Chapter 4: Hospitalization

- On average, end-stage renal disease (ESRD) patients are admitted to the hospital nearly twice a year. About 35% of ESRD patients who are discharged alive have a rehospitalization within the 30 days following discharge.
- Hospitalization represents a significant societal and financial burden, accounting for approximately 33% of total Medicare expenditures for dialysis patients.
- Over the past decade, the frequency of hospital admissions and resulting number of hospital days for ESRD patients have declined gradually and consistently. In 2015, the adjusted rates of admission for hemodialysis (HD) patients and for peritoneal dialysis (PD) patients decreased to 1.7 per patient year (PPY) as compared to 2.1 in 2006, a reduction of 19.0%. During that same period, admission rates for transplant patients reduced by 20.0%, to 0.8 days in 2015 from 1.0 in 2006 (Figure 4.1).
- During this same decade, HD patient hospitalizations due to cardiovascular events and for vascular access infections fell by 23.3% and 8.3% (Figure 4.2.b).
- During 2014-2015, some patient groups exhibited a higher risk of hospitalization when data was adjusted for age, sex, race, ethnicity, primary cause of kidney failure, and vintage, both overall and for most cause-specific diagnoses (Table 4.1).
- In general mortality rates increased with age. However, there was inconsistent variation in hospitalization rates by age, with relatively higher rates for the youngest and oldest age groups. The relatively high hospitalization rates for young patients were not due to kidney transplantation, which was excluded from these analyses.
- Hospitalization rates were 17.5% higher for females than for males, whereas males had higher mortality rates.
- Non-Hispanic White patients and Non-Hispanic Black/African American patients were hospitalized more often than those of other races.
- Persons with diabetes were 11.8% more likely to be hospitalized than the overall patient average.
- Patients with chronic kidney disease (CKD) and ESRD experienced rehospitalization rates of 21.4% and 35.2%, as compared to only 15.4% for older Medicare beneficiaries without a diagnosis of kidney disease (Figure 4.7).
- Among HD patients prevalent in 2015, 37.1% of discharges from a hospitalization for any cause were followed by a rehospitalization within 30 days (Figure 4.8.a).

Introduction

Admissions and readmissions to the hospital represent major burdens for patients with ESRD. On average, patients with ESRD are admitted to the hospital nearly twice a year, and about 35% have a rehospitalization within the 30 days following discharge. Given the disruption of everyday life stemming from dialysis treatment, hospital admissions and readmissions additionally compromise patients' well-being and quality of life, and are associated with adverse clinical outcomes. Furthermore, inpatient treatment represents a significant societal and financial burden, accounting for approximately 33% of total Medicare expenditures for patients with ESRD (see Volume 2, Chapter 9, *Health Care Expenditures for Persons with ESRD*).

Clinical studies conducted in a broad range of settings have demonstrated that both improved health care and care coordination may reduce rates of unplanned or non-elective hospitalization and rehospitalization; some studies have suggested that a sizable portion of such readmissions may be preventable (Coleman et al. 2006; MedPAC 2007;

Rich et al. 1995; Stewart et al. 1999). Hence, monitoring trends in hospitalization and rehospitalization is a key to ensuring that quality of care is maintained, potential problems are identified, and cost-effective health care is provided. Informed care providers can respond with targeted strategies to prevent or minimize inappropriate admissions and reduce the incidence of rehospitalization.

Methods

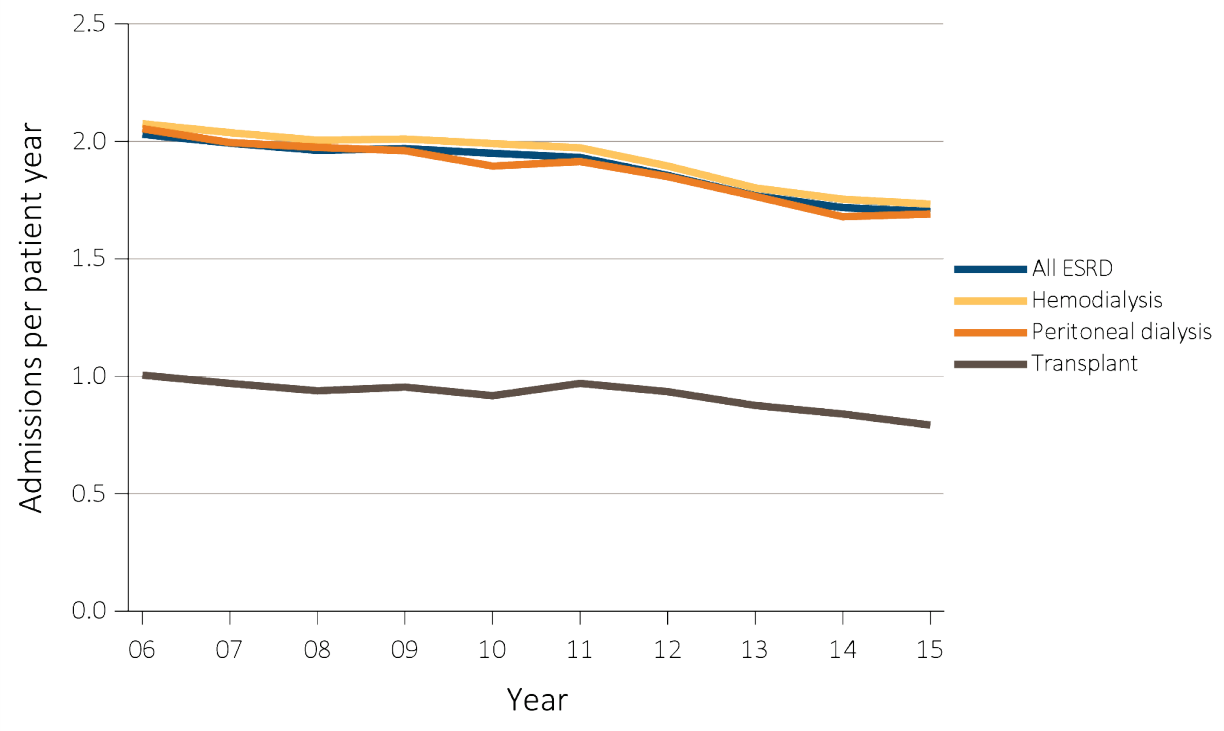
The findings presented in this chapter were drawn from data sources from the Centers for Medicare & Medicaid Services (CMS). Details of these are described in the *Data Sources* section of the *ESRD Analytical Methods* chapter.

See 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.

Trends in Hospitalization Rates

Over the past decade, the frequency of hospital admissions and resulting number of hospital days for ESRD patients have declined gradually, but fairly consistently. As shown in Figure 4.1, in 2015 the adjusted rates of admission for HD and PD patients decreased to 1.7 PPY as compared to 2.1 in 2006, a reduction of 19.0%. During that same period, admission rates for transplant patients reduced by 20.0%, to 0.8 PPY in 2015 from 1.0 in 2006.

vol 2 Figure 4.1 Adjusted hospitalization rates for ESRD patients, by treatment modality, 2006-2015



Data Source: Reference Tables G.1, G.3, G.4, G.5, G.6, G.8, G.9, G.10, and special analyses, USRDS ESRD Database. Period prevalent ESRD patients; adjusted for age, sex, race, primary cause of kidney failure, & their two-way interactions; standard population: ESRD patients, 2011. Abbreviation: ESRD, end-stage renal disease.

The USRDS Annual Data Report (ADR) regularly highlights cause-specific hospitalization as an important morbidity surveillance issue, with a focus on hospitalizations resulting from infections and cardiovascular conditions. Hospitalizations for these causes have also declined over the 2006-2015 period (see Figure 4.2). The decline in hospitalizations due to infection was more pronounced among patients receiving PD (14.8%), as compared to HD (8.1%) and transplant patients (8.2%; see Figure 4.2). These improvements likely reflect, at least in part, targeted interventions to prevent and reduce infection rates, especially among PD patients.

vol 2 Figure 4.2 Adjusted all-cause & cause-specific hospitalization rates for ESRD patients, by treatment modality, 2006-2015

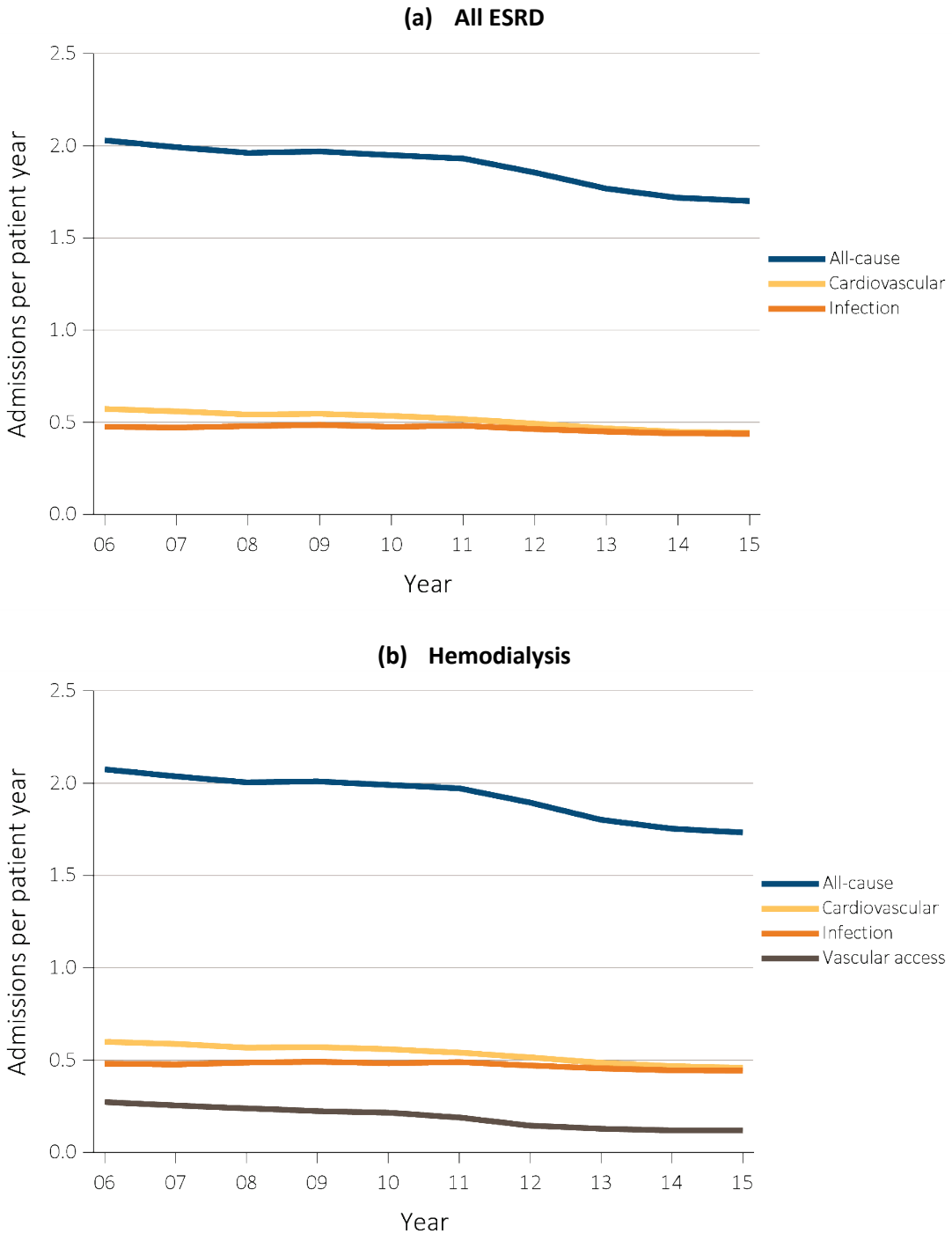
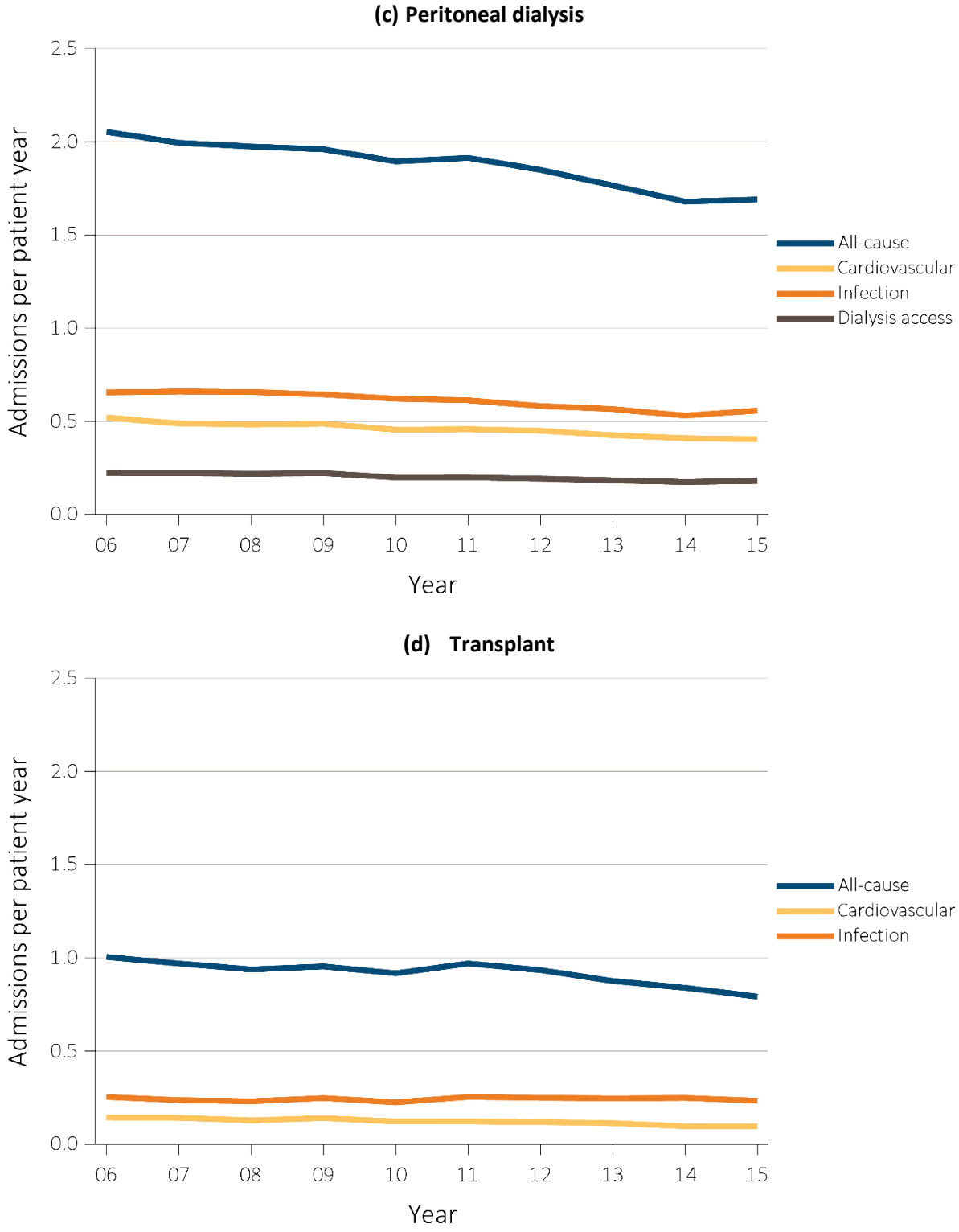


Figure 4.2 continued on next page.

vol 2 Figure 4.2 Adjusted all-cause & cause-specific hospitalization rates for ESRD patients, by treatment modality, 2006-2015 *(continued)*



Data Source: Reference Tables G.1, G.3, G.4, G.5, and special analyses, USRDS ESRD Database. Period prevalent ESRD patients; adjusted for age, sex, race, primary cause of kidney failure, & their two-way interactions; standard population: ESRD patients, 2011. Abbreviation: ESRD, end-stage renal disease.

All-cause hospitalization rates among adult HD patients decreased by 14.9% from 2006 to 2015 (see Table 4.1). Hospitalizations due to cardiovascular events and those for vascular access infection fell by 22.0% and 53.7%. Patient groups with a higher risk of overall hospitalization included those aged 22–44 years or 75 years and older, females, and those of White or Black/African American race. Patients who had diabetes as their primary cause of kidney failure had a higher risk of hospitalization both overall, and for most cause-specific diagnoses.

While the overall trends of decreasing hospitalization rates are encouraging, it is plausible that these all-cause and cause-specific declines were influenced at least in part by changes in clinical care practices and policies that emphasize greater utilization of ambulatory care services.

vol 2 Table 4.1 Adjusted rates of all-cause & cause-specific hospitalization per patient year for adult hemodialysis patients, 2006-2015

	All	Cardiovascular	Any infection	Vascular access infection
2006-2007	2.04	0.59	0.48	0.25
2008-2009	2.01	0.57	0.49	0.22
2010-2011	1.97	0.54	0.49	0.19
2012-2013	1.80	0.49	0.45	0.13
2014-2015	1.73	0.46	0.44	0.12
2014-2015, by patient characteristics				
Age				
22-44	1.93	0.44	0.45	0.15
45-64	1.69	0.44	0.42	0.12
65-74	1.74	0.48	0.45	0.11
75+	1.79	0.49	0.49	0.11
Sex				
Male	1.58	0.43	0.41	0.10
Female	1.92	0.50	0.48	0.14
Race				
White	1.76	0.45	0.47	0.11
Black/African American	1.76	0.48	0.41	0.14
American Indian or Alaska Native	1.54	0.33	0.49	0.09
Asian	1.22	0.34	0.33	0.10
Native Hawaiian or Pacific Islander	1.19	0.34	0.34	0.08
Other or Multiracial	1.60	0.44	0.46	0.10
Ethnicity				
Hispanic	1.57	0.42	0.41	0.11
Non-Hispanic	1.76	0.47	0.45	0.12
Non-Hispanic White	1.86	0.48	0.50	0.11
Non-Hispanic Black/African American	1.74	0.48	0.41	0.13
Cause of Renal Failure				
Diabetes	1.96	0.50	0.50	0.13
Hypertension	1.60	0.46	0.38	0.11
Glomerulonephritis	1.47	0.39	0.38	0.11
Other cause	1.70	0.40	0.47	0.12
Vintage				
<1 year	1.79	0.47	0.49	0.13
1-<2 years	1.70	0.45	0.43	0.10
2-<5 years	1.71	0.47	0.42	0.10
5+ years	1.75	0.45	0.45	0.14

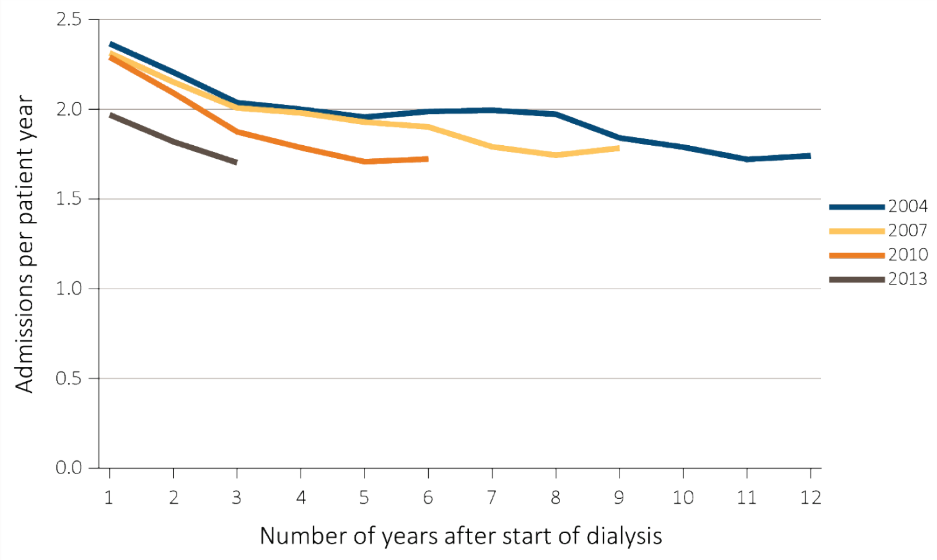
Data Source: Reference Tables G.3, G.13, and special analyses, USRDS ESRD Database. Period prevalent hemodialysis patients aged 22 & older; adjusted for age, sex, race, ethnicity, primary cause of kidney failure, & their two-way interactions. Rates by one factor adjusted for the remaining three; standard population, hemodialysis patients, 2011. See Vol. 2, ESRD Analytical Methods for principal ICD-9-CM diagnosis codes included in each cause of hospitalization category.

For patients starting HD, hospitalization rates were highest in their first year but fell considerably through the first three years of HD, before stabilizing (Figure 4.3.a). More recent cohorts of incident HD patients consistently experienced lower hospitalization rates throughout their time on HD than did previous cohorts. Incident HD patients in 2013 had a relatively low hospitalization rate of 1.7 PPY during their first year of treatment, compared to the previous cohorts, who experienced hospitalization rates near 2.3 PPY in the first year of HD (Figure 4.3.a).

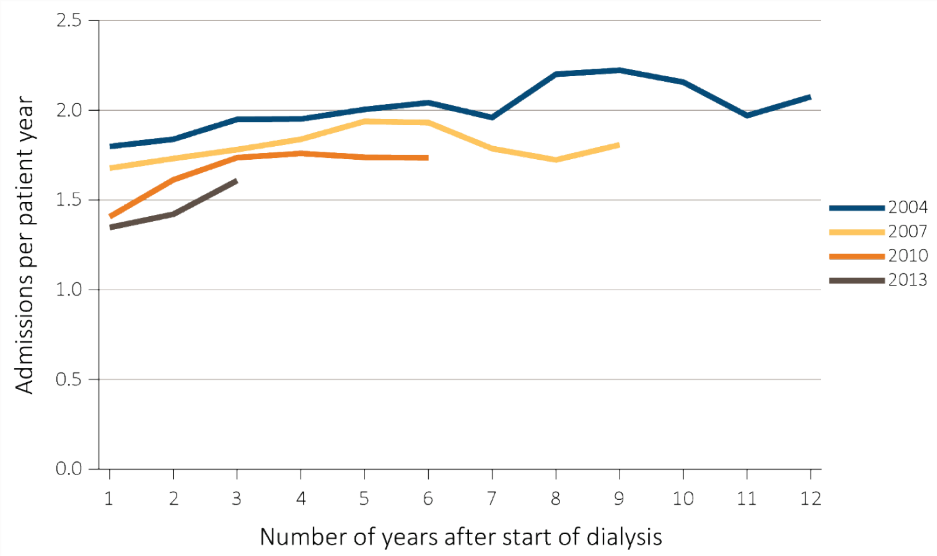
While patients on HD experienced falling hospitalization rates as they accumulated time on dialysis, PD patients saw rising hospitalization rates. However, recent cohorts of incident PD patients still had fewer hospitalizations overall than did the older cohorts. Incident PD patients in 2013 had 1.4 hospitalizations PPY, rising to 1.6 PPY by the third year of PD (Figure 4.3.b).

vol 2 Figure 4.3 Adjusted all-cause hospitalization rates by treatment modality and number of years after start of dialysis, for cohorts of incident patients in 2004, 2007, 2010, and 2013

(a) Hemodialysis patients



(b) Peritoneal dialysis patients

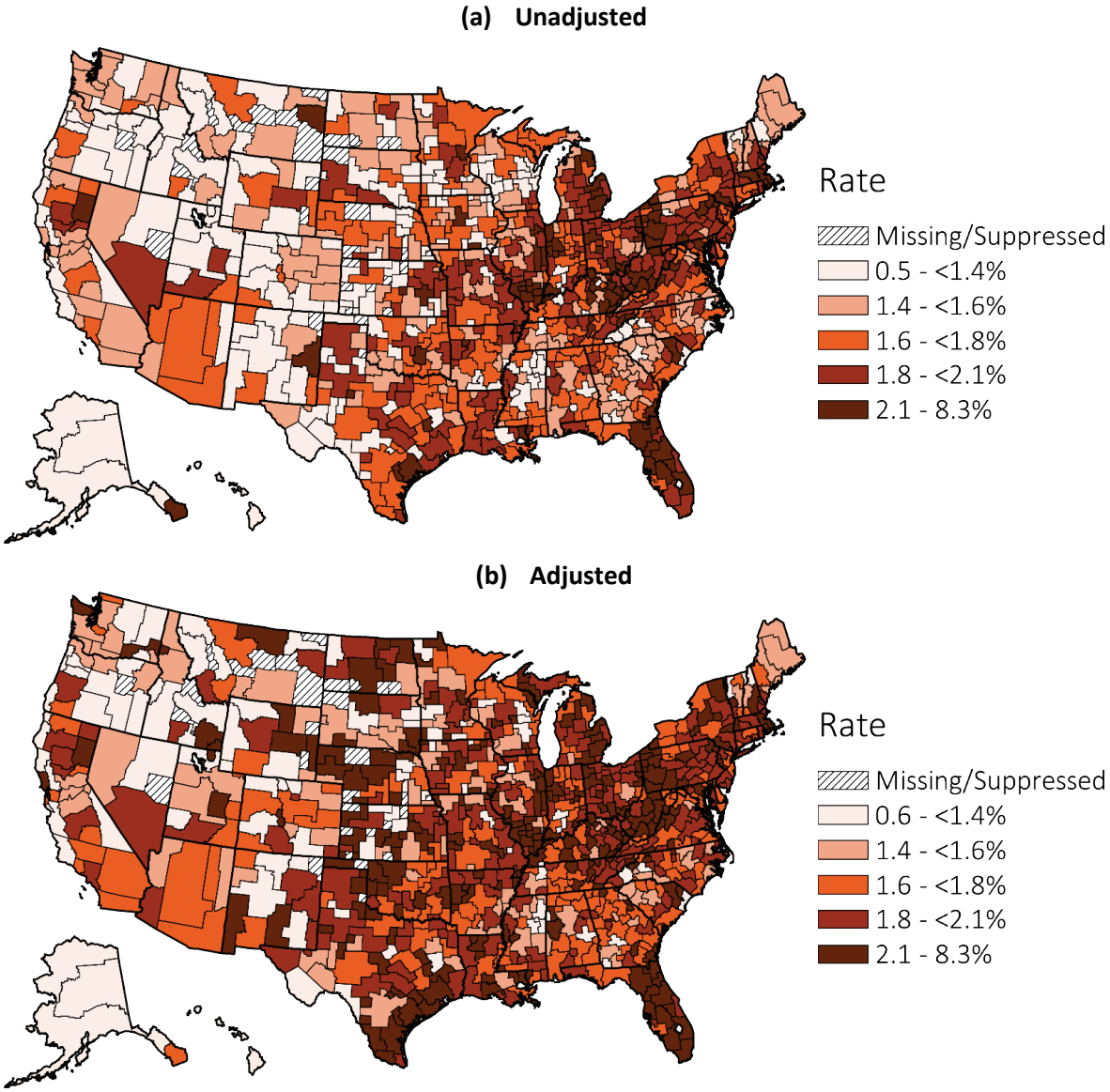


Data Source: Special analyses, USRDS ESRD Database. Period prevalent ESRD patients, adjusted for age, sex, race, ethnicity, primary cause of kidney failure; standard population: ESRD patients, 2011.

The 2014-2015 unadjusted hospitalization rates of patients with ESRD varied considerably across 805 U.S. Health Service Areas (HSAs), from a low of 0.49 PPY in Brookings and Kingsbury counties in South Dakota to a high of 3.20 PPY in McPherson county in Kansas (interquartile range: 0.44 PPY; Figure 4.4.a). The rates were generally highest in a wide band stretching from the Midwest through the Northeast.

It is also important to present these by-HAS rates adjusted for demographic characteristics. This allows for comparisons across HSAs without the effects of the demographic composition of different regions. After adjusting for age, sex, race, ethnicity, primary cause of kidney failure, and vintage, the adjusted hospitalization rates of patients with ESRD in 2014-2015 were more consistent across the HSAs, from a low of 0.56 PPY near Juneau and Sitka in Alaska to a high of 8.25 PPY in Harrison and Robertson counties in Kentucky (interquartile range: 0.54 PPY; Figure 4.4.b). While many differences in the unadjusted rates were attenuated after adjustment, the Rocky Mountain states continued to have generally lower hospitalization rates.

vol 2 Figure 4.4 Map of the hospitalization rates of ESRD, by Health Service Area, in the U.S. population, 2014-2015

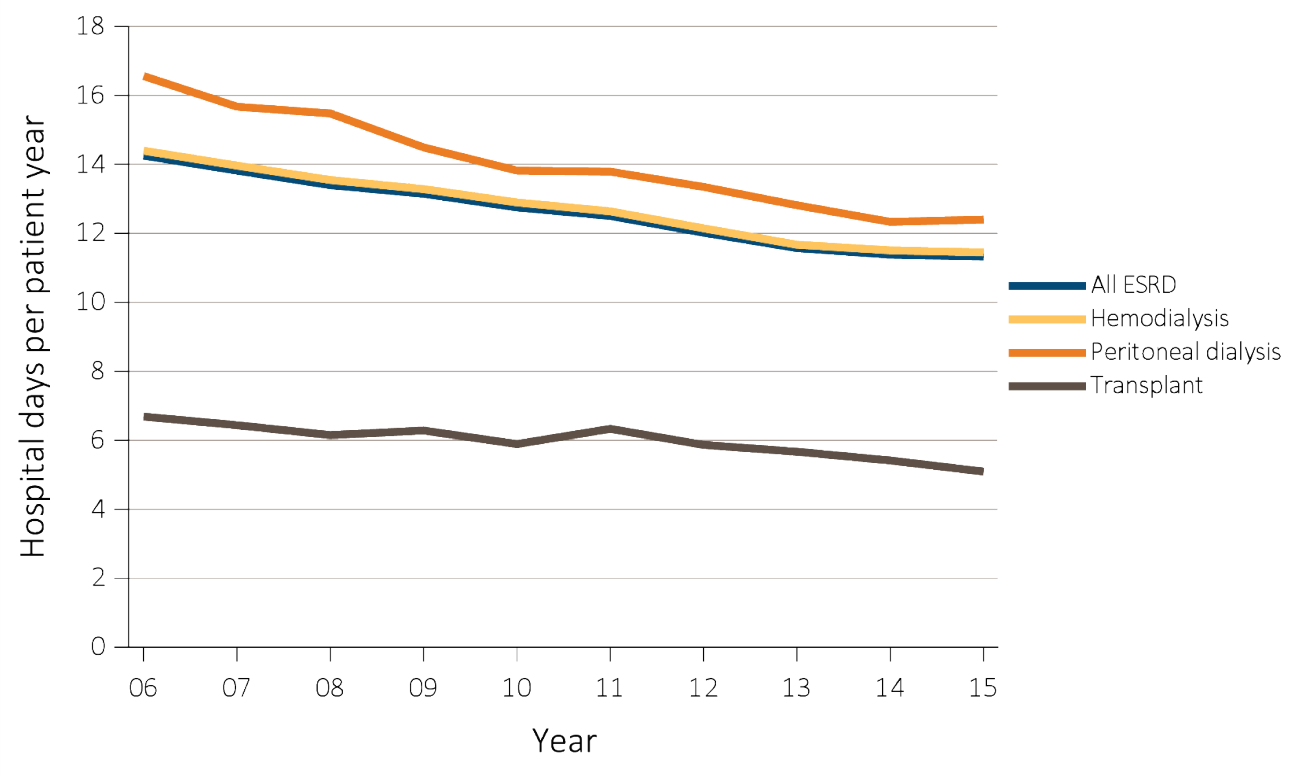


Data Source: Reference Tables G.1, G.3, G.4, G.5, and special analyses, USRDS ESRD Database. Period prevalent ESRD patients; adjusted for age, sex, race, & primary cause of kidney failure; standard population: ESRD patients, 2011. Values for HSAs with 10 or fewer patients are suppressed. Abbreviation: ESRD, end-stage renal disease.

Hospital Days

Continuing a downward trend observed since 2006, the number of total hospital days among all patients with ESRD has decreased from 14.3 PPY to 11.3 PPY (Figure 4.5). From 2006 to 2015, hospital days PPY decreased to 11.4 for HD patients, 12.4 for PD patients, and to 5.1 days for those with a functioning kidney transplant.

vol 2 Figure 4.5 Adjusted hospital days for ESRD patients, by treatment modality, 2006-2015



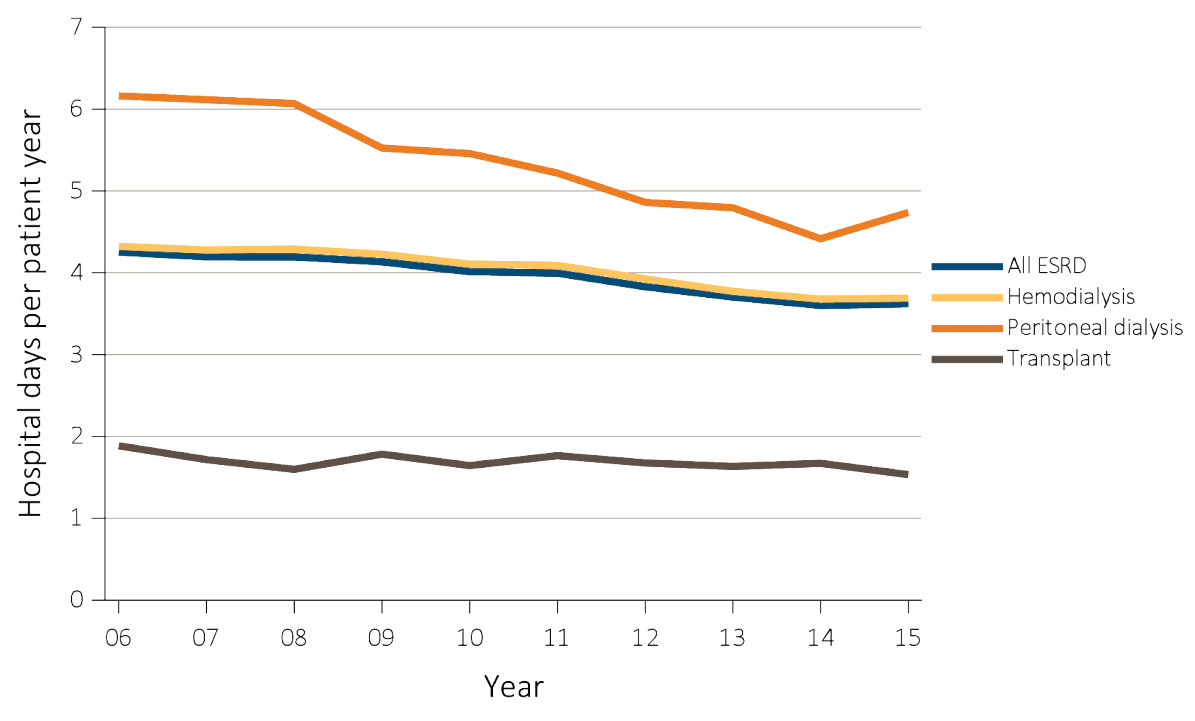
Data Source: Reference Tables G.1, G.3, G.4, G.5, G.6, G.8, G.9, G.10, and special analyses, USRDS ESRD Database. Period prevalent ESRD patients; adjusted for age, sex, race, primary cause of kidney failure, & their two-way interactions. standard population: ESRD patients, 2011. Abbreviation: ESRD, end-stage renal disease.

With adjustment for differences in patient characteristics, from 2006-2015 the number of infection-related hospital days decreased by 14.6% for HD patients, 23.1% for those on PD, and by 18.7% for patients with a kidney transplant (Figure 4.6). The number of inpatient days for cardiovascular hospitalization fell by 27.1% for all patients with ESRD, and by 38.2% for those with a transplant.

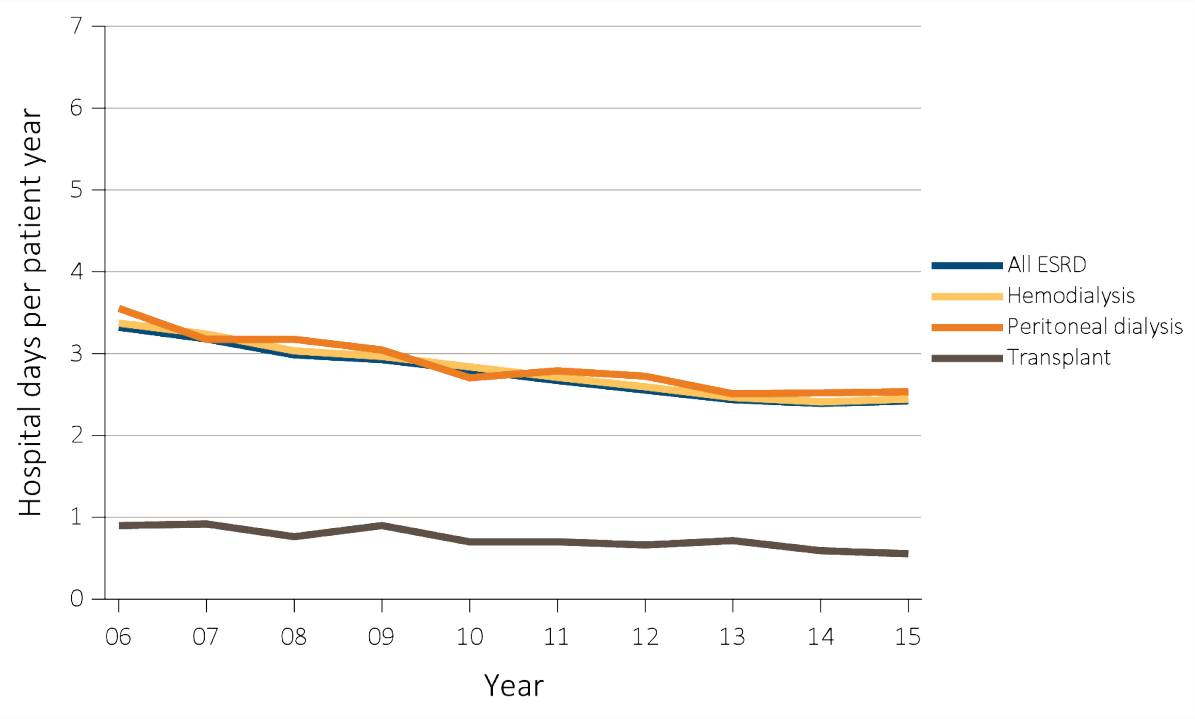
Even after adjustment, the number of hospital days due to infections and cardiovascular events for patients on dialysis were more than twice that of those with a transplant. For HD and PD patients in 2015, infection-related hospital days were 3.7 and 4.7 PPY, compared to 1.5 PPY for transplant recipients. Hospital days for cardiovascular admissions were approximately four times more frequent for patients on dialysis than for those with a transplant—2.4 and 2.5 PPY for HD and PD patients, as compared to 0.6 PPY for transplant recipients.

vol 2 Figure 4.6 Adjusted hospital days for infection & cardiovascular causes, for ESRD patients by their treatment modality, 2006-2015

(a) Infection



(b) Cardiovascular



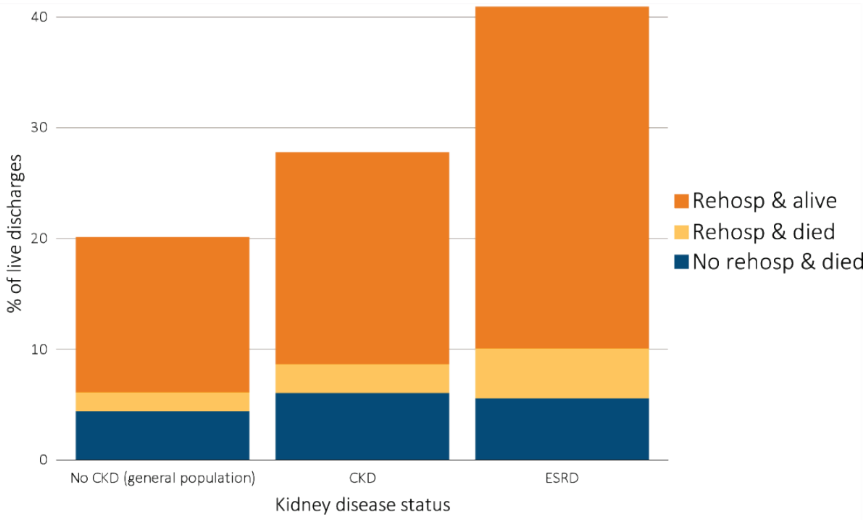
Data Source: Special analyses, USRDS ESRD Database. Period prevalent hemodialysis patients, all ages, 2015; adjusted for age, sex, race, primary cause of kidney failure, & their two-way interactions. Includes live hospital discharges from January 1 to December 1, 2015. Cause-specific hospitalizations are defined by principal ICD-9-CM codes. See Vol. 2, ESRD Analytical Methods for principal ICD-9-CM diagnosis codes included in each cause of hospitalization category. Abbreviation: ESRD, end-stage renal disease.

Rehospitalization

Readmissions following a hospital discharge are an important predictor of subsequent adverse clinical events, both in the general and ESRD populations. Among dialysis patients, rehospitalizations are associated with increased morbidity and mortality and reduced quality of life. Recurrent hospitalizations also pose a significant societal and financial burden, particularly for ESRD patients.

In this chapter, rehospitalization/readmission is defined as a hospital admission occurring within 30 days of a hospital discharge, excluding emergency room visits and those intended for rehabilitation purposes. Hospital readmissions with associated death were more common among patients with CKD or ESRD than in the general population. Patients with CKD and ESRD experienced rehospitalization rates of 21.4% and 35.2%, as compared to only 15.4% of older Medicare beneficiaries without a diagnosis of kidney disease (Figure 4.7). This held true for the combined outcomes of post-discharge death and/or rehospitalization—experienced by 27.6% of CKD patients and 41.0% of those with ESRD, versus only 20.0% of patients without diagnosed kidney disease.

vol 2 Figure 4.7 Proportion of patients aged 66 & older discharged alive from the hospital who were either rehospitalized or died within 30 days of discharge, by kidney disease status, 2015



Data Source: Special analyses, USRDS ESRD Database and Medicare 5% sample. January 1, 2015 point prevalent Medicare patients aged 66 & older on December 31, 2013. For general Medicare: January 1, 2015 point prevalent, Medicare patients aged 66 & older, discharged alive from an all-cause index hospitalization between January 1, 2015, and December 1, 2014, unadjusted. CKD determined using claims for 2014. Abbreviations: CKD, chronic kidney disease; ESRD, end-stage renal disease; rehosp, rehospitalization.

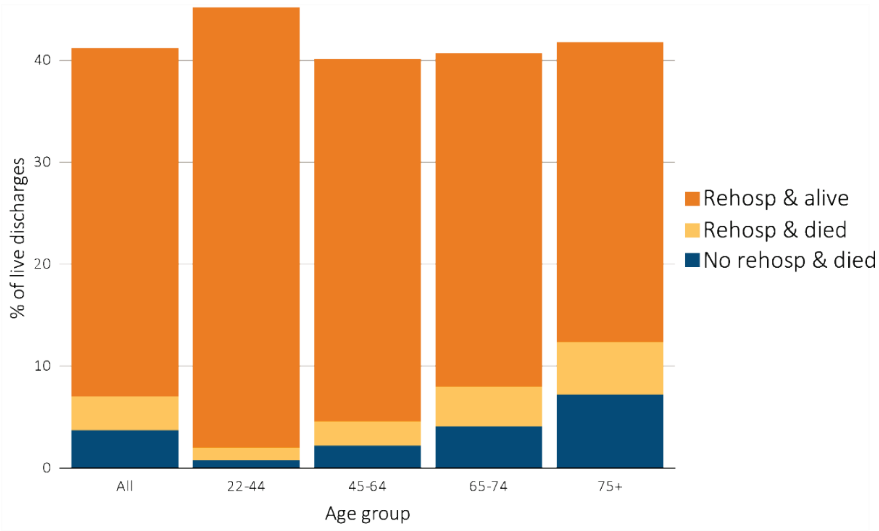
Among HD patients prevalent in 2015, 37.2% of discharges from a hospitalization for any cause were followed by a rehospitalization within 30 days (see Figure 4.8.a). For older patients, rehospitalization rates decreased as their mortality rates increased, illustrating these competing risks, as death precluded the outcome of readmission. Rates of post-discharge death without rehospitalization, for example, were highest in patients aged 75 years and older, at 7.4%, while these patients had the lowest rehospitalization rates, at 34.2%.

The highest rates of rehospitalization with survival occurred for adults aged 22 to 44 years—43.0% of their discharges were followed by a readmission within 30 days. For the two combined outcomes of rehospitalization followed by either survival or death, the highest rates were again seen among patients aged 20–44 years, at 44.2%. The rate of survival following rehospitalization exceeded the two combined death outcomes for all age groups (33.8% vs. 7.2%), even in patients aged 75 and older, at 29.1% and 12.5%. These data illustrate that the observed, elevated rehospitalization rates among younger versus older cohorts were not fully due to the competing risk of mortality in the aged.

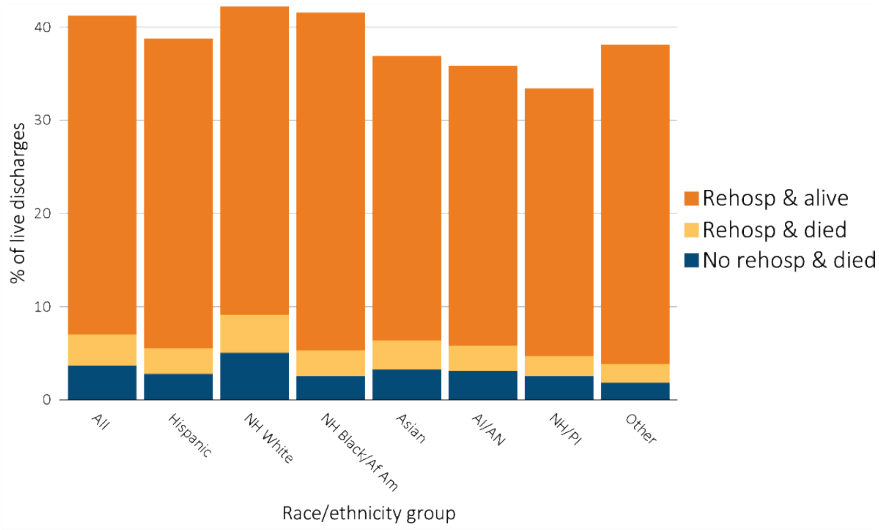
We examined the proportion of HD patients discharged alive who were either rehospitalized or died within 30 days of discharge, by their race and ethnicity (Figure 4.8.b). The highest rates were observed among Blacks—35.8% were rehospitalized and lived while 38.6% were rehospitalized with the combined outcomes of either survival or death. They were followed by the Other or Multiracial group (33.8% vs. 35.9%). The lowest such rates occurred among Native Hawaiians and Pacific Islanders, of whom 28.3% were rehospitalized and lived, and 30.5% were rehospitalized with the combined outcomes of either survival or death. The highest rate of post-discharge death occurred among Non-Hispanic White HD patients at 4.1%, possibly influenced by the older average age among this group.

vol 2 Figure 4.8 Proportion of hemodialysis patients discharged alive from the hospital who either were rehospitalized or died within 30 days of discharge, by demographic characteristics, 2015

(a) By age



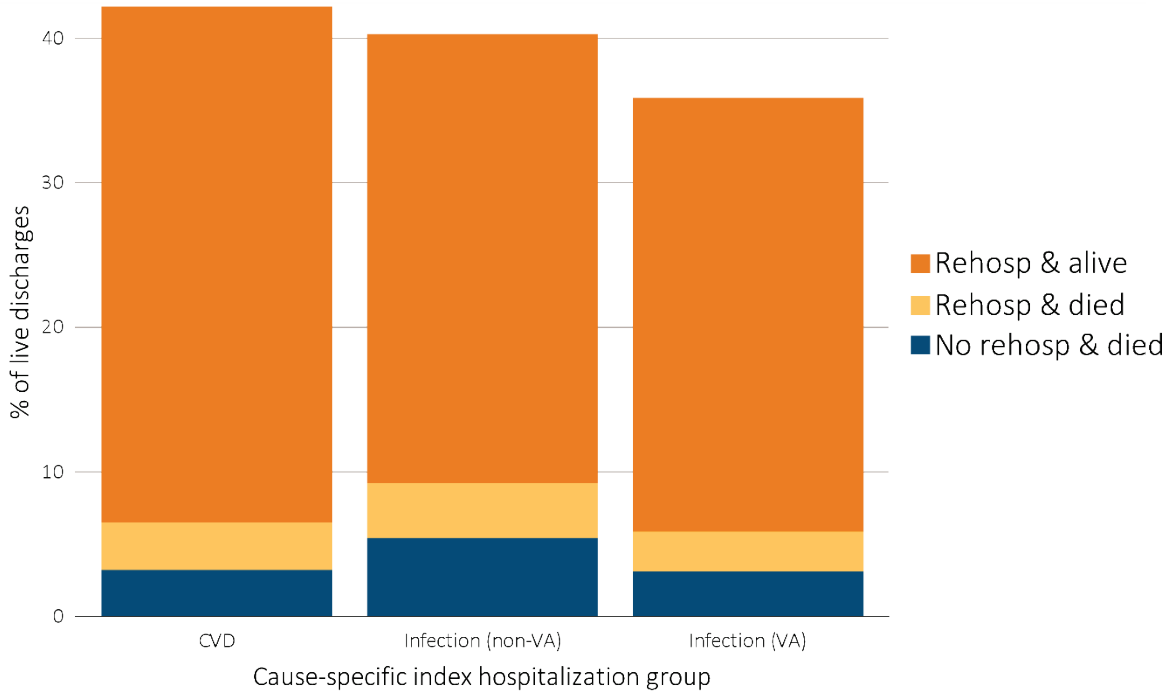
(b) By race/ethnicity



Data Source: Special analyses, USRDS ESRD Database. Period prevalent hemodialysis patients, all ages, 2015, unadjusted. Patients less than age 22 are not represented as a group due to insufficient sample size. Includes live hospital discharges from January 1 to December 1, 2015. Cause-specific hospitalizations are defined by principal ICD-9-CM codes. See Vol. 2, ESRD Analytical Methods for principal ICD-9-CM diagnosis codes included in each cause of hospitalization category. Af Am, African American; AI, American Indian; AN, Alaska Native; NH, Native Hawaiian; NH Black/Af Am, Non-Hispanic Black/African American; NH White, Non-Hispanic White; Other, other, multiracial, or unidentified race; PI, Pacific Islander; rehosp, rehospitalization.

For HD patients in 2015, the all-cause rehospitalization rate was 37.2% (Figure 4.8.a). For index hospitalizations due to cardiovascular conditions, infections, and vascular access infections, 38.8%, 34.5%, and 32.4% of these patients were rehospitalized within 30 days (see Figure 4.9).

vol 2 Figure 4.9 Proportion of hemodialysis patients discharged alive that either were rehospitalized or died within 30 days of discharge, by cause of index hospitalization, 2015



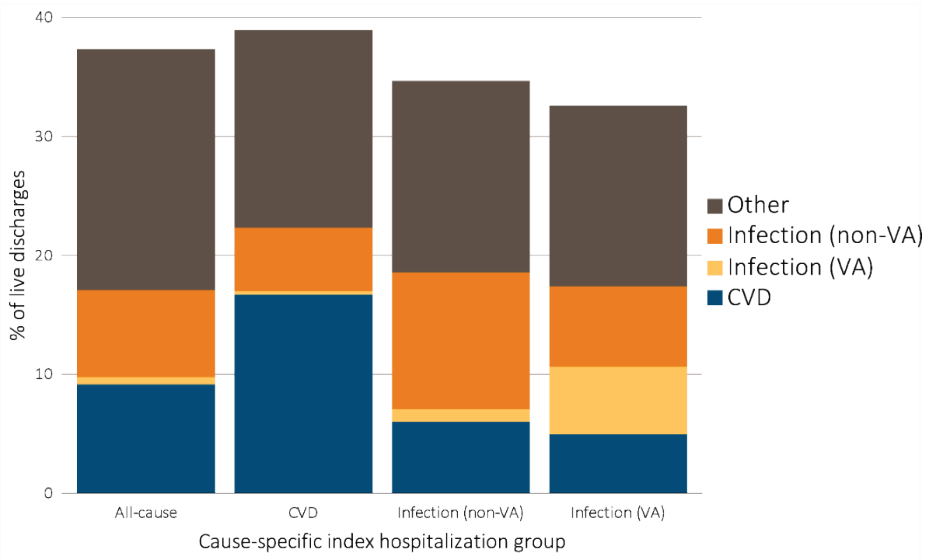
Data Source: Special analyses, USRDS ESRD Database. Period prevalent hemodialysis patients, all ages, 2015, unadjusted. Includes live hospital discharges from January 1 to December 1, 2015. Cause-specific hospitalizations are defined by principal ICD-9-CM codes. See Vol. 2, ESRD Analytical Methods for principal ICD-9-CM diagnosis codes included in each cause of hospitalization category. Abbreviations: CVD, cardiovascular disease; rehosp, rehospitalization; VA, vascular access.

Figure 4.10 illustrates that rehospitalization in the 30 days following a hospital discharge does not always result from a similar diagnostic cause as the index hospitalization.

During 2015, of those admitted for treatment of cardiovascular issues and then soon rehospitalized, nearly half (43.5%) were admitted to treat the same or another cardiovascular condition. However, this pattern differed for those initially hospitalized to address vascular access infection (17.5%), and other types of infections (33.3%). The proportion of cause-specific readmission among those with all-cause index hospitalization were also fairly low—only 25.1% returned for additional cardiovascular treatment, 1.6% for vascular access infection, and 19.7% to address other types of infection.

The patterns of rehospitalization following an unrelated index hospitalization suggest the development of new conditions or complications of the original condition. These differences might in part be attributed to the nature of chronic conditions that typically do not resolve (i.e. cardiovascular disease) versus acute conditions that are expected to resolve (i.e. infection).

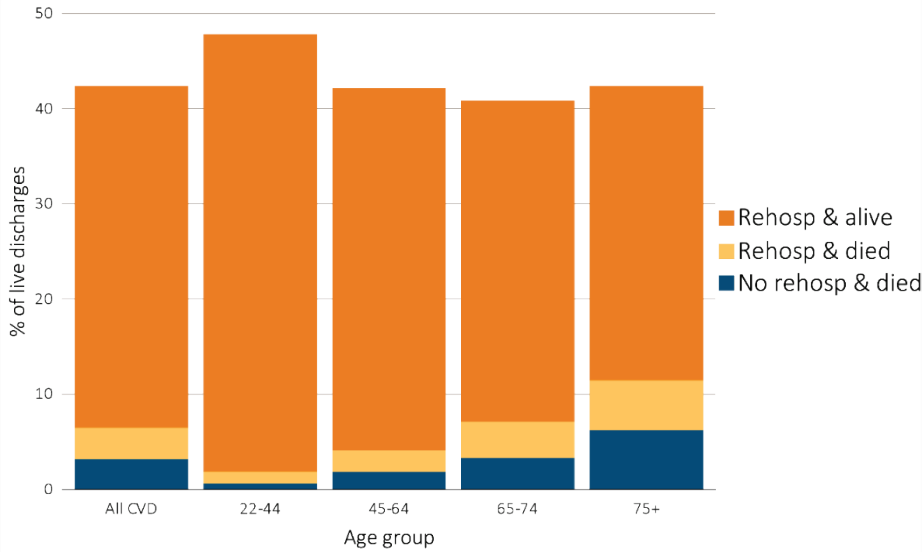
vol 2 Figure 4.10 Proportion of hemodialysis patients with cause-specific rehospitalizations within 30 days of discharge, by cause of index hospitalization, 2015



Data Source: Special analyses, USRDS ESRD Database. Period prevalent hemodialysis patients, all ages, 2015, unadjusted. Includes live hospital discharges from January 1 to December 1, 2015. Cause-specific hospitalizations are defined by principal ICD-9-CM codes. See Vol. 2, ESRD Analytical Methods for principal ICD-9-CM diagnosis codes included in each cause of hospitalization category. Abbreviations: CVD, cardiovascular disease; VA, vascular access.

Rehospitalization rates following discharge from a cardiovascular index hospitalization were slightly higher among younger adults compared with all other age groups, for whom the rehospitalization rates appeared similar. For those aged 22–44, for example, 46.8% of such discharges were followed by a rehospitalization within 30 days (Figure 4.11). In general, these rates mirrored those for all-cause index hospitalizations as seen in Figure 4.8.a, although the rates in Figure 4.11 for those aged 22-44 were slightly higher.

vol 2 Figure 4.11 Proportion of hemodialysis patients discharged alive who were either rehospitalized or died within 30 days of discharge for cardiovascular index hospitalization, by age, 2015

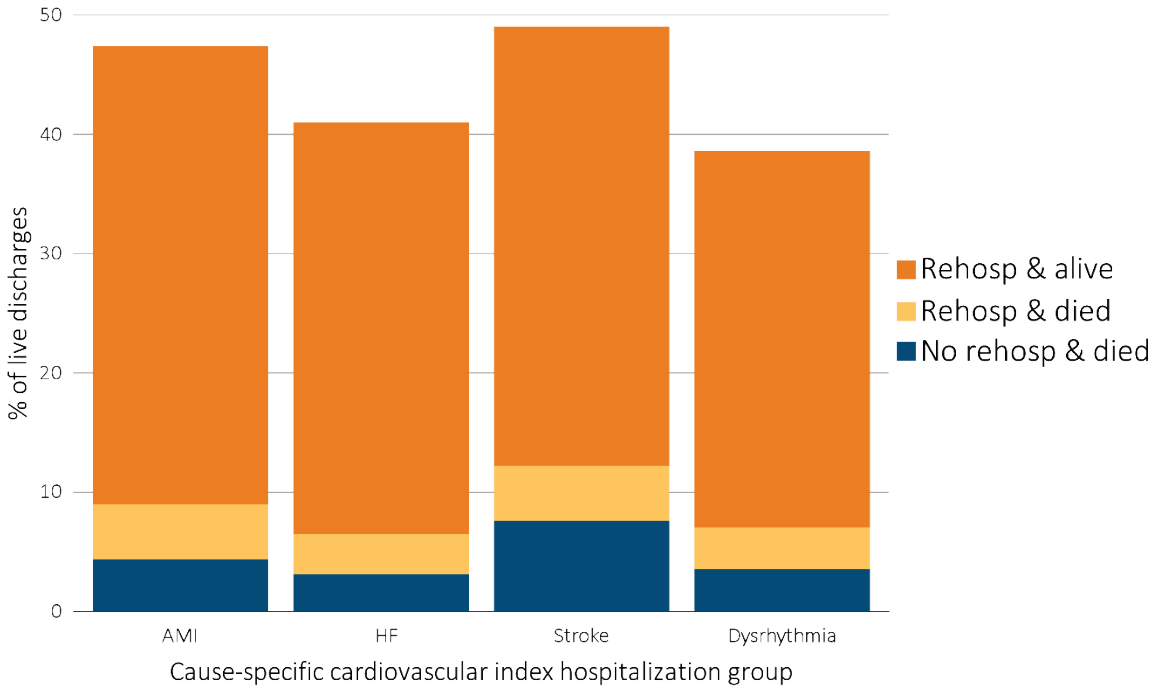


Data Source: Special analyses, USRDS ESRD Database. Period prevalent hemodialysis patients, all ages, 2015, unadjusted. Patients less than age 22 are not represented as a group due to insufficient sample size. Includes live hospital discharges from January 1 to December 1, 2015. Cause-specific hospitalizations are defined by principal ICD-9-CM codes. See Vol. 2, ESRD Analytical Methods for principal ICD-9-CM diagnosis codes included in each cause of hospitalization category. Abbreviation: rehosp, rehospitalization.

In subgroups of cardiovascular index hospitalizations (Figure 4.12), rehospitalization occurred most frequently following discharge from treatment of acute myocardial infarction (AMI), at 42.6%, and stroke, at 41.0%. The lowest rates occurred following discharge after dysrhythmia, at 34.6%. When not rehospitalized, stroke patients had the highest post-discharge mortality rate of 7.8%.

As comorbid cardiovascular disease and its complications have a critical interaction with kidney disease of all types, this 2017 ADR features two chapters specifically addressing these issues—Volume 1, Chapter 4 *Cardiovascular Disease in Patients with CKD*, and Volume 2, Chapter 8, *Cardiovascular Disease in Patients with ESRD*.

vol 2 Figure 4.12 Proportion of hemodialysis patients discharged alive who were either rehospitalized or died within 30 days of discharge for cardiovascular index hospitalization, by cause-specific cardiovascular index hospitalization, 2015



Data Source: Special analyses, USRDS ESRD Database. Period prevalent hemodialysis patients, all ages, 2015, unadjusted. Includes live hospital discharges from January 1 to December 1, 2015. Cause-specific hospitalizations are defined by principal ICD-9-CM codes. See Vol. 2, ESRD Analytical Methods for principal ICD-9-CM diagnosis codes included in each cause of hospitalization category. Abbreviations: AMI, acute myocardial infarction; HF, heart failure; rehosp, rehospitalization.

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Stewart S, Marley JE, & Horowitz JD. Effects of a multidisciplinary, home-based intervention on planned readmissions and survival among patients with chronic congestive heart failure: a randomised controlled study. *The Lancet. 1999*, 354(9184): 1077-1083.

Notes