Chapter 2: HOSPITALIZATIONS

Introduction

As a primary morbidity in the dialysis population, hospitalizations provide a focal point for provider efforts to improve patient care and outcomes. This chapter presents data on rates of hospitalization among patients treated in freestanding dialysis facilities, overall and by cause inferred from discharge diagnosis codes.

We begin by examining rates during the first year of dialysis for incident patients. After little change in admission rates among successive cohorts of incident patients from 1999 to 2005, rates began to decline in 2006 (Figure 2.1). The decline was modest until 2011, at an average of slightly more than 2% per year, but the trend was clear. However, the hospitalization rate for the cohort that began dialysis in 2012 was substantially lower in the first year, almost 10% lower than in 2011. In subsequent sections, we show evidence that this decline may be due to declining readmission rates related to policies implemented by the Centers for Medicare & Medicaid Services across the general Medicare population, part of a quality improvement program (QIP) (Zuckerman et al, New Engl J Med 2016;374;1543-51).

Despite this broad decline across the country, marked regional variation in first-year hospitalization rates is evident, as shown by the maps and tables in this section (Figure 2.2 and Table 2.a). The highest rates were in the Middle Atlantic and East North Central census divisions, and the lowest in the Mountain and Pacific divisions. These differences are especially relevant to the potential use and interpretation of standardized hospitalization ratios, which do not adjust for the location of the dialysis facility.

We next present parallel figures, maps, and tables for the prevalent population. Seasonality of risk is apparent in this setting; month-by-month admission rates reached their apex in the winter months and their nadir in the summer months (Figure 2.3). Such patterns are similar to those for common communicable diseases, such as influenza (Figure 2.24), and we investigate them further throughout this chapter.

While admission rates in the prevalent population declined across many areas of the country, the changes in 2012 and 2013 were striking. The rank order of prevalent patient hospitalization rates by census division changed little, but all show abrupt change after 2011 (Figure 2.4). The spark lines shown in Table 2.b are revealing, as they contrast the overall census division patterns and individual state patterns. The East North Central division had the lowest average annual percent decline from 2004 to 2013, at 1.6% per year; in comparison, the West South Central division had the greatest decline, at 3.0% per year. States with at least a 3.0% decline per year included Rhode Island, Pennsylvania, Iowa, North Dakota, Maryland, Alabama, Arkansas, Louisiana,
Oklahoma, Montana, Alaska, and Oregon. These data raise complex questions about geographic, socioeconomic, and environmental conditions. The extent to which these factors are addressed by risk adjustment schema has received very little attention during the development and promulgation of quality metrics and should be further studied.

The next section presents data on cardiovascular hospitalizations, overall and by diagnosis. Overall rates have declined consistently in both the incident and prevalent dialysis patient populations, and, perhaps surprisingly, exhibit clear seasonal variation in the prevalent population (Figures 2.5 and 2.6). Rates of change, admissions in the first year of dialysis, and the magnitude of seasonal oscillations, however, vary considerably by the specific type of cardiovascular morbidity. Admissions with a primary diagnosis of acute coronary syndrome (ACS; myocardial infarction and unstable angina), for example, have changed little in recent years and exhibit seasonality (Figures 2.7 and 2.8). Admissions with a primary diagnosis of arrhythmia show a similar stability over time, but much less seasonality (Figures 2.13 and 2.14). These two types of admissions may be linked to the effect of the dialysis treatment session itself, with its attendant changes in fluid and electrolytes balance and hemodynamics. Cardiac stunning during hemodialysis due to ultrafiltration may create cardiac stress with resulting oxygen supply and demand mismatch and myocardial ischemia. The issue has received considerable attention in recent years and may underlie the lack of improvement in ACS and arrhythmia hospitalizations. Additionally, newer troponin assays with more sensitive measures of myocyte injury are being used to diagnose ACS. This may have resulted in a shift from ST-segment elevation myocardial infarctions (STEMI) to non-ST segment elevation myocardial infarctions (non-STEMI).

In this report, we show patterns of admissions in which the diagnosis of interest was in the primary or leading secondary position, demonstrating a greater disease burden once the phenomenon of “coding drift” (changes in coding over time due to financial or regulatory reasons) was considered. The sharp change in some admission rates can be attributed to the
introduction, in October 2007, of the Medicare Severity-Diagnosis Related Group (MS-DRG; http://library.ahima.org/doc?oid=106590#.WCSiQC0rKUk) reimbursement system. Under MS-DRG, end-stage renal disease was identified as a major complicating condition (https://www.cms.gov/Medicare/Medicare-Fee-for-Service-Payment/AcuteInpatientPPS/downloads/cms-1533-p.pdf, Table 6J), so its use as the leading secondary diagnosis increased markedly, displacing other diagnoses that were previously used to secure higher reimbursement. Notably, MS-DRG also altered the relative weights for many diagnoses, including an increase in the relative weight for the diagnosis of fluid overload. In turn, since the advent of MS-DRG, rates of hospitalization for fluid overload appeared to have increased among dialysis patients (Figures 2.11 and 2.12). However, the rise in admissions with a diagnosis code for fluid overload has stabilized in recent years while admissions with a diagnosis code for congestive heart failure have continued to decline (Figures 2.9 and 2.10), suggesting true progress in this area. However, these shifts in coding practices due to alterations to reimbursement policies and practices complicate the true assessment of morbidity and, ultimately, of quality of care, and must be carefully considered before broad conclusions of public health importance are rendered. As a result, assessments of cause-specific hospitalization in the dialysis patient population should consider both specific and sensitive case definitions to more completely characterize the phenomenon being observed.

Hospitalization due to infection remains a major concern, yet progress has occurred over recent years (Figures 2.17 and 2.18). Shifts in the apparent causes of these hospitalizations may also be related to changes in reimbursement. Hospitalizations for bacteremia and sepsis as the primary diagnosis, for example, have increased about 40% among incident (since 2003) and prevalent (since 2004) dialysis patients (Figures 2.21 and 2.22). Hospitalizations for dialysis access infection as the primary diagnosis, however, have declined among incident and prevalent patients (Figures 2.19 and 2.20). Rather than a true change in the incidence of the composite endpoint of access infections and systemic complications thereof, these two opposing trends suggest that the narrowly defined changes may be manifestations of shifts in coding practices (with one group of codes effectively displacing another). Measures of dialysis facility performance that do not recognize coding shifts may falsely reward or punish facilities for the diagnosis codes that local hospitals elect to include in claims for inpatient care. These issues demand careful consideration, particularly since findings from inpatient claims will soon be reconciled with outpatient blood cultures results (which are collected by in-center hemodialysis facilities to satisfy the mandate of the National Healthcare Safety Network).

Hospitalizations for pneumonia and influenza predictably exhibit marked seasonality among prevalent dialysis patients, but rates have changed little despite
recent targeting of readmissions for pneumonia (Figures 2.23 and 2.24). The seasonal pattern does not differ from what is observed in the general population, so reducing seasonal changes in amplitude is difficult. However, these data should give pause to dialysis providers and their staffs, as the physical concentration of patients in dialysis facilities three times each week presents a risk for disease transmission, which could, theoretically, be modified through vaccination, isolation, and good hygiene practices. Perhaps even more interesting than the oscillations in pneumonia and influenza hospitalizations are the similar concurrent oscillations in other types of morbidity. Admission rates for chronic pulmonary disease (Figures 2.31 and 2.32) move in step with rates for pneumonia and influenza, possibly suggesting that patients with decreased pulmonary function may be appropriate targets for infection control. Rates of admission for these causes have seen little progress, and deserve greater attention. Admission rates for some types of cardiovascular disease fluctuate with rates for pneumonia and influenza, an unsurprising observation in light of studies linking infection, inflammation, and cardiovascular insults.

Rates of admission for *C. Difficile* have been increasing since 2003, a major concern (Figures 2.25 and 2.26). This is likely a complication of antibiotic use, which is frequent in the dialysis population, particularly for access infections and episodes of bacteremia-sepsis. Prevention of infectious complications has been a focus of the Centers for Disease Control and Prevention, which provides increased surveillance under the National Patient Safety Network infection control surveys of dialysis units. Additional considerations in infection control relate to vaccination against viruses. Antibody response to vaccination (e.g., hepatitis B) is limited in the dialysis population, so high-dose influenza vaccines (with four times the antigen load) may be the most appropriate approach for this population. Providers could test the efficacy of the vaccinations in pragmatic trials to determine antibody response and the potential protective effect.

Rates of admission for gastrointestinal bleeding have generally increased, which is concerning (Figures 2.27 and 2.28). It is unclear whether this increase reflects a higher burden of gastrointestinal complications or changes in anemia management, leading to limited hemoglobin reserve when patients are seen in the emergency department (ED). This issue will require additional surveillance data and detailed analyses of ED visits and observation stays to determine whether gastrointestinal bleeding is truly increasing. Rates of admission for hyperkalemia have not improved (Figures 2.35 and 2.36), although this may reflect coding shifts related to the MS-DRG system. This issue will also require further assessment, particularly as potassium concentrations can be readily manipulated by dialysis providers. Whether newer medications to bind potassium may be appropriate to offer the dialysis population should be studied.
We added information on ED visits and observation stays with trends over the past 10 years. Defining the cause of ED visits and observation stays is challenging because no simple DRG-type principle diagnosis code system is in use. Many visits are categorized by symptoms, with the underlying diseases coded secondarily. Additionally, ED visits and observation stays may be conflated, as the revenue codes may appear on the same claims. We therefore report ED visits with no observation codes, observation stays with no ED codes, and, for completeness, their co-occurrence. Overall, rates of ED visits or observational stays appear to have slowly increased over the past 10 years (Figure 2.46), while hospitalization rates have remained steady or declined over the same period (Figures 2.1 and 2.3).

Data in this chapter illuminate important opportunities for providers to improve care across several domains. The combined hospitalizations for arrhythmias, ACS, and hyperkalemia may be amenable to new approaches to the dialysis procedure itself. Seasonal and geographic variations in admission rates have important implications for novel approaches to risk reduction and to quality measurement in the public sphere. Coding drift—particularly for hospitalizations related to heart failure, fluid overload, sepsis, and dialysis access infection—needs greater attention, particularly when data about such admissions are incorporated into performance metrics. Changes in the inpatient prospective payment system have created different billing incentives for hospitals, such that shifts in coding may be decoupled from shifts in the actual incidence of morbidity. Further detailed investigation is needed to ensure that Medicare claims truly reflect the incidence of disease. Ultimately, unambiguous outcomes such as death and all-cause hospitalization may prove to be the most consistent markers of health status among dialysis patients.
Chapter 2: Hospitalizations
Hospital admission rates among incident & prevalent dialysis patients

2.1 First-year hospital admission rates among incident dialysis patients, by annual & monthly cohorts.
Patients aged 18 years or older.

2.2 First-year hospital admission rates among incident dialysis patients, overall & by US census division
Patients aged 18 years or older (% change from 2003 to 2012).
Hospitalization during the first year of maintenance dialysis occurs relatively frequently, complicating coordination of care during an already difficult time for incident patients. From 1999 to 2005, first-year hospital admission rates were unchanged (Figure 2.1). Subsequently, rates began to decline. Among incident patients in 2006, first-year admission rates were more than 3% lower than among incident patients in 2005. Rates continued to decline among successive annual cohorts of incident patients, leading to a reduction of more than 12% from 2005 to 2011. The recent decrease in hospitalizations for the cohort incident in 2012 appears to reflect a decrease in readmissions, which also occurred in the overall general Medicare population. This decline in readmissions is likely due to a new Medicare Quality Improvement Program (QIP) incentive for all hospitals to reduce readmissions within 30 days of discharge (Zuckerman et al, New Engl J Med 2016;374;1543-51).

Regional variation was apparent; declines in rates ranged from 24.3% in the West South Central census division to 15.9% in the East North Central division from 2003 to 2012 (Figure 2.2). Declines were steep in all regions in 2012, demonstrating the widespread effect of the Medicare QIP. The lowest first-year hospitalization rates were in the Mountain and Pacific divisions, at 1.7 and 1.8 hospitalizations per patient-year, respectively, in 2013. The highest first-year rates were in the Middle Atlantic and East North Central divisions, each with 2.3 hospitalizations per patient-year in 2013.

Variation by region may indicate important differences in access to health care, use of dialysis catheters, placement rates for internal accesses, and socioeconomic factors. The borders of Illinois, Indiana, Ohio, West Virginia, and Kentucky, for instance, are within the Ohio River basin, an area with high incidence of end-stage renal disease. It is possible that local concentrations of poverty and the historical legacy of air and water pollution could play a role in this phenomenon. Rates of first-year hospitalizations in each of these states were higher than in other areas (Table 2.a, Divisions 3, 5, and 6), suggesting that local factors may play an important role in addressing medical care.
Chapter 2: Hospitalizations
Hospital admission rates among prevalent dialysis patients

2.3 Annual & monthly hospital admission rates among prevalent dialysis patients
Patients aged 18 years or older.

2.4 Annual hospital admission rates among prevalent dialysis patients, overall & by US census division
Patients aged 18 years or older (% change from 2004 to 2013).
From the beginning of 1999 through the end of 2005, admission rates changed little among prevalent dialysis patients (Figure 2.3). At the beginning of 2006, however, rates began to decline. Among patients alive on January 1, 2006, the rate during the calendar year was more than 2% lower than among corresponding patients alive on January 1, 2005. This year-over-year reduction of 1% to 2% continued from 2006 to 2012, for an overall reduction of more than 8.7% from 2005 to 2011. A large decrease in prevalent patient hospitalization rates occurred in 2012 and 2013, a cumulative decrease of 14%. Note that the substantial decline in hospital admission rates at the end of 2013 is largely due to data limitations in the most recent year of available data. Hospital claims at the end of a year may not be resolved until after the start of the next year, leaving rates for the end of 2013 artificially low.

Rates within calendar months follow strong cyclical patterns, a clear manifestation of seasonality. In recent years, the rate in the first quarter has exceeded the corresponding rate in the fourth quarter by 7% to 10%. From this perspective, January and February are clear targets for quality improvement efforts.

Progress has been slower in some parts of the country (Figure 2.4). Some of the differences might be due to regional variation in influenza intensity, which merits further study. Alternatively, in states with very large patient populations, progress may vary substantially across metropolitan areas within the states.
Chapter 2: Hospitalizations
Hospital admission rates by US census division & state

2.a  First-year hospital admission rates among incident dialysis patients, by US census division & state, divisions 1-3
Rate per 100 patient-years. APC, annual percent change. Maps show 2012 rates.

**DIVISION 1 ● New England**

<table>
<thead>
<tr>
<th>Year</th>
<th>CT</th>
<th>ME</th>
<th>MA</th>
<th>NH</th>
<th>RI</th>
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<tr>
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<tr>
<td>2007</td>
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<td>238.5</td>
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</tr>
<tr>
<td>2008</td>
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<td>205.8</td>
<td>287.1</td>
<td>267.2</td>
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</tr>
<tr>
<td>2009</td>
<td>236.2</td>
<td>205.6</td>
<td>275.9</td>
<td>220.1</td>
<td>226.6</td>
</tr>
<tr>
<td>2010</td>
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<td>277.2</td>
<td>199.4</td>
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<tr>
<td>2011</td>
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<td>154.2</td>
<td>229.1</td>
<td>209.0</td>
<td>211.9</td>
</tr>
</tbody>
</table>

* First-year hospital admission rates declined in New England, at an annual percent change of -1.6 from 2003 to 2012.
* Rates declined sharply, though inconsistently, in Maine, from 225 admissions per 100 patient-years in 2004 to 134 in 2012, an overall decline of about 40%.
* The highest admission rate in the division occurred in Massachusetts, with 229 admissions per 100 patient-years in 2012.
* Denotes cells with 11 or fewer.

**DIVISION 2 ● Mid Atlantic**

<table>
<thead>
<tr>
<th>Year</th>
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<td>2007</td>
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<td>2008</td>
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<tr>
<td>2010</td>
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<td>262.9</td>
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<tr>
<td>2011</td>
<td>248.2</td>
<td>248.2</td>
<td>226.0</td>
</tr>
<tr>
<td>2012</td>
<td>237.1</td>
<td>237.1</td>
<td>226.0</td>
</tr>
</tbody>
</table>

* First-year hospital admission rates decreased 2.1% per year in the Middle Atlantic division, where rates have generally been similar among the constituent states.
* The largest decrease occurred in New Jersey, where rates fell 2.7% per year.

**DIVISION 3 ● East North Central**

<table>
<thead>
<tr>
<th>Year</th>
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<th>MI</th>
<th>OH</th>
<th>WI</th>
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<td>295.0</td>
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<td>2005</td>
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<tr>
<td>2006</td>
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<td>228.7</td>
<td>277.7</td>
<td>290.1</td>
<td>235.0</td>
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<tr>
<td>2007</td>
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<td>244.4</td>
<td>277.1</td>
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<tr>
<td>2008</td>
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<td>278.2</td>
<td>292.3</td>
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<tr>
<td>2010</td>
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<td>248.6</td>
<td>231.8</td>
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<tr>
<td>2011</td>
<td>231.8</td>
<td>259.4</td>
<td>221.4</td>
<td>263.5</td>
<td>213.0</td>
</tr>
</tbody>
</table>

* First-year hospital admission rates changed little in the East North Central division until 2011 and 2012, when they declined throughout the division, except in Indiana and Wisconsin.
* Admission rates in Indiana have varied substantially over the years studied, with increases and decreases in alternate years.
Hospital admission rates among prevalent dialysis patients, by US census division & state, divisions 1-3

Patients prevalent on January 1 of each year; aged 18 years or older. Rate per 100 patient-years. 
APC, annual percent change. Maps show 2013 rates.

**Division 1 ● New England**

- Although hospital admission rates were relatively flat from 2004 to 2009 in New England, rates decreased sharply thereafter, with a cumulative decline of more than 19% from 2009 to 2013.
- Leading the division was Rhode Island, where admission rates declined 3.9% per year.
- In Massachusetts, the most populous state in the division, admission rates decreased more than 19% from 2010 to 2013.

**Division 2 ● Mid Atlantic**

- In the Middle Atlantic division, admission rates decreased by 2.3% per year from 2004 to 2013.
- Leading the division was Pennsylvania, where rates decreased by 3.1% per year.
- Trailing the division was New York, where rates did not decline noticeably until 2012 and 2013.

**Division 3 ● East North Central**

- Hospital admission rates in the East North Central division changed little until 2012 and 2013, when a large decrease occurred.
- Wisconsin showed the most improvement in the division; rates declined 2.7% per year from 2004 to 2013.
**Chapter 2: Hospitalizations**

**Hospitalization rates, by US census division & state**

### 2.a First-year hospital admission rates in incident dialysis patients, by US census division & state, divisions 4-6

*Patients aged 18 years or older. APC, annual percent change. Maps show 2012 rates.*

#### Division 4 • West North Central

#### Division 5 • South Atlantic

#### Division 6 • East South Central

#### Division 7 • Pacific

<table>
<thead>
<tr>
<th>Division &amp; State</th>
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<th>2004</th>
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<th>2012</th>
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- First-year hospital admission rates decreased 2.5% per year in the West North Central division.
- Leading the division were Iowa and Minnesota, where hospital admission rates decreased 2.8% and 3.1% per year, respectively.

- Changes in first-year hospital admissions rates in the South Atlantic division generally declined, but not in all states.
- Florida showing little progress until 2010, when rates began to decline.
- In contrast, Virginia has shown steady progress over the past 10 years, with the second-largest decline, 2.9% per year, versus North Carolina, 3.1% per year.

- First-year hospital admission rates declined 2.5% per year in the East South Central division.
- Alabama had the highest rate in the division in 2003, but after a decrease of 4.6% per year over the subsequent 9 years, had the lowest rate in 2012.
- After peaking in 2006, rates in Tennessee decreased cumulatively 23% in the subsequent 6 years.
Hospital admission rates in prevalent patients, by US census division & state, divisions 4-6

Patients prevalent on January 1 of each year; aged 18 years or older. APC, annual percent change. Maps show 2013 rates.

### Division 4 ● West North Central

- Hospital admission rates in the West North Central division decreased by 2.2% per year from 2004 to 2013.
- Rates in Iowa fell consistently over time reaching an average of decrease of 3.6% per year from 2004 to 2013.

### Division 5 ● South Atlantic

- Hospital admission rates in the South Atlantic division decreased by 2.2% per year from 2004 to 2013.
- The District of Columbia, Georgia, Maryland, and North Carolina had the largest decreases on average over the 10 years.

### Division 6 ● East South Central

- In the East South Central division, hospital admission rates decreased by 2.7% per year from 2004 to 2013.
- Leading the division was Alabama, where rates decreased 4.0% per year from 2004 to 2013.
- Kentucky showed little progress until 2012 and 2013, when rates began to decline.
Chapter 2: Hospitalizations
Hospitalization rates, by US census division & state

2.a First-year hospital admission rates in incident dialysis patients, by US census division & state, divisions 7-9

Patients aged 18 years or older. APC, annual percent change. Maps show 2012 rates.

Division 7 ● West South Central

- First-year hospital admission rates decreased 2.7% per year in the West South Central division, the largest rate of decline among all US census divisions.
- Leading the division were Arkansas and Louisiana, where rates fell 4.6% and 4.5% per year, respectively, from 2003 to 2012.
- Admission rates in Oklahoma decreased 3.3% per year from 2003 to 2012, but, in a notable deviation from trend, increased substantially in 2010.

Division 8 ● Mountain

- First-year hospital admission rates decreased 2.2% per year in the Mountain division, and in 2012 the rate (174 per 100 patient-years) was the lowest among all US census divisions.
- In this division, rates by state did not decline steadily from 2003 to 2012, differing from the national trend.

Division 9 ● Pacific

- In the Pacific division, first-year hospital admission rates decreased 2.1% per year, although rates remained relatively stable from 2006 to 2010.
- In California, rates were routinely the highest in the division, and decreased most slowly from 2003 to 2012.
2.b Hospital admission rates in prevalent patients, by US census division & state, divisions 7-9

Patients prevalent on January 1 of each year; aged 18 years or older. APC, annual percent change. Maps show 2013 rates.

Division 7 ● West South Central

- In the West South Central division, hospital admission rates showed a steady decline over many years, in contrast to states with decreases only in 2012 and 2013 when the general Medicare QIP to reduce readmission was implemented (Affordable Care Act, subpart I of 42 CFR part 412).
- The overall annual percent change was -3.0% from 2004 to 2013, the most rapid rate of decline among all US census divisions.
- Leading the division was Louisiana, where rates declined 4.3% per year from 2004 to 2013, the third most rapid rate of decline in the nation.

Division 8 ● Mountain

- From 2004 to 2013, hospital admission rates fell 2.1% per year in the Mountain division. However, little progress was made until 2012 and 2013.
- Rates decreased most rapidly in Montana and Colorado.

Division 9 ● Pacific

- In the Pacific division, hospital admission rates decreased 2.2% per year from 2004 to 2013.
- Hawaii had the lowest admission rate in 2013, 110 per 100 patient-years.
- Rates decreased most rapidly in Alaska, at 4.1% per year.
- In California, the most populous state, rates decreased more slowly, at 2.0% per year. California also made little progress in reducing rates until 2012 and 2013.
For both the incident and the prevalent dialysis populations, clear progress in reducing cardiovascular hospitalizations occurred across the country (Figures 2.5 and 2.6). The unadjusted annual first-year admission rate for incident patients decreased 28% from 2003 to 2012, and the unadjusted annual rate for prevalent patients decreased 27% from 2004 to 2013. The 2013 rates for the incident and prevalent cohorts were 55.7 and 46.5 per 100 patient-years, respectively. Among the quarterly cohorts, hospitalization rates were similar to annual trends, but seasonality was apparent, as shown in Figure 2.6, which presents hospitalization rates during the quarter for patients prevalent at the beginning of the quarter. In all years studied, rates were highest in the first quarter, January-March, and lowest, by 9% on average, in the fourth quarter, October-December.

Details regarding all-cause cardiovascular hospitalizations are important to consider, and are addressed in subsequent pages where we present cause-specific data (Figures 2.7-2.16). We separate hospitalizations by both primary and primary/leading secondary discharge diagnoses. Heart failure, cardiomyopathy, and fluid overload are challenging to separate; however, patterns in hospital service billing (as can be carefully observed in the use of applicable diagnosis codes as primary or leading secondary) provide insights into overarching billing trends and into the changing classifications, which are based on the Medicare severity diagnosis-related group (MS-DRG) payment system. We end this section with data on hospitalizations for stroke which, like ACS, has a more reliable coding method for assessment. Together, these data give perspective regarding which trends appear to be more stable and which may be subject to potential bias and to changes in billing practices.
Chapter 2: Hospitalizations
Acute coronary syndrome (myocardial infarction & unstable angina)

2.7 First-year admission rates
Discharge diagnosis as primary only or primary/leading secondary. Patients incident within the year or quarter & followed for up to 1 year; patients aged 18 years or older.

2.8 Annual & quarterly admission rates
Discharge diagnosis as primary only or primary/leading secondary. Patients prevalent on the first day of the year or quarter & rates within the year or quarter; patients aged 18 years or older.

The rate of hospitalization with a primary discharge diagnosis of ACS—which includes acute myocardial infarction, with or without ST segment elevation (STEMI), and angina pectoris—showed modest change over the decade studied (Figures 2.7 and 2.8). However, when the relevant leading secondary discharge diagnosis codes were included, hospitalization rates for ACS were not consistent over time. The rate of hospitalization with either a primary or leading secondary diagnosis of ACS declined meaningfully until 2008; first-year rates (incident patients) changed 40% from 2003 to 2008, and annual rates among prevalent patients 34% from 2004 to 2008. Rates in subsequent years remained relatively flat. The substantial annual rates of decline becoming less pronounced in 2008 may relate to changes in the MS-DRG system announced for fiscal year 2008, in which disease severity adjustment was introduced, and the total number of DRGs increased from approximately 500 to more than 700, but this is uncertain.

Another factor influencing the diagnosis of ACS is recent advances in the troponin assay. While rates of non-STEMI hospitalizations have been increasing in both the general and the dialysis populations, hemodialysis patients represent a unique case: “cardiac stunning” resulting from the hemodialytic procedure can elevate circulating markers of myocardial damage and prompt admissions and evaluations for ACS. Whether altering the fundamental delivery system of conventional three-times-per-week hemodialysis could reduce ACS admissions is something that the nephrology community should debate.
Chapter 2: Hospitalizations
Heart failure & cardiomyopathy

2.9 First-year admission rates
Discharge diagnosis as primary only or primary/leading secondary. Patients incident within the year or quarter & followed for up to 1 year; patients aged 18 years or older.

2.10 Annual & quarterly admission rates
Discharge diagnosis as primary only or primary/leading secondary. Patients prevalent on the first day of the year or quarter & rates within the year or quarter; patients aged 18 years or older.

Hospital admissions for heart failure or cardiomyopathy have steadily declined, with first-year rates of admissions with relevant primary diagnosis codes declining 34% and annual rates almost 40% over the decade studied, (Figures 2.9 and 2.10). However, with a first-year rate of 12.0 per 100 patient-years among patients incident in 2012 and a rate of 9.5 per 100 patient-years among those prevalent on January 1, 2013, admissions with principal diagnosis of heart failure or cardiomyopathy remain common among dialysis patients.

Seasonal variation is evident in heart failure admissions, as demonstrated by the variation in quarterly admission rates among prevalent patients (Figure 2.10).
Heart failure and fluid overload can be indistinguishable. In Figures 2.11 and 2.12, we present admission rates for fluid overload and the related complication of pleural effusion.

Rates of hospitalizations with a primary discharge diagnosis of fluid overload or pleural effusion were steady until 2006, increased from 2006 to 2010, and remained relatively unchanged from 2010 on. The cumulative change over the study period was a doubling of the rates. From 2003 to 2012, first-year rates among annual cohorts of incident patients increased 156%, and from 2004 to 2013, annual rates among prevalent patients increased 146%. Both first-year incident and annual prevalent rates were about 5 per 100 patient-years in 2013.

Full understanding of the importance of the changes in fluid overload and pulmonary edema can occur only by considering Figures 2.11 and 2.12 along with Figures 2.9 and 2.10 (previous page). Previously, heart failure admissions declined while, in nearly reciprocal fashion, fluid overload admissions increased. Since either diagnosis might be used for a dialysis patient with pulmonary edema, a decrease in one diagnosis mirrored by an increase in the other could not be said to represent true progress. Collective consideration of Figures 2.09-2.12, however, suggests that the decrease in heart failure admissions has not been attenuated by a reciprocal increase in fluid overload admissions, and that real progress likely is being made.
Chapter 2: Hospitalizations

Arrhythmia

Hospitalizations for arrhythmias include atrial, ventricular, and asystolic events. While rates of arrhythmia as a primary cause of hospitalization remained unchanged over the past decade at about 5 per 100 patient-years, changes in secondary diagnosis code reporting were apparent through 2007 (Figures 2.13 and 2.14); again, changes in the MS-DRG system may be responsible for the “resetting” that occurred in 2008, but this is uncertain.

Several issues related to these hospitalizations merit further exploration, such as the timing of events across days of the dialysis week, the risk of hyperkalemia over a long interdialytic interval, and the risk of post-dialysis hypokalemia and other electrolyte changes induced by dialysis. Foley et al., for example, showed an increased risk of hospitalization and death on the first day of the dialysis week (New Engl J Med 2011;365:1099-1107). However, whether these events occur before or after treatment is unknown. Either or both could be true, and each poses different problems. If the greatest risk is before the treatment session, hyperkalemia and fluid overload are the likely culprits; this could be investigated to determine whether the condition appears as a leading secondary diagnosis. If, however, hospitalizations and deaths occur after the treatment session, metabolic changes during treatment should be considered. The risk of post-dialysis arrhythmia is an important consideration, as sudden cardiac death is the largest cause of death overall in the dialysis population (Chapter 3, Figures 3.7 and 3.8); the risk is especially high among incident patients in the first 6 months (Chapter 3, Figure 3.11). The question arises, then, that if electrolyte changes during a hemodialysis treatment session were a large risk, why do so few cardiac arrests occur in dialysis units? Patients may be scrutinized as treatment ends, and patients who are symptomatic sent to emergency departments, possibly averting more serious events. If the most vulnerable period is when patients leave the hemodialysis unit to go home, where there is little medical supervision, the late effects of treatment might result in sudden cardiac death.

Concerns also relate to use of low-potassium dialysis baths (K ≤2.0) for patients with pre-dialysis potassium levels less than 5.0 mEq/L, and to use of relatively low magnesium levels (0.75-1.0 mEq/L). Numerous studies in recent years have shown an association between hypomagnesia and death in dialysis patients, suggesting that more analyses are needed to determine a safe and effective level of magnesium in hemodialysate. The level of calcium in the dialysate should also be examined, particularly with regard to patients receiving calcium with phosphate binders. Baths in which the calcium level is less than 2.5 mg/dL, and which often contain lower potassium levels, may cause prolonged QT intervals, potentially increasing the risk of arrhythmia and sudden cardiac death. Additionally, the dialyzability of many medications, including beta blockers, has been a concern. Collectively, these concerns should be evaluated with pragmatic clinical trials to determine whether levels of calcium, magnesium, and potassium in the dialysate should be revisited.

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Unlike hospitalization rates for other cardiovascular-related diagnoses, rates for stroke showed steady decline in both the incident and prevalent dialysis populations (Figures 2.15 and 2.16). Rates declined consistently over the 10 years studied—an important sign of progress. From 2003 to 2012, annual first-year admission rates for stroke declined more than 30%, and from 2004 to 2013, annual rates among prevalent patients declined more than 35%. Also unlike hospitalization rates for other cardiovascular-related diagnoses, there was no difference in the trend in rates by primary versus primary or leading secondary diagnosis positions.

Seasonal patterns for stroke hospitalization are less apparent than for other diagnoses, but factors such as the degree of blood pressure control on dialysis may vary to a greater degree based on events, such as holidays, that affect fluid intake. Regardless of the reasons, rates of hospitalization for stroke have declined substantially.
Chapter 2: Hospitalizations
Infection as the primary discharge diagnosis

2.17 First-year admission rates
Patients incident within the year or quarter & followed for up to 1 year; patients aged 18 years or older.

2.18 Annual & quarterly admission rates
Patients prevalent on the first day of the year or quarter & rates within the year or quarter; patients aged 18 years or older.

Infectious complications are the second leading causes of hospitalization among dialysis patients, and their rates have shown little improvement aside from a slight decline in recent years (Figures 2.17 and 2.18). In 2012, first-year admission rates for infection were 59.0 per 100 patient-years among incident patients, and in 2013, the annual admission rate with infection as primary diagnosis for prevalent patients was 40.4 per 100 patient-years. For both groups, these rates represent a 10% decline in rates since 2010. Subcategories of infection are important to evaluate (Figures 2.19-2.28). However, changes in billing practices by hospitals, colloquially known as “coding drift” are often undertaken to increase revenues, complicating interpretation of trends. Rates of sepsis syndrome, as defined in MS-DRG coding, have increased, while rates of vascular access-related infection and peritonitis have declined. Because these changes in coding practices could alter the reporting of rates of individual infection types, actual event rates reported may not have truly changed. Cause-specific data should therefore be used with caution in any performance rating system. A complete assessment of all infections is therefore the most prudent way to assess progress in this area, since it reduces the potential danger of overstating improvement in any one area of infection-related diagnoses.
Overall rates of admission for dialysis access infections (including peritonitis) have decreased (Figures 2.19 and 2.20). Among incident patients, first-year admission rates with dialysis access infection as primary discharge diagnosis decreased 30% from 22.3 to 15.6 per 100 patient-years from 2003 to 2012. The decrease was even more dramatic among prevalent patients, for whom the annual rate declined 46% from 14.5 to 7.8 per 100 patient-years from 2004 to 2013. However, these data must be considered in the context of findings regarding bacteremia/septicemia admissions (Figures 2.21 and 2.22). While first-year and annual rates of hospital admissions in which dialysis access infection was the primary discharge diagnosis declined 30% to 46%, rates of admissions for bacteremia or septicemia increased 38% to 40%, suggesting that these changes may be related to changes in provider coding practices.

Data on seasonal changes in rates of dialysis access infection, as seen in the quarterly rates for prevalent patients (Figure 2.20), show patterns opposite to those for other diagnoses, with a peak in the summer months. A potential explanation is the effect of skin perspiration on bacterial growth.
In both the incident and prevalent dialysis populations, a recent upward trend in hospitalizations with primary discharge diagnoses of bacteremia or septicemia is evident (Figures 2.21 and 2.22), and predates changes to the MS-DRG payment system. In 2012, the first-year admission rate among incident patients was 17.8 per 100 patient-years and the corresponding annual rate for prevalent patients was 12.0 per 100 patient-years, representing 37.9% and 40.0% increases, respectively, over the decade studied. Admissions with bacteremia or sepsis as a primary or leading secondary discharge diagnosis were substantially more common than hospitalizations of this type reported from the principal diagnosis code only, however, and did not demonstrate a consistent trend over the decade studied.

These complications, bacteremia and sepsis, have been a quality focus of the Centers for Medicare & Medicaid Services for some time, with efforts directed at reducing line infections in intensive care units and rates of antibiotic-resistant infections such as methicillin-resistant Staphylococcus aureus (MRSA), vancomycin-resistant enterococci (VRE), and Clostridium difficile (C. diff). With continued high use of dialysis catheters (Chapter 1, Figure 1.11), particularly among incident patients, increased rates of these infections are not surprising. The combination of high catheter use at the start of dialysis and the increase in reported bacteremia or septicemia admissions deserves attention, as these complications have clear adverse consequences for patients.
Chapter 2: Hospitalizations
Pneumonia & influenza

The seasonal patterns of admissions for pneumonia and influenza, major pulmonary complications in the dialysis population, are clearly evident, as seen in the quarterly admission rates for prevalent patients (Figure 2.24). In all years, admission rates for pneumonia and influenza were highest in the first quarter, January to March, and lowest (by about 40%) in the third quarter, July to September. While intuitive, these seasonal patterns have not been fully investigated, despite important implications for patients.

Dialysis patients are immunosuppressed, with poor white cell function, compromised bacterial killing, and poor response to vaccinations. Given the level of mortality related to influenza and pneumonia, and the hypothesized link between infectious and non-infectious events (e.g., cardiovascular events), preventive and interventional approaches are essential. For example, the optimal way to vaccinate dialysis patients for influenza is unknown. While the Centers for Disease Control and Prevention has recommended influenza vaccinations for high-risk populations such as kidney disease patients, and while providers have responded by increasing vaccination rates, little is known about antibody responsiveness to single-dose vaccines. It has been suggested that dialysis patients should receive high-dose influenza vaccinations and more frequent pneumococcal pneumonia vaccinations. At a minimum, clinical trials are needed to help guide these therapies, and pragmatic clinical trials on a population level could be considered for multiple infection-prevention strategies.
Chapter 2: Hospitalizations
Intestinal infection with C. difficile

2.25 First-year admission rates
Discharge diagnosis as primary only or primary/leading secondary. Patients incident within the year or quarter & followed for up to 1 year; patients aged 18 years or older.

2.26 Annual & quarterly admission rates
Discharge diagnosis as primary only or primary/leading secondary. Patients prevalent on the first day of the year or quarter & rates within the year or quarter; patients aged 18 years or older.

C. difficile gastroenteritis is a serious infection that classically develops as a complication of antibiotic use. Resultant clinical consequences are persistent diarrhea with weight loss and, in some instances, malabsorption. Treatment can be challenging, depending on the resistance pattern of the C. difficile organism. Not infrequently, treated patients experience recurrence, often related to treatment with antibiotics for other indications.

In both the incident and prevalent dialysis populations, rates of admission for intestinal infection with C. difficile have increased more than 60% since 2003, when considering the primary discharge diagnosis only (Figures 2.25 and 2.26). Rates of admission with C. difficile as the primary discharge diagnosis rose 60.8%, to 2.2 per 100 patient-years, within the first year for incident patients. Rates rose 68.3%, to 1.2 per 100 patient-years, within the year for prevalent patients. While this increase has slowed, as yet no meaningful sustained progress toward reducing these hospitalizations has occurred.

It is not clear whether the antibiotic use in question is mainly driven by increased administration in dialysis units, or is a result of hospital stays and emergency department encounters in which suspected sepsis syndrome leads to increased preemptive antibiotic use. Some seasonal variation is evident, consistent with admissions for respiratory infections (pneumonia and influenza, Figure 2.24). These trends should be monitored closely, as the increase in C. difficile infections may be under-recognized.
Gastrointestinal (GI) bleeding is an important complication in dialysis patients. Rates of GI bleeding are relatively high, compared with the general population, for several reasons, including routine treatment with heparin among hemodialysis patients, uremic platelet dysfunction, and the high prevalence of angiodysplasia—malformations of small blood vessels in the GI tract that are chronically challenging to manage.

Rates of admissions with GI bleeding as primary discharge diagnosis increased 13.3% among incident dialysis patients from 2003 to 2012, when the first-year admission rate rose to 2.4 per 100 patient-years. In the prevalent population, annual rates increased nearly 30% from 2004 to 2013, when the rate was 2.6 per 100 patient-years (Figures 2.27 and 2.28). As with other diagnosis-specific hospitalization analyses, the “gap” in admissions (the difference between rates calculated using the primary position or the primary plus leading secondary positions) for GI bleeding closed in 2008, possibly due to the introduction of the MS-DRG system.

While hospitalizations for GI bleeding have increased for both the incident and the prevalent populations, the underlying factors are unclear. Some hypotheses focus on lower hemoglobin levels noted in the emergency department leading to more preemptive admissions. Alternatively, increased use of anticoagulants or antiplatelet drugs may predispose patients to greater risk of GI bleeding.
Admissions with acute respiratory failure as the principal discharge diagnosis increased in the first part of the decade studied, then declined slightly, and remained relatively unchanged for the last half-decade in both the incident and prevalent populations (Figures 2.29 and 2.30). However, when considering primary or leading secondary discharge diagnoses, rates generally increased throughout the decade, more than 80%. Rates of hospitalizations due to primary versus primary/leading secondary diagnosis codes for acute respiratory failure deviated beginning in 2007, a pattern that differs from the pattern observed for other diagnosis subgroups studied.

The challenge regarding both acute and chronic lung disease hospitalizations is that lung disease is not usually addressed in outpatient dialysis units or by nephrologists. Manifestations of acute pulmonary processes, such as “flash pulmonary edema,” may be due to some other underlying process, such as acute myocardial ischemia.
Annual rates of admissions with chronic pulmonary disease as primary discharge diagnosis increased for prevalent dialysis patients (Figure 2.32). Specifically, from 2004 to 2013, annual rates increased 17.7% from 2.1 to 2.5 per 100 patient-years. Seasonal variation is clear and substantial in admissions for chronic lung disease, and patterns are consistent with those for influenza-like illnesses (Figure 2.24). While rates of admissions, by primary discharge diagnosis, for chronic pulmonary disease were lower than those for influenza/pneumonia (3.6 vs. 12.0 per 100 patient-years for the prevalent cohort in the first quarter of 2013), rates for both diagnosis groups were highest in January-March and lowest in July-September.

Chronic pulmonary disease treatments typically involve medications such as bronchodilators, antibiotics, and steroids, all of which can potentially contribute to arrhythmias and sudden death. The complex nature of chronic lung disease treatments requires more attention to reduce potential collateral risks.
Chapter 2: Hospitalizations
Dialysis access complication, excluding infection

Dialysis access complications exclusive of infection typically relate to placement of, and revisions to, an internal access (fistula or a graft), but can also include malfunction of a hemodialysis or peritoneal dialysis catheter.

Rates of admissions for dialysis access complications (excluding infection) declined steadily and by more than 50% over the past decade in both the incident and prevalent populations (Figures 2.33 and 2.34). When considering relevant primary diagnosis codes only, first-year admission rates decreased from 19.5 to 8.8 per 100 patient-years, and annual rates for prevalent patients from 15.4 to 7.1 per 100 patient-years. The pattern for admissions with primary or leading secondary diagnoses for access complications was similar.

Higher rates of access complications in the first year of dialysis therapy likely reflect overreliance on catheters (with associated complications) and internal access revisions associated with fistula or graft placement. Initial malfunctions of a peritoneal dialysis catheter also occur often early in treatment.
Hyperkalemia is a commonly encountered life-threatening event for dialysis patients, placing patients at high risk of lethal arrhythmias. While dietary intake is the most common reason for hyperkalemia, additional causes include GI bleeding, breakdown of blood from hematomas (from retroperitoneal bleeding or large access infiltrations), and access recirculation (resulting in insufficient clearance). Additionally, numerous drugs commonly used in dialysis patients, such as angiotensin-converting enzyme inhibitors/angiotensin receptor blockers, mineralocorticoid receptor antagonists, and even beta blockers, can cause hyperkalemia by interfering with residual kidney function excretion and GI tract excretion.

Rates of admission for hyperkalemia have been relatively unchanged since 2008, at about 2.4 and 3.8 per 100 patient-years for incident and prevalent cohorts, respectively (Figures 2.35 and 2.36). Before introduction of the MS-DRG system in 2007, hyperkalemia was frequently submitted as a secondary diagnosis code, complicating the condition coding for DRG payment; this is no longer the case.
Rates of hospitalization for infection in hemodialysis patients varied substantially by state, as shown by the map in Figure 2.37. The difference in unadjusted rates between states with the lowest and highest rates of admission was nearly 2-fold. Some regional trends are apparent. For example, rates tended to be low in states in the southeast (exception for Florida, which is demographically distinct from many other southeastern states), and among the highest in several states in the Ohio River Valley region. Whether this represents a true biological effect (such as differences in the prevalence of infectious organisms) or a complex mixture of historical, socioeconomic, demographic, cultural, and geographic factors is uncertain, but should be further investigated.
2.38 Hospital admission rates in 2013, among patients on peritoneal dialysis, by state
Rate per 100 patient-years. Patients prevalent as of January 1, 2013; aged 18 years or older.

As with hemodialysis dialysis patients, rates of hospitalization for infection in peritoneal dialysis patients varied substantially by state (Figure 2.38). The pattern of rates showed some similarities with the pattern for hemodialysis patients (for example, high rates in the Ohio River Valley region), but also notable differences; rates in the southeast were not among the lowest in the country for peritoneal dialysis patients as they were for hemodialysis patients. Possibly, patients treated with peritoneal dialysis, who represent a select group of ESRD patients, vary in demographic and clinical characteristics by state, which may partially explain the variation in hospitalizations for infection by state.
Unadjusted infectious hospitalization rates for both hemodialysis and peritoneal dialysis patients are shown, by organ system, in Figure 2.39. In general, as might be expected, rates of infection were higher for hemodialysis patients than for peritoneal dialysis patients. Exceptions are rates of dialysis access and abdominal infections, which were much higher in peritoneal dialysis patients, demonstrating the risks attendant with peritoneal dialysis catheters. However, rates of hospitalization for dialysis access or abdominal infections among peritoneal dialysis patients declined over time, by 36.3% and 27.1%, respectively. These improvements may be due to technological or technique advances. Access infection rates also declined for hemodialysis patients. Ominously, bacteremia and sepsis, which make up circulatory infections, appear to be increasing. However, changes in coding, and the recent public health campaigns against sepsis, which likely increased the identification of sepsis cases, may be partially responsible. Cardiac infections, which likely represent endocarditis, and musculoskeletal infections decreased, especially in hemodialysis patients. Lung, skin, and genitourinary infections were relatively stable over the years examined.
Declines in hospital lengths of stay are evident in both the incident and prevalent dialysis populations (Figures 2.40 and 2.41). In the first year of dialysis, hospital days per patient-year for all-cause hospitalizations declined 21.4% for hemodialysis patients, from 20.2 in 2003 to 15.9 in 2012. During the same period, first-year total hospital days per patient-year in peritoneal dialysis patients declined from 14.3 in 2003 to 9.5 in 2012, a 33.5% decline. In the incident populations, the number of hospital days was about 40% lower for peritoneal dialysis than for hemodialysis patients. However, in the prevalent populations, the pattern of hospital days did not differ by modality. From 2004 to 2013, hospital days for prevalent hemodialysis patients declined 26.4%, from 15.7 days in 2004 to 11.6 in 2013, and for peritoneal dialysis patients 28.1%, from 16.6 days in 2004 to 12 in 2013. The differences between incident and prevalent hemodialysis and peritoneal dialysis populations likely represent, in part, use of hemodialysis catheters and placement of internal vascular accesses. In the prevalent population after the first year, peritoneal dialysis patients develop complications related to ultrafiltration failure, and are hospitalized for congestive heart failure/fluid overload and infections, thereby closing the hospitalization gap.

New regulations regarding conditions of participation, issued by the Centers for Medicare & Medicaid Services in May 2013, state that dialysis units should receive the same information that hospitals send to nursing homes and rehabilitation centers. Whether hospitals are aware of this new requirement, or whether they are being held accountable for the transfer of information, is unclear. In any case, the transfer of information about hospital stays is an ongoing challenge for dialysis units.
Chapter 2: Hospitalizations

Length of stay, cardiovascular

**2.42 First-year hospital-day rates, by modality**
Patients incident within the year or quarter & followed for up to 1 year; patients aged 18 years or older.

**2.43 Hospital-day rates, by modality**
Patients prevalent on the first day of the year or quarter & rates within the year or quarter; patients aged 18 years or older.

Lengths of stay for cardiovascular hospitalizations are shown in Figures 2.42-2.43. Cardiovascular hospitalizations in the incident populations accounted for 5.7 days for hemodialysis and 4.1 days for peritoneal dialysis patients in 2003, decreasing to 3.8 days and 2.5 days, respectively, in 2012. These represent 32.8% and 38.5% decreases, respectively. First-year cardiovascular hospital days were about 34% lower for peritoneal dialysis than for hemodialysis patients. However, in the prevalent populations, hospital days per patient-year were similar for both modalities. From 2004 to 2010, cardiovascular hospitalization days among prevalent patients were 7%-14% lower for peritoneal dialysis patients than for hemodialysis patients, but the difference narrowed to 5%-6% from 2011 to 2013. Cardiovascular hospitalization days per patient-year decreased substantially for the prevalent hemodialysis and peritoneal dialysis populations, 36.0% and 35.0%, respectively, from 2004 to 2013. Slowing of the decreases noted in the incident peritoneal dialysis population and lack of progress in the prevalent peritoneal dialysis population in 2010 and 2011 may reflect expansion of peritoneal dialysis therapy under the new bundled dialysis payment system, as incentives were created for peritoneal dialysis as a home-based therapy. Fortunately, declines in prevalent peritoneal dialysis patient cardiovascular hospitalizations resumed in 2012, mirroring declines for hemodialysis patients, normalized to patient-years of exposure.
From 2003 to 2012, the number of hospital days per patient-year with infection as the primary discharge diagnosis remained about 6.5 among incident hemodialysis patients but declined slightly for peritoneal dialysis patients (Figures 2.44). In 2012, infections accounted for almost 6 of the approximately 16 total days per year among incident hemodialysis patients, and for about 3 of the approximately 9.5 days among incident peritoneal dialysis patients. From 2003 to 2012, infection hospitalization days per patient-year decreased 7.1% for hemodialysis and 21.1% for peritoneal dialysis patients. Infection hospital days in the first year for peritoneal dialysis patients were almost half those for hemodialysis patients. For prevalent patients, the patterns differed; the number of infection hospital days averaged about 30% higher for peritoneal dialysis than for hemodialysis patients (Figure 2.45). Infection hospital days decreased over the past 10 years, 14.6% for hemodialysis and 21.6% for peritoneal dialysis patients. The gap between modalities closed as the number of days decreased, but further progress is needed.

Infection control has been a focus of CMS state surveyor reviews of dialysis units in recent years, and infection control procedures are the most frequently cited concern. Infection control measures are important in the in-center setting, regarding touch contamination and vascular access procedures, and in the home hemodialysis setting, where procedural inconsistency may contribute to higher infection rates. Infection control may extend beyond vascular access and blood-borne infections, to conditions such as respiratory diseases during the influenza-like illness winter months.

Seasonal variations in hospitalizations and mortality raise concerns about potential transmission of communicable respiratory diseases in dialysis units, which may be more important than previously considered. Dialysis units collect immunosuppressed patients into a common space where these diseases may be more easily transmitted. Pragmatic clinical trials on a unit level could be carried out to help understand whether greater attention to communicable disease control practices would reduce the transmission of respiratory diseases.
Assessing emergency department (ED) and observation stays is complex because they may occur separately or combined on the same hospital claim. Some patients seen in the ED and are discharged to their respective care settings. Some patients are seen as observation stays, have no ED revenue coded services, and are discharged to their care settings. However, some ED-observation stays are billed together. Figure 2.46 shows the distribution of claims for ED visits and observation stays separately and combined. In 2004, ED visits accounted for about 80% of acute non-hospitalization visits, declining to about 70% in 2013. Observation stays and observation stays with ED visits have increased, accounting for almost 30% of acute care hospital visits in 2013, compared with only about 20% in 2004.

Determining the reasons for ED and observation visits is more complex than for hospitalization because symptom codes are used frequently in the primary diagnosis field. We assessed diagnosis codes in the first five positions to clinically define disease conditions. Cardiovascular disease accounted for about 50% of the ED/observation visits in 2004 and for almost 65% by 2013, a more than 40% increase (Figures 2.49 and 2.50). Infection coded in the first five positions ranged from 21.4 per 100 patient-years in 2004 among prevalent patients to 27.8 by 2013, a 29.4% increase (Figures 2.51 and 2.52).
2.47 First-year ED visit/obs stay rates, all-causes
*Patients incident within the year or quarter & followed for up to 1 year; patients aged 18 years or older.*

2.48 Annual & quarterly ED visit/obs stay rates, all-causes
*Patients prevalent on the first day of the year or quarter & rates within the year or quarter; patients aged 18 years or older.*

2.49 First-year ED visit/obs stay rates, cardiovascular
*Patients incident within the year or quarter & followed for up to 1 year; patients aged 18 years or older. Cardiovascular-related diagnosis in any of the first 5 diagnosis code positions.*

2.50 Annual & quarterly ED visit/obs stay rates, cardiovascular
*Patients prevalent on the first day of the year or quarter & rates within the year or quarter; patients aged 18 years or older. Cardiovascular-related diagnosis in any of the first 5 diagnosis code positions.*

2.51 First-year ED visit/obs stay rates, infection
*Patients incident within the year or quarter & followed for up to 1 year; patients aged 18 years or older. Infection diagnosis in any of the first 5 diagnosis code positions.*

2.52 Annual & quarterly ED visit/obs stay rates, infection
*Patients prevalent on the first day of the month or quarter & rates within the year or quarter; patients aged 18 years or older. Infection diagnosis in any of the first 5 diagnosis code positions.*
This year we present information on hospital readmissions within 30 days of discharge for dialysis patients in freestanding dialysis units. The readmission data must be understood in the context of the overall Medicare QIP for hospitals to reduce readmissions within 30 days for acute myocardial infarction, congestive heart failure, and pneumonia, first assessed in October 2012. The general Medicare program imposed a financial penalty of a 1% decrease in all DGR payments if the adjusted readmission rate was greater than the national average for all discharges in fiscal year October 2012 through September 2013. The decrease was 2% in the next year and 3% in the third year. Additional readmission diagnoses were added in 2015 for chronic lung disease and hip and knee arthroplasty. Oncology patients were excluded from assessment but ESRD patients were not specifically targeted or excluded (https://www.cms.gov/medicare/medicare-fee-for-service-payment/acuteinpatientpps/readmissions-reduction-program.html).

Most patients (72.0%) were discharged to home and the outpatient dialysis unit (Figure 2.53). Discharges to skilled nursing facilities accounted for 18.8%, to hospice 7.3%, and to other care settings 1.9%. Of patients sent to the home setting, 55.8% were discharged with no additional care assistance, and 16.3% were discharged with home health follow-up care (Figure 2.56).
2.54 Type of inpatient facility among living discharges on maintenance dialysis
Hospital admissions in 2013; patients aged 18 years or older.

2.55 Total number of living discharges on maintenance dialysis, per hospital
Hospital admissions in 2013; patients aged 18 years or older.

2.56 Discharge status among living discharges on maintenance dialysis
Hospital admissions in 2013; patients aged 18 years or older.
The index hospitalization discharge destination was associated with differing rates of readmissions within 30 days, as shown in Figure 2.57. The 30-day readmission rate was 31.3% for patients discharged to home with no supportive care and 36.4% for those with home health assistance. The rate was 37.5% for patients discharged to a skilled nursing facility. The 30-day rate for patients who left the hospital against medical advice was 54.1%.

The readmission percentage within 30 days was relatively constant from 2004 to 2011 at about 35%-36%, then decreased over the next two years to 33.4% in 2013 (Figure 2.58). Regional readmission percentages within 30 days are shown in Figure 2.59. The rate was about 36% from 1999 to 2011, and then the rate decreased to 34.4% in 2012 and 33.3% in 2013, an almost 8% decrease since 2011. Overall and across divisions, rates followed this pattern of generally no change from 1999 to 2011 and then a decline from 2011 to 2013. Geographically, reductions ranged from about 9% in the Mid-Atlantic and East North Central census divisions to about 7% in the West South Central and Pacific divisions from 2011 to 2013. The largest reductions occurred in regions with the highest overall hospitalization rates shown earlier in this chapter (Figures 2.2 and 2.4).
30-day readmission rates among living discharges on maintenance dialysis, by US census division & state

In short-term & critical access hospitals; patients aged 18 years or older. Rate as percentage of discharges. APC, annual percent change. Maps show 2013 rates.

Division 1 ● New England

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APC sparklines

- The 30-day readmission rate in New England peaked in 2008-2010 and then declined in successive years, for an overall decrease of about 8% from 2004 to 2013.
- The states in this division did not follow a consistent trend over the years studied.
- Massachusetts had the highest 30-day readmission rates in the division at 35.6% in 2013, compared with 23.8% in Vermont.
- * Denotes cells with 11 or fewer.

Division 2 ● Mid Atlantic

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APC sparklines

- The 30-day readmission rate in the Middle Atlantic division was 34.1% in 2013, among the highest of all US census divisions.
- The readmission rate was relatively constant from 2004 to 2011, then decreased in 2012 and again in 2013; rates dropped 8.9% from 2001 to 2013.
- The pattern for states in this division was similar to the overall pattern, with declines in the most recent two years.

Division 3 ● East North Central

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APC sparklines

- The 30-day readmission rate in the East North Central division was 35.2% in 2013, the highest among all US census divisions.
- Within the division, Illinois and Michigan had the highest readmission rates in 2013 at 35.7% and 36.5%, respectively.
- Wisconsin, at 31.8%, had the lowest rates of the division in 2013.
### 30-day readmission rates among living discharges on maintenance dialysis, by US census division & state

**In short-term & critical access hospitals; patients aged 18 years or older. Rate as percentage of discharges. APC, annual percent change. Maps show 2013 rates.**

#### Division 4 ● West North Central

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- The 30-day readmission rate in the West North Central division remained nearly unchanged from 2004 to 2011 at slightly over 36%, then decreased to 33.3% in 2013, a decline of 8.5% from 2011 to 2013.
- Overall change, however, was only 0.7% per year.
- Within the division, Minnesota had the highest rate in 2013, 35.0%, and North Dakota the lowest, 23.1%.

#### Division 5 ● South Atlantic

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- In the South Atlantic division, rates generally decreased across the decade studied with an overall estimated decline of about 0.7% per year, ending in a 30-day readmission rate of 33.6% in 2013.
- The readmission rate in Maryland was 37.2% in 2013, one of the highest in the nation, although it declined, from 2004 to 2013, more than in any other state in the division.

#### Division 6 ● East South Central

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- The 30-day readmission rate in the East South Central division was mostly unchanged from 2004 to 2011 at slightly over 35%, then decreased to 33.0% by 2013.
- Tennessee and Alabama had the most consistent improvement in rates with an annual decline of 1.1%.
- In Kentucky and Mississippi, rates were elevated from 2008 to 2011, then followed the division pattern of decreasing in 2012 and 2013.
2.c 30-day readmission rates among living discharges on maintenance dialysis, by US census division & state, divisions 7-9

In short-term & critical access hospitals; patients aged 18 years or older. Rate as percentage of discharges. APC, annual percent change. Maps show 2013 rates.

Division 7 • West South Central

- The 30-day readmission rate in the West South Central division declined by almost 1% per year from 2004 to 2013, a relatively rapid decline compared with other US census divisions.
- Within the division, the readmission rate tended to decrease in all states.
- Rates were very similar among the states in this division in 2013; Louisiana had the highest, at 32.7%, and Arkansas the lowest, at 31.6%.

Division 8 • Mountain

- In the Mountain division, the 30-day readmission rate decreased markedly from 2011 to 2013 (8.6% decline) to 31.5% in 2013.
- While rates within the division tended to decline over the decade, they varied substantially from year to year.

Division 9 • Pacific

- The 30-day readmission rate in the Pacific division was 34.6% in 2011, nearly unchanged from 2004, and declined to 32.4% in 2013.
- Within the division, Alaska had both the largest decline (annual percent change -3.5) from 2004 to 2013) and the lowest 2013 rate, 24.6%.
- In 2013, readmission rates within the division were highest in California, at 33.1%.
Readmissions may occur very soon after discharge or several weeks later. Figure 2.60 displays the cumulative readmission rate by days after discharge. Half of readmissions occurred within the first 10 days after discharge and two-thirds within 18 days. The overall 30-day readmission rate was 33.4% and the rate within 10 days 16.1%. Initial hospitalizations that occurred on the weekend were associated with slightly higher readmission rates, especially after the first 10 days. The 30-day readmission rate was 33.0% when the initial admission was on a weekday and 34.9% when it was on a weekend.

Rates of readmission after cardiovascular hospitalization were initially higher than corresponding rates after infection, but the difference decreased with more days from discharge (2.61). Within 1 to 10 days after discharge, the readmission rate from cardiovascular hospitalizations was 16.7% compared with only 14.4% after infection hospitalizations. The rates of readmission within 21 to 30 days of discharge from cardiovascular compared with infection hospitalizations were 7.4% and 7.2%, respectively. Rates within 1 to 10 days were highest for acute coronary syndrome (19.0%), hyperkalemia (17.0%), fluid overload/pleural effusion (17.0%), and bacteremia/septicemia (16.9%).
2.61 30-day readmission rates among living discharges on maintenance dialysis, by primary discharge diagnosis

In short-term & critical access hospitals; patients aged 18 years or older.

- Cardiomyopathy
- Arrhythmia
- Heart failure & cardiomyopathy
- Fluid overload & pleural effusion
- Stroke

- Infection as the primary discharge diagnosis
- Bacteremia & septicemia
- Dialysis access infection, including peritonitis
- Pneumonia & influenza
- Intestinal infection with C. difficile

- Gastrointestinal hemorrhage
- Acute respiratory failure
- Chronic pulmonary disease
- Dialysis access complication, excluding infection
- Hyperkalemia

Readmission within 1-10 days
Readmission within 11-20 days
Readmission within 21-30 days
Death
Beginning in about 2005, hospitalization rates among both incident and prevalent dialysis patients in freestanding facilities declined, although geographic variation was substantial.

Across the dialysis population, hospitalization for principle diagnosis of cardiovascular disease decreased, with clear declines in the incidence of admissions for heart failure/cardiomyopathy and stroke. However, for non-ischemic morbidity, gains were more elusive. The rate of admission for arrhythmia did not change and the declining rate of admission for heart failure was partially counterbalanced by an increasing rage of admission for fluid overload.

Across the dialysis population, hospitalization for infection changed little, although some promising signs of modest declines appeared in recent years. Rates of admission for dialysis access infections steadily declined over the past decade, but rates of *C. difficile*, when considered as a primary discharge diagnosis, appear to have increased.

Seasonality was a common feature of hospital admissions for a number of diagnoses. Predictably, pneumonia and influenza exhibited marked seasonality. Admissions for chronic pulmonary disease also exhibited seasonality, presumably as a result of acute exacerbations of underlying disease secondary to respiratory infections. Admissions for dialysis access infections peaked annually in the summer months, possibly due to increased heat and humidity.

Hospital lengths of stay declined in both the incident and prevalent dialysis populations, especially for cardiovascular hospitalizations.

Overall, rates of ED visits or observation stays appear to have slowly increased over the past decade, likely as part of larger trends in the US healthcare system.

Readmission within 30 days of a living discharge was common among dialysis patients; likelihood of readmission within the first 10 days was especially high. A slight decrease in recent years reduced readmissions to 33.4% in 2013, down from approximately 35% to 36% in previous years. Readmission rates demonstrated substantial geographic variation.