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HOSPITALIZATION

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The Annual Data Report has increasingly focused on cause-specific hospitalization as an important morbidity surveillance issue. This year we continue to explore the significant increases in rates of hospitalization due to infection in the ESRD population, rates which remain 31 percent greater than those of 1994. Despite repeated presentation of these rates in the past seven Annual Data Reports, this issue remains unaddressed.

Of particular concern are the rates of hospitalization for infection in the hemodialysis population, which have increased 43 percent since 1994 (in contrast, for example, to a 50 percent decrease in vascular access hospitalizations). Hospitals have made significant progress in using less costly settings to address vascular access interventions, but equivalent progress in lowering the rate of infectious complications is lacking. The use of dialysis catheters continues to have the largest associated risk, a finding well known in the dialysis community.

In the peritoneal dialysis population the overall rate of hospitalization for infection has changed little over time. Admissions for peritonitis, in contrast, have fallen, and in 2010 were close to those for vascular access infections in the hemodialysis population, which have shown an encouraging decline since 2005. Caution is needed, however, in interpreting this trend. Rising rates of hospitalization for bacteremia/sepsis across modalities may reflect a major shift in hospital billing practices, making comparisons over time more challenging. From this perspective, the overall infection rates provide a better measure of progress.

Clear progress has been made in the total number hospital days per person year, which has dropped almost a full day per year in the hemodialysis population. This shift has important implications for dialysis providers, as a greater number of outpatient treatments, with their associated revenue, enhance options to leverage costs. With the new bundled payment system, begun in January, 2011, additional incentives to reduce hospitalization may further reduce the total hospital days per year.

These data look at hospitalization as a single, isolated event. Next we look at data on rehospitalization, overall and by major organ systems, within 30 days of a hospital discharge. Not surprisingly, rates of rehospitalization for ESRD patients are double those in the general Medicare population. Particularly striking is the 36 percent all-cause rehospitalization rate among hemodialysis patients, and the fact that the highest rates — reaching 43 percent — occur among patients age 20–44. Among patients with an index hospitalization for cardiovascular disease, almost half of the rehospitalizations are related to that primary indication.

Remote from universal nature and living by complicated artifice, man in civilization surveys the creature through the glass of his knowledge and sees thereby a feather magnified and the whole image in distortion. We patronize them for their incompleteness, for their tragic fate of having taken form so far below ourselves. And therein do we err. For the animal shall not be measured by man. They move finished and complete, gifted with the extension of the senses we have lost or never attained, living by voices we shall never hear. They are not brethren, they are not underlings: they are other nations, caught with ourselves in the net of life and time, fellow prisoners of the splendour and travail of the earth.

HENRY BESTON,
The Outermost House



The highest rates of rehospitalization after a cardiovascular event occur among patients with an acute myocardial infarction or congestive heart failure; rates are lower among those originally hospitalized for a stroke or dysrhythmia.

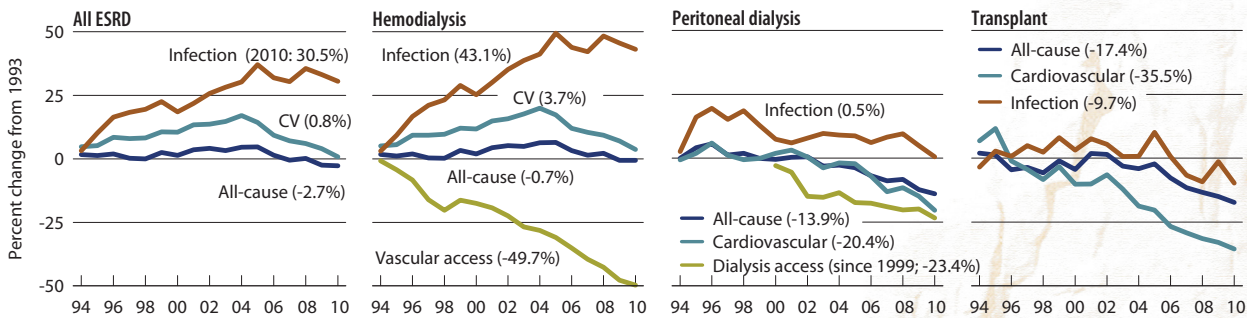
Interestingly, rates of rehospitalization have changed little over the past decade. It is not clear exactly what type of care is delivered at the index hospitalization to treat the noted condition, and what additional therapy might be given after the initial discharge. Given that fluid overload, congestive heart failure, and vascular access complications are major complications for hemodialysis patients, these findings provide important information on areas for improvement.

These findings clearly illustrate some of the high costs associated with the ESRD population. A major effort is needed to determine areas that can be addressed to reduce this significant source of morbidity.

We conclude this chapter by looking at admission rates by interdialytic interval, following up on our 2011 publication in the *New England Journal of Medicine*. In comparison to that study, which used the sample cohort from the Clinical Performance Measures (CPM) quality monitoring system, we here use data on the entire Medicare hemodialysis population, with reported dates for each dialysis treatment since 2010. This allows us to define the day of the week each hemodialysis session occurs, and to link the days to cause-specific hospitalization events. This more inclusive approach yields the same results, showing the highest event rates after the long interdialytic interval, and dramatizing the issues associated with thrice weekly hemodialysis. A comparable study of peritoneal dialysis and daily home hemodialysis population is underway and will be reported in next year's ADR. » **Figure 3.1**; see page 432 for analytical methods. *Period prevalent ESRD patients; adjusted for age, gender, race, & primary diagnosis; ref: ESRD patients, 2005.*

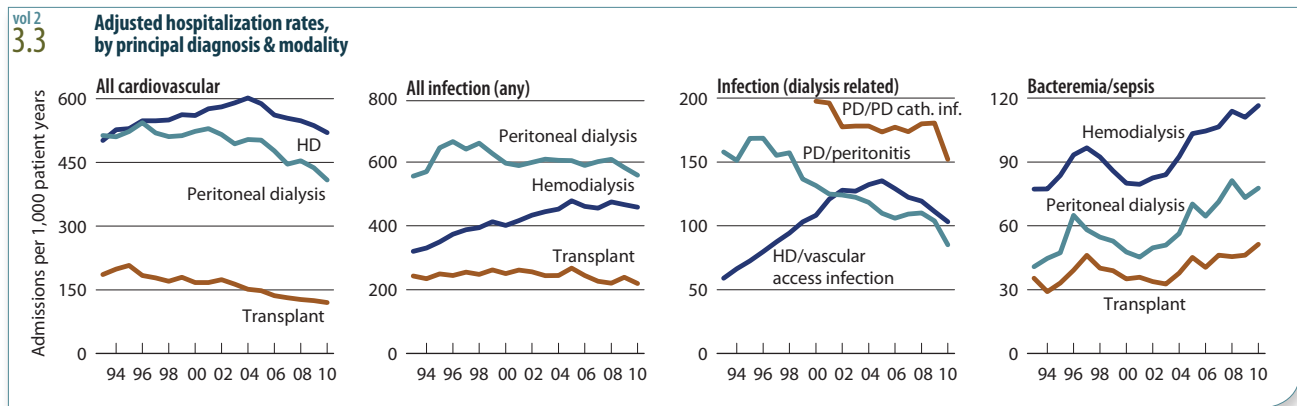
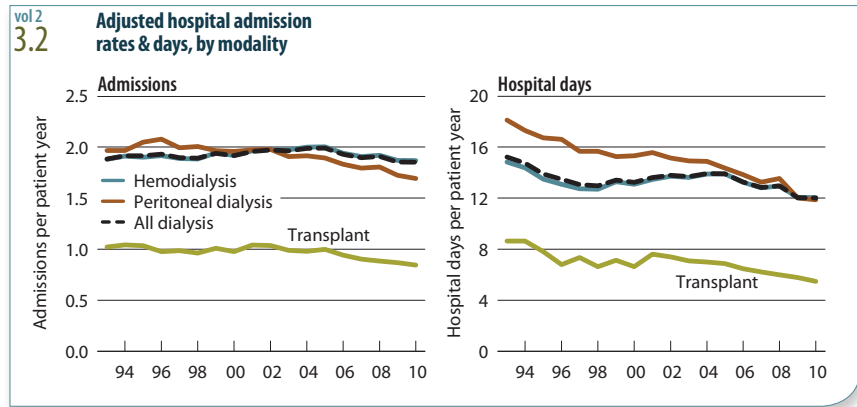
vol 2
3.1

Change in adjusted all-cause & cause-specific hospitalization rates, by modality



In 2010, admissions per patient year for hemodialysis patients were nearly identical to those in 1993, at 1.9. Rates for peritoneal dialysis and transplant patients, in contrast, have fallen 13.9 and 17.4 percent. Hospital days per patient year have fallen to 12 for both hemodialysis and peritoneal dialysis patients, and to 5.5 for those with a transplant.

» **Figure 3.2;** see page 432 for analytical methods. *Period prevalent ESRD patients. Adj: age/gender/race/primary diagnosis; ref: ESRD patients, 2005.*



Adjusted cardiovascular admission rates for hemodialysis patients peaked in 2004, at 601 per 1,000 patient years, and have since fallen 13.5 percent. In the same period, rates for peritoneal dialysis and transplant patients fell 19 and 21 percent, respectively. Rates remain lowest for patients with a transplant, at 120 in 2010.

Peritoneal dialysis patients have the highest rate of admission for any infection, at 558 per 1,000 patient years in 2010, yet this rate is 16 percent lower than the 663 seen in 1996. The admission rate for peritonitis among these patients has been falling since the mid-1990s, from a peak of 169 in 1995 to 85 in 2010, and rates of admission for a peritoneal catheter infection have declined 23 percent since 2000, falling to 152 per 1,000 in 2010. Among hemodialysis patients, admissions for vascular access infection rose steadily until 2005, but since have fallen 24 percent, to 103 in 2010. Admissions for bacteremia/sepsis remain highest for hemodialysis patients, at 116 per 1,000 patient years in 2010.

» **Figure 3.3;** see page 432 for analytical methods. *Period prevalent ESRD patients. Adj: age/gender/race/primary diagnosis; ref: ESRD patients, 2005.*

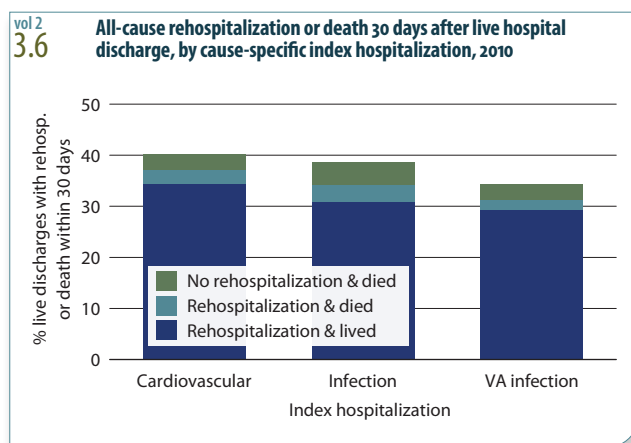
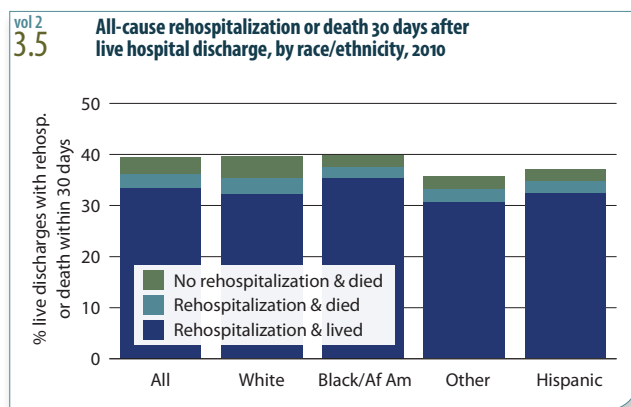
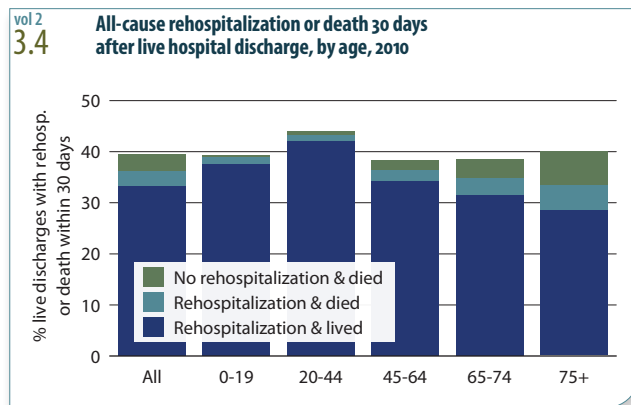
	All		Cardiovascular		Infection (overall)		Vascular access inf.	
	Unadj.	Adj.	Unadj.	Adj.	Unadj.	Adj.	Unadj.	Adj.
1999-2000	1.94	1.95	0.57	0.58	0.41	0.41	0.11	0.10
2001-2002	1.98	1.99	0.59	0.59	0.43	0.43	0.12	0.12
2003-2004	2.00	2.00	0.61	0.61	0.45	0.45	0.13	0.13
2005-2006	1.99	1.99	0.59	0.59	0.47	0.47	0.13	0.13
2007-2008	1.93	1.93	0.56	0.56	0.47	0.47	0.12	0.12
2009-2010	1.88	1.88	0.54	0.54	0.47	0.46	0.11	0.11
2009-2010								
Age: 20-44	1.90	2.10	0.45	0.49	0.45	0.48	0.15	0.15
45-64	1.82	1.81	0.51	0.50	0.44	0.44	0.11	0.11
65-74	1.92	1.88	0.58	0.57	0.47	0.46	0.09	0.09
75+	1.95	1.97	0.60	0.59	0.51	0.51	0.09	0.09
Male	1.75	1.75	0.51	0.51	0.43	0.43	0.09	0.09
Female	2.05	2.03	0.57	0.57	0.51	0.50	0.12	0.12
White	1.91	1.90	0.54	0.53	0.49	0.49	0.10	0.10
Black/Af Am	1.90	1.93	0.55	0.56	0.44	0.45	0.12	0.12
Other race	1.54	1.52	0.43	0.43	0.40	0.39	0.08	0.08
Hispanic	1.80	1.79	0.51	0.51	0.46	0.46	0.10	0.10
Diabetes	2.08	2.12	0.59	0.59	0.52	0.52	0.11	0.11
Hypertension	1.77	1.76	0.56	0.56	0.41	0.41	0.10	0.10
Glomerulonephritis	1.55	1.62	0.42	0.46	0.37	0.39	0.10	0.09
Other	1.77	1.78	0.43	0.45	0.48	0.48	0.11	0.11

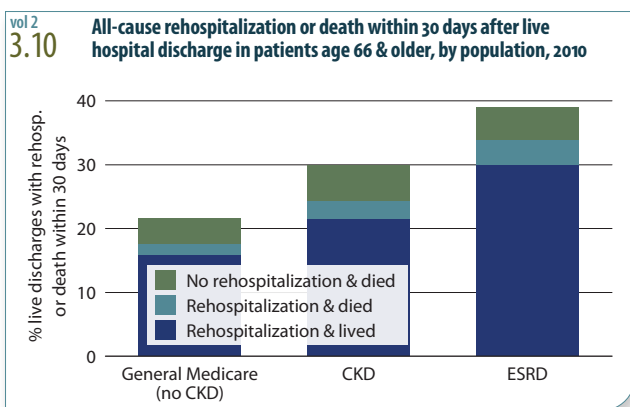
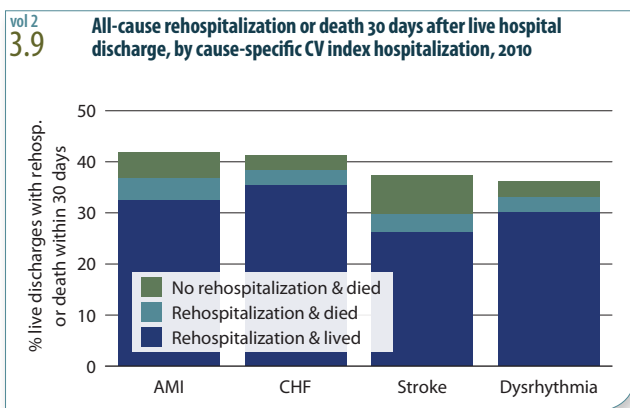
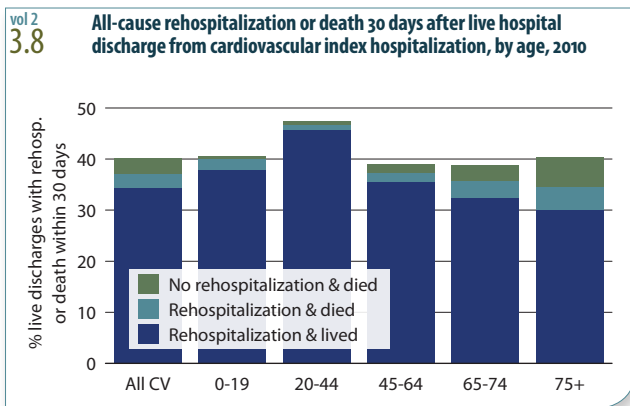
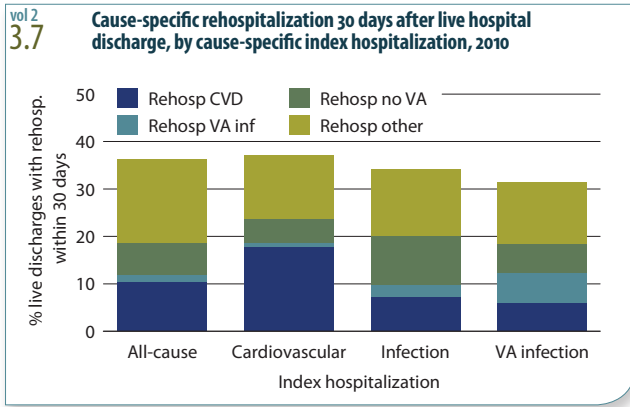
Adjusted all-cause and cause-specific hospitalization rates per patient year among hemodialysis patients have changed little since 1999–2000. In 2009–2010, adjusted rates were 1.88 and 0.54 for all-cause and cardiovascular hospitalizations, and 0.46 and 0.11, respectively, for hospitalizations due to infection (overall) and to vascular access infection. Patients who are older, female, black/African American, or have diabetes as their primary cause of renal failure generally have the highest rates of hospitalization — overall and for cause-specific conditions. » **Table 3.a;** see page 432 for analytical methods. *Period prevalent hemodialysis patients age 20 & older. Adj: age/gender/race/primary diagnosis; rates by one factor adjusted for the remaining three; ref: hemodialysis patients, 2005.*

Among hemodialysis patients prevalent in 2010, 36.3 percent of discharges from an all-cause hospitalization were followed by a rehospitalization within 30 days. The rehospitalization rate decreases as mortality increases in the older age groups, illustrating the competing risks of mortality and rehospitalization, as death precludes the opportunity for readmission. Rates of death without rehospitalization, for example, were highest in patients age 75 and older, at 7 percent, while these patients had the lowest rehospitalization rates, at 34 percent. Young adults age 20–44 and pediatric patients age 0–19 had the highest rates of rehospitalization — 43 and 39 percent of their discharges, respectively, were followed by a readmission within 30 days. For the combined endpoint of rehospitalization and/or death, the highest rates were again among patients age 20–44, at 44 percent. And the rehospitalization rate exceeded the rate of the combined endpoint even in patients age 75 and older, at 40 percent. These data suggest that the observed elevated rehospitalization rates among younger versus older groups may not be entirely attributable to the competing risk of mortality.

By race, the highest rates for rehospitalization or rehospitalization/death were among blacks/African Americans, at 38 and 40 percent, respectively, while the lowest occurred among patients of races other than white or black/African American, at 33 and 36 percent.

Among hemodialysis patients in 2010, 37 percent of discharges from cardiovascular hospitalizations were followed by a rehospitalization within 30 days, compared to 34 and 31 percent of hospitalizations for overall infection or vascular access infection. » **Figures 3.4–6**; see page 432 for analytical methods. *Period prevalent hemodialysis patients, all ages, 2010; unadjusted. Includes live hospital discharges from January 1 to December 1, 2010.*





In the 30 days following a live hospital discharge from a cardiovascular index hospitalization in 2010, 48 percent of rehospitalizations were for cardiovascular issues. Rehospitalization for overall infection and vascular access infection, respectively, followed 13 and 6 percent of discharges from index hospitalizations of the same category, compared to 8 percent and less than 2 percent of discharges from all-cause index hospitalizations.

Rehospitalization rates following discharge from a cardiovascular index hospitalization were highest among the youngest patients. In those age 0–19 and 20–44, for example, 40 and 47 percent of discharges were followed by a rehospitalization within 30 days. These rates mirror those for all-cause index hospitalizations (Figure 3.4), but their values are greater. As with the all-cause rates, the 30-day rehospitalization rates following a cardiovascular index hospitalization among patients younger than age 45 were comparable to or greater than rates of the combined endpoint of rehospitalization and/or mortality among even the oldest patients, at 40 percent.

For cardiovascular index hospitalizations, the highest rehospitalization rates were after discharge from hospitalizations for myocardial infarction and CHF, at 37–38 percent, while the lowest rates occurred following discharge after stroke, at 30 percent. It is important to note, however, that the highest 30-day mortality rates also occurred following index hospitalization for stroke (11 percent), suggesting that the competing risk of mortality may contribute to this lower rehospitalization rate.

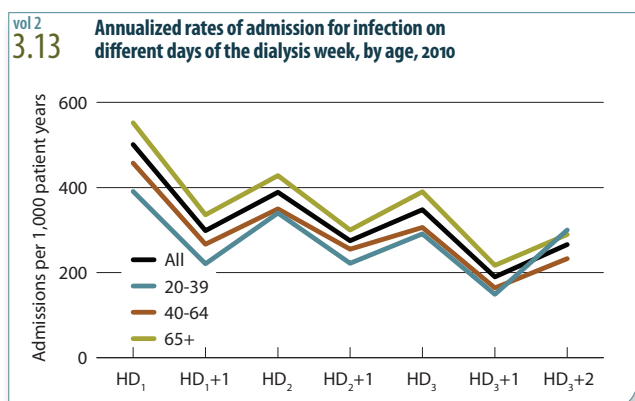
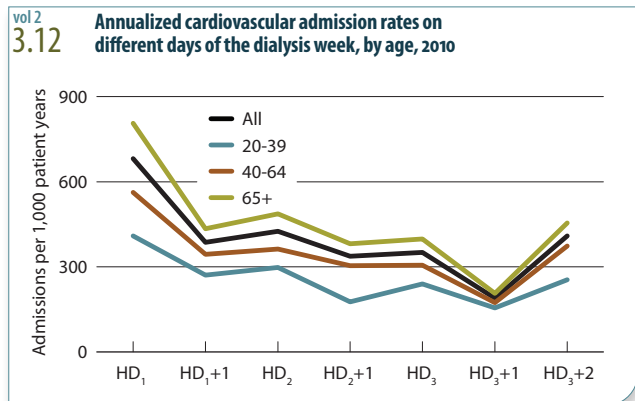
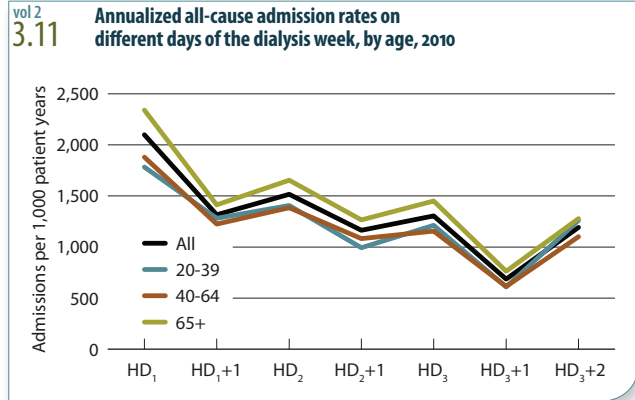
Among the general Medicare population without CKD, and among those with CKD or ESRD, rehospitalization rates within 30 days were 18, 24, and 34 percent, respectively, while those for death and/or rehospitalization were 22, 30, and 39 percent. » **Figures 3.7–10**; see page 432 for analytical methods. *Period prevalent hemodialysis patients, all ages, 2010, unadjusted; includes live hospital discharges from January 1 to December 1, 2010 (3.7–9). January 1, 2010 point prevalent Medicare patients age 66 & older on December 31, 2009 (3.10).*

Maintenance hemodialysis is typically delivered three times a week, and concern has emerged that the two-day, or “long,” interval may be associated with higher than expected rates of adverse outcomes. To explore this issue, we here present data on hospitalization rates by different days of the hemodialysis week among prevalent adult hemodialysis patients in 2010.

In the framework of the “hemodialysis week,” HD₁, for example, is defined as Monday for patients dialyzed on Monday, Wednesday, and Friday (MWF) and as Tuesday for those treated on Tuesday, Thursday, and Saturday (TTS). HD₃ + 2, the second day of the long interval, is Sunday for MWS and Monday for TTS.

As shown in Figure 3.11, hospitalization rates in the overall population are highest, at 2,101 per 1,000 patient years, on the day following the long interval (HD₁), and a downward sawtooth pattern is apparent thereafter, with an opposing direction of changes on any pair of successive days and a decline when any pair separated by two days is studied.

This pattern is replicated across age groups. Figures 3.12 and 3.13 show corresponding analyses for hospitalization rates attributed to cardiovascular disease and infection, respectively, and show patterns similar to those seen with all-cause hospitalization. » **Figures 3.11–13;** see page 432 for analytical methods. *January 1, 2010 point prevalent Medicare HD patients alive on January 31. Includes patients age 20 & older receiving hemodialysis three times weekly on a Monday–Wednesday–Friday or Tuesday–Thursday–Saturday schedule; HD₁, HD₂, & HD₃ are the first, second, & third hemodialysis sessions. Rates for all patients are adjusted for age, gender, race, Hispanic ethnicity, & primary diagnosis; rates by age are adjusted for the other four factors. Ref: all included HD patients in 2010.*



Annualized all-cause admission rates (per 1,000 patient years) on days after the long & short interdialytic intervals & on days without dialysis, 2010

	Events on day after long interdialytic interval	Events on day after short interdialytic interval	Events on days without dialysis
All patients	2,101	1,412	1,093
Age: 20-39	1,784	1,312	1,040
40-64	1,881	1,272	1,009
≥ 65	2,341	1,555	1,184
Male	1,975	1,313	1,035
Female	2,267	1,539	1,169
White	2,204	1,447	1,134
Black/Af Am	1,982	1,404	1,065
Other	1,868	1,187	913
Hispanic	2,079	1,326	1,077
Diabetes	2,327	1,588	1,226
Hypertension	1,989	1,329	1,004
Glomerulonephritis	1,770	1,176	975
Other	1,949	1,272	1,001
ESRD duration			
< 4 years	2,073	1,361	1,064
≥ 4 years	2,127	1,465	1,123

Day of the dialysis week

- HD₁ Monday for patients on a Monday–Wednesday–Friday schedule; Tuesday for patients on a Tuesday–Thursday–Saturday schedule.
- HD₁₊₁ Tuesday or Wednesday for the respective schedules.
- HD₂ Wednesday or Thursday, respectively.
- HD₂₊₁ Thursday or Friday, respectively.
- HD₃ Friday or Saturday, respectively.
- HD₃₊₁ Saturday or Sunday, respectively.
- HD₃₊₂ Sunday or Monday, respectively.

Interdialytic intervals

- 1 Day after long interdialytic interval: Monday for patients with a Monday–Wednesday–Friday dialysis schedule; Tuesday for patients with a Tuesday–Thursday–Saturday dialysis schedule.
- 2 Day after short interdialytic interval: Wednesday and Friday for patients with a Monday–Wednesday–Friday dialysis schedule; Thursday and Saturday for patients with a Tuesday–Thursday–Saturday dialysis schedule.
- 3 Days without dialysis: Other respective weekdays.

This table summarizes all-cause hospitalization rates on three types of days of the hemodialysis week: after the single long-interval dialysis day, after the two short-interval days, and on the four days without dialysis. In 2010, rates were 2,101 per 1,000 patient years for the first category, 1,412 for the second, and 1,093 for the third. Additional analyses, performed in subgroups defined by age, gender, race, ethnicity, and primary diagnosis, show temporal patterns similar to those seen in the overall patient population. » **Table 3.b**; see page 432 for analytical methods. *January 1, 2010 point prevalent Medicare hemodialysis patients alive on January 31. Includes patients age 20 & older receiving hemodialysis three times weekly on a Monday–Wednesday–Friday or Tuesday–Thursday–Saturday schedule. Rates for all patients & groups by ESRD duration are adjusted for age, gender, race, Hispanic ethnicity, & primary diagnosis; rates by age, gender, & primary diagnosis are adjusted for the other four factors. Rates by race & ethnicity are adjusted for age, gender, & primary diagnosis. Ref: all included hemodialysis patients in 2010.*

OVERALL HOSPITALIZATION

adjusted admissions & hospital days per patient year, 2010 (Figure 3.2)

admissions	» all dialysis · 1.85	» hemodialysis · 1.87	» peritoneal dialysis · 1.69	» transplant · 0.84
hospital days	· 12.0	· 12.1	· 11.9	· 5.5

REHOSPITALIZATION

all-cause rehospitalization or death 30 days after live hospital discharge, by age, 2010 (percent; Figure 3.4)

no rehospitalization, died	» all · 3.28	» 0–19 · 0.34	» 20–44 · 0.77	» 45–64 · 1.91	» 65–74 · 3.64	» 75+ · 6.65
rehospitalization, died	· 2.83	· 1.34	· 1.03	· 2.03	· 3.26	· 4.78
rehospitalization, lived	· 33.4	· 37.7	· 42.3	· 34.4	· 31.6	· 28.7

all-cause rehospitalization or death 30 days after live hospital discharge, by race/ethnicity, 2010 (percent; Figure 3.5)

no rehospitalization, died	» all · 3.28	» white · 4.16	» black/African American · 2.17	» other · 2.42	» Hispanic · 2.21
rehospitalization, died	· 2.83	· 3.29	· 2.25	· 2.43	· 2.26
rehospitalization, lived	· 33.4	· 32.3	· 35.4	· 30.8	· 32.6

all-cause rehospitalization or death 30 days after live hospital discharge, age 66 & older, 2010 (percent; Figure 3.10)

no rehospitalization, died	» general population (no CKD) · 4.0	» CKD · 5.6	» ESRD · 5.0
rehospitalization, died	· 1.8	· 2.8	· 3.9
rehospitalization, lived	· 15.9	· 21.5	· 30.0

ADMISSION RATES BY INTERDIALYTIC INTERVAL

annualized all-cause admission rates on different days of the dialysis week, by age (per 1,000 patient years; Figure 3.11)

day of week HD ₁ (Monday or Tuesday)	» all · 2,101	» 20–39 · 1,783	» 40–64 · 1,881	» 65+ · 2,341
day of week HD ₂ (Wednesday or Thursday)	· 1,517	· 1,407	· 1,386	· 1,656
day of week HD ₃ (Friday or Saturday)	· 1,305	· 1,214	· 1,157	· 1,453