

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 30 percent greater than those of 1993. Despite repeated presentation of these rates in the past eight ADRS, this issue remains unaddressed.

Of particular concern are rates of hospitalization for infection in the hemodialysis population, which have increased 43 percent since 1993 (in contrast, for example, to a 57 percent decrease in hospitalizations for vascular access procedures). 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 are now 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.

Among hemodialysis patients, the overall hospitalization rate in 2011 reached 1.84 admissions per patient year — down from 1.90 in 2010 and 1.87 in 2009. Total hospital days per year fell to 11.7 from 12.1 in 2009. In the peritoneal dialysis population the hospitalization rate remained stable, at 1.7.

The new “bundled” dialysis Prospective Payment System was implemented in January, 2011. Overall hospitalization rates in 2011 continue to decline compared to prior years. Hospital length of stay, particularly for cardiovascular admissions, also declined, continuing a downward trend since 2004. This year we have addressed some of the major issues of coding drift, seen in rising rates for bacteremia/sepsis across the hemodialysis, peritoneal dialysis, and transplant populations. The drift has been driven by increased



For me, my craft is sailing on,
 Through mists to-day, clear seas anon.
 Whate'er the final harbor be
 'T is good to sail upon the sea!

John Kendrick Bangs
 "THE VOYAGE"

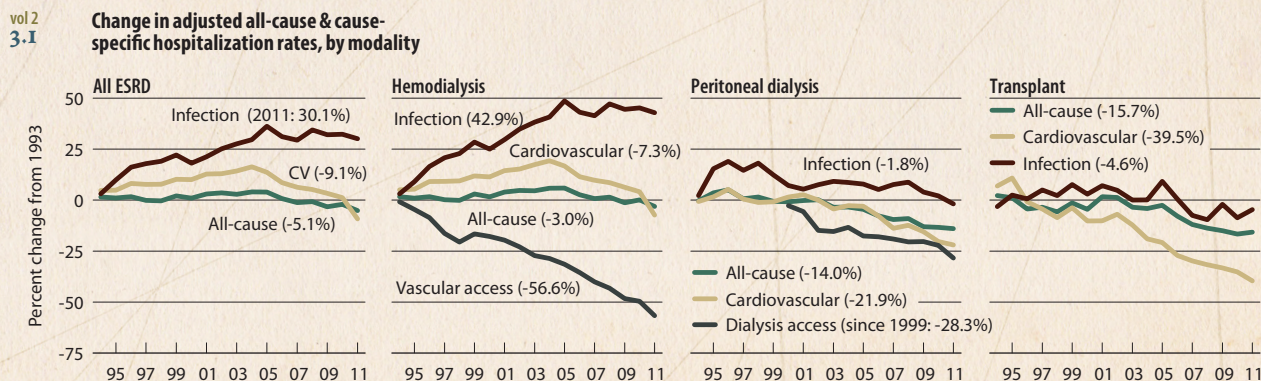
provider use of DRG codes for sepsis syndrome. It has been noted that, since 2006, use of these codes has resulted in a greater payment for hospitals.

These realities have made it quite challenging to assess cause-specific trends in infection. To address this issue of coding drift related to the principal diagnosis, we compare hospitalizations with a principal diagnosis code for infection to those in which infection is listed as either a primary or a secondary diagnosis. We are comparing, therefore, hospitalizations *for* infection to hospitalizations *with* infection.

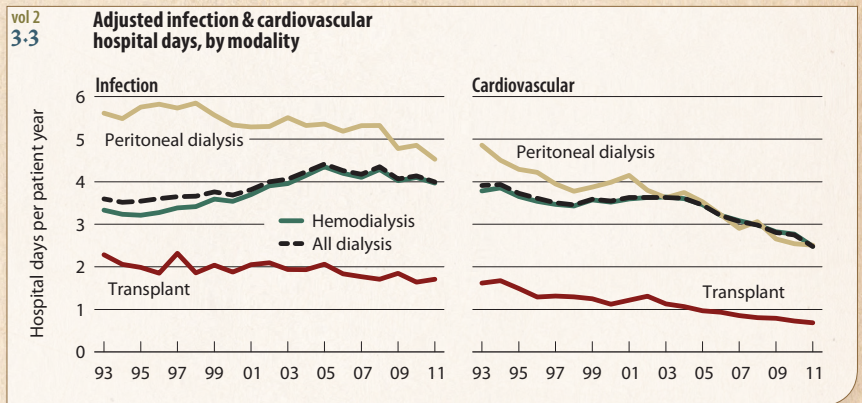
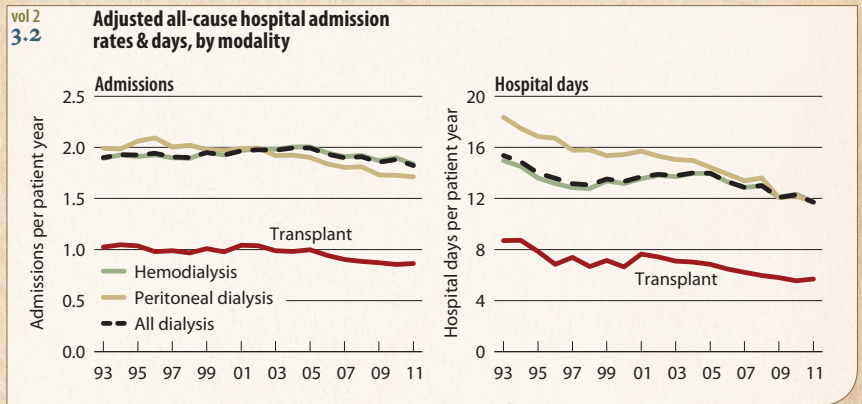
Figure 3.4 shows that, when infection is noted as either the primary or secondary diagnosis (a more complete method of assessment), rates of admission among hemodialysis patients are now approaching those of their counterparts on peritoneal dialysis. In contrast, if only the principal diagnosis field is considered, admission

rates continue to be highest in the peritoneal dialysis population. The absolute rate when all infections are considered is almost twice that seen when using only using the principal diagnosis code, indicating that past analyses using the older method identified only half of the actual infections associated with hospitalizations. Data on all infections also illustrate dramatic increases since 1993 in admissions with some types of infections, including pneumonia in the hemodialysis population. Infections across all modalities continue to be a major concern.

We present similar analyses for other types of infection and for cardiovascular events as well, showing that the latter are also under-reported when only the principal diagnosis code is considered. • **Figure 3.1; see page 433 for analytical methods.** *Period prevalent ESRD patients; adjusted for age, gender, race, & primary diagnosis; ref: ESRD patients, 2010.*



In 2011, admissions per patient year for hemodialysis patients were 1.84 nearly identical to those in 1993. Rates for peritoneal dialysis and transplant patients, in contrast, have fallen 14.0 and 15.7 percent. Hospital days per patient year have fallen to 11.7 for both hemodialysis and peritoneal dialysis patients, and to 5.7 for those with a transplant. ♦ **Figure 3.2;** see page 433 for analytical methods. *Period prevalent ESRD patients. Adj: age/gender/race/primary diagnosis; ref: ESRD patients, 2010.*



Since 1993, adjusted infection hospital days per patient year have increased 19.2 percent for hemodialysis patients, but have decreased 19.4 and 25.2 percent, respectively, for patients on peritoneal dialysis or with a transplant. Among patients with a cardiovascular hospitalization, in contrast, hospital days have fallen 36.7 overall for dialysis patients and 57.6 percent in those with a transplant.

Adjusted infection and cardiovascular hospital days are higher for patients on dialysis than for those with a transplant. For infection hospital admissions, for example, hospital days per patient year in 2011 were 4.0 and 4.5, respectively, for hemodialysis and peritoneal dialysis patients, compared to 1.7 for those with a transplant. And among patients with a cardiovascular admission, hospital days were 2.5 per patient year for hemodialysis and peritoneal patients compared to 0.7 for those with a transplant. ♦ **Figure 3.3;** see page 433 for analytical methods. *Period prevalent ESRD patients. Adj: age/gender/race/primary diagnosis; ref: ESRD patients, 2010.*

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Unadjusted & adjusted all-cause & cause-specific hospitalization rates (per patient year) in hemodialysis patients

	All		Cardiovascular		Infection (overall)		Vascular access inf.	
	Unadj.	Adj.	Unadj.	Adj.	Unadj.	Adj.	Unadj.	Adj.
2000-2001	1.96	1.97	0.58	0.58	0.41	0.41	0.11	0.11
2002-2003	2.00	2.00	0.60	0.60	0.44	0.44	0.13	0.13
2004-2005	2.02	2.02	0.61	0.61	0.47	0.47	0.13	0.13
2006-2007	1.94	1.94	0.57	0.57	0.46	0.46	0.13	0.13
2008-2009	1.91	1.91	0.55	0.55	0.47	0.47	0.11	0.11
2010-2011	1.88	1.88	0.51	0.51	0.47	0.47	0.10	0.10
2010-2011								
Age: 20-44	1.89	2.10	0.41	0.44	0.45	0.48	0.13	0.14
45-64	1.81	1.81	0.47	0.47	0.44	0.45	0.10	0.10
65-74	1.92	1.89	0.55	0.54	0.48	0.47	0.08	0.08
75+	1.94	1.95	0.57	0.56	0.52	0.52	0.08	0.08
Male	1.74	1.75	0.48	0.48	0.43	0.44	0.08	0.08
Female	2.05	2.03	0.54	0.53	0.51	0.51	0.11	0.11
White	1.91	1.91	0.51	0.51	0.50	0.49	0.09	0.09
Black/Af Am	1.88	1.91	0.51	0.52	0.43	0.45	0.11	0.11
Other race	1.52	1.50	0.40	0.40	0.40	0.40	0.07	0.07
Hispanic	1.77	1.75	0.47	0.47	0.45	0.45	0.09	0.09
Diabetes	2.07	2.11	0.55	0.55	0.52	0.52	0.10	0.10
Hypertension	1.76	1.75	0.52	0.52	0.41	0.41	0.09	0.09
Glomerulonephritis	1.53	1.59	0.39	0.43	0.37	0.39	0.09	0.08
Other	1.77	1.78	0.40	0.42	0.48	0.48	0.10	0.10

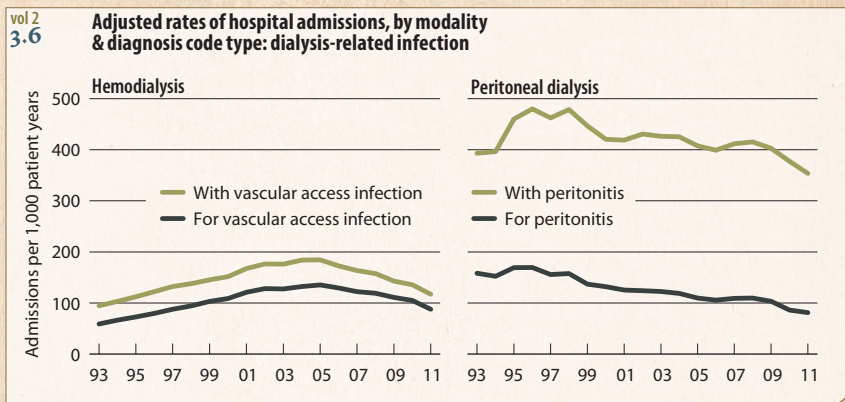
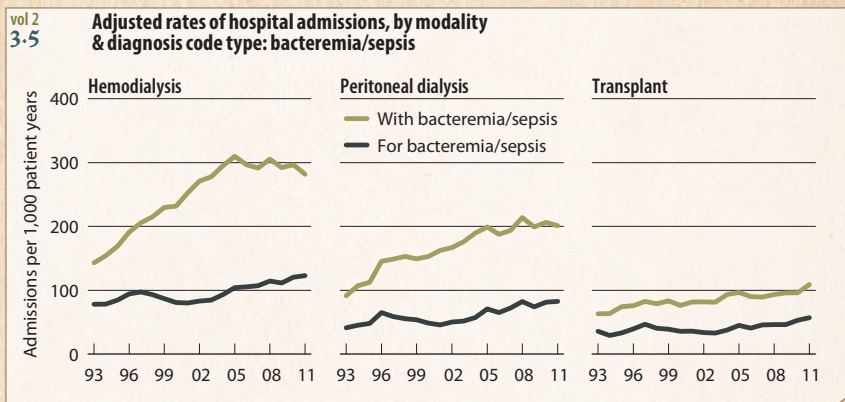
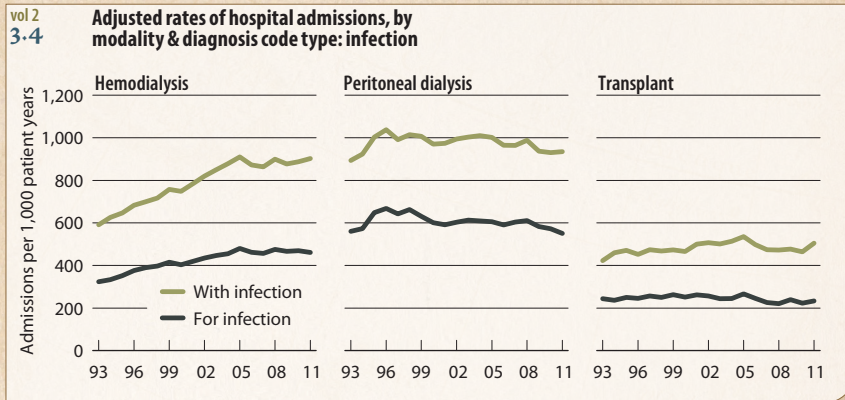
Adjusted all-cause hospitalization rates per patient year among hemodialysis patients have changed little in the past decade. In 2010–2011, the adjusted rate was 1.88, a 4.7 decrease since 2000–2001. Rates related to cardiovascular admissions and those for vascular access infection fell 13.3 and 17.0 percent, respectively, during the same time period; rates for infection overall, however, increased 12.9 percent. Patients who are age 20–44 or 75 and older, female, white, 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 diagnoses. ♦ **Table 3.a**; see page 433 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, 2010.*

Figures 3.4–13 illustrate two methods of defining cause-specific hospital admission categories for infection and cardiovascular disease. Both methods use ICD-9-CM diagnosis codes to categorize admissions into cause-specific groups. Rates produced from either method should not be interpreted as event rates, but rather are admission rates where the numerator counts admissions and the denominator includes time at risk. The difference is that one method uses only principal diagnoses while the other includes both principal and secondary inpatient diagnoses during the hospital stay.

Cause-specific hospital admissions in previous ADRS traditionally have been defined by principal diagnosis codes. Such admissions can be thought of as admissions for the reason of the stated condition, or, in other words, as admissions for the condition responsible for the admission. One advantage is that principal diagnoses create mutually exclusive admission categories. A potential limitation, however, is that assignment of principal diagnoses could be susceptible to billing incentives since principal diagnoses are related to the DRG assignment used for reimbursement.

Another method of categorizing admissions includes use of all ICD-9-CM inpatient diagnosis codes, for both principal and secondary diagnoses. A hospital stay with at least one inpatient diagnosis code (principal or secondary) for a given condition is counted as one admission with the condition. These rates are interpreted differently than those restricted to principal diagnoses: respectively, they are interpreted as admissions *with* the stated condition rather than *for* the purpose of the stated condition. By definition these rates are higher because the groups are more inclusive.

One disadvantage of this approach is the fact that admission categories including secondary diagnoses are not mutually exclusive. Groups including secondary codes may, however, be less susceptible to possible bias introduced by payment incentives.



definitions

- 1 Admission **with** the condition: uses principal & secondary inpatient diagnosis codes during hospital stay
- 2 Admission **for** the condition: uses principal diagnosis codes only

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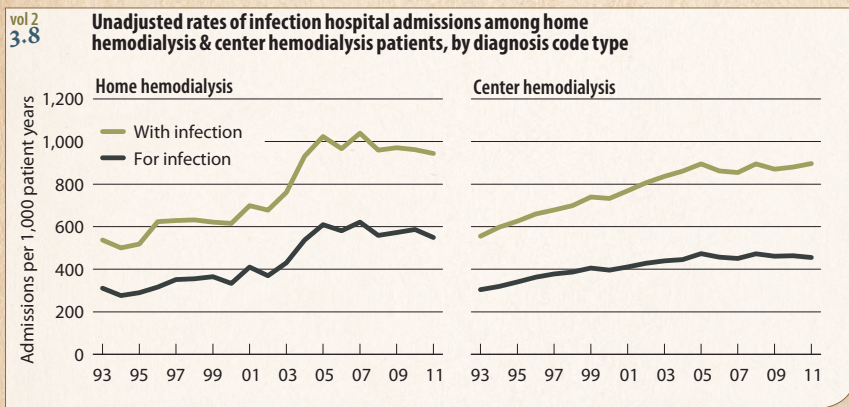
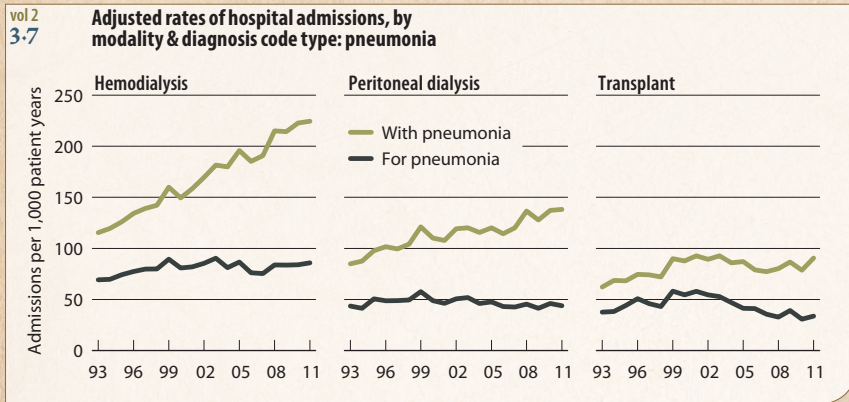
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For infection hospitalizations, the adjusted hospital admission rate for hemodialysis patients in 2011 is 903 per 1,000 patient years when both principal and secondary inpatient diagnosis codes are used; when only principal codes are used, the rate falls to 462. Among patients on peritoneal dialysis or with a transplant, 2011 rates using both types of codes are 551 and 233, respectively, while rates using only principal diagnosis codes are 118 and 81, respectively. Overall, infectious hospital admission rates did not improve across years with either method.

Rates in 2011 for bacteremia/sepsis admissions in hemodialysis, peritoneal dialysis, and transplant patients are 282, 201, and 109 per 1,000 patient years, respectively, when using both types of diagnosis codes, and 123, 82, and 57 when using only principal diagnosis codes.

Among hemodialysis and peritoneal dialysis patients, 2011 dialysis-related infection rates using both code types are 118 and 354, respectively, in contrast to rates of 88 and 81 when using principal diagnosis codes alone. Rates of admission with peritonitis in peritoneal dialysis patients, using both code types, are 2–4 times higher than rates of admission with vascular access infection in hemodialysis patients.

For 2011, pneumonia hospitalization rates based on both principal and secondary diagnosis codes are 225, 138, and 91 per

1,000 patient years, respectively, for hemodialysis, peritoneal dialysis, and transplant patients; rates based on principal diagnoses only are 86, 44, and 34. In 2011, pneumonia admissions for hemodialysis and peritoneal patients were 1.9 and 1.6 times higher than rates in 1993.

When compared to in-center hemodialysis patients, those who received treatment at home between 2004 and 2011 tended to have higher hospitalization rates related to infection. If both principal and secondary inpatient diagnosis codes are used as identifiers, 2011 rates of hospitalization for home patients are 5.4 percent higher than rates for their in-center counterparts, at 945 and 896 per 1,000 patient years, respectively. When only principal diagnosis codes are used, home and in-center rates differ by 21 percent, at 549 and 456.

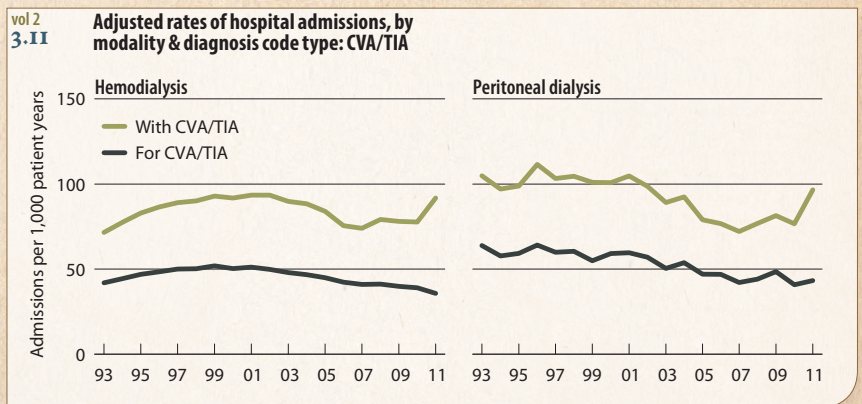
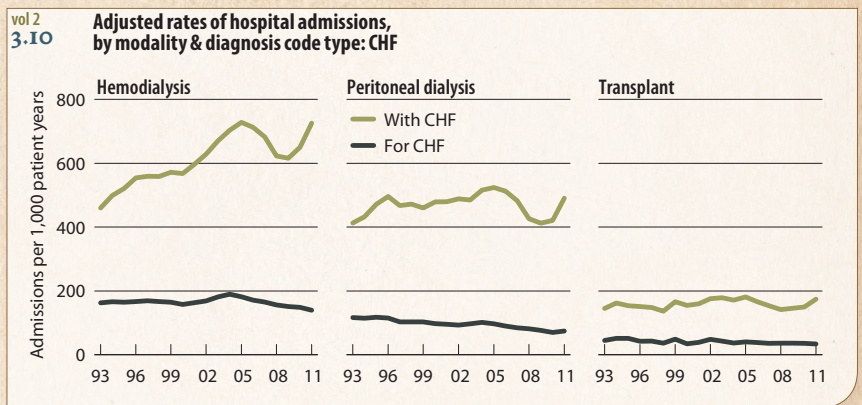
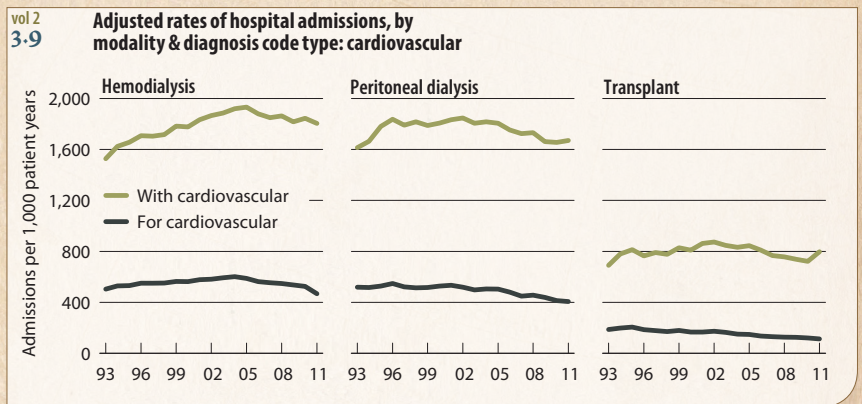
† Figures 3.4–8; see page 433 for analytical methods. *Period prevalent ESRD patients (3.4–5, 3.7); period prevalent dialysis patients (3.6); period prevalent hemodialysis patients (3.8; unadjusted). Adj in 3.4–7: age/gender/race/primary diagnosis; ref: ESRD patients, 2010. Admission rates with the stated condition using both principal & secondary diagnosis codes could be elevated in 2010 & 2011 due to availability of additional inpatient diagnosis code fields beginning in 2010.*

In the previous spread we presented infection hospitalization rates based on principal and secondary diagnosis codes together and on principal diagnosis codes alone, with data showing that rates are generally 2–4 times greater with the combined codes. Here we present rates of cardiovascular hospitalizations, which show patterns similar to those of infection hospitalizations.

For cardiovascular hospitalizations, the adjusted admission rate for hemodialysis patients in 2011 is 1,805 per 1,000 patient years when both principal and secondary inpatient diagnosis codes are used, compared to 468 using principal diagnosis codes alone. In patients on peritoneal dialysis or with a transplant, rates using both codes are 1,671 and 798, respectively, while rates using only principal codes are 406 and 113.

Congestive heart failure hospitalization rates in 2011 for hemodialysis, peritoneal dialysis, and transplant patients are 726, 491, and 174 per 1,000 patient years, respectively, when using both types of inpatient codes, and 140, 74, and 34 with only the principal diagnosis codes.

Among hemodialysis and peritoneal dialysis patients in 2011, CVA/TIA admission rates using both inpatient code types are 92 and 97, respectively, in contrast to rates of 36 and 43 when using principal diagnosis codes alone. ♦ **Figures 3.9–11**; see page 433 for analytical methods. *Period prevalent ESRD patients. Adj: age/gender/race/primary diagnosis; ref: ESRD patients, 2010.*



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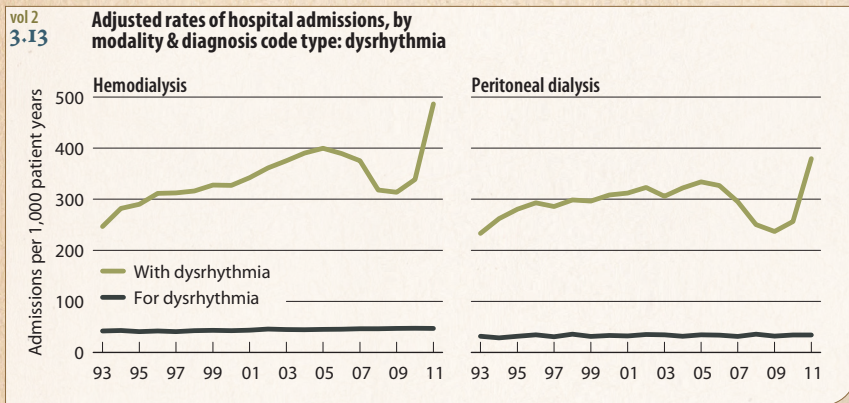
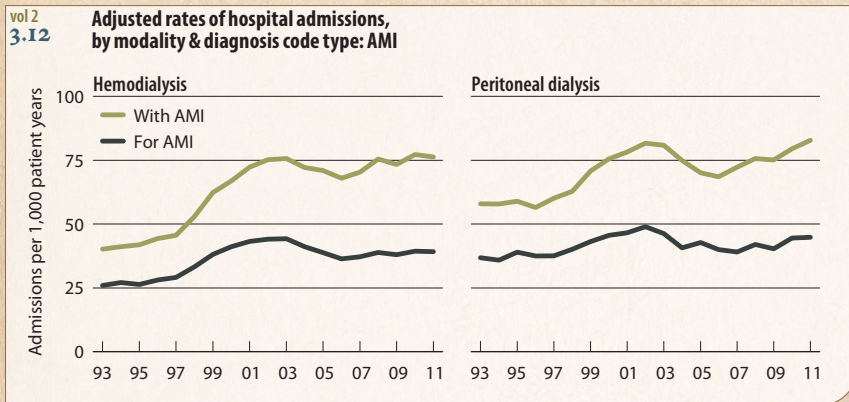
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definitions

- 1 Admission **with** the condition: uses principal & secondary inpatient diagnosis codes during hospital stay
- 2 Admission **for** the condition: uses principal diagnosis codes only

For 2011, AMI hospitalization rates based on primary and secondary inpatient codes are 76 and 83 per 1,000 hospital admissions, respectively, for hemodialysis and peritoneal dialysis; rates based on principal diagnosis codes alone are 39 and 45.

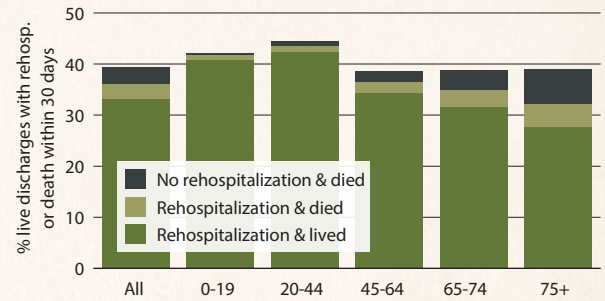
Dysrhythmia hospital admission rates using both inpatient principal and secondary codes are 487 and 379 in 2011 for hemodialysis and peritoneal dialysis patients, compared to 47 and 35 when only principal codes are used. + Figures 3.12–13; see page 433 for analytical methods. *Period prevalent dialysis patients. Adj: age/gender/race/primary diagnosis; ref: ESRD patients, 2010.*

Among hemodialysis patients prevalent in 2011, 36 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, are highest in patients age 75 and older, at 6.7 percent, while these patients have the lowest rehospitalization rates, at 32 percent. Adults age 20–44 and pediatric patients age 0–19 have the highest rates of rehospitalization — 44 and 42 percent of their discharges, respectively, are followed by a readmission within 30 days. For the combined endpoint of rehospitalization and/or death, the highest rates are again among patients age 20–44, at 44 percent. And the rehospitalization rate exceeds the rate of the combined endpoint even in patients age 75 and older, at 39 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.

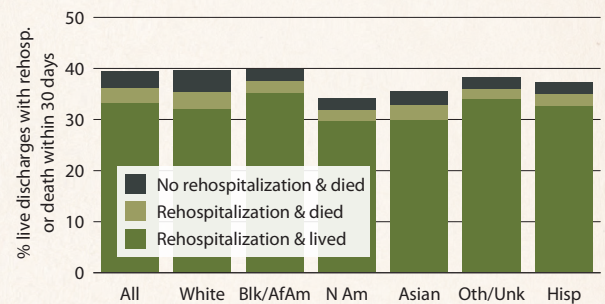
By race, the highest rates for rehospitalization or rehospitalization/death are among black/sAfrican Americans, at 37.6 and 39.8 percent, respectively, while the lowest occur among Native Americans, at 32 and 34 percent.

Among hemodialysis patients in 2011, 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 3.14–16**; see page 433 for analytical methods. *Period prevalent hemodialysis patients, all ages, 2011; unadjusted. Includes live hospital discharges from January 1 to December 1, 2011. Cause-specific hospitalizations are defined by principal ICD-9-CM codes.*

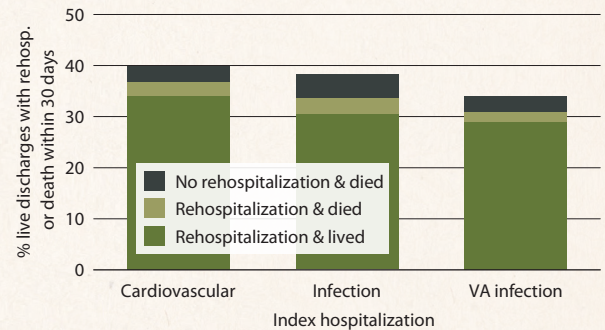
vol 2
3.14 All-cause rehospitalization or death 30 days after live hospital discharge, by age, 2011



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3.15 All-cause rehospitalization or death 30 days after live hospital discharge, by race/ethnicity, 2011



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3.16 All-cause rehospitalization or death 30 days after live hospital discharge, by cause-specific index hospitalization, 2011



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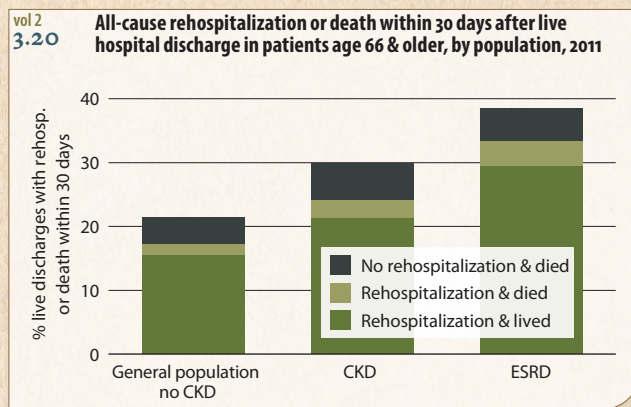
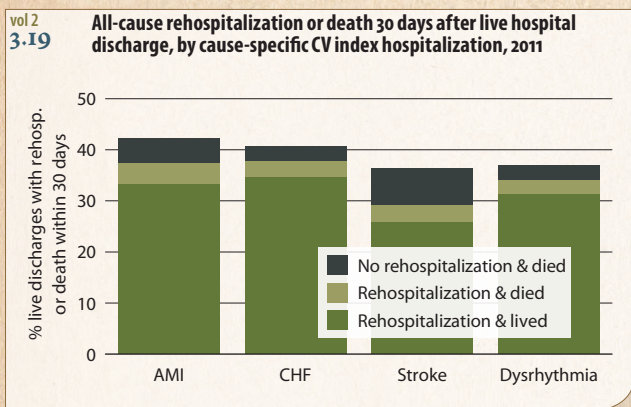
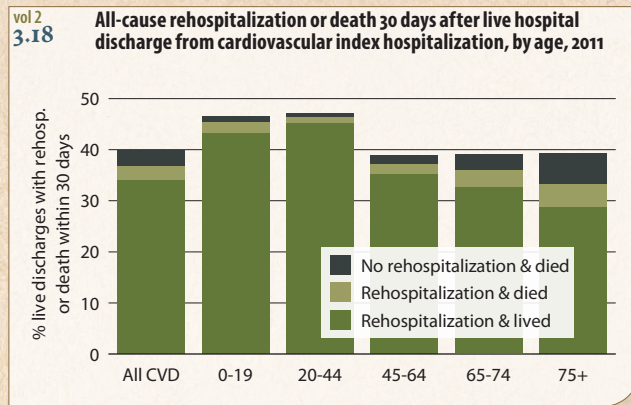
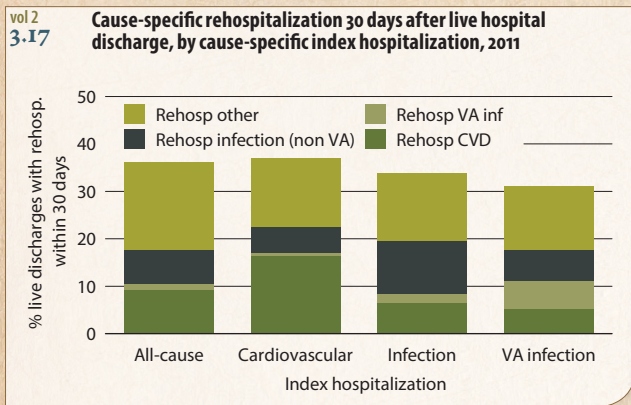
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In the 30 days following a live hospital discharge from a cardiovascular index hospitalization in 2011, 16.4 percent of discharges were followed by a cardiovascular rehospitalization. Rehospitalization for overall infection and vascular access infection, respectively, followed 13.1 and 5.9 percent of discharges from index hospitalizations of the same category, compared to 8.4 percent and 1.3 percent of discharges from all-cause index hospitalizations.

Rehospitalization rates following discharge from a cardiovascular index hospitalization are highest among the youngest patients. In those age 0–19 and 20–44, for example, 46 and 47 percent of discharges are followed by a rehospitalization within 30 days. These rates mirror those for all-cause index hospitalizations (Figure 3.14), 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 are greater than rates of the combined endpoint of rehospitalization and/or mortality among even the oldest patients, at 39 percent.

For cardiovascular index hospitalizations, the highest rehospitalization rates are after discharge from hospitalizations for myocardial infarction and CHF, at 38 percent, while the lowest rates occur following discharge after stroke, at 29 percent. It is important to note, however, that the highest 30-day mortality rates also occur following index hospitalization for stroke (10.5 percent), suggesting that the competing risk of mortality may contribute to this lower rehospitalization rate.

Among the general population without CKD, and among those with CKD or ESRD, rehospitalization rates within 30 days were 17.4, 24, and 33 percent, respectively, while those for death and/or rehospitalization were 22, 30, and 39 percent. + **Figures 3.17–20; see page 434 for analytical methods.** 3.17–19: period prevalent hemodialysis patients, all ages, 2011, unadjusted; includes live hospital discharges from January 1 to December 1, 2011. 3.20: January 1, 2011 point prevalent Medicare patients age 66 & older on December 31, 2010; for the CKD & no CKD cohorts during 2010, CKD is defined & patients are continuously enrolled in Medicare Parts A & B with no HMO coverage & without ESRD. Cause-specific hospitalizations are defined by principal ICD-9-CM codes.



overall hospitalization

ADJUSTED ALL-CAUSE HOSPITAL ADMISSION RATES & DAYS, BY MODALITY, 2011 (PER PATIENT YEAR; FIGURE 3.2)

	all dialysis	hemodialysis	peritoneal dialysis	transplant
admissions	1.8	1.8	1.7	0.9
hospital days	11.7	11.7	11.7	5.7

ADJUSTED INFECTION AND CARDIOVASCULAR HOSPITAL DAYS, BY MODALITY, 2011 (PER PATIENT YEAR; FIGURE 3.3)

	hemodialysis	peritoneal dialysis	transplant	all dialysis
infection	4.0	4.5	1.7	4.0
cardiovascular	2.5	2.5	0.7	2.5

hospital admissions: infection

ADJUSTED RATES OF HOSPITAL ADMISSIONS FOR OR WITH INFECTION, 2011 (PER 1,000 PATIENT YEARS; FIGURE 3.4)

	hemodialysis	peritoneal dialysis	transplant
with infection	903	935	505
for infection	462	551	233

hospital admissions: cardiovascular

ADJUSTED RATES OF CARDIOVASCULAR HOSPITAL ADMISSIONS, 2011 (PER 1,000 PATIENT YEARS; FIGURE 3.9)

	hemodialysis	peritoneal dialysis	transplant
with CVD	1,805	1,671	798
for CVD	468	406	113

rehospitalization

ALL-CAUSE REHOSPITALIZATION OR DEATH 30 DAYS AFTER LIVE HOSPITAL DISCHARGE, BY AGE, 2011 (FIGURE 3.14)

	all	0-19	20-44	45-64	65-74	75+
no rehospitalization, died	3.3%	0.3%	0.8%	2.0%	3.7%	6.7%
rehospitalization, died	2.8%	1.0%	1.1%	2.1%	3.3%	4.6%
rehospitalization, lived	33%	41%	43%	35%	32%	28%

ALL-CAUSE REHOSPITALIZATION OR DEATH 30 DAYS AFTER LIVE HOSPITAL DISCHARGE, BY RACE/ETHNICITY, 2011 (FIGURE 3.15)

	all	white	black/ Af Am	N Am	Asian	other/unk.	Hispanic
no rehospitalization, died	3.3%	4.2%	2.2%	2.2%	2.7%	2.4%	2.4%
rehospitalization, died	2.8%	3.3%	2.2%	2.1%	2.8%	1.8%	2.4%
rehospitalization, lived	33%	32%	35%	30%	30%	34%	33%

ALL-CAUSE REHOSPITALIZATION OR DEATH 30 DAYS AFTER LIVE HOSPITAL DISCHARGE, AGE 66 & OLDER, 2011 (FIGURE 3.20)

	general population (no CKD)	CKD	ESRD
no rehospitalization, died	4.2%	5.7%	5.1%
rehospitalization, died	1.8%	2.8%	3.9%
rehospitalization, lived	16%	21%	30%