Chapter 2: Identification and Care of Patients with CKD

- Over half of patients in the Medicare 5% sample (aged 65 and older) had at least one of three diagnosed chronic conditions – chronic kidney disease (CKD), cardiovascular disease (CVD), or diabetes mellitus (DM), while 19.9% had two or more of these conditions. Within a younger population derived from the Optum Clinformatics™ Data Mart (ages 22-64 years), 10.6% had at least one of the three conditions, and 1.6% had two or more. As indicated by diagnosis claims and biochemical data from the Department of Veterans Affairs (VA), 15.6% of patients had at least one of the three conditions, while 2.4% had at least two (Table 2.2.b).
- In the Medicare 5% sample and VA data, 13.8% and 14.9% of patients had a diagnosis of CKD in 2016, as opposed to only 2.0% of patients in the Optum Clinformatics™ population (Table 2.4).
- The proportion of patients with recognized CKD in the Medicare 5% sample has grown steadily, from 2.7% in 2000 to 13.8% in 2016 (Figure 2.2).
- Of those in the 2011 Medicare 5% sample who had a diagnosis of CKD Stage 3, by 2016 3.2% had progressed to end-stage renal disease (ESRD) with or without death, and 40.9% had died (without reaching ESRD). For these Medicare patients without identified CKD, progressions to ESRD and death by 2016 were 0.2% and 20.9% (Table 2.5).
- Testing for urine albumin is recommended for patients with DM. Among Medicare patients with a diagnosis of DM, claims data indicated that testing for urine albumin has become more common, but was conducted for less than half of these patients—41.8% in 2016, up from 26.4% in 2006. In 2016, urine albumin testing was performed in 49.9% of diabetic Medicare patients who also had diagnoses of CKD and hypertension (HTN). Patterns were similar in the Optum Clinformatics™ population, but with somewhat lower rates of testing (Figures 2.3 and 2.4).
- Among Medicare patients with recognized CKD in 2015, patients who saw a nephrologist were roughly twice as likely to have a claim for urine albumin testing in 2016 (55.4%) than those who saw only a primary care physician (26.7%; Figure 2.5).

Introduction

Epidemiological evaluations of the identification and care of patients with CKD are a significant challenge, as unlike with ESRD, no single data source contains all the information necessary to definitively identify CKD-related care practices in the United States (U.S.) population. Furthermore, most large administrative health care datasets lack the biochemical data (serum creatinine and urine albumin or urine total protein) required per Kidney Disease Improving Global Outcomes (KDIGO) guidelines for definitive identification of CKD.

As presented in Volume 1, Chapter 1: *CKD in the General Population*, The National Health and Nutrition Examination Survey (NHANES) is a nationally representative survey that contains the biochemical information with which to estimate the prevalence of CKD in the United States. However, NHANES is constrained by its cross-sectional nature, a relatively small sample size, and lack of geographic detail. This limits precision in estimating prevalence, in evaluating long-term outcomes, adverse events, and quality of care delivered, and in the ability to conduct analyses by geography or on subsets of patients.

In addition, NHANES includes only a single measure of serum creatinine and urine albumin for each patient. Per KDIGO guidelines, two abnormal measures over at least 90 days are necessary to definitively diagnose CKD. Because NHANES-based calculations rely on laboratory measures at a single

time point, they may overestimate the national prevalence of CKD. Nevertheless, NHANES is generally considered the best available source of such information at the present time.

To provide a more comprehensive picture of the identification and care of CKD throughout the nation, in this chapter, we complement NHANES with the examination of health care data in large and diverse administrative health care datasets: the Medicare 5% sample, Optum Clinformatics™ Data Mart, and from the U.S. Veterans Health Administration (VHA).

We first present the prevalence of CKD in these health system populations as recognized through diagnosis claims (Medicare 5% and Optum Clinformatics™ Data Mart), and biochemical data (VHA)—both for the overall disease state and with the comorbidities of DM and HTN. This was achieved through comparison of rates in the NHANES, Medicare 5% sample, Optum Clinformatics™, and VHA populations among cohorts of patients aged 22-64, or 65 and older. These were stratified by demographic characteristics in order to highlight challenges with identification of CKD across these various types of data.

We next examined longitudinal changes in CKD status and general outcomes for patients at high risk for kidney disease, by presenting trends in laboratory screening and monitoring of patients with and without CKD. Finally, we assessed the spectrum and impact of follow-up care received by newly diagnosed CKD patients.

Methods

For this year's chapter we utilized several large health care datasets. The general Medicare 5% sample includes an average of 1.2 million patients each year. The Optum Clinformatics™ Data Mart cohort was drawn from the commercial plans of a large U.S. national health insurance company, and holds health care information on about nine million lives per year. The national health system-derived data from the U.S. Veterans Health Administration (VHA), also referred to here as Veterans Affairs data, represents more than six million veterans.

Analyses using the Medicare 5% dataset are restricted to patients aged 65 and older with both Part A and Part B fee-for-service coverage. Persons covered by Medicare managed care programs are not included in this source because of the absence of billing claims. The Optum Clinformatics™ Data Mart data provides insight into a younger, employed population and their dependent children. Like Medicare data, it contains diagnosis and procedure codes as found on claims. The Optum Clinformatics™ dataset also includes information on pediatric age groups, although for some analyses in this chapter only adult patients (ages 22-64 years) are included. Finally, the VHA dataset includes both diagnosis and procedure codes and more complete biochemical test data. This allowed us to estimate the prevalence of CKD as indicated by diagnosis codes combined with serum creatinine blood test results, wherever available.

Throughout this chapter, the term 'recognized CKD' is used when patients are identified based on the presence of a relevant diagnosis code in Medicare, Optum Clinformatics™, or Veterans Affairs data. This implies that either a provider or billing coder in the health care system recognized the presence of CKD. As such, prevalence of 'recognized CKD' likely underestimates true disease prevalence. An observed trend may not necessarily indicate a true change in disease prevalence, but rather a change in clinical awareness or recognition of CKD, or indeed, evolving billing practice. Studies have shown that diagnosis codes for CKD generally have excellent specificity (>90%), though their sensitivity is low (Grams et al., 2011).

To identify the recognized CKD population we selected a variety of ICD-9-CM diagnosis codes, some of which are sub-codes under related comorbidities such as DM (250.4x) and HTN (403.9x), and other conditions that are kidney-disease specific, such as glomerular disease (583.x). In 2006, CKD stage-specific codes (585.x) were introduced, providing an opportunity to track trends in the severity of CKD over time. Since their introduction, the CKD stage-specific codes have been increasingly utilized, accounting for 49% of all CKD diagnostic documentation in 2007 and 68% in 2016.

Beginning on October 1, 2015, the new ICD-10-CM coding system was implemented, and its related diagnosis codes were then utilized to identify CKD stages and comorbid conditions. Table A lists the CKD-related ICD-9-CM and ICD-10-CM codes used in this chapter.

Further details of the data utilized for this chapter are described in the *Data Sources* section of the *CKD Analytical Methods* chapter.

For an explanation of the analytical methods used to generate the study cohorts, figures, and tables in this chapter, see the section on *Chapter 2* within the *CKD Analytical Methods* chapter. Downloadable Microsoft Excel and PowerPoint files containing the data and graphics for these figures and tables are available from the *USRDS website*.

Table A. ICD-9-CM and ICD-10-CM codes for Chronic Kidney Disease (CKD) stages

ICD-9-CM code[a]	ICD-10-CM code[a]	Stage
585.1	N18.1	CKD, Stage 1
585.2	N18.2	CKD, Stage 2 (mild)
585.3	N18.3	CKD, Stage 3 (moderate)
585.4	N18.4	CKD, Stage 4 (severe)
585.5	N18.5	CKD, Stage 5 (excludes 585.6: Stage 5, requiring chronic dialysis[b])
CKD Stage-unspecified	CKD Stage-unspecified	For these analyses, identified by multiple codes including 585.9, 250.4x, 403.9x & others for ICD-9-CM and A18.xx, E08.xx, E11.xx and other for ICD-10-CM.

[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 or ICD-10-CM code N18.6 & with no ESRD 2728 form or other indication of end-stage renal disease (ESRD) are considered to have code 585.5 or N18.5.

Patient Characteristics across Datasets

Table 2.1 presents demographic and comorbidity characteristics of individuals in the Medicare 5% sample (aged 65 and older), the Optum Clinformatics™ dataset (aged 22 and older), and Veterans Affairs data (aged 22 and older). The mean age of Medicare patients was 74.7 years, of Optum Clinformatics™ patients was 44.7 years, and for U.S. Veterans was 62.7 years. The high prevalence of comorbid conditions in the Medicare 5% sample reflects the older age of these patients. For example, 60.5% and 24.0% of the Medicare sample had diagnoses of HTN or DM. In comparison, only 14.5% and 6.1% of the total Optum Clinformatics™ population had diagnoses of HTN or DM. In VHA data these proportions were 24.0% (HTN) and 16.6% (DM).

vol 1 Table 2.1 Demographic characteristics of all patients, among Medicare (aged 65+ years), Optum Clinformatics™ (ages 22 or older) and Veterans Affairs (ages 22 or older) patients, 2016

	Medicare 5%		Optum Clinformatics™		Veterans Affairs	
	Sample count	Percent (%)	Sample count	Percent (%)	Sample count	Percent (%)
All	1,286,211	100	5,354,131	100	6,673,889	100
Age						
22-30	-	-	934,959	17.5	311,807	4.7
31-40	-	-	1,223,069	22.8	647,353	9.7
41-50	-	-	1,258,509	23.5	640,908	9.6
51-64	-	-	1,674,668	31.3	1,485,870	22.3
65-74	729,462	56.7	206,188	3.9	2,010,195	30.1
75-84	388,900	30.2	39,653	0.7	918,428	13.9
85+	167,849	13.1	17,085	0.3	659,328	9.9
Sex						
Male	559,118	43.5	2,725,981	50.9	692,611	10.4
Female	727,093	56.5	2,627,281	49.1	5,981,174	89.6
Race/Ethnicity						
White	1,098,136	85.4	3,458,337	67.8	4,626,512	69.3
Black/African American	96,120	7.5	463,015	9.1	1,040,546	15.6
Native American	5,681	0.4	-	-	53,816	0.8
Asian	24,921	1.9	285,804-	5.6	67,768	1.0
Hispanic	42818	3.3-	646,123	12.7	-	-
Other/Unknown/Missing	18535	1.44	245,002	4.8	885,247	13.3
Comorbidity						
Diabetes mellitus	309,241	24.0	328,822	6.1	1,110,214	16.6
Hypertension	777,832	60.5	778,159	14.5	1,604,804	24.0
Cardiovascular disease	513,794	40.0	327,865	6.1	766,053	11.5

Data Source: Special analyses, Medicare 5% sample (aged 65 and older), Optum Clinformatics™ (ages 22 or older) and Veterans Affairs (ages 22 or older) alive & eligible for all of 2016. Abbreviation: CKD, chronic kidney disease. CVD is defined as presence of any of the following comorbidities: cerebrovascular accident, peripheral vascular disease, atherosclerotic heart disease, heart failure, dysrhythmia or other cardiac comorbidities. - No available data.

Table 2.2 provides the prevalence of recognized CKD, DM, and cardiovascular comorbid conditions among patients aged 65 and older in the Medicare population, for Optum Clinformatics™ adults aged 22 through 64 years, and for VHA patients aged 22 to 64. Younger Optum Clinformatics™ patients were excluded as these comorbidities are rare in this population. Of Medicare patients aged 65 and older, recognized (i.e., coded diagnosis of) CKD was observed in 13.8%. Over half of the Medicare cohort (53.1%) had at least one of these comorbid conditions, 19.9% had two or more, and 4.8% had all three. As expected, the prevalence of recognized CKD in the Optum Clinformatics™ population was substantially lower, driven by the lower prevalence among younger patients. Approximately 10.6% of this cohort had at least one of these comorbid conditions, and 1.6% had two or more.

vol 1 Table 2.2 Prevalence of comorbid conditions by diagnosis codes (CKD, CVD, & DM), (a) total & (b) one or more, among Medicare (aged 65+ years) , Optum Clinformatics™ (aged 22-64 years) and Veterans Affairs (aged 22-64 years) patients, 2016

(a) Any diagnosis of CKD, CVD, or DM

	Medicare 5%		Clinformatics™		Veterans Affairs	
	Sample count	%	Sample count	%	Sample count	%
All	1,286,211	100	5,091,205	100	3,085,938	100
Total CKD	178,025	13.8	85,789	1.7	82,755	2.7
Total CVD	513,794	39.9	261,580	5.1	152,029	4.9
Total DM	309,241	24.0	282,139	5.5	302,803	9.8

(b) Combinations of CKD, CVD, or DM diagnoses

	Medicare 5%		Clinformatics™		Veterans Affairs	
	Sample count	%	Sample count	%	Sample count	%
All	1,286,211	100	5,091,205	100	3,085,938	100
Only CKD	33,386	2.6	48,807	1.0	41,469	1.3
Only CVD	281,665	21.9	195,910	3.8	94,794	3.1
Only DM	112,358	8.7	217,275	4.3	238,002	7.7
CKD & DM, no CVD	23,971	1.9	13,293	0.3	18,637	0.6
CKD & CVD, no DM	59,217	4.6	14,099	0.3	11,071	0.4
DM & CVD, no CKD	111,461	8.7	41,981	0.8	34,586	1.1
CKD & CVD & DM	61,451	4.8	9,590	0.2	10,529	0.3
At least one comorbidity	683,509	53.1	540,955	10.6	438,559	14
At least two comorbidities	256,100	19.9	78,963	1.6	74,823	2.4
No CKD, no CVD, no DM	602,702	46.9	4,550,250	89.4	2,635,801	85.4

Data Source: Special analyses, Medicare 5% sample (aged 65 and older), Optum Clinformatics™ (aged 22-64), and Veterans Affairs (ages 22-64 years) alive & eligible for all of 2016. Abbreviations: CKD, chronic kidney disease; CVD, cardiovascular disease; DM, diabetes mellitus. CVD is defined as presence of any of the following comorbidities: cerebrovascular accident, peripheral vascular disease, atherosclerotic heart disease, congestive heart failure, dysrhythmia or other cardiac comorbidities. CKD in the VA is defined as anyone with at least one inpatient ICD-9 or ICD-10 diagnosis or two outpatient diagnosis codes in 2016 or eGFR<60 ml/min/1.73m^2 based on at least one outpatient serum creatinine available in 2016; eGFR was calculated using the CKD-EPI formula; if more than one value was available, the last one in the year was used. The denominator included everyone with at least one outpatient visit in 2016.

Comparison of CKD Prevalence across Datasets

Table 2.3 compares the prevalence of CKD in the NHANES, Medicare 5% sample, Optum Clinformatics™, and VHA populations among patients aged 65 and older. We stratified by demographic characteristics in order to highlight issues with identification of CKD in the varying types of data. Across all datasets, the prevalence of CKD increased with older age. Variance between the data sources, however, can somewhat be explained by the nature of their measurements and specific populations.

The absolute prevalence of CKD was highest in the NHANES data, intermediate in the VHA data (code and eGFR-based), and lowest when based on diagnosis codes alone in Medicare claims and Optum Clinformatics™.

The NHANES, by design, includes laboratory measurement of kidney function in all participants, thus providing the closest estimate of the true prevalence of CKD in the United States. Overestimation is possible, however, because it relies on a single measurement. In addition, NHANES does not represent people living in long-term care facilities—many of those residents have Medicare insurance and are represented in the Medicare 5% sample.

The prevalence of recognized CKD based on diagnosis codes was lowest due to under-recognition and likely under-coding of the condition, particularly in its earlier stages, with more accurate capture of advanced cases of CKD.

For the VHA population, CKD prevalence is presented based on diagnosis codes and available laboratory data documenting at least one serum creatinine result corresponding to an eGFR <60 ml/min/1.73m^2. Blood and urine assays are initiated by clinical indication and not performed in all patients, and thus likely underestimate the true prevalence in the population served by the VHA health system.

The overall CKD prevalence, and CKD prevalence by gender and race/ethnicity varies substantially depending on the method of CKD ascertainment: survey (NHANES), vs. claim-based (Medicare and Optum Clinformatics™), vs. claim and lab based data (VHA data).

vol 1 Table 2.3 Percent of patients with CKD by demographic characteristics, among individuals aged 65+ years in NHANES (2013-2016), Optum Clinformatics™ (2016), Medicare 5% sample (2016), and Veterans Affairs (2016) datasets

	Survey-based	Claim-based		Claim and lab-based
	NHANES	Optum	Medicare	Veterans Affairs
	CKD(eGFR)	CKD (Code)	CKD (Code)	CKD (Code or eGFR)
All	38.1	8.1	13.8	23.9
Age				
65-74	28.7	6.2	10.1	17.1
75-79	42.6	13.5	17.2	29.3
80+	58.5	18.9	22.6	37.4
Race				
White	38.1	8.4	13.5	24.4
Black/African American	39.7	9.5	18.7	25.7
Native American		-	14.1	21.1
Asian		5.73	14.3	17.3
Other/Unknown	33.8	7.86	11.6	19.6
Sex				
Male	36.0	9.2	15.6	24.1
Female	38.9	6.8	12.5	19.3

Data Source: Special analyses, Medicare 5% sample aged 65 and older alive & eligible for all of 2016. NHANES 2013-2016 participants aged 65 and older, Clinformatics patients aged 65 and older, and VA aged 65 and older alive & eligible for all of 2016. CKD in the Veterans Affairs data is defined as anyone with at least one inpatient ICD-9 or ICD-10 diagnosis or two outpatient diagnosis codes in 2016 or eGFR<60 ml/min/1.73m^2 based on at least one outpatient serum creatinine available in 2016; eGFR was calculated using the CKD-EPI formula; if more than one value was available, the last one in the year was used. The denominator included everyone with at least one outpatient visit in 2016. Abbreviations: CKD, chronic kidney disease; VA, Veterans Affairs. - No available data.

Table 2.4 presents the prevalence of recognized CKD by demographic characteristics and comorbidities in the Medicare (ages 65 years and older), Optum Clinformatics™ (ages 22 years and older) and the VHA (ages 22 years and older) populations, overall and with DM or HTN. The prevalence of recognized CKD increased with age in all three datasets, and from 10.1% at ages 65–74 to 22.6% at age 85 and older in the Medicare data. Males had slightly higher prevalence than females in all of the datasets.

The prevalence of CKD among Blacks/African Americans (hereafter, Blacks) was higher than among Whites in the Medicare and Optum Clinformatics™ datasets, but lower in the VHA dataset. Results from adjusted analyses of the Medicare dataset (data not shown) confirm greater odds of recognized CKD in older patients, Blacks, and those with DM, HTN, or cardiovascular disease. Among Optum Clinformatics™ patients comparable in age to the Medicare population, the prevalence remained lower, possibly reflecting a healthier, employed population. As expected, the prevalence of recognized CKD was higher in all three datasets among those with a diagnosis of DM or HTN, and particularly so among younger patients in the Optum Clinformatics™ dataset.

vol 1 Table 2.4 Prevalence of CKD, by demographic characteristics and comorbidities, among Medicare 5% sample (aged 65+ years), Optum Clinformatics™ (ages 22 or older), and Veterans Affairs (ages 22 or older) patients overall, and with diabetes mellitus or hypertension, 2016

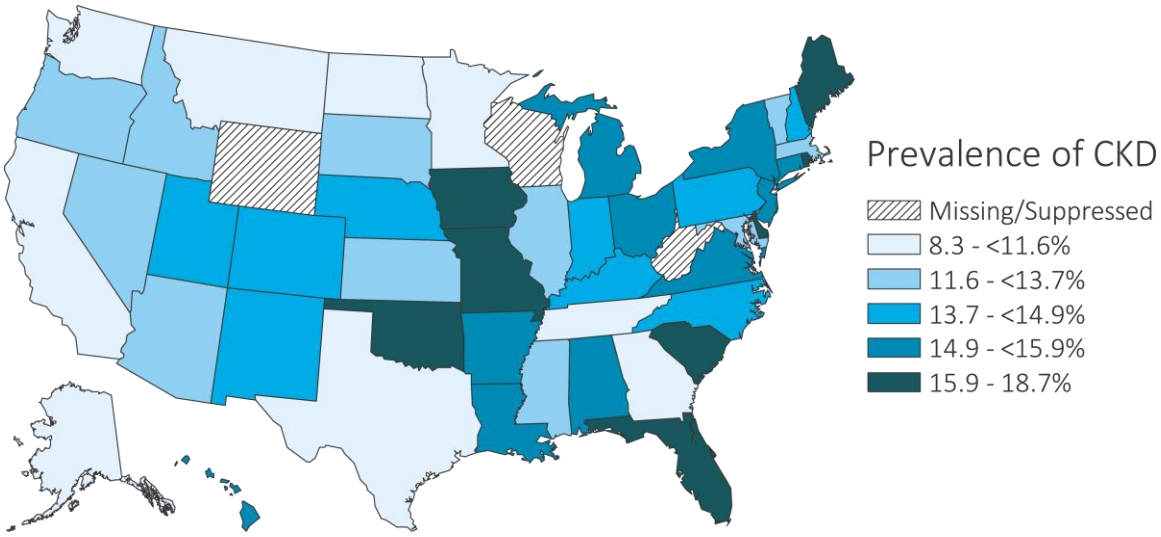
	All			Diabetes mellitus (with or without hypertension)			Hypertension (without diabetes mellitus)		
	Medicare 5%	Optum Clinformatics™	Veterans Affairs	Medicare 5%	Optum Clinformatics™	Veterans Affairs	Medicare 5%	Optum Clinformatics™	Veterans Affairs
Overall	13.8	2.0	14.9	27.6	9.7	31.3	15.6	6.6	23.8
Age									
22-30	-	0.6	0.4	-	5.0	3.2	-	6.2	3.6
31-40	-	0.9	1.0	-	4.8	3.7	-	5.0	4.4
41-50	-	1.5	2.5	-	6.1	6.9	-	4.9	6.3
51-64	-	3.0	7.2	-	9.4	16.2	-	6.1	11.6
65-74	10.1	6.2	17.1	23.1	15.9	29.5	11.1	9.6	21.3
75-84	17.2	13.5	29.3	31.4	27.4	47.8	17.4	17.6	38.2
85+	22.6	18.9	37.4	37.1	33.9	61.4	24.3	26.1	55.2
Sex	.	.		.	.		.	.	
Male	15.6	2.2	16.0	29.9	10.5	31.8	18.0	7.3	24.3
Female	12.5	1.8	5.3	25.6	8.5	20.5	13.9	5.8	15.7
Race/Ethnicity	.	.		.	.		.	.	
White	13.5	2.1	16.3	27.4	10.1	32.5	15.4	6.8	25.0
Black/African American	18.7	2.3	12.8	31.1	10.5	27.6	18.8	6.7	19.5
Native American	14.1	-	11.5	25.4	-	26.1	13.7	5.7	19.8
Asian	14.3	1.2	7.4	26.8	6.5	22.8	14.9	-	19.8
Hispanic	13.2	1.7	-	25.5	8.4	-	14.5	5.9	-
Other/Unknown	7.8	2.0	9.9	19.7	9.0	31.2	9.9	6.8	25.6

Data Source: Special analyses, Medicare 5% sample (aged 65 and older), Optum Clinformatics™ data (ages 22 or older) and the Veterans Affairs data (ages 22 or older) alive & eligible for all of 2016. Abbreviation: CKD, chronic kidney disease. CKD in the VA is defined as anyone with at least one inpatient ICD-9 or ICD-10 diagnosis or two outpatient diagnosis codes in 2016 or eGFR<60 ml/min/1.73m^2 based on at least one outpatient serum creatinine available in 2016; eGFR was calculated using the CKD-EPI formula; if more than one value was available, the last one in the year was used. The denominator included everyone with at least one outpatient visit in 2016. - No available data. Data suppressed.*

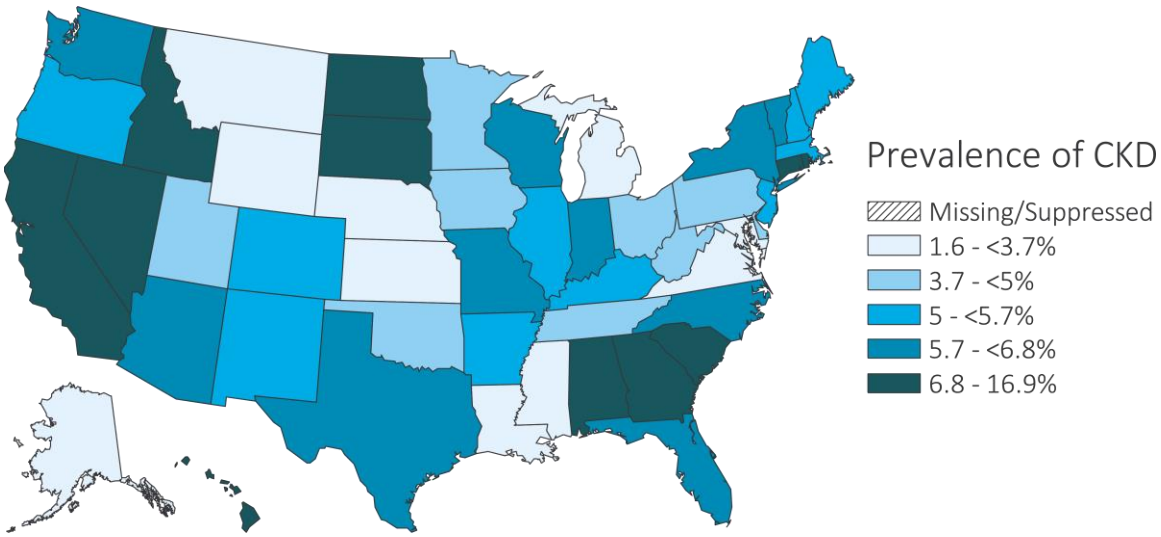
The maps in Figure 2.1 illustrate the prevalence of recognized CKD by state in the Medicare 5% sample and the Optum Clinformatics™ dataset. Variation in prevalence across states was more than two-fold in both datasets.

vol 1 Figure 2.1 Prevalence of CKD by state among Medicare 5% sample (aged 65+ years) and Optum Clinformatics™ (ages 22 or older) patients, 2016

(a) Medicare 5%



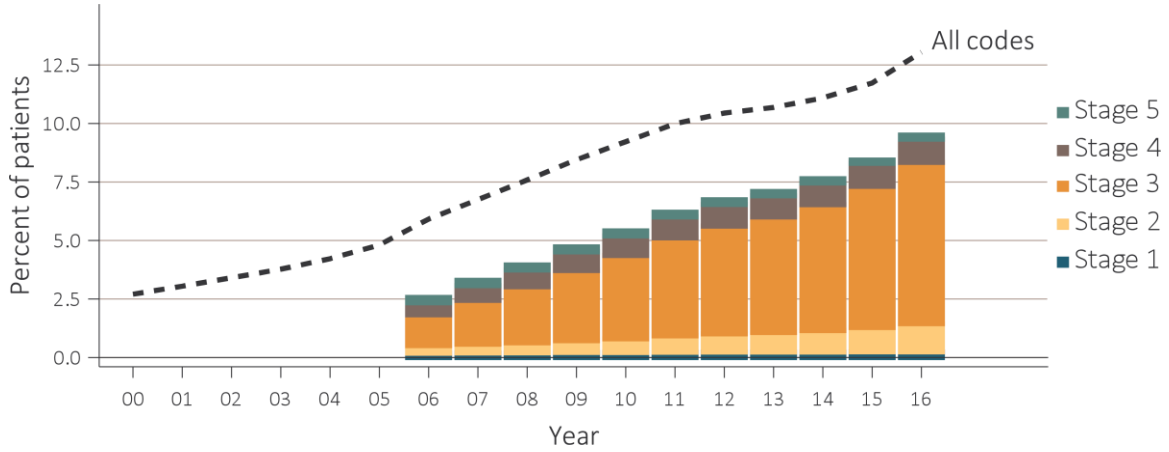
(b) Optum Clinformatics™



Data Source: Special analyses, Medicare 5% sample (aged 65 and older) and Optum Clinformatics™ data (ages 22 or older) alive & eligible for all of 2016. Abbreviation: CKD, chronic kidney disease.

Figure 2.2 shows the 2000-2016 Medicare trend in prevalence of recognized CKD overall and by CKD stage-specific code. The prevalence of recognized CKD has steadily risen each year, accompanied by a comparable increase in the percentage of patients with a stage-specific CKD diagnosis code. There was a particularly sharp increase in 2016 versus 2015, possibly related to the switch to the ICD-10 diagnosis coding system which occurred on October 1, 2015.

vol 1 Figure 2.2 Trends in prevalence of recognized CKD, overall and by CKD stage, among Medicare patients (aged 65+ years), 2000-2016



Data Source: Special analyses, Medicare 5% sample. Known CKD stages presented as bars; curve showing "All codes" includes known CKD stages (ICD-9 codes 585.1-585.5 or ICD-10 codes N18.1-N18.5) and the CKD-stage unspecified codes (ICD-9 code 585.9, ICD-10 code N18.9 and remaining non-stage specific CKD codes). For years 2000-2016, ICD-9 codes are used to identify CKD; additionally, starting October 1, 2015, ICD-10 codes are used to identify CKD. Note: In previous years, this graph reported 585.9 codes as a component of the stacked bars. Abbreviation: CKD, chronic kidney disease.

Longitudinal Change in CKD Status and Outcomes, Based on Diagnosis Codes

Table 2.5 shows patient status of CKD stage, ESRD, or death in 2015-2016 for those who had a CKD diagnosis in 2011. Among patients with no CKD in 2011, 20.9% had died after five years, while 0.1% had reached ESRD prior to dying, and 0.1% were alive with ESRD by the end of 2016. In comparison, patients with any CKD diagnosis in 2011 were much more likely to have these outcomes. Among CKD patients, by 2016, 42.9% had died without ESRD, while 2.0% had reached ESRD prior to dying, and 1.7% were alive with ESRD by the end of 2016.

vol 1 Table 2.5 Change in CKD status from 2011 to 2016, among Medicare patients (aged 65+ years) alive and without ESRD in 2011

2011Status	2015-2016 Status (row %)											
	No CKD Diagnosis	CKD Stage 1	CKD Stage 2	CKD Stage 3	CKD Stage 4	CKD Stage 5	CKD Stage-unspecified	ESRD alive	ESRD death	Death without ESRD	Lost to follow-up	Total N
No CKD Diagnosis	54.6	0.2	1.0	5.2	0.5	0.1	4.5	0.1	0.1	20.9	12.8	1,101,461
Any CKD	11.6	0.5	2.4	19.1	4.2	0.6	6.2	1.7	2.0	42.9	8.9	122,233
CKD Stage 1	14.7	5.5	4.6	17.7	2.2	0.5	6.1	1.0	0.8	36.2	10.7	2,761
CKD Stage 2	13.7	0.8	10.6	20.2	2.5	0.3	4.9	0.5	0.6	35.4	10.4	8,571
CKD Stage 3	7.6	0.3	1.8	28.1	5.1	0.5	3.5	1.6	1.6	40.9	9.0	51,237
CKD Stage 4	2.3	0.2	0.5	8.1	11.6	1.7	1.5	7.0	8.4	52.2	6.5	10,942
CKD Stage 5	6.0	0.2	0.7	6.8	2.9	1.9	3.1	8.2	10.8	52.6	6.9	2,455
CKD Stage Unspecified	17.8	0.4	1.8	12.4	2.1	0.4	10.6	0.6	0.7	44.1	9.0	46,267
Total	50.3	0.2	1.1	6.6	0.9	0.2	4.6	0.3	0.3	23.1	12.4	
Total N	615,594	2,894	13,904	80,181	11,059	1,940	56,545	3,294	3,584	283,057	151,642	1,223,694

Data Source: Special analyses, Medicare 5% sample. Patients alive & eligible for all of 2011. Death and ESRD status were examined yearly between 2011-2016, and were carried forward if present. Among patients without death or ESRD by 2016, the last CKD diagnosis claim was used; if not available, then the last CKD diagnosis claim from 2015 was used. Lost to follow-up represents the patients who were not in Medicare Part A and Part B fee for service in 2015 or 2016. These persons moved to a Medicare Advantage Plan and thus did not generate billing data from which CKD status could be determined. Abbreviations: CKD, chronic kidney disease; ESRD, end-stage renal disease.

Laboratory Testing of Patients with and without CKD

Assessing the care of patients at high risk for kidney disease has long been a focus of the USRDS, and is part of the Healthy People 2020 goals developed by the Department of Health and Human Services (see the *Healthy People 2020* volume). Individuals at high risk for CKD, most notably those with DM, should be screened periodically for kidney disease and those with CKD should be monitored for progression of disease.

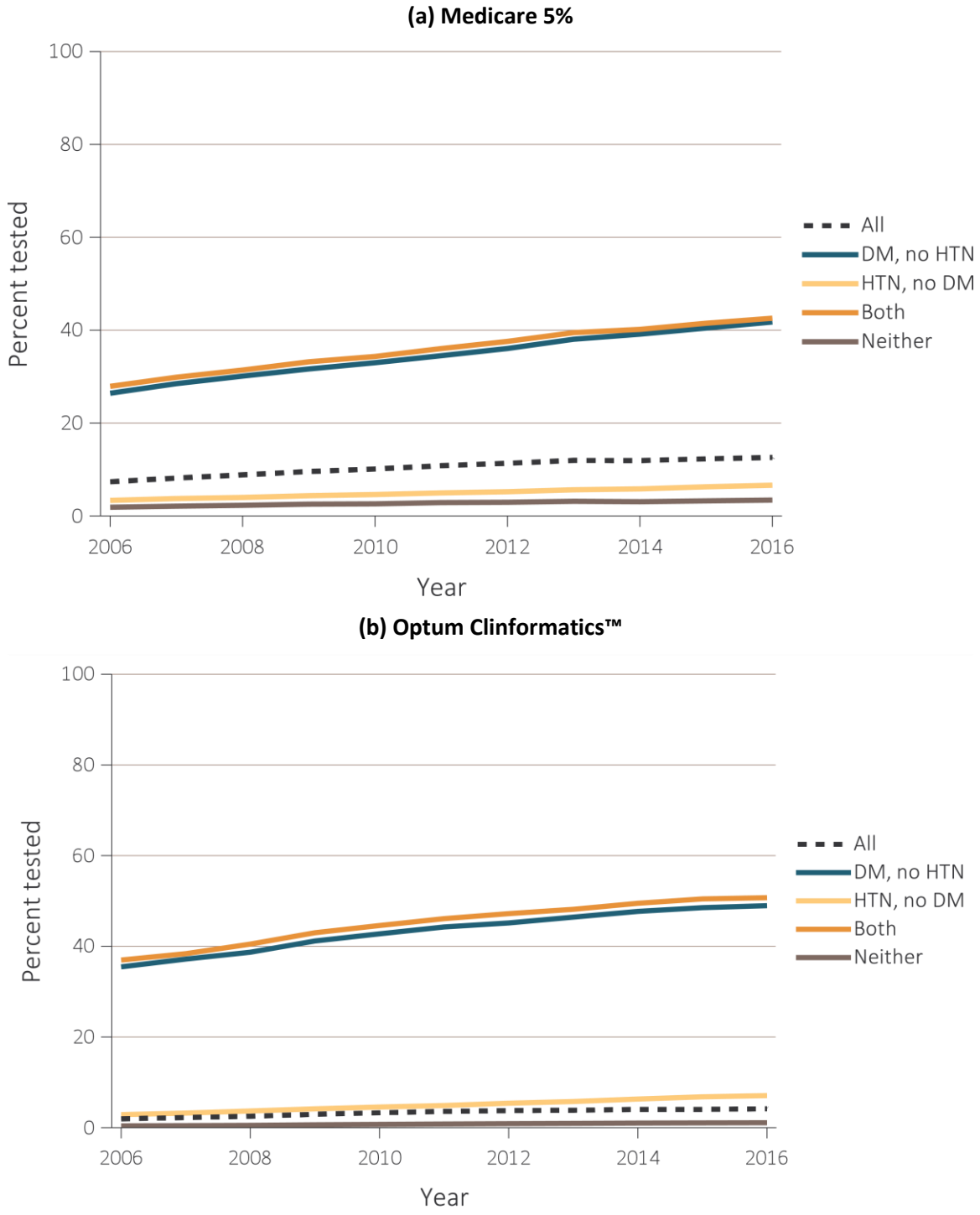
Urine albumin is a valuable laboratory marker used to detect signs of kidney damage and to evaluate for disease progression. Serum creatinine measurement is usually included as part of a standard panel of blood tests, but urine albumin testing must be ordered separately. For this reason, urine albumin testing may better represent intent to assess kidney disease.

The American Diabetes Association recommends urine testing for albumin in patients with DM. The 2012 KDIGO guidelines on CKD evaluation and management recommend risk stratification of CKD patients using both the urine albumin/creatinine ratio and the estimated eGFR (based on estimating equations incorporating serum creatinine values). They emphasized that these tests are needed to understand patients' kidney disease status, risk of death, and progression to ESRD (Matsushita et al., 2010; KDIGO CKD Work Group, 2012).

As shown in Figure 2.3, 12.6% of Medicare patients aged 65 and over and 4.2% of Optum Clinformatics™ patients aged 22 to 64 years without diagnosed CKD received urine albumin testing in 2016. Assessment of urine protein was also included in these percentages, representing approximately 20% of the testing performed. Among Medicare patients, 41.8% with DM alone had urine albumin testing, compared to 6.6% of patients with HTN alone.

Having both DM and HTN is known to increase the likelihood of developing CKD. Among Medicare beneficiaries without a CKD diagnosis, 42.6% had urine albumin testing in 2016. Similar patterns were seen in the Optum Clinformatics™ population—49.0% of patients with DM alone in 2016 had urine albumin testing, compared to 7.1% with HTN alone, and 50.7% with both DM and HTN.

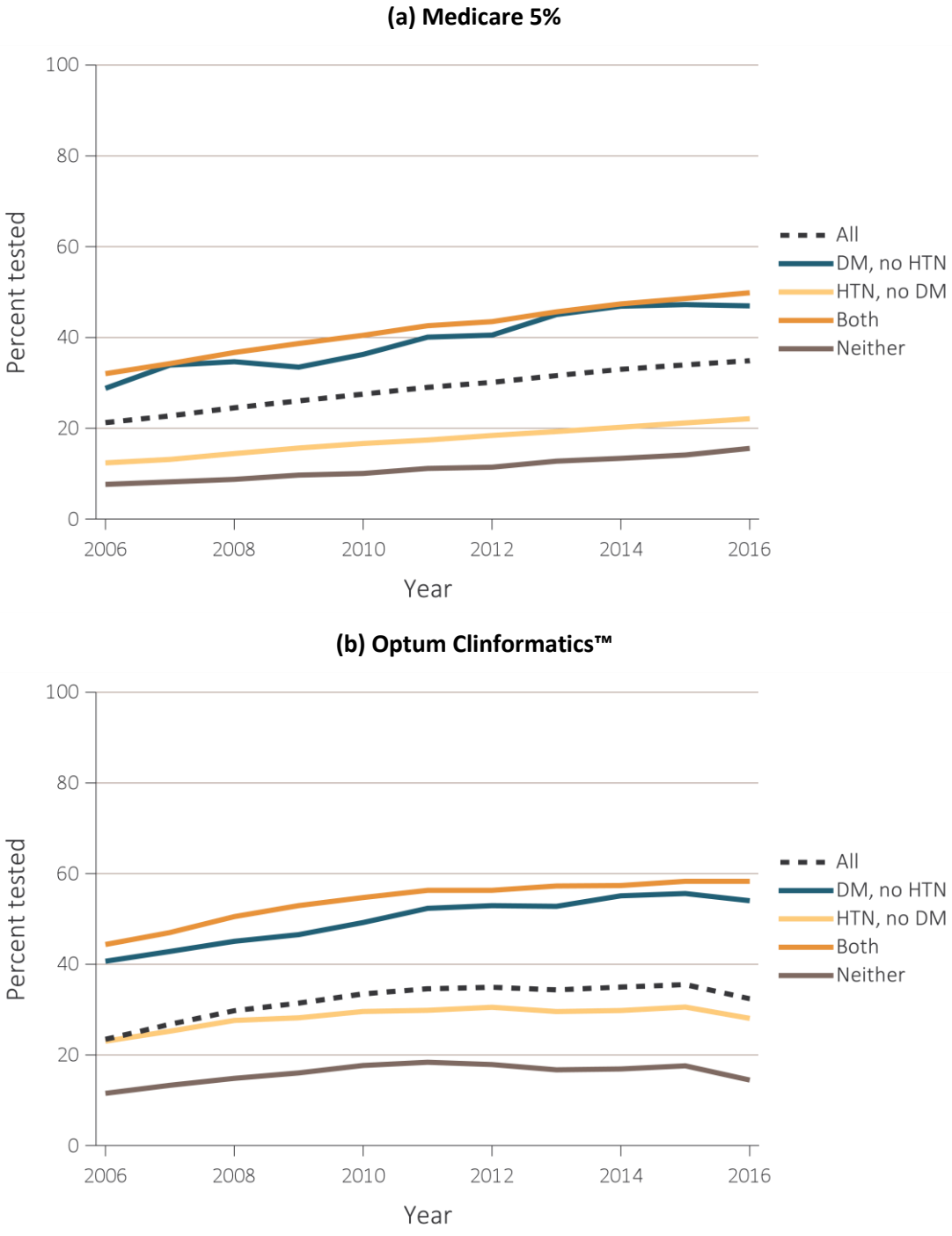
vol 1 Figure 2.3 Trends in percent of patients with testing of urine albumin (a) in Medicare 5% sample (aged 65+ years), & (b) Optum Clinformatics™ (aged 22-64 years) patients without a diagnosis of CKD, by year from 2006 to 2016



Data Source: Special analyses, Medicare 5% sample aged 65 and older with Part A & B coverage in the prior year and Optum Clinformatics™ patients aged 22-64 years. Tests tracked during each year. Abbreviations: CKD, chronic kidney disease; DM, diabetes mellitus; HTN, hypertension.

As shown in Figure 2.4, patients with a diagnosis of CKD were tested for urine albumin at similar, though somewhat higher rates, than patients without CKD. In 2016, patients with the combined diagnoses of CKD, DM, and HTN, were tested for urine albumin in 49.9% of the Medicare and 58.3% of the Optum Clinformatics™ cohorts.

vol 1 Figure 2.4 Trends in percent of patients with testing of urine albumin in (a) Medicare 5% (aged 65+ years), & (b) Optum Clinformatics™ (aged 22-64 years) patients with a diagnosis of CKD, by year from 2006-2016



Data Source: Special analyses, Medicare 5% sample (aged 65 and older) with Part A & B coverage in the prior year and Optum Clinformatics™ population (aged 22-64 years). Tests tracked during each year. Abbreviations: CKD, chronic kidney disease; DM, diabetes mellitus; HTN, hypertension.

Physician Visits after a CKD Diagnosis

Table 2.6 indicates the percentage of patients with a CKD diagnosis in 2015 who had at least one visit to a primary care physician, cardiologist, or nephrologist in 2016. Patients with any CKD diagnosis were far more likely to visit a primary care physician or a cardiologist than a nephrologist. This may relate to the fact that most guidelines, including KDIGO CKD, indicate the need for referral to nephrology only for those with advanced, Stage 4 CKD (see Table A), unless there are other concerns such as rapid progression of disease. Indeed, one-quarter of patients with any CKD claim in 2015 were seen by a nephrologist in the subsequent year. However, 41.1% with CKD Stage 3 and roughly two-thirds with CKD Stage 4 or higher visited a nephrologist in 2016. Whether the involvement of a nephrologist improves outcomes, and at what stage of CKD, is a matter of ongoing research interest.

Overall, the patterns of physician visits varied little across demographic categories. A notable exception was that patients aged 85 and older with CKD Stage 3 or higher were as likely as younger patients to visit a primary care physician or cardiologist, but substantially less likely to visit a nephrologist.

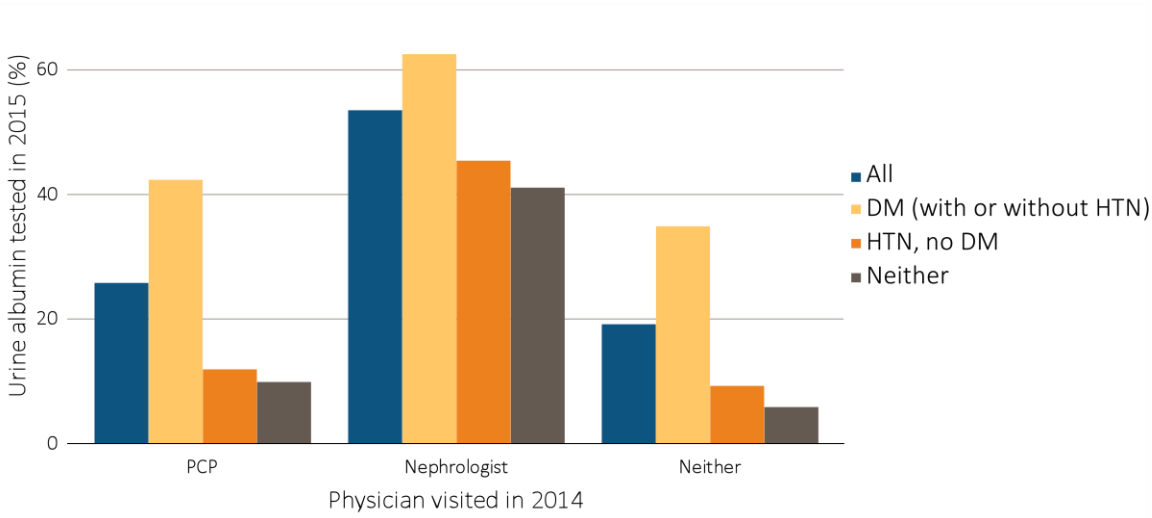
vol 1 Table 2.6 Percent of patients with a physician visit in 2016 after a CKD diagnosis in 2015, among Medicare 5% patients (aged 65+ years)

	Any CKD diagnosis			CKD diagnosis code of 585.3/N18.3 (Stage 3)			CKD diagnosis code of 585.4/N18.4 (Stage 4) or 585.5/N18.5 (Stage 5)		
	Primary care	Cardiologist	Nephrologist	Primary care	Cardiologist	Nephrologist	Primary care	Cardiologist	Nephrologist
Overall	89.6	54.4	25.7	90.8	55.6	41.1	89.9	60.9	64.2
Age									
65-74	87.6	49.0	26.1	89.1	51.2	47.1	80.9	46.4	69.7
75-84	91.3	58.9	27.3	91.7	58.2	41.0	84.3	51.8	66.6
85+	92.9	61.5	21.9	92.7	59.9	29.2	86.6	51.8	52.0
Sex									
Male	89.9	54.7	24.8	91.0	55.9	39.8	83.7	49.8	63.8
Female	90.8	56.6	32.8	90.9	56.6	48.0	84.0	50.3	67.7
Race									
White	89.4	49.9	25.7	89.7	50.6	41.2	82.6	46.0	64.8
Black/African American	90.4	51.8	25.2	91.0	52.0	38.6	84.0	46.9	62.3
Other	89.5	57.5	26.2	90.8	59.6	43.3	83.2	52.9	67.1

Data Source: Special analyses, Medicare 5% sample aged 65 and older alive & eligible for all of 2015. CKD diagnosis is at date of first CKD claim in 2015; claims for physician visits were searched during the 12 months following that date. ICD-9 CKD diagnosis code of 585.4 or higher or ICD-10 CKD diagnosis code of N18.4 or higher represents CKD Stages 4-5. Abbreviation: CKD, chronic kidney disease.

Figure 2.5 illustrates the proportion of patients with CKD in 2015 who were tested for urine albumin in 2016, according to whether they saw a primary care physician or nephrologist in 2015. Patients who saw a nephrologist were more likely to be tested for urine albumin than those who saw only a primary care physician. This difference was greatest for those without DM. Diabetic patients showed a smaller difference in testing for urine albumin across provider type, which is likely due to the wide dissemination of guidelines for routine renal function assessment in diabetics that are directed at primary care physicians by organizations such as the American Diabetes Association.

vol 1 Figure 2.5 Percent of CKD patients in 2015 with physician visit (nephrologist, primary care provider, both, and neither), with laboratory testing in the following year (2016), by comorbidity



Data Source: Special analyses, Medicare 5% sample aged 65 and older alive & eligible for all of 2016, with a CKD diagnosis claim based on ICD-9 diagnostic codes and a physician visit in 2015. Patient visits with both PCP and nephrologists are classified as nephrologist. Abbreviations: CKD, chronic kidney disease; DM, diabetes mellitus; HTN, hypertension; PCP, primary care physician.

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