular risk equivalent (Sarnak et al., 2003).

Volume 1 of the 2015 USRDS ADR provides key statistics on CKD in the United States. Volume 1 includes the following chapters: CKD in the General Population (Chapter 1); Identification and Care of Patients With CKD (Chapter 2); Morbidity and Mortality in Patients With CKD (Chapter 3); Cardiovascular Disease in Patients With CKD (Chapter 4); Acute Kidney Injury (Chapter 5); Medicare Expenditures for Persons With CKD (Chapter 6); Medicare Part D Prescription Drug Coverage in Patients With CKD (Chapter 7); and Transition of Care in Chronic Kidney Disease (Chapter 8).

Chapter 1: CKD in the General Population

As for many other conditions, the National Health and Nutrition Examination Survey (NHANES) has been a valuable resource for estimation of the prevalence of CKD in the United States. Chapter 1 uses these data to describe CKD in the U.S. general (non-institutionalized) population of people aged 20 and older. We find that CKD is more common than diabetes mellitus in the United States; an estimated 13.6% of adults have CKD, compared to 12.3% with diabetes mellitus (CDC, 2015b). This may well be an overestimate of CKD prevalence, as it is based on the single point estimates of serum creatinine and urine albumin available in the NHANES survey, while the consensus clinical definition of CKD requires the demonstration of persistent abnormality over at least a three-month period. However, for public health surveillance of CKD, a single measurement in stable, ambulatory individuals appears to be a satisfactory compromise, as implementation of two or more measurements is likely not practical in a national study such as NHANES. As shown in Figure i.1, the overall prevalence of CKD increased from 12% to 14% between 1988-1994 and 1999-2004, but has since remained relatively stable. The largest increase has occurred in patients with Stage 3 CKD, from 4.5% to 6.0% since 1988.

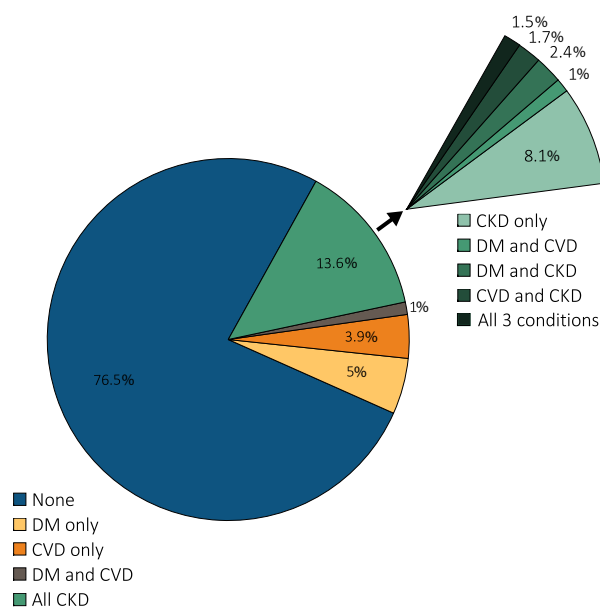
vol 1 Figure i.1 Prevalence of CKD by stage among NHANES participants, 1988-2012



Data Source: National Health and Nutrition Examination Survey (NHANES), 1988–1994, 1999–2004 & 2007–2012 participants aged 20 & older. Whisker lines indicate 95% confidence intervals. Abbreviations: CKD, chronic kidney disease. This graphic also appears as Figure 1.2.

Aging as a risk factor for CKD has emerged as important theme in recent years. Other important and clinically relevant risk factors that should prompt screening for the presence of CKD include the presence of diabetes mellitus, hypertension, cardiovascular disease, obesity, or metabolic syndrome, a family history of ESRD or CKD, and a history of AKI. Consistent with the fact that CKD often occurs in the context of multiple comorbidities and has been termed a ‘disease multiplier’, we find that almost half of individuals with CKD also have diabetes and self-reported cardiovascular disease (Figure i.2).

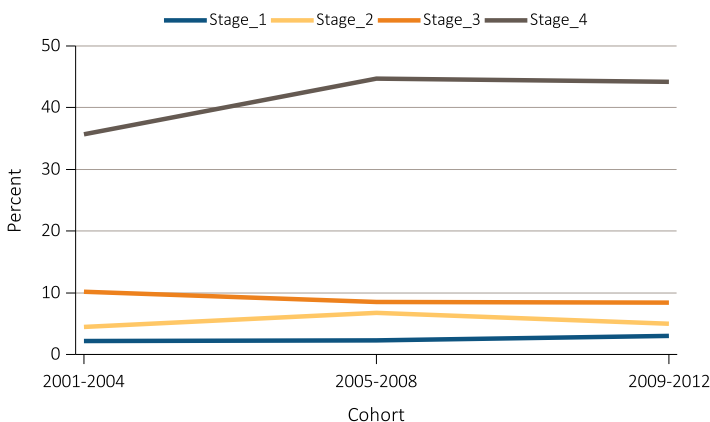
vol 1 Figure i.2 Distribution of NHANES participants with diabetes, self-reported cardiovascular disease, & single-sample markers of CKD, 2007-2012



Data Source: National Health and Nutrition Examination Survey (NHANES), 1988–1994, 1999–2004 & 2007–2012 participants aged 20 & older. Note: Cardiovascular disease designation is based on self-report of any CVD condition (see CKD Analytical Methods chapter for detail); CKD is defined as eGFR <60 or ACR ≥30. Abbreviations: ACR, urine albumin/creatinine ratio; CKD, chronic kidney disease; DM, diabetes mellitus; eGFR, estimated glomerular filtration rate; SR CVD, self-reported cardiovascular disease. This graphic also appears as Figure 1.1.

CKD is a notoriously silent disease, and patient awareness remains very low at less than 10% for those with Stages 1-3 CKD (Figure i.3). Not surprisingly, awareness is higher among those with Stage 4 CKD, by which time patients often experience overt symptoms.

vol 1 Figure i.3 NHANES participants with CKD aware of their kidney disease, 2001-2012

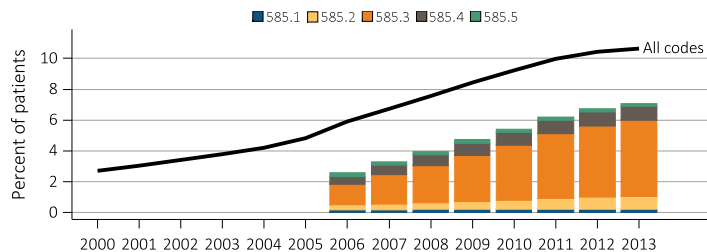


Data Source: National Health and Nutrition Examination Survey (NHANES), 2001-2012 participants aged 20 & older. Abbreviations: CKD, chronic kidney disease. This graphic also appears as Figure 1.16.

Chapter 2: Identification and Care of Patients With CKD

While the NHANES continues to serve as a rich source of information for estimating the prevalence of CKD and analyzing risk factors, it does not contain health system derived data, such as claims data from Medicare or other health plans or health systems. For this reason, this chapter utilizes ‘recognized CKD,’ which is indicated by the presence of a CKD diagnosis on an inpatient claim or two outpatient claims for services reimbursed by Medicare. Chapter 2 presents findings from the Medicare 5 percent sample for age-eligible Medicare enrollees (aged 65 and older), which is a very high-risk population for development of CKD and other comorbid conditions. Data for adults aged 20 and older can be found in the accompanying Reference Tables for this volume. The prevalence of recognized CKD in the Medicare population aged 65 years and older continues to rise over time, peaking at 10.7% in 2013, as shown in Figure i.4. This diagnosis claims-based estimate likely underestimates the true prevalence of CKD in enrollees using Medicare-reimbursed health care services (especially when compared to the high rate of CKD estimated from NHANES), but has high specificity, identifying the individuals likely to have an accurate diagnosis.

vol 1 Figure i.4 Trends in prevalence of recognized CKD, overall and by CKD stage, among Medicare patients aged 65+, 2000-2013

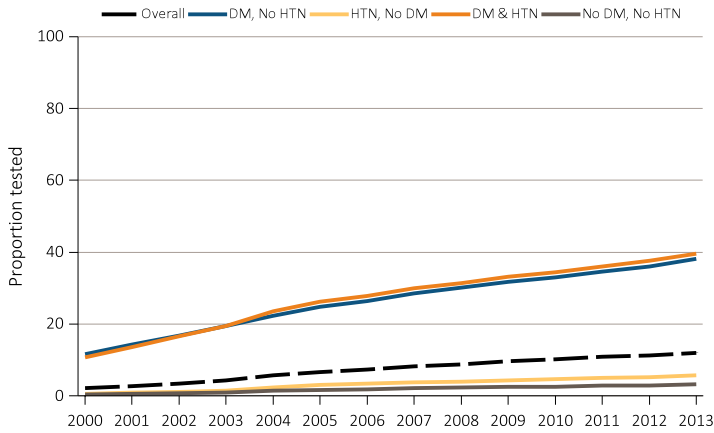


Data Source: Special analyses, Medicare 5 percent sample. Known CKD stages presented as bars; curve showing “All codes” includes known CKD stages (codes 585.1-585.5) and the CKD-stage unspecified codes (585.9, and remaining non-585 CKD codes). Note: In previous years, this graph reported 585.9 codes as a component of the stacked bars. Abbreviation: CKD, chronic kidney disease. This graphic also appears as Figure 2.1.

New this year, progression of CKD using stage-specific claims from a cohort of Medicare patients in 2008 was assessed over the period 2012-2013 (see Vol 1 Chapter 2, Table 2.5). Among patients with CKD Stages 4-5 in 2008, roughly 60% had died as of 2013 and 8% were alive with ESRD as of 2013.

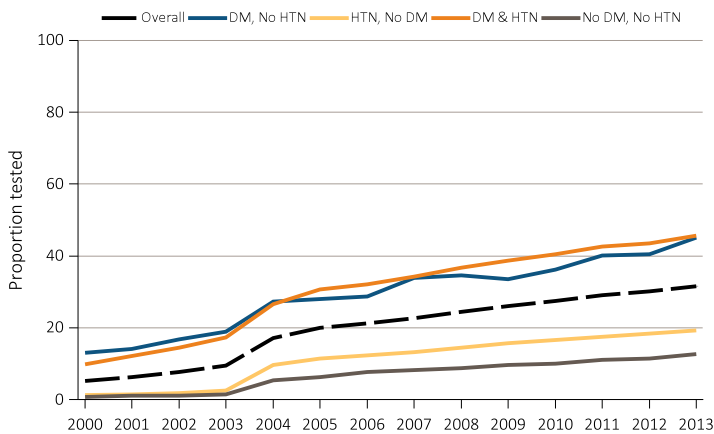
Urine albumin testing is important for monitoring patients with diabetes mellitus, and the recent Kidney Disease: Improving Global Outcomes (KDIGO) guidelines on CKD evaluation and management emphasize the importance of testing CKD patients for the presence of albuminuria in addition to estimated glomerular filtration rate (eGFR) for risk stratification purposes (KDIGO, 2013). In Medicare patients with or without CKD, the proportions with rates of urine albumin testing in the Medicare population have increased slowly over time in both those without and with CKD (Figures i.5 and i.6). Among patients with CKD, those seeing a nephrologist were more likely to receive urine albumin testing (Vol 1 Chapter 2, Table 2.7).

vol 1 Figure i.5 Trends in proportion of patients with urine albumin testing, by year, among Medicare patients aged 65+ WITHOUT a diagnosis of CKD, 2000-2013



Data Source: Special analyses, Medicare 5 percent sample. Patients aged 65 and older with Part A & B coverage in the prior year. Tests tracked during each year. Abbreviations: CKD, chronic kidney disease; DM, diabetes mellitus; HTN, hypertension. This graphic is adapted from Figure 2.3.a.

vol 1 Figure i.6 Trends in proportion of patients with urine albumin testing, by year, among Medicare patients aged 65+ WITH a diagnosis of CKD, 2000-2013



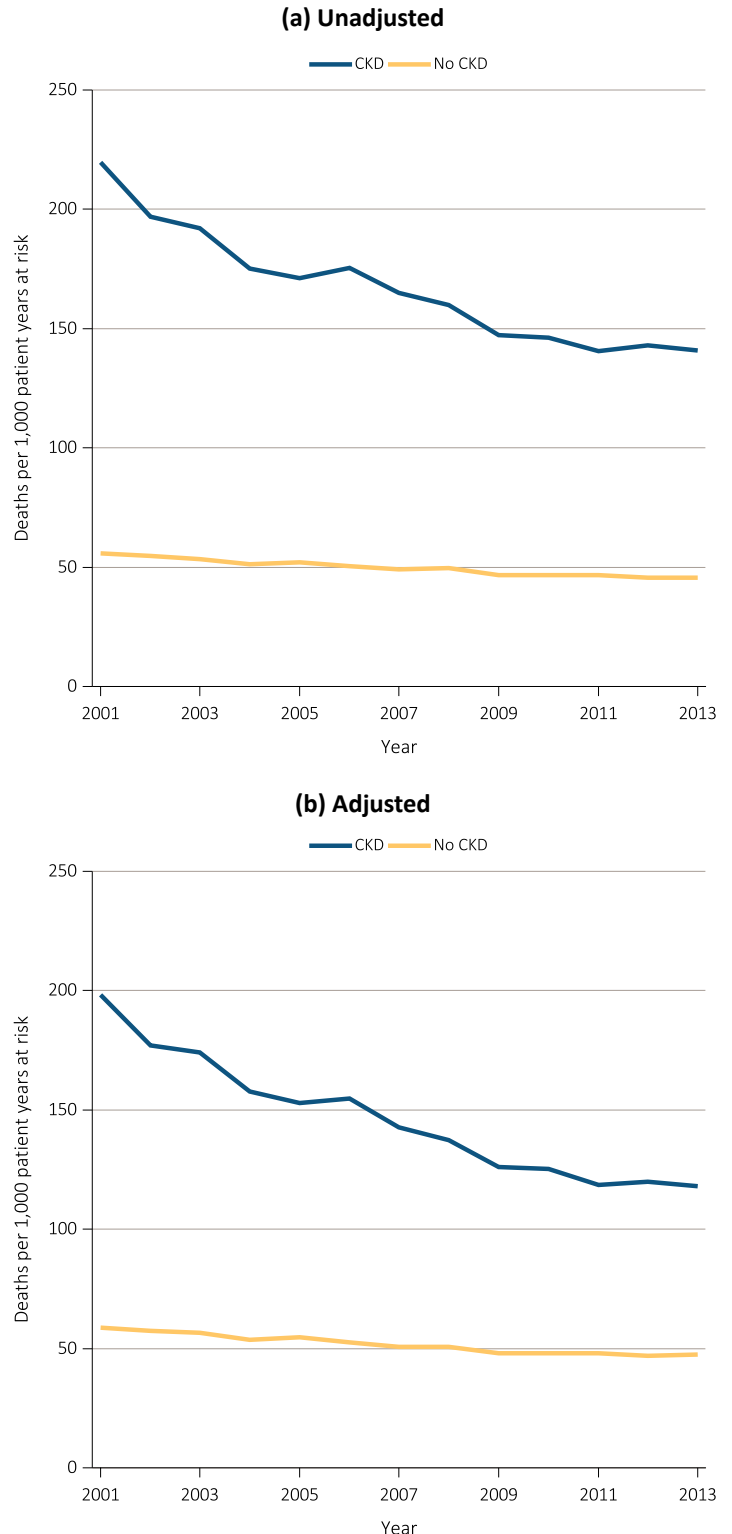
Data Source: Special analyses, Medicare 5 percent sample. Patients aged 65 and older with Part A & B coverage in the prior year. Tests tracked during each year. Abbreviations: CKD, chronic kidney disease; DM, diabetes mellitus; HTN, hypertension. This graphic is adapted from Figure 2.4.a.

Chapter 3: Morbidity and Mortality in Patients With CKD

Chapter 3 examines hospitalization and mortality for Medicare CKD patients as compared to other Medicare patients. Adjusted mortality rates are higher for Medicare patients with CKD than those without, and rates increase with CKD stage, a finding consistent with studies using biochemical measures to define CKD (serum creatinine with validated equations to eGFR, as in Matsushita et al., 2010).

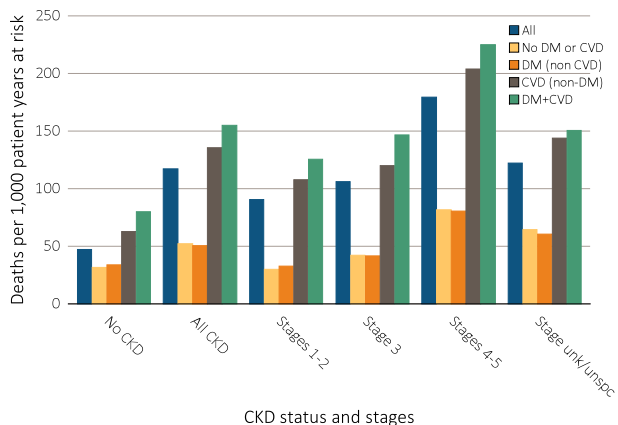
Figure i.7 shows the declining trends in adjusted and unadjusted mortality rates for Medicare patients. The co-occurrences of DM and CVD with CKD multiply a patient’s risk of death, as shown in Figure i.8.

vol 1 Figure i.7 Unadjusted and adjusted all-cause mortality rates (per 1,000 patient years at risk) for Medicare patients aged 66 and older, by CKD status and year, 2001-2013



Data source: Special analyses, Medicare 5 percent sample. January 1 of each reported year, point prevalent Medicare patients age 66 and older. Adj: age/sex/race. Ref: 2012 patients. Abbreviation: CKD, chronic kidney disease. This graphic also appears as Figure 3.1.

vol 1 Figure i.8 Adjusted all-cause mortality rates (per 1,000 patient years at risk) for Medicare patients aged 66 and older, by cardiovascular disease and diabetes mellitus, CKD status and stage, 2013



Data source: Special analyses, Medicare 5 percent sample. January 1, 2013 point prevalent patients aged 66 and older. Adj: age/sex/race. Ref: all patients, 2013. Abbreviations: CKD, chronic kidney disease; CVD, cardiovascular disease; DM, diabetes mellitus. This graphic also appears as Figure 3.6.

A consistent finding regarding hospitalization in the CKD population was an increasing rate of both overall and cause-specific admissions with advancing stages of CKD. When data were adjusted for age, race, and sex, CKD patients were hospitalized at a rate of 0.63 admissions per patient year overall: 0.54 for those in Stages 1-2, 0.61 for Stage 3, and 0.87 for Stages 4-5 (0.61 where stage was not specified; see Table A. ICD-9-CM codes for Chronic Kidney Disease (CKD) stages). In general, hospitalizations among CKD patients also increased in the presence of underlying comorbidities, such as diabetes and cardiovascular disease. This is consistent with previously published studies (Go et al., 2004).

Table A. ICD-9-CM codes for Chronic Kidney Disease (CKD) stages

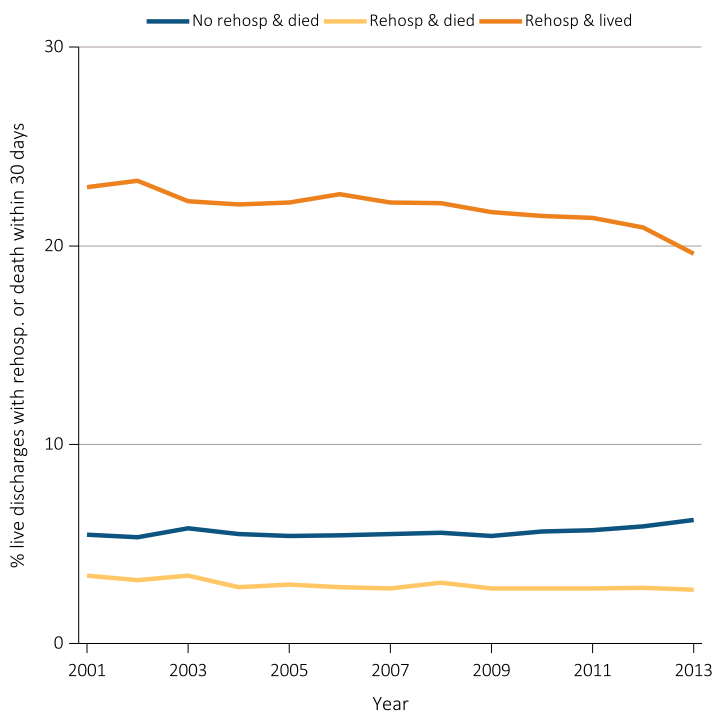
ICD-9-CM code ^a	Stage
585.1	CKD, Stage 1
585.2	CKD, Stage 2 (mild)
585.3	CKD, Stage 3 (moderate)
585.4	CKD, Stage 4 (severe)
585.5	CKD, Stage 5 (excludes 585.6: Stage 5, requiring chronic dialysis ^b)
CKD stage-unspecified	For these analyses, identified by multiple codes including 585.9, 250.4x, 403.9x & others

^a For analyses in this chapter, CKD stage estimates require at least one occurrence of a stage-specific code, and the last available CKD stage in a given year is used.

^b In USRDS analyses, patients with ICD-9-CM code 585.6 & with no ESRD 2728 form or other indication of end-stage renal disease (ESRD) are considered to have code 585.5.

Hospital readmissions are a key quality indicator for the Medicare program. In an attempt to lower the rate of readmission, the Medicare Hospital Readmission Reduction Program was instituted as part of the Patient Protection and Affordable Care Act (Centers for Medicare & Medicaid Services, 2010), reducing Medicare payments to hospitals with excess readmissions. Rates of rehospitalization for CKD patients were higher than those for patients without diagnosed CKD. In 2013, 22.3% of patients with CKD were readmitted within 30 days, compared to only 15.8% of those without CKD (Figure i.9).

vol 1 Figure i.9 Adjusted percentage of patients readmitted to the hospital within 30 days of discharge, among Medicare CKD patients aged 66 and older, discharged alive from an all-cause index hospitalization between January 1 and December 1, by year, 2001-2013

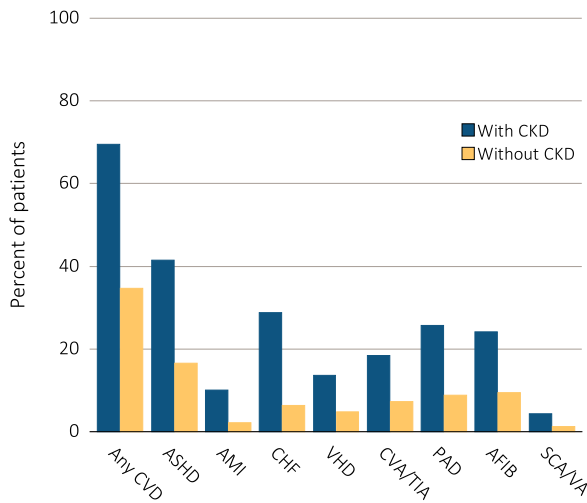


Data Source: Special analyses, Medicare 5 percent sample. Point prevalent Medicare patients aged 66 and older with CKD (defined during the prior year), discharged alive from an all-cause index hospitalization between January 1 and December 1 of the reported year. Adj: age/sex/race. Ref: 2013. Abbreviations: CKD, chronic kidney disease; Rehosp, rehospitalized. This graphic also appears as Figure 3.16.

Chapter 4: Cardiovascular Disease in Patients With CKD

Chapter 4 explores cardiovascular disease as an important comorbidity for patients with CKD. CKD patients are at high-risk for cardiovascular disease, and the presence of CKD often complicates cardiovascular disease treatment and prognosis. This year we continue to examine Medicare data with respect to the interaction of CKD and cardiovascular disease. Figure i.10 shows that the prevalence of any cardiovascular disease defined using Medicare claims is about twice as high for those with CKD compared to those without (69.8% versus 35.2%).

vol 1 Figure i.10 Cardiovascular disease in patients with or without CKD, 2013

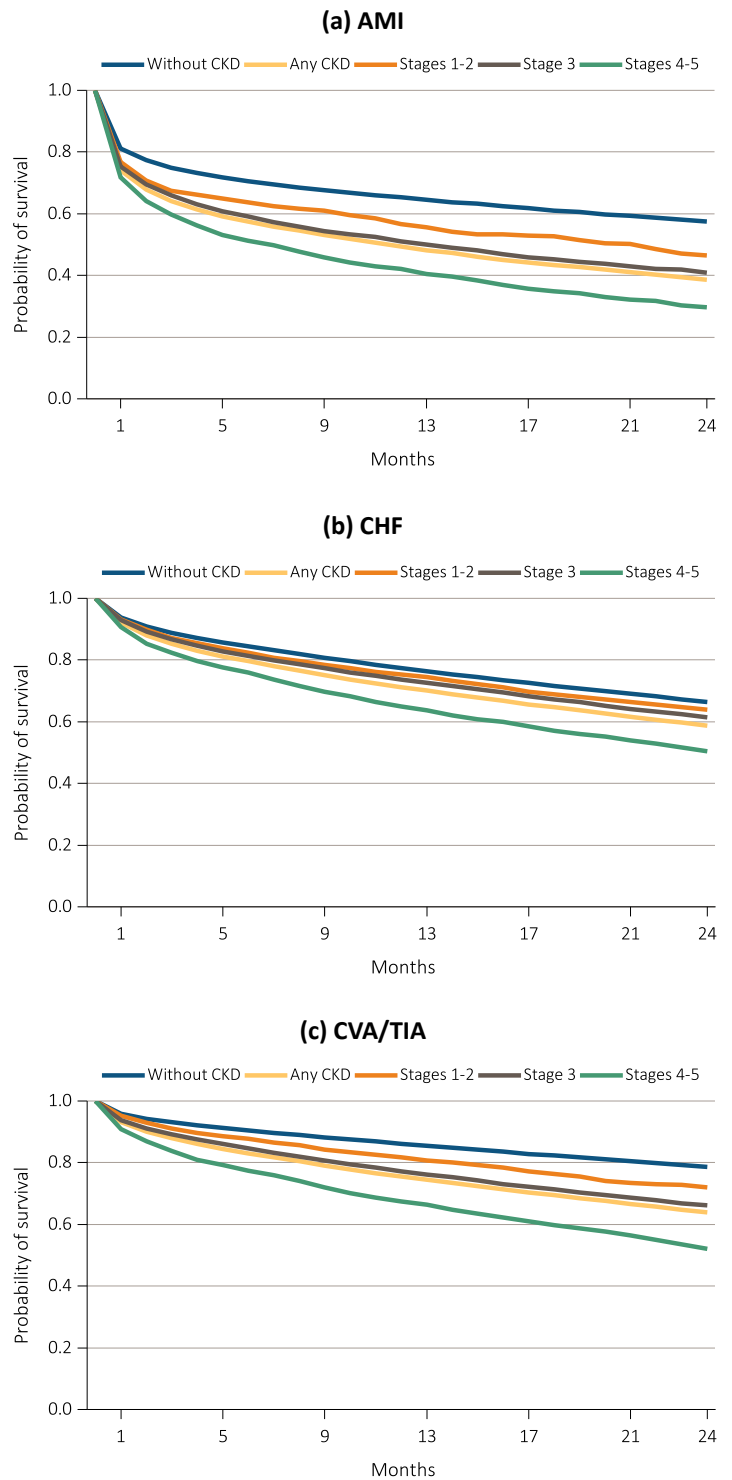


Data Source: Special analyses, Medicare 5 percent sample. Patients aged 66 and older, alive, without end-stage renal disease, and residing in the U.S. on 12/31/2013 with fee-for-service coverage for the entire calendar year. Totals of patients for the study cohort: N=1,238,888; With CKD=132,840; Without CKD=1,106,048. Abbreviations: AFIB, atrial fibrillation; AMI, acute myocardial infarction; ASHD, atherosclerotic heart disease; CHF, congestive heart failure; CKD, chronic kidney disease; CVA/TIA, cerebrovascular accident/transient ischemic attack; CVD, cardiovascular disease; PAD, peripheral arterial disease; SCA/VA, sudden cardiac arrest and ventricular arrhythmias; VHD, valvular heart disease. This graphic also appears as Figure 4.1.

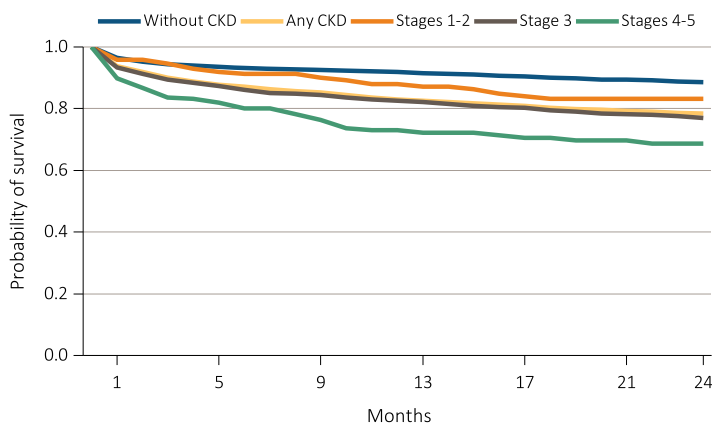
It is of note that atherosclerotic heart disease (ASHD) is the most frequent cardiovascular disease linked to CKD; its prevalence in CKD patients aged 66 years and older exceeds 40% in 2013. This data also shows that the proportion of cardiovascular disease patients undergoing cardiovascular procedures is higher among those with CKD than those without. This is gratifying to note, and suggests that ‘therapeutic nihilism’ toward those with CKD might well be on the decline. However, this issue will require further examination.

The presence of CKD worsens the short- and long-term prognosis for cardiovascular disease and many interventions, as shown in Figure i.11.

vol 1 Figure i.11 Survival of patients with a cardiovascular diagnosis or procedure, by CKD status, 2011-2013



(d) CABG

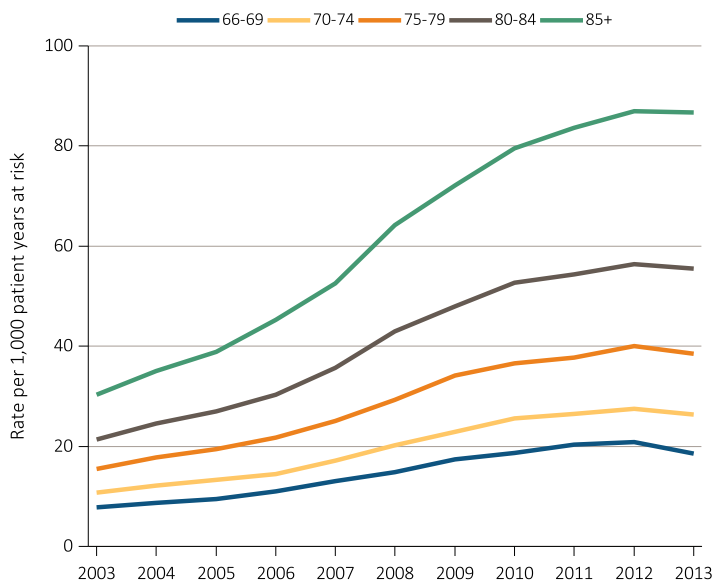


Data Source: Special analyses, Medicare 5 percent sample. Patients aged 66 and older, alive, without end-stage renal disease, and residing in the U.S. on the index date, which is the date of the first condition/procedure claim, with fee-for-service coverage for the entire year prior to this date. Abbreviations: AMI, acute myocardial infarction; CABG, coronary artery bypass grafting; CHF, congestive heart failure; CKD, chronic kidney disease; CVA/TIA, cerebrovascular accident/transient ischemic attack. This graphic is adapted from Figure 4.2.

Chapter 5: Acute Kidney Injury

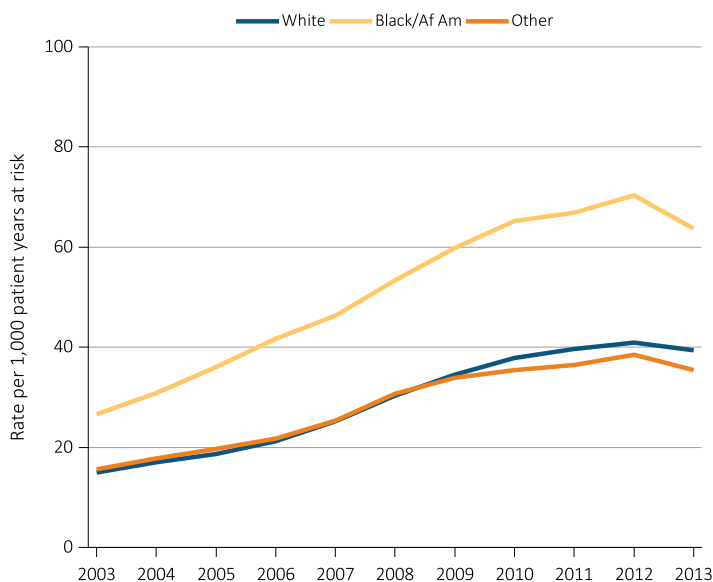
In 2013, the unadjusted rate of AKI hospitalizations in the Medicare population fell by 4.9%. This fall was observed across all age and race groups (Figures i.12 and i.13). For Medicare patients aged 66 years and older with an AKI hospitalization in 2011, the cumulative probability of a recurrent AKI hospitalization within two years was 48% (Figure i.14). Among Medicare patients aged 66 years and older with a first AKI hospitalization, the in-hospital mortality rate in 2013 was 9.5% (or 14.4% when including discharge to hospice) and less than half of all patients were discharged to their home (Figure i.15).

vol 1 Figure i.12 Unadjusted rates of first hospitalization with AKI for Medicare patients aged 66+, by age and year, 2003-2013



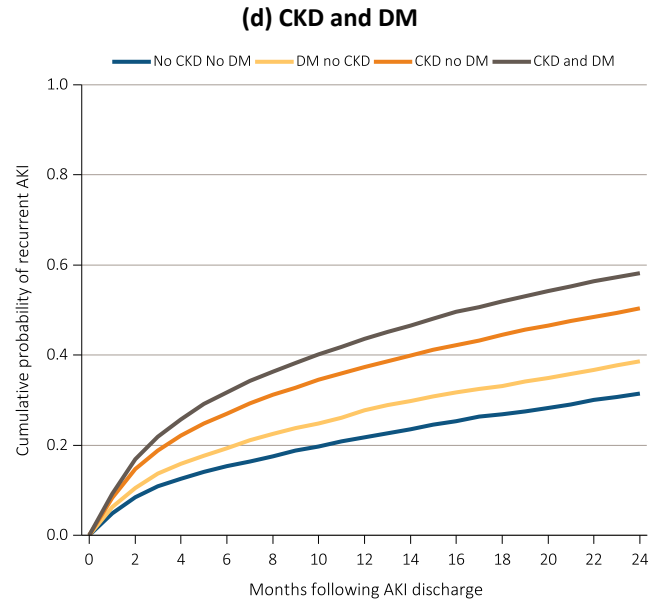
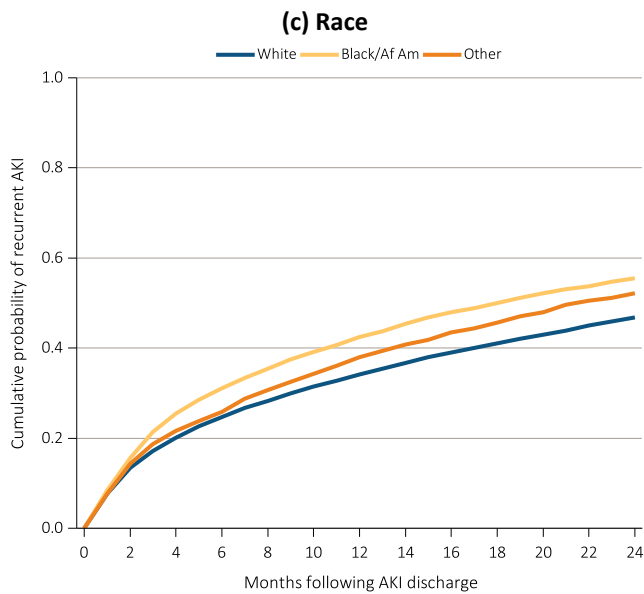
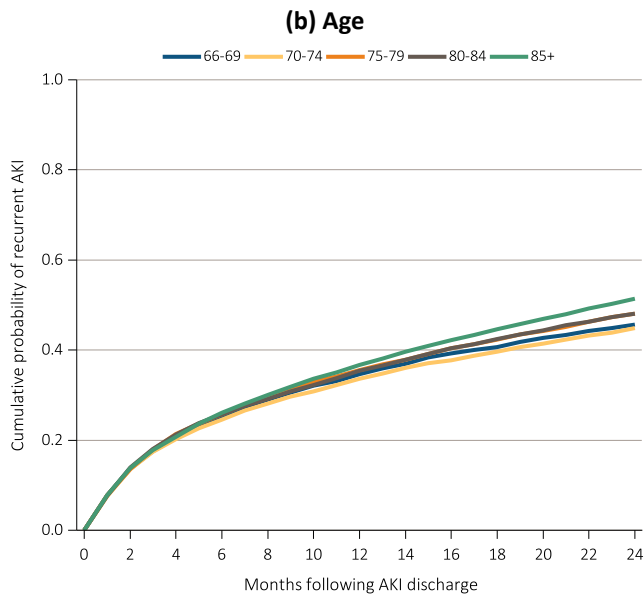
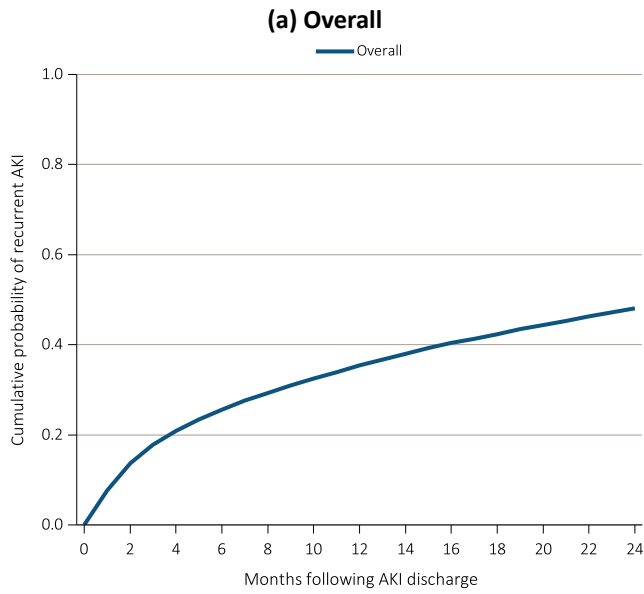
Data Source: Special analyses, Medicare 5 percent sample. Age as of January 1 of specified year. All patient-years at risk for Medicare patients aged 66 and older who had both Medicare Parts A & B, no Medicare Advantage plan, no ESRD by first service date from Medical Evidence form, and were alive on January 1 of year shown. Censored at death, ESRD, end of Medicare Parts A & B participation, or switch to Medicare Advantage program. Abbreviations: AKI, acute kidney injury; ESRD, end-stage renal disease. This graphic also appears as Figure 5.2.

vol 1 Figure i.13 Unadjusted rates of first hospitalization with AKI for Medicare patients aged 66+, by race and year, 2003-2013



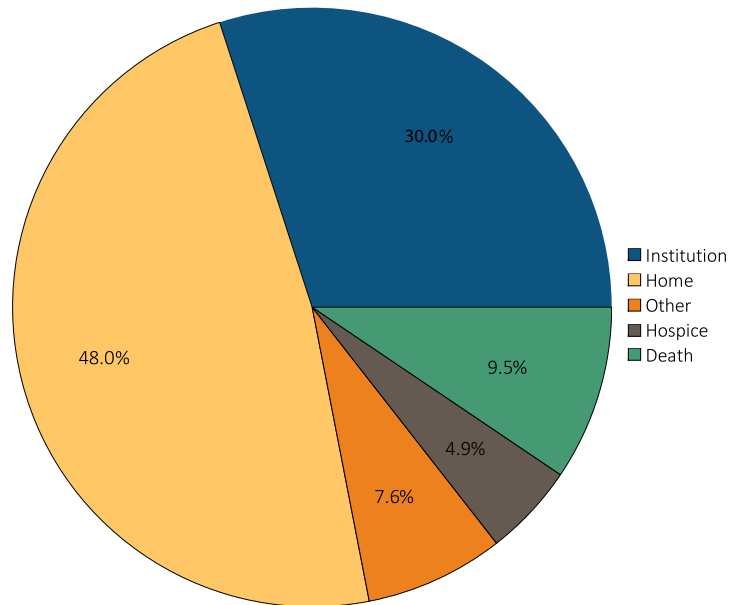
Data Source: Special analyses, Medicare 5 percent sample. All patient-years at risk for Medicare patients aged 66 and older who had both Medicare Parts A & B, no Medicare Advantage plan, no ESRD by first service date from Medical Evidence form, and were alive on January 1 of year shown. Censored at death, ESRD, end of Medicare Parts A & B participation, or switch to Medicare Advantage program. Abbreviations: Af Am, African American; AKI, acute kidney injury; ESRD, end-stage renal disease. This graphic also appears as Figure 5.3.

vol 1 Figure i.14 Cumulative probability of a recurrent AKI hospitalization within two years of live discharge from first AKI hospitalization in 2011 for Medicare patients aged 66+, (a) overall, (b) by age, (c) by race, and (d) by CKD and DM



Data Source: Special analyses, Medicare 5 percent sample. Age on January 1, 2011. Medicare patients aged 66 and older who had both Medicare Parts A & B, no Medicare Advantage plan, no ESRD by first service date from Medical Evidence form on 1/1/2011 and were discharged alive from an AKI hospitalization in 2011. Censored at death, ESRD, end of Medicare Parts A & B participation, or switch to Medicare Advantage program. Abbreviations: AKI, acute kidney injury; CKD, chronic kidney disease; DM, diabetes mellitus; ESRD, end-stage renal disease. This graphic also appears as Figure 5.7.

vol 1 Figure i.15 Hospital discharge status of first AKI hospitalization for Medicare patients aged 66+, 2013

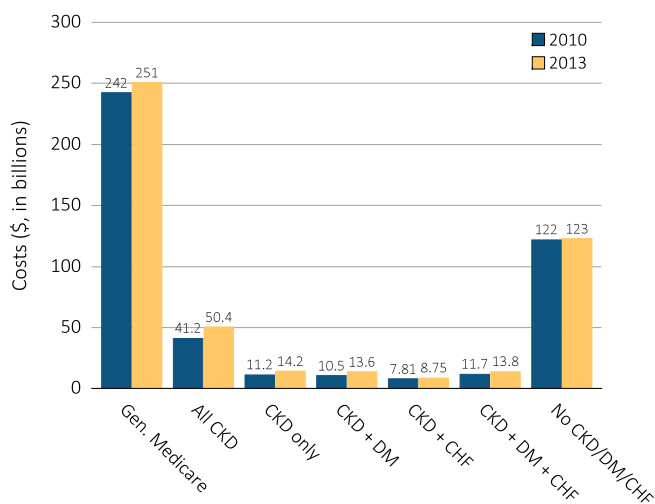


Data Source: Special analyses, Medicare 5 percent sample. Medicare patients aged 66 and older who had both Medicare Parts A & B, no Medicare Advantage plan, did not have ESRD on 1/1/2013, and had a first AKI hospitalization in 2013. Institution includes short-term skilled nursing facilities, rehabilitation hospitals, and long-term care facilities. Home also includes patients receiving home health care services. Excludes patients admitted to the acute care hospital from a skilled nursing facility. Abbreviations: AKI, acute kidney injury; ESRD, end-stage renal disease. This graphic also appears as Figure 5.14.

Chapter 6: Medicare Expenditures for Persons With CKD

Among the general Medicare population aged 65 and older, total costs for Parts A, B, and D rose 3.7% to \$251 billion between 2010 and 2013, while such costs rose 22.3% to \$50.4 billion among CKD patients (Figure i.16). Therefore, costs in the non-ESRD CKD population exceeded those in the ESRD population (\$30.9 billion, see Volume 2, Chapter 11, Medicare Expenditures for Persons with ESRD). Costs for these patients with CKD now represent 20.1% of all Medicare Parts A, B, and D spending. Although there was a universal rise in expenditure for all covered groups, certain patient populations with comorbid conditions in addition to CKD experienced higher rates of growth. Costs for patients without CKD, diabetes mellitus, or CHF increased by only 0.8%, while the costs for those with one or more of these three conditions increased by \$9 billion. This is equivalent to the \$9 billion increase in general Medicare spending on all elderly patients between 2010 and 2013.

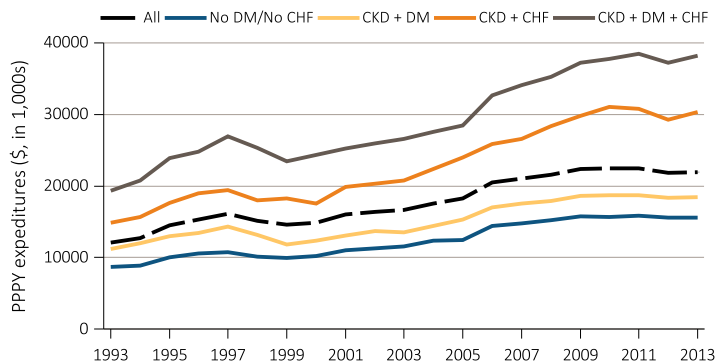
vol 1 Figure i.16 Overall Medicare Parts A, B, and D costs for fee-for-service patients aged 65 and older, by CKD, DM, CHF, and year, 2010 & 2013



Data source: Special analyses, Medicare 5 percent sample. Abbreviations: CKD, chronic kidney disease; CHF, congestive heart failure, DM, diabetes mellitus. This graphic also appears as Figure 6.1.

Figure i.17 illustrates PPPY costs for Medicare CKD patients aged 65 and older by the presence of diabetes mellitus and CHF. In 2013, PPPY costs for CKD patients varied greatly by the presence of their comorbidities. CKD patients without diabetes mellitus and without CHF cost \$15,614 per person per year. Those with diabetes mellitus in addition to CKD averaged \$18,404 PPPY, and patients with CKD and CHF cost \$30,312, while expenditures for those with all three conditions reached \$38,230 PPPY.

vol 1 Figure i.17 Per person per year expenditures on Parts A, B, and D services for the CKD Medicare population aged 65+, by DM, CHF, and year, 1993-2013

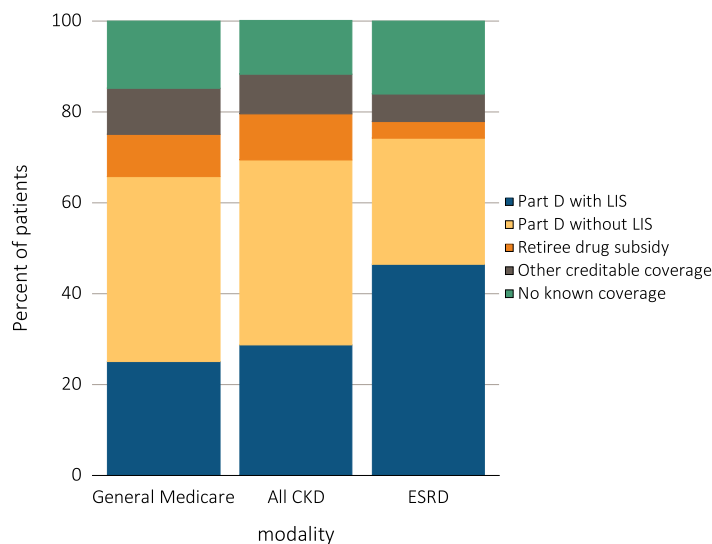


Data Source: Special analyses, Medicare 5 percent sample. Abbreviations: CKD, chronic kidney disease; CHF, congestive heart failure, DM, diabetes mellitus; PPPY, per person per year. This graphic also appears as Figure 6.5.

Chapter 7: Medicare Part D Prescription Drug Coverage in Patients With CKD

Approximately 69% of CKD patients were enrolled in Medicare Part D (including both stand-alone and Medicare Advantage plans) in 2013, slightly higher than enrollment in the general Medicare population and slightly lower than enrollment in the ESRD population. Compared to the general population, however, a higher percentage of CKD patients qualified for the Low-income Subsidy (LIS) (Figure i.18).

vol 1 Figure i.18 Sources of prescription drug coverage in Medicare enrollees, by population, 2013

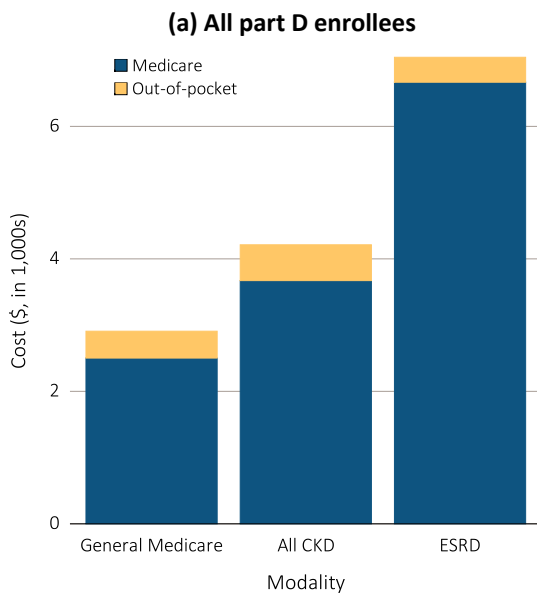


Data source: Special analyses, Medicare 5 percent sample. Point prevalent Medicare enrollees alive on January 1, 2013. Abbreviations: CKD, chronic kidney disease; ESRD, end-stage renal disease; LIS, Medicare Low-income Subsidy; Part D, Medicare prescription drug coverage benefit. This graphic also appears as Figure 7.1.

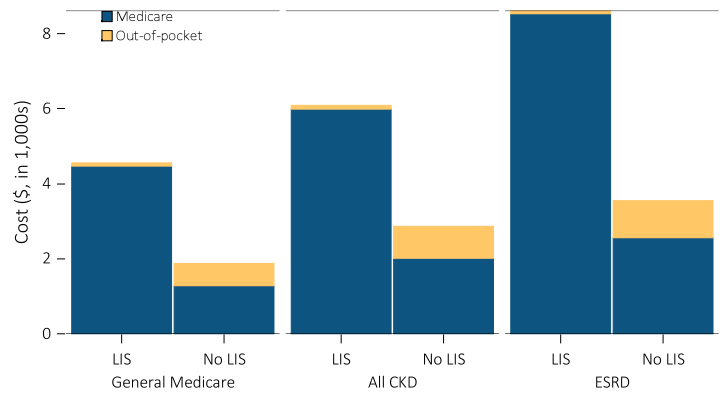
In 2013, PPPY net Part D spending for CKD patients was 46% higher than for general Medicare patients, at \$3,675 compared to \$2,509. Similar to total Part D costs, out-of-pocket costs for CKD patients were 35% higher than for the general Medicare population. Due to the much higher proportion of LIS in the ESRD population, out-of-pocket costs represented a smaller share of total spending (5%) than in the other two groups (13% for CKD, and 14% for general Medicare) (Figure 1.19a).

Total spending for Part D-covered medications in 2013 was more than twice as high for patients with the LIS than for those without (Figure 1.19b). In the LIS population, however, out-of-pocket costs represented only 1-2% of these total expenditures, compared to 28-32% in each of the non-LIS populations.

vol 1 Figure i.19 Per person per year Medicare & out-of-pocket Part D costs for enrollees, 2013



(b) Part D enrollees by low income subsidy status



Data source: Special analyses, Medicare 5 percent sample. Medicare totals include Part D claims for Part D enrollees with traditional Medicare (Parts A & B). CKD totals include Medicare CKD patients as determined from claims. ESRD totals include all Part D claims for Medicare ESRD patients with Medicare Part D stand-alone prescription drug plans. Costs are per person per year for calendar year 2013. Medicare total is the sum of Medicare net payment plus Low-income Supplement amount. Abbreviations: CKD, chronic kidney disease; ESRD, end-stage renal disease; Part D, Medicare prescription drug coverage benefit. This graphic also appears as Figure 7.5.a & b.

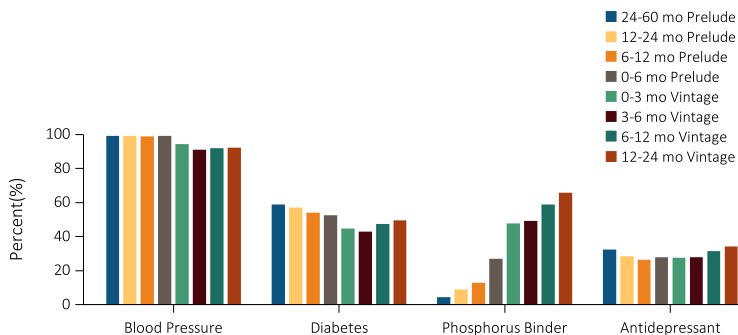
Chapter 8: Transition of Care in Chronic Kidney Disease (TC-CKD)

The Transition of Care in Chronic Kidney Disease (TC-CKD) Special Study Center examines the transition of care to renal replacement therapy, i.e., dialysis or transplantation, in patients with very-late-stage non-dialysis dependent (NDD) CKD. The main databases used in these analyses are created from the linkage between the national USRDS data and two large longitudinal databases of NDD-CKD patients, i.e., the national (entire U.S.) Veterans Affairs (VA) database, and the regional (Southern California) Kaiser Permanente (KP-SC) database.

Patterns of medication use before, during and after transition to ESRD are examined. As shown in Figure i.20, over 90% of patients were on blood pressure lowering medications prior to ESRD transition, and this high medication rate persisted during and throughout post-transition period. Diabetes medications were given to 50% of all veterans prior to ESRD transition, but this rate declined to 40% in Year 1 of the vintage. Phosphorus binders were rarely prescribed during the prelude to ESRD, but a major surge was observed in the final six months of the prelude and immediately prior to transition to ESRD, followed by a substantial rise during the vintage period. Anti-depressants show a rather constant prescription pattern independent of transition

to ESRD, in that almost 30% of veterans received these medications during both prelude and vintage, although some upwards trends is observed after transition to ESRD.

vol 1 Figure i.20 Medications prescribed to 52,172 incident ESRD veterans who transitioned to ESRD from 10/1/2007-9/30/2011

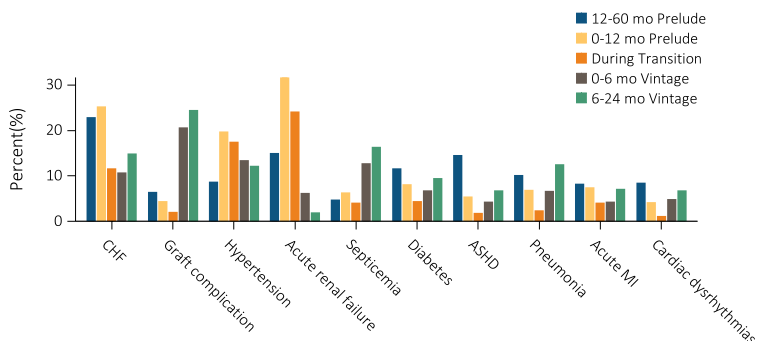


Data source: Special analyses, VHA Administrative data and CMS Medicare Inpatient and Outpatient data. An individual's data includes the period from 60 months prior to transition (prelude) to 24 months following transition (vintage). Abbreviations: CMS, Centers for Medicare & Medicaid; ESRD, end-stage renal disease; mo, month; VHA, Veterans Health Administration. This graphic also appears as Figure 8.3.

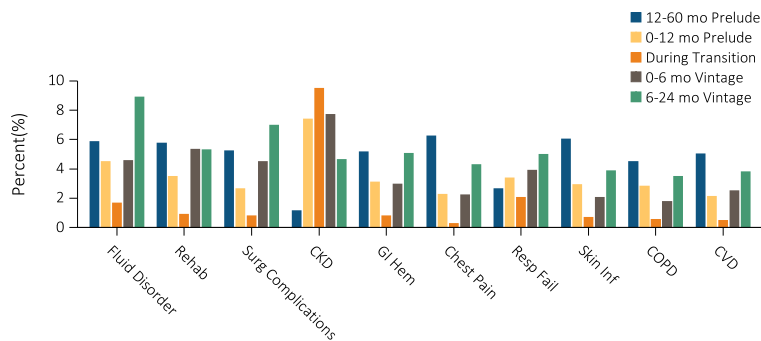
Cause-specific hospitalization events were also analyzed. Figure i.21 shows the top 20 causes of hospitalization among 46,625 veterans who transitioned to ESRD over the 4-year period (10/2007-9/2011) with at least one hospitalization event from -5 years prelude to +2 years vintage surrounding the transition intercept. Of the top 20 causes of hospitalization, notably septicemia-related hospital events increased dramatically after ESRD transition. The most common causes of hospital admission that also consisted of the ESRD transition day included acute renal failure, hypertension, CHF, and CKD.

vol 1 Figure i.21 Top 20 causes of hospitalizations in 46,625 incident ESRD veterans who were hospitalized at least once during the -60 months prior to ESRD transition (prelude) up to +24 months after ESRD transition (vintage)

(a) 10 of the top 20 causes of hospitalizations



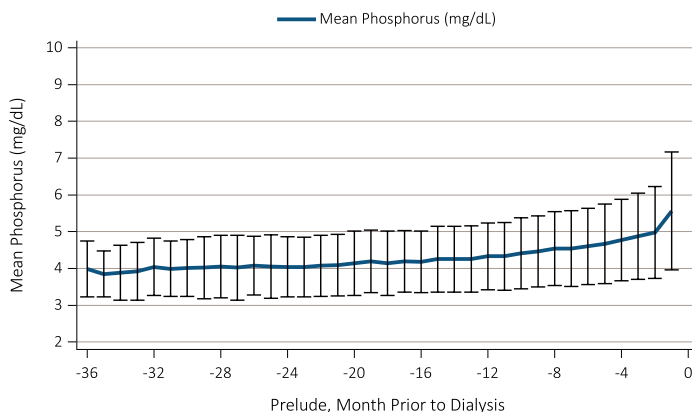
(b) 10 of the top 20 causes of hospitalizations



Data source: Special analyses, VHA Administrative data, USRDS ESRD Database, CMS Medicare Inpatient and Outpatient data. Abbreviations: ASHD, atherosclerotic heart disease; CHF, congestive heart failure; CKD, chronic kidney disease; CMS, Centers for Medicare & Medicaid; COPD, chronic obstructive pulmonary disease; CVD, acute cerebrovascular disease; GI Hem, gastrointestinal hemorrhage; MI, myocardial infarction; mo, month; Resp Fail, respiratory failure; Skin Inf, skin infection; surg, surgical; VHA, Veterans Health Administration. This graphic also appears as Figure 8.6.

Figure i.22 shows the pre-ESRD trend in serum phosphorus in 11,896 veterans who eventually transitioned to ESRD over 20 calendar quarters or 5 years. Serum phosphorus increased from 4 to above 5.5 mg/dL immediately prior to transition to ESRD.

vol 1 Figure i.22 Trend in serum phosphorus level during the prelude (pre-ESRD) time over 36 months in 11,896 veterans who later transitioned to ESRD during 10/1/2007-9/31/2011



Data source: Special analyses, VHA Administrative data, USRDS ESRD Database. Abbreviations: ESRD, end-stage renal disease; g/dL, grams per deciliter; VHA, Veterans Health Administration. This graphic also appears as Figure 8.9.

References

- Astor BC, Matsushita K, Gansevoort RT, van der Velde M, Woodward M, Levey AS, de Jong PE, Coresh, and the Chronic Kidney Disease Prognosis Consortium. Lower estimated glomerular filtration rate and higher albuminuria are associated with mortality and end-stage renal disease. A collaborative meta-analysis of kidney disease population cohorts. *Kidney Intl* 2011;79(12):1331-1340.
- Centers for Disease Control and Prevention. Chronic Kidney Disease Surveillance System—United States. <http://nccd.cdc.gov/CKD>. Accessed October 30, 2015.
- Centers for Disease Control and Prevention. Chronic Kidney Disease. <http://www.cdc.gov/diabetes/programs/initiatives/kidney.html>. Accessed October 30, 2015.
- Centers for Disease Control and Prevention. National Diabetes Statistics Report: Estimates of Diabetes and Its Burden in the United States, 2014. Atlanta, GA: U.S. Department of Health and Human Services, 2014.
- Centers for Medicare & Medicaid Services. Readmissions Reduction Act 2010. <http://cms.gov/Medicare/Medicare-Fee-for-Service-Payment/AcuteInpatientPPS/Readmissions-Reduction-Program.html>. Accessed October 30, 2015.
- Chawla LS, Eggers PW, Star RA, Kimmel PL. Acute kidney injury and chronic kidney disease as interconnected syndromes. *N Engl J Med* 2014;371:58-66.
- Chronic Kidney Disease Prognosis Consortium. Association of estimated glomerular filtration rate and albuminuria with all-cause and cardiovascular mortality in general population cohorts: a collaborative meta-analysis. *Lancet* 2010;375(9731):2073-2081.
- Go AS, Chertow GM, Fan D, McCulloch CE, Hsu C. Chronic kidney disease and the risks of death, cardiovascular events, and hospitalization. *N Engl J Med* 2004;351(13):1296-1305.
- Kidney Disease: Improving Global Outcomes (KDIGO) CKD Work Group. KDIGO 2012 clinical practice guideline for the evaluation and management of chronic kidney disease. *Kidney Int Suppl* 2013;3(1):1-150.
- Matsushita K, van der Velde M, Astor BC, Woodward M, Levey AS, de Jong PE, Coresh J, Gansevoort RT. Association of estimated glomerular filtration rate and albuminuria with all-cause and cardiovascular mortality in general population cohorts: a collaborative meta-analysis. *Lancet* 2010;375:2073-2081.
- National Institute of Diabetes and Digestive and Kidney Diseases (NIDDK). National Kidney Disease Education Program. <http://nkdep.nih.gov/>. Accessed October 30, 2015.
- National Kidney Foundation. KDOQI Clinical Practice Guidelines for Chronic Kidney Disease: Evaluation, Classification and Stratification. *Am J Kidney Dis* 2002;39(suppl 1):S1-S266.
- Sarnak MJ, Levey AS, Schoolwerth AC, Coresh J, Culleton B, Hamm LL, McCullough PA, Kasiske BL, Kelepouris E, Klag MJ, Parfrey P, Pfeffer M, Raij L, Spinosa DJ, Wilson PW. Kidney disease as a risk factor for development of cardiovascular disease: a statement from the American Heart Association Councils on Kidney in Cardiovascular Disease, High Blood Pressure Research, Clinical Cardiology, and Epidemiology and Prevention. American Heart Association Councils on Kidney in Cardiovascular Disease, High Blood Pressure Research, Clinical Cardiology, and Epidemiology and Prevention. *Circulation*. 2003;108(17):2154.
- United Nations General Assembly. Resolution 66/2, Political Declaration of the High-level Meeting of the General Assembly on the Prevention and Control of Non-communicable Diseases, A/RES/66/92 (19 September 2011). Retrieved October 30, 2014 from http://www.who.int/nmh/events/un_ncd_summit2011/political_declaration_en.pdf