Chapter 1: Incidence, Prevalence, Patient Characteristics, and Treatment Modalities

INCIDENCE

- In 2015, there were 124,114 newly reported cases of ESRD; the unadjusted (crude) incidence rate was 378 per million population (PMP; Table 1.1). Since 2011, both the number of incident cases and the unadjusted incidence rate have risen (Figure 1.1).
- The age-gender-race adjusted incidence rate of ESRD in the United States (U.S.) rose sharply in the 1980s and 1990s, leveled off in the early 2000s, and has declined slightly since its peak in 2006 (Figure 1.1).
- In 2015, the adjusted ESRD incidence rate ratios for Native Hawaiians/Pacific Islanders, Blacks/African Americans, American Indians/Alaska Natives, and Asians as compared with Whites were 8.4, 3.0, 1.2, and 1.0. All these represent reductions in relative risk of ESRD for these minorities compared to Whites over the past 15 years. The rate ratio for Hispanics versus non-Hispanics was 1.3 (Figures 1.5 and 1.6).

PREVALENCE

- On December 31, 2015, there were 703,243 prevalent cases of ESRD; the unadjusted prevalence was 2,128 per million in the U.S. population (PMP; Table 1.3).
- In contrast to incidence, the number of ESRD prevalent cases continued to rise by about 20,000 cases per year (Table 1.1).
- Compared to Whites, ESRD prevalence in 2015 was about 9.5 times greater in Native Hawaiians/Pacific Islanders, 3.7 times greater in Blacks, 1.5 times greater in American Indians/Alaska Natives, and 1.3 times greater in Asians (Figure 1.11).

CHARACTERISTICS OF INCIDENT ESRD CASES

- In 2015, 36% of incident ESRD patients received little or no pre-ESRD nephrology care (Table 1.7).
- Mean eGFR at initiation of dialysis in 2015 was 9.8 ml/min/1.73 m^2, down from a peak of 10.4 in 2010. The percentage of incident ESRD cases starting with eGFR at ≥10 ml/min/1.73 m^2 rose from 13% in 1996 to 43% in 2010, but decreased to 39% in 2015 (Figure 1.18).

TREATMENT MODALITIES

- In 2015, 87.3% of incident individuals began renal replacement therapy with hemodialysis (HD), 9.6% started with peritoneal dialysis (PD), and 2.5% received a preemptive kidney transplant (Figure 1.2).
- On December 31, 2015, 63.2% of all prevalent ESRD patients were receiving HD therapy, 7.0% were treated with PD, and 29.6% had a functioning kidney transplant (Figure 1.8). Among HD cases, 98.0% used in-center HD, and 1.9% used home HD (Figure 1.15).

Introduction

In this chapter, we describe the population of those individuals living with end-stage renal disease (ESRD) in the U.S., the numbers and relative rates of new and enduring cases, the sex, age, race, and ethnicity of those most often affected, the clinical precursors of their developing kidney disease, and the therapies used to treat it. This information creates the foundation from which to understand and interpret the current state and trends of ESRD as presented in the 2017 Annual Data Report (ADR).

The foci of this chapter are the incidence and prevalence of ESRD in the U.S. population. We report the absolute numbers of individuals affected, rates, and temporal trends. We examine the composition of this group specifically by their sex, age, race, and ethnicity. The population is also described in terms of geographic residence, listed primary cause of ESRD, the renal replacement therapy (RRT) chosen for treatment, and individual medical characteristics such as receipt of pre-ESRD care, and estimated glomerular filtration rate (eGFR) and prevalence and severity of anemia at onset of ESRD.

The definitions of ESRD incidence and prevalence used throughout the ADR are treatment-based, not purely physiological or biological constructs. These terms as used refer only to treated cases of ESRD, to patients starting or receiving dialysis or transplantation. Although a diagnosis of ESRD is often equated with RRT treatment, and usually commences in Stage 5 CKD (GFR <15 ml/min/1.73 m^2), many do not begin RRT until the eGFR is much lower than 15, and some never receive dialysis or transplantation. In addition, there are "ESRD treated" patients on RRT who were initiated on dialysis at an eGFR greater than 15. Thus, although the terms "incident ESRD" and "prevalent ESRD" are used throughout this chapter, they should always be interpreted as "treated ESRD."

Incidence refers to the occurrence or detection of new cases of a disease during a given period. In this chapter, ESRD incidence is a count of the number of incident cases in one year or a rate calculated as the number of incident cases in one year divided by person-years at risk. Person-years at risk are approximated by the mid-year census for the population in that year. Incidence rates are expressed as per million population per year (PMP).

Prevalence refers to the presence of existing cases of a disease at a point in time (point prevalence) or during a specific period (period prevalence). In this chapter, ESRD point prevalence is a count of the number of prevalent cases, or a proportion of the number of prevalent cases divided by the size of the population from which those cases were identified. ESRD prevalences at the end of each year are expressed as PMP. ESRD prevalence in a population depends on both the incidence rate of ESRD and the duration of the disease from the start of RRT to death, or loss to follow-up.

Methods

This chapter uses data from the Centers for Medicare & Medicaid Services (CMS). Findings were primarily drawn from special analyses based on the USRDS ESRD Database. Details of these are described in the *Data Sources* section of the *ESRD Analytical Methods* chapter. Trends in overall incidence and prevalence are provided since 1980, when data were first available. Most adjusted data are provided since 2000, as race categories in the U.S. census were changed in that year.

Incidence rates and prevalences in this chapter are presented both without adjustment for other factors (i.e., as crude measures) and with adjustment for sex, age, and race by using a method known as "standardization." This method involves stratification of the population by those three variables, and calculation of a weighted average of stratum-specific rates or prevalences. The weights are the numbers of persons in strata of a "standard population," which, since the 2014 ADR, has been the U.S. population in 2011. Each standardized or adjusted incidence rate or prevalence is interpreted as the expected (crude) rate or prevalence if that group or year had exhibited the age-gender-race distribution of the 2011 standard population. Because we are only adjusting for age, race, and sex the trends we see may be due to other variables such as differences in treatment and differences in case-mix.

See the section on Chapter 1 in the *Analytical Methods Used in the ESRD Volume* section of the *ESRD Analytical Methods* chapter for an explanation of the analytical methods used to generate the study cohorts, figures, and tables in this chapter. Downloadable Microsoft Excel and PowerPoint files containing the data and graphics for these figures and tables are available on the USRDS website.

Primary cause of ESRD: A cautionary note

A caution in the interpretation of this chapter is that the reliability of clinician-assigned "primary-cause" of ESRD has not been well established. Because causation for some diagnoses cannot be, or are not definitively established through clinical judgment or

testing, and because many patients arrive at ESRD without benefit of prior nephrology care, establishing the validity of these etiologic subtypes of ESRD remains a challenge. For example, in diabetics with CKD (Yuan et al., 2017), confirmatory kidney biopsies are rarely performed, and published data suggest that assigned diagnoses for glomerular disease may be specific, but relatively insensitive (i.e. under-reported; Langenecker et al., 2000).

The reverse may be the case for diabetes mellitus (DM) or hypertension (HTN). For HTN in those of Black/African American race, for example, this may especially apply, as the APOL1 high-risk genotype and other emerging risk factors are recognized. For DM, often quoted as the leading "cause" of ESRD, authorities such as KDIGO provide guidance for assigning a diagnosis of diabetic CKD (DM as the primary cause). In reality, it is likely that this judgment is quite variable among nephrologists completing the CMS Medical Evidence form (CMS 2728). Single center studies suggest that DM as a "cause" of ESRD is over-reported on CMS 2728 compared to KDIGO criteria. It is likely that CMS 2728 data indicating primary cause of ESRD actually reflect ESRD patients who have DM, but not necessarily as the cause of their ESRD. This parallels reports of biopsy-confirmed diabetic nephropathy, although there is clear selection bias in patients who undergo biopsy.

The "primary cause of renal failure," as assessed by individual physicians and reported on the CMS 2728 form, has been used for many years in nephrology to compare populations and assess trends. It may even have played a role in risk factor assessment for CKD screening, particularly in the primary roles of DM and HTN, in addition to NHANES and other cohorts. In the Annual Data Report (ADR), it allows us to estimate the ESRD incidence rate and prevalence for different subtypes of chronic kidney disease: those with the primary cause listed as DM, HTN, glomerulonephritis, or cystic kidney disease. It should be noted, however, that this approach is not the same as stratifying on comorbidity status. For example, in this chapter we are not estimating adjusted incidence rates of ESRD among diabetics and non-diabetics because we do not have laboratory-based data on DM status in the total U.S. population by strata of sex, age, and race. In Reference Table A.11, incidence rates of ESRD are estimated for self-reported DM in the U.S. population. As many persons with DM either do not report their condition or are not aware of it, those estimated should be viewed in that context.

Incidence of ESRD: Counts, Rates, and Trends

Overall Incidence Counts and Rate

In 2015, there were 124,114 incident cases of ESRD in the U.S., with an unadjusted incidence rate of 378 PMP. After a year-by-year rise in the number of incident ESRD cases from 1980 through 2000, the increase plateaued between 2001 and 2012, but rose again from 2013 to 2015. Table 1.1 and Figure 1.1 provide the annual counts and unadjusted and sex, age, and race adjusted incidence rates of ESRD from 1980 through 2015.

While the unadjusted and adjusted rates were the same in 2011 because the standard population was the 2011 U.S. population, the trends for these two rates were different. The unadjusted ESRD incidence rate increased steadily from 1980 through 2006, remained relatively stable until 2012, and has increased again since 2012. The implication of this recent trend is that the burden of kidney failure in the U.S.—with respect to the expected impact on health-care utilization and costs—continues to increase.

In contrast, the adjusted ESRD incidence rate increased from 1980 through 2001, leveled off through 2006, then has since declined slightly in most years (Table 1.1). The specific implication of this recent downward trend is more difficult to interpret, as suggested above, but it likely reflects improvements in the prevention of ESRD. Our aging population and the rising prevalence of obesity and DM influence the increasing number of incident ESRD cases and the increasing unadjusted incidence rate. The recent decline in the adjusted rate may reflect successful efforts to prevent or postpone kidney failure in the U.S.

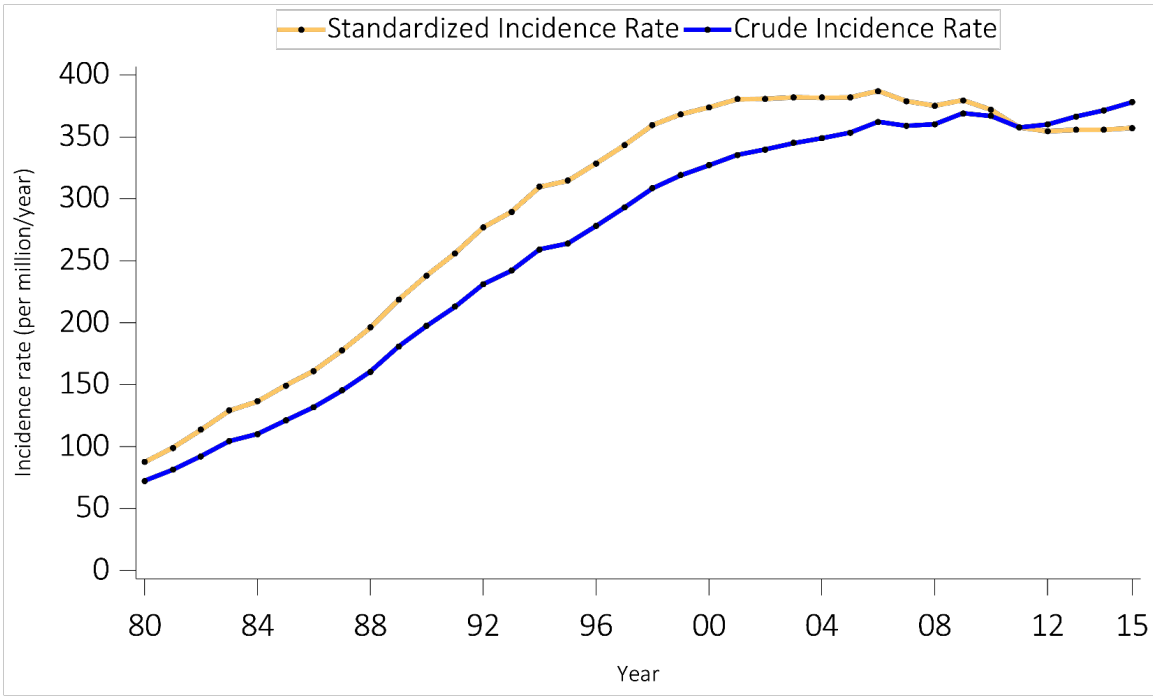
vol 2 Table 1.1 Trends in annual number of ESRD incident cases, unadjusted and adjusted incidence rates of ESRD, and annual percentage change in the U.S. population, 1980-2015

	Incident count		Unadjusted rate		Adjusted rate	
Year	**No. cases**	**% Change from previous year**	**Unadjusted rate (per million/year)**	**% Change from previous year**	**Adjusted rate (per million/year)**	**% Change from previous year**
1980	17,903	n/a	72	n/a	87	n/a
1981	20,039	11.9	81	12.3	99	13.4
1982	22,567	12.6	92	13.5	114	14.5
1983	25,774	14.2	104	13.1	129	13.7
1984	27,325	6.0	110	5.6	136	5.7
1985	30,214	10.6	121	9.9	149	9.5
1986	33,109	9.6	132	8.9	161	7.9
1987	36,604	10.6	145	10.1	178	10.2
1988	40,994	12.0	161	10.6	196	10.4
1989	46,304	13.0	181	12.6	219	11.5
1990	50,826	9.8	198	9.2	238	9.0
1991	55,388	9.0	213	7.7	256	7.5
1992	60,891	9.9	231	8.6	277	8.2
1993	64,488	5.9	242	4.7	290	4.5
1994	69,958	8.5	259	7.1	310	7.0
1995	72,199	3.2	264	1.8	315	1.6
1996	77,000	6.6	278	5.3	329	4.5
1997	82,120	6.6	293	5.3	343	4.4
1998	87,330	6.3	309	5.3	360	4.8
1999	91,409	4.7	319	3.4	368	2.4
2000	94,702	3.6	327	2.5	374	1.5
2001	97,966	3.4	336	2.6	380	1.7
2002	100,177	2.3	340	1.3	381	0.1
2003	102,599	2.4	345	1.5	382	0.3
2004	104,465	1.8	349	1.2	382	-0.1
2005	106,623	2.1	354	1.3	382	0.1
2006	110,327	3.5	362	2.5	387	1.4
2007	110,316	0.0	359	-0.9	379	-2.1
2008	111,843	1.4	360	0.4	375	-1.0
2009	115,497	3.3	369	2.5	380	1.2
2010	115,829	0.3	367	-0.6	372	-2.0
2011	113,735	-1.8	358	-2.5	358	-3.8
2012	115,437	1.5	360	0.7	355	-0.9
2013	118,160	2.4	367	1.8	356	0.3
2014	121,033	2.4	372	1.4	356	0.0
2015	124,114	2.5	378	1.8	357	0.4

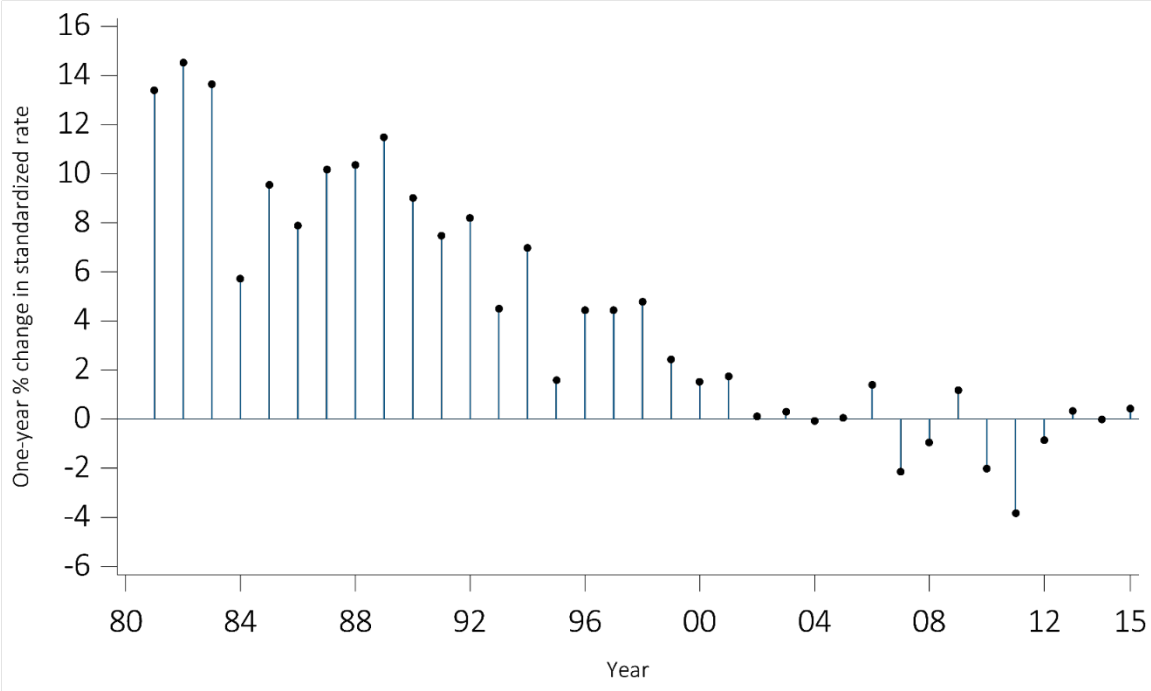
Data Source: Reference Tables A.1 and special analyses. The special analyses exclude U.S. Territories, unknown/other races. USRDS ESRD Database. Standardized for age, sex, and race. Abbreviations: ESRD, end-stage renal disease; n/a, not applicable.

vol 2 Figure 1.1 Trends in the (a) unadjusted and standardized incidence rates of ESRD, and (b) the annual percentage change in the standardized incidence rate of ESRD in the U.S. population, 1980-2015

(a) Incidence rate per million/year

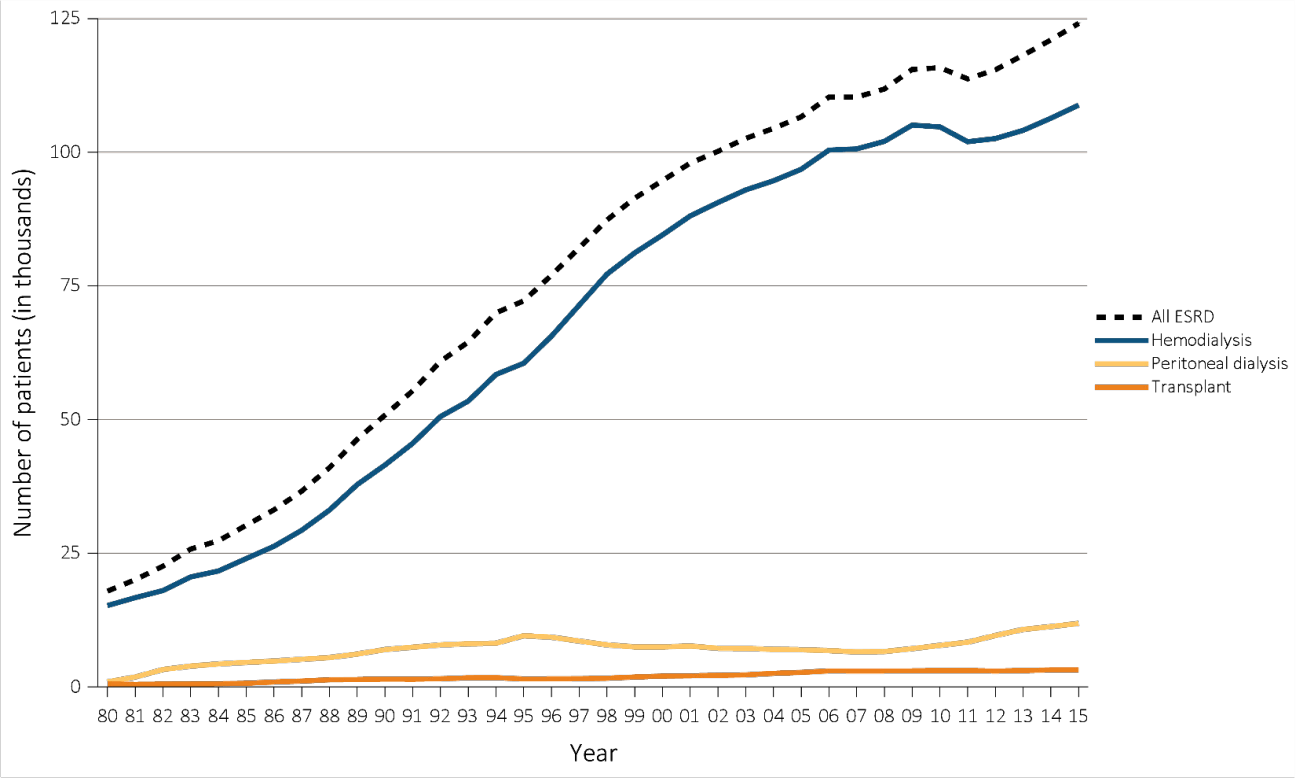


(b) One-year percentage change in standardized incidence rate



Data Source: Reference Table A.2(2) and special analyses, USRDS ESRD Database. Standardized for age, sex, and race. The standard population was the U.S. population in 2011. Abbreviation: ESRD, end-stage renal disease.

vol 2 Figure 1.2 Trends in the annual number of ESRD incident cases, by modality, in the U.S. population, 1980-2015



Data Source: Reference Table D1. Abbreviation: ESRD, end-stage renal disease.

INCIDENCE RATE: BY REGION

Variation in ESRD incidence rates among the 18 ESRD Networks remains substantial (Table 1.2). Adjusting for differences in sex, age, and race, the rate was lowest at 254 PMP in Network 16 (AK, ID, MT, OR, and WA), and highest at 455 PMP in Network 14 (TX)—79% higher than Network 16. Much of the additional incidence in Texas and Southern California (Network 18) represents cases among Hispanics, of whom large numbers live in these States. Individuals who identify themselves as being ethnically Hispanic comprise 38% of the populations in both Texas and California, compared to 18% nationwide.

Renal replacement therapy (RRT) modality use by region is also presented in Table 1.2.; this is further discussed in the section *Modality of Renal Replacement Therapy: Incident ESRD Cases* later in this chapter.

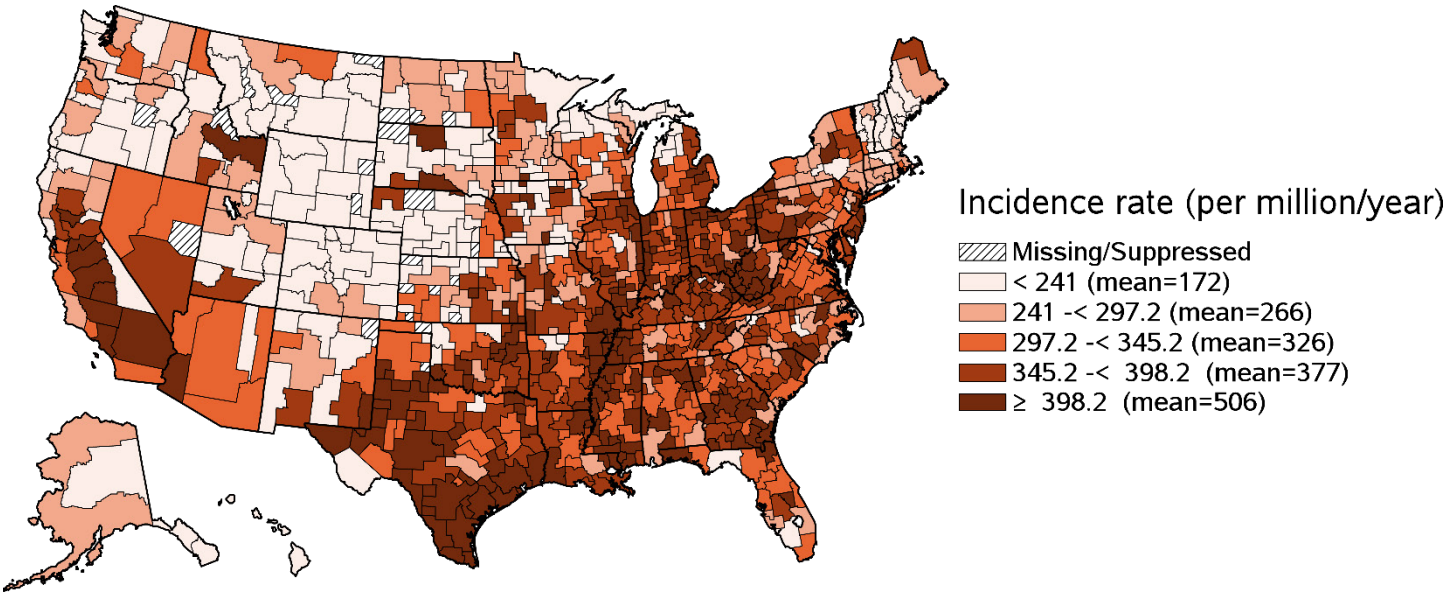
vol 2 Table 1.2 Unadjusted and adjusted incidence rates of ESRD and annual number of ESRD incident cases, overall and by modality and ESRD Network, in the U.S. population, 2015

		Total ESRD			Hemodialysis		Peritoneal dialysis		Transplant	
Network	**States in Network***	**No. of cases**	**Adjusted incidence rate (per million/year)**	**Unadjusted incidence rate (per million/year)**	**No. of cases**	**% of network**	**No. of cases**	**% of network**	**No. of cases**	**% of network**
14	TX	11,472	455	415	10,318	89.9	896	7.8	237	2.1
18	Southern CA	9,480	419	384	8,365	88.2	925	9.8	182	1.9
13	AR, LA, OK	5,200	396	446	4,509	86.7	612	11.8	78	1.5
3	NJ, PR, VI	5,376	395	431	3,517	90.0	270	6.9	115	2.9
10	IL	5,387	391	414	4,647	86.3	585	10.9	130	2.4
9	IN, KY, OH	9,301	388	407	8,278	89.0	807	8.7	181	1.9
8	AL, MS, TN	6,688	368	461	5,809	86.9	782	11.7	88	1.3
12	IA, KS, MO, NE	4,640	349	329	3,919	84.5	587	12.7	127	2.7
17	Northern CA, HI, GU, AS, MP	6,144	347	356	4,914	83.5	842	14.3	124	2.1
4	DE, PA	5,326	342	386	4,737	88.9	439	8.2	128	2.4
11	MI, MN, ND, SD, WI	7,576	336	330	6,597	87.1	645	8.5	297	3.9
2	NY	7,548	336	377	6,953	92.1	359	4.8	229	3.0
6	NC, SC, GA	10,858	336	428	9,416	86.7	1,209	11.1	216	2.0
5	MD, DC, VA, WV	6,938	334	406	6,189	89.2	574	8.3	156	2.2
7	FL	8,310	327	405	7,379	88.8	758	9.1	150	1.8
15	AZ, CO, NV, NM, UT, WY	6,084	309	288	5,241	86.1	647	10.6	186	3.1
1	CT, MA, ME, NH, RI, VT	3,995	262	268	3,467	86.8	361	9.0	162	4.1
16	AK, ID, MT, OR, WA	3,500	254	237	2,943	84.1	446	12.7	108	3.1
All networks		124,114	354	376	107,198	87.8	11,744	9.6	2,894	2.4

*Data Source: Reference Table A.10, and special analyses, USRDS ESRD Database. The special analyses exclude U.S. Territories, unknown/other races. Standardized for age, sex, and race. The standard population was the U.S. population in 2011. Listed from highest to lowest adjusted rate per million/year. * Includes 50 states, Washington, D.C. (DC), Puerto Rico (PR), Guam (GU), American Samoa (AS), U.S. Virgin Islands, and Northern Mariana Islands. Northern and Southern California (CA) split into Networks 17 and 18. Abbreviations: Af Am, African American; ESRD, end-stage renal disease; Hisp, Hispanic; N Am, Native American.*

Across 806 Health Service Areas (HSA) in 2011-2015, the adjusted incidence rate of ESRD ranged from 75 to 1731 PMP (interquartile range: 255 to 393 PMP; Figure 1.3). Without further geospatial analyses, specific geographic patterns based on these HSA-level data were difficult to identify. In general, the rates were highest in parts of the Ohio and Mississippi River valleys, sections of the southeastern U.S., Texas, and California, and lowest in areas of New England, the Northwest, and certain Upper Midwest and Rocky Mountain states.

vol 2 Figure 1.3 Map of the adjusted incidence rate of ESRD, by Health Service Area, in the U.S. population, 2011-2015

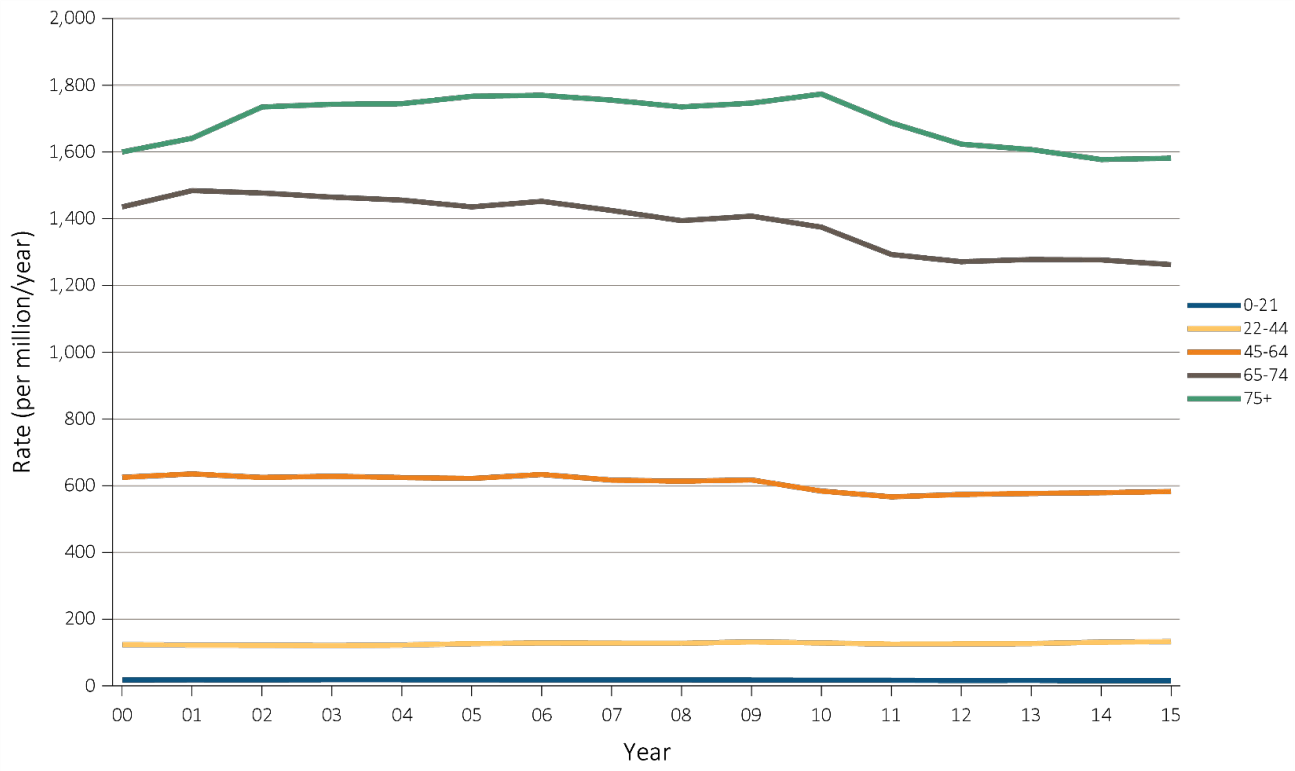


Data Source: Special analyses, USRDS ESRD Database. Standardized for age, sex, and race. The standard population was the U.S. population in 2011. Values for cells with 10 or fewer patients are suppressed. Abbreviation: ESRD, end-stage renal disease.

Incidence Rate: By Age

Across age groups, adjusted ESRD incidence rates either have been generally stable or have fallen for a decade or more (Figure 1.4). Recent pronounced declines have been observed for older patients. Among those aged 65-74 the ESRD incidence rate was lowest in 2015, and the lowest in 2014 for those aged 75 and older.

vol 2 Figure 1.4 Trends in adjusted ESRD incidence rate, by age group, in the U.S. population, 2000-2015



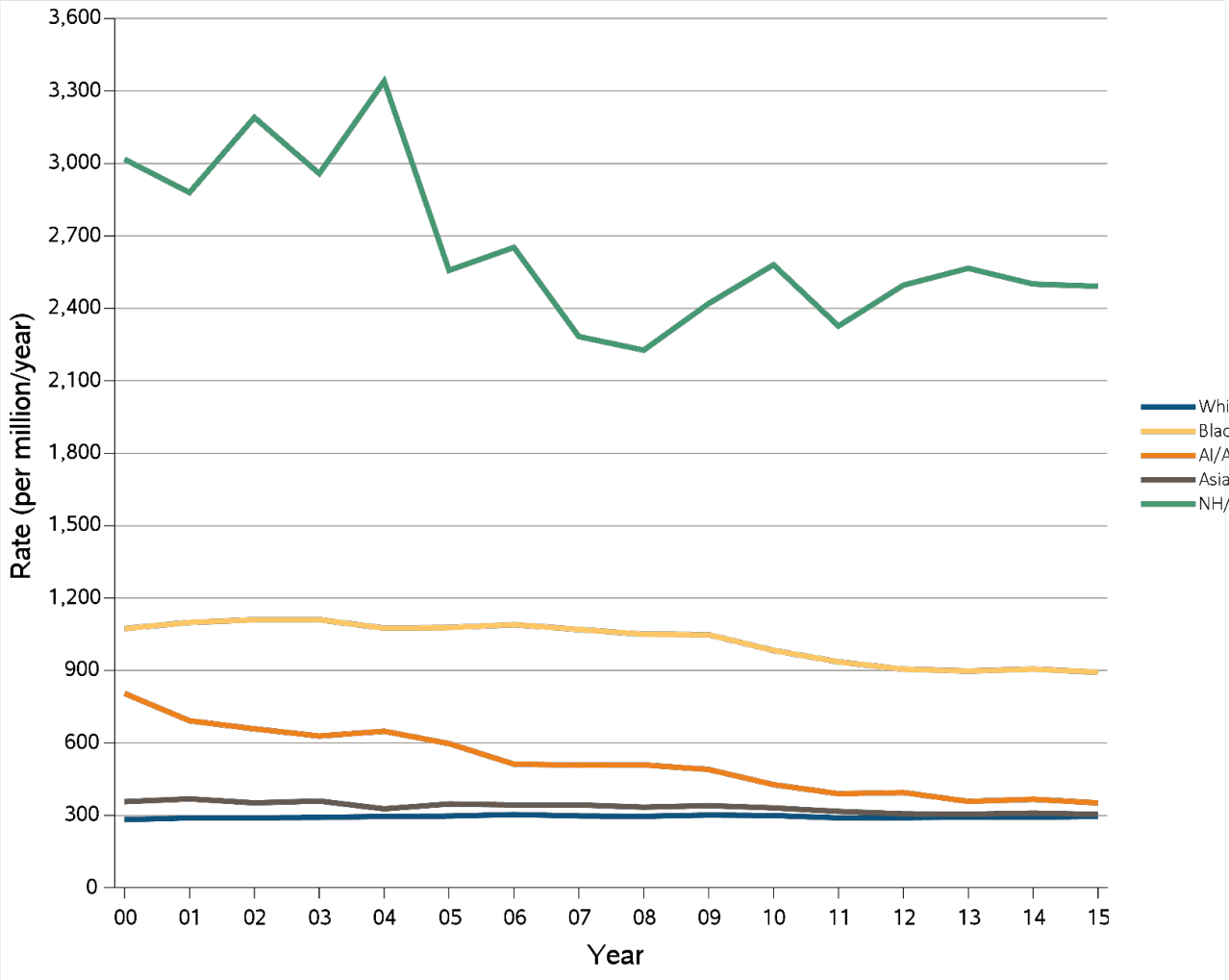
Data Source: Reference Table A.2(2) and special analyses, USRDS ESRD Database. Standardized for sex and race. The standard population was the U.S. population in 2011. Abbreviation: ESRD, end-stage renal disease.

Incidence Rate: By Race and Ethnicity

The adjusted ESRD incidence rate among Native Hawaiians/Pacific Islanders was many times higher than for other race groups; in 2015 this group had an adjusted incidence rate ratio versus Whites of 8.4 (Figure 1.5). As noted in the *Healthy People 2020* chapter, there is a significant difference between data contained in the U.S. Census and the USRDS ESRD Database regarding the reporting of multiple race status among Native Hawaiians/Pacific Islanders; this makes the ESRD rates for this racial group inconclusive.

The rate among Blacks was also much higher than for other groups, with a 2015 adjusted incidence rate ratio versus Whites of 3.0. The adjusted ESRD incidence rate among Whites has been generally stable since around 2000, but has declined in other race groups. The decline has been greatest, over 2-fold, among American Indians/Alaska Natives. The net result is that the excess risk of ESRD among minorities compared to Whites has decreased markedly. In the 15-year period from 2000 to 2015, the adjusted risk ratio for ESRD for African Americans has declined from 3.7 to 2.9, for American Indians/Alaska Natives from 2.8 to 1.5, and for Asians the excess risk no longer exists (1.4 in 2000 and 1.0 in 2015). These changes appear to represent a reduction in health inequalities, whether in the general population or the CKD population.

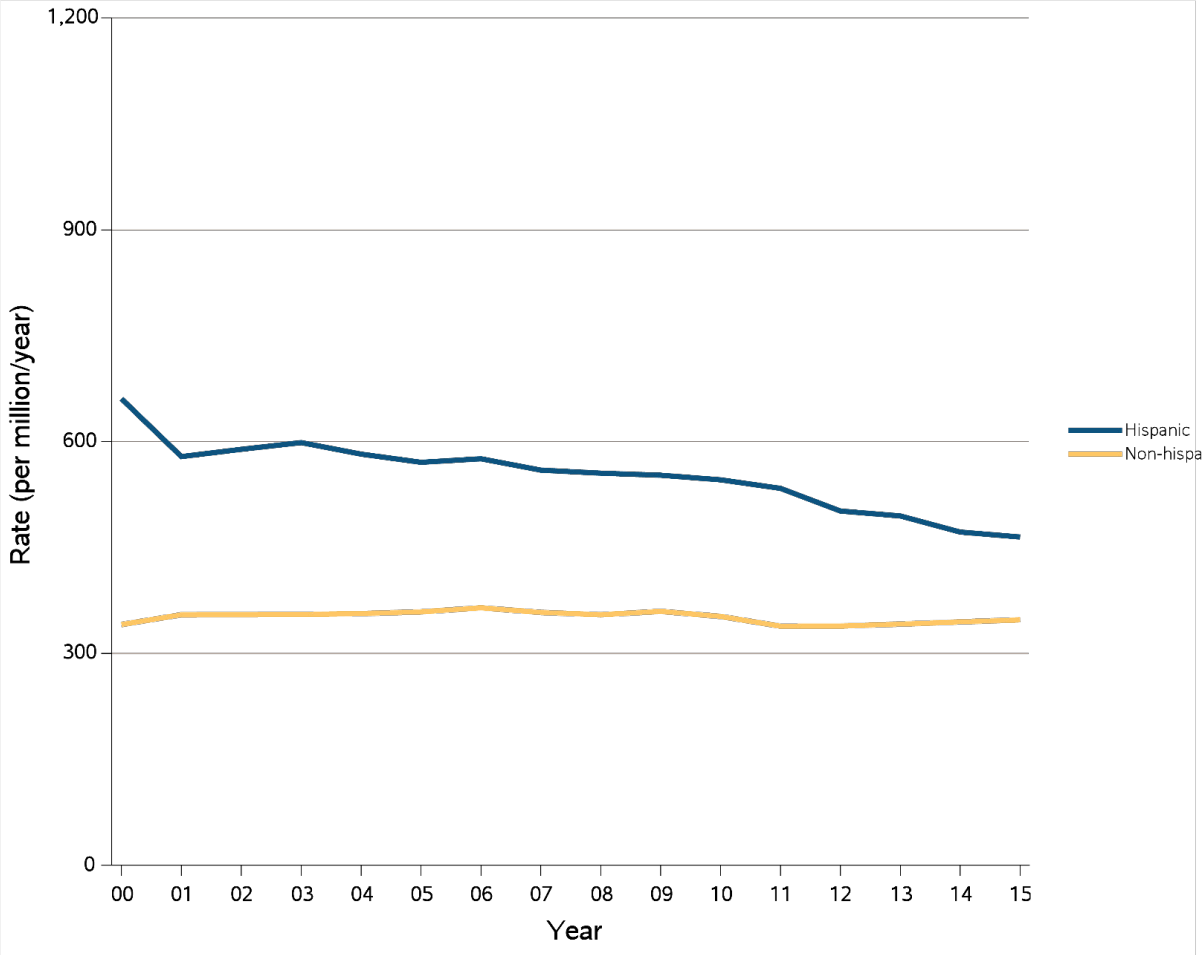
vol 2 Figure 1.5 Trends in adjusted ESRD incidence rate, by race, in the U.S. population, 2000-2015



Data Source: Reference Table A.2(2) and special analyses, USRDS ESRD Database. Standardized for age and sex. The standard population was the U.S. population in 2011. Abbreviations; AI/AN: Americans Indian/Alaska Native; NA/PI: Native Hawaiian/Pacific Islander; ESRD, end-stage renal disease.

Between both Hispanic and non-Hispanic populations, the adjusted ESRD incidence rates have been stable or somewhat declining since 2001 (Figure 1.6). Although the absolute difference in adjusted rates between the two ethnic groups has declined since 2000, the ESRD incidence rate in 2015 remained nearly 34% higher among Hispanics than non-Hispanics.

vol 2 Figure 1.6 Trends in adjusted ESRD incidence rate, by Hispanic ethnicity, in the U.S. population, 2000-2015



Data Source: Reference Tables A.2(2). Standardized for age, sex, and race. The standard population was the U.S. population in 2011. Abbreviation: ESRD, end-stage renal disease.

Prevalence of ESRD: Counts, Prevalence, and Trends

Overall Prevalence

On December 31, 2015, there were 703,243 prevalent cases of ESRD in the U.S.; this represents an increase of 3.4% since 2014, and of 80% since 2000 (Table 1.3 and Figure 1.8). The unadjusted ESRD prevalence reached 2,128 PMP, or 0.21% of the U.S. population. This was an increase of 2.4% since 2014 and of 58% since 2000 (Table 1.3).

As shown in Table 1.3 and Figure 1.7, both unadjusted and adjusted prevalence of ESRD increased steadily between 1980 and 2015. In general, however, the absolute and proportional yearly changes were a little greater for the unadjusted prevalence than for the adjusted, particularly after 2000 (Table 1.3). The increasing prevalent count and unadjusted prevalence indicate the need for additional resources to manage ESRD in the U.S. population, as demonstrated in Volume 2, Chapter 10: *Healthcare Expenditures for Persons with ESRD*.

Because prevalence reflects both the incidence and course of the disease, these ESRD prevalence trends could result from not only an increasing number of incident cases (Table 1.1), but also longer survival among ESRD patients. This interpretation is supported by the observation that the adjusted ESRD prevalence has continued to increase in recent years, while the adjusted incidence rate has declined (Table 1.1). This trend is encouraging regarding the success of efforts to treat kidney disease and kidney failure in the U.S.

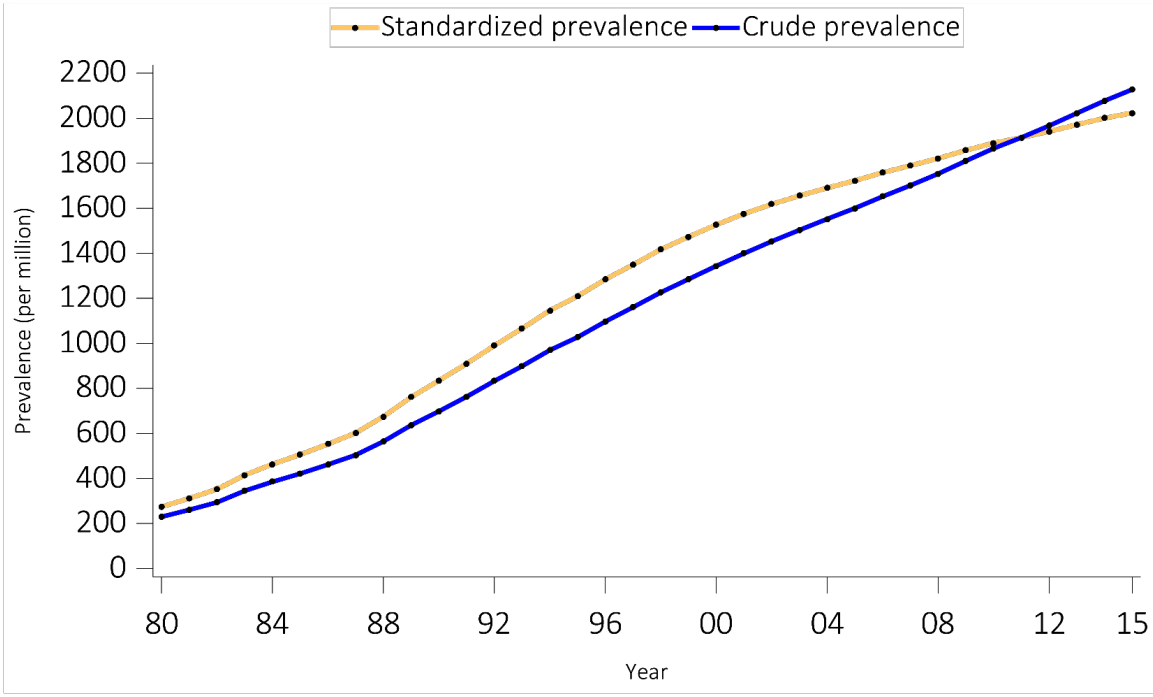
vol 2 Table 1.3 Trends in annual number of ESRD prevalent cases, unadjusted and adjusted of ESRD, and annual percentage change, in the U.S. population, 1980-2015

	Prevalent count		Unadjusted prevalence		Age-sex-race standardized	
Year	No. of cases	% change from previous year	Prevalence (per million year)	% change from previous year	Prevalence (per million year)	% change from previous year
1980	56,434	n/a	229.3	n/a	273.7	n/a
1981	64,252	13.9	260.3	13.5	311.6	13.8
1982	72,491	12.8	293.5	12.8	352.0	13.0
1983	85,570	18.0	344.8	17.5	414.7	17.8
1984	95,887	12.1	384.8	11.6	463.1	11.7
1985	105,423	9.9	421.1	9.4	505.9	9.2
1986	116,109	10.1	461.5	9.6	552.2	9.2
1987	127,468	9.8	503.9	9.2	601.9	9.0
1988	143,523	12.6	564.1	11.9	674.7	12.1
1989	162,662	13.3	636.2	12.8	760.9	12.8
1990	180,474	11.0	698.0	9.7	834.5	9.7
1991	199,548	10.6	762.8	9.3	909.6	9.0
1992	220,348	10.4	832.5	9.1	990.0	8.8
1993	240,557	9.2	898.6	7.9	1,065.8	7.7
1994	262,626	9.2	969.5	7.9	1,146.0	7.5
1995	281,557	7.2	1,027.1	5.9	1,209.0	5.5
1996	304,413	8.1	1,096.5	6.8	1,283.9	6.2
1997	326,185	7.2	1.160.2	5.8	1,349.0	5.1
1998	348,762	6.9	1.226.1	5.7	1,417.0	5.0
1999	369,623	6.0	1,284.9	4.8	1,473.2	4.0
2000	390,561	5.7	1,343.5	4.6	1,526.5	3.6
2001	410,502	5.1	1,399.1	4.1	1,575.2	3.2
2002	429,876	4.7	1,452.8	3.8	1,617.8	2.7
2003	448,514	4.3	1,503.2	3.5	1,655.6	2.3
2004	467,038	4.1	1,552.4	3.3	1,690.2	2.1
2005	485,905	4.0	1,600.2	3.1	1,722.5	1.9
2006	506,633	4.3	1,652.1	3.2	1,758.4	2.1
2007	526,709	4.0	1,701.3	3.0	1,789.5	1.8
2008	547,750	4.0	1,753.0	3.0	1,821.6	1.8
2009	570,416	4.1	1,810.2	3.3	1,857.3	2.0
2010	592,656	3.9	1,865.8	3.1	1,890.0	1.8
2011	612,417	3.3	1,914.1	2.6	1,913.9	1.3
2012	633,912	3.5	1,966.4	2.7	1,940.8	1.4
2013	656,856	3.6	2,022.1	2.8	1,971.5	1.6
2014	680,320	3.6	2,077.1	2.7	2,000.4	1.5
2015	703,243	3.4	2,127.6	2.4	2,023.6	1.2

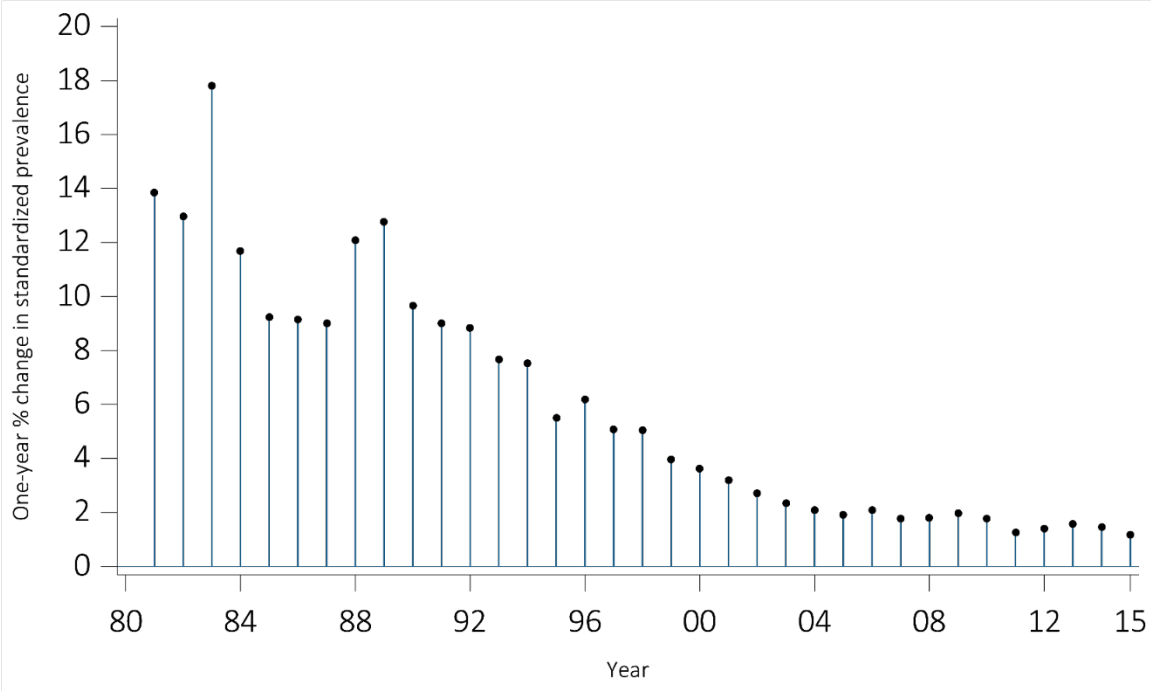
Data Source: Reference Tables B.1, B.2, B2(2) and special analyses, USRDS ESRD Database. The special analyses exclude U.S. Territories, unknown/other races. Standardized for age, sex, and race. Abbreviations: ESRD, end-stage renal disease; n/a, not applicable.

vol 2 Figure 1.7 Trends in the (a) unadjusted and standardized prevalence of ESRD, and (b) annual percentage change in the standardized prevalence of ESRD, in the U.S. population, 1980-2015

(a) Prevalence per million



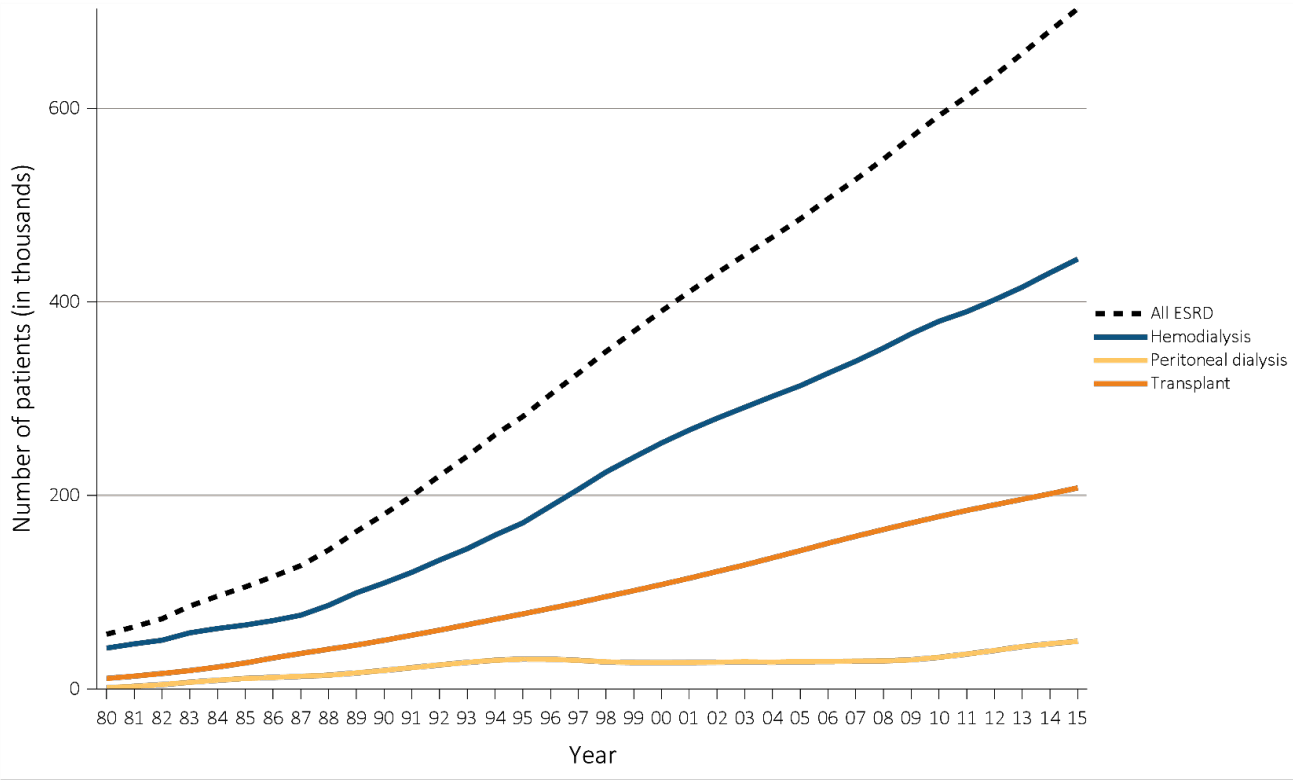
(b) One-year percentage change in standardized prevalence



Data Source: Reference Table B.2(2) and special analyses, USRDS ESRD Database. Standardized for age, sex, and race. The standard population was the U.S. population in 2011. Abbreviation: ESRD, end-stage renal disease.

Among prevalent ESRD cases on December 31, 2015, 63.2% used HD as their RRT, 7.0% used PD, and 29.6% had a functioning kidney transplant (Figure 1.8). The size of the prevalent HD population in 2015 was 74.8% larger than in 2000 (Figure 1.8), with the PD population reaching 81.8% larger. The size of the transplant population was 92.6% larger than in 2000.

vol 2 Figure 1.8 Trends in the number of ESRD prevalent cases, by modality, in the U.S. population, 1980-2015



Data Source: Reference Table D.1. Abbreviation: ESRD, end-stage renal disease.

PREVALENCE: BY REGION

Among the 18 ESRD Networks, the age-sex-race-adjusted prevalence of ESRD ranged from 2,375 PMP in Network 8 (AL, MS, and TN) to 1,437 PMP in Network 16 (AK, ID, MT, OR, and WA; Table 1.4). Renal replacement modality use by region, also presented in Table 1.4., is discussed in the *Modality of Renal Replacement Therapy: Incident ESRD Cases* section later in this chapter.

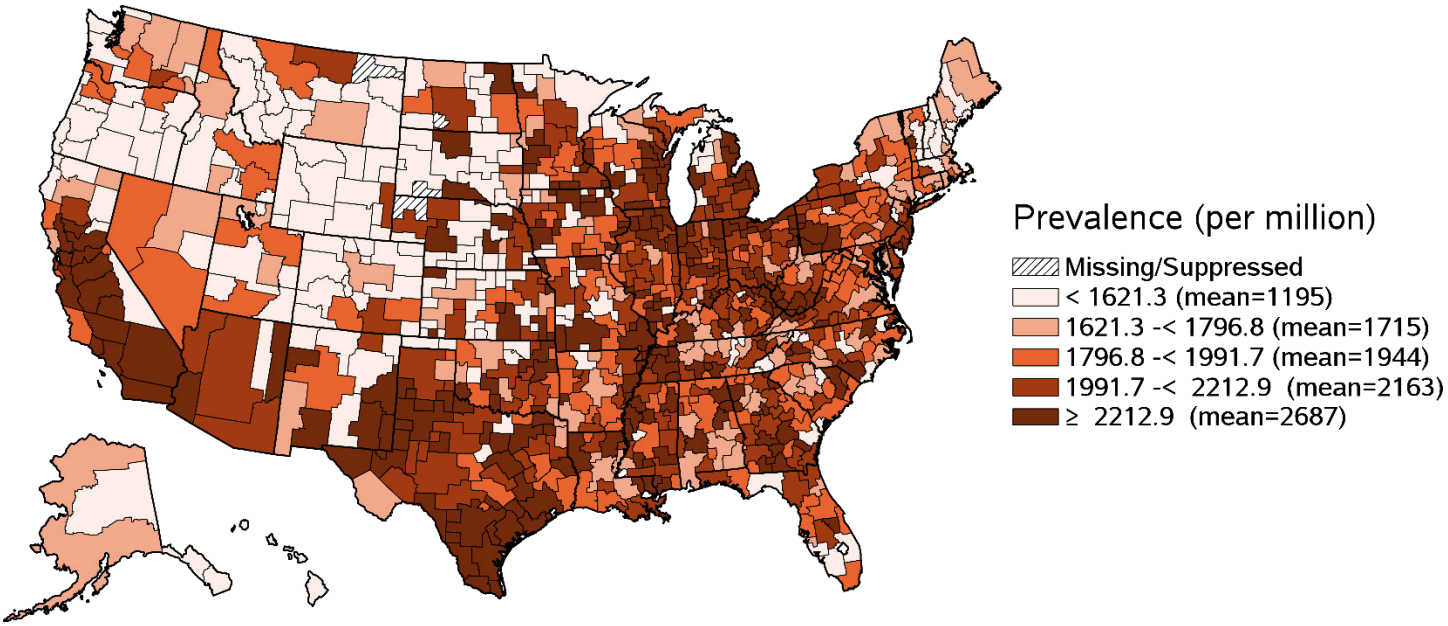
vol 2 Table 1.4 Unadjusted and adjusted* prevalence of ESRD and annual number of ESRD prevalent cases, by modality and ESRD Network, in the U.S. population, 2015

		Total ESRD			Hemodialysis		Peritoneal dialysis		Transplant	
Network	**States in network***	**No. of cases**	**Adjusted prevalence (per million)**	**Unadjusted prevalence (per million)**	**No. of cases**	**% of network**	**No. of cases**	**% of network**	**No. of cases**	**% of network**
8	AL, MS, TN	36,231	2,375	2,493	24,557	67.8	2,954	8.2	8,639	23.8
6	NC, SC, GA	61,901	2,295	2,437	42,206	68.2	5,161	8.3	14,379	23.2
10	IL	31,186	2,284	2,405	19,036	61.0	2,112	6.8	9,960	31.9
5	MD, DC, VA, WV	40,283	2,244	2,366	25,508	63.3	2,540	6.3	12,118	30.1
18	Southern CA	58,464	2,233	2,370	39,367	67.3	4,583	7.8	14,433	24.7
14	TX	62,691	2,162	2,254	43,515	69.4	4,106	6.5	14,910	23.8
3	NJ, PR, VI	28,142	2,154	2,266	13,130	64.0	970	4.7	6,387	31.1
13	AR, LA, OK	25,861	2,146	2,261	17,373	67.2	2,236	8.6	6,174	23.9
2	NY	44,189	2,133	2,221	29,035	65.7	1,619	3.7	13,460	30.5
4	DE, PA	29,800	2,090	2,192	18,180	61.0	1,855	6.2	9,662	32.4
17	Northern CA, HI, GU, AS, MP	38,296	2,055	2,156	22,885	61.4	3,254	8.7	11,019	29.6
9	IN, KY, OH	47,341	1,986	2,077	29,914	63.2	3,557	7.5	13,710	29.0
7	FL	42,167	1,956	2,050	27,134	64.3	3,091	7.3	11,795	28.0
11	MI, MN, ND, SD, WI	45,422	1,883	1,980	25,329	55.8	2,608	5.7	17,384	38.3
12	IA, KS, MO, NE	25,378	1,726	1,799	14,057	55.4	2,138	8.4	9,119	35.9
15	AZ, CO, NV, NM, UT, WY	35,998	1,611	1,705	21,161	58.8	2,650	7.4	12,049	33.5
1	CT, MA, ME, NH, RI, VT	23,875	1,521	1,606	13,080	54.8	1,401	5.9	9,325	39.1
16	AK, ID, MT, OR, WA	22,340	1,437	1,508	12,060	54.0	1,935	8.7	8,287	37.1
All networks		703,243	2,026	2,129	437,527	63.3	48,770	7.1	202,810	29.4

*Data Source: Reference Table B.10 and special analyses, USRDS ESRD Database. The special analyses exclude U.S. Territories, unknown/other races. Standardized for age, sex, and race. The standard population was the U.S. population in 2011. Listed from lowest to highest prevalence per million. *Includes 50 states, Washington, D.C. (DC), Puerto Rico (PR), Guam (GU), American Samoa (AS), U.S. Virgin Islands, and Northern Mariana Islands. Northern and Southern California (CA) split into Networks 17 and 18. Unknown counties in California are grouped to Network*

Across 801 Health Service Areas, the adjusted prevalence of ESRD in 2011-2015 ranged from 400 PMP to 6546 PMP (interquartile range: 1,652 to 2,227 PMP; Figure 1.9). Although specific geographic patterns are difficult to identify without further geospatial analyses, examples of high ESRD prevalence in 2015 included parts of the Ohio and Mississippi River valleys, Michigan, northern Illinois and parts of Wisconsin along Lake Michigan, Texas, and California. Lower prevalence was observed in northern New England, the Northwest, and certain Upper Midwest and Rocky Mountain regions. These patterns are roughly similar to patterns of ESRD incidence shown earlier in this chapter in Figure 1.3.

vol 2 Figure 1.9 Map of the adjusted prevalence of ESRD, by Health Service Area, in the U.S. population, 2011-2015*

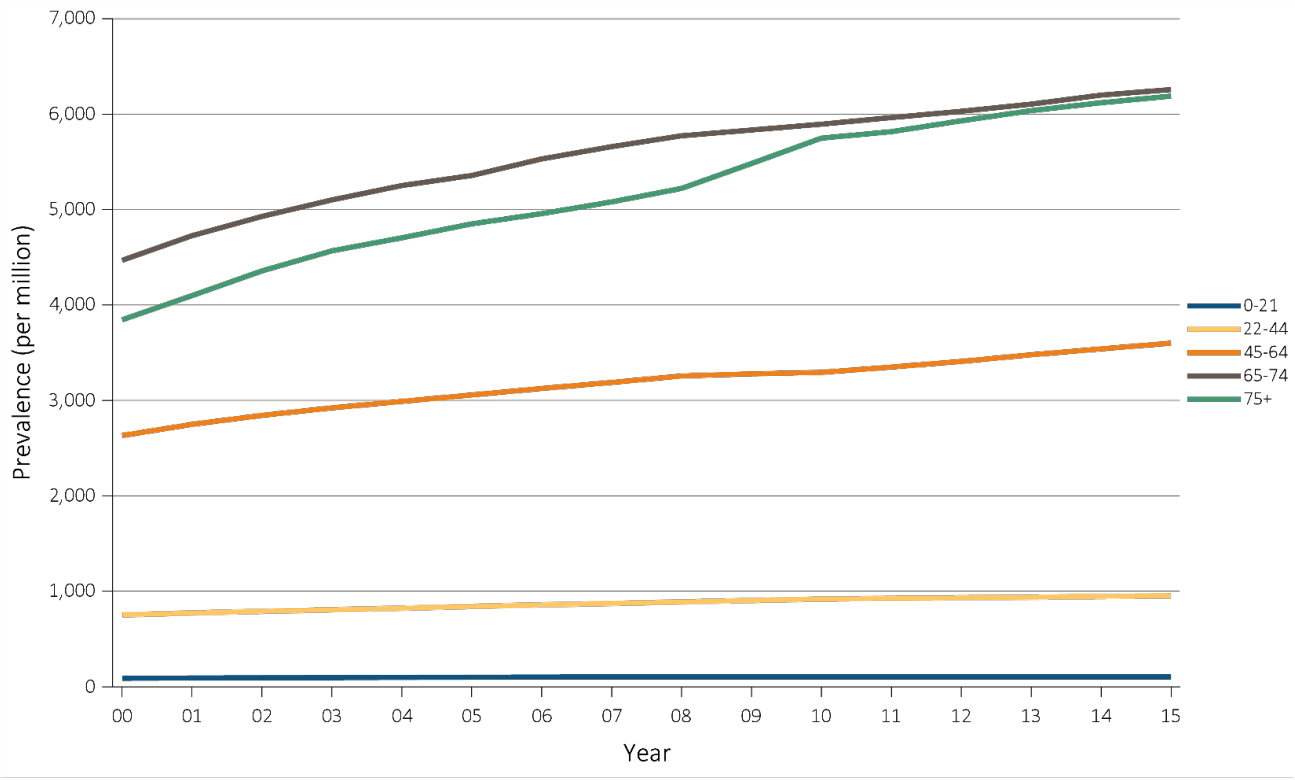


*Data Source: Special analyses, USRDS ESRD Database. Standardized for age, sex, and race. The standard population was the U.S. population in 2011. *Three Health Service Areas were suppressed because the ratio of unadjusted rate to adjusted rate or adjusted rate to unadjusted rate was greater than 3. Values for cells with 10 or fewer patients are suppressed. Abbreviation: ESRD, end-stage renal disease.*

Prevalence: By Age

Across age groups, adjusted ESRD prevalence has risen over time, with steeper increases among the older age groups (Figure 1.10). These increases contrast with the ongoing declines in adjusted ESRD incidence rate across age groups (Figure 1.4). This discrepancy likely results from both longer survival among ESRD patients and the expected progression of patients from one age group at incidence into other groups over time. Among the age groups, ESRD prevalence PMP was highest for the 65-74 years cohort. Although those aged 75 and older had the highest ESRD incidence rate, lower prevalence PMP was presumably due to higher mortality among these oldest ESRD patients.

vol 2 Figure 1.10 Trends in the adjusted prevalence of ESRD, by age group, in the U.S. population, 2000-2015



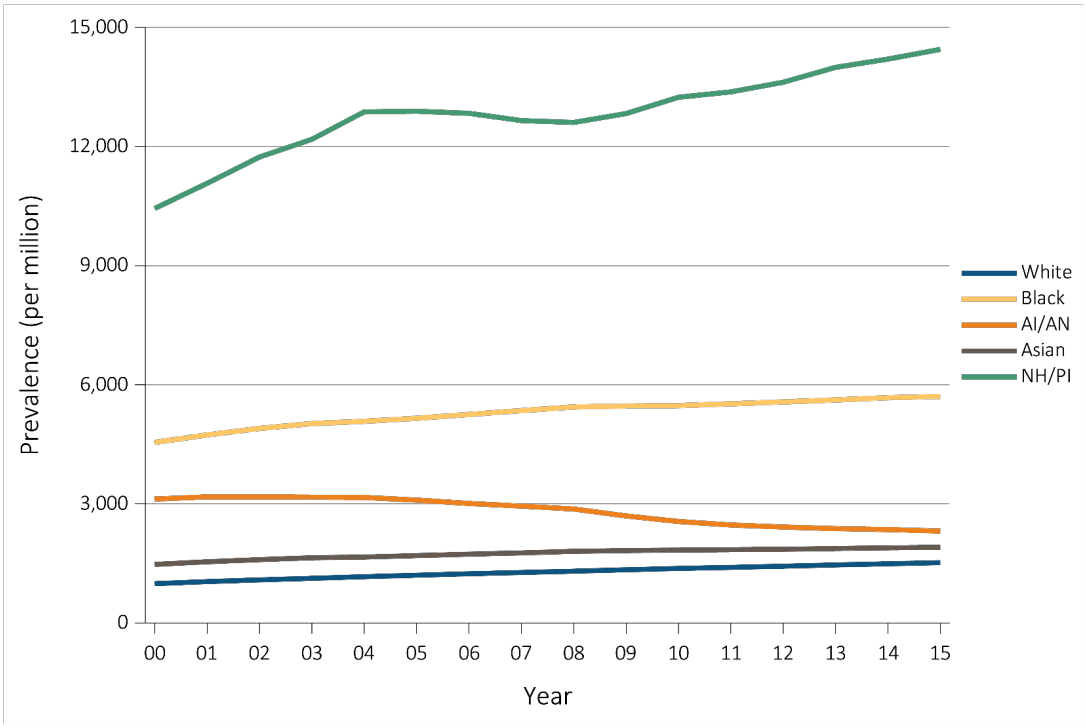
Data Source: Reference Table B.2(2) and special analyses, USRDS ESRD Database. Point prevalence on December 31 of each year. Standardized for sex and race. The standard population was the U.S. population in 2011. Abbreviations: ESRD, end-stage renal disease.

PREVALENCE: BY RACE AND ETHNICITY

In 2015, ESRD prevalence PMP was 14,448 among Native Hawaiians/Pacific Islanders, 5,705 among Blacks, 2,315 among American Indians/Alaska Natives, 1,905 among Asians, and 1,519 among Whites (Figure 1.11). The prevalence of ESRD for Native Hawaiians/Pacific Islanders was much higher than in other racial groups, by more than 9.5-fold as compared to Whites, nearly 7.6-fold higher than Asians, 6.2-fold higher than American Indians/Alaska Natives, and nearly 2.5-fold higher than Blacks.

The adjusted prevalence of ESRD continued to rise among Whites, Blacks, Native Hawaiians/Pacific Islanders, and Asians. However, the remarkable decline in incidence rates among American Indians/Alaska Natives has resulted in a 21% reduction in the prevalence of ESRD in this population over the past decade, from a peak of 3,017 in 2000 to 2,491 in 2015 (Figure 1.5).

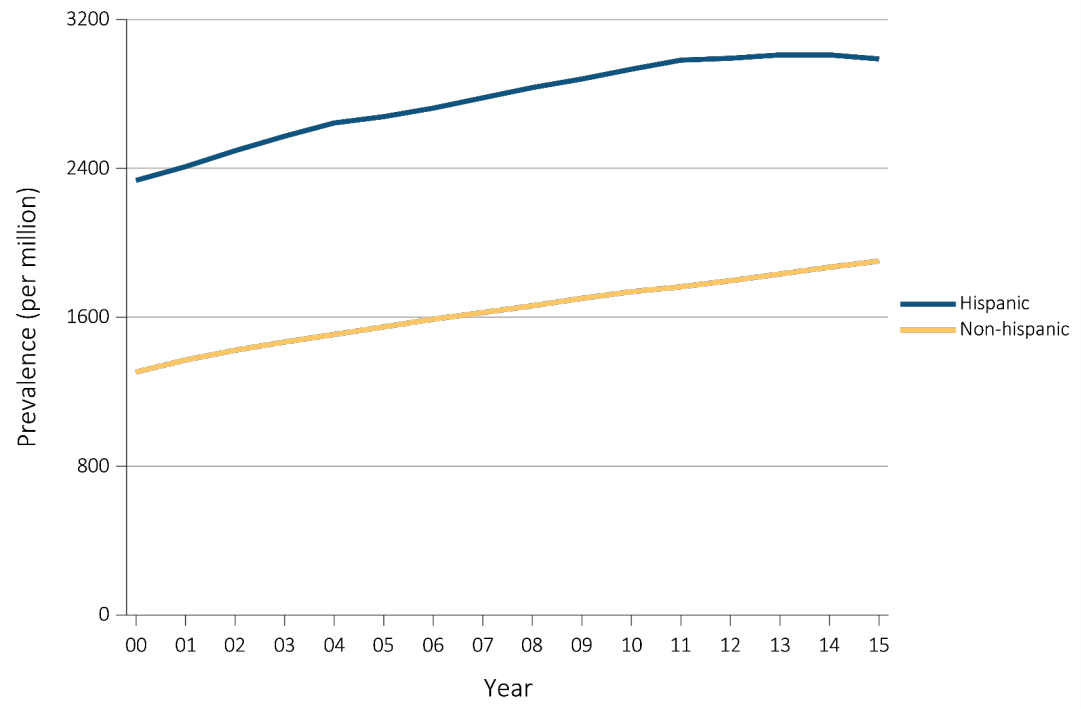
vol 2 Figure 1.11 Trends in adjusted prevalence of ESRD, by race, in the U.S. population, 2000-2015



Data Source: Reference Table B.2(2) and special analyses, USRDS ESRD Database. Point prevalence on December 31 of each year. Standardized for age and sex. The standard population was the U.S. population in 2011. Abbreviations NH/PI: Native Hawaiian/Pacific Islander; AI/AN: Americans Indian/Alaska Natives; ESRD, end-stage renal disease.

In 2015, the adjusted ESRD prevalence was 1,902 PMP among non-Hispanics, and nearly 57% higher, at 2,988 PMP, among Hispanics (Figure 1.12). The adjusted ESRD prevalence has risen for both non-Hispanics and Hispanics, though it shows signs of plateauing among Hispanics since 2011.

vol 2 Figure 1.12 Trends in the adjusted prevalence of ESRD, by Hispanic ethnicity, in the U.S. population, 2000-2015



Data Source: Reference Tables B.1, B.2(2). Point prevalence on December 31 of each year. Standardized for age, sex, and race. The standard population was the U.S. population in 2011. Abbreviation: ESRD, end-stage renal disease.

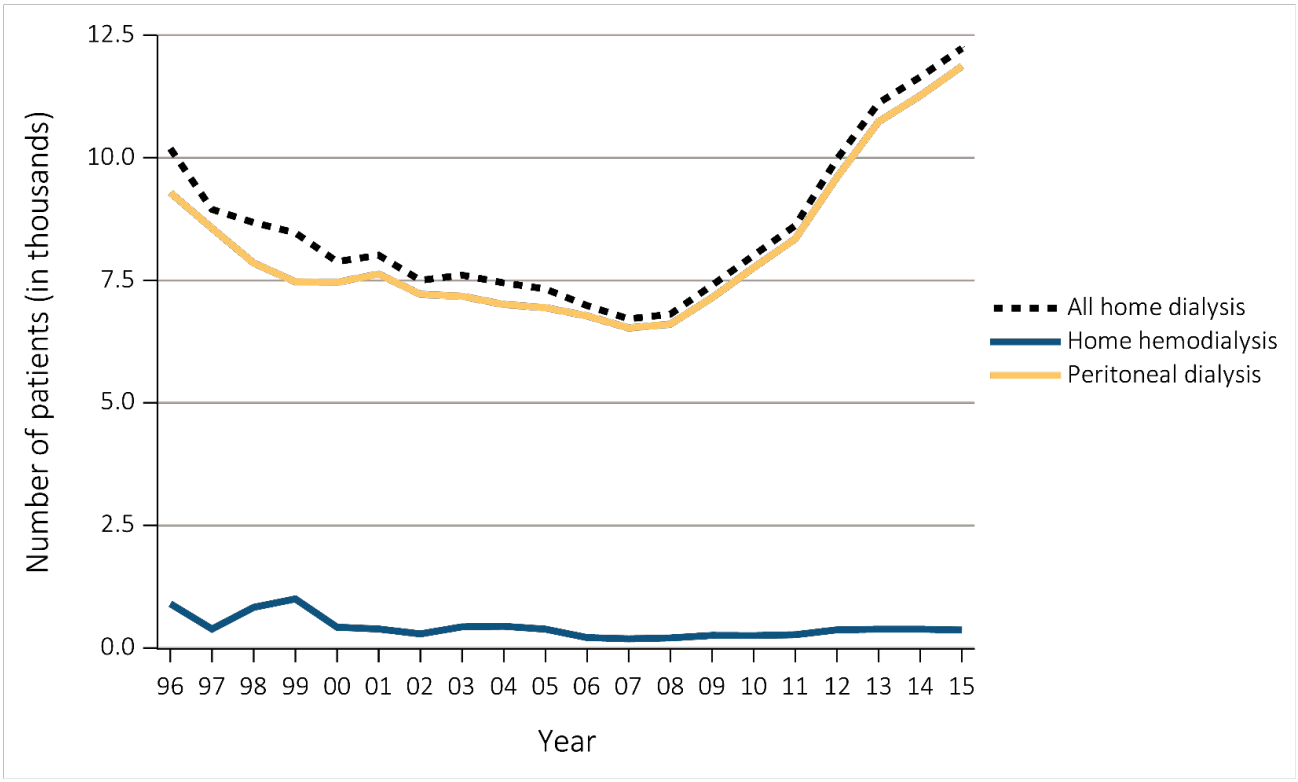
Modality of Renal Replacement Therapy: Incident ESRD Cases

As seen in Figure 1.2, among incident ESRD patients in 2015, 87.7% used HD as their RRT, 9.6% used PD, and 2.5% received a preemptive kidney transplant. Since 2000, the size of the incident HD population has increased by 29%. The size of the incident PD population has become 59% larger, and the preemptive transplant population 57% larger. By comparison, the U.S. population was 14% larger than in 2000.

Trends in Incident Counts: By Renal Replacement Therapy Modality

Use of home dialysis among incident ESRD patients has increased notably in recent years (Figure 1.13). Overall, home dialysis use in 2015 was 82% higher than at its least utilized point in 2007. In 2015, use of PD and home HD were 82% and 97% higher than in 2007. Peritoneal dialysis remained the dominant form of home dialysis. Despite the large relative rise in home HD, its overall use was only 3.5% among incident ESRD patients receiving home dialysis in 2015.

vol 2 Figure 1.13 Trends in the number of incident ESRD cases using home dialysis, by type of therapy, in the U.S. population, 1996-2015



Data Source: Reference Table D.1. Abbreviations: ESRD, end-stage renal disease.

Renal Replacement Therapy Modality Use: By Patient Characteristics

Use of PD and preemptive kidney transplants were markedly more common in younger groups, and were somewhat less common among Black or Hispanic patients (Table 1.5). Use of PD and preemptive kidney transplants were more common among patients with glomerular or cystic kidney disease as the primary cause of ESRD, versus DM or HTN. This difference is partially due to age, as both glomerular and cystic kidney disease are more common in younger patients.

vol 2 Table 1.5 Number and percentage of incident cases of hemodialysis, peritoneal dialysis, and transplantation by age, sex, race, ethnicity, and primary cause of ESRD, in the U.S. population, 2015

	Total	HD		PD		Transplant	
		N	%	N	%	N	%
Age							
0-21	1,399	739	52.8	367	26.2	293	20.9
22-44	13,855	11,035	79.6	2,052	14.8	768	5.5
45-64	47,809	41,235	86.2	5,057	10.6	1,517	3.2
65-74	32,125	28,898	90.0	2,705	8.4	522	1.6
75+	28,644	26,919	94.0	1,683	5.9	42	0.1
Sex							
Male	71,984	63,256	87.9	6,839	9.5	1,889	2.6
Female	51,848	45,570	87.9	5,025	9.7	1,253	2.4
Race							
White	83,059	72,504	87.3	8,225	9.9	2,330	2.8
Black/African American	32,429	29,532	91.1	2,635	8.1	262	0.8
American Indian or Alaska Native	1,124	988	87.9	87	7.7	49	4.4
Asian	5,029	4,028	80.1	699	13.9	302	6.0
Native Hawaiian or Pacific Islander	1,466	1,298	88.5	158	10.8	10	0.7
Other or Multiracial	390	324	83.1	44	11.3	22	5.6
Unknown	335	152	45.4	16	4.8	167	49.9
Ethnicity							
Hispanic	18,151	16,201	89.3	1,649	9.1	301	1.7
Non-Hispanic	104,627	92,113	88.0	10,167	9.7	2,347	2.2
Unknown	1,054	512	48.6	48	4.6	494	46.9
Primary Cause of ESRD							
Diabetes	56,218	50,748	90.3	5,062	9.0	408	0.7
Hypertension	34,727	31,220	89.9	3,243	9.3	264	0.8
Glomerulonephritis	9,198	7,063	76.8	1,633	17.8	502	5.5
Cystic Kidney	2,833	1,764	62.3	596	21.0	473	16.7
Other/Unknown	20,856	18,031	86.5	1,330	6.4	1,495	7.2
Total	123,832	108,826	87.9	11,864	9.6	3,142	2.5

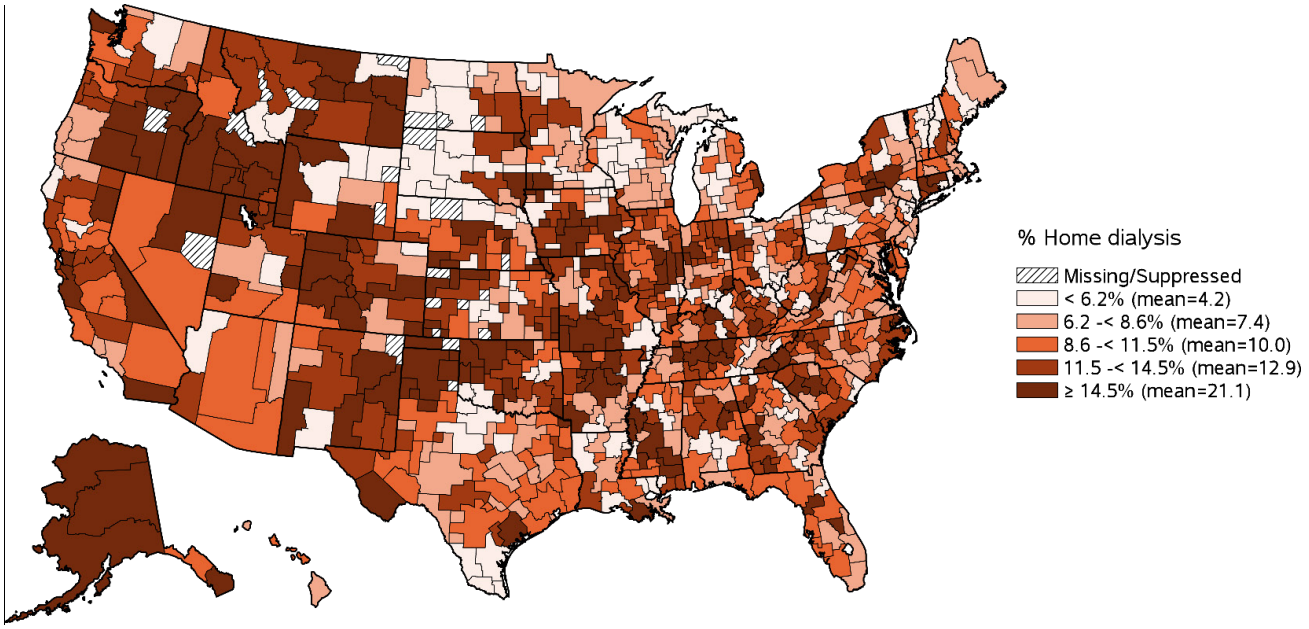
Data Source: Special analyses, USRDS ESRD Database. The numbers in this table exclude "Other PD" and "Uncertain Dialysis." Abbreviations: ESRD, end-stage renal disease; HD, hemodialysis, including home hemodialysis and in center hemodialysis; PD, peritoneal dialysis.

Renal Replacement Therapy Modality Use: By Region

Among incident ESRD cases, HD was the predominant modality in all networks, ranging from 83.5% in Network 17 (N. CA, HI, GU, and AS) to 92.1% in Network 2 (NY; Table 1.2). Use of PD varied over 2-fold, from 4.8% in Network 2 (Table 1.2) to 14.3% in Network 17 (Table 1.2). Overall, preemptive kidney transplantation remained an uncommon initial RRT modality, at 2.5%, although its use ranged over 3-fold from 1.3% in Network 8 (IN, KY, and OH) to 4.1% in Network 1 (CT, MA, ME, NH, RI, and VT).

The proportion of incident dialysis patients using home dialysis varied substantially across 783 HSAs, ranging from 0% to 62% (interquartile range: 6.8% to 13.4%; Figure 1.14). Few geographic patterns were apparent, supporting the likelihood that differences in home dialysis use were largely driven by variations between individual dialysis centers or groups of centers, rather than by large-scale regional effects.

vol 2 Figure 1.14 Map of the percentage of incident dialysis cases using home dialysis (peritoneal dialysis or home hemodialysis), by Health Service Area, 2011-2015



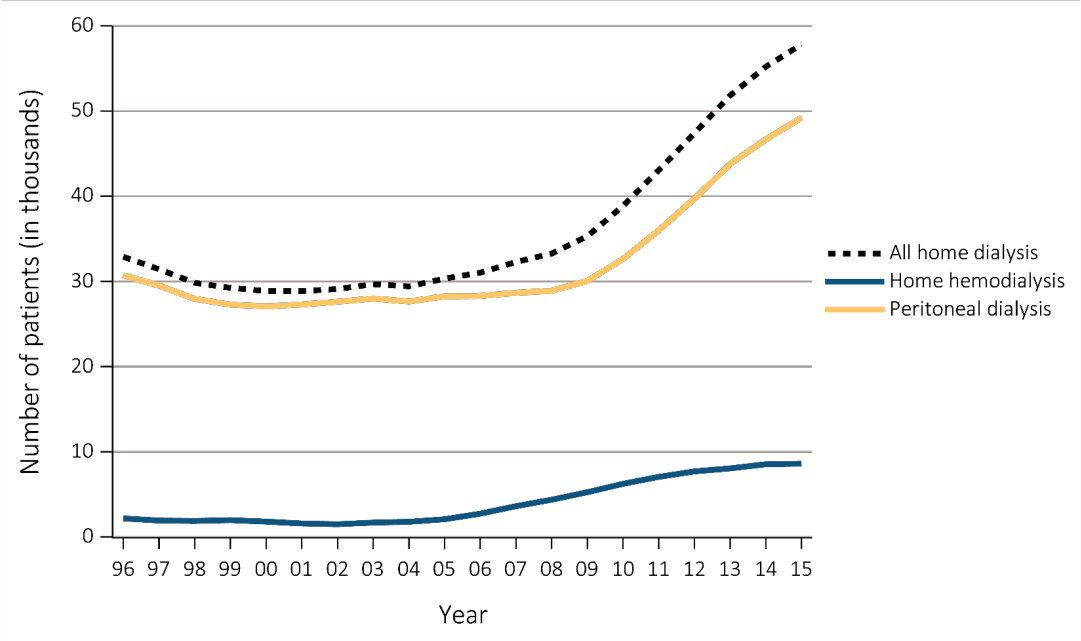
Data Source: Special analyses, USRDS ESRD Database. Values for cells with 10 or fewer patients are suppressed.

Modality of Renal Replacement Therapy: Prevalent ESRD Cases

Trends in Prevalent Counts: By Renal Replacement Therapy Modality

The use of home dialysis (PD or home HD) among prevalent ESRD patients has increased appreciably in recent years (Figure 1.15), mirroring patterns shown for incident dialysis (Figure 1.17). Home dialysis accounted for 8.6% of all prevalent dialysis patients in 2015, up from a low of 4.4% in 2008. In this group, the proportion using HD was over 2.4-fold higher in 2015 (14.5%) than in 2000 (6.2%).

vol 2 Figure 1.15 Trends in number of prevalent ESRD cases using home dialysis, by type of therapy, in the United States, 1996-2015



Data Source: Reference Table D.1. December 31 prevalent ESRD patients. Peritoneal dialysis consists of CAPD and CCPD only. Abbreviations: CAPD, continuous ambulatory peritoneal dialysis; CCPD, continuous cycler peritoneal dialysis; ESRD, end-stage renal disease.

Renal Replacement Therapy Modality Use: By Patient Characteristics

Distributions of the modality used, by patient characteristics, generally mirrored those for incident patients. Uses of PD and kidney transplant were more common among patients who were younger, White, non-Hispanic, and with glomerular disease or cystic kidney disease as the primary cause of their ESRD (Table 1.6).

vol 2 Table 1.6 Percentage of prevalent cases of hemodialysis, peritoneal dialysis, and transplant by age, sex, race, ethnicity, and primary ESRD diagnosis, in the United States, 2015

	Total	Hemodialysis		Peritoneal dialysis		Transplant	
		N	%	N	%	N	%
Age							
0-21	9,738	1,775	18.2	1,008	10.4	6,955	71.4
22-44	102,744	51,188	49.8	9,072	8.8	42,484	41.3
45-64	308,616	184,098	59.7	21,791	7.1	102,727	33.3
65-74	166,679	112,875	67.7	10,899	6.5	42,905	25.7
75+	113,575	94,401	83.1	6,435	5.7	12,739	11.2
Sex							
Male	405,248	254,066	62.7	27,262	6.7	123,920	30.6
Female	296,046	190,240	64.3	21,941	7.4	83,865	28.3
Race							
White	430,569	251,259	58.4	32,543	7.6	146,767	34.1
Black/African American	215,299	160,990	74.8	12,304	5.7	42,005	19.5
American Indian or Alaska Native	7,497	5,228	69.7	421	5.6	1,848	24.6
Asian	32,968	18,927	57.4	3,104	9.4	10,937	33.2
Native Hawaiian or Pacific Islander	8,453	6,208	73.4	640	7.6	1,605	19.0
Other or Multiracial	3,333	1,176	35.3	142	4.3	2,015	60.5
Unknown	3,233	549	17.0	51	1.6	2,633	81.4
Ethnicity							
Hispanic	122,272	82,510	67.5	7,733	6.3	32,029	26.2
Non-Hispanic	561,794	359,578	64.0	41,248	7.3	160,968	28.7
Unknown	17,286	2,249	13.0	224	1.3	14,813	85.7
Primary Cause of ESRD							
Diabetes	267,956	203,295	75.9	18,294	6.8	46,367	17.3
Hypertension	178,875	130,537	73.0	13,459	7.5	34,879	19.5
Glomerulonephritis	112,235	44,897	40.0	8,785	7.8	58,553	52.2
Cystic Kidney	33,194	10,357	31.2	2,268	6.8	20,569	62.0
Other/Unknown	109,092	55,251	50.6	6,399	5.9	47,442	43.5
Total	701,352	444,337	63.4	49,205	7.0	207,810	29.6

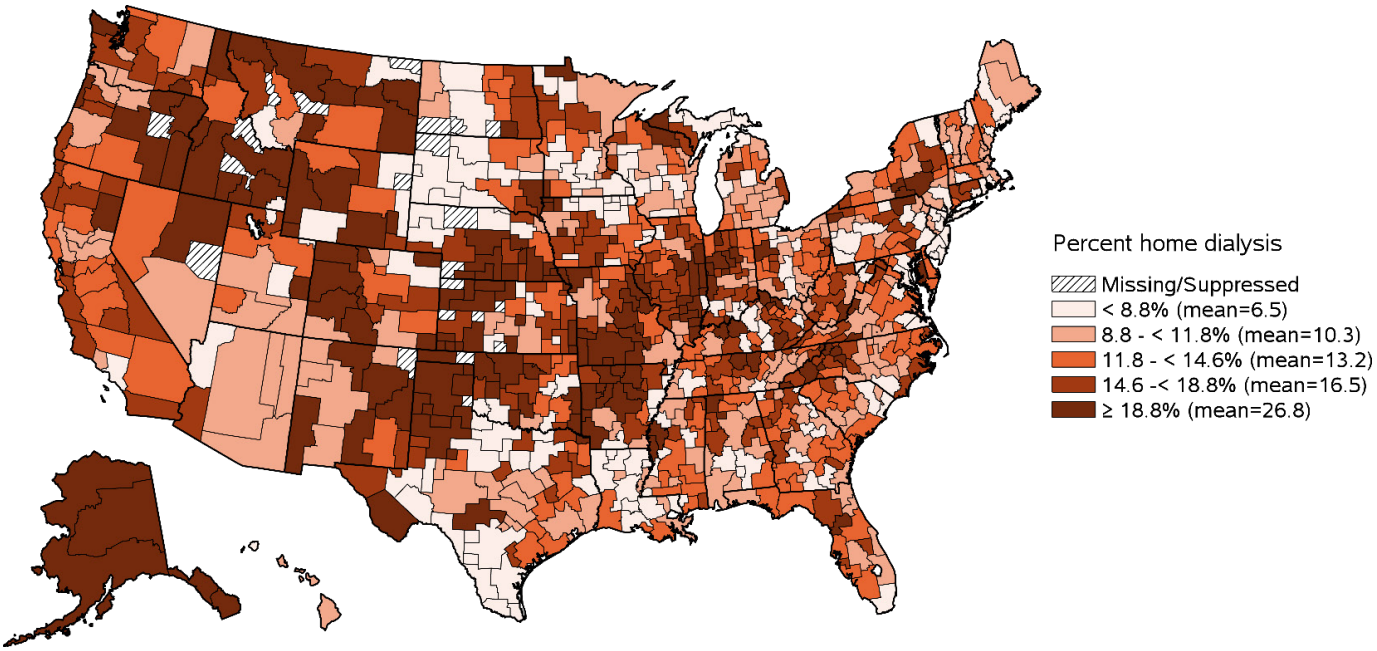
Data Source: Special analyses, USRDS ESRD Database. The numbers in this table exclude "Other PD" and "Uncertain Dialysis." Abbreviation: ESRD, end-stage renal disease; HD, hemodialysis; PD, peritoneal dialysis.

Renal Replacement Therapy Modality Use: By Region

As observed for incident dialysis cases, RRT modality use among the prevalent ESRD population varied by region. Use ranged between networks, from 54% to 69% for HD, 4% to 9% for PD, and from 23% to 39% for transplantation (Table 1.4). The percentage of patients on HD was generally higher and the percentage with a transplant was generally lower in the networks with higher prevalence of ESRD.

Across 784 HSAs in 2011-2015, the percentage of prevalent patients using home dialysis ranged from 0% to 79% (interquartile range: 9.4% to 17.2%; Figure 1.16). Use of home dialysis varied considerably across the country; there were no apparent regional patterns of low versus high use of home HD in these HSAs.

vol 2 Figure 1.16 Map of the percentage of prevalent dialysis cases using home dialysis, by Health Service Area, 2011-2015



Data Source: Special analyses, USRDS ESRD Database. Values for cells with 10 or fewer patients are suppressed.

Patient and Treatment Characteristics at ESRD Onset

Pre-ESRD care

In 2015, 22% of patients starting ESRD therapy were reported on the CMS 2728 form as not having received nephrology care prior to ESRD onset (Table 1.7), a decrease of 2% from 2014. An additional 14% had an unknown duration of pre-ESRD nephrology care. Because treatment characteristics, such as erythropoiesis-stimulating agent (ESA) use and dietary care, for the unknown group were similar to those with no pre-ESRD nephrology care, one may assume that up to 36% of new ESRD cases received little or no pre-ESRD nephrology care (Table 1.7.a).

Several differences were notable in the distributions of pre-ESRD nephrology care by patient characteristics. The youngest patients 0-21 years old were most likely (44%), and adults aged 22-64 years were least likely to have had longer duration (12 months or more) of pre-ESRD nephrology care (27%-29%). Blacks were slightly less likely to have had pre-ESRD care than were other racial groups, and Hispanics were less likely to have had pre-ESRD care than were non-Hispanics.

ESRD patients with a primary etiologic diagnosis of cystic kidney disease or, to a lesser extent, glomerulonephritis, were more likely to have had pre-ESRD nephrology care than were patients with a diagnosis of DM or HTN. Having no nephrology care was most common for patients with HTN as the primary cause of ESRD. One could surmise that some patients initially presenting with advanced CKD, approaching the need for dialysis, might be assigned the diagnosis of HTN in the absence of evidence of other possible etiologies.

Extensive pre-ESRD care was associated with greatly improved initial ESRD status. Over 50% of those patients with more than 12 months of nephrology care also received dietary care, received ESAs, and started dialysis with an arteriovenous (AV) fistula. The comparable rates for nephrology care of less than 6 months were 21% diet care, 17% ESA use, and 10% AV fistula. Patients receiving longer pre-ESRD nephrology care were less likely to start dialysis at either very low eGFR levels (<5 ml/min/1.73m^2) or very high (≥15 ml/min/1.73m^2) eGFR levels.

vol 2 Table 1.7 Distribution of the reported duration of pre-ESRD nephrology care, by (a) demographic and (b) clinical characteristics, among incident ESRD cases in the U.S. population, 2015

(a) Demographic characteristics (% within row)

		Duration of pre-ESRD nephrology care				
	No. of cases	>12 months	6-12 months	0-6 months	None	Unknown
Total	119,580	30.9	19.3	13.4	22.4	14.0
Age						
0-21	1,449	44.1	14.7	14.1	20.5	6.5
22-44	13,573	27.4	18.3	13.9	28.3	12.2
45-64	45,701	28.9	19.4	13.6	23.9	14.1
65-74	31,082	32.6	19.9	13.0	20.1	14.3
75+	27,775	33.4	19.2	13.1	19.6	14.9
Sex						
Female	50,327	31.1	19.7	13.5	21.6	14.2
Male	69,253	30.8	19.0	13.3	22.9	13.9
Race						
American Indian/Alaska Native	1,123	31.3	20.6	13.5	23.8	10.8
Asian	4,850	33.1	20.2	14.8	18.6	13.3
Black/African American	31,580	27.1	19.0	13.4	24.5	16.0
White	80,581	32.4	19.4	13.2	21.7	13.4
Native Hawaiian/ Pacific Islander	1,440	28.1	19.2	14.4	27.2	11.1
Other/Unknown	*	50	17	*	*	33.4
Ethnicity						
Hispanic	17,158	24.0	19.0	14.4	27.0	15.7
Non-Hispanic	102,422	32.1	19.4	13.2	21.6	13.8
Primary Diagnosis						
Diabetes	56,369	31.6	21.4	13.6	19.5	13.8
Hypertension	34,821	28.0	18.6	13.7	23.3	16.4
Glomerulonephritis	9,336	40.0	18.1	12.0	21.6	8.3
Cystic kidney	2,873	57.2	18.1	9.1	9.2	6.5
Other/Unknown	16,181	24.9	14.7	13.2	33.1	14.1

Table 1.7 continued on next page.

vol 2 Table 1.7 Distribution of the reported duration of pre-ESRD nephrology care, by (a) demographic and (b) clinical characteristics, among incident ESRD cases in the U.S. population, 2015 *(continued)*

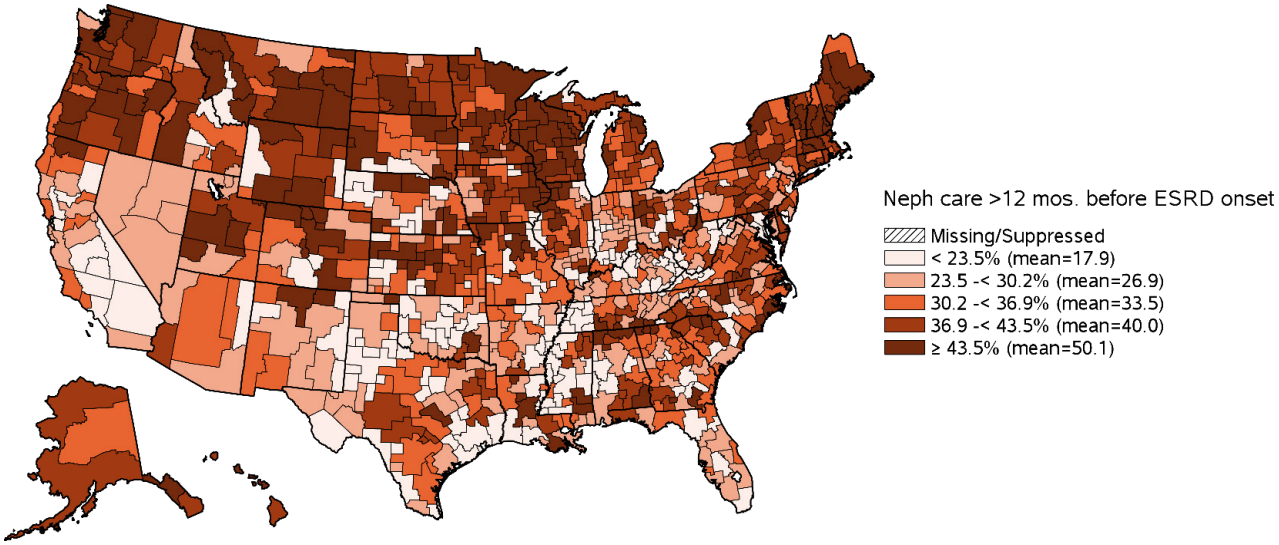
(b) Clinical characteristics (% within row)

		Duration of pre-ESRD nephrology care				
	No. of cases	**>12 mo.**	**6-12 mo.**	**0-6 mo.**	**None**	**Unknown**
Dietary care						
No	110,306	29.1	18.9	12.7	24.2	15.2
Yes	9,274	53.2	24.6	20.9	0.7	0.7
ESA use						
No	103,238	27.4	18.4	12.7	25.4	16.1
Yes	16,342	53.6	24.8	17.3	3.3	0.9
eGFR at RRT start						
<5	16,846	26.2	16.4	11.6	32.1	13.7
5-<10	56,028	33.2	20.1	13.4	20.3	13.0
10-<15	32,624	32.0	20.2	14.0	19.8	14.0
>=15	14,008	25.4	17.7	14.1	24.8	17.9
Vascular Access						
AV fistula	17,897	54.3	24.8	9.8	3.6	7.4
AV graft	3,147	42.5	26.3	13.6	8.5	9.0
CV catheter with maturing fistula/graft	19,078	32.8	21.7	14.4	18.2	12.8
CV catheter only	65,153	19.5	15.7	14.1	32.7	18.1
Other/Unknown	14,305	49.0	24.3	12.8	7.6	6.3

*Data Source: Special analyses, USRDS ESRD Database. Population only includes incident cases with CMS form 2728. *Count ≤10. eGFR calculated using the CKD-EPI equation (CKD-EPI eGFR (ml/min/1.73 m^2) for those aged ≥18 years and the Schwartz equation for those aged <18 years. Abbreviations: AV, arteriovenous; CKD-EPI, chronic kidney disease epidemiology calculation; CV, central venous; eGFR, estimated glomerular filtration rate; ESA, erythropoiesis-stimulating agents; ESRD, end-stage renal disease; RRT, renal replacement therapy.*

The proportion of incident ESRD cases in 2015 with greater than 12 months of pre-ESRD nephrology care varied substantially across 783 HSAs, ranging from a low of 2% to a high of 67% (interquartile range: 25% to 41%; Figure 1.17). Health Service Areas with the highest proportions of patients with more than 12 months of pre-ESRD care were clustered in the Northeast, Upper Midwest, and Northwest, where over 40% of patients were under a nephrologist's care for greater than 12 months prior to ESRD.

vol 2 Figure 1.17 Percentage of incident cases who had received >12 months of pre-ESRD nephrology care, by Health Service Area, 2011-2015

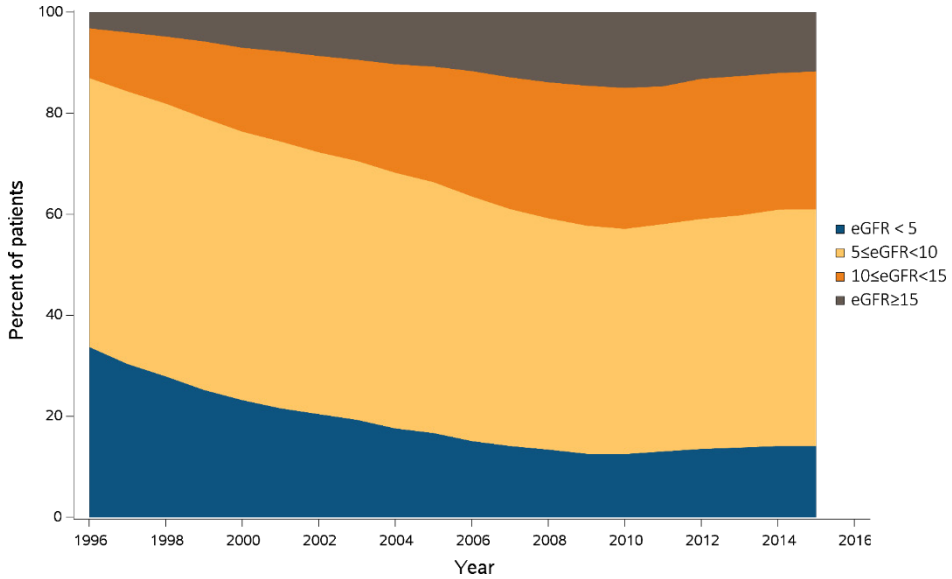


Data Source: Special analyses, USRDS ESRD Database. Population only includes incident cases with CMS form 2728. Values for cells with 10 or fewer patients are suppressed. Abbreviations: ESRD, end-stage renal disease; Neph., nephrology.

eGFR at ESRD onset

Figure 1.18 shows that the percentage of incident ESRD patients who initiated RRT at higher eGFR levels increased steadily from 1996 until 2010. Since 2010, eGFR at the start of dialysis has remained stable or has slightly declined. For example, the percentage of incident ESRD cases starting with eGFR at ≥10 ml/min/1.73 m² rose from 13% in 1996 to 43% in 2010, but decreased to 39% in 2015. The percentage who started therapy at eGFR <5 ml/min/1.73 m² decreased from 34% in 1996 to 13% in 2010, and then to 14% in 2015. This could reflect the influence of a number of publications questioning the advisability of early start dialysis.

vol 2 Figure 1.18 Trends in the distribution of eGFR (ml/min/1.73 m²) among incident ESRD patients, 1996-2015



Data Source: Special analyses, USRDS ESRD Database. Population only includes incident cases with CMS form 2728. eGFR calculated using the CKD-EPI equation (CKD-EPI eGFR (ml/min/1.73 m²) for those aged ≥18 and the Schwartz equation for those aged <18. Abbreviations: CKD-EPI; chronic kidney disease epidemiology calculation; eGFR, estimated glomerular filtration rate; ESRD, end-stage renal disease.

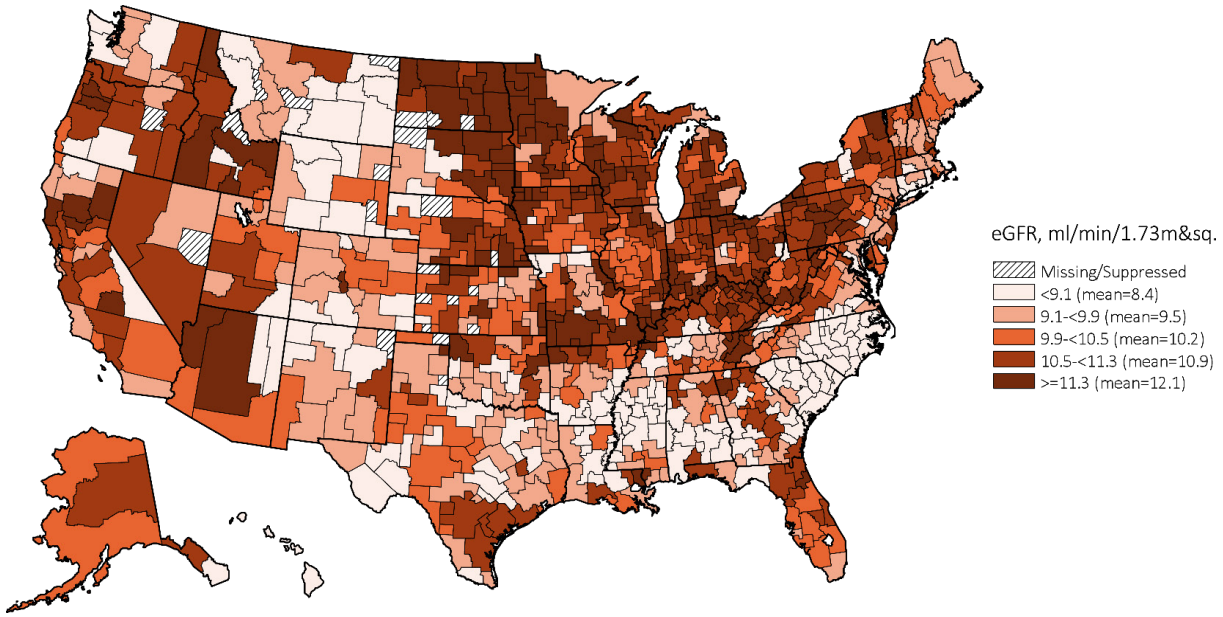
Mean eGFR at ESRD start was higher among young patients (0-21 years), males, Whites, non-Hispanics, and those with DM as their primary cause of ESRD (Table 1.8). Mean eGFR at ESRD start in 2013 varied substantially by HSA (Figure 1.19). For example, HSAs with higher average eGFRs at initiation of ESRD clustered in the North and Midwest regions, while those with lower averages clustered in the South.

vol 2 Table 1.8 Distributions of laboratory values (mean) and treatment characteristics (%), by age, sex, race, ethnicity, and primary cause of ESRD, among incident ESRD cases, 2015

		Nutrition		Anemia		Lipids		Diabetes
	eGFR (mL/min/1.73 m^2)	Serum albumin (g/dL)	Dietary care (%)	Hemoglobin (g/dL)	ESA use (%)	Total cholesterol (mg/dL)	LDL (mg/dL)	Hgb (%)
Age								
0-21	13.8	3.4	38.4	9.6	26.2	184.0	109.0	5.0
22-44	9.5	3.2	7.3	9.2	10.0	171.3	102.2	7.0
45-64	10.0	3.2	7.4	9.4	11.2	159.8	94.1	6.8
65-74	10.2	3.2	7.7	9.4	13.8	150.7	84.7	6.6
75+	10.4	3.2	6.6	9.5	15.4	141.2	77.3	6.4
Sex			0.0		0.0			
Male	10.4	3.2	7.8	9.5	11.7	149.3	86.3	6.7
Female	9.7	3.1	7.4	9.2	14.5	165.3	94.3	6.7
Race			0.0		0.0			
White	8.8	3.3	11.6	9.3	19.0	160.8	90.2	6.6
Black/African American	9.2	2.9	8.0	9.2	14.0	147.3	82.0	6.7
American Indian/Alaska Native	10.4	3.2	7.7	9.5	13.0	152.7	86.9	6.7
Asian	9.8	3.2	6.6	9.1	11.8	161.4	95.8	6.6
Native Hawaiian/Pacific Islander	8.3	3.2	9.9	9.3	16.0	155.6	87.6	6.8
Ethnicity			0.0		0.0			
Yes	9.6	3.1	7.5	9.2	11.3	156.1	88.5	6.8
No	10.2	3.2	7.6	9.4	13.3	155.4	89.6	6.7
Primary Cause of ESRD			0.0		0.0			
Diabetes	10.3	3.1	7.2	9.3	14.3	153.0	87.8	7.0
Hypertension	9.7	3.3	6.0	9.4	11.5	154.6	89.4	6.1
Glomerulonephritis	9.2	3.3	11.5	9.4	17.0	174.8	100.8	5.8
Cystic kidney	9.5	3.8	15.2	10.2	15.8	164.6	94.9	5.5
Total	10.1	3.2	7.6	9.4	12.9	155.5	89.5	6.7

Data Source: Special analyses, USRDS ESRD Database. Abbreviations: eGFR, estimated glomerular filtration rate; ESA, erythropoiesis-stimulating agents; ESRD, end-stage renal disease; Hgb, glycosylated hemoglobin; LDL, low-density lipoprotein.

vol 2 Figure 1.19 Map of mean eGFR at initiation of renal replacement therapy, by Health Service Area, 2011-2015

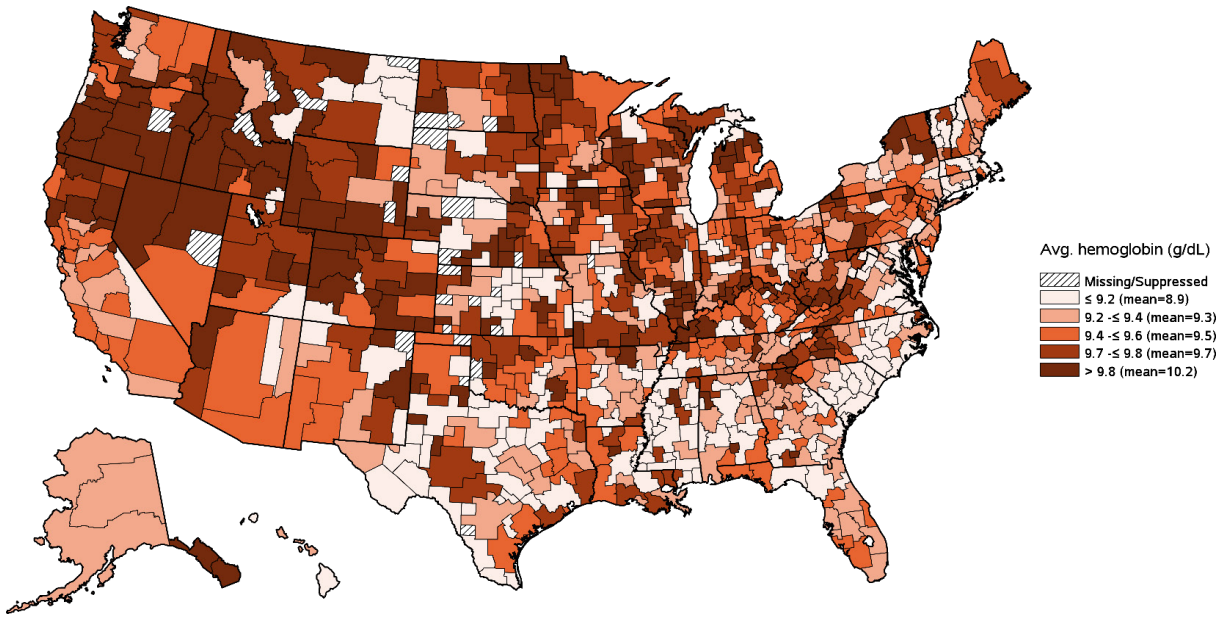


Data Source: Special analyses, USRDS ESRD Database. Population only includes incident cases with CMS form 2728. eGFR calculated using the CKD-EPI equation (CKD-EPI eGFR (ml/min/1.73 m^2) for those aged ≥18 and the Schwartz equation for those aged <18. Values for cells with 10 or fewer patients are suppressed. Abbreviations: eGFR, estimated glomerular filtration rate; CKD-EPI, chronic kidney disease epidemiology calculation.

Anemia at ESRD onset

In 2015, the overall average hemoglobin (Hgb) level at ESRD onset was 9.4 g/dL. Incident ESRD patients with cystic kidney disease listed as the primary cause had higher mean Hgb levels at ESRD onset than did other groups (Table 1.9). Figure 1.20 shows the distribution of average Hgb levels by HSA across the U.S. Large HSAs with higher average Hgb levels were present in the western half of the U.S., especially in the Rocky Mountain region. Smaller areas of higher Hgb were evenly distributed throughout the rest of the country.

vol 2 Figure 1.20 Map of average hemoglobin level at initiation of renal replacement therapy, by Health Service Area, 2011-2015



Data Source: Special analyses, USRDS ESRD Database. Population only includes incident cases with CMS form 2728. Values for cells with 10 or fewer patients are suppressed. Abbreviation: ESRD, end-stage renal disease.

Variation in Treatment Characteristics by ESRD Network

Geographic variation in pre-ESRD care was also evident by ESRD Network. Most pronounced was an over 2-fold variation in the percentage of incident ESRD patients with pre-ESRD nephrology care of greater than 12 months. This ranged from 47% in Network 1 (CT, MA, ME, NH, RI, and VT) to 21% in Network 18 (Southern CA). Mean eGFR at ESRD start ranged from 8.9 ml/min/1.73m² in Network 6 (NC, SC, and GA) to 10.7 ml/min/1.73m² in Network 11 (MI, MN, ND, SD, and WI). Mean Hgb at dialysis start ranged from 9.1 to 10.5 g/dL across the 18 Networks (Table 1.9). At the ESRD Network level, regional variation in eGFR at initiation did not seem to be associated with regional variation in length of pre-ESRD nephrology care (Table 1.9).

vol 2 Table 1.9 Distribution of duration of pre-ESRD nephrology care, hemoglobin level, and eGFR, by ESRD Network, among incident ESRD cases, 2015

Network	States in network*	Duration of pre-ESRD nephrology care (% in row)					Mean eGFR (ml/min/1.73 m²)	Mean Hgb (g/dL)
		>12 months	6-12 months	0-6 months	None	Unknown		
18	Southern CA	21.1	17.5	17.5	22.3	21.5	10.3	9.5
14	TX	24.3	18.8	14.0	28.7	14.2	9.6	9.3
10	IL	25.7	17.9	15.5	19.0	22.0	10.2	9.3
7	FL	27.0	19.2	12.1	24.3	17.5	10.1	9.3
5	MD, DC, VA, WV	28.4	20.4	14.0	20.6	16.7	9.5	9.3
3	NJ, PR, VI	28.6	19.4	11.7	31.9	8.4	9.6	9.5
13	AR, LA, OK	28.8	19.3	10.8	25.8	15.2	9.3	9.5
8	AL, MS, TN	29.7	18.9	12.2	26.0	13.2	9.1	9.2
9	IN, KY, OH	30.1	21.7	12.3	17.9	18.1	10.7	9.4
17	Northern CA, HI, GU, AS, MP	31.9	22.6	14.8	19.4	11.3	9.8	9.4
15	AZ, CO, NV, NM, UT, WY	32.5	19.2	16.1	20.9	11.3	10.3	9.7
2	NY	32.7	17.5	11.4	22.2	16.2	9.3	9.2
6	NC, SC, GA	34.0	19.7	13.6	21.2	11.5	8.9	9.3
12	IA, KS, MO, NE	34.1	20.8	12.8	23.8	8.5	10.5	9.4
4	DE, PA	36.9	18.2	13.1	20.3	11.5	9.9	9.4
11	MI, MN, ND, SD, WI	40.6	17.8	12.5	20.0	9.1	10.5	9.5
16	AK, ID, MT, OR, WA	43.7	19.7	13.9	18.3	4.4	9.9	9.6
1	CT, MA, ME, NH, RI, VT	47.4	20.7	9.5	14.4	8.1	9.2	9.3
All networks		31.0	19.3	13.4	22.4	14.0	9.8	9.4

*Data Source: Special analyses, USRDS ESRD Database. Population only includes incident cases with CMS form 2728. eGFR calculated using the CKD-EPI equation (CKD-EPI eGFR (ml/min/1.73 m2) for those aged ≥18 years and the Schwartz equation for those aged <18 years. Listed from lowest to highest by >12 months duration of pre-ESRD nephrology care. * Includes 50 states, Washington, D.C. (DC), Puerto Rico (PR), Guam (GU), American Samoa (AS), U.S. Virgin Islands, and Northern Mariana Islands. Northern and Southern California (CA) split into Networks 17 and 18. Abbreviations: ESRD, end-stage renal disease; eGFR, estimated glomerular filtration rate; CKD-EPI, chronic kidney disease epidemiology calculation; Hgb, hemoglobin.*

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