



Peer Kidney Care Initiative

PEER REPORT

Dialysis Care & Outcomes
in the United States, 2014

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In collaboration with the Chief Medical Officers of these organizations, the Peer Kidney Care Initiative is operated by the Chronic Disease Research Group, a division of the Minneapolis Medical Research Foundation, in Minneapolis, Minnesota. Allan Collins, MD, FACP, is the Executive Director of Peer and Eric Weinhandl, MS, PhD candidate, is the Principal Investigator. Allan Collins serves as a co-investigator on Phase I and II studies for DaVita Clinical Research. Eric Weinhandl reports no conflict of interest. Graphic design work was provided by Susan Everson, PhD, and Edward Constantini, MA. Analytic support was provided by Craig Solid, PhD, Suying Li, PhD, and David Gilberston, PhD.

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IMAGES Front cover: Copperplate engraving: Ch. Thiemen, physician in hospital sickroom, 1682. Otto Wilhelm Thomé, digitalis (fox-glove, used to treat cardiovascular disease), *Flora von Deutschland, Österreich und der Schweiz*, 1885. Back cover: Janus Kops, cranberries (used to treat wounds, urinary disorders, diabetes), *Flora Batava*, 1872.

TITLE PAGE IMAGE Janus Kops, alfalfa (used to treat digestive and kidney disorders), *Flora Batava*, 1881.

TABLE OF CONTENTS IMAGE Jan Beerblock, Medieval infirmary, circa 1778.

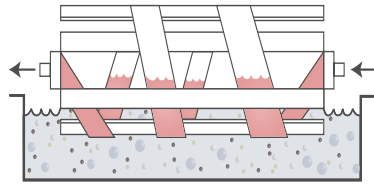
peerkidney.org



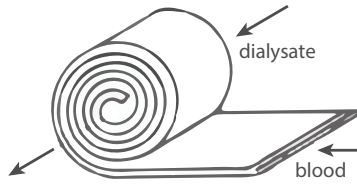
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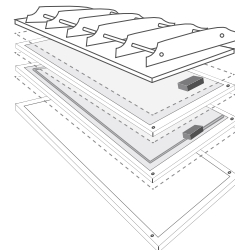
A HISTORY OF DIALYSIS



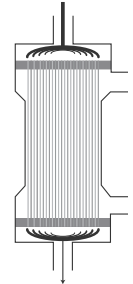
DRUM DIALYZER



STATIC COIL DIALYZER



PARALLEL PLATE DIALYZER



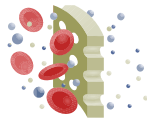
HOLLOW FIBER DIALYZER

Hemodialysis

1861 Thomas Graham coins the word “dialysis,” from the Greek “dia,” meaning through, and “lysis,” to loosen. He also creates the Hoop dialyzer, tying parchment around a hoop floating in water. Into this hoop dialyzer he places solutions of colloids and crystalloids, and demonstrates that only crystalloids pass through the membrane.

1855 German physiologist Adolph Fick uses membranes made from collodion, which allow diffusion of small particles, and proposes the quantitative laws of diffusion.

1854 Scottish chemist Thomas Graham presents a paper entitled “On Osmotic Force,” describing the principles of solute transport across a semipermeable membrane. Having founded the study of colloids, he is widely regarded as the father of colloidal chemistry.



1923 German physician Heinrich Necheles develops a “sandwich” technique to increase the surface area of a dialyzer membrane in relation to blood volume, ultimately increasing dialysis efficiency.

1914 Charles von Hess and Hugh McGuigan, at Northwestern University, improve the efficiency of the vividiffusion apparatus by creating pulsatile flow through the celloidin tubes, thus inhibiting clotting. They also introduce the use of a turbulent flow dialysis fluid around the dialyzing tubes, a principle still used in modern dialysis.

1913 At Johns Hopkins University, John Able, Leonard Rowntree, and BB Turner devise a vividiffusion apparatus they call an “artificial kidney,” which consists of a series of tubes made of celloidin contained in a glass jacket filled with saline or artificial serum. They describe a method “by which the blood of a living animal may be submitted to dialysis outside the body and again returned to the natural circulation.”



Related developments

1896 Mathieu Jaboulay and Eugene Briau (Lyon, France) and John Murphy (Chicago) use experimental techniques for repair or anastomosis of blood vessels, laying the foundation for dialysis vascular access.

1902 French surgeon and biologist Alexis Carrel publishes on the three-point end-to-end and side-to-side blood vessel anastomosis techniques.

1916 Working under WH Howell at Johns Hopkins University, medical student Jay McLean isolates heparin from canine liver cells. Howell coins the term “heparin” two years later.

Peritoneal dialysis

1744–1745 Christopher Warrick and the Reverend Stephan Hales introduce peritoneal lavage for the treatment of severe ascites. **1877** German investigator G Wegner reports on animal experiments involving the perfusion of the abdominal cavity with cold saline, and determines the absorption rates of various solutions from the peritoneum. **1894** English physiologist EH Starling and cohorts confirm the work of Wegner and describe the fluid removal characteristics of the peritoneum. **1923** Georg Ganter performs the first clinical application of peritoneal dialysis. **1930s** Peritoneal dialysis remains relatively unknown as a treatment for uremia, with clinicians lacking knowledge about its efficiency and procedural issues such as optimal flows and perfusion fluid concentrations. **1946** Boston physicians Howard Frank, Arnold Seligman, and Jacob Fine report a successful application of peritoneal irrigation on a patient with severe uremia. **1959** Intermittent peritoneal dialysis gradually becomes a safe and standardized technique thanks to the pioneering work of groups headed by PD Doolan and MH Maxwell. **1959** The first case of chronic, irreversible renal failure is successfully treated with intermittent peritoneal dialysis (IPD). **1962** ST Boen and colleagues introduce the automatic cycling machine, making periodic peritoneal dialysis far more dependable. **1964–1966** Semiautomatic peritoneal dialysis cyler machines are used to treat patients. Boen publishes the first textbook on PD for use in clinical medicine. **1965** Recirculation peritoneal dialysis is introduced. **1968** The Tenckhoff in-dwelling catheter, which allows long-term access to the abdominal cavity, is introduced. **1972** Closed loop, reverse osmosis automatic peritoneal dialysis machines are introduced. **1976** J Moncrief and R Popovich propose the kinetics of continuous ambulatory peritoneal dialysis (CAPD). **1978** Reciprocating, fresh fluid semicontinuous PD is introduced, aimed at improving peritoneal clearance. **1981** JA Diaz Buxo and FF Adams introduce continuous cyclic peritoneal dialysis (CCPD).

1956 Dr. Frank Parsons installs a Kolff-Brigham rotating drum dialysis machine in the Leeds' General Infirmary, establishing the first artificial kidney unit in the UK. ♦ With development help from Willem Kolff, the first pre-sterilized, disposable coil dialyzer is made commercially available by Baxter Laboratories.

1952 During the Korean war, Colonel Paul Techan reports use of the Kolff-Brigham Drum Kidney for treating severely injured troops.

1948 Using stainless steel, researchers at Peter Bent Brigham Hospital in Boston develop the Kolff-Brigham rotating drum kidney. ♦ At Mount Sinai Hospital in New York, Drs. Alfred Fishman and Irving Kroop use a Kolff machine to perform the first human dialysis in the United States.

1947 Swedish physician Nils Alwall develops the first dialyzer with controllable ultrafiltration, creating the first truly practical device for hemodialysis.

1946 At Case Western Reserve University in Ohio, Leonard Skeggs and Jack Leonards develop a large-surface multichannel dialyzer using two sheets of membrane sandwiched between two rubber pads, reducing blood volume and assuring a uniform distribution of blood across the membrane.

1945 Canadian surgeon Gordon Murray designs a static coil dialyzer, with cellophane tubing wound around a steel frame, and is credited with the first successful use of an artificial kidney machine in North America.

1943–1945 In the Netherlands, Willem Kolff constructs the first modern drum dialyzer. In 1945, a 67 year-old woman in a uremic coma becomes the first patient successfully treated with the Kolff dialyzer.

1940

1950

1960

1970

1980

1990

2000

2010

1935 The first human trials of heparin begin in May, 1935. By 1937 it is clear that heparin is a safe, easily-available, and effective blood anticoagulant.

1947 At Michael Reese Hospital in Chicago, MR Malinow and W Korzon pioneer methods of fluid removal from the blood of uremic animals using negative pressure.

1949 Swedish physician Nils Alwall conducts experiments on vascular access using rubber tubing and a glass cannula device to connect an artery and vein, but results are unsuccessful.

1964 Richard Stewart and colleagues at Dow Chemical Company develop the first capillary dialyzer, with hollow fiber membranes made from deacetylated cellulose di-acetate.

1962 The first outpatient dialysis unit opens in Seattle.

1960 Norwegian Fredrik Kiil modifies a Skeggs-Leonard dialyzer and develops the Kiil parallel-plate dialyzer, increasing solute clearance efficiency.

1960 In Seattle, Belding Scribner, Wayne Quinton, and David Dillard advance the arteriovenous shunt, using silastic tubes fitted with Teflon tips. This shunt provides continuous circulation of the blood when the patient is not attached to the machine, effectively eliminating clotting, providing ready access for repeated long-term hemodialysis, and opening the door to chronic renal replacement therapy.

1961 In London, Stanley Shaldon introduces the temporary femoral vein catheter for use in acute and chronic dialysis.

1966 Brescia, Cimino, Appel, and Hurwich describe a native arteriovenous fistula for chronic vascular access, generally created by an end-to-side vein-to-artery anastomosis. A mature native AV fistula is by far the safest and longest lasting vascular access for hemodialysis.

1973 T Buselmeier and colleagues introduce a new subcutaneous shunt.

Dialyzer types

COIL DIALYZER The first single use hemodialyzer. Early designs used a tubular membrane supported by a fibrous mesh wound around a central core. Use of the coil dialyzer gradually declined as more efficient hemodialyzer designs evolved. **SINGLE USE FLAT PLATE DIALYZER** Dialyzers of this type consist of membrane sheets supported on either side by rigid plastic plates. During the early 1960s, these types of dialyzers (Kiil) were considered non-disposable, with only the membrane and blood ports requiring replacement. The Gambro-Alwall dialyzer was the first commercially produced device of this type exhibiting a greatly reduced physical size. **HOLLOW FIBER DIALYZER** Present designs of the hollow fiber hemodialyzer can be traced back to experimental designs in the early 1960s from the Cordis Dow Chemical Company, consisting of regenerated cellulosic hollow fibers. Until 1975, these were the only commercially available fibers for use in hemodialyzers. Since 1975, more refined hollow fiber dialyzers using modified cellulosic and synthetic membranes have become available. **HIGH FLUX DIALYZER** Dialyzers of this type are the newest generation of the hollow fiber dialyzers, constructed of synthetic membranes that offer larger pore sizes for increased middle molecule clearance and higher ultrafiltration coefficients, and said to be more biocompatible than their low-flux counterparts.

1993 The Renal Physicians Association publishes "Clinical Practice Guidelines on Adequacy of Hemodialysis," defining acceptable methods for measuring hemodialysis adequacy (urea kinetic modeling) and a minimum acceptable level of hemodialysis dose ($Kt/V=1.2$, or a urea reduction ratio of 65%).

1980s High-efficiency therapies (hemodialysis, hemofiltration, hemodiafiltration, and high-flux dialysis) are introduced, yielding shortened dialysis times. ♦ Ultrafiltration control systems are incorporated into hemodialysis delivery systems allowing precise fluid removal and safe use of hemodialyzers with high ultrafiltration coefficients.

1985 Drs. Frank Gotch and John Sargent present a mathematical description of urea kinetics (Kt/V), establishing the measurement as an important marker of clinical outcomes.

1981 The National Cooperative Dialysis Study (NCDS) establishes that average urea concentration and protein catabolic rate (PCR) are important factors in determining morbidity and mortality in hemodialysis patients, and that a higher dialysis dose results in reduced morbidity.

Milestones in dialysis policy

1972 Congress passes the Social Security Amendments of 1972, authorizing Medicare coverage of the End-Stage Renal Disease (ESRD) program in patients younger than 65. **1973** The ESRD program launches on July 1. **1978** Congress authorizes creation of the ESRD networks. **1981** The Omnibus Budget Reconciliation Act (OMBA) includes a Medicare Secondary Payor provision. **1983** The composite rate payment system for dialysis becomes effective; cyclosporine is introduced. **1988** The United States Renal Data System is established. **1989** Erythropoietin (EPO) receives FDA approval. **1990** The United States Department of Health & Human Services develops the Healthy People 2000 initiative. **1995** The National Kidney Foundation (NKF) launches the Dialysis Outcomes Quality Initiative (KDOQI). **1997** The NKF publishes KDOQI guidelines; the Health Care Financing Administration (HCFA) begins the Hematocrit Measurement Audit program. **2001** The National Institutes of Health begin the National Kidney Disease Education Program (NKDEP). **2004** The Center for Medicare and Medicaid Services (CMS) launches the Fistula First initiative, aimed at increasing the use of arteriovenous fistulas in hemodialysis patients. **2006** CMS adopts 26 new Clinical Performance Measures to monitor the quality of care received by ESRD patients. **2011** The new bundled Prospective Payment System for dialysis patients is implemented.

EXECUTIVE SUMMARY

The Peer Kidney Care Initiative is the result of collaboration among the Chief Medical Officers (CMOs) of thirteen dialysis provider organizations in the United States, including all of the ten largest organizations, according to number of patients treated. The overarching emphases of Peer are on the ways by which provider organizations are addressing the challenges of mortality, morbidity, quality of life, and patient satisfaction, both collaboratively and within each provider organization, and on how provider organizations can learn from one another through examination of available data, all with the goal of advancing patient care. Objectivity is an important aim of Peer, with foci on the successes in the industry and on directions for improvement.

The first meeting of the CMOs was held in Chicago in March 2013, and organized by DaVita HealthCare Partners, Dialysis Clinic, Inc. (DCI), Fresenius Medical Care, and Renal Ventures Management, with Tom F. Parker III, MD, and Doug Johnson, MD, providing the initial structure. This was entirely a clinical meeting, attended by those involved daily in patient care issues. Material was presented on the morbidity associated with fluid overload and left ventricular hypertrophy, as well as on infectious complications, sudden cardiac death, catheters for vascular access, and other topics affecting outcomes. Members of the group shared information on the different approaches used by each dialysis provider to address these and other clinical challenges.

The second meeting of the CMOs was held in Baltimore in March 2014. Participants described their efforts during the prior year and discussed new directions to further address fluid overload and congestive heart failure, infectious complications, sudden cardiac death, dialysis bath composition, and reduction of readmission rates. The predominant feeling was that traditional quality measures are insufficient tools for achieving desired improvements. Members of the group began considering a more comprehensive effort aimed at change via collaborative data sharing, relying on both Medicare and provider data to guide efforts at the local and national levels.

The Chronic Disease Research Group (CDRG), which previously served as the contractor for the United States Renal Data System (USRDS) Coordinating Center, participated in these first meetings, presenting an array of issues related to morbidity and mortality that providers could consider for focused attention. In the months following the second meeting, the CMOs and CDRG developed the Peer Kidney Care Initiative, a collaborative group aimed at assessing a wide range of areas of care, with a focus on enhancing patient outcomes and reducing hospitalizations and premature deaths. Guided by the providers and the appointed Steering Committee, CDRG serves as the independently operated Data Coordinating Center. In this first report, Peer examines Medicare data.

Although organizations such as the USRDS have long presented data on patient care and outcomes, areas that relate more directly to the delivery



Gerrit Dou, *The Dropsical Woman*, 1663

of care have only occasionally received attention. Overall mortality on an annual basis, for example, has been reported for 25 years, yet few if any organizations have reported variation in mortality within each year. In this first report, we show that mortality patterns vary seasonally, with the highest rates occurring in January through March of each year, an intuitive finding in light of the seasonal virulence of influenza and other upper respiratory infections in the general population. We also show that counts of incident ESRD patients are cyclical, as are rates of various cause-specific hospital admissions, including acute coronary syndrome, arrhythmia, heart failure, and chronic pulmonary disease. These patterns raise questions about preventive care and interventions, at the levels of the dialysis facility and provider organization alike, that might blunt the impact of this seasonal burden.

This first Peer Report is framed with artwork illustrating the relationships among patients, families, and healthcare providers. As they teach and learn from one another, each provides a different perspective on human existence under the stress of illness. From depictions of medieval patient wards—which bear a remarkable similarity to patient modules in contemporary dialysis units—to those showing the care of soldiers in twentieth-century wars, these paintings illustrate how the interaction of doctors, nurses, patients, and families remains at the center of medical care. We place this relationship of peers at the center of the Peer Kidney Care Initiative, as we work to advance care and improve outcomes for patients undergoing dialysis.

In this first Peer Report we show how mortality patterns vary seasonally, with the highest rates occurring in January through March of each year—a finding not unexpected, considering the seasonal virulence of influenza and other upper respiratory virus infections in the general population.

EXECUTIVE SUMMARY

To give our work additional context and perspective, we first present a brief history of dialysis therapy. The timeline begins in 1854, when chemist Thomas Graham presented a paper entitled “On Osmotic Force,” describing solute transfer across a semipermeable membrane, thereby founding the study of colloidal chemistry. The historical details are quite remarkable, and frequently forgotten in the current era, as dialysis procedures have become routine and commoditized for widespread application.

Other important markers in the history of hemodialysis include the creation in 1960 of the arteriovenous shunt by Belding Scribner, Wayne Quinton, and David Dillard. Using a silastic tube with Teflon tips to connect the radial artery to the cephalic vein, Scribner and colleagues created the first sustainable vascular access for hemodialysis. The dialysis membrane itself evolved through several different configurations, including the rotating drum designed by Willem Kolff in 1945; the coil dialyzer created by Gordon Murray in the same year; the Kiil dialyzer with parallel plates in a steel frame, developed in 1960; and finally the hollow fiber dialyzer, created in 1964 by the Dow Chemical Company. Subsequent years saw the development of more biocompatible synthetic membranes, used in the range of dialyzers that are available today.

Peritoneal dialysis has also had a unique history. In 1976, Jack Moncrief and Robert Popovich developed continuous ambulatory peritoneal dialysis (CAPD). Shortly thereafter, in 1981, Jose Diaz-Buxo introduced continuous cyclic peritoneal dialysis (CCPD), leading to today’s dominant variant of peritoneal dialysis treatment in the U.S.

While many challenges remain in the work to advance dialysis patient care, the remarkable evolution of dialysis treatment has allowed millions of individuals around the world to extend their lives.

This report uses unadjusted data to give a clear picture, on national and regional levels, of trends in clinical outcomes. On the levels of U.S. Census Divisions and constituent states, these data reflect stark variation in local trends, with impressive progress in some areas and middling progress in others. In subsequent Peer reports, we will develop adjusted rates and risks and contrast them with unadjusted inferences. As it is widely understood that the U.S. dialysis population has become more complex during the past 25 years, the data presented here generally reflect minimum achieved changes in risk with passing time.

In the first section, we describe the incidence of ESRD. We show how the rate rose during the late 1990s and early 2000s, but plateaued in the middle of the 2000s, and even declined slightly between 2010 and 2011. Data stratified by U.S. Census Division and age, however, demonstrate that this pattern has not been uniform. Trends in the number of incident patients have also been quite different across both U.S. Census Divisions and constituent states, obviously due in part to the size of the local population. We also examine pre-dialysis care delivered by nephrologists and cardiologists, and

The paintings in this report illustrate how the interaction of doctors, nurses, patients, and families remains at the center of medical care on a human level. We place this relationship of peers at the center of the Peer Dialysis Initiative, as we work to advance care and improve outcomes for patients receiving dialysis therapy.

examine patient comorbidity at dialysis initiation, as ascertained from the Medical Evidence Report and diagnosis codes in Medicare claims around dialysis initiation. Comorbidity data from the Medical Evidence Report are used in risk adjustment schema for several CMS metrics, but we show that discordance between the Medical Evidence Report and diagnoses in claims is substantial. We conclude by examining trends in vascular access at dialysis initiation; the data demonstrate that widespread use of catheters at dialysis initiation continues, likely acting as a drag on early outcomes after initiation.

We next focus on hospitalization, reviewing trends in rates of admission and length of stay, overall and by specific causes. Data illustrate variation in rates across U.S. Census Divisions and constituent states, changes in rates during the first year of dialysis, and, for the prevalent population, cyclical patterns of rates across the seasons.

The subsequent section regarding mortality also illustrates seasonal variation in outcomes. Data about mortality during the first year of dialysis demonstrate that some areas of the country have realized little progress, while others have achieved consistent gains. Mortality rates have declined overall, particularly since 2004, and growth in the cumulative number of deaths per year has slowed—an important finding. Declining mortality rates translate to longer lives, as illustrated by displays of gains in expected remaining lifetimes and deaths averted.

We conclude by examining the 5-Star Quality Rating System that CMS reveals in 2015. We analyze public use files at data.medicare.gov to assess the current methodology, and compare ratings to those derived from alternative definitions that rely on the same seven metrics used by CMS. The different results yielded by these analyses suggest that star ratings are not as stable as they might seem, and that consumer conceptions of quality may depend heavily on the methodology of the system. Whether geography plays an important role in the distribution of star ratings, as it does in the patterns of hospitalization and mortality, is unaddressed, but represents a target of future investigation.

In subsequent reports, we will assess additional areas of provider performance, with the Peer Data Coordinating Center continuing to work with the Steering Committee to identify priorities that can be accurately measured and are within the domain of dialysis providers to address. As new areas are identified, they will become part of the Peer assessment of provider performance.

We are committed to change through an understanding of meaningful outcomes data. Our progress has been remarkable, but we believe that we can do more. As President John F. Kennedy remarked, “The problems of the world cannot possibly be solved by skeptics or cynics, by blank faces in the crowd, whose horizons are limited by the obvious realities. We need men and women who can dream of things that never were.”

Mortality rates have declined overall, particularly since 2004, and the number of deaths has slowed—an important finding. These declining rates result in increased survival of the existing population, illustrated by data showing the cumulative number of lives saved.

EXECUTIVE SUMMARY

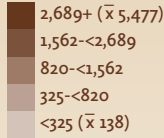
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DIVISION 2 MIDDLE ATLANTIC

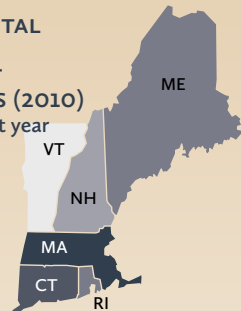
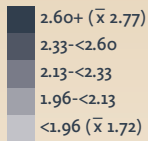
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DIVISION 4 WEST NORTH CENTRAL

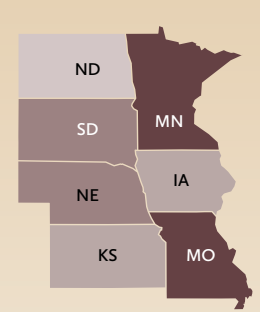
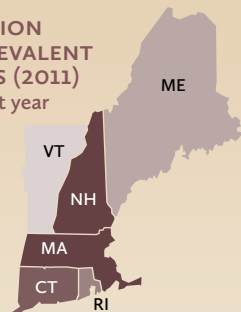
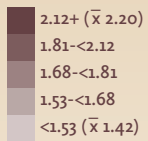
COUNTS OF INCIDENT ESRD CASES INITIATING ON DIALYSIS IN FREESTANDING FACILITIES (2011)



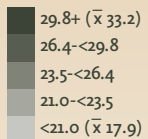
FIRST-YEAR HOSPITAL ADMISSION RATES AMONG INCIDENT DIALYSIS PATIENTS (2010)
admissions per patient year



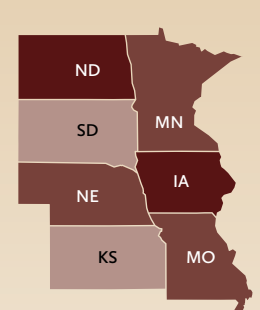
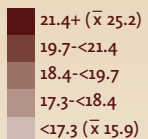
HOSPITAL ADMISSION RATES AMONG PREVALENT DIALYSIS PATIENTS (2011)
admissions per patient year



FIRST-YEAR MORTALITY RATES AMONG INCIDENT DIALYSIS PATIENTS (2011)
deaths per 100 patient years



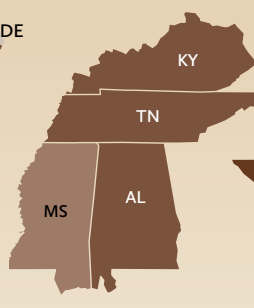
MORTALITY RATES IN PREVALENT DIALYSIS PATIENTS (2011)
deaths per 100 patient years



DIVISION 5
SOUTH ATLANTIC



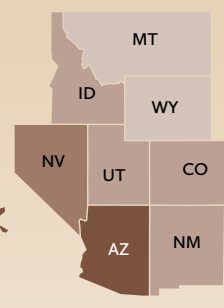
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EAST SOUTH CENTRAL



DIVISION 7
WEST SOUTH CENTRAL



DIVISION 8
MOUNTAIN

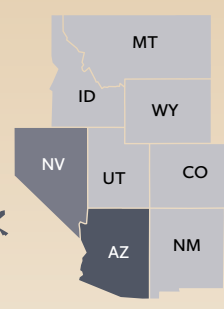
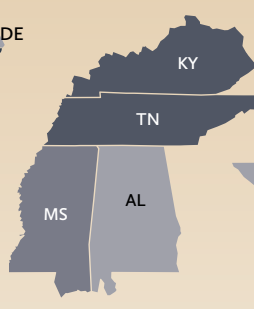


DIVISION 9
PACIFIC



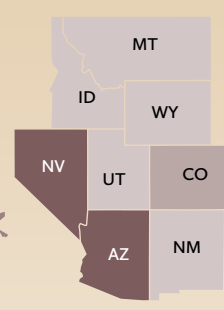
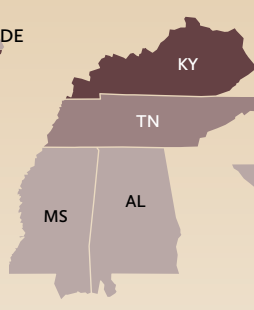
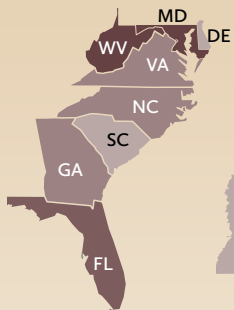
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2004-2011



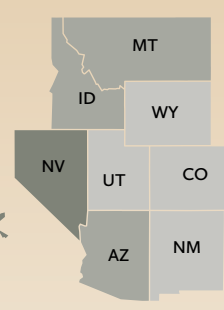
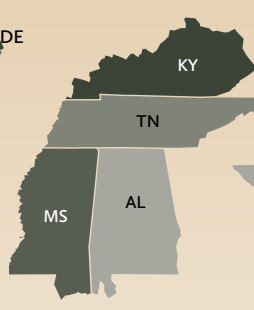
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8	-1.3
9	-1.8

2003-2010



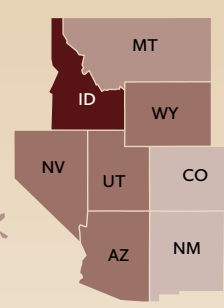
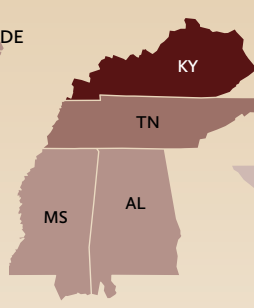
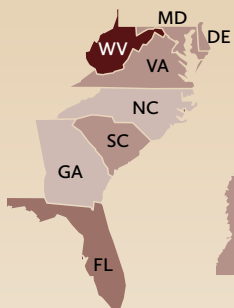
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2004-2011



DIV	APC
1	-1.9
2	-2.9
3	0.4
4	-2.2
5	-2.4
6	-2.6
7	-3.4
8	-3.2
9	-3.2

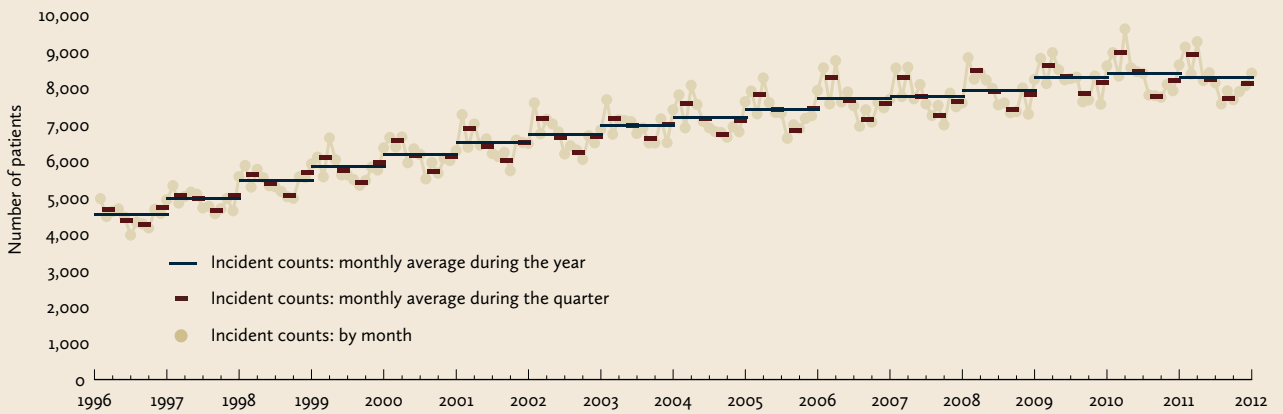
2004-2011



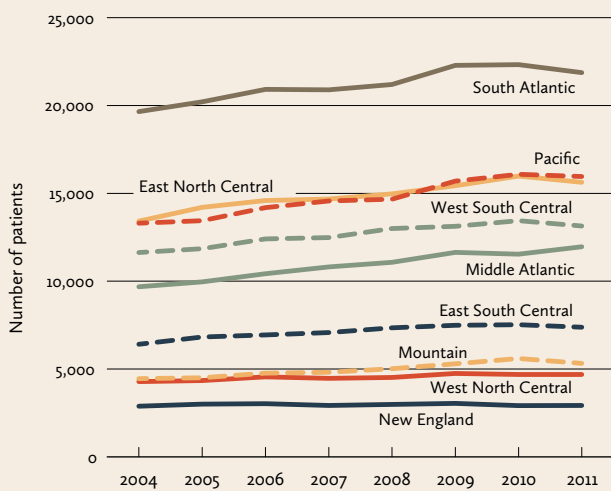
DIV	APC
1	-3.4
2	-3.2
3	-2.2
4	-2.3
5	-3.3
6	-2.2
7	-2.9
8	-2.9
9	-3.8

2004-2011

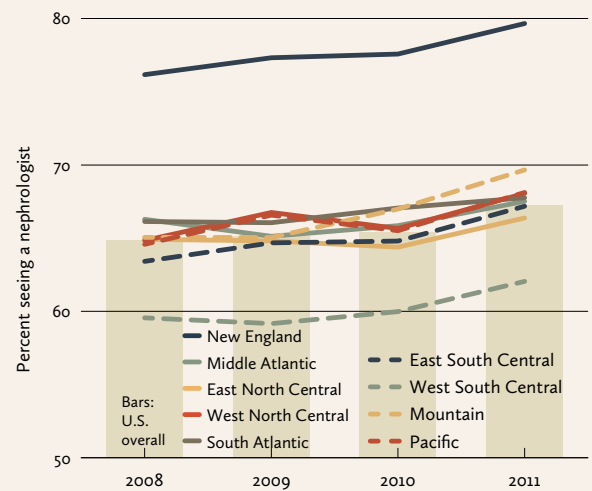
Incident counts by month, quarter, & year



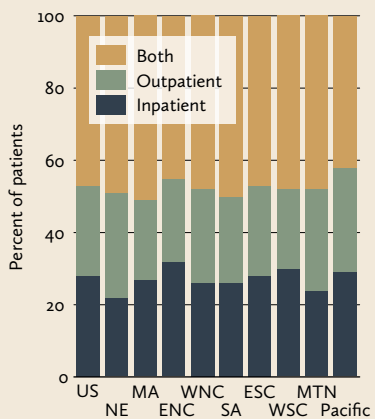
Incident counts, overall & by U.S. Census Division



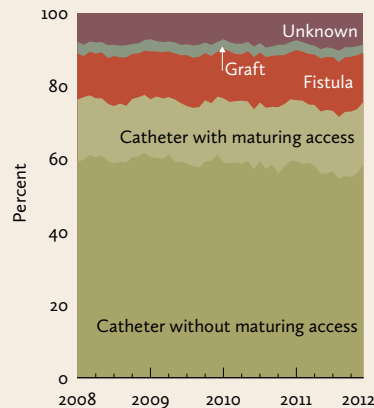
Percent of patients under nephrology care before starting dialysis, according to the ME Report



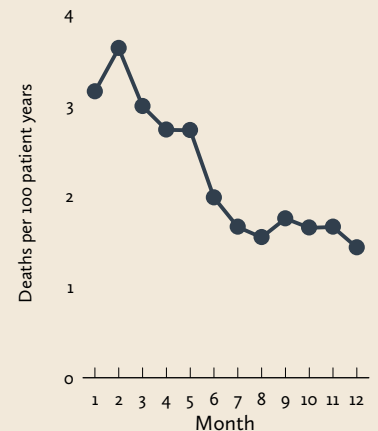
Setting of pre-dialysis nephrology care according to Medicare claims



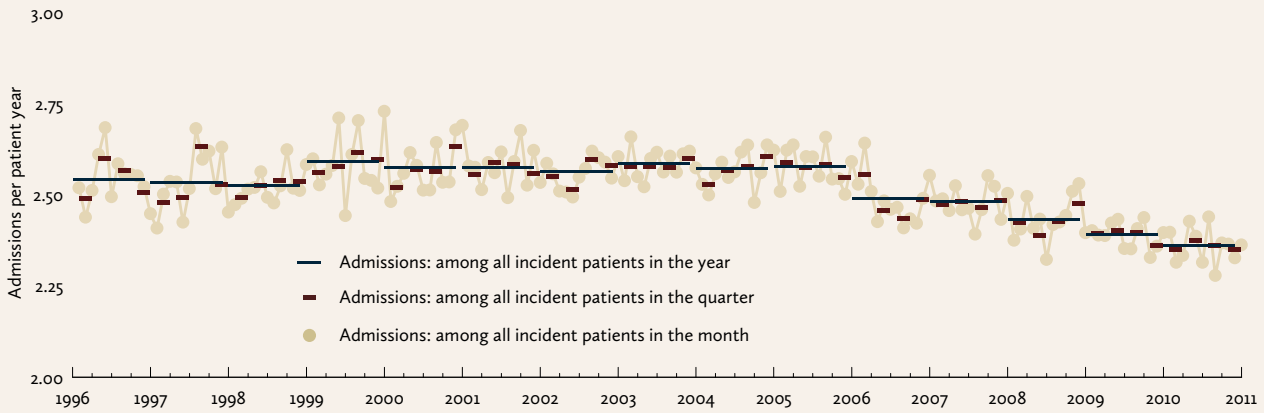
Distribution of vascular access technique among all HD patients



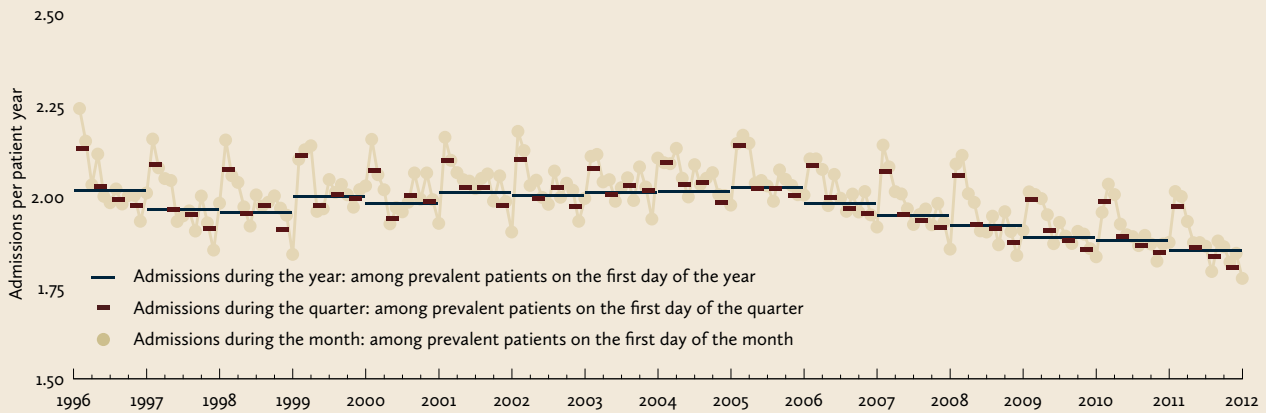
Cause-specific mortality due to infection; incident dialysis patients



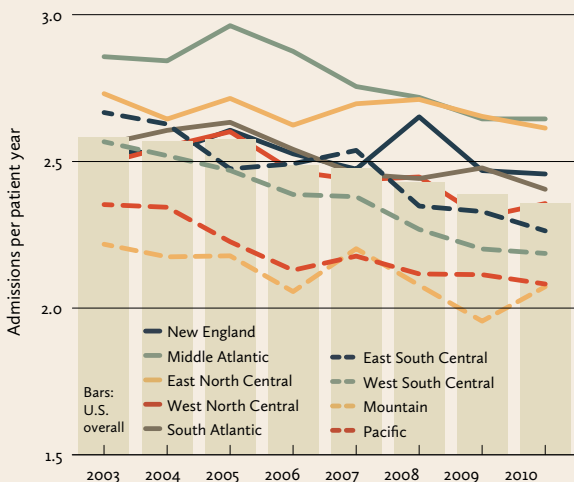
First-year admission rates among incident dialysis patients, by annual, quarterly, & monthly cohorts



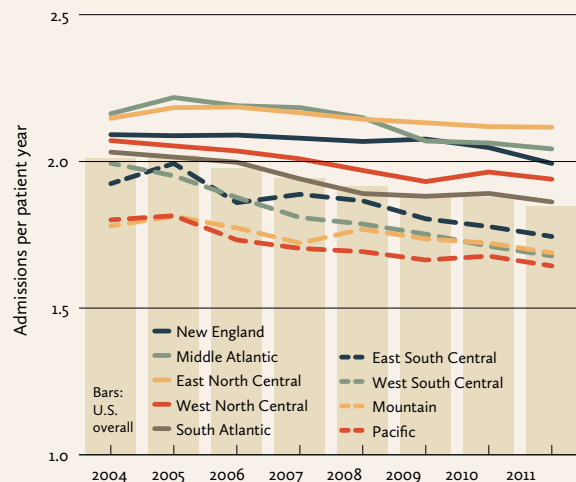
Admission rates among prevalent dialysis patients, by annual, quarterly, & monthly cohorts



First-year admission rates among incident dialysis patients, overall & by U.S. Census Division



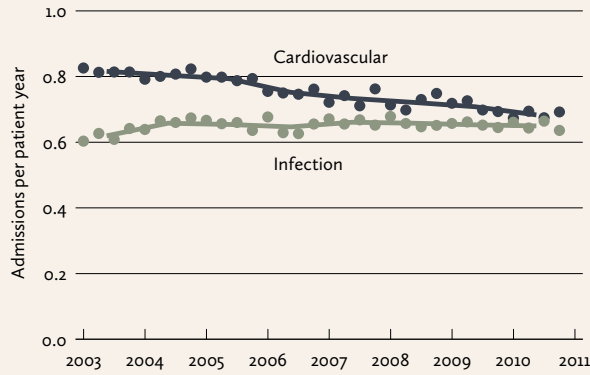
Admission rates among prevalent dialysis patients, overall & by U.S. Census Division



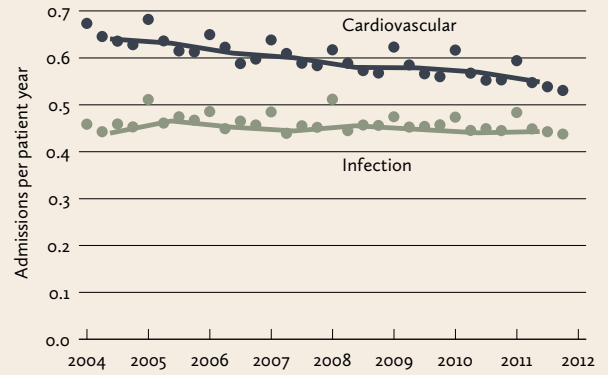
EXECUTIVE SUMMARY

HOSPITALIZATION

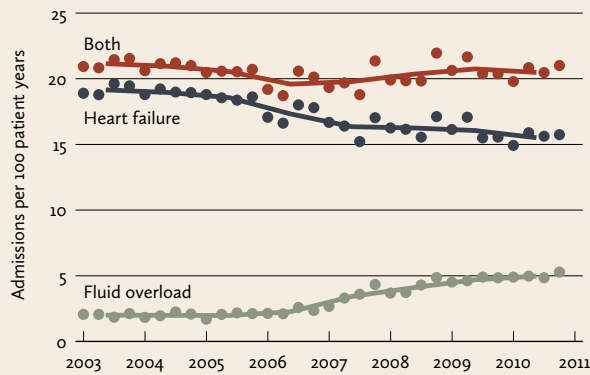
First-year admission rates among incident dialysis patients, by annual & quarterly cohorts



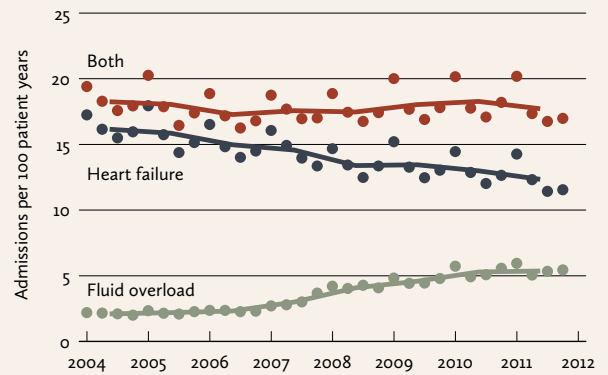
Admission rates among prevalent dialysis patients, within quarter & year



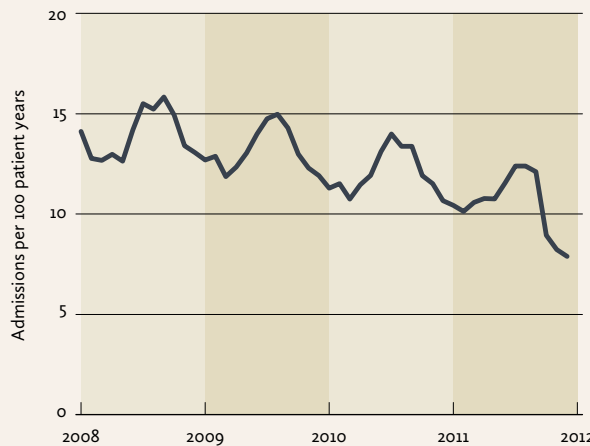
First-year admission rates for heart failure & fluid overload among incident dialysis patients, by annual & quarterly cohorts



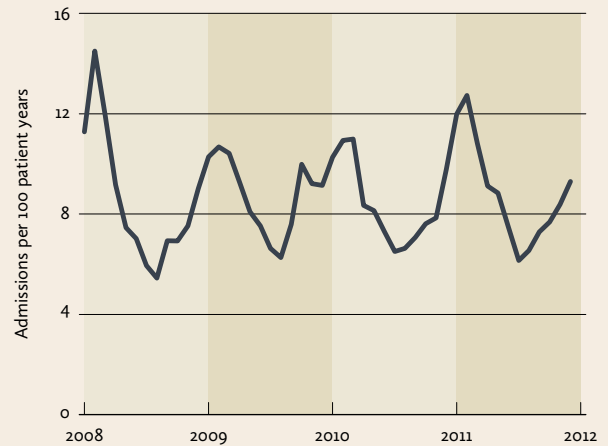
Admission rates for heart failure & fluid overload among prevalent dialysis patients, within quarter & year



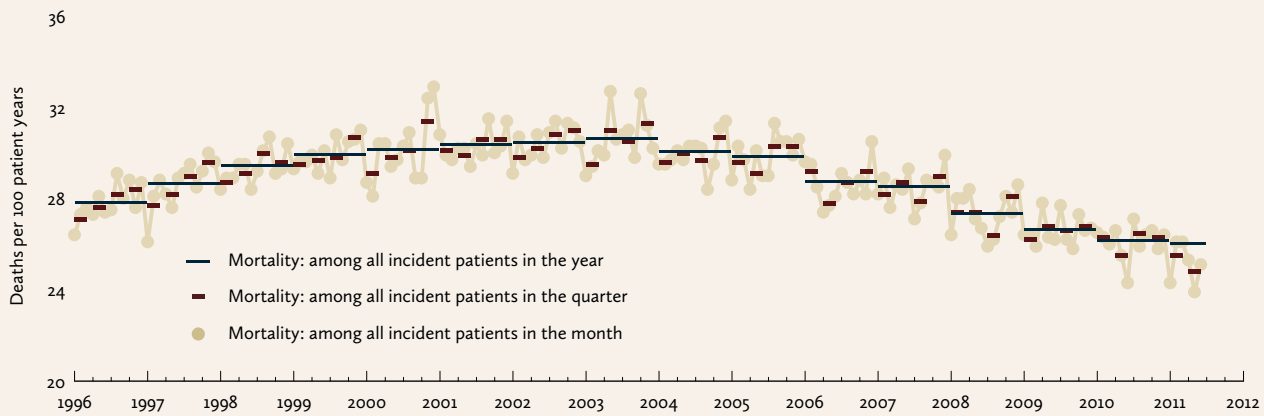
Admission rates for dialysis access infection (including peritonitis) among prevalent dialysis patients, within calendar month



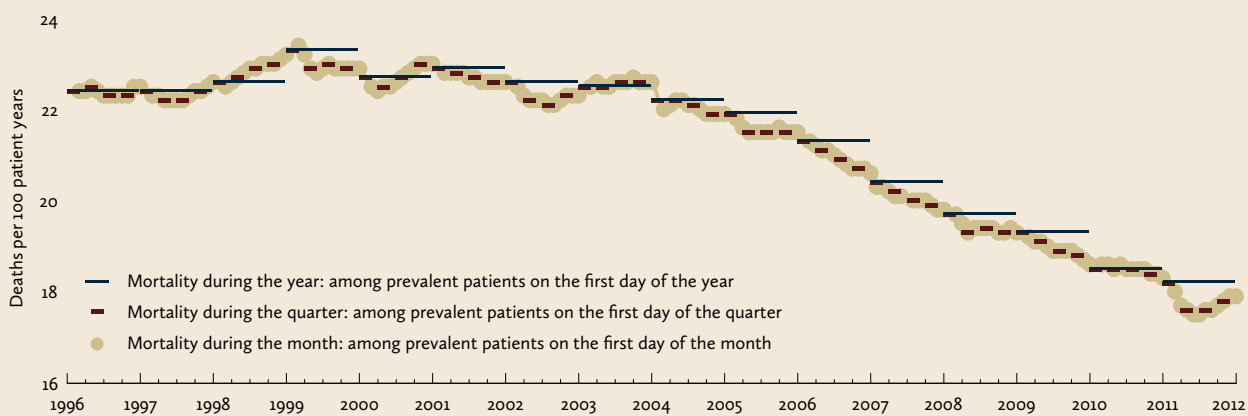
Admission rates for pneumonia & influenza among prevalent dialysis patients, within calendar month



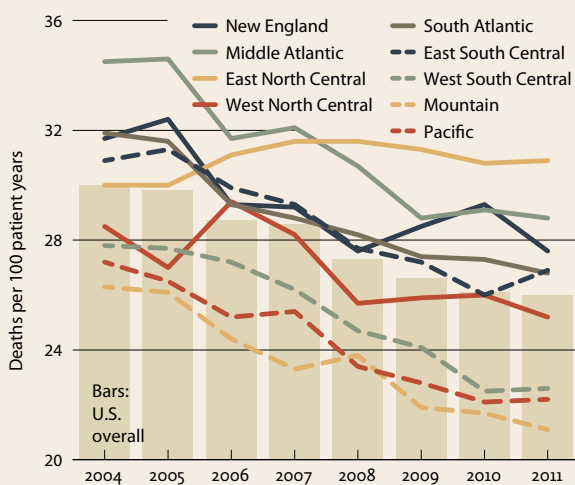
First-year mortality in incident dialysis patients, by incident year, quarter, & month



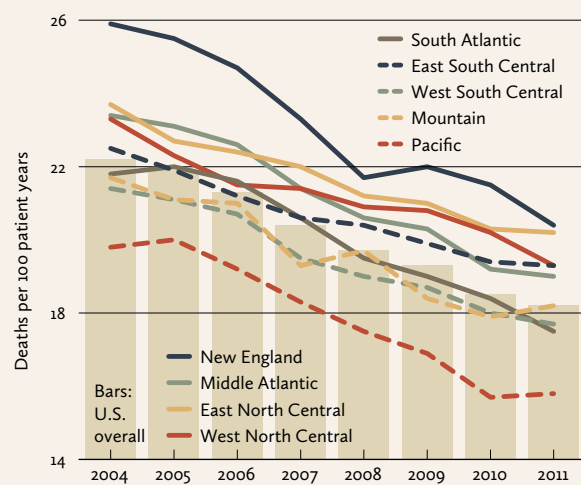
Mortality in prevalent dialysis patients, by year, quarter, & month



First-year mortality in incident dialysis patients, by U.S. Census Division

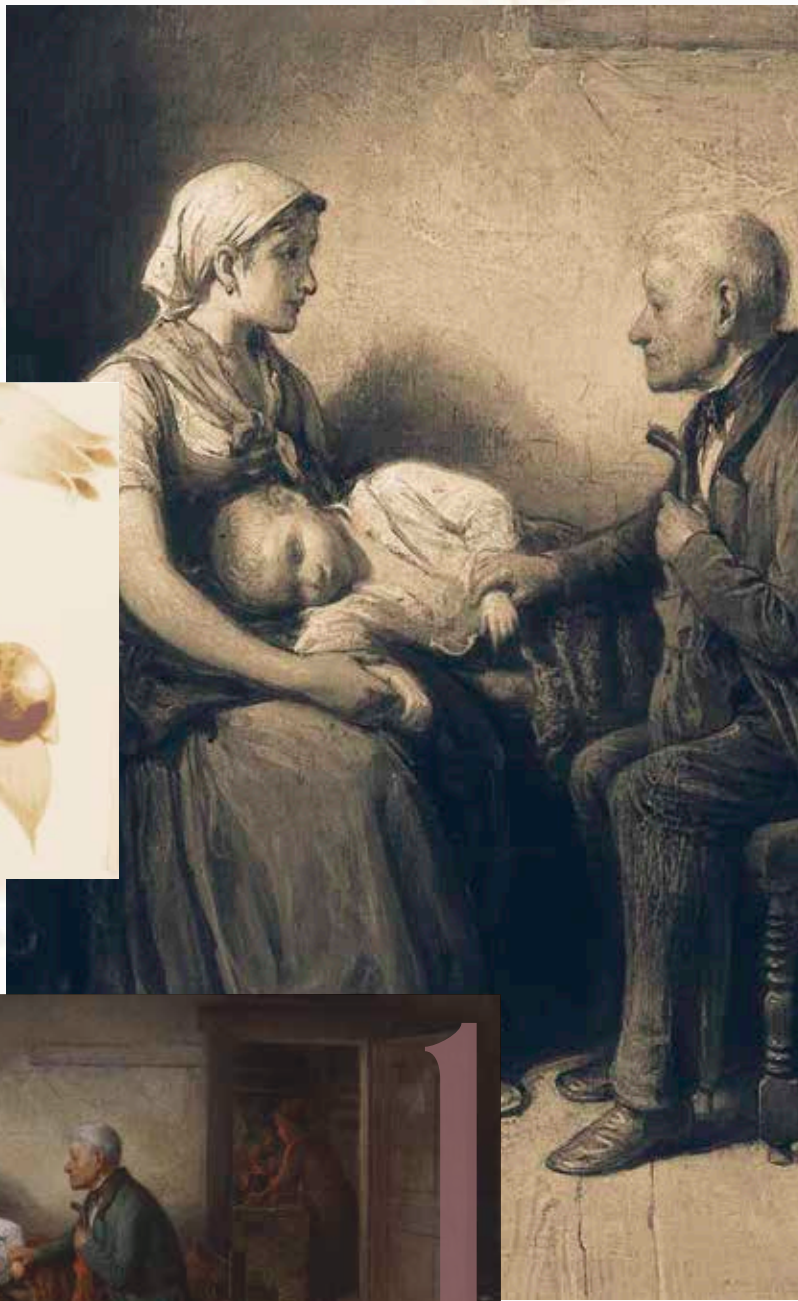
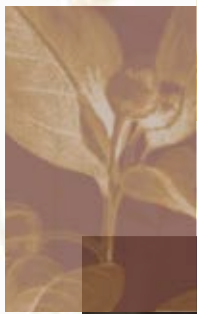


Mortality in prevalent dialysis patients, by U.S. Census Division





SMALL PICTURES atropa belladonna (deadly nightshade); medicinal use: anesthetic, pain reliever, anti-inflammatory **LARGE PICTURE** lotus; medicinal use: treatment of urinary disorders, cholesterol-lowering agent



Friedrich Friedländer, *Der Doktor*, 1870

Incidence

INCIDENCE

Introduction

Tracking new cases of end-stage renal disease (ESRD) is challenging, because only patients who receive treatment for ESRD are reliably identified by the CMS ESRD Medical Evidence Report (form CMS-2728). Because there is no comprehensive registration system, patients with ESRD who choose not to initiate chronic dialysis are uncounted.

In this section we report on new ESRD patients in freestanding dialysis facilities, which provide the vast majority of dialysis treatments in the U.S. This does undercount the total number of new ESRD cases in the U.S., as we are not reporting new patients in hospital-based dialysis facilities (these patients pose an analytic challenge, with respect to the provision of inpatient versus outpatient dialysis, which we will address in the coming year) or new patients who immediately receive a kidney transplant. We begin with a flowchart that identifies this subset of new ESRD cases in 2011, and subsequently illustrate incident rates and counts, overall, by U.S. Census Division and by state. While incident rates have begun to decline, there is considerable geographic variation in the absolute burden of ESRD, with important implications for the capacity to deliver care.

Like the rates of hospitalization and mortality illustrated in subsequent chapters, counts of new ESRD patients vary in a cyclical manner, with the highest counts occurring in the winter and the lowest in the summer. This pattern was reported in Okinawa, Japan, in 1996 (Iseki et al, American Journal of Nephrology) and is clearly present in domestic data as well. As shown in trends by Census Division and state, the slowing of both rates and counts has been far from uniform across the country. Growth in counts continues, for example, in the Middle Atlantic Division, at 3.1 percent per year since 2004. Within the division, however, the corresponding rate of growth was 4.7 percent per year in New York, but only 1.3 percent per year in Pennsylvania.

Nephrologist care prior to dialysis initiation has been tracked for more than a decade through questions in the Medical Evidence Report. Differences by Census Division are quite striking, with 80 percent of new patients in New England receiving pre-ESRD nephrologist care, compared to just 62 percent in the West South Central division. These geographic variations deserve greater attention from the physician community, as dialysis providers do not influence referral to a nephrologist prior to the start of dialysis treatment. The CKD education benefit, which became available to Medicare beneficiaries in January 2010, has been used by fewer than 2 percent of new ESRD patients (2013 USRDS ADR, page 117). This is a major concern, as poor preparation for ESRD has been reported to impact patient survival and access to home dialytic modalities. Interestingly, data from Medicare claims paints a more complex picture of nephrologist care prior to dialysis initiation. Some patients appear to have seen a nephrologist only in the inpatient setting, and even in the outpatient setting, a substantial share of patients have only seen a nephrologist once or twice during the six months before dialysis initiation. These findings suggest that data from the Medical Evidence Report may overstate the progress that has been made.

- Key observations 20
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- Rates of incident ESRD cases initiating on dialysis in freestanding facilities 23
- Counts of incident ESRD cases initiating on dialysis in freestanding facilities 24
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- Comparison of comorbid conditions, according to the Medical Evidence Report & Medicare claims 30
- Hemoglobin (Hb) & estimated glomerular filtration rate (eGFR) at dialysis initiation 32
- Vascular access at first outpatient dialysis session 33

The reporting of comorbidity at dialysis initiation has been a core part of the Medical Evidence Report since 1995. Several studies have noted under-reporting of comorbidity compared to prevalence estimates from other sources, including medical charts and administrative claims. Data here illustrate that, for several comorbid conditions, prevalence according to the Medical Evidence Report is 30–50 percent lower than prevalence according to the assessment of diagnosis codes in Medicare claims for medical services during the six months before dialysis initiation. Plausibly, under-reporting may vary by location and provider organization. These comorbidity designations are used for risk adjustment of several metrics of facility performance, including standardized mortality and hospitalization ratios, and the lack of consistent and comprehensive reporting may bias metrics—leading, for example, to distortions in star ratings.

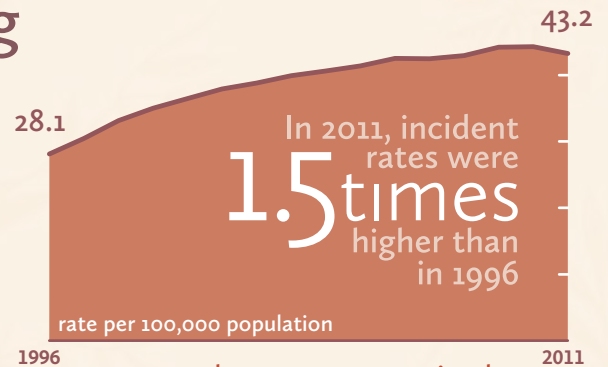
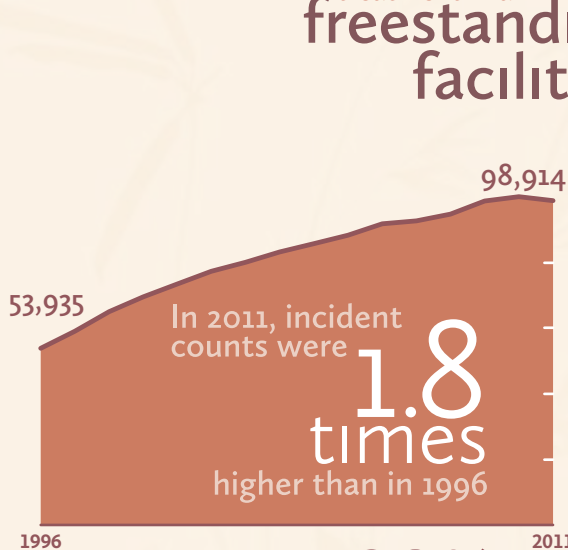
Ultimately, these data speak to a much broader issue: many aspects of regulatory oversight, including Dialysis Facility Compare, the Quality Incentive Program, and the 5-Star Quality Rating System, are influenced by the extent to which the Medical Evidence Report is accurately completed, yet those who typically complete the form, including nephrologists and nursing staff, have no direct incentive to verify accurate completion, let alone enough history with the patient to ascertain comorbidity more rigorously than through self-reporting.

The starting point for determining when to initiate dialysis treatment has been based on clinical symptoms and biochemistry. Several studies, however, have shown no benefit in using biochemical criteria to justify starting dialysis at an earlier time. Data here show that the historical trend of rising estimated glomerular filtration rate (eGFR) at dialysis initiation has ceased in recent years. In contrast to the stable landscape surrounding eGFR, the distribution of hemoglobin at dialysis initiation has changed markedly in recent years, with declines in mean hemoglobin due to more limited use of erythropoiesis-stimulating agents (ESAs) in non-dialysis-dependent chronic kidney disease patients.

We conclude this chapter with data regarding initial vascular access. The exceedingly common use of catheters at dialysis initiation is a major concern, and one that dialysis providers would like to address. However, these providers do not treat patients prior to the onset of ESRD. Data from 2011 do indicate increased placement of maturing fistulas, but progress is modest. Further changes must be tracked closely, as the structure of the ESRD Prospective Payment System forces providers to limit costs per treatment. Catheter use has been shown in many studies to increase the use of ESAs, likely as a result of increased risk of infectious complications, which themselves might engender hospitalizations that necessarily result in missed outpatient dialysis treatments. Hopefully, these pressures lead providers to work more closely with physicians to reduce the use of catheters and, in particular, to remove catheters as soon as possible when their use is acutely required.

INCIDENCE

Of the 112,453 patients initiating dialysis treatment in 2011, 91% eventually began treatment in a freestanding facility



and were greatest in the East South Central division, at 54.1

and rose 20% in the Mountain & Pacific divisions

Geographic variations in pre-ESRD nephrologist care deserve greater attention from the physician community, as dialysis providers do not influence referral to a nephrologist prior to the start of ESRD treatment

Between 2008 & 2011,

the percentage of pre-ESRD patients receiving an ESA



the ESA dose per administration during a visit fell 16.4%,



and the mean hemoglobin among patients with pre-dialysis ESA use declined,



In the New England
Census Division,
80%
of patients saw a
nephrologist
prior to starting dialysis,
compared to
67%
in the U.S.
as a whole

In 2011,
1 in 3
patients did not see a
nephrologist
prior to starting
dialysis therapy

In 2011,
1 in 5
patients received
an **ESA**
during a nephrology
visit prior to ESRD

Between 2008 & 2011,
the mean number of
nephrology
office visits
during the
6 months
before starting
dialysis fell
9%

Fewer
than **2%**
of new ESRD patients
used the
CKD education
benefit approved by Congress
and introduced
in January 2010*

In 2011,
1 in 8
patients initiated
hemodialysis
treatment with a
fistula

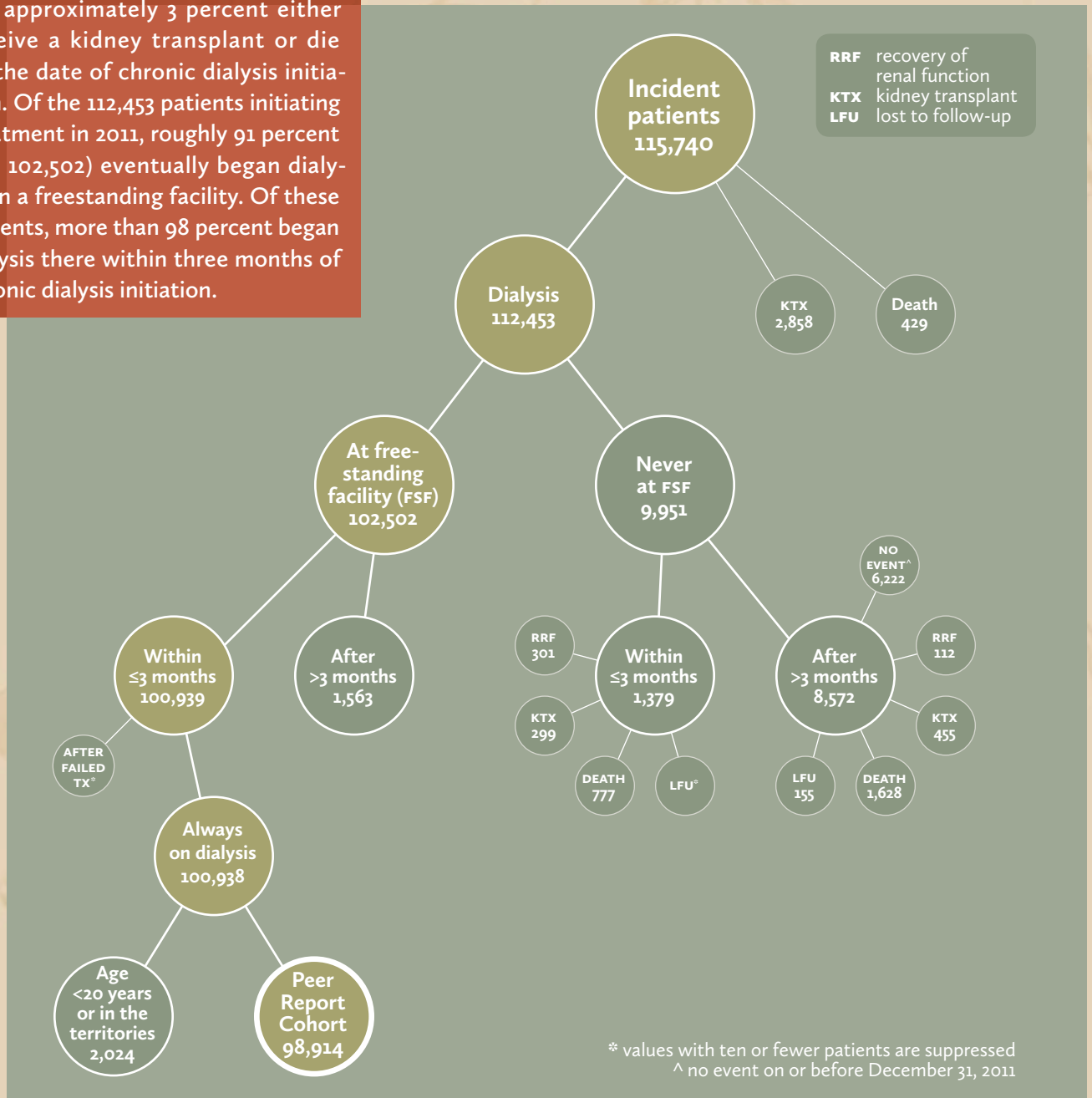
*USRDS 2013 ADR, page 117.

INCIDENCE

Identification of new patients in freestanding dialysis facilities

Displays patients from 2011

In 2011, there were 115,740 incident ESRD patients in the United States. Not all incident patients, however, undergo treatment in a freestanding dialysis facility, or even initiate dialysis; approximately 3 percent either receive a kidney transplant or die on the date of chronic dialysis initiation. Of the 112,453 patients initiating treatment in 2011, roughly 91 percent (n = 102,502) eventually began dialysis in a freestanding facility. Of these patients, more than 98 percent began dialysis there within three months of chronic dialysis initiation.



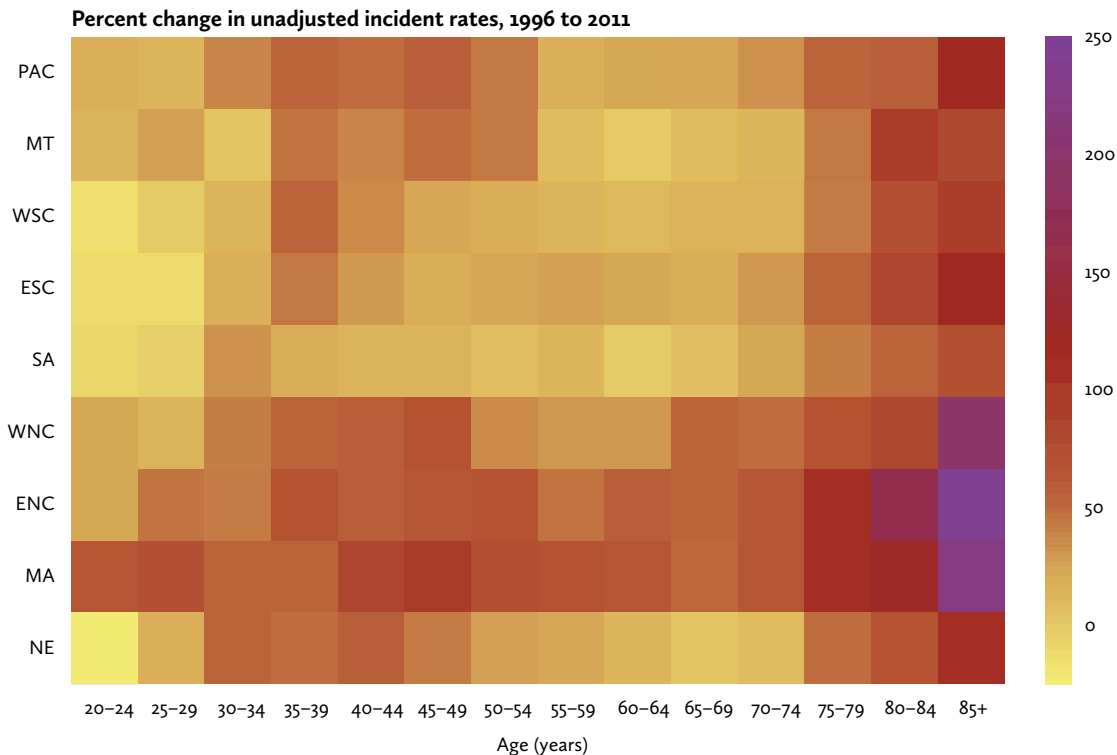
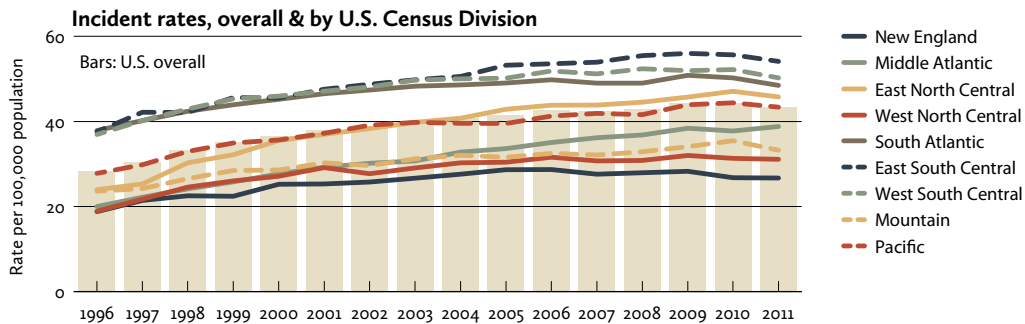
Rates of incident ESRD cases initiating on dialysis in freestanding facilities

First outpatient dialysis session within three months of chronic dialysis initiation

After increasing between 1996 and 2006, rates of incident ESRD patients initiating dialysis in freestanding units have stabilized. Rates in 2011 remained highest in the East South Central and West South Central divisions, and were lowest in the New England and West North Central divisions. ✦ The heat map shows the percent change in rates of incident ESRD cases between 1996 and 2011, stratified by U.S. Census Division and age. The largest positive changes have occurred among the very elderly in the Middle Atlantic, East North Central, and West North Central areas. Across the country, relatively large positive changes have occurred among patients age 30–49.

Incident rates in 2011 were highest in the East South Central Census Division, at

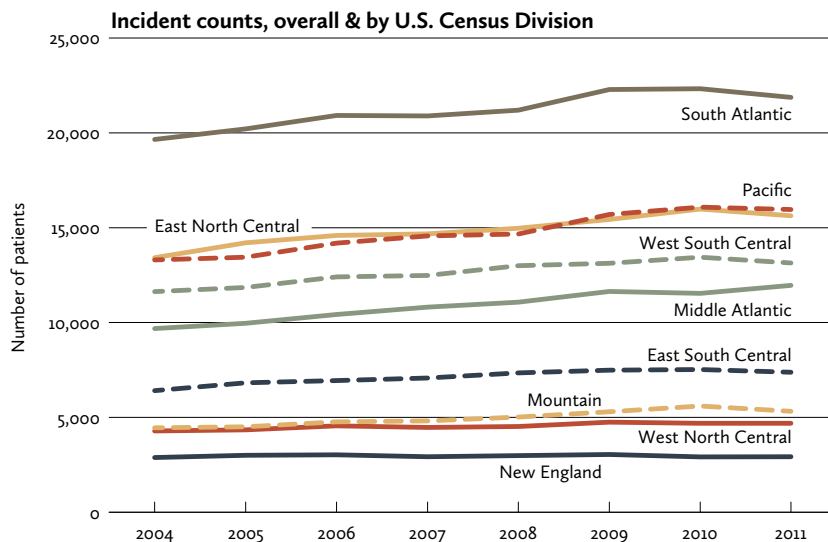
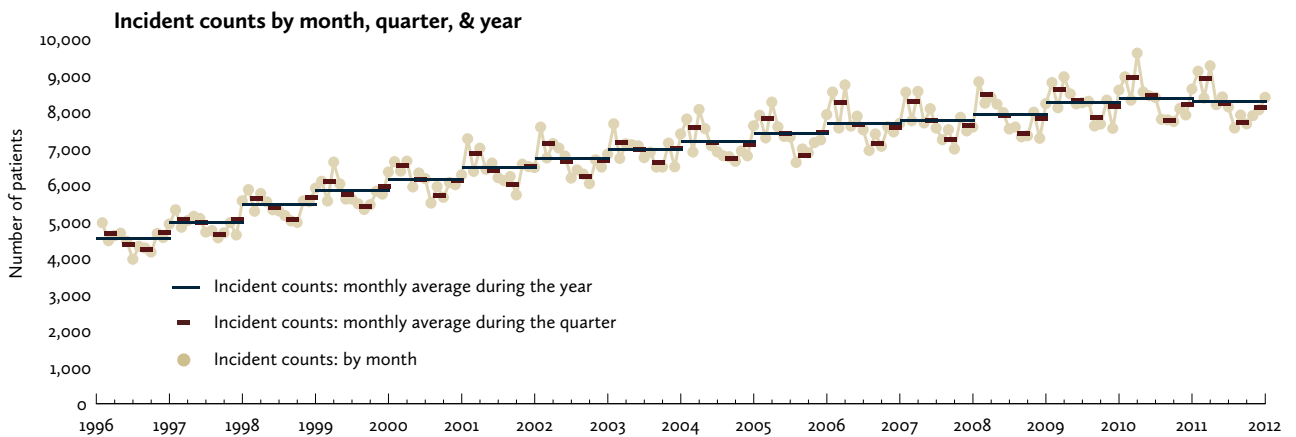
54.1
per 100,000 population



INCIDENCE

Counts of incident ESRD cases initiating on dialysis in freestanding facilities

Average monthly counts of incident ESRD patients initiating on dialysis in freestanding facilities increased steadily between 1996 and 2010, reaching a peak of more than 8,000 patients per month in 2009 and 2010. In 2011 the average monthly count actually declined, albeit by only slightly more than 1 percent. While it is uncertain whether this decline might represent an aberration due to recent economic weakness or portend a robust downturn in the incidence of Stage 5 CKD, the increasing age of the U.S. population, and the rising prevalence of diabetes, suggests that the former is more likely. Interestingly, average monthly counts of incident patients exhibit substantial seasonality, with those during the first quarter of recent years exceeding those during the third quarter by roughly 15 percent. This pattern may be due to broadly increased use of healthcare resources during the winter season, resulting in the detection of previously undiagnosed Stage 5 CKD. That more patients begin dialysis during the first quarter, a period marked by substantial risk of communicable disease, will be an ongoing challenge for dialysis providers.



Incident counts in 2011 were **1.8 times** higher than those recorded in 1996

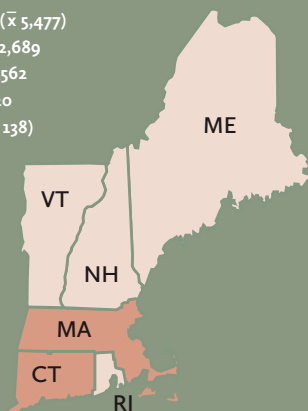
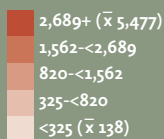
The South Atlantic Census Division had the highest number of incident patients in 2011, at **21,875**

Counts of incident ESRD cases initiating on dialysis in freestanding facilities

First outpatient dialysis session within three months of chronic dialysis initiation; APC, Annual Percent Change.

Maps show 2011 rates.

DIVISION 1 • NEW ENGLAND

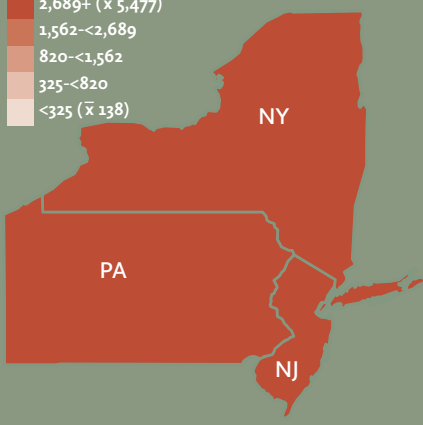
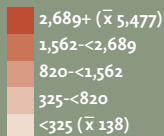


	2004	2005	2006	2007	2008	2009	2010	2011	APC	
All	2894	3011	3033	2934	2990	3056	2916	2927	0.0	
Connecticut	763	806	835	815	837	897	850	822	1.2	
Maine	193	233	215	158	188	176	136	159	-5.2	
Mass.	1415	1436	1454	1415	1413	1424	1408	1417	-0.2	
New Hamp.	232	261	286	279	271	284	272	245	0.6	
Rhode Island	288	275	243	266	277	270	237	269	-1.0	
Vermont	.	.	.	.	.	.	13	15	.	

- Annual counts of incident ESRD patients initiating on dialysis in freestanding facilities have been stable in New England since 2004.
- Counts in Massachusetts, the divisional leader in incident cases, have declined modestly.
- Most dialysis facilities in Vermont are hospital-based, resulting in very few incident cases in freestanding facilities.

*10 or fewer patients. "." Zero values in this cell.

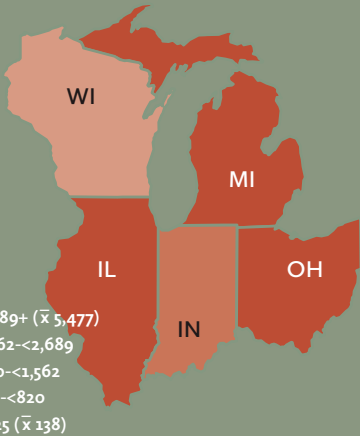
DIVISION 2 • MIDDLE ATLANTIC



	2004	2005	2006	2007	2008	2009	2010	2011	APC	
All	9,687	9,966	10,430	10,811	11,079	11,646	11,548	11,965	3.1	
New Jersey	1,973	2,061	2,204	2,179	2,187	2,375	2,400	2,689	3.8	
New York	3,588	3,720	3,753	4,206	4,499	4,661	4,671	4,753	4.7	
Pennsylvania	4,126	4,185	4,473	4,426	4,393	4,610	4,477	4,523	1.3	

- Annual counts of incident ESRD cases initiating on dialysis in freestanding facilities have increased by 3.1 percent per year in the Middle Atlantic, the second highest rate among all Census Divisions.
- Leading the division has been New York, with a nearly 5 percent annual increase in counts of incident cases. More study is needed to assess within-state variation in incident count trends.
- New Jersey trails New York only slightly, with a nearly 4 percent annual increases in counts of incident cases.

DIVISION 3 • EAST NORTH CENTRAL



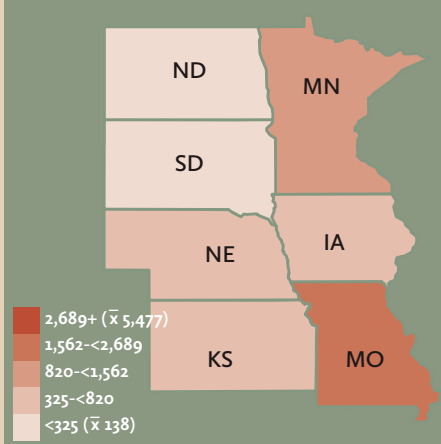
	2004	2005	2006	2007	2008	2009	2010	2011	APC	
All	13,431	14,210	14,596	14,686	14,975	15,438	15,987	15,629	2.2	
Illinois	3,818	3,981	4,086	4,220	4,229	4,434	4,534	4,468	2.4	
Indiana	1,791	2,013	2,165	2,212	2,275	2,240	2,274	2,362	3.2	
Michigan	3,081	3,278	3,282	3,140	3,326	3,364	3,440	3,283	1.0	
Ohio	3,727	3,941	3,954	4,123	4,094	4,328	4,648	4,405	2.7	
Wisconsin	1,014	997	1,109	991	1,051	1,072	1,091	1,111	1.3	

- The East North Central division is complex, with major population centers (e.g., Chicago, Detroit, and Cincinnati), wide rural expanses (in Illinois, Indiana, and Wisconsin), and challenging socioeconomic conditions in the Ohio River Valley basin.
- Annual counts of incident ESRD cases initiating on dialysis in freestanding facilities have increased by 2.2 percent per year in the East North Central division, but trends have varied across states.
- Counts have increased most rapidly in Indiana and Ohio, and most slowly in Michigan and Wisconsin.

INCIDENCE

Counts of incident ESRD cases initiating on dialysis in freestanding facilities

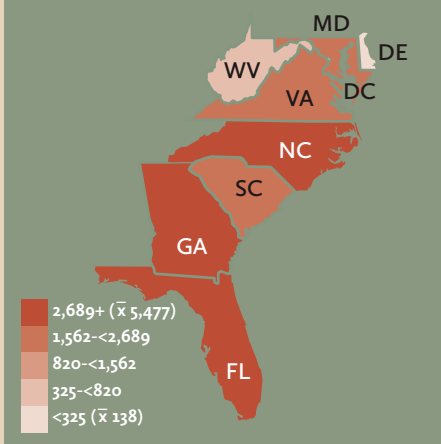
DIVISION 4 • WEST NORTH CENTRAL



	2004	2005	2006	2007	2008	2009	2010	2011	APC
All	4,288	4,346	4,558	4,479	4,529	4,747	4,689	4,690	1.4
Iowa	422	461	474	447	474	478	513	560	3.1
Kansas	629	702	704	685	723	742	769	797	2.8
Minnesota	854	835	950	883	853	830	862	820	-0.7
Missouri	1,861	1,813	1,859	1,931	1,930	2,124	1,950	1,954	1.3
Nebraska	430	438	483	452	437	422	453	418	-0.6
North Dakota	22	15	13	19	48	75	80	67	30.5
South Dakota	70	82	75	62	64	76	62	74	-1.1

- Annual counts of incident ESRD patients initiating on dialysis in freestanding facilities have increased only modestly in this division, but in North Dakota rose dramatically between 2007 and 2009, with the opening of new freestanding facilities.
- Among more populous states, annual increases in both Iowa and Kansas have led the division, while annual counts in Minnesota and Nebraska have tended to decrease.

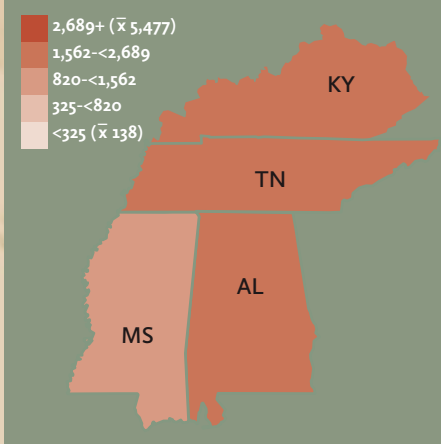
DIVISION 5 • SOUTH ATLANTIC



	2004	2005	2006	2007	2008	2009	2010	2011	APC
All	19,660	20,219	20,923	20,899	21,204	22,288	22,332	21,875	1.7
Delaware	212	272	305	269	237	309	257	254	1.1
D.C.	358	362	338	319	342	359	316	343	-0.9
Florida	6,242	6,281	6,552	6,588	6,728	7,126	7,260	6,985	2.1
Georgia	2,947	3,238	3,442	3,481	3,549	3,811	3,749	3,828	3.5
Maryland	2,138	2,251	2,217	2,116	2,197	2,314	2,269	2,221	0.6
N Carolina	3,041	3,240	3,225	3,315	3,350	3,350	3,439	3,325	1.3
S Carolina	1,877	1,746	1,785	1,782	1,826	1,830	1,824	1,730	-0.3
Virginia	2,282	2,232	2,425	2,426	2,365	2,461	2,547	2,454	1.4
West Virginia	563	597	634	603	610	728	671	735	3.5

- No division has more incident ESRD cases initiating on dialysis in freestanding facilities than the South Atlantic, although the rate of increase in annual counts has been modest.

DIVISION 6 • EAST SOUTH CENTRAL



	2004	2005	2006	2007	2008	2009	2010	2011	APC
All	6,410	6,822	6,949	7,081	7,351	7,499	7,522	7,381	2.1
Alabama	1,834	1,862	2,003	1,895	2,010	1,957	1,983	2,017	1.2
Kentucky	1,301	1,399	1,348	1,427	1,533	1,564	1,640	1,562	3.1
Mississippi	1,202	1,361	1,323	1,379	1,396	1,466	1,392	1,332	1.4
Tennessee	2,073	2,200	2,275	2,380	2,412	2,512	2,507	2,470	2.6

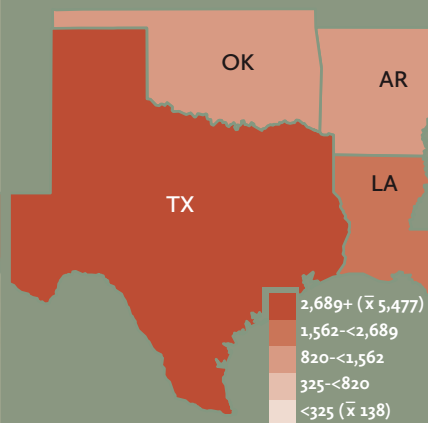
- Annual counts of incident ESRD patients initiating on dialysis in freestanding facilities have increased by 2.1 percent per year in the East South Central division.
- Interestingly, annual counts have grown most rapidly in Kentucky, which shares its northern border with Indiana and Ohio, the two states in the East North Central division with the most rapid increases in annual counts.

Counts of incident ESRD cases initiating on dialysis in freestanding facilities (continued)

First outpatient dialysis session within three months of chronic dialysis initiation; APC, Annual Percent Change.

Maps show 2011 rates.

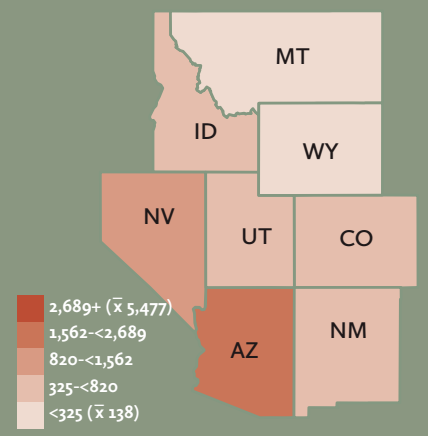
DIVISION 7 • WEST SOUTH CENTRAL



	2004	2005	2006	2007	2008	2009	2010	2011	APC
All	11,632	11,853	12,418	12,485	13,005	13,130	13,450	13,145	2.0
Arkansas	886	847	944	976	1,053	1,012	1,030	919	1.8
Louisiana	2,312	2,178	2,111	2,188	2,184	2,213	2,238	2,188	-0.1
Oklahoma	1,000	1,027	1,039	1,104	1,123	1,188	1,183	1,068	1.9
Texas	7,434	7,801	8,324	8,217	8,645	8,717	8,999	8,970	2.7

- Annual counts of incident ESRD patients initiating on dialysis in freestanding facilities have grown by 2.0 percent per year in the West South Central division.
- Leading the division has been Texas, with almost 3 percent annual increases in counts of incident cases. More study is needed to assess within-state variation in incident count trends.
- Annual counts of incident cases in Louisiana have been very stable since 2005, when Hurricane Katrina struck the Gulf Coast.

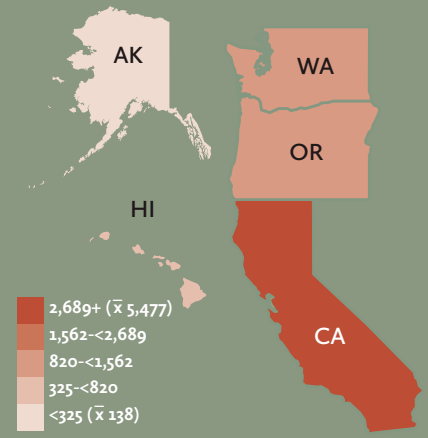
DIVISION 8 • MOUNTAIN



	2004	2005	2006	2007	2008	2009	2010	2011	APC
All	4,460	4,509	4,769	4,825	5,030	5,300	5,604	5,333	3.3
Arizona	1,877	1,841	1,908	1,929	2,000	2,080	2,270	2,163	2.8
Colorado	787	769	811	808	815	892	861	814	1.3
Idaho	179	234	233	305	326	355	376	325	9.8
Montana	62	84	81	61	73	71	67	109	3.1
Nevada	725	720	820	810	871	891	995	913	4.3
New Mexico	490	470	538	545	591	614	640	579	3.9
Utah	295	332	341	327	316	351	353	374	2.4
Wyoming	45	59	37	40	38	46	42	56	0.5

- Annual counts of incident ESRD patients initiating on dialysis in freestanding facilities have increased by 3.3 percent per year in the Mountain division, the highest rate among all Census Divisions. Leading the division have been Idaho, Nevada, and New Mexico.

DIVISION 9 • PACIFIC



	2004	2005	2006	2007	2008	2009	2010	2011	APC
All	13,308	13,451	14,195	14,569	14,676	15,702	16,091	15,969	3.0
Alaska	109	83	111	120	117	115	137	136	5.0
California	10,954	10,986	11,359	11,730	11,942	12,585	13,043	13,017	2.9
Hawaii	307	309	658	555	535	646	565	564	8.9
Oregon	752	783	804	851	812	940	969	848	2.8
Washington	1,186	1,290	1,263	1,313	1,270	1,416	1,377	1,404	2.2

- The Pacific division has more incident ESRD patients initiating on dialysis in freestanding facilities than any other division, except the South Atlantic.
- The vast majority of incident cases are in California, where annual counts have increased by almost 3 percent per year.
- Annual counts in Hawaii have been relatively stable since 2006, when a large set of dialysis facilities switched from hospital-based to freestanding status.

INCIDENCE

Pre-dialysis nephrology & cardiology care

According to the Medical Evidence Report & Medicare claims

Multiple studies suggest that nephrology care before initiation of dialysis is associated with improved outcomes following the start of therapy, although it is likely that confounding limits these studies. Several studies, however, have reported that pre-dialysis nephrology care is very strongly associated with permanent vascular access placement; the use of mature fistulas and grafts at initiation likely improves outcomes, compared to those seen with the use of central venous catheters. ✦ According to the Medical Evidence Report, roughly two in three patients have seen a nephrologist before initiating dialysis, with markedly higher and lower proportions in New England and the West South Central divisions, respectively. The Medical Evidence Report, however, lacks granularity about the nature of such care. According to Medicare claims for elderly patients (age ≥ 66), roughly three in four who saw a nephrologist before initiating dialysis actually received care in an outpatient setting. Nearly half received nephrology care in both inpatient and outpatient settings prior to initiation.

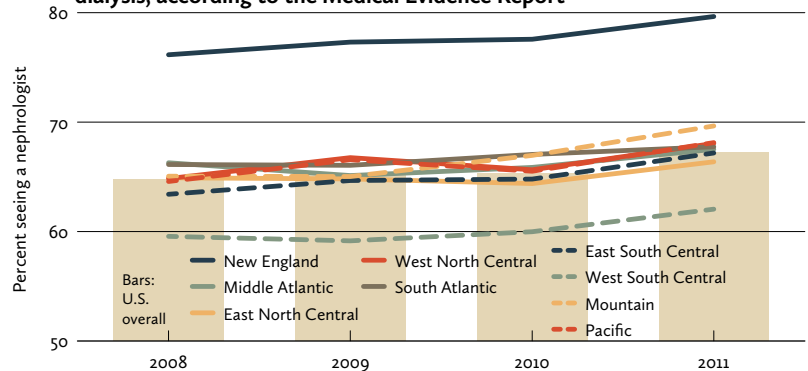
80%

of patients in New England received nephrology care prior to starting dialysis, compared to

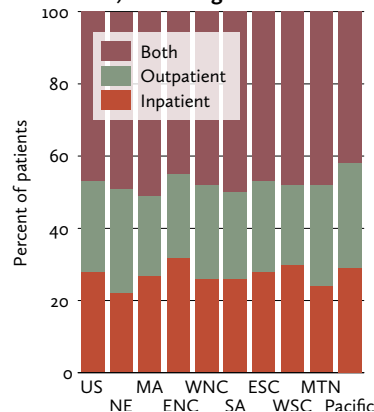
67%

in the U.S. as a whole

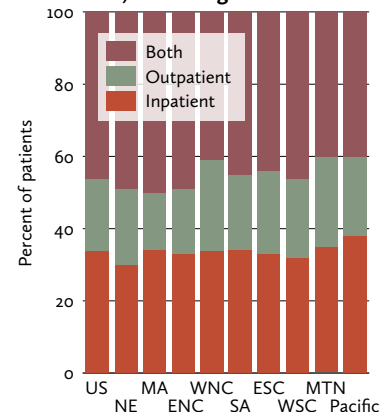
Percent of patients under nephrology care before starting dialysis, according to the Medical Evidence Report



Setting of pre-dialysis nephrology care, according to Medicare claims



Setting of pre-dialysis cardiology care, according to Medicare claims



Nephrology office visits in the 6 months before starting dialysis

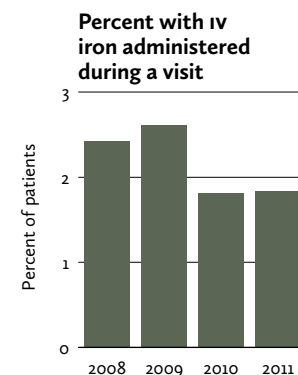
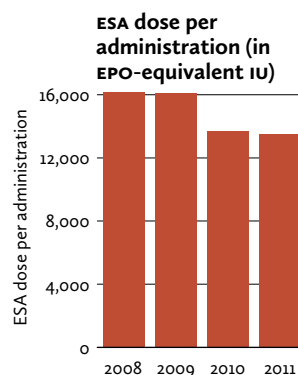
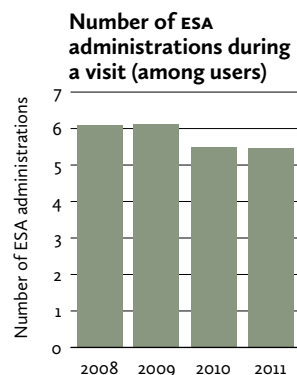
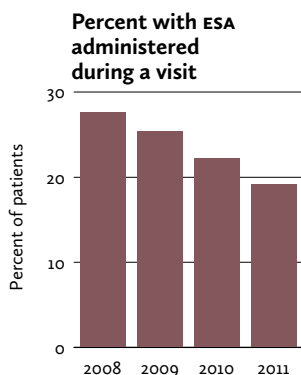
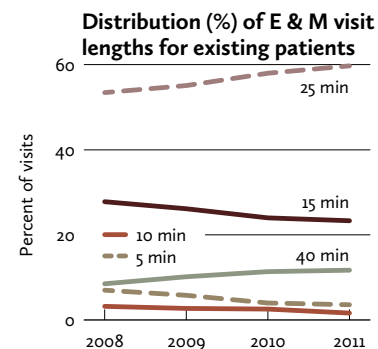
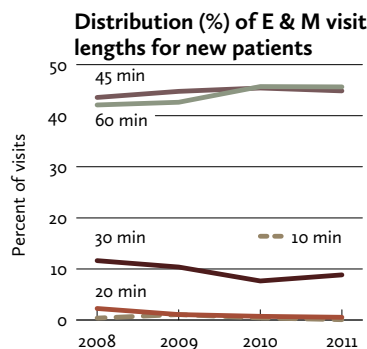
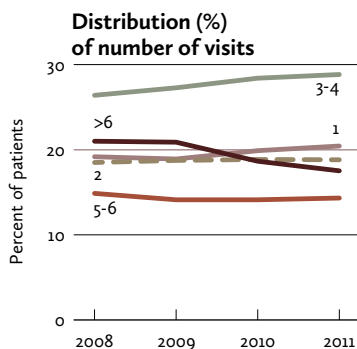
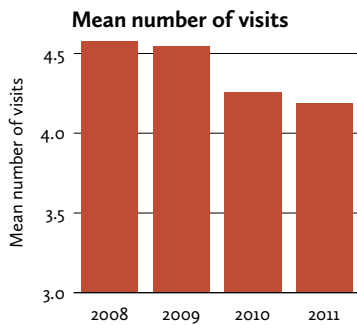
Among elderly patients with at least one office visit to a nephrologist during the six months before initiating dialysis, the mean number of visits per patient decreased modestly between 2008 and 2011, while the percentage with more than six visits fell sharply between 2009 and 2011. Evaluation and management (E & M) visits by both new and existing patients, however, appear to have increased in duration. ♦ Coinciding with the publication of the TREAT study of darbepoetin, the percentage of patients receiving an erythropoiesis-stimulating agent (ESA), among those with at least one office visit to a nephrologist, fell steadily between 2008 and 2011. Among ESA users, the mean number of administrations and mean dose per administration both decreased between 2009 and 2010. Concurrently, administration of IV iron in the nephrology clinic decreased, although the absolute percentage of users was already low.

1 in 5

patients who saw a nephrologist prior to the start of dialysis had just one visit

19%

of patients received an ESA during a nephrology office visit in 2011



INCIDENCE

Comorbid conditions on the Medical Evidence Report & in Medicare claims

The Medical Evidence Report notably includes item 17, “Comorbid Conditions,” with a single instruction to the attending physician: “Check all that apply currently and/or during the last 10 years.” According to data from the report, the prevalence of most comorbid conditions among incident ESRD patients initiating on dialysis in freestanding facilities changed very little between 2006 and 2011. The prevalence of hypertension and other cardiac disease (presumably, valvular diseases and arrhythmias) has increased modestly, as has the prevalence of patients needing assistance with daily activities. The prevalence of insulin-treated diabetes has also increased, but has been offset by decreased prevalence of oral medication-treated diabetes. ✦ These data ultimately suggest that concurrent decreases in rates of death and hospitalization during the first year after dialysis initiation are unlikely to be attributable to increasingly healthier cohorts of incident cases.

87%

of new dialysis patients were classified as hypertensive in 2011

Prevalence of comorbid conditions, according to the Medical Evidence Report



A number of comorbid conditions recorded on the Medical Evidence Report are used for regulatory action. Such conditions are:

- Congestive heart failure
- Atherosclerotic heart disease
- Other cardiac disease
- Cerebrovascular disease
- Peripheral vascular disease
- Diabetes
- Chronic obstructive pulmonary disease
- Tobacco use
- Cancer
- Alcohol dependence
- Drug dependence
- Inability to ambulate
- Inability to transfer

These conditions are used for statistical adjustment of important metrics for dialysis facilities:

- Standardized Mortality Ratio
- Standardized Hospitalization Ratio
- Standardized Transfusion Ratio

Comparison of comorbid conditions, according to the Medical Evidence Report & Medicare claims

Patients age 66 & older at dialysis initiation

Despite widespread use of comorbidity designations on the Medical Evidence (ME) Report, there are serious questions about the validity of the designations. For elderly patients with at least six months of Medicare coverage before initiating dialysis, it is feasible to carefully compare comorbid designations from Medicare claims and the ME form. These comparisons indicate widespread disagreement between the sources. The prevalence of congestive heart failure, atherosclerotic heart disease, cerebrovascular accident, peripheral vascular disease, chronic obstructive pulmonary disease, and tobacco use are all higher in claims than in data from the ME form. And in large minorities of patients, designations of comorbid conditions on the ME form are not substantiated by claims with corresponding diagnosis codes. These data cast considerable doubt on the validity of standardized outcomes measures.

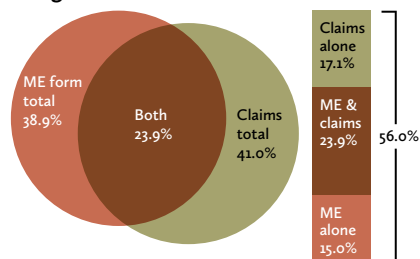
1 in 5

patients with CVA were identified by both the ME report & claims

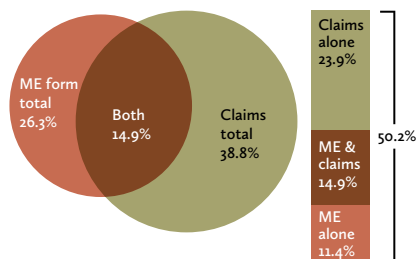
3 in 10

patients with ASHD were identified by both the ME report & claims

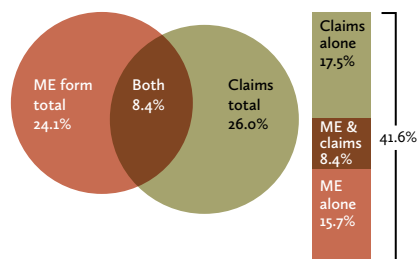
Congestive heart failure



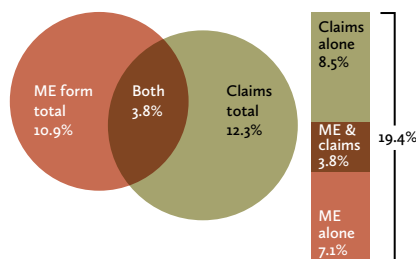
Atherosclerotic heart disease



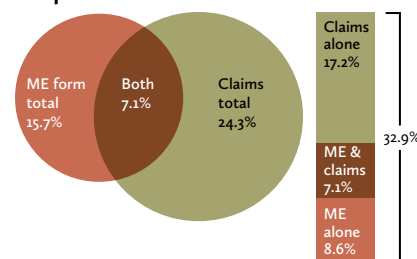
Other cardiac disease



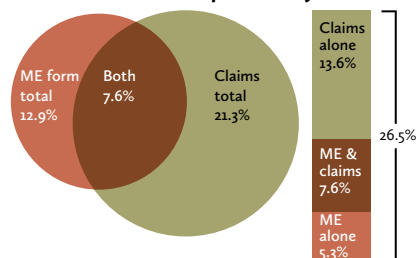
Cerebrovascular accident



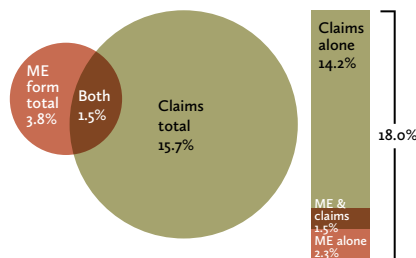
Peripheral vascular disease



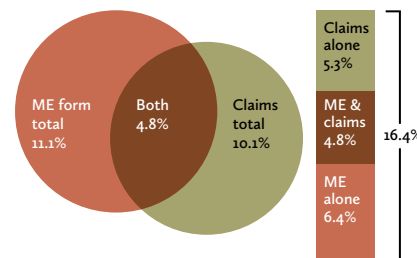
Chronic obstructive pulmonary disease



Tobacco use



Cancer

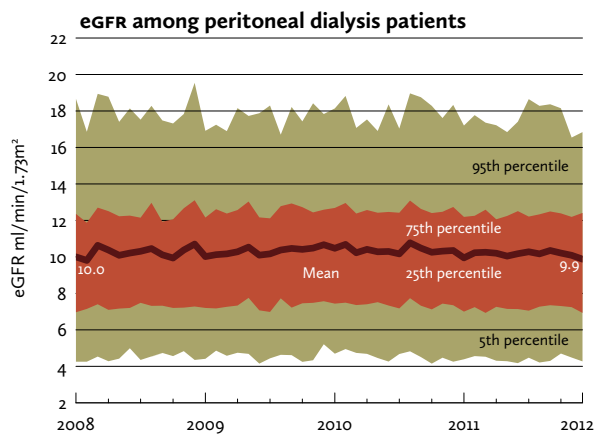
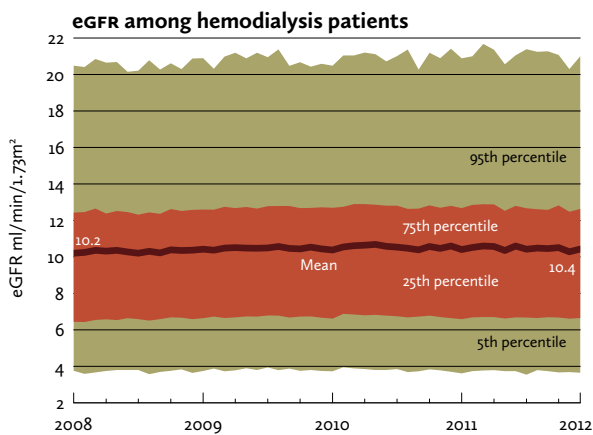
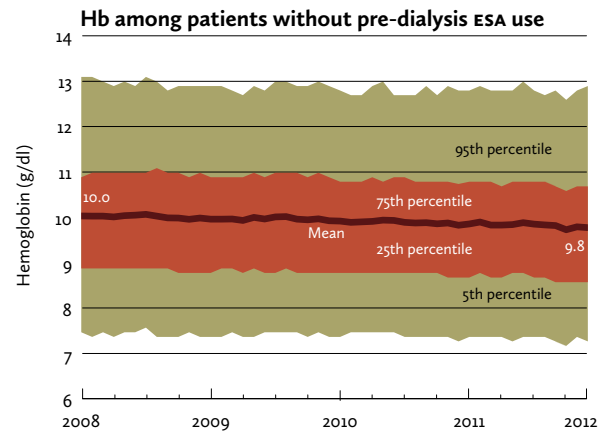
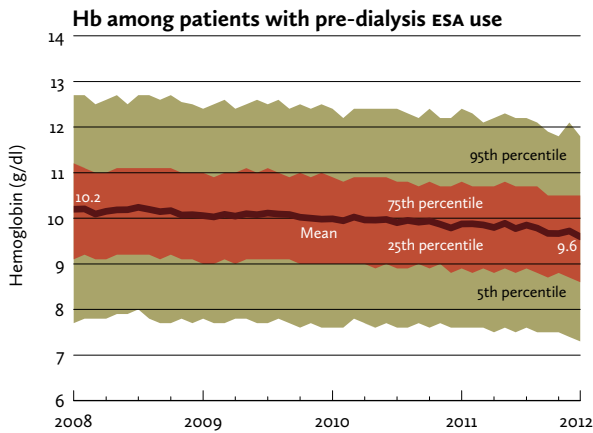


INCIDENCE

Hemoglobin (Hb) & estimated glomerular filtration rate (eGFR) at dialysis initiation

According to the Medical Evidence Report

The Medical Evidence Report includes several measures of biochemistry at dialysis initiation, including hemoglobin and serum creatinine. ♦ Between 2008 and 2011, the distribution of hemoglobin shifted downward, independent of the history of erythropoiesis-stimulating agent (ESA) use before initiation. Among patients with pre-dialysis ESA use, mean hemoglobin declined from 10.2 to 9.6 g/dL, while the 95th percentile of hemoglobin fell below 12 g/dL. ♦ The distribution of estimated glomerular filtration rate (eGFR) at dialysis initiation, as calculated from the CKD-EPI equation, was relatively stable after 2008, following more than ten years of increases.



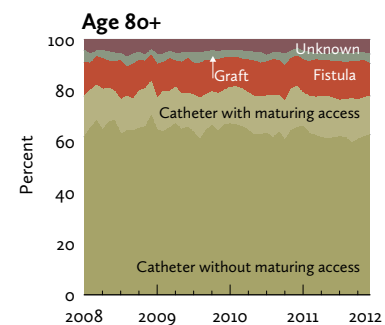
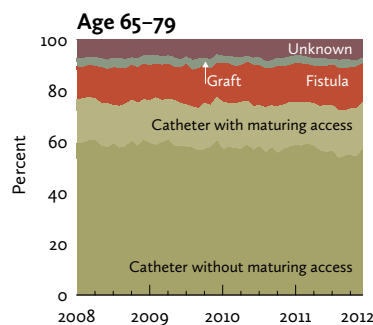
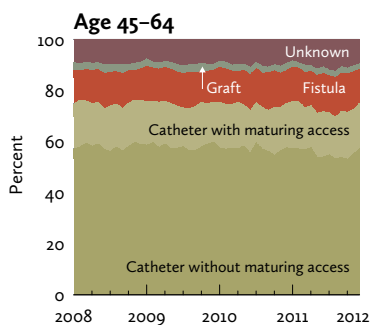
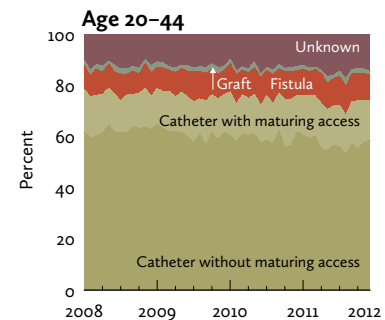
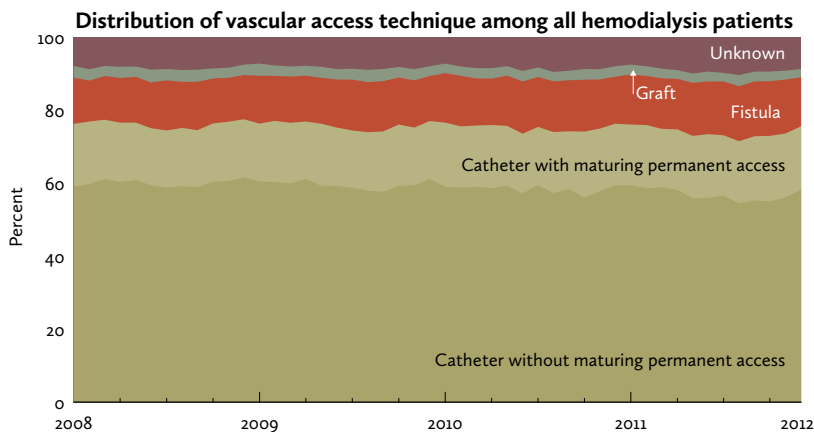
Vascular access at first outpatient dialysis session

According to the Medical Evidence Report

The 2005 revision to the Medical Evidence Report added fields regarding vascular access technique at the first outpatient dialysis session, including the use of a venous catheter in the presence of a maturing permanent access. ♦ Between 2008 and 2011, roughly three of four patients initially dialyzed with a venous catheter, although 17 percent of such patients had a maturing permanent access. ♦ In 2011, however, there were new highs in the prevalence of patients initially dialyzing with a permanent access, reaching more than 18 percent in August, 2011. ♦ Among very elderly patients, initiation of outpatient dialysis with a venous catheter was relatively more likely. The extent to which this reflects lack of preparation for hemodialysis versus careful consideration of the probability of access maturation deserves further scrutiny, as life expectancy after dialysis initiation remains low in this subset of patients.

1 in 8

patients initiated hemodialysis therapy in 2011 with a fistula



INCIDENCE

Major findings

1

After years of increasing rates of ESRD incidence and counts of incident patients, both rates and counts have generally stabilized, according to data accumulated through 2011. Annual counts of incident patients, however, continue to grow in regional pockets, notably in the densely populated Middle Atlantic. There has also been profound growth across the nation in the incidence of ESRD among the very elderly.

2

The majority of new patients report having received nephrology care before dialysis initiation, although performance in the West South Central region is lagging. And according to analysis of Medicare claims in the elderly, almost one in three patients saw a nephrologist only in the inpatient setting before dialysis initiation. Among patients who saw a nephrologist in the outpatient setting, the frequency of office visits decreased between 2008 and 2011, in tandem with less frequent administration of erythropoiesis-stimulating agents.

3

According to the Medical Evidence Report, the comorbidity profile of incident patients changed very little between 2006 and 2011. In elderly patients with Medicare coverage before dialysis initiation, however, comorbidity data from the Medical Evidence Report were frequently in disagreement with corresponding data from claims. In particular, the prevalence of peripheral vascular disease and pulmonary disease was understated by data from the Medical Evidence Report.

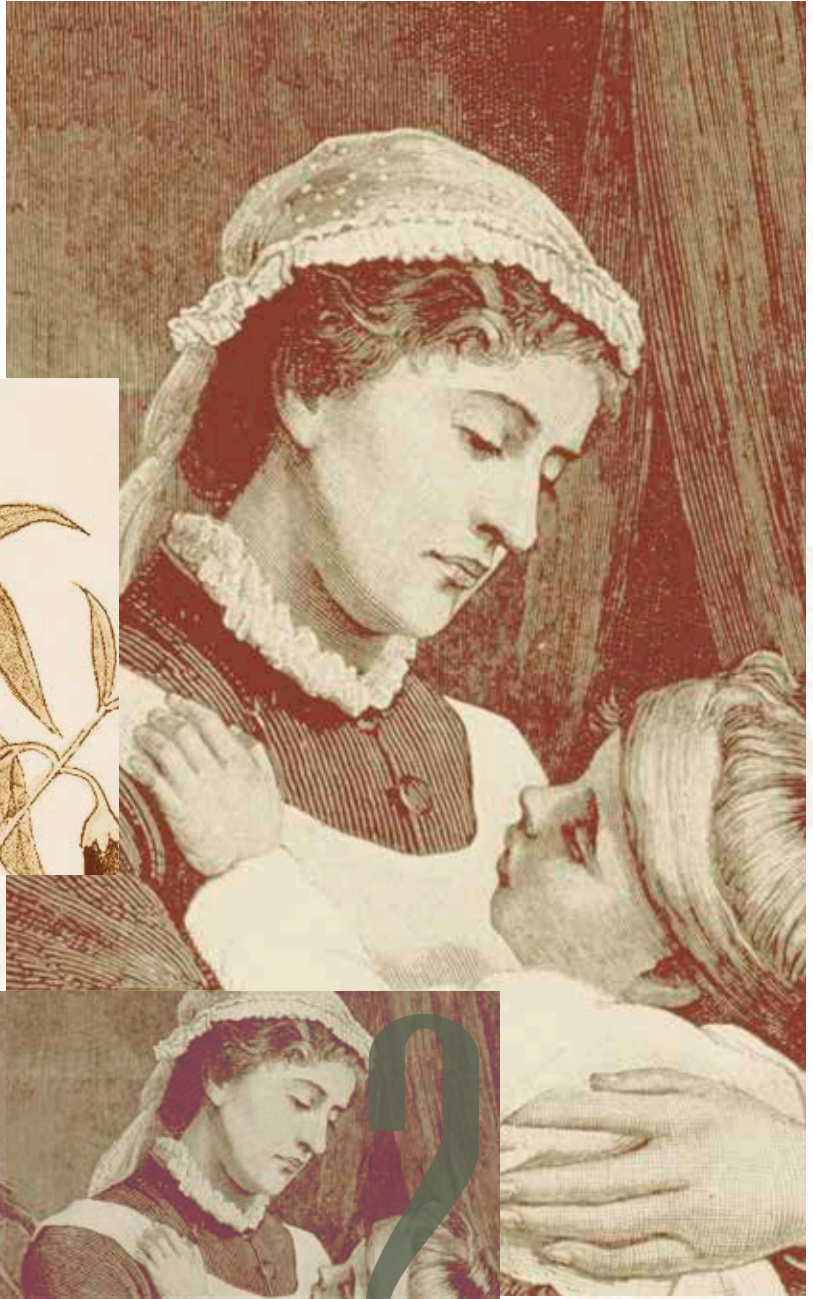
4

Between 2008 and 2011, the distribution of estimated glomerular filtration rate at dialysis initiation was stable, ending a long-running shift toward higher rates at initiation.

5

Almost three in four incident patients begin outpatient dialysis with a catheter for vascular access, although a minority of these patients has a maturing fistula. Early reliance on catheters remains common across all strata of age.

SMALL PICTURE cayenne; medicinal use: treatment for pain and swelling, triglyceride and cholesterol lowering agent
LARGE PICTURE celery; medicinal use: diuretic



Thomas Davidson, *The Children's Hospital*, 1882

Hospitalization

HOSPITALIZATION

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Hospital admission rates among prevalent dialysis patients 46

Cardiovascular disease as the primary discharge diagnosis 50

Acute coronary syndrome (myocardial infarction & unstable angina) 52

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Dialysis access infection, including peritonitis 66

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Dialysis access complication, excluding infection 78

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Length of stay: all-cause hospitalization 82

Rehospitalization 84

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. After very little change in admission rates among successive cohorts of incident patients between 1996 and 2005, rates began to decline among incident patients in 2006. The decline has been modest, at slightly more than 1.5 percent per year, but the trend is clear. Maps and tables in this section show striking regional variations in first-year hospitalization rates, with the highest rates 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 interpretation of standardized hospitalization ratios, which are not adjusted for the location of the dialysis facility.

Data for individual states illustrate wide variation not only in hospitalization rates themselves, but also in changes in those rates with time. Since 2003, for example, the first-year admission rate has fallen 1.4 percent per year in the entire Middle Atlantic Division, but 2.1 percent per year in New Jersey. In the East North Central Division, Wisconsin has achieved the greatest decline, at 3.1 percent per year; other states in the division, however, have made far less progress, resulting in a decrease of only 0.3 percent per year for the entire division. First-year admission rates increased in seven states, including Indiana and Michigan; underlying causes of these deleterious changes should be investigated.

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

While admission rates in the prevalent population have fallen across many areas of the country, the states in the East North Central Division have seen little change since 2004, which is a source of concern. Hospitalization rates have also tended to increase in nearby states, including Kentucky and

West Virginia. The common geographical feature for all of these states is the Ohio River basin. This feature of the data raises complex questions about environmental pollution, persistent unemployment and poverty, and local capacity for health care (beyond dialysis providers). 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. Admission rates continue to be lowest in the states of the Mountain and Pacific Census Divisions, followed by the West South Central Division, all areas with relatively large shares of Hispanic white patients.

The next section presents data on cardiovascular hospitalizations, overall and by diagnosis. Overall rates have fallen consistently in both the incident and prevalent dialysis patient populations, but perhaps surprisingly exhibit clear seasonal variation in the latter population. Rates of change, differences by region, 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 (myocardial infarction and unstable angina), for example, have changed little in recent years, but vary by region of the country and exhibit seasonality. Admissions with a primary diagnosis of arrhythmia show a similar stability over time, but exhibit much less seasonality.

Patterns for admissions in which the diagnosis is either the primary or leading secondary diagnosis show different patterns compared to those using the primary diagnosis alone. The sharp change seen in some admission rates can be attributed to the introduction, in October 2007, of the Medicare Severity Diagnosis Related Group (MS-DRG) reimbursement system. Under MS-DRG, end-stage renal disease was enconced as a major complicating condition (MCC), so its use as the leading secondary diagnosis increased markedly, thus displacing other diagnoses that were previously used to secure higher reimbursement. Notably, MS-DRG also altered the relative weights for a large number of diagnoses, including an increase in the relative weight for the diagnosis of fluid overload. In turn, since the advent of MS-DRG, rates of hospitalizations for fluid overload have ostensibly increased among dialysis patients. These shifts in coding practices secondary to shifts in reimbursement complicate the assessment of morbidity and ultimately, the quality of care. True assessments of cause-specific hospitalization in the dialysis patient population should thus consider both specific and sensitive case definitions; this will be addressed more completely in the next edition of the Peer Report.

HOSPITALIZATION

Introduction

Hospitalization due to infection continues to be a major concern, yet over the last eight years there has been little or no progress in reducing admission rates. 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 60 percent since 2003 among both incident and prevalent dialysis patients. Hospitalizations for dialysis access infection as the primary diagnosis, however, have been declining among both incident and prevalent patients. 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. Measures of dialysis facility performance that do not recognize these issues may falsely reward or punish facilities for the diagnosis codes that local hospitals elect to include in claims for inpatient care. These areas demand careful consideration, particularly as findings from inpatient claims are soon reconciled with findings from blood cultures in the outpatient setting, 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. This pattern is no different than what it is observed in the general population, so blunting seasonal swings is a difficult challenge. However, these data should give pause to dialysis providers and their staff, as the physical concentration of patients in facilities three times per week presents a unique risk for disease transmission, which may be modified through vaccination, isolation, and good hygiene practices. Perhaps even more interesting than the oscillations in pneumonia and influenza are the perfectly concurrent oscillations in other types of morbidity. Admission rates for chronic pulmonary disease move in step with rates for pneumonia and influenza, possibly suggesting that patients with decreased pulmonary function may be an excellent target for infection control. Admission rates for some types of cardiovascular disease also move in step with rates for pneumonia and influenza, an unsurprising observation in light of studies linking infection, inflammation, and cardiovascular insults.

Rates of admission for vascular access procedures and complications (excluding access infection) have been on the decline for more than a decade, with repair procedures shifting to the outpatient setting. There is little variation across the country. In the incident patient population,

rates are highest in the Middle Atlantic and lowest in the West North Central states.

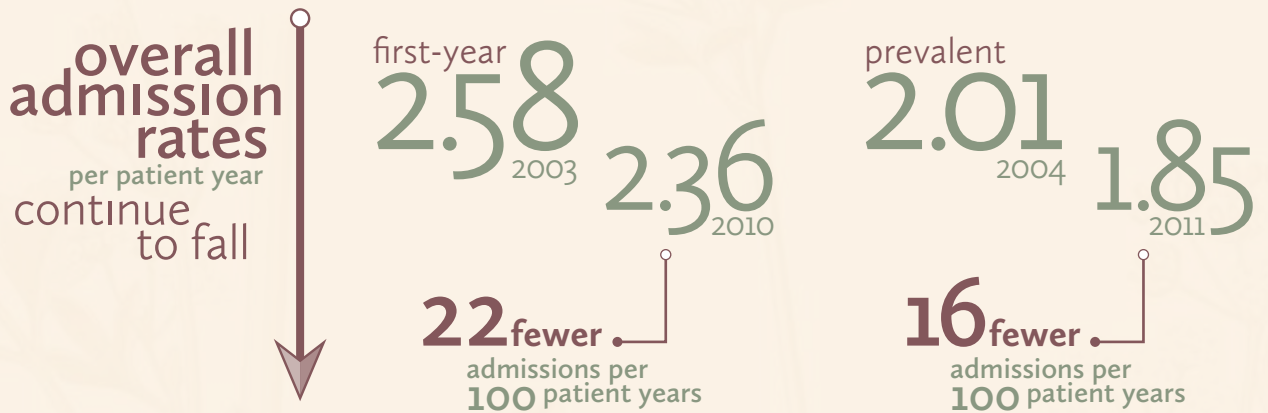
While there is considerable variation across the country in rates of admission for gastrointestinal bleeding, the general rise is concerning. It is unclear whether this increase reflects a higher burden of gastrointestinal complications or, instead, reflects changes in anemia management, leading to limited hemoglobin reserve; such issues will need to be addressed in future reports. Hospitalizations for hyperkalemia also appear to be on the rise in recent years, although this may reflect coding shifts secondary to the advent of MS-DRG. This area will also require further assessment in the future, particularly as potassium concentrations can be readily manipulated by dialysis providers.

Despite these variations in rates of cause-specific hospitalizations, the length of stay has been falling since 2005. In 2003–2005, dialysis patients spent an average of 14 days per patient year in the hospital; this has since decreased to less than 12. Across the country, the length of stay varies by nearly four days per patient year—an important observation. Days per patient year have declined for hospitalizations related to cardiovascular disease, but have remained unchanged for those related to infection, with the result that hospitalizations for infection now account for more hospital days.

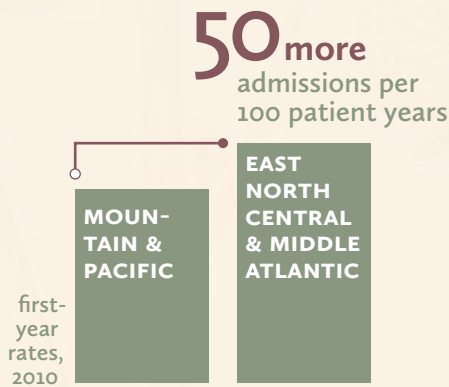
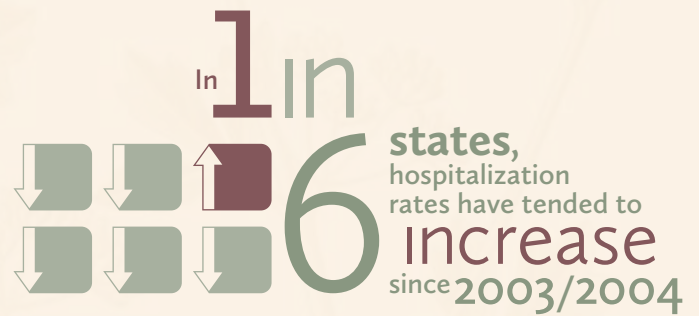
Data in this chapter illuminate important opportunities for providers to improve care across several domains. Seasonal and geographic variations in admission rates, for example, have important implications for novel approaches to risk reduction and to quality measurement in the public sphere. Coding 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, rather than gaming of the reimbursement system. Ultimately, unambiguous outcomes such as death and all-cause hospitalization may prove to be more consistent markers of health status among dialysis patients.

HOSPITALIZATION

As a primary morbidity in the dialysis population, **hospitalizations** provide a focal point for provider efforts to improve patient care & outcomes



While hospitalization rates have fallen overall, there are **geographic variations** in the degree of change across **U.S. CENSUS REGIONS**

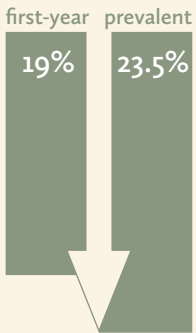


The **East North Central** states have seen the **least improvement** in hospitalization rates

There has been clear **progress** across the country in reducing hospital admissions due to **cardiovascular disease**



overall admissions per patient year have **fallen** since 2003/2004



admissions for **heart failure** have **fallen** as well

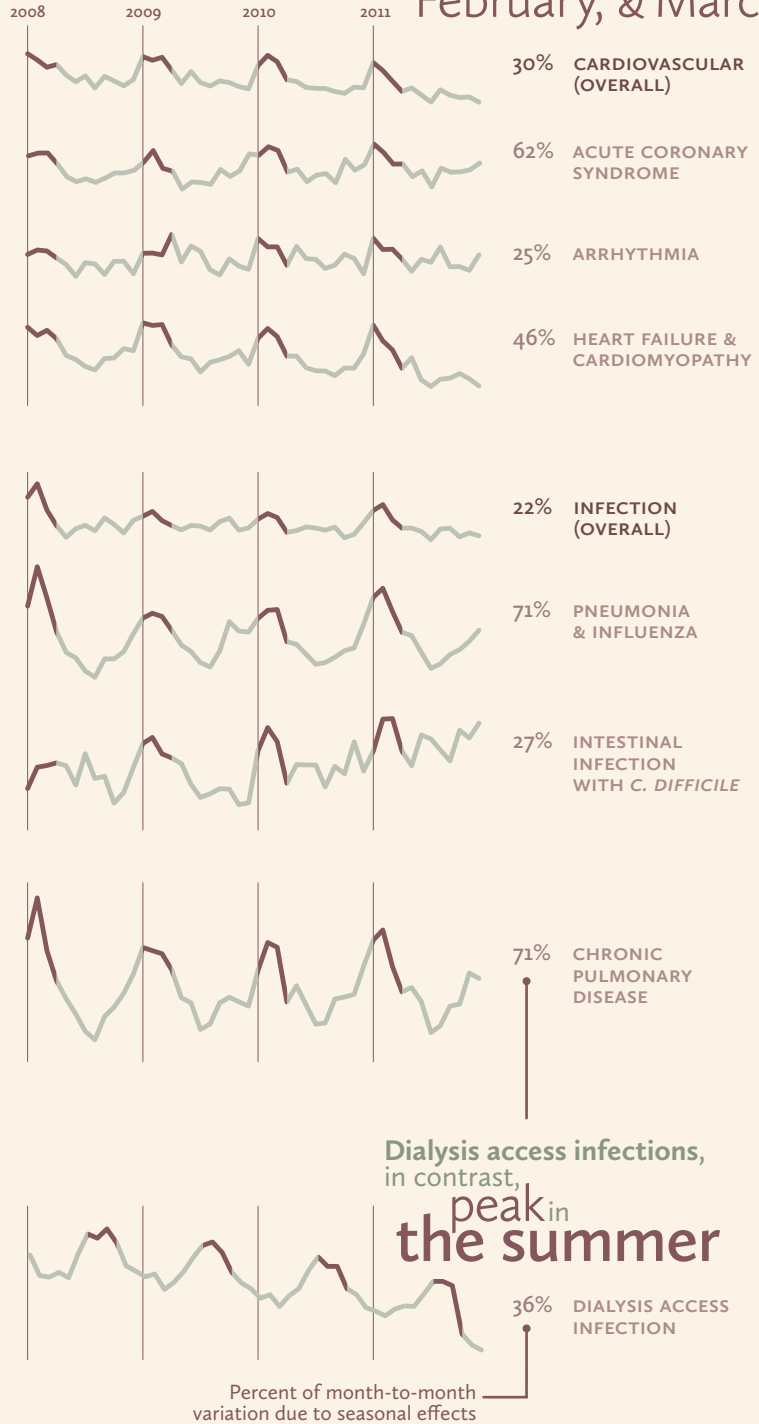
admissions for **fluid overload**, however, are **2.5 times** higher than in 2003/2004



and admissions for **infection** are **higher** as well

In the prevalent dialysis population, hospitalization rates for many causes

peak in January, February, & March



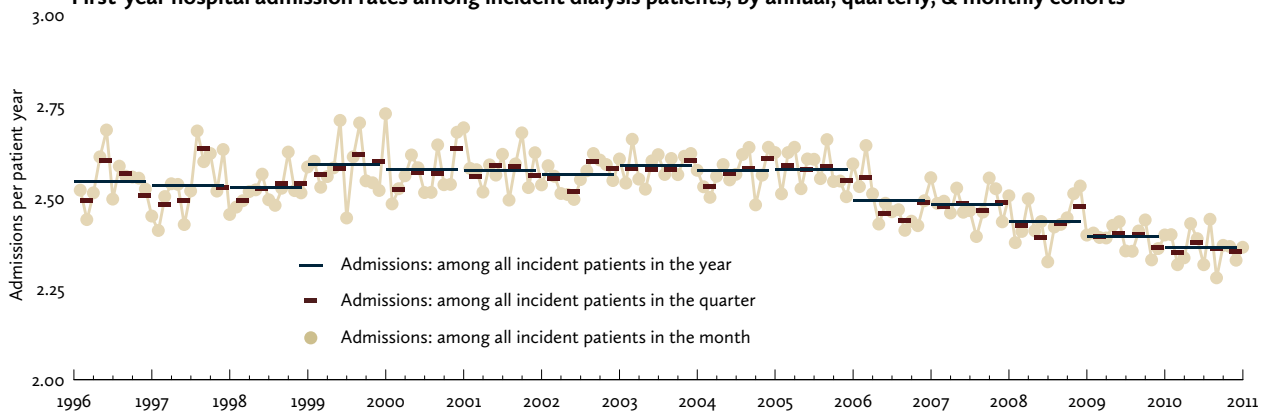
Dialysis access infections, in contrast, **peak** in the summer

HOSPITALIZATION

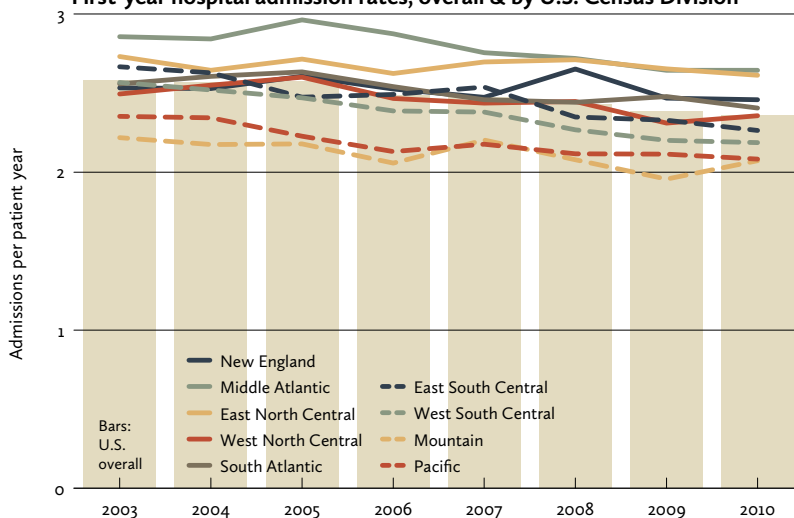
First-year hospital admission rates among incident dialysis patients

Hospitalization during the first year of chronic dialysis occurs relatively frequently, complicating the coordination of care during an already difficult time for incident patients. Between the beginning of 1996 and the end of 2005, first-year hospital admission rates were unchanged. Subsequently, however, rates began to decline. Among patients in 2006, rates were more than 3 percent lower than among corresponding patients in 2005. Rates continued to fall among successive annual cohorts of incident patients, leading to a cumulative reduction of more than 0.2 admissions per patient year between 2005 and 2010. ♦ Regional variation in rates is apparent, with a difference of more than 0.5 admissions per patient year between the Census Divisions with lowest and highest first-year hospital admission rates among incident dialysis patients in 2010. ♦ This variation may indicate important differences in socioeconomic status and access to health care. The southern borders of Illinois, Indiana, and Ohio, for instance, are within the Ohio River basin, an area with high incidence of ESRD, substantial poverty, and historical air and water pollution. From this perspective, the absence of a downward trend in first-year hospitalization in the East North Central region is concerning.

First-year hospital admission rates among incident dialysis patients, by annual, quarterly, & monthly cohorts



First-year hospital admission rates, overall & by U.S. Census Division



Between 1996 and 2010, the reduction in incident patient admissions was

7%
to 2.36
per patient year in 2010

In 2010, admissions per patient year were lowest in the Mountain and Pacific Census Divisions, at

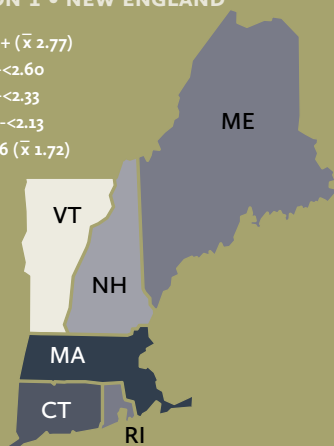
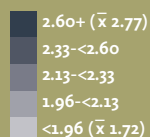
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First-year hospital admission rates among incident dialysis patients

After first Medicare-covered dialysis session in freestanding facility

Admissions per patient year; APC, Annual Percent Change. Maps show 2010 rates.

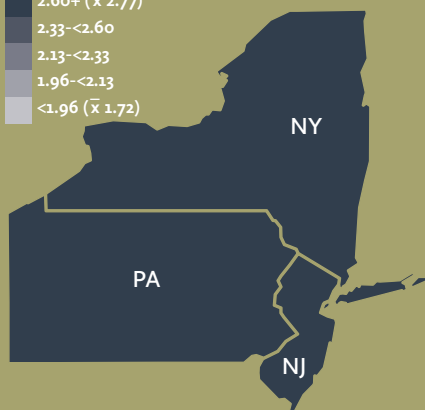
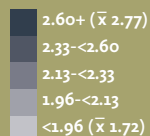
DIVISION 1 • NEW ENGLAND



	2003	2004	2005	2006	2007	2008	2009	2010	APC	
All	2.53	2.53	2.61	2.53	2.47	2.65	2.47	2.46	-0.4	
Connecticut	2.43	2.32	2.39	2.53	2.39	2.44	2.34	2.36	-0.2	
Maine	1.98	2.32	2.08	1.85	1.73	2.14	1.98	2.14	-0.3	
Mass.	2.72	2.65	2.88	2.70	2.69	3.00	2.76	2.68	0.2	
New Hamp.	2.22	2.49	2.36	2.52	2.24	2.73	2.09	2.06	-1.3	
Rhode Island	2.73	2.81	2.63	2.20	2.40	2.04	2.22	2.25	-3.7	
Vermont	.	.	.	.	.	.	.	.	.

- First-year hospital admission rates have declined modestly in New England, at a rate of 0.4 percent per year between 2003 and 2010.
- Rates have declined sharply in Rhode Island, from a peak of 2.81 admissions per patient year in 2004 to a nadir of 2.04 in 2008, with some rebound thereafter.
- The highest rate in the division has consistently been observed in Massachusetts, with 2.68 admissions per patient year in 2010. In that state, rates have changed very little since 2003.

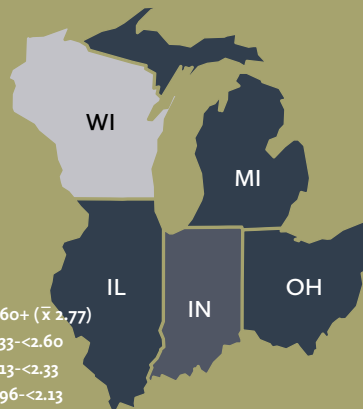
DIVISION 2 • MIDDLE ATLANTIC



	2003	2004	2005	2006	2007	2008	2009	2010	APC	
All	2.86	2.84	2.96	2.88	2.76	2.72	2.65	2.65	-1.4	
New Jersey	2.93	2.97	3.09	3.03	2.85	2.88	2.62	2.60	-2.1	
New York	2.73	2.71	2.90	2.77	2.75	2.70	2.68	2.65	-0.6	
Pennsylvania	2.93	2.89	2.95	2.87	2.69	2.62	2.63	2.68	-1.8	

- First-year hospital admission rates have decreased 1.4 percent per year in the Middle Atlantic, where rates have tended to be very similar among the constituent states.
- The largest decrease has occurred in New Jersey, where rates have fallen 2.1 percent per patient year, resulting in roughly 1 fewer admission per 9 patient years in 2010 versus 2003.
- Rates in New York have fallen relatively less than in the rest of the division.

DIVISION 3 • EAST NORTH CENTRAL



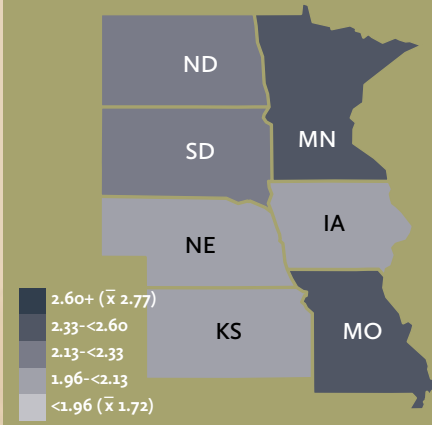
	2003	2004	2005	2006	2007	2008	2009	2010	APC	
All	2.73	2.64	2.71	2.62	2.70	2.71	2.65	2.61	-0.3	
Illinois	2.83	2.86	2.84	2.74	2.79	2.79	2.75	2.73	-0.6	
Indiana	2.36	2.20	2.49	2.23	2.43	2.54	2.32	2.46	0.8	
Michigan	2.70	2.63	2.73	2.60	2.73	2.81	2.77	2.70	0.4	
Ohio	2.94	2.81	2.78	2.88	2.87	2.76	2.85	2.69	-0.7	
Wisconsin	2.51	2.25	2.42	2.32	2.23	2.35	1.98	1.92	-3.1	

- First-year hospital admission rates have fallen 0.3 percent per year in the East North Central states, the smallest rate of decline among all U.S. Census Divisions.
- Rates in Indiana and Michigan actually tended to increase between 2003 and 2010.
- Rates in Wisconsin, however, have decreased 3.1 percent per year, one of the ten largest rates of decline in the country.

HOSPITALIZATION

First-year hospital admission rates among incident dialysis patients (continued)

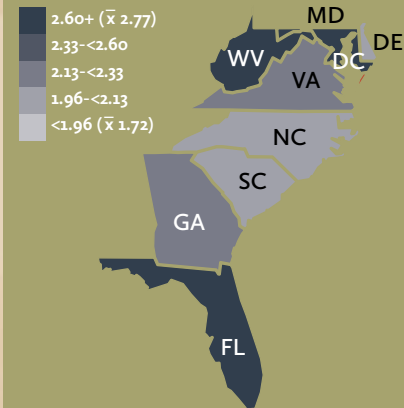
DIVISION 4 • WEST NORTH CENTRAL



	2003	2004	2005	2006	2007	2008	2009	2010	APC	
All	2.49	2.55	2.60	2.47	2.44	2.45	2.31	2.36	-1.3	
Iowa	2.40	2.38	2.29	2.52	2.17	2.27	2.03	2.11	-2.2	
Kansas	2.21	2.40	2.50	2.14	2.17	2.24	2.28	2.06	-1.3	
Minnesota	2.57	2.72	2.99	2.90	2.58	2.50	2.35	2.43	-2.1	
Missouri	2.66	2.66	2.76	2.57	2.63	2.59	2.45	2.59	-0.9	
Nebraska	2.29	2.37	2.10	1.96	2.30	2.39	2.05	2.12	-0.8	
North Dakota	2.25	1.90	1.52	.	.	1.77	2.41	2.30	.	
South Dakota	1.97	2.12	1.91	2.18	1.33	2.17	1.90	2.27	0.4	

- First-year hospital admission rates have decreased 1.3 percent per year in the West North Central states. Leading the division are Iowa and Minnesota, where admission rates have fallen by slightly more than 2 percent per year.
- Among all states in the division, the highest rate in 2010 was observed in Missouri.

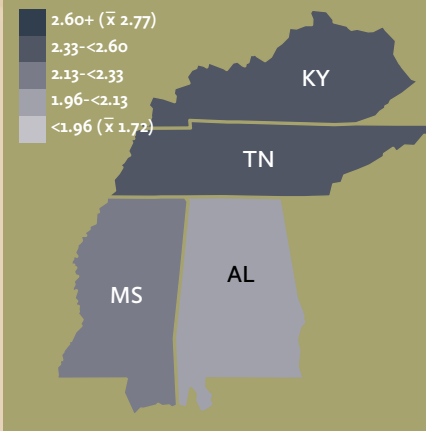
DIVISION 5 • SOUTH ATLANTIC



	2003	2004	2005	2006	2007	2008	2009	2010	APC	
All	2.56	2.61	2.63	2.54	2.46	2.44	2.48	2.41	-1.1	
Delaware	1.84	2.05	2.30	2.18	2.10	1.92	2.03	2.11	0.4	
D.C.	2.49	2.51	2.99	2.25	2.50	2.60	2.98	2.41	0.4	
Florida	2.90	2.83	2.85	2.82	2.83	2.84	2.80	2.74	-0.6	
Georgia	2.37	2.38	2.47	2.35	2.20	2.19	2.24	2.21	-1.5	
Maryland	3.00	3.12	3.17	3.12	2.98	3.00	3.34	2.77	-0.5	
N Carolina	2.29	2.43	2.42	2.31	2.13	2.08	2.10	2.10	-2.2	
S Carolina	2.14	2.33	2.33	2.18	2.21	2.02	1.95	2.03	-2.0	
Virginia	2.48	2.43	2.44	2.37	2.25	2.26	2.17	2.16	-2.1	
West Virginia	2.86	2.97	2.93	2.94	2.74	2.85	3.03	3.44	1.5	

- Changes in first-year admission rates in the South Atlantic have been heterogeneous, with some increases in the northern part of the area and modest decreases in the Carolinas.

DIVISION 6 • EAST SOUTH CENTRAL



	2003	2004	2005	2006	2007	2008	2009	2010	APC	
All	2.67	2.63	2.47	2.49	2.54	2.35	2.33	2.26	-2.2	
Alabama	2.86	2.78	2.40	2.54	2.44	2.24	2.13	2.04	-4.6	
Kentucky	2.74	2.78	2.65	2.50	2.92	2.64	2.72	2.57	-0.5	
Mississippi	2.48	2.35	2.23	2.13	2.22	2.07	2.11	2.13	-2.1	
Tennessee	2.57	2.56	2.57	2.70	2.62	2.43	2.38	2.34	-1.5	

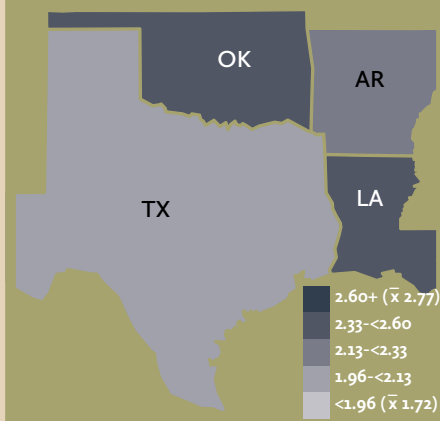
- First-year hospital admission rates have fallen 2.2 percent per year in the East South Central division.
- Alabama had the highest rate in the division in 2003, but after a 4.6 percent decrease per year during the subsequent seven years, had the lowest rate in 2010.
- In Kentucky, rates have decreased only modestly, at a rate of 0.5 percent per year.
- After peaking in 2006, rates in Tennessee decreased cumulatively by more than 13 percent in the subsequent four years.

First-year hospital admission rates among incident dialysis patients (continued)

After first Medicare-covered dialysis session in freestanding facility

Admissions per patient year; APC, Annual Percent Change. Maps show 2010 rates.

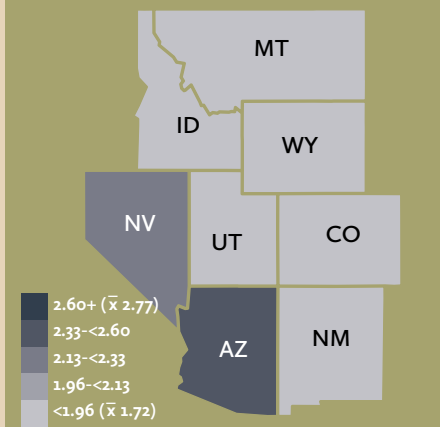
DIVISION 7 • WEST SOUTH CENTRAL



	2003	2004	2005	2006	2007	2008	2009	2010	APC
All	2.57	2.52	2.47	2.39	2.38	2.27	2.20	2.19	-2.4
Arkansas	2.67	2.82	2.73	2.51	2.40	2.55	2.25	2.20	-3.2
Louisiana	3.13	2.92	2.86	2.65	2.64	2.45	2.36	2.33	-4.2
Oklahoma	2.74	2.62	2.63	2.42	2.39	2.31	2.20	2.40	-2.6
Texas	2.37	2.36	2.32	2.31	2.31	2.18	2.16	2.12	-1.6

- First-year hospital admission rates have decreased 2.4 percent per year in the West South Central states, the largest rate of decline among all U.S. Census Divisions.
- Leading the division is Louisiana, where rates fell 4.2 percent per year between 2003 and 2010.
- Admission rates in Oklahoma decreased 2.6 percent per year since 2003 and 2010, but, in a notable deviation from trend, increased substantially between 2009 and 2010.

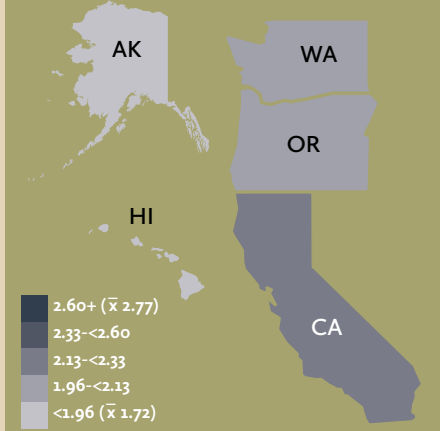
DIVISION 8 • MOUNTAIN



	2003	2004	2005	2006	2007	2008	2009	2010	APC
All	2.22	2.18	2.18	2.06	2.20	2.08	1.96	2.07	-1.3
Arizona	2.39	2.52	2.37	2.26	2.45	2.23	2.27	2.47	-0.5
Colorado	2.44	2.21	2.31	2.34	2.38	1.92	1.73	1.90	-4.1
Idaho	1.79	1.17	2.02	1.73	1.76	2.03	1.80	1.44	0.8
Montana	2.15	2.22	1.74	1.53	1.95	1.10	1.70	1.95	-3.7
Nevada	2.15	2.33	2.68	1.99	2.26	2.51	2.24	2.13	-0.4
New Mexico	2.19	1.83	1.89	1.93	2.05	1.90	1.71	1.80	-1.9
Utah	1.47	1.58	1.41	1.42	1.67	1.57	1.26	1.48	-0.7
Wyoming	1.33	1.50	1.35	2.08	1.19	1.78	1.28	1.83	2.1

- First-year admission rates have fallen 1.3 percent per year in the Mountain division, and in 2010 the rate was the lowest among all Census Divisions. In Colorado, rates fell 4.1 percent per year between 2003 and 2010, primarily due to an abrupt decline between 2007 and 2008.

DIVISION 9 • PACIFIC



	2003	2004	2005	2006	2007	2008	2009	2010	APC
Pacific	2.35	2.34	2.23	2.13	2.18	2.12	2.11	2.08	-1.8
Alaska	1.92	1.90	1.71	1.67	1.67	1.21	1.63	1.30	-5.3
California	2.40	2.43	2.28	2.24	2.26	2.25	2.22	2.14	-1.5
Hawaii	1.57	1.75	1.47	1.48	1.48	1.25	1.36	1.59	-2.0
Oregon	2.14	1.97	2.22	1.78	2.12	1.65	1.87	1.96	-1.8
Washington	2.33	2.10	2.06	1.92	1.98	1.79	1.82	1.96	-2.7

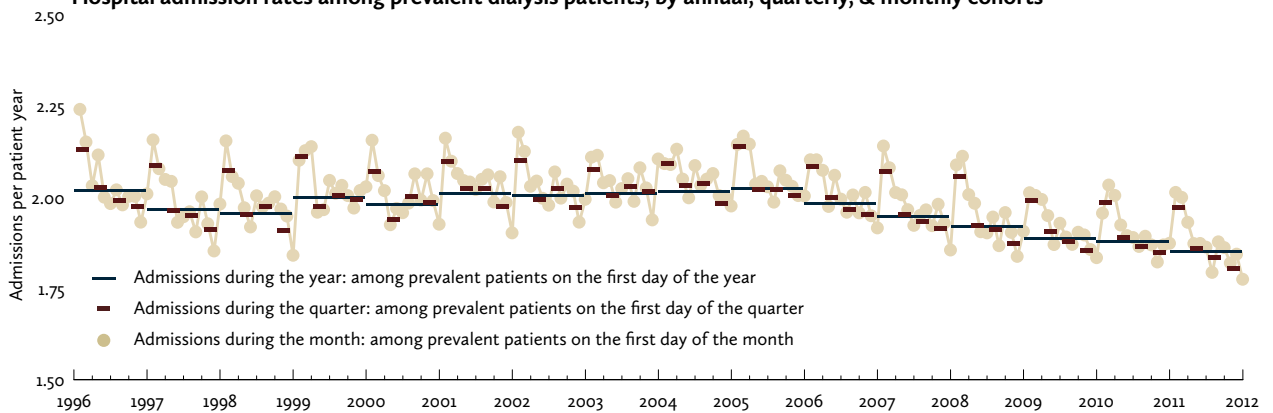
- In the Pacific division, first-year hospital admission rates have fallen by 1.8 percent per year, although rates remained relatively stable between 2006 and 2010.
- In California, rates were routinely the highest in the division, and decreased most slowly between 2003 and 2010.
- Alaska's first year hospital admission rates fell 5.3 percent per year between 2003 and 2010, the greatest decrease nationwide.

HOSPITALIZATION

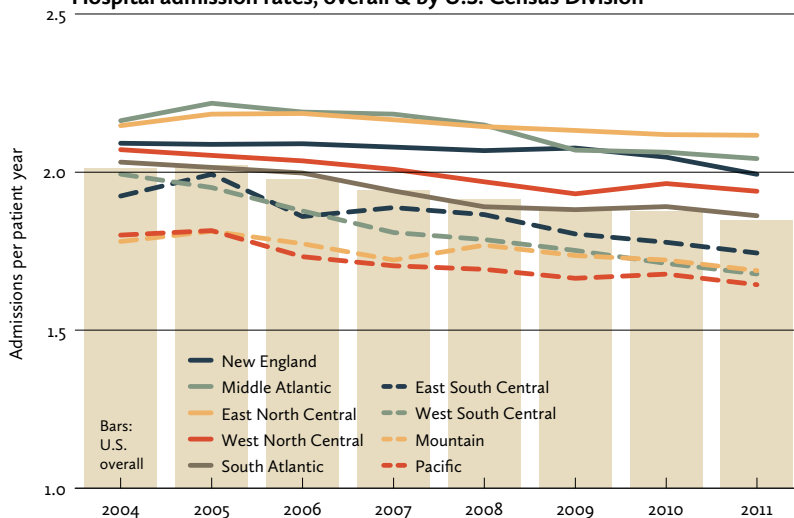
Hospital admission rates among prevalent dialysis patients

Between the beginning of 1996 and the end of 2005, there was little change in the admission rate among prevalent dialysis patients. Since the beginning of 2006, however, rates have begun to decline. ♦ Among patients alive on January 1, 2006, the rate during the calendar year was more than 2 percent lower than among corresponding patients alive on January 1, 2005. In successive years, year-over-year declines in the rate were typically between 1 and 2 percent, for a cumulative reduction of more than 8 percent between 2005 and 2011. ♦ Rates within calendar quarters and months follow strong cyclical patterns, a clear manifestation of seasonality. In recent years, the rate in the first quarter exceeds the corresponding rate in the fourth quarter by 7–10 percent. From this perspective, January and February are clear targets for quality improvement efforts, especially regarding infection control. ♦ Progress has been markedly slower in some parts of the country. Some of these differences might be due to regional variation in influenza intensity, an area that merits further study. Alternatively, in states with much larger patient populations, there may be substantial variation in progress across metropolitan statistical areas within the states.

Hospital admission rates among prevalent dialysis patients, by annual, quarterly, & monthly cohorts



Hospital admission rates, overall & by U.S. Census Division



The admission rate per patient year for prevalent dialysis patients in 2011 was

2.1 in the East North Central Census Division,
1.85 overall, and

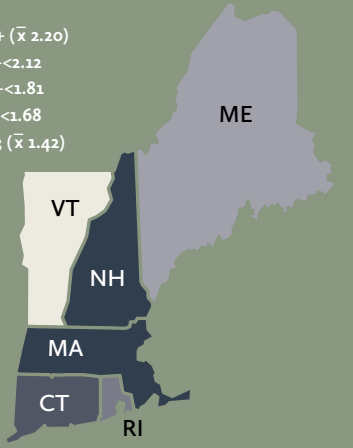
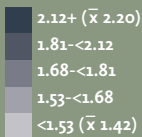
1.64 in the Pacific Census Division

Hospital admission rates among prevalent dialysis patients

Among Medicare-enrolled dialysis patients on January 1 of each year

Admissions per patient year; APC, Annual Percent Change. Maps show 2011 rates.

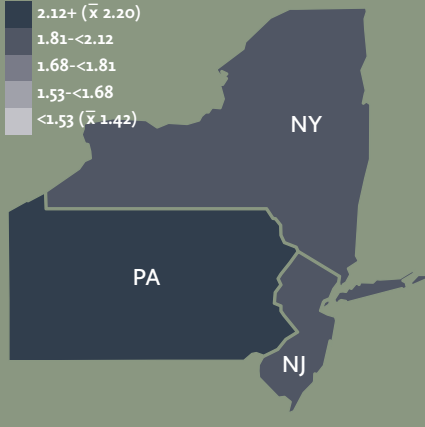
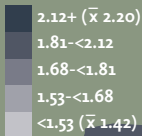
DIVISION 1 • NEW ENGLAND



	2004	2005	2006	2007	2008	2009	2010	2011	APC	
All	2.09	2.09	2.09	2.08	2.07	2.08	2.05	1.99	-0.5	
Connecticut	1.86	1.87	1.92	1.94	1.89	1.91	1.89	1.83	-0.1	
Maine	1.56	1.77	1.67	1.64	1.57	1.75	1.57	1.53	-0.8	
Mass.	2.44	2.33	2.34	2.31	2.34	2.30	2.32	2.20	-0.9	
New Hamp.	1.83	1.77	1.93	2.05	2.00	1.93	1.94	2.21	2.1	
Rhode Island	1.99	2.28	1.98	1.93	1.87	1.99	1.78	1.73	-2.6	
Vermont	0.85	0.99	1.48	1.61	.	.	.	.	.

- Although rates decreased by only 0.5 percent per year between 2004 and 2011 in New England, they have fallen sharply since 2009, with a cumulative decline of more than 4 percent. Leading the area has been Rhode Island, with a decline of 2.6 percent per year. In Massachusetts, the most populous state in the division, the rate fell more than 5 percent between 2010 and 2011. The rate in New Hampshire, in contrast, rose 2.1 percent per year between 2004 and 2011, with a substantial increase from 2010 to 2011.

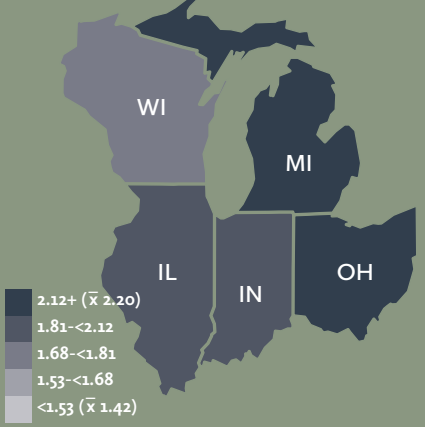
DIVISION 2 • MIDDLE ATLANTIC



	2004	2005	2006	2007	2008	2009	2010	2011	APC	
All	2.16	2.22	2.19	2.18	2.15	2.07	2.06	2.04	-1.1	
New Jersey	2.25	2.31	2.20	2.19	2.19	2.10	2.06	2.04	-1.7	
New York	1.96	2.00	2.03	2.09	2.06	1.98	2.02	1.98	0.1	
Pennsylvania	2.36	2.44	2.40	2.30	2.23	2.16	2.11	2.12	-2.1	

- In the Middle Atlantic states, hospital admission rates fell by slightly more than 1 percent per year between 2004 and 2011.
- Leading the division was Pennsylvania, where rates decreased by 2.1 percent per year.
- Trailing the division was New York, where rates have been stable since 2004.

DIVISION 3 • EAST NORTH CENTRAL



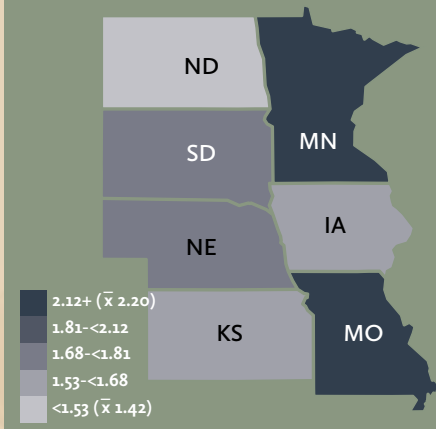
	2004	2005	2006	2007	2008	2009	2010	2011	APC	
All	2.15	2.18	2.19	2.17	2.14	2.13	2.12	2.12	-0.4	
Illinois	2.19	2.25	2.21	2.23	2.20	2.18	2.16	2.10	-0.6	
Indiana	1.92	1.88	1.88	1.90	1.97	1.99	1.96	2.00	0.8	
Michigan	2.24	2.28	2.30	2.23	2.22	2.26	2.22	2.23	-0.3	
Ohio	2.18	2.26	2.25	2.25	2.19	2.13	2.17	2.20	-0.4	
Wisconsin	1.99	1.94	2.06	1.94	1.90	1.82	1.75	1.75	-2.1	

- Hospital admission rates in the East North Central division fell by only 0.4 percent per year between 2004 and 2011, the lowest rate of decline among all U.S. Census Divisions.
- In turn, the rate in 2011 was 2.12 admissions per patient year, the highest among all U.S. Census Divisions.
- In Indiana, rates rose almost 1 percent per year between 2004 and 2011.
- In Wisconsin, rates fell by more than 2 percent per year between 2004 and 2011, and in 2011 the rate was the lowest in the division.

HOSPITALIZATION

Hospital admission rates among prevalent dialysis patients (continued)

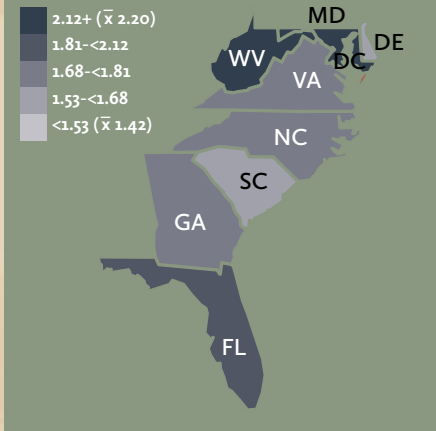
DIVISION 4 • WEST NORTH CENTRAL



	2004	2005	2006	2007	2008	2009	2010	2011	APC
All	2.07	2.05	2.04	2.01	1.97	1.93	1.96	1.94	-1.0
Iowa	2.04	1.92	1.96	1.96	1.80	1.78	1.73	1.62	-2.9
Kansas	1.85	1.80	1.73	1.60	1.65	1.65	1.67	1.53	-2.1
Minnesota	2.27	2.29	2.32	2.29	2.27	2.12	2.25	2.17	-0.8
Missouri	2.16	2.16	2.15	2.18	2.09	2.09	2.12	2.16	-0.2
Nebraska	1.78	1.80	1.75	1.61	1.74	1.56	1.62	1.68	-1.4
North Dakota	2.10	2.00	1.67	1.99	1.56	2.04	1.41	1.51	-4.3
South Dakota	1.97	1.80	1.89	1.91	1.80	2.02	1.69	1.74	-1.2

♦ Rates in this division fell 1.0 percent per year between 2004 and 2011. In North Dakota, the per year decline was 4.3 percent, although the case mix of patients has likely undergone substantial change with the opening of freestanding facilities in the state. Otherwise leading the division was Iowa, with a decline of 2.9 percent per year. In 2011, Minnesota had the highest hospital admission rate in the division, at 2.17 admissions per patient year.

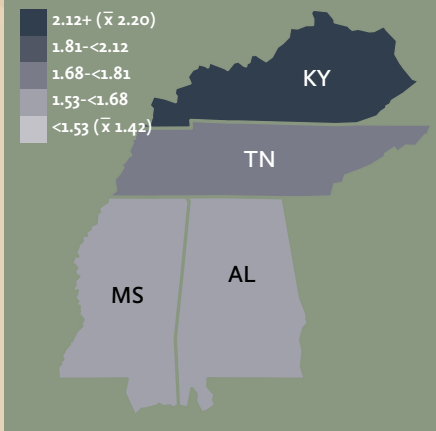
DIVISION 5 • SOUTH ATLANTIC



	2004	2005	2006	2007	2008	2009	2010	2011	APC
All	2.03	2.02	2.00	1.94	1.89	1.88	1.89	1.86	-1.3
Delaware	1.73	1.79	1.91	1.94	1.67	1.63	1.62	1.60	-1.9
D.C.	2.33	2.24	2.13	1.93	2.15	2.05	1.92	1.78	-3.1
Florida	2.18	2.17	2.17	2.11	2.09	2.13	2.10	2.09	-0.6
Georgia	1.85	1.87	1.86	1.77	1.72	1.68	1.71	1.69	-1.6
Maryland	2.49	2.45	2.42	2.42	2.38	2.33	2.39	2.26	-1.1
N Carolina	1.94	1.91	1.90	1.84	1.75	1.71	1.75	1.71	-2.0
S Carolina	1.82	1.86	1.76	1.70	1.67	1.64	1.63	1.63	-2.0
Virginia	1.96	1.88	1.84	1.79	1.72	1.74	1.74	1.75	-1.7
West Virginia	2.15	2.07	2.21	2.35	2.15	2.20	2.18	2.37	1.0

♦ Hospital admission rates in this division decreased by 1.3 percent between 2004 and 2011, but, in a notable deviation, increased 1.0 percent per year in West Virginia

DIVISION 6 • EAST SOUTH CENTRAL



	2004	2005	2006	2007	2008	2009	2010	2011	APC
All	1.92	1.99	1.86	1.89	1.87	1.80	1.78	1.74	-1.6
Alabama	1.97	2.01	1.91	1.92	1.77	1.69	1.65	1.66	-3.1
Kentucky	2.04	2.18	2.01	1.96	2.08	2.07	2.14	2.12	0.4
Mississippi	1.73	1.87	1.57	1.73	1.72	1.65	1.61	1.55	-1.6
Tennessee	1.97	1.95	1.97	1.95	1.96	1.89	1.84	1.77	-1.4

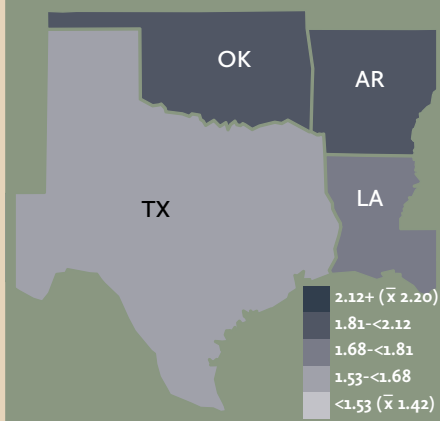
♦ In the East South Central division, hospital admission rates decreased 1.6 percent per year between 2004 and 2011.
 ♦ Leading the division was Alabama, where rates fell by more than 3 percent per year between 2004 and 2011.
 ♦ In Kentucky, after admission rates fell to a nadir of 1.96 admissions per patient year in 2007, they have cumulatively increased by 8 percent.

Hospital admission rates among prevalent dialysis patients (continued)

Among Medicare-enrolled dialysis patients on January 1 of each year

Admissions per patient year; APC, Annual Percent Change. Maps show 2011 rates.

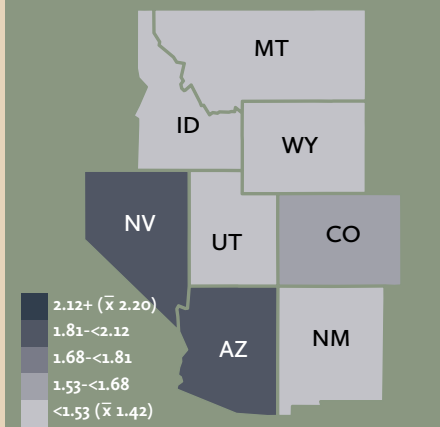
DIVISION 7 • WEST SOUTH CENTRAL



	2004	2005	2006	2007	2008	2009	2010	2011	APC
All	1.99	1.95	1.88	1.81	1.79	1.75	1.71	1.68	-2.4
Arkansas	2.02	2.14	2.04	2.02	2.00	1.84	1.80	1.82	-2.2
Louisiana	2.23	2.11	2.04	1.88	1.84	1.82	1.69	1.68	-4.0
Oklahoma	2.15	2.11	2.02	2.02	1.97	1.91	1.80	1.84	-2.4
Texas	1.91	1.88	1.81	1.75	1.74	1.71	1.70	1.65	-2.0

- In the West South Central division, hospital admission rates decreased 2.4 percent per year between 2004 and 2011, the most rapid rate of decline among all U.S. Census Divisions.
- Leading the division was Louisiana, where rates fell 4.0 percent per year between 2004 and 2011, the third most rapid rate of decline in the nation.

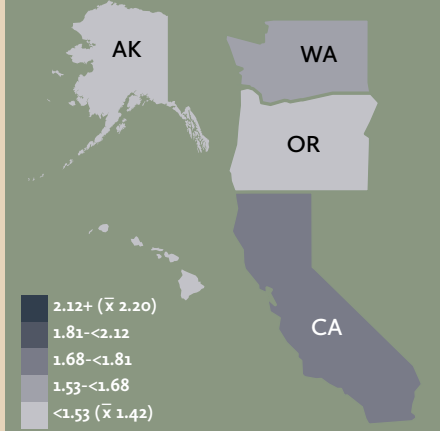
DIVISION 8 • MOUNTAIN



	2004	2005	2006	2007	2008	2009	2010	2011	APC
All	1.78	1.81	1.77	1.72	1.77	1.74	1.72	1.69	-0.8
Arizona	1.96	2.04	2.00	1.93	2.03	1.95	1.96	1.93	-0.4
Colorado	1.78	1.82	1.78	1.65	1.70	1.68	1.60	1.56	-2.0
Idaho	1.41	1.32	1.32	1.48	1.47	1.52	1.57	1.44	1.7
Montana	1.61	1.69	1.70	1.66	1.52	1.26	1.40	1.48	-3.0
Nevada	1.82	1.83	1.83	1.79	1.90	1.86	1.86	1.81	0.2
New Mexico	1.69	1.66	1.60	1.59	1.60	1.56	1.51	1.48	-1.7
Utah	1.27	1.45	1.42	1.37	1.29	1.37	1.36	1.40	0.3
Wyoming	1.37	1.15	1.17	1.43	1.16	1.54	1.55	1.46	3.1

- Between 2004 and 2011, hospital admission rates fell 0.8 percent per year in the Mountain division.
- Rates decreased most rapidly in Montana and Colorado.

DIVISION 9 • PACIFIC



	2004	2005	2006	2007	2008	2009	2010	2011	APC
Pacific	1.80	1.82	1.73	1.70	1.69	1.66	1.68	1.64	-1.4
Alaska	1.51	1.83	1.60	1.47	1.41	1.24	1.19	1.20	-5.3
California	1.81	1.84	1.76	1.76	1.75	1.72	1.72	1.69	-1.1
Hawaii	1.43	1.35	1.31	1.11	1.14	1.19	1.31	1.15	-2.3
Oregon	1.69	1.75	1.61	1.58	1.63	1.42	1.53	1.50	-2.2
Washington	1.85	1.78	1.67	1.65	1.60	1.65	1.66	1.67	-1.4

- In the Pacific division, hospital admission rates decreased by 1.4 percent per year between 2004 and 2011.
- In 2011, the admission rate was 1.64 admissions per patient year, the lowest among all U.S. Census Divisions.
- Rates decreased most rapidly in Alaska, at 5.3 percent per year.
- In California, the most populous state, rates decreased most slowly, at 1.1 percent per year.

HOSPITALIZATION

Cardiovascular disease as the primary discharge diagnosis

In both incident and prevalent dialysis patient populations, there has been clear progress across the country in reducing hospital admissions due to cardiovascular disease. The first-year admission rate fell by more than 16 percent between annual cohorts of patients initiating chronic dialysis in 2003 and 2010. Among prevalent patients, the rate fell by more than 14 percent between 2004 and 2011. ♦ Large differences in rates among Census Divisions persist, however. By the end of the study period, relative differences between divisions with the highest and lowest rates ranged from 25 to 30 percent. Some of this variation can certainly be attributed to case mix, as all of the displayed rates are unadjusted. The absence of parallel trends across the divisions, however, circumstantially suggests that regional opportunities for quality improvement exist. Increased prescription of and improved adherence to oral medications for primary and secondary prevention of cardiovascular morbidity may be one such opportunity. ♦ An interesting aspect of admission rates for cardiovascular disease is the apparent seasonality in the prevalent population. In each year between 2008 and 2011, there are clear peaks in January or February. The reasons for this pattern are likely complex. Certainly, the incidence of communicable disease, particularly influenza, follows a seasonal pattern in the general population; epidemiologic studies show that seasonal patterns occur in cold-weather and warm-weather states alike, and some have suggested that the patterns are actually more profound in warm-weather states. In the dialysis patient population, infectious diseases are likely to elicit inflammatory reactions that may engender subsequent cardiovascular events, resulting in the seasonal pattern displayed here. Some portion of the pattern may, however, be due to non-modifiable factors like air temperature, atmospheric pressure, and sunlight hours per day. ♦ Cardiovascular morbidity comprises a diverse set of conditions which are important to consider in their own rights, as the pathophysiology and possible iatrogenic risk factors for each differ. In subsequent pages we explore acute coronary syndrome, comprising myocardial infarction and unstable angina; arrhythmia, including atrial fibrillation; heart failure and the related conditions of cardiomyopathy, fluid overload, and pleural effusion; and stroke. In each case, there are challenges in interpreting Medicare claims submitted by hospitals, as the diagnosis codes used to document either the incidence or mere presence of specific diseases tend to be used more or less frequently as reimbursement rules evolve. For this reason, in the case of each specific cardiovascular condition, we display rates of hospital admissions defined by queries of the principal discharge diagnosis code and alternative queries of both the principal and leading secondary discharge diagnosis codes. In many cases, we find that the advent of Medicare Severity Diagnosis Related Groups (MS-DRGs) on October 1, 2007, resulted in substantial changes in secondary diagnosis coding.

In 2011, prevalent patient cardiovascular admission rates were **14% lower** than those in 2004, at **0.54** per patient year

Key Discharge Diagnoses (ICD-9-CM codes)

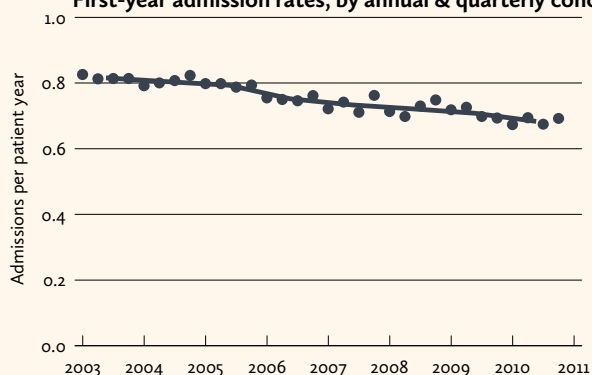
428	Heart failure (24,931)
403	Hypertensive chronic kidney disease (17,715)
427	Cardiac dysrhythmia (9,168)
276.6	Fluid overload (8,722)
410	Acute myocardial infarction (8,517)
414.0	Coronary atherosclerosis (7,103)
440.2	Atherosclerosis of native arteries of the extremities (5,542)
458	Hypotension (5,055)
404	Hypertensive heart and chronic kidney disease (4,308)

Counts: admissions among prevalent patients in 2011

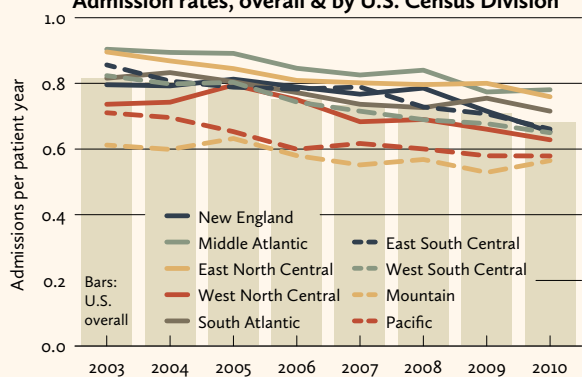
Cardiovascular disease as the primary discharge diagnosis

Incident patients

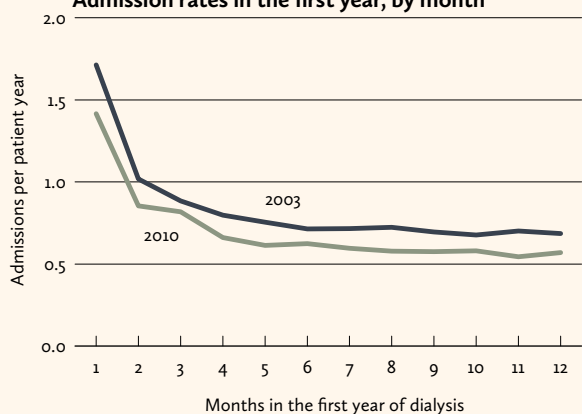
First-year admission rates, by annual & quarterly cohorts



Admission rates, overall & by U.S. Census Division

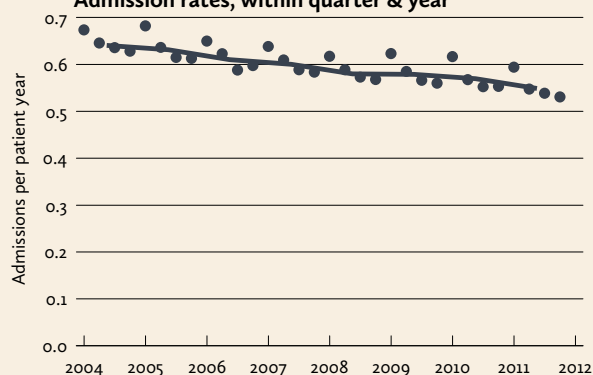


Admission rates in the first year, by month

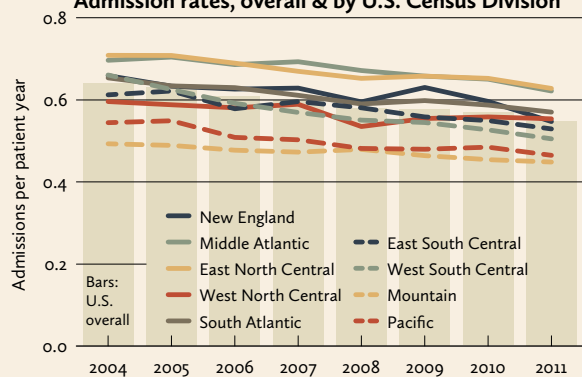


Prevalent patients

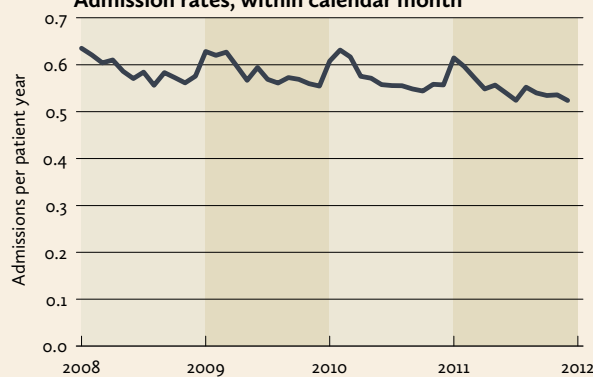
Admission rates, within quarter & year



Admission rates, overall & by U.S. Census Division



Admission rates, within calendar month



HOSPITALIZATION

Acute coronary syndrome (myocardial infarction & unstable angina)

The rate of hospitalization with a primary diagnosis of acute coronary syndrome (ACS)—which includes acute myocardial infarction, with or without ST-segment elevation, and angina pectoris—changed very little between 2003 and 2011, with a rate of roughly five admissions per 100 patient years during the first year of dialysis among incident patients, and of slightly more than four among prevalent patients. By far, the most common primary discharge diagnosis has been subendocardial infarction (i.e., NSTEMI). ♦ The rate of hospitalization with either a primary or leading secondary diagnosis of ACS, in contrast, changed meaningfully during the same era, with a decline during the interval preceding the advent of MS-DRGs and a subtle increase during the interval afterward. That latter feature should be assessed closely in subsequent reports, as it may be a harbinger of further increases due to widening use of more sensitive troponin assays, rather than the leading edge of increased incidence. Regarding the broader definition including primary and leading secondary diagnoses, most of the decline during the interval preceding the advent of MS-DRGs can be attributed to sharp declines in coding of unstable angina, specifically intermediate coronary syndrome (ICD-9-CM diagnosis code 411.1), which was declared to be only a complicating condition under MS-DRG. This suggests that the incidence of unstable angina, in contrast to the incidence of myocardial infarction, may be more sensitive to reimbursement rules and thus more difficult to discern from Medicare claims. ♦ There is some geographic variation in the incidence of coronary syndrome among both incident and prevalent dialysis patients, with a tendency toward higher rates in the northeastern quadrant of the country. ♦ Among incident dialysis patients, there was a clear downward shift between 2003 and 2010 in the rate of hospitalization for ACS during the first three months of dialysis, and less of a shift thereafter. The reasons for this decrease in early risk are unclear. It may reflect better medication management before initiating dialysis, improved delivery of dialysis (specifically, better management of arterial blood pressure), or both. ♦ Interestingly, there is strong evidence of seasonality in the incidence of ACS, with periodic peaks during the winter months and an especially high peak during the winter of 2011. This latter case is interesting in itself, as the Centers for Disease Control

and Prevention has characterized the severity of influenza during the winter of 2010–2011 as less pronounced than during the preceding winter. Of course, the final months of 2010, during which the rate of hospitalization for ACS spiked, also coincided with sharp changes in anemia management in anticipation of the ESRD Prospective Payment System, complicating attribution of the spike in risk to specific mechanisms. In any case, the recurrent wintertime peaks in hospitalization for ACS point toward a potentially fruitful target for quality improvement.

Hospitalizations for acute coronary syndrome show little change over the past decade

Key Primary Discharge Diagnoses (ICD-9-CM codes)

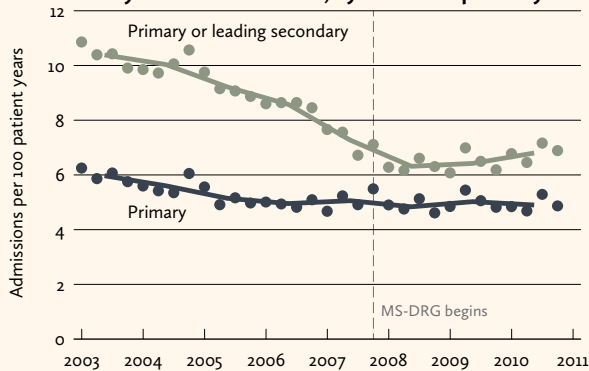
410.71	Subendocardial infarction (7,269)
410.91	Myocardial infarction of unspecified site (414)
410.41	Myocardial infarction of inferior wall (295)
411.1	Intermediate coronary syndrome (263)
410.11	Myocardial infarction of anterior wall (209)

Counts: admissions among prevalent patients in 2011

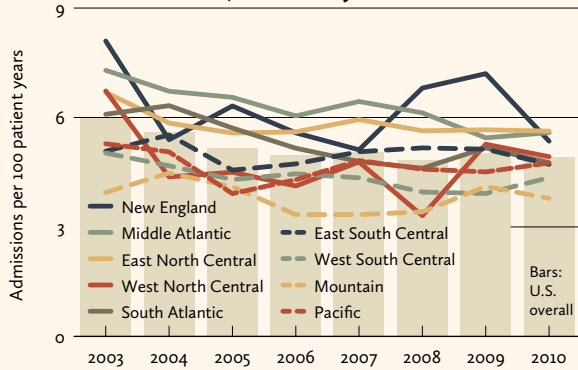
Acute coronary syndrome (myocardial infarction & unstable angina)

Incident patients

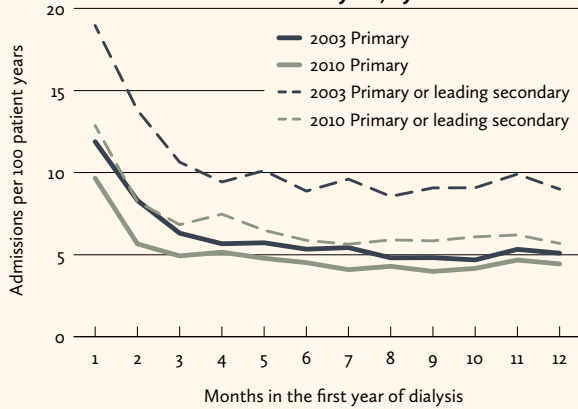
First-year admission rates, by annual & quarterly cohorts



Admission rates, overall & by U.S. Census Division

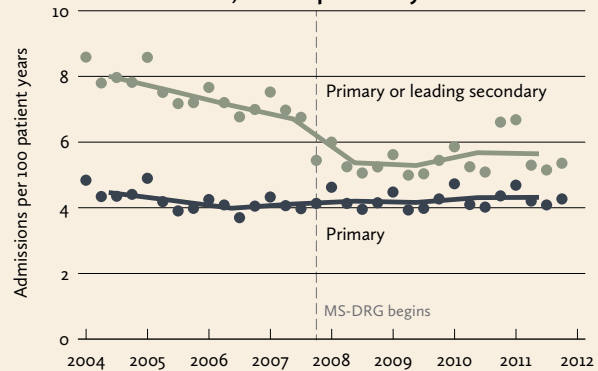


Admission rates in the first year, by month

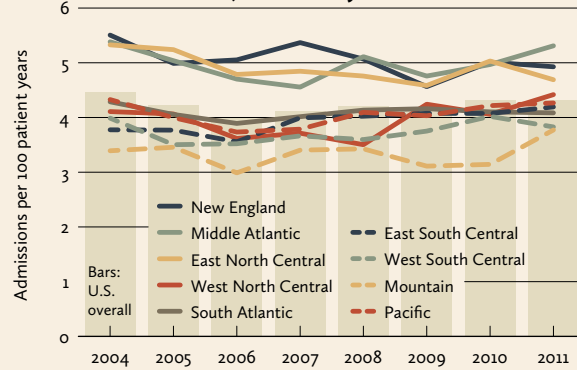


Prevalent patients

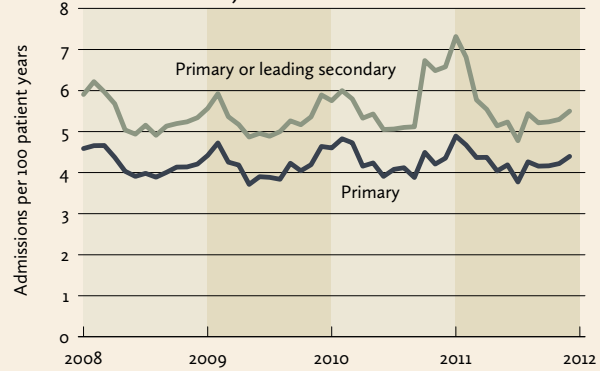
Admission rates, within quarter & year



Admission rates, overall & by U.S. Census Division



Admission rates, within calendar month



HOSPITALIZATION

Arrhythmia

Hospitalizations for arrhythmia include atrial, ventricular, and asystolic events, although atrial fibrillation has been the most common primary discharge diagnosis, at least among prevalent dialysis patients in 2011. The rate of hospitalization with arrhythmia as the primary discharge diagnosis was constant during the study era among both incident and prevalent dialysis patients. In contrast, admissions with arrhythmia as either the primary or leading secondary discharge diagnosis exhibited a substantial decline before the advent of MS-DRGs. This can be attributed almost exclusively to less intensive coding of atrial fibrillation (ICD-9-CM diagnosis code 427.31). In fact, the diagnosis of atrial fibrillation not only evaporated in the leading secondary discharge diagnosis slot, but declined meaningfully in all of the first four secondary slots. This begs the question of whether more than incidence of the most severe cases of arrhythmia can be reliably estimated from Medicare claims; this is certainly a topic that merits further analysis in subsequent reports. Also among incident patients, it is noteworthy that the admission rate for arrhythmia as the principal diagnosis during the first three months of dialysis actually increased between the annual cohorts in 2003 and 2010. ♦ There is substantial regional variation in the rate of hospitalization for arrhythmia, particularly during the first year of dialysis among incident patients. Seasonality of arrhythmia admissions is not apparent. ♦ Several issues related to

arrhythmia merit further exploration, such as the timing of events across days of the dialysis week, the risk of hyperkalemia during the long interdialytic interval, and the risk of post-dialysis hypokalemia and other iatrogenic electrolyte changes. Foley et al reported an increased risk of hospitalization and death on the first day of the dialysis week (NEJM). Unknown is whether these events occur predominantly before or after dialysis. Either could be the case, and each pose different challenges. If the apparent risk manifests before dialysis, hyperkalemia is the likely issue; this could be investigated by determining if the condition appears as a leading secondary diagnosis. If, however, the apparent risk manifests after dialysis, metabolic changes

during treatment need to be considered. ♦ There are also concerns about the use of low potassium dialysis baths ($K \leq 2.0$) for patients with pre-potassium levels less than 5.0 mEq/L, and about the relatively low magnesium level (0.75–1.0 mEq/L), which has not changed for more than 30 years. A recent study in Japan found that lower pre-dialysis serum magnesium is associated with a higher risk of death, suggesting that more analyses are needed to determine an effective and safe level. The level of calcium in the dialysate should also be examined, particularly among patients using calcium-containing phosphate binders. Baths in which the calcium level is less than 2.5 mg/dL may cause prolonged QT intervals, potentially increasing the risk of arrhythmia and sudden cardiac death.

Between 2003 and 2011, the New England, Pacific, and West South Central Census Divisions showed the greatest percent decrease in incident hospital admissions for arrhythmia, at

-18, -15, and -9

Key Primary Discharge Diagnoses (ICD-9-CM codes)

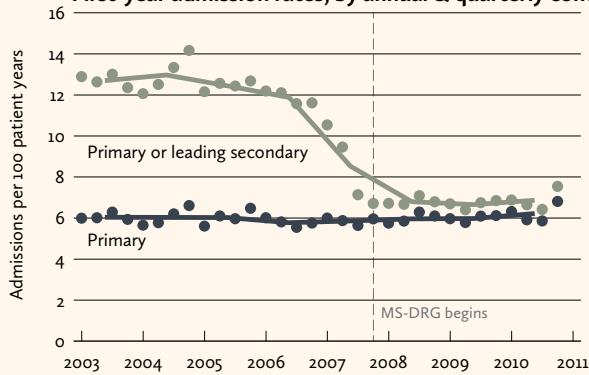
427.31	Atrial fibrillation (4,402)
427.89	Dysrhythmia (1,627)
427.1	Paroxysmal ventricular tachycardia (866)
427.32	Atrial flutter (694)
427.81	Sinoatrial node dysfunction (547)
426.0	Complete atrioventricular block (407)
427.41	Ventricular fibrillation (328)
427.5	Cardiac arrest (320)
427.0	Paroxysmal supraventricular tachycardia (304)

Counts: admissions among prevalent patients in 2011

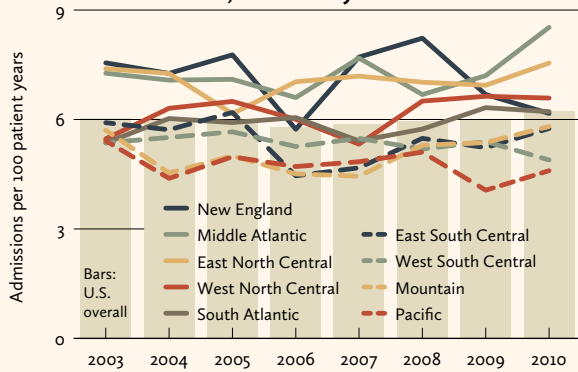
Arrhythmia

Incident patients

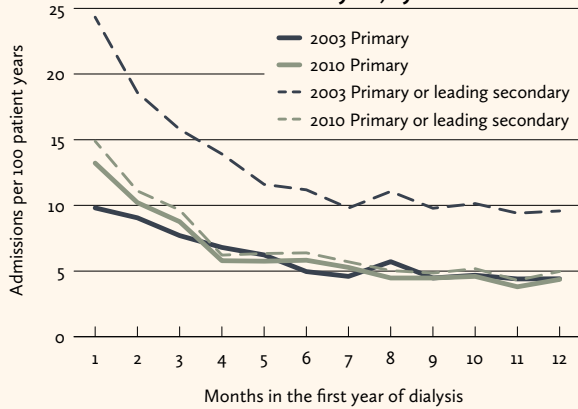
First-year admission rates, by annual & quarterly cohorts



Admission rates, overall & by U.S. Census Division

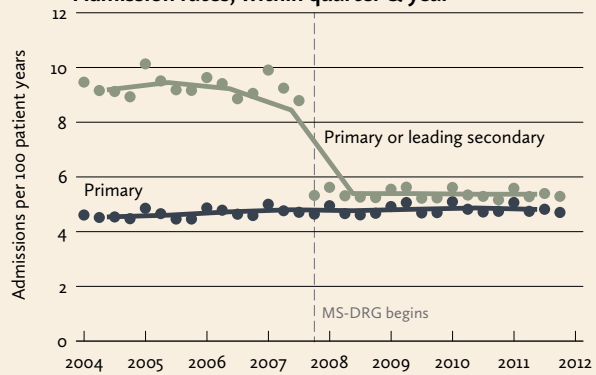


Admission rates in the first year, by month

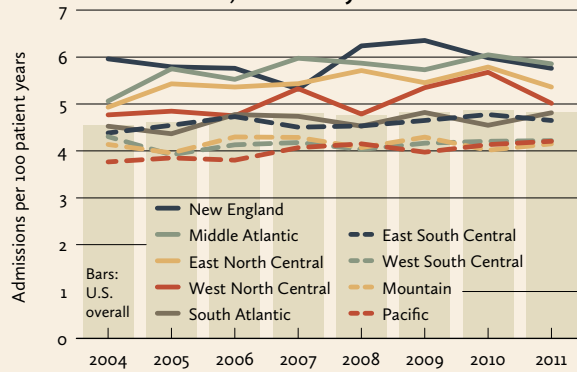


Prevalent patients

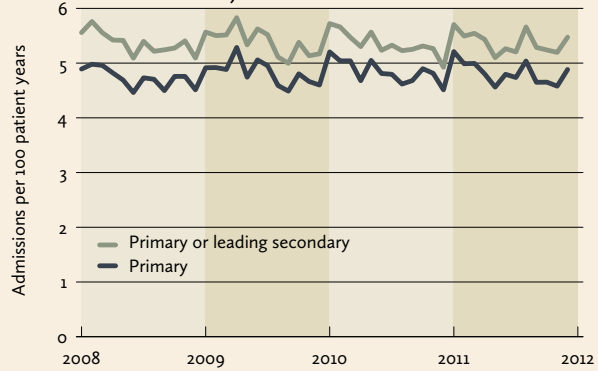
Admission rates, within quarter & year



Admission rates, overall & by U.S. Census Division



Admission rates, within calendar month



HOSPITALIZATION

Heart failure & cardiomyopathy

Hospital admissions for heart failure & cardiomyopathy in incident and prevalent patients dialyzing in the Mountain Census Division in 2011 were

29%
and 35%

lower than rates recorded for the entire U.S.

Key Primary Discharge Diagnoses (ICD-9-CM codes)

428.0	Congestive heart failure (10,140)
428.33	Acute on chronic diastolic heart failure (4,387)
428.23	Acute on chronic systolic heart failure (4,099)
428.43	Acute on chronic combined systolic and diastolic heart failure (1,583)
428.31	Acute diastolic heart failure (1,368)
428.21	Acute systolic heart failure (952)
428.30	Diastolic heart failure, unspecified acuity (803)
428.32	Chronic diastolic heart failure (397)
428.22	Chronic systolic heart failure (388)
428.20	Systolic heart failure, unspecified acuity (298)

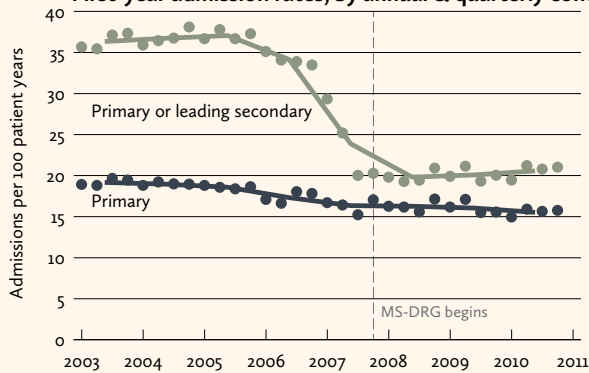
Counts: admissions among prevalent patients in 2011

Admissions for heart failure, as well as for the related pathology of cardiomyopathy, are very common among dialysis patients. Explicit designations of heart failure in Medicare claims, however, do not tell the entire story. From a clinical perspective, heart failure and fluid overload can be difficult to distinguish. A diagnosis of heart failure implies that the major area of dysfunction is cardiac in nature, arising from systolic dysfunction, diastolic dysfunction, or both, while a diagnosis of fluid overload suggests that the major problem is volumetric, with cardiac function relatively intact. But these are pathophysiologic principles. The extent to which they extend to coding practices is at least partially dictated by the detailed features of MS-DRGs and the relative rates of reimbursement that accompany alternative arrangements of diagnosis codes. On these two pages we explore admissions for heart failure and cardiomyopathy; on the next two we look at admissions for fluid overload and pleural effusion, a common consequence of fluid overload. ♦ Admissions for a primary discharge diagnosis of heart failure, which are overwhelmingly ascertained from ICD-9-CM diagnosis code series 428, appear to have decreased in frequency during the study era among both incident and prevalent dialysis patients. After the advent of MS-DRGs, rates of admission for a primary or leading secondary diagnosis of heart failure were only modest higher than corresponding rates based on the primary diagnosis alone. There is substantial geographic variation, particularly among incident dialysis patients, in which first-year admission rates vary by a factor of two between the Census Divisions with highest and lowest rates. Between the annual cohorts of incident dialysis patients from 2003 and 2010, there were improvements in admission rates during every month of the first year of dialysis. Among prevalent patients, there is clear evidence of seasonality—similar to, if not more pronounced than, the seasonality observed in admissions for acute coronary syndrome. ♦ While the rate of hospitalization for heart failure appears to have declined since 2003, analyses displayed in the subsequent pair of pages show that hospitalizations for fluid overload appear to have increased by a roughly commensurate amount since 2006. Collectively, hospitalization for the composite of heart failure and fluid overload appears to have changed very little since 2003. The fact that these rates are unadjusted should certainly be given due consideration, as the gradual aging of the dialysis population has likely increased the underlying risk of heart failure. Nonetheless, these data suggest that increased attention to fluid control is warranted.

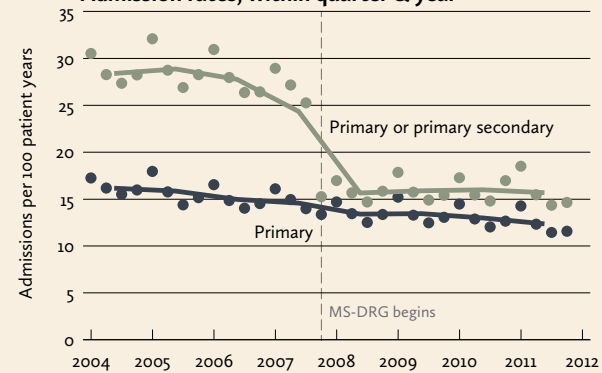
Heart failure & cardiomyopathy

Incident patients

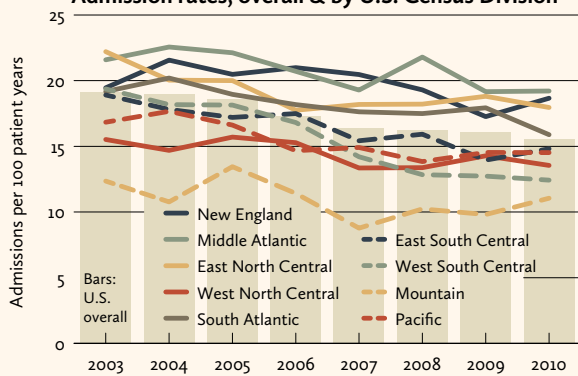
First-year admission rates, by annual & quarterly cohorts



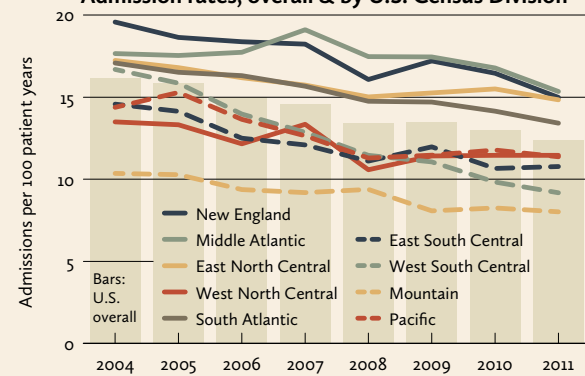
Admission rates, within quarter & year



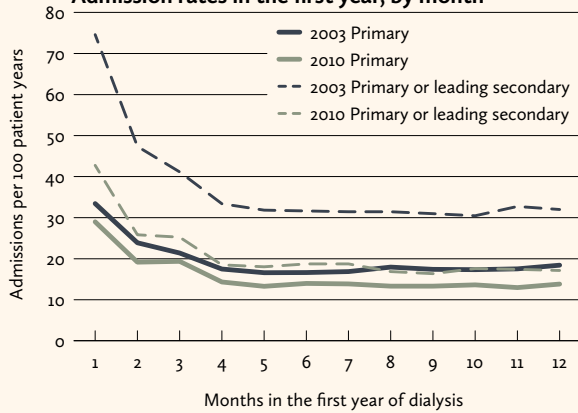
Admission rates, overall & by U.S. Census Division



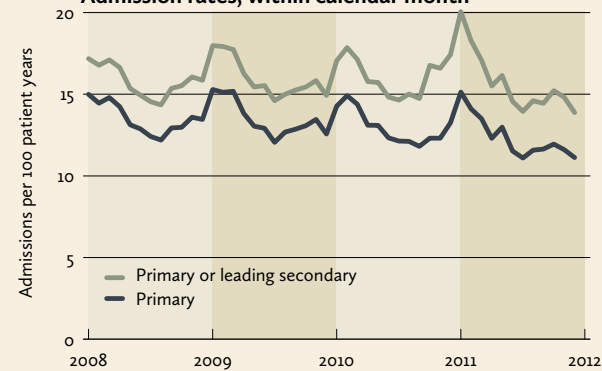
Admission rates, overall & by U.S. Census Division



Admission rates in the first year, by month



Admission rates, within calendar month



HOSPITALIZATION

Fluid overload & pleural effusion

Heart failure and fluid overload, with or without pulmonary congestion, can be clinically indistinguishable. On these pages we explore hospitalization for fluid overload and the related complication of pleural effusion. The set of diagnosis codes marking such admissions is concise and, among prevalent dialysis patients in 2011, admissions with primary discharge diagnoses of fluid overload outnumbered those for pleural effusion by a ratio of about four to one. ♦ Unlike the rate of hospitalization for heart failure, the rate for fluid overload has tended to increase, especially since 2006. Once again, the evolution of reimbursement likely plays an important role. Both before and after the advent of MS-DRGs, the principal diagnosis of fluid overload (ICD-9-CM diagnosis code 276.6) has been mapped to DRGs regarding miscellaneous disorders of nutrition, metabolism, fluid, and electrolytes—entirely distinct from those regarding heart failure. Importantly, the advent of MS-DRGs substantially increased the relative weight (i.e., reimbursement rate) of the DRGs regarding miscellaneous disorders of nutrition, metabolism, fluid, and electrolytes, although only to a level that remained substantially below the relative weight of DRGs regarding heart failure. Interestingly, the ordering of Census Divisions by rate of hospitalization for fluid overload and pleural effusion appears quite different than that for heart failure and cardiomyopathy. In short, the story of heart failure and fluid overload appears to be frayed at the edges. There is evidence of coding shifts between the two diagnoses during the study era, and of regional variation in coding practices. Further analyses are needed to examine methodologies for identifying these admissions, so trends can be reliably estimated. As it stands, there is clear potential for regulatory agencies

and researchers to arrive at conflicting conclusions about trends in admission rates for this important source of cardiovascular morbidity among dialysis patients. ♦ Rates of admission with a principal diagnosis of fluid overload appear to have increased in all Census Divisions, with particularly high rates in the West North Central, West South Central, and Mountain states. The high rate during the first month of dialysis probably reflects the challenge of achieving volume control and appropriate dry weight in the new dialysis patient, while at least some of the seasonality in admissions among prevalent dialysis patients may be attributable to excessive sodium and fluid intake during holiday seasons.

Hospitalization rates in 2011 for fluid overload & pleural effusion were

2.5 times
higher than rates recorded in 2004

Key Primary Discharge Diagnoses (ICD-9-CM codes)

276.69 Fluid overload (8,709)

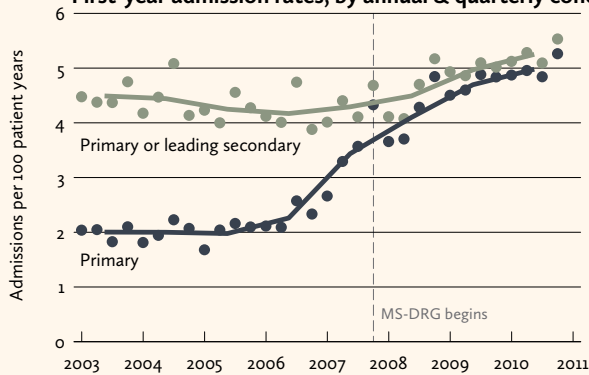
511.9 Pleural effusion (2,171)

Counts: admissions among prevalent patients in 2011

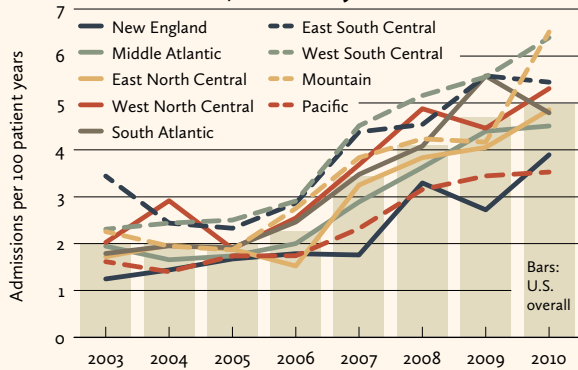
Fluid overload & pleural effusion

Incident patients

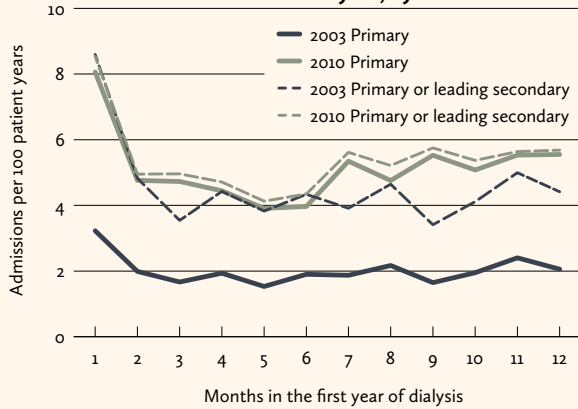
First-year admission rates, by annual & quarterly cohorts



Admission rates, overall & by U.S. Census Division

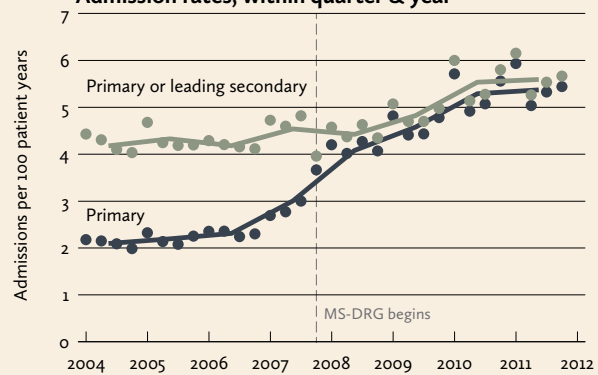


Admission rates in the first year, by month

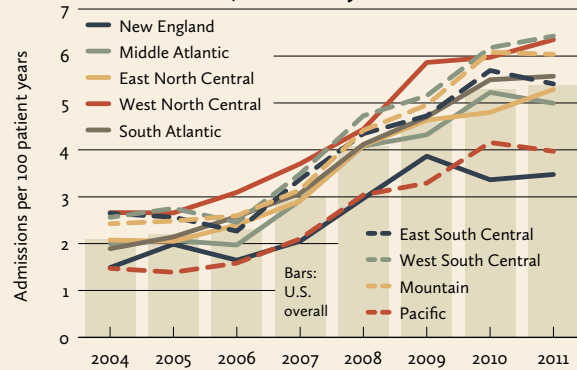


Prevalent patients

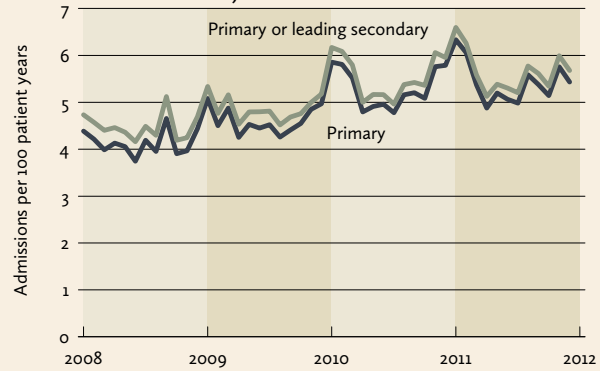
Admission rates, within quarter & year



Admission rates, overall & by U.S. Census Division



Admission rates, within calendar month



HOSPITALIZATION

Stroke

Strokes can be either ischemic or hemorrhagic in nature. Ischemic strokes may occur due to narrowing of the cerebral vessels, secondary to calcification, and, among prevalent dialysis patients in 2011, were much more common than hemorrhagic strokes. ♦ Unlike admission rates for other diagnoses of cardiovascular disease, those for stroke have clearly decreased, with no interference wrought by the advent of MS-DRGs. In both the incident and prevalent dialysis patient populations, rates have decreased by 20 percent or more. Because of the catastrophic nature of stroke and its consequences on physical function and quality of life, this decline is an important sign of progress. Regional variation in the incidence of stroke has been also limited. Particularly striking is the decline in incidence of stroke during the first year of dialysis among incident patients in the East South Central area, which includes most of the so-called Stroke Belt states; there, the first-year admission rate for stroke was cut in half between 2003 and 2010. ♦ Among incident dialysis patients, the admission rate for stroke declined during the entire first year of dialysis between 2003 and 2010, with a particularly large decrease during the second month of dialysis. It remains true, however, that the risk of stroke is elevated during the first three months of dialysis, relative to the remainder of the first year. Early stroke is therefore a possible target for quality improvement. ♦ Seasonality is not apparent in the incidence of stroke among prevalent dialysis patients, although epidemiologic studies have suggested that ischemic strokes and hemorrhagic strokes may follow different seasonal patterns, with the risk of hemorrhagic stroke actually peaking during the spring season. ♦ Regarding hemorrhagic stroke specifically, there are some published data suggesting iatrogenic risk associated with warfarin exposure, particularly among patients with atrial fibrillation. Little is known about regional and facility-level variation in the use of warfarin and novel oral anticoagulants; use of the latter remain rare, but may grow in coming years, as randomized trials of their use in hemodialysis patients are completed.

Rates of hospitalization for stroke in prevalent dialysis patients have declined consistently since 2004, falling approximately

20–30%

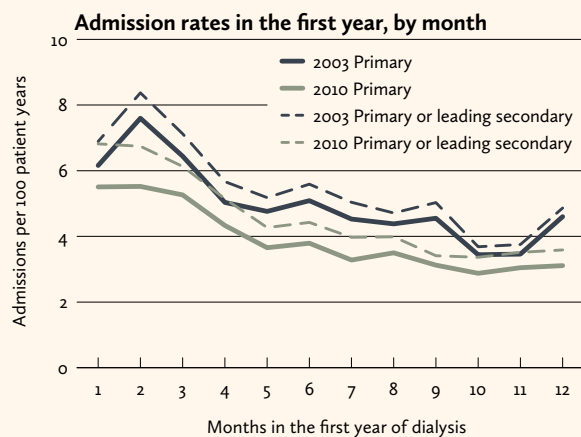
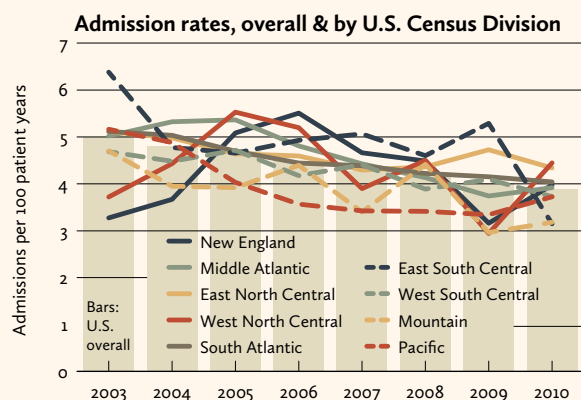
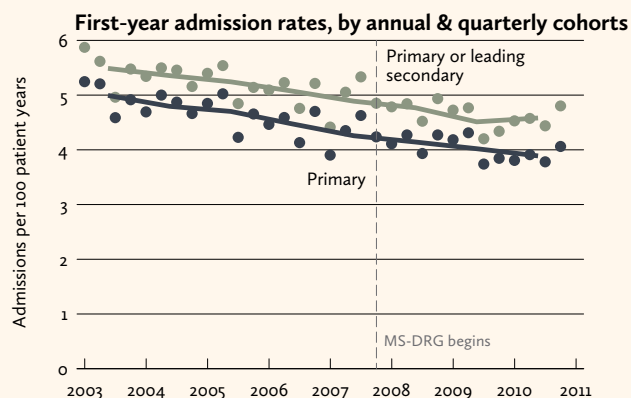
Key Primary Discharge Diagnoses (ICD-9-CM codes)

434.91	Cerebral artery occlusion, with cerebral infarction (2,808)
431	Intracerebral hemorrhage (670)
433.10	Carotid artery occlusion, without infarction (598)
434.11	Cerebral embolism, with infarction (499)
433.11	Carotid artery occlusion, with infarction (137)
430	Subarachnoid hemorrhage (120)

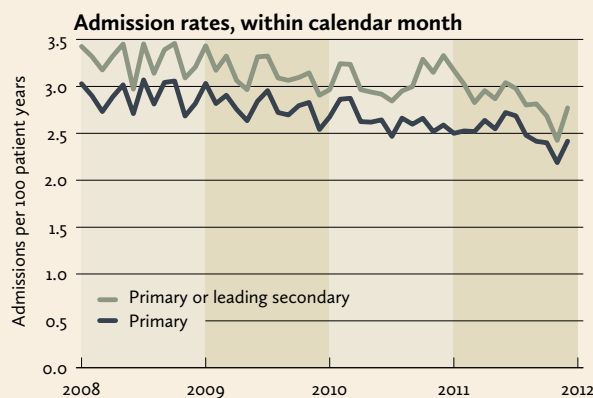
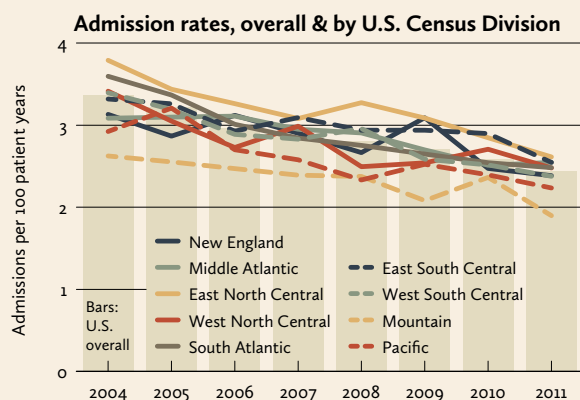
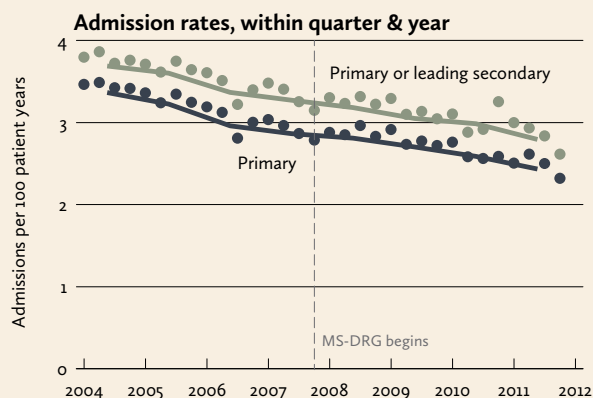
Counts: admissions among prevalent patients in 2011

Stroke

Incident patients



Prevalent patients



HOSPITALIZATION

Infection as the primary discharge diagnosis

Infection is the second leading cause of hospitalization among dialysis patients. The rate of admission due to infection has not meaningfully improved in recent years, a pattern remarkably consistent across the Census Divisions. The highest rates, among both incident and prevalent dialysis patients, are apparent in the East North Central, Middle Atlantic, and New England areas, while rates tend to be lower in the Mountain and Pacific states. This ordering of rates among the Census Divisions is similar to that seen for primary diagnoses of cardiovascular disease. ♦ Because of widespread use of venous catheters for vascular access during the first year of dialysis, especially at initiation, the rate of admission for infection is markedly higher among incident dialysis patients than in the prevalent population. Unfortunately, between 2003 and 2010, the rate appears to have increased during the first five months of dialysis, especially during the second month. This is concerning. Careful surveillance of infectious complications is needed to assist dialysis providers in addressing this important source of morbidity. ♦ Complicating matters in this domain, just as in the domain of cardiovascular disease, are shifting coding practices likely designed to maximize reimbursement for hospitals. In subsequent pages, we show that hospitalization rates for vascular access infections, including peritonitis, have ostensibly decreased. At this same time, however, hospitalization rates for sepsis have increased. It is important to recognize that Medicare claims may be limited in their capability to distinguish between specific infectious complications among dialysis patients. An assessment of the incidence of all infectious complications is likely necessary both to guide quality improvement and to undergird rating systems, so that improvements are not overstated. ♦ More broadly, it is important to remember these data arise from hospitalization. The burden of infectious complications necessitating inpatient care is important to characterize, but these data fail to represent the burden of infectious complications diagnosed and treated exclusively in the outpatient setting. In future reports we will delve into this area in greater detail, examining outpatient diagnoses of infection, the use of both intravenous and oral antibiotic agents, and the relationship between vascular access technique and the incidence of infection.

Rates of admission for infection are highest in the first year of dialysis, due to a

greater use
of dialysis
catheters
during that time

Key Primary Discharge Diagnoses (ICD-9-CM codes)

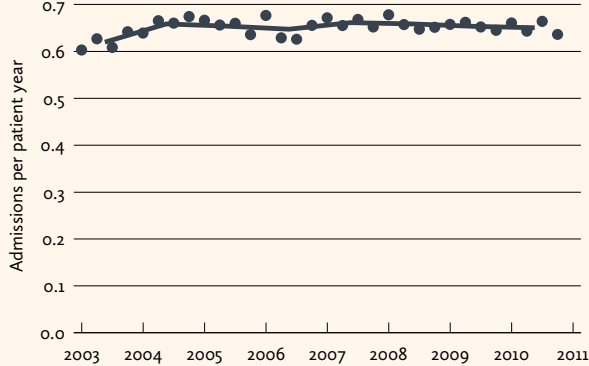
038	Septicemia (22,465)
486	Pneumonia due to unspecified organism (15,383)
996.62	Infection due to vascular device, implant, or graft (10,811)
999.31	Infection due to central venous catheter (6,510)
682	Cellulitis and abscess (4,973)
008	Intestinal infection due to organisms (3,713)
599.0	Urinary tract infection (3,604)
567	Peritonitis and retroperitoneal infections (1,758)
482	Bacterial pneumonia (1,609)
998.5	Post-operative infection (1,564)

Counts: admissions among prevalent patients in 2011

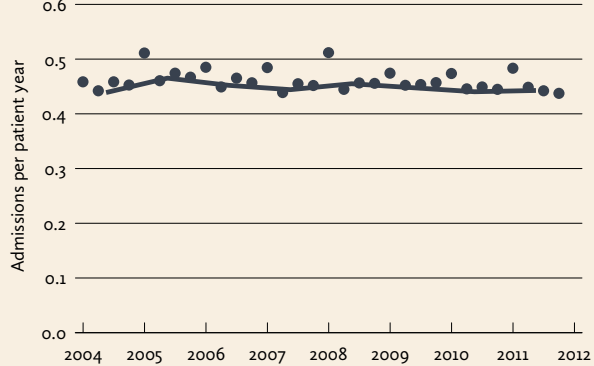
Infection as the primary discharge diagnosis

Incident patients

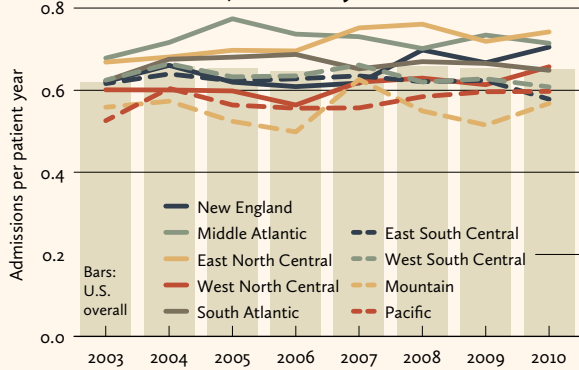
First-year admission rates, by annual & quarterly cohorts



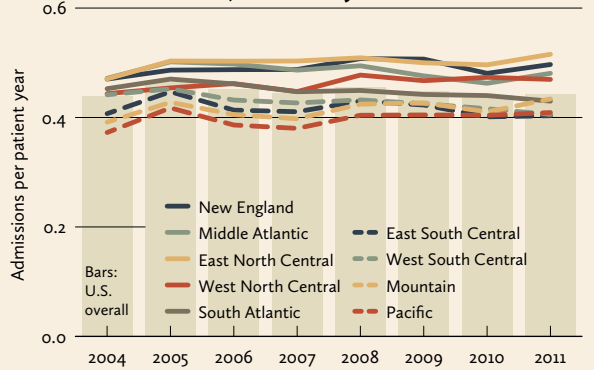
Admission rates, within quarter & year



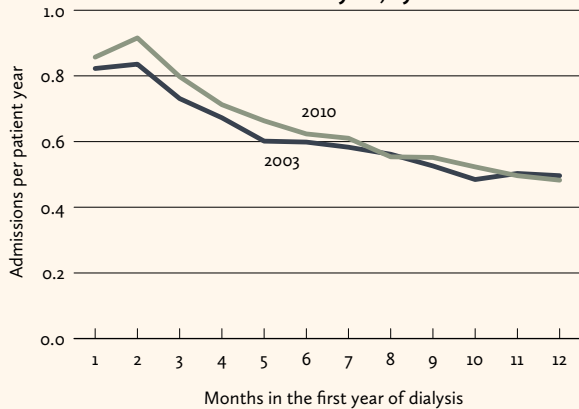
Admission rates, overall & by U.S. Census Division



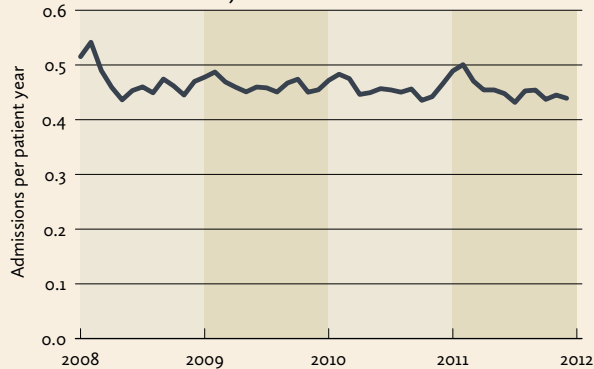
Admission rates, overall & by U.S. Census Division



Admission rates in the first year, by month



Admission rates, within calendar month



HOSPITALIZATION

Bacteremia & septicemia

In both the incident and prevalent dialysis patient populations, admissions with a primary discharge diagnosis of bacteremia or septicemia increased steadily during the study era, predating the advent of MS-DRGs. Admission rates in the incident dialysis patient population have been roughly 50 percent higher than those among prevalent patients, likely pointing to the influence of venous catheters as a critically important source of infection-related morbidity in patients initiating chronic dialysis. The relatively large discordance between rates based on primary diagnosis codes and on corresponding rates based on both primary and leading diagnosis codes may partially reflect the development of bloodstream infections during hospitalization for localized infections. Medicare claims in the modern era include present-on-admission (POA) codes that may be exploited to assess the development of complications during hospitalization, although there are no published data about the use of these codes among hospitalized dialysis patients. ♦ While rates varied by 100 percent between the Census Divisions with the lowest and highest first-year admission rates among incident dialysis patients in 2010, the secular trend of increasing rates was consistent across all divisions. Among incident dialysis patients, rates were highest in the Middle Atlantic, East North Central, and Pacific divisions. Among prevalent patients, these same areas were joined by the West North Central division. ♦ Again likely a manifestation of early reliance on catheters for vascular access, admission rates for bacteremia and septicemia during the first year of dialysis actually peak during the second month of dialysis, in contrast to the consistent peaks of admissions for specific forms of cardiovascular disease during the first month. This latency is predictable, as localized catheter infections progress to sepsis during the first weeks on dialysis. The most reliable solution to this problem is to avoid catheters in the first place, but this requires placing fistulas and grafts before dialysis initiation. Doing so is no trivial task and, in any case, is outside the scope of dialysis provider responsibilities. In the absence of higher use of permanent accesses at chronic dialysis initiation, prophylactic use of antibiotic agents may be worthwhile. Pragmatic trials of novel interventions are clearly needed.

Data on admissions for bacteremia and septicemia as a primary or leading secondary cause show that there are

more infectious complications

during a hospitalization then are reported from the principal diagnosis code

Key Primary Discharge Diagnoses (ICD-9-CM codes)

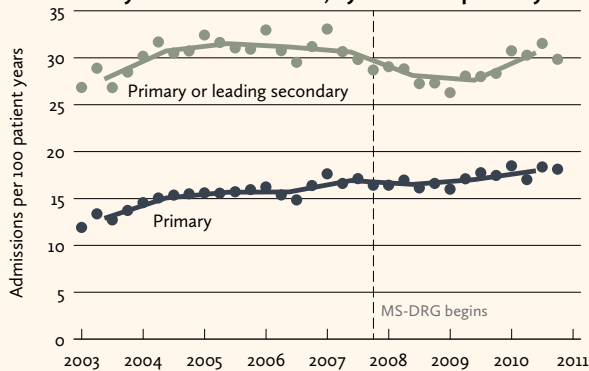
038.9	Septicemia due to unspecified organism (14,060)
038.12	MRSA septicemia (1,693)
038.11	MSSA septicemia (1,495)
790.7	Bacteremia (1,208)
038.0	Streptococcal septicemia (1,153)
038.49	Septicemia due to other Gram-negative organism (832)
038.42	E. coli septicemia (827)
038.19	Staphylococcal septicemia not due to MSSA or MRSA (634)
038.8	Septicemia due to other specified bacteria (555)
038.40	Septicemia due to unspecified Gram-negative organism (284)

Counts: admissions among prevalent patients in 2011

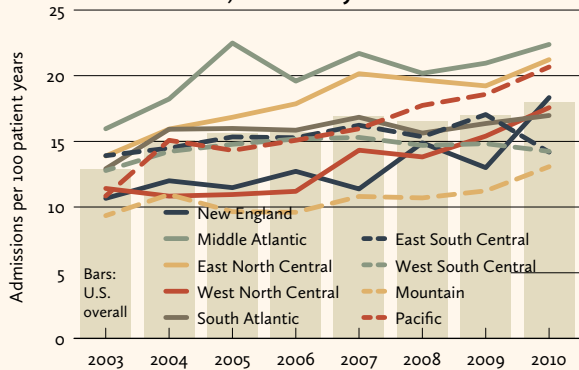
Bacteremia & septicemia

Incident patients

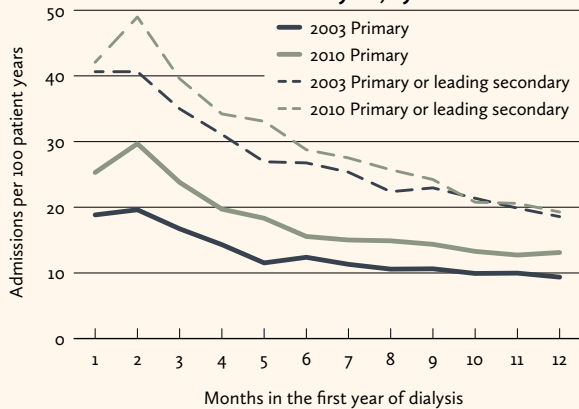
First-year admission rates, by annual & quarterly cohorts



Admission rates, overall & by U.S. Census Division

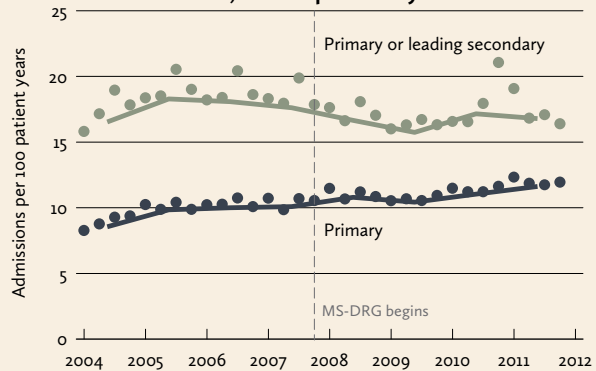


Admission rates in the first year, by month

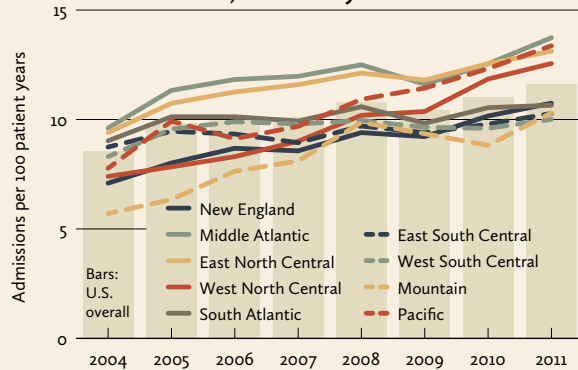


Prevalent patients

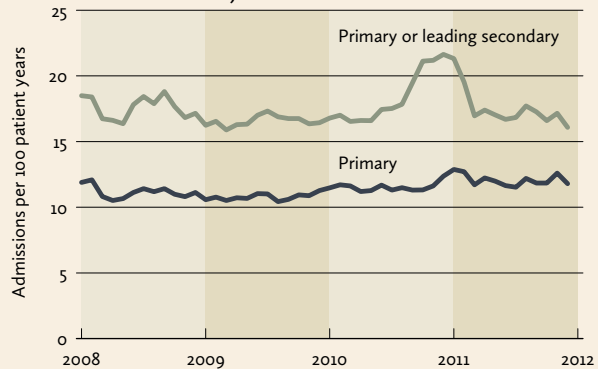
Admission rates, within quarter & year



Admission rates, overall & by U.S. Census Division



Admission rates, within calendar month



HOSPITALIZATION

Dialysis access infection, including peritonitis

Regardless of the diagnosis code slots queried on each claim, rates of hospitalization with diagnoses of dialysis access infection, including peritonitis—which overwhelmingly occurs among patients on peritoneal dialysis—have been decreasing, although interpretation of these data without consideration of concurrent data regarding bacteremia and septicemia is a clear mistake. In fact, the increases in the admission rates for bacteremia and septicemia during the study era among both incident and prevalent dialysis patients are slightly larger in absolute magnitude than the concurrent decreases in the admission rates for dialysis access infections. Thus, even if a substantial minority of the hospitalized cases of sepsis were originally due to infections of sites other than the vascular access, it would be true that the incidence of hospitalization for either simple or complicated infection of the access did not change during the study era. As we described previously, moreover, these data only summarize the incidence of access infections of sufficient severity to necessitate hospitalization. They do not speak to the incidence of access infections in any setting; the incidence of hospitalized access infections could decrease even if the incidence of all access infections were to be stable, in the case that access infections diagnosed in the outpatient setting were promptly and effectively treated. ♦ Regional estimates indicate that, among both incident and prevalent dialysis patients, the East North Central and South Atlantic divisions have the highest admission rates in the country. This is an interesting finding, as the percentage of black patients is generally high in both of these areas. Dialysis providers may consider quality improvement efforts targeted at vascular access care among black patients. ♦ The seasonality of hospitalization for dialysis access infections is vivid, but the timing of peaks and nadirs during the annual cycle is different than for many other pathologies, including cardiovascular events. In the case of access infections, the rate of hospitalization peaks during summer months and reaches its annual nadir during the winter. Potential explanations include the impact of skin perspiration on bacterial growth, as well as bacterial growth in pools, lakes (including lakes used for drinking water), and private wells. There have been no detailed studies about the seasonal pattern of access infections.

Declines in rates of admission for dialysis access infection (including peritonitis) should be interpreted with caution, and may be related to changes in the coding system

Key Primary Discharge Diagnoses (ICD-9-CM codes)

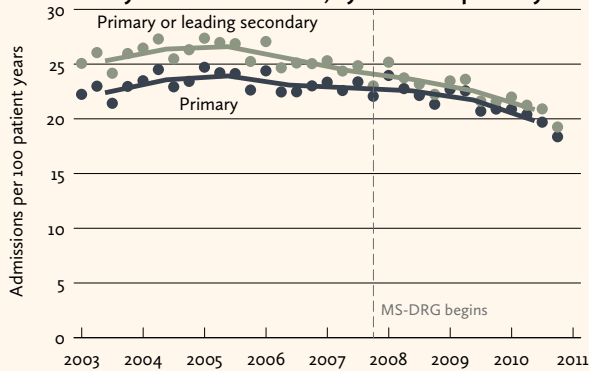
996.62	Infection due to vascular device, implant, or graft (10,811)
999.31	Infection due to central venous catheter (5,051)
996.68	Infection to peritoneal dialysis catheter (2,661)
567.29	Suppurative peritonitis (516)
567.9	Peritonitis, unspecified (488)
567.23	Spontaneous bacterial peritonitis (274)
567.89	Peritonitis, other specified (198)
567.22	Peritoneal abscess (160)

Counts: admissions among prevalent patients in 2011

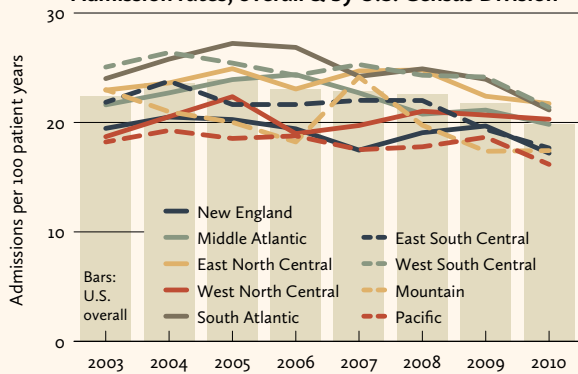
Dialysis access infection, including peritonitis

Incident patients

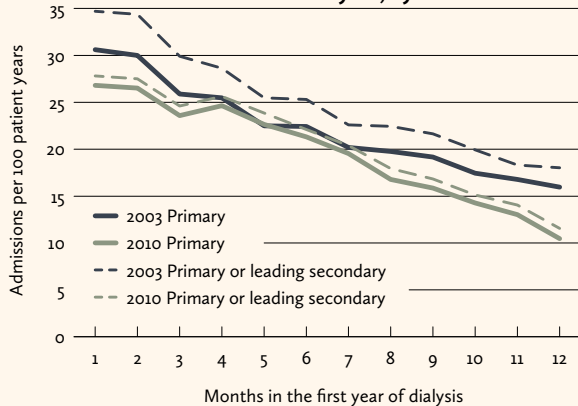
First-year admission rates, by annual & quarterly cohorts



Admission rates, overall & by U.S. Census Division

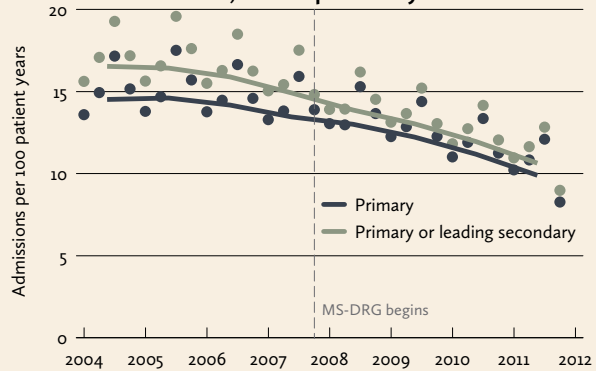


Admission rates in the first year, by month

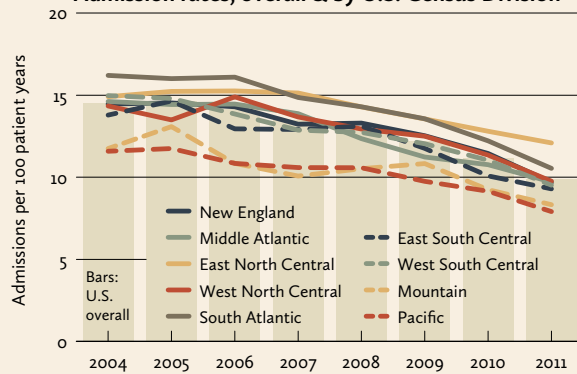


Prevalent patients

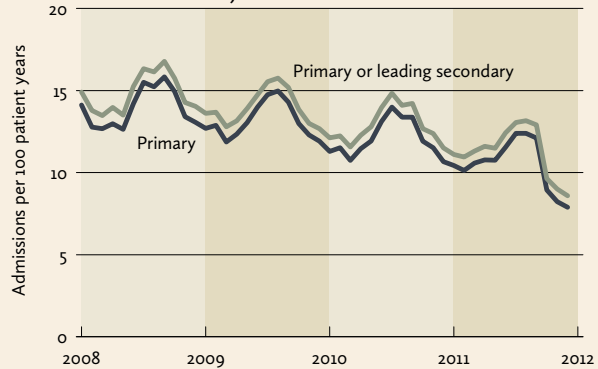
Admission rates, within quarter & year



Admission rates, overall & by U.S. Census Division



Admission rates, within calendar month



HOSPITALIZATION

Pneumonia & influenza

In the prevalent dialysis population,

71%

of month-to-month variation in rates of admission for pneumonia and influenza is due to seasonal effects

Key Primary Discharge Diagnoses (ICD-9-CM codes)

486	Pneumonia due to unspecified organism (15,383)
482.9	Pneumonia due to unspecified bacteria (372)
482.83	Pneumonia due to Gram-negative bacteria (370)
490	Bronchitis (320)
482.42	MRSA pneumonia (307)
487.1	Influenza with respiratory manifestations (256)
482.1	Pneumonia due to pseudomonas (161)
487.0	Influenza with pneumonia (157)
481	Pneumococcal pneumonia (143)
485	Bronchopneumonia due to unspecified organism (137)

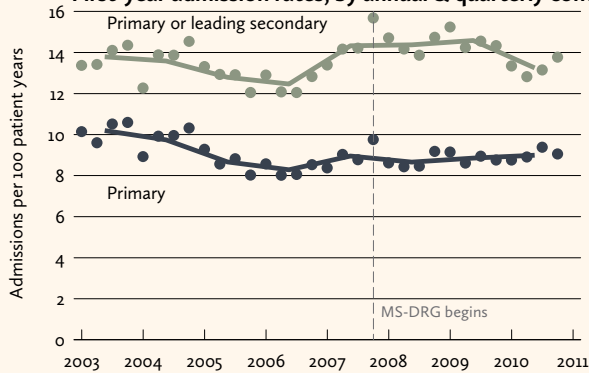
Counts: admissions among prevalent patients in 2011

From the perspective of Medicare claims, hospitalizations for pneumonia and influenza overwhelmingly reflect the incidence of bacterial pneumonia, as the dominant ICD-9-CM diagnosis code that hospitals list is 486, “Pneumonia due to unspecified organism.” Whether all of these cases are truly bacterial in etiology is uncertain, as accumulating epidemiologic studies suggest that our historical assumption that pneumonia in adults is most often bacterial, rather than viral, is incorrect. Adenoviruses, coronaviruses, and enteroviruses likely all contribute to the milieu of pathogens that engender pneumonia. On the other hand, because viral pneumonia tends to be less severe than bacterial pneumonia, it is reasonable to hypothesize that hospitalized cases of pneumonia are more likely to be bacterial in etiology. Regardless of etiology, the seasonality of admission rates for pneumonia and influenza among prevalent dialysis patients is tremendously clear. This seasonality is intuitive, but has not been reported in the past. The implications are substantial. ♦ The dialysis patient population is known to be immunosuppressed, with poor white cell function and bacterial killing. Poor response to hepatitis B vaccination is common, thus requiring multiple administrations to elicit a clinically significant response in the antibody titer. Because pneumonia and influenza are important sources of morbidity and mortality in their own rights, and because their occurrence is associated with increased risk of subsequent cardiovascular events, both preventive and interventional approaches demand consideration. ♦ While the Centers for Disease Control and Prevention has recommended influenza vaccinations for high-risk populations, including those with kidney disease, and providers have responded by increasing vaccination rates, little is known about short-run and long-run immune system responsiveness to single vaccinations. There have been suggestions that dialysis patients should receive high-dose influenza vaccinations, as well as more frequent pneumococcal vaccines. There has also been debate over the use of polyvalent pneumococcal vaccines. At a minimum, pragmatic clinical trials are needed to guide the use of these therapies. ♦ In addition, greater attention could be afforded to the transmission of respiratory diseases among in-center dialysis patients, including vaccination of all staff and required masking of infectious patients. Cleaning procedures to prevent blood borne disease transmission in dialysis facilities could be adapted, with surface cleaning on a more frequent basis, and, as is done in acute care settings, cleaning of all surfaces, not only chairs and machines. Pragmatic clinical trials could test these approaches. Regional variation in admission rates for pneumonia and influenza suggest that conducting these trials in cold-weather states may be particularly illustrative.

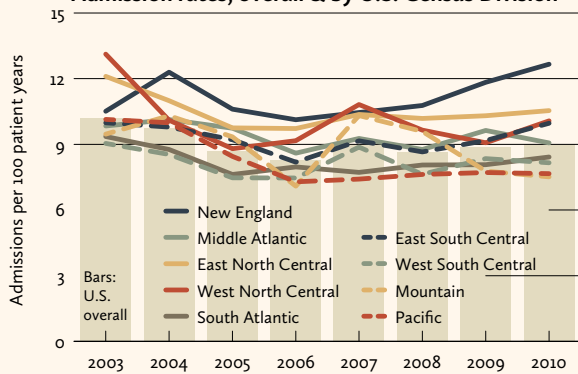
Pneumonia & influenza

Incident patients

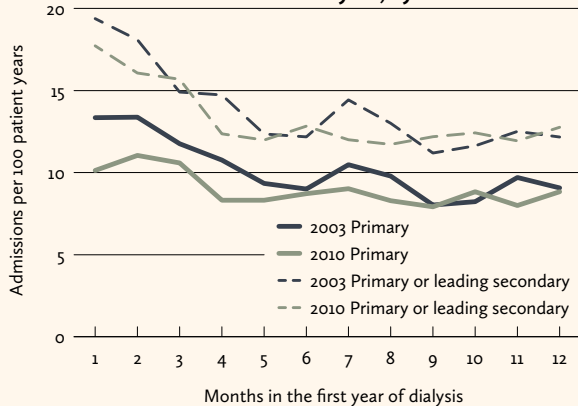
First-year admission rates, by annual & quarterly cohorts



Admission rates, overall & by U.S. Census Division

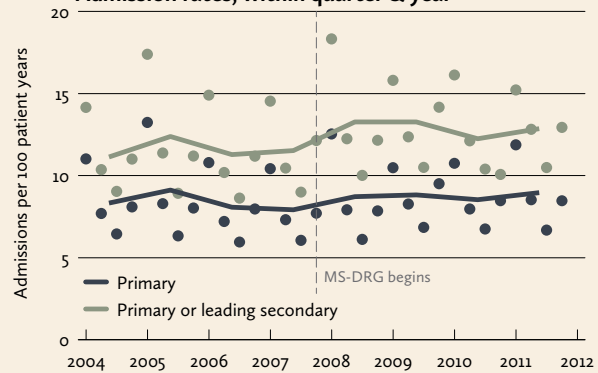


Admission rates in the first year, by month

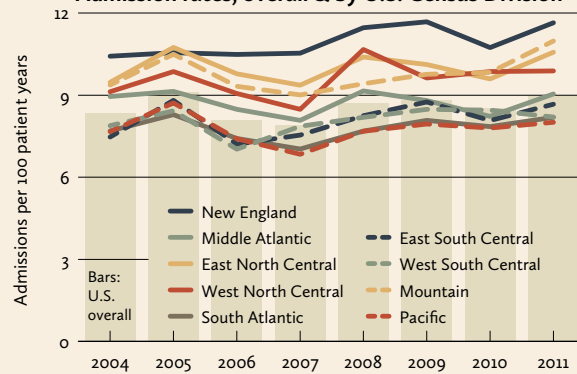


Prevalent patients

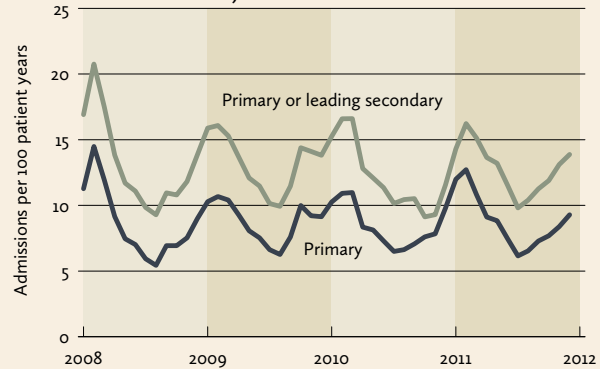
Admission rates, within quarter & year



Admission rates, overall & by U.S. Census Division



Admission rates, within calendar month



HOSPITALIZATION

Intestinal infection with *C. difficile*

Intestinal infections due to *Clostridium difficile* (i.e., *C. difficile*) are rising nationally, and data here suggest that the dialysis patient population is not immune to this trend. The characteristic gastroenteritis associated with *C. difficile* infection is caused by a toxin produced by the bacterium. The clinical consequences can be severe, and include persistent diarrhea and acute weight loss. Treatment can be challenging. Antibiotics commonly used to treat *C. difficile* infection include metronidazole and oral vancomycin; more recently, the U.S. Food and Drug Administration approved fidaxomicin, a first-in-class macrolide antibiotic. Despite treatment, up to 20 percent of patients suffer a recurrence, often iatrogenic in nature, when the recurrence is due to the use of other antibiotics that allow colonized *C. difficile* to expand in the gastrointestinal tract. ♦ Rates of hospitalization for intestinal infection with *C. difficile* roughly doubled during the study era among both incident and prevalent dialysis patients. Regional variation in admission rates is substantial, with the lowest rates observed in the East South Central and West South Central areas and the highest in the New England and East North Central divisions. Among incident dialysis patients, admission rates during the first six months of dialysis increased markedly between 2003 and 2010. The timing of such high rates is important, as many dialysis patients are malnourished at the initiation of chronic dialysis, due to poor appetite that accompanies worsening uremia prior to initiating dialysis. Among prevalent dialysis patients, there is some evidence of seasonality, which might reflect increased use of oral antibiotics for respiratory infection during the winter season. ♦ All of these trends, along with trends of hospitalization for infection with antibiotic-resistant bacteria, should be watched closely, as the increase in *C. difficile* infection is underappreciated, with many patients simply receiving outpatient treatment. In the future we will assess oral antibiotic treatment patterns, the antibiotic profiles that precede *C. difficile* hospitalizations, and the duration of antibiotic treatments. We will also assess regional and facility-level variation in the use of proton pump inhibitors, which are widely used in the dialysis patient population and likely increase the risk of *C. difficile* infection by altering the chemistry of the gut.

Rates of admission for intestinal infection with *C. diff* have been

on the rise
since 2003

Key Primary Discharge Diagnoses
(ICD-9-CM codes)

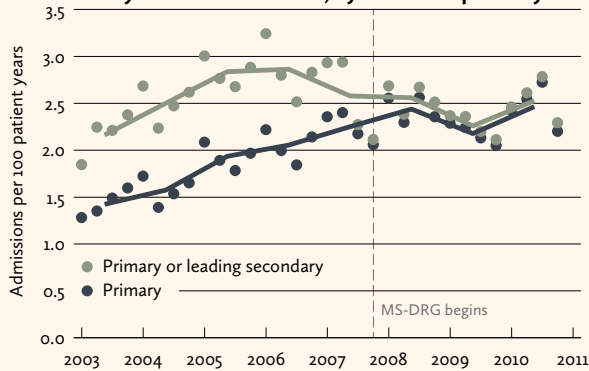
008.45 *C. difficile* infection (2,605)

Counts: admissions among prevalent patients in 2011

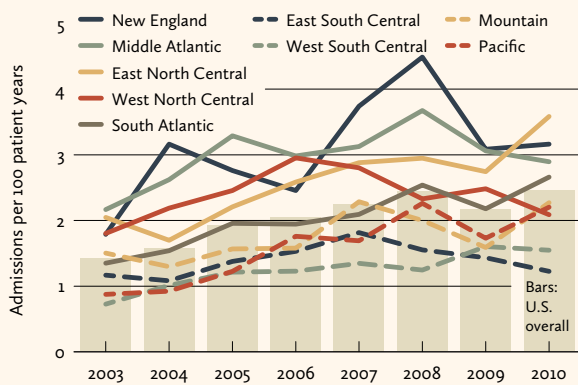
Intestinal infection with *C. difficile*

Incident patients

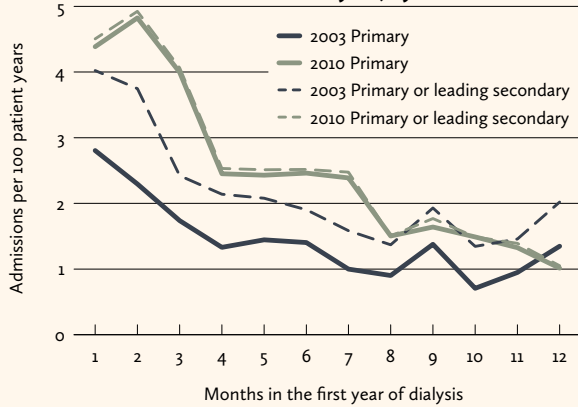
First-year admission rates, by annual & quarterly cohorts



Admission rates, overall & by U.S. Census Division

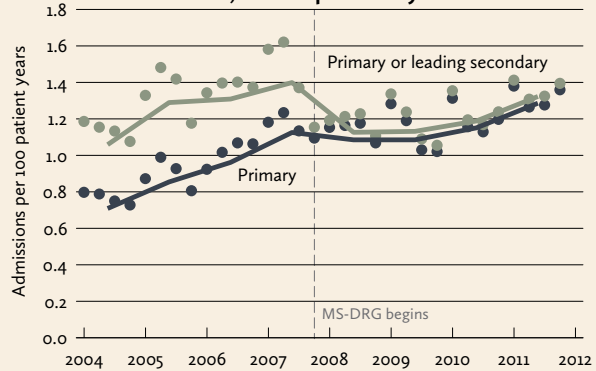


Admission rates in the first year, by month

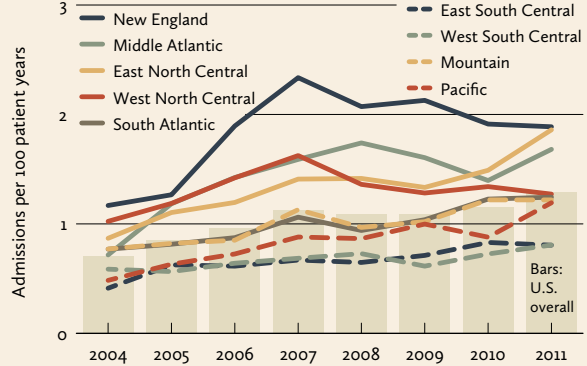


Prevalent patients

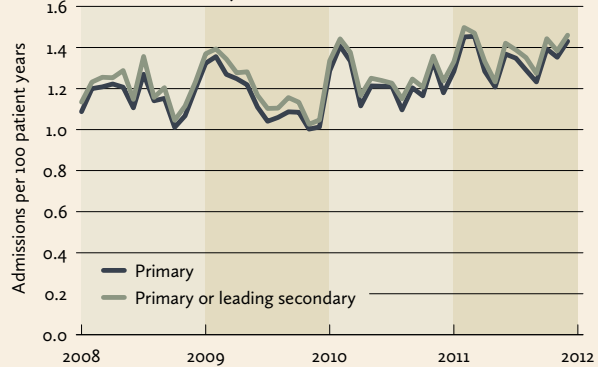
Admission rates, within quarter & year



Admission rates, overall & by U.S. Census Division



Admission rates, within calendar month



HOSPITALIZATION

Gastrointestinal hemorrhage

Gastrointestinal bleeding is an important complication in dialysis patients, resulting in blood loss and high protein and potassium reabsorption in the intestines, and possibly leading to metabolic complications. The source of the bleed determines how much of the blood is dissolved in the gut versus passed in the stool and thereby recognized with a clinical diagnosis. Hematochezia, or bright red blood in the stool, is well-known as having sources in the lower gastrointestinal tract, including hemorrhoids, diverticular bleeding, colonic ulcers, and potentially, colonic polyps or cancers. Upper gastrointestinal tract bleeding is typically recognized by the melena color of the stool, as stomach acid reduces the hemoglobin content of the blood. This bleeding can lead to catabolism of the hemoglobin from pancreatic enzymes, raising the blood urea nitrogen (BUN) and creating a disproportionate BUN/serum creatinine ratio. Each 100 milliliters of packed cells contains approximately 10 grams of protein, which can be a significant load in addition to the recommended daily intake of one gram per kilogram. Gastrointestinal bleeding, therefore, has a relatively widespread impact, beyond direct blood loss and reduction of oxygen-carrying capacity. ♦ First-year rates of hospitalization for a primary discharge diagnosis of gastrointestinal bleeding increased slightly during the study era among incident dialysis patients, but rose more meaningfully among prevalent patients between 2004 and 2011. Regional variation is apparent and, at least among prevalent dialysis patients, consistent with the nature of variation for many diagnoses of cardiovascular disease and infection. Specifically, admission rates are highest in the Middle Atlantic and East North Central divisions and lowest in the Mountain and Pacific areas. ♦ Rates exhibit modest seasonality, but, perhaps more importantly, increased notably in 2011, coinciding with the introduction of the ESRD Prospective Payment System and the Food and Drug Administration's later decision to add a 'black box' warning to erythropoiesis-stimulating agents. It is possible that, as hemoglobin levels fell in the dialysis patient population, and as more patients presented in acute care settings with very low hemoglobin concentrations, ascertainment of gastrointestinal bleeding also increased, as hospitalists sought to identify factors other than the anemia of chronic kidney disease that may engender especially low hemoglobin. Future reports will continue to monitor this outcome and assess the extent to which the incidence of gastrointestinal bleeding and the rate of red blood cell transfusions are related.

Rates of admissions for GI bleeding in the prevalent population have risen nearly

30%

between 2004 and 2011

Key Primary Discharge Diagnoses (ICD-9-CM codes)

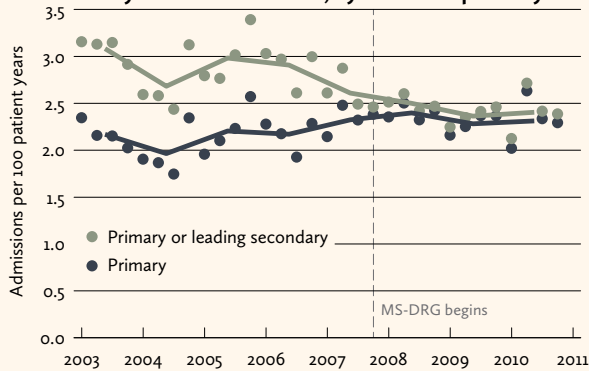
578.9	Hemorrhage of gastrointestinal tract (3,118)
578.1	Blood in stool (1,029)
578.0	Hematamesis (571)

Counts: admissions among prevalent patients in 2011

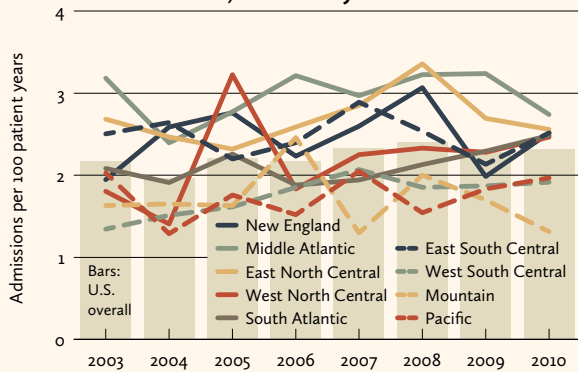
Gastrointestinal hemorrhage

Incident patients

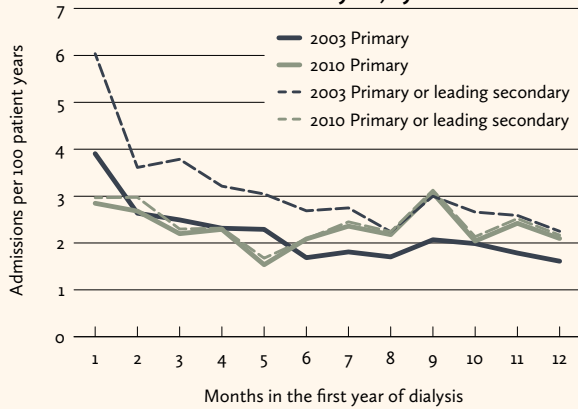
First-year admission rates, by annual & quarterly cohorts



Admission rates, overall & by U.S. Census Division

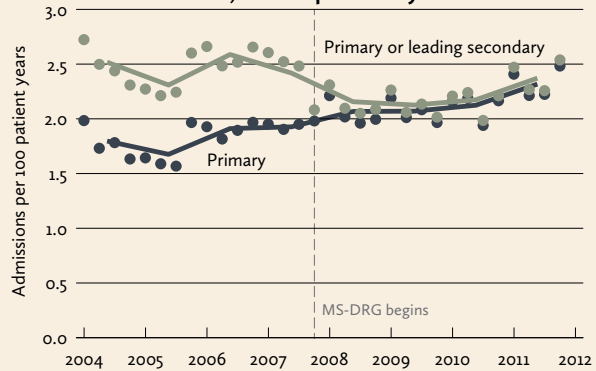


Admission rates in the first year, by month

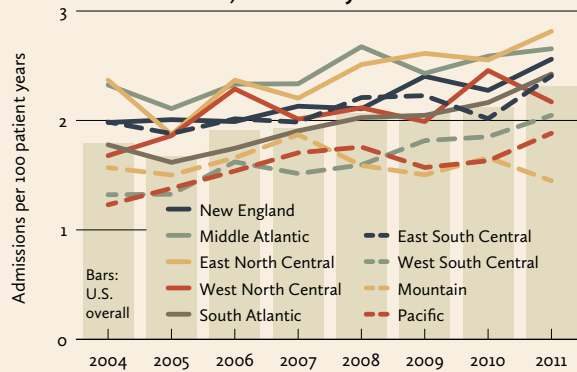


Prevalent patients

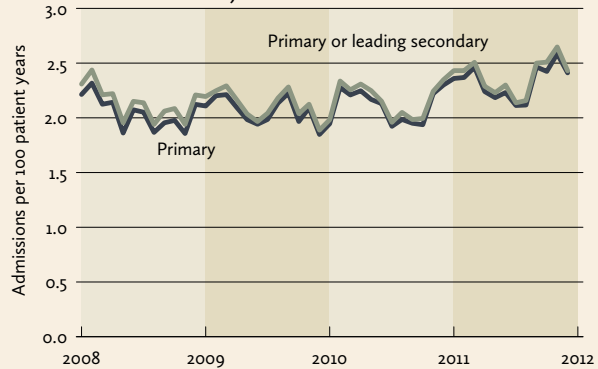
Admission rates, within quarter & year



Admission rates, overall & by U.S. Census Division



Admission rates, within calendar month



HOSPITALIZATION

Acute respiratory failure

Chronic pulmonary disease is common among dialysis patients, and constitutes an important risk factor for respiratory failure. Rates of hospitalization for a primary discharge diagnosis of acute respiratory failure increased during the early portion of the study era, plateaued, and subsequently declined. Unlike many other conditions, in which rates estimated with contrasting definitions have tended to converge since the advent of MS-DRGs, the rate of hospitalization for either a primary or leading secondary discharge diagnosis of acute respiratory failure has recently diverged from the corresponding rate for a primary discharge diagnosis alone. This divergence creates uncertainty about the true frequency of respiratory failure among dialysis patients. The totality of the data, however, as well as the high prevalence of mechanisms that may lead to respiratory failure, suggest that the event is not rare. Fluid overload, as might be observed among patients with heart failure or pneumonia, clearly increases the risk of respiratory failure. And with stroke another risk factor, it is perhaps unsurprising that the absolute magnitude of hospitalization for acute respiratory failure among prevalent dialysis patients in 2011 is similar to the corresponding magnitude of hospitalization for stroke. ♦ There is some regional variation in admission rates. Areas with the highest rates include the East North Central, West North Central, and East South Central divisions. In the case of the first two divisions, an important commonality is the Ohio River Valley, an area with historical pollution, including air pollution from industrial processes. Particulate matter is an established factor for exacerbations of pulmonary disease, including acute respiratory failure. ♦ The aberrant increase in hospitalizations for acute respiratory failure during the winter of 2011 is of unclear etiology, and certainly might represent anomalous coding practices that were quickly resolved. On the other hand, the peak coincides perfectly with a spike in hospitalizations for heart failure, underscoring the connection between volume status, cardiac function, and pulmonary function.

For prevalent patients in 2011, admissions per 100 patient years for acute respiratory failure were

16% higher
in the West North Central
Census Division than the
overall rate in the U.S., at
3.1

Key Primary Discharge Diagnoses
(ICD-9-CM codes)

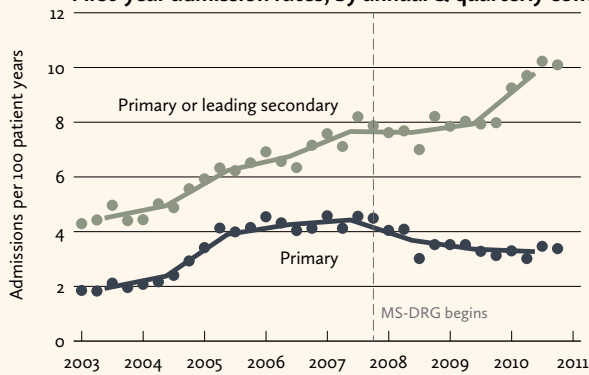
518.81 Acute respiratory failure (5,438)

Counts: admissions among prevalent patients in 2011

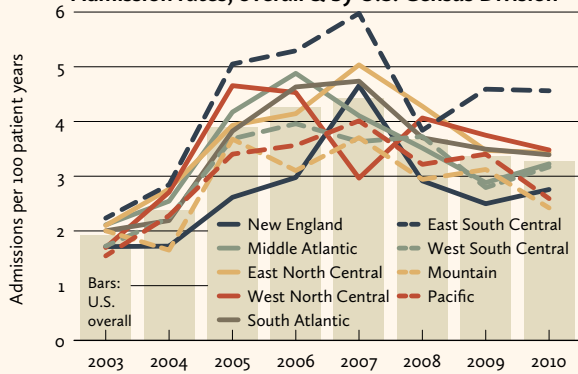
Acute respiratory failure

Incident patients

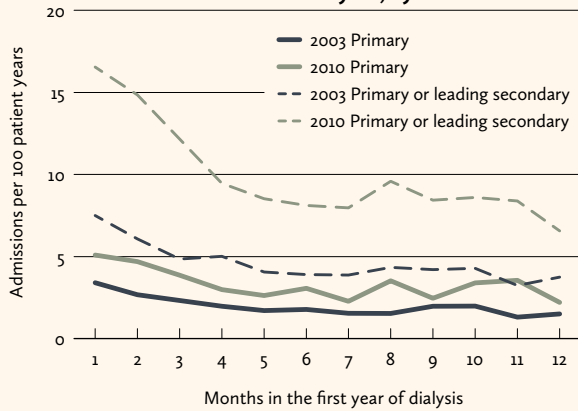
First-year admission rates, by annual & quarterly cohorts



Admission rates, overall & by U.S. Census Division

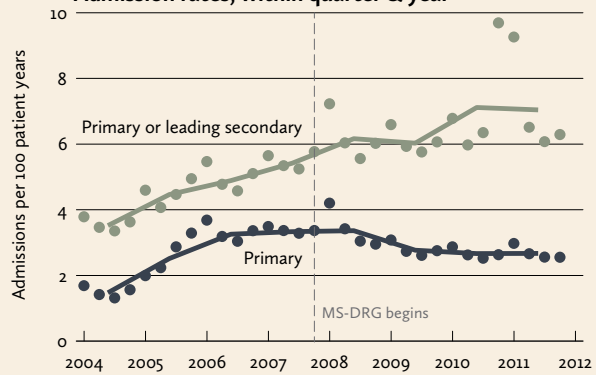


Admission rates in the first year, by month

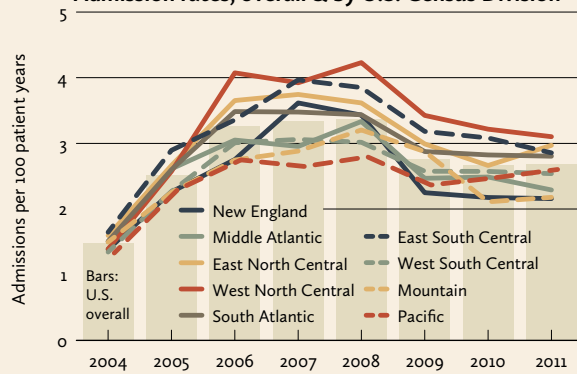


Prevalent patients

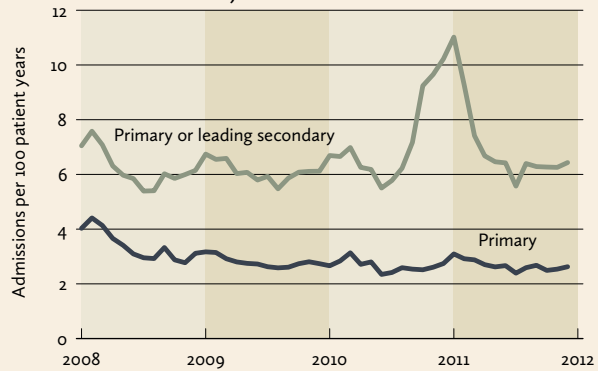
Admission rates, within quarter & year



Admission rates, overall & by U.S. Census Division



Admission rates, within calendar month



HOSPITALIZATION

Chronic pulmonary disease

Chronic pulmonary disease spans a variety of conditions, including bronchitis and emphysema. Data presented earlier in this report show that the Medical Evidence Report severely underestimates the prevalence of current or former tobacco use among incident dialysis patients, suggesting that an important underlying cause of exacerbations of chronic pulmonary disease in the dialysis population is alveolar damage due to smoking. ♦ The rate of hospitalization for a primary discharge diagnosis of chronic pulmonary disease increased modestly during the study era. Perhaps more striking than the secular trend, however, is the regional variation in rates. Among incident dialysis patients in 2010, first-year admissions vary by more than a factor of

two between the Census Divisions with lowest and highest rates. The story is similar among prevalent dialysis patients. Interestingly, in the prevalent population, rates have been highest in the East North Central states. The Centers for Disease Control and Prevention report that smoking prevalence in Kentucky and Ohio is among the highest in the nation. Obviously, there is little that dialysis providers can do to compensate for damage wrought by tobacco use before dialysis initiation. All of these data collectively suggest that a history of tobacco use may be an underappreciated risk adjustment factor in dialysis facility surveillance. ♦ There is clear evidence of seasonality in admission rates for chronic pulmonary disease, with annual peaks during the winter months. These peaks likely point to the involvement of respiratory infection in engendering acute exacerbations of chronic pulmonary disease. ♦ The treatment of chronic pulmonary disease involves medications such as bronchodilators and steroids. While the impact of these medications typically receives little attention, they may increase the risk of arrhythmia and sudden cardiac death. Beta agonists, in tandem with the use of QT-prolonging antibiotics and the electrolyte shifts that occur during dialysis, may expose dialysis patients to iatrogenic risk of sudden cardiac death. The complex nature of chronic disease management requires more devotion to lowering such risks.

Rates for chronic pulmonary disease in prevalent dialysis patients are highest in the

East North
Central
& Middle
Atlantic states

Key Primary Discharge Diagnoses (ICD-9-CM codes)

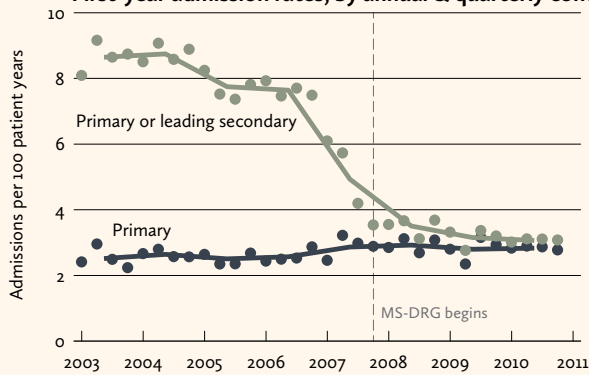
491.21	Obstructive chronic bronchitis, with acute exacerbation (2,686)
491.22	Obstructive chronic bronchitis, with acute bronchitis (979)
493.22	Chronic obstructive asthma, with acute exacerbation (690)
490	Bronchitis (320)
493.92	Asthma, with acute exacerbation (308)
416.8	Chronic pulmonary heart disease (294)

Counts: admissions among prevalent patients in 2011

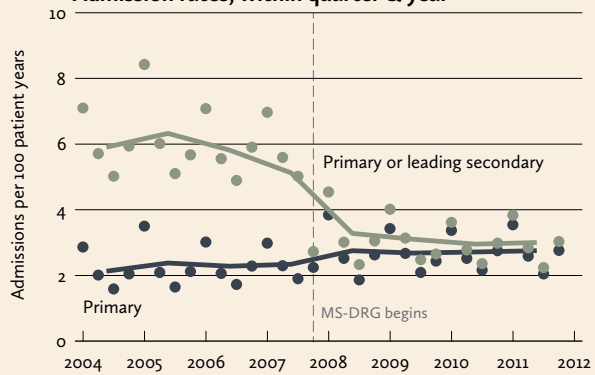
Chronic pulmonary disease

Incident patients

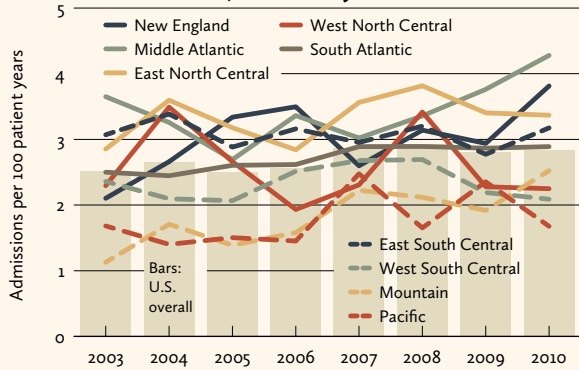
First-year admission rates, by annual & quarterly cohorts



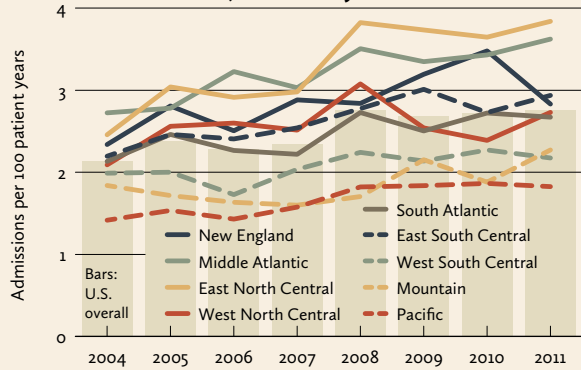
Admission rates, within quarter & year



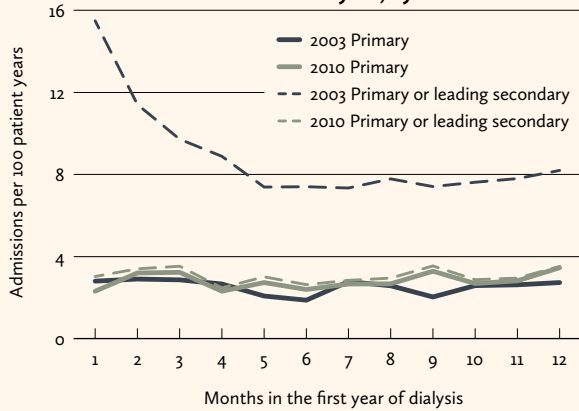
Admission rates, overall & by U.S. Census Division



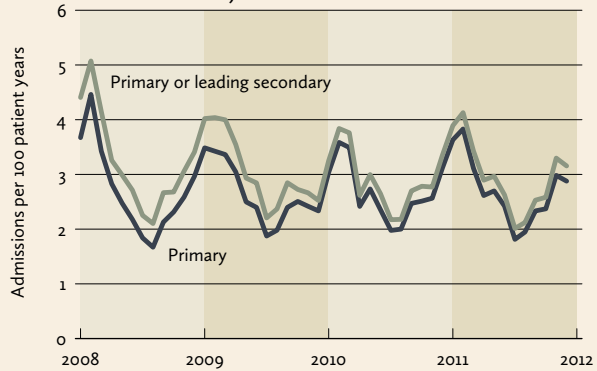
Admission rates, overall & by U.S. Census Division



Admission rates in the first year, by month



Admission rates, within calendar month



HOSPITALIZATION

Dialysis access complication, excluding infection

Dialysis access complications, excluding infection of the access, typically relate to placement of and revisions to a permanent vascular access, such as a fistula or a graft, but also include procedures to correct the malfunction of a peritoneal dialysis catheter. ♦ During the study era, hospitalizations with a primary discharge diagnosis of dialysis access complications declined very steadily. This is entirely consistent with the trend of treating access complications in outpatient settings, including ambulatory surgical centers, vascular access centers, and physician offices. As a result, any comprehensive analysis of dialysis access complications in the current era must assess events in both inpatient and outpatient settings. ♦ Rates of admission for these complications have fallen across the country, although there continues to be some regional variation in first-year rates among incident dialysis patients. This is an interesting observation in its own right, as it suggests that the utilization of inpatient care for surgical interventions that might be performed in either inpatient or outpatient settings may partially reflect the supply of outpatient care in a locale, a point that has not been discussed in any public debate about the utility of standardized hospitalization ratios. ♦ The relatively high rate of admission during the first six months of dialysis likely reflects early revisions to fistulas and grafts—a precise set of hospitalizations that would not occur if permanent accesses were not placed. Early malfunction of a peritoneal dialysis catheter can also occur, and is likely to be overrepresented in Medicare claims, as home dialysis training entitles patients to Medicare coverage immediately upon initiation of chronic dialysis. ♦ Unlike the pattern seen with dialysis access infection, there appears to be very little seasonality in the incidence of access complications necessitating hospitalization.

Between 2003 and 2011, rates of admission for dialysis complications, excluding infection, in the incident and prevalent populations decreased

40-43%

Key Primary Discharge Diagnoses (ICD-9-CM codes)

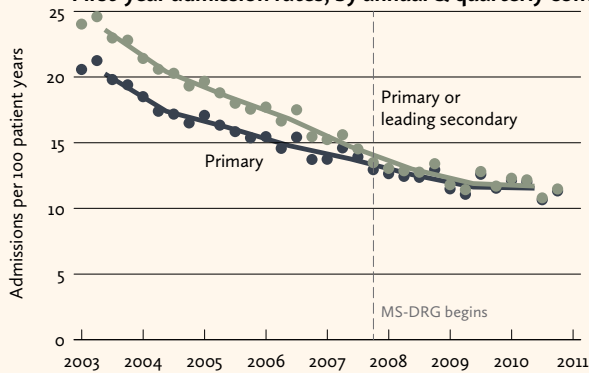
- 996.73 Complication of vascular device, implant, or graft (16,126)
- 996.1 Mechanical complication of vascular device, implant, or graft (2,760)
- 996.56 Mechanical complication of peritoneal dialysis catheter (601)

Counts: admissions among prevalent patients in 2011

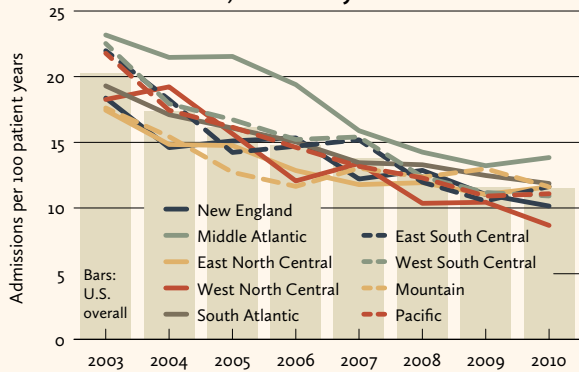
Dialysis access complication, excluding infection

Incident patients

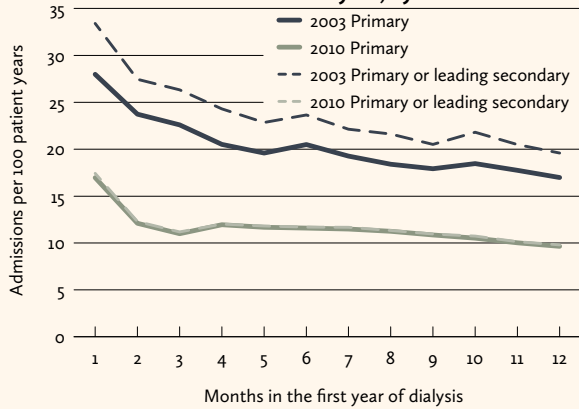
First-year admission rates, by annual & quarterly cohorts



Admission rates, overall & by U.S. Census Division

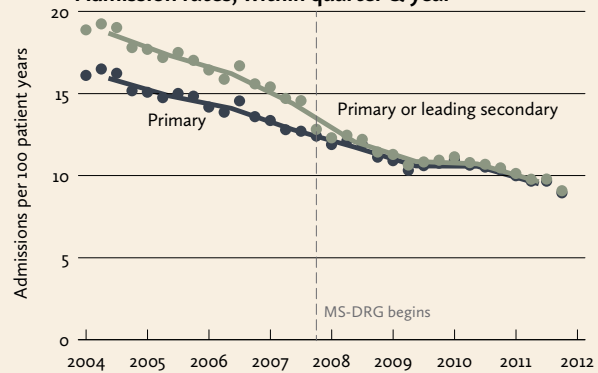


Admission rates in the first year, by month

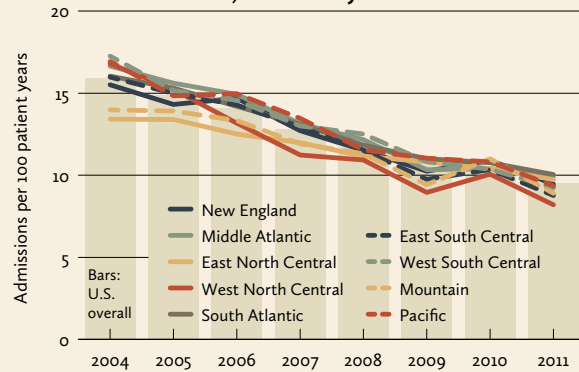


Prevalent patients

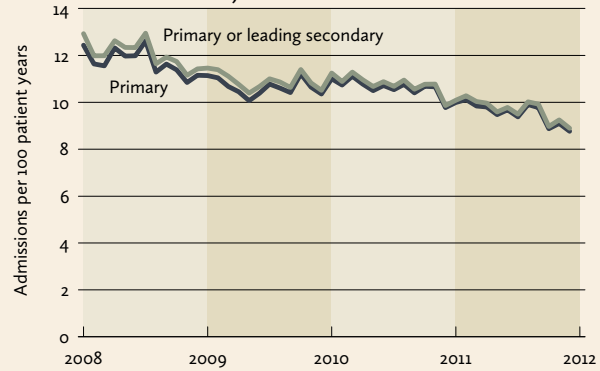
Admission rates, within quarter & year



Admission rates, overall & by U.S. Census Division



Admission rates, within calendar month



HOSPITALIZATION

Hyperkalemia

Hyperkalemia can be a life-threatening complication, impacting electrical conduction systems in the heart and muscle cells. The normal range of potassium is approximately 3.5–5.2 mEq/L, but dialysis patients frequently manifest pre-run levels exceeding 6.0 mEq/L. Chronic dialysis patients have a somewhat greater tolerance for potassium levels above the normal range, but the risk of cardiac arrest and ventricular fibrillation is still present. ♦ While diet is the most common reason for hyperkalemia, additional causes include gastrointestinal bleeding and catabolism of blood from hematomas, such as from retroperitoneal bleeds or access infiltrations. Hemolysis rarely causes hyperkalemia, but it is life-threatening when it occurs. Moreover, numerous drugs, such as angiotensin-converting enzyme (ACE) inhibitors, angiotensin II receptor blockers (ARBs), and mineralocorticoid receptor antagonists, can cause hyperkalemia by interfering with residual renal function and gastrointestinal tract excretion. Regardless of the cause, the clinical challenge is treatment, which must immediately address conduction problems in the heart. Conservative treatments include dextrose with insulin, intravenous bicarbonate, intravenous calcium, beta agonists, and potassium-binding resins, which either shift potassium into cells or trap potassium in the gastrointestinal tract, buying time for the patient to receive dialysis. ♦ Rates of admission for the principal discharge diagnosis of hyperkalemia have been fairly stable, but increased slightly at the end of the study era in both the incident and prevalent dialysis populations. Prior to the advent of MS-DRGs on October 1, 2007, hyperkalemia was frequently used as a leading secondary diagnosis code, as it established a complicating condition; after the advent of MS-DRGs, this practice ended. ♦ Regional variation in rates of admission for hyperkalemia is quite different than that observed for most other diagnoses examined in this report. Rates are highest in the Mountain and Pacific states, and lowest in the Middle Atlantic and East South Central areas. These variations may relate to different practices of treating hyperkalemia in the emergency room, in the observation room, or during a hospital admission—another example of the potential influence of the supply of care in the outpatient setting on the utilization of care in the inpatient setting. Further analyses are needed to clarify variations in practice patterns across the country.

Rates of admission for hyperkalemia have been fairly stable, but in 2010 a slight increase was seen in both the incident and prevalent populations

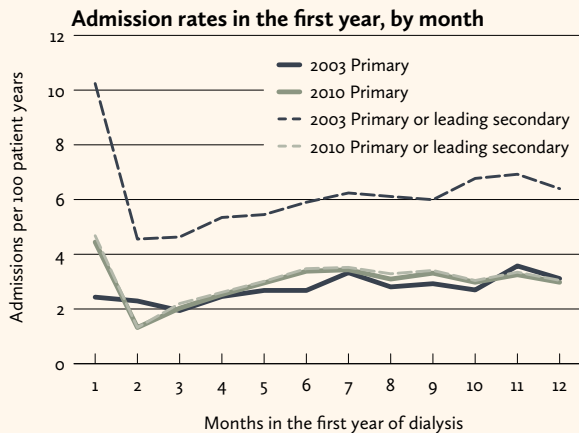
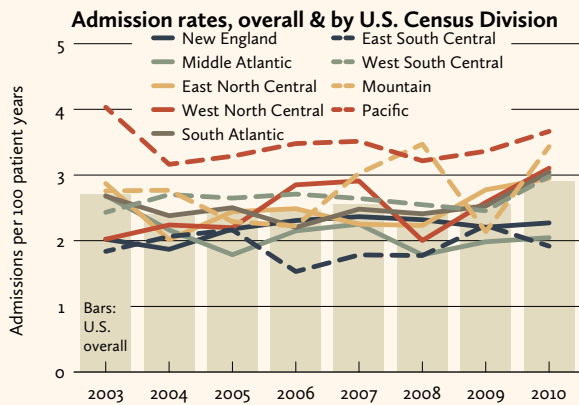
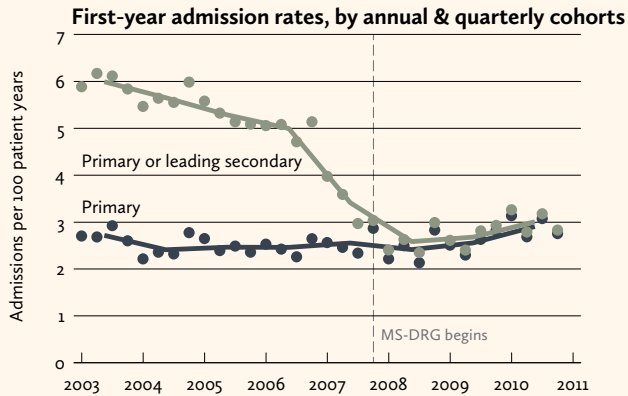
Key Primary Discharge Diagnoses (ICD-9-CM codes)

276.7 Hyperkalemia (8,760)

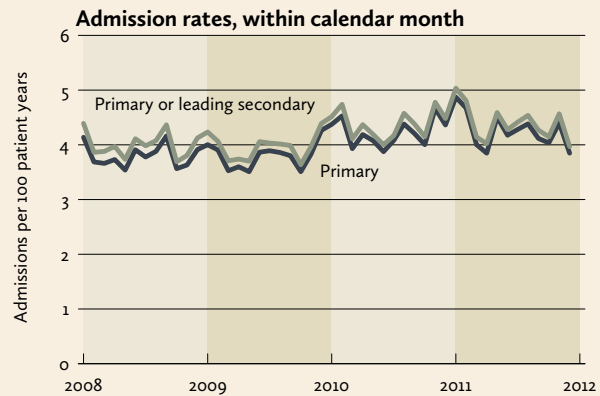
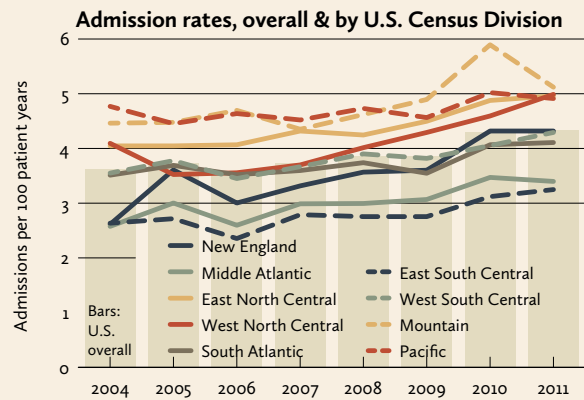
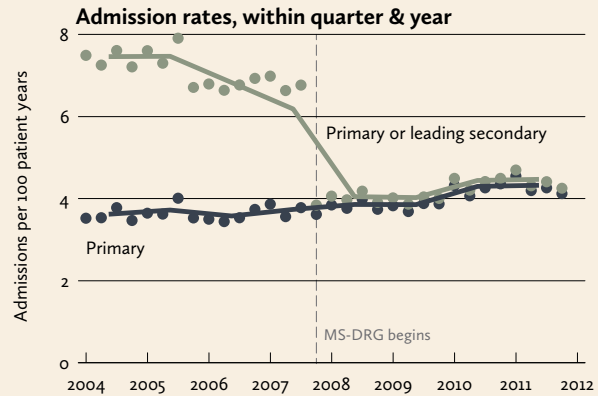
Counts: admissions among prevalent patients in 2011

Hyperkalemia

Incident patients



Prevalent patients



HOSPITALIZATION

Length of stay: all-cause hospitalization

During the first year of dialysis, hospitalized days per patient year for all-cause hospitalization fell almost 14 percent between 2003 and 2010, from 21.8 to 18.9. Among prevalent patients, the rate also fell 14 percent, from 14.3 in 2004 to 12.0 in 2011. In both populations, the rate was highest in the Middle Atlantic area and lowest in the Mountain and Pacific divisions, with very little reordering of the Census Divisions during the study era. ♦ Hospitalized days per patient year may change as a result of three factors. First and foremost: admission rates. Data presented earlier in this section show that these rates have declined since 2006. Second, the distribution of major diagnostic categories among admissions, which may change if cause-specific admission rates change differentially. As we have shown, admission rates for cardiovascular disease have declined in recent years, but those for infection have not. In the dialysis population, hospital stays for infectious complications tend to be longer than those for cardiovascular complications. And third, the length of stay per admission, which can be affected by hospitals discharging patients sooner in an attempt to control costs. ♦ Admissions per patient year declined during the study era, but hospitalized days declined more rapidly. This pattern is compatible with a theoretical shift toward more admissions for cardiovascular disease, but in reality, cardiovascular-related admissions were declining more rapidly than infection-related admissions. The conclusion, therefore, is that dialysis patients were progressively discharged more quickly after admission. ♦ Shortened lengths of stay raise concerns, because readmission may be related to inadequate preparation for discharge. Dialysis patients have a complex set of issues to address after discharge, but dialysis facilities have had difficulty acquiring adequate information from discharging hospitals. Facility staff must have information about a patient's new dry weight and changes in the dialysis prescription. Potassium and calcium baths may have been altered in the hospital, where there is more dietary control. Changes in medication must be resolved, particularly with respect to cardiovascular agents and antibiotics. Facility staff must also be apprised of anticipated follow-up care, so that outpatient plans can be coordinated. ♦ New regulations on conditions of participation, issued by CMS in May 2013, indicate that dialysis units should receive the same information that hospitals release to nursing homes and rehabilitation centers. Whether hospitals are being held accountable for the transfer of this information is unclear.

Among incident patients in 2010, hospital days per patient year were

23.5 in the Middle Atlantic division,

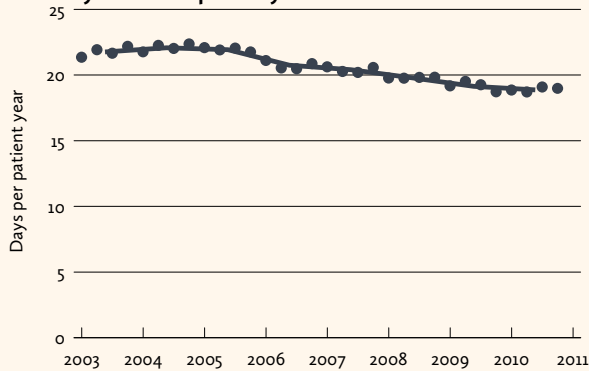
18.9 overall, and

15.0 in the Mountain division

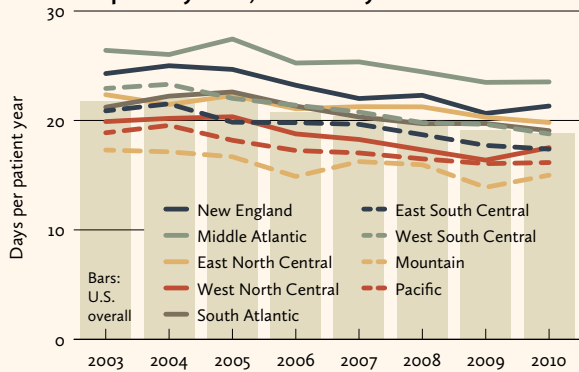
Length of stay: all-cause hospitalization

Incident patients

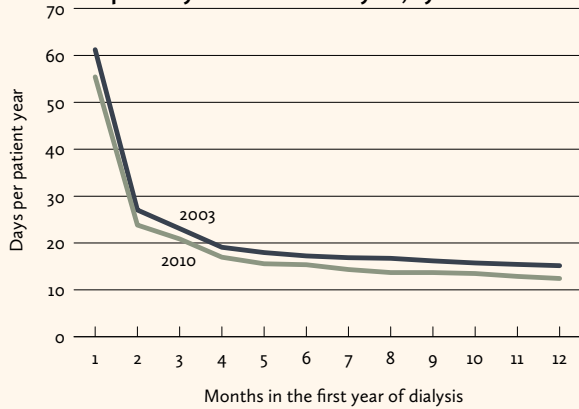
First-year hospital day rates, by annual & quarterly cohorts



Hospital day rates, overall & by U.S. Census Division

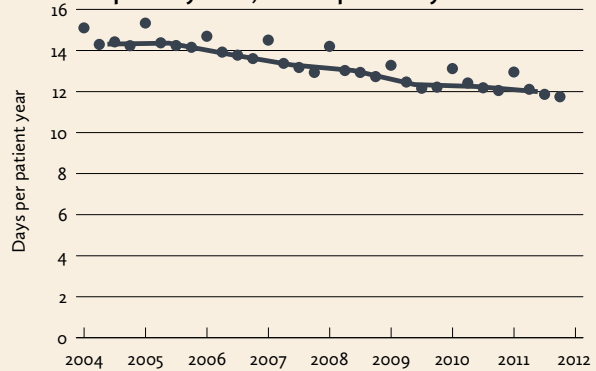


Hospital day rates in the first year, by month

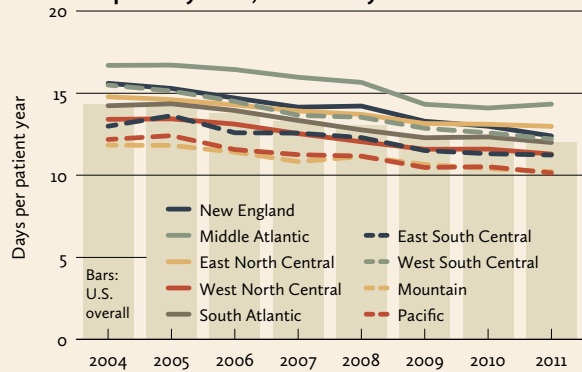


Prevalent patients

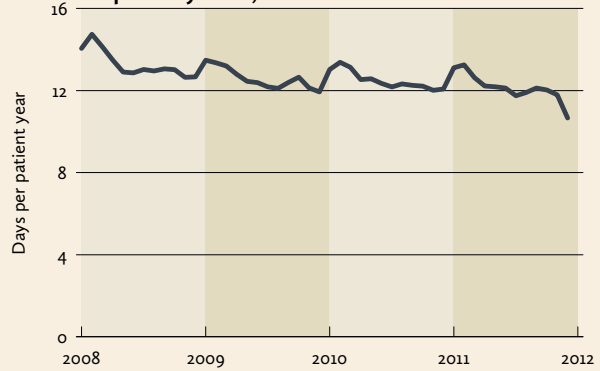
Hospital day rates, within quarter & year



Hospital day rates, overall & by U.S. Census Division



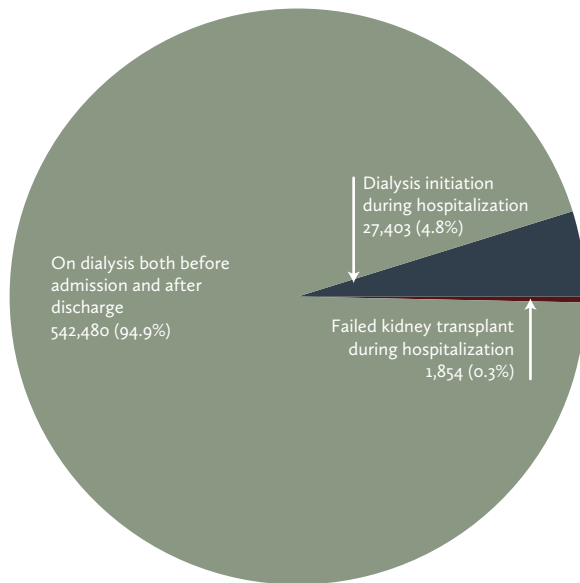
Hospital day rates, within calendar month



HOSPITALIZATION

Characteristics of live discharges to chronic dialysis in 2011

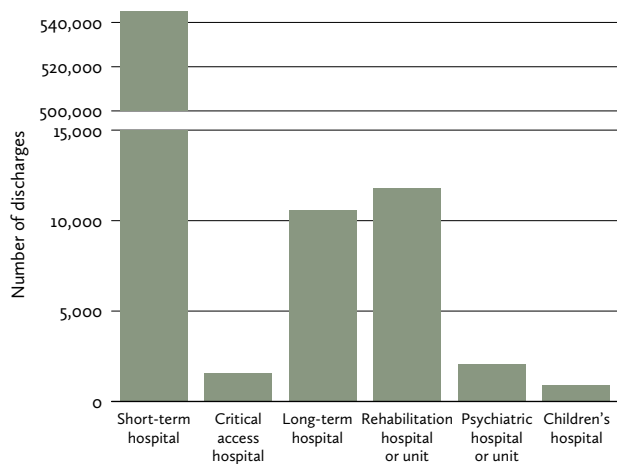
Patient status among live discharges to chronic dialysis in 2011



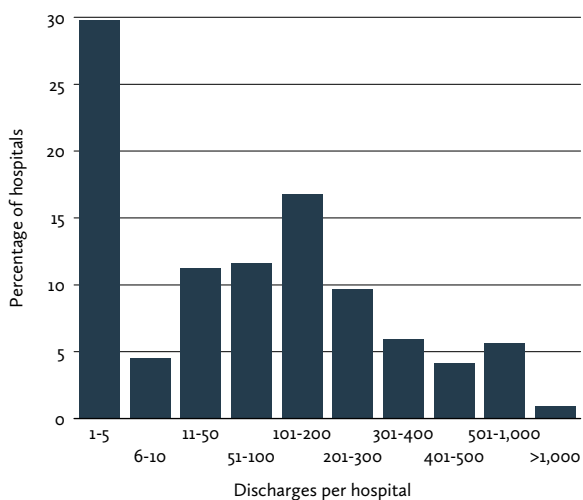
The building blocks of hospital readmission analysis are Medicare Part A claims for inpatient care. Analysis is complicated, however, by vagaries of the claims, including overlapping dates of care across multiple claims, adjoining dates possibly reflecting transfers between hospitals, and revisions for proper reimbursement. These vagaries must be carefully addressed before analysis commences. ♦ During 2011, there were 571,737 live discharges among patients who received chronic dialysis treatment upon discharge; 95 percent occurred in patients who received chronic dialysis treatment both before and after hospitalization. Most discharges were made by short-term and critical access hospitals. Among such hospitals with at least one discharge, there was wide variation in the cumulative number of discharges during the year. Approximately 34 percent of hospitals made just 1–10 discharges during 2011. Another 23 percent made 11–100 discharges during the year. For the remainder of hospitals, 101–500 discharges were typical; only 6.5 percent made more than 500 discharges during 2011. ♦ Discharge status is determined by the hospital and attending physician, and often reflects the overall condition of the patient. Among discharges made by short-term and critical access hospitals, patients were typically discharged to home, under self-care; a skilled nursing facility; or home, under the supervision of a home health agency. Other statuses comprised only 6.3 percent of discharges. ♦ Among the three principal statuses, the 30-day readmission rate was lowest for patients discharge to home, under self-care (32.1 percent); intermediate for patients discharged to home, under supervision of a home health agency (37.9 percent); and highest for patients discharged to a skilled nursing facility (39.7 percent). The probability of death in the 30 days following live discharge followed the same trend among the three statuses.

Characteristics of live discharges to chronic dialysis in 2011

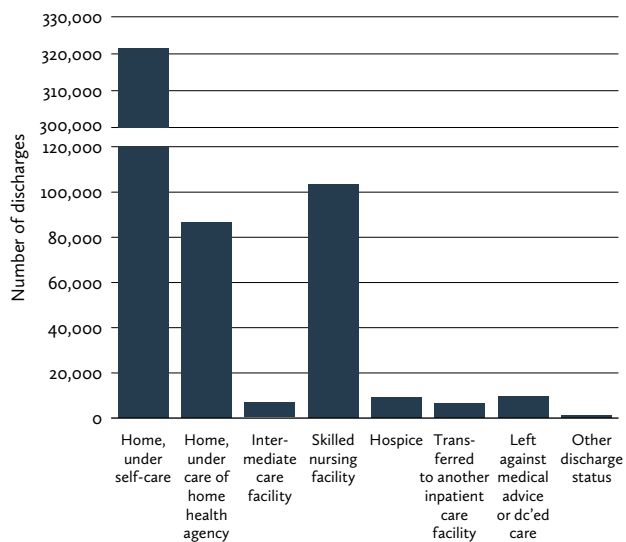
Type of inpatient facility among live discharges to chronic dialysis in 2011



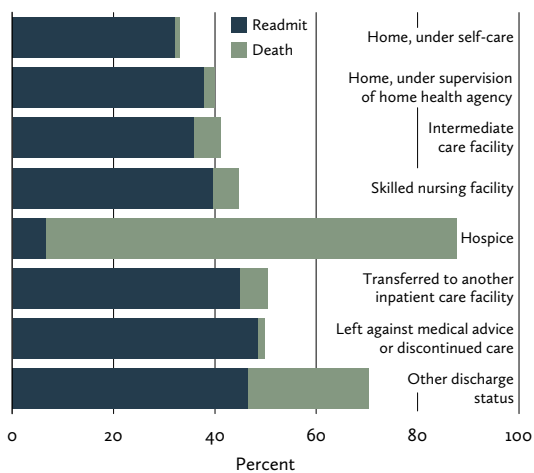
Cumulative number of live discharges to chronic dialysis in 2011, per hospital



Discharge status among live discharges to chronic dialysis in 2011



30-day readmission and death rates among live discharges to chronic dialysis in 2011

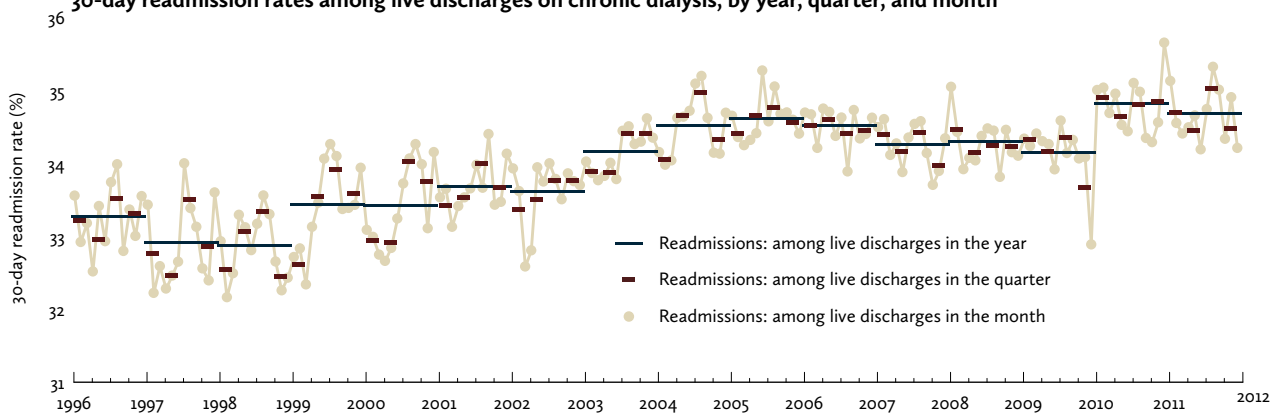


HOSPITALIZATION

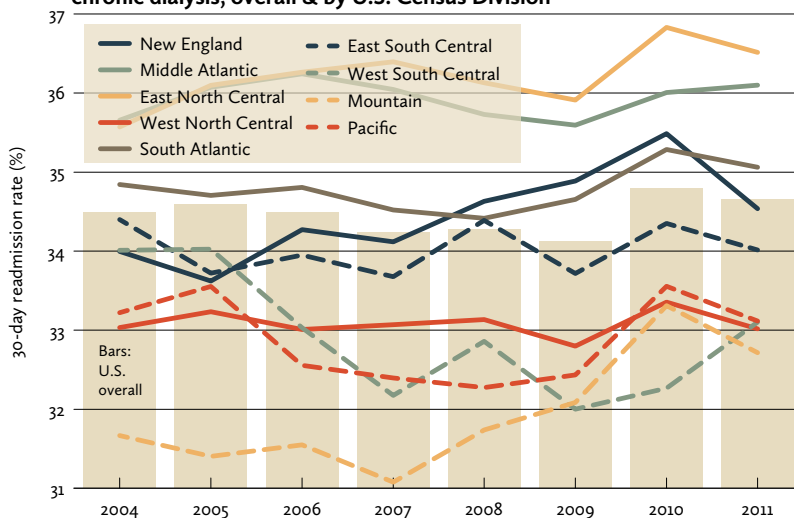
30-day readmission rates among live discharges on chronic dialysis

Compared to all Medicare beneficiaries, the 30-day readmission rate in dialysis patients is highly elevated. During all of 2011, the rate was 34.7 percent, higher than corresponding rates in all years dating to 1996, other than the preceding year. ♦ Across quarters and months, rates vary unpredictably, although within a relatively narrow absolute range. In recent years, they tend to be highest among discharges in the first and third quarters of each year. This pattern may be due to differences in admission rates for specific discharge diagnoses, which often follow seasonal patterns. ♦ Like hospital admission rates, readmission rates vary across Census Divisions. Between 2005 and 2011, the highest rates occurred in the East North Central and Middle Atlantic Divisions; in 2011, rates in both exceeded 36 percent. Rates are generally lowest in areas west of the Mississippi River. In 2011, rates were near 33 percent in the West North Central, West South Central, Mountain, and Pacific Divisions. ♦ Between 2004 and 2007, the rate was lowest in Mountain states, but it increased by roughly 2 percentage points between 2007 and 2010. The reasons for this rapid increase are uncertain and demand further attention.

30-day readmission rates among live discharges on chronic dialysis, by year, quarter, and month



30-day readmission rates among live discharges on chronic dialysis, overall & by U.S. Census Division



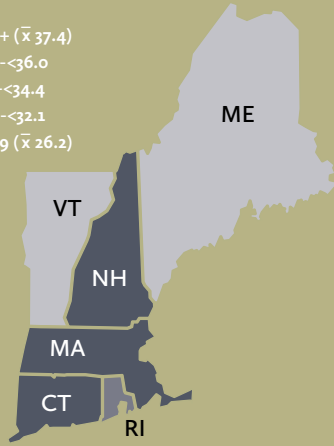
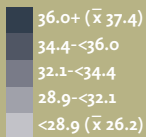
In 2011, the readmission rate was **34.7%** compared to **33.6%** in 1996

In 2010, readmissions were highest in the East North Central & Middle Atlantic Census Divisions, exceeding **36%**

30-day readmission rates (%) among live discharges on chronic dialysis, overall & by U.S. Census Division

APC, Annual Percent Change. Maps show 2011 rates.

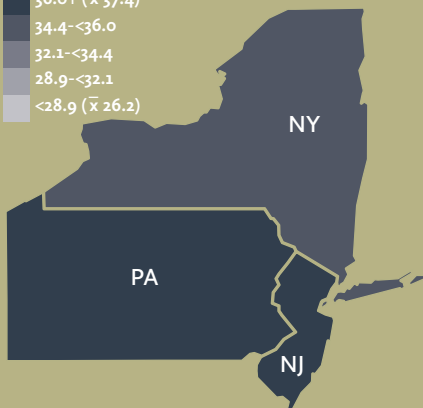
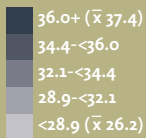
DIVISION 1 • NEW ENGLAND



	2004	2005	2006	2007	2008	2009	2010	2011	APC	
All	34.00	33.62	34.27	34.12	34.63	34.89	35.49	34.54	0.5	
Connecticut	32.54	33.08	32.73	33.69	34.97	35.25	35.36	34.83	1.3	
Maine	28.73	31.15	31.64	31.35	26.11	29.61	30.79	28.24	-0.7	
Mass.	36.57	35.55	36.38	35.25	36.02	36.31	36.90	35.57	0.0	
New Hamp.	31.07	29.51	32.33	35.11	36.83	32.82	32.10	35.43	1.7	
Rhode Island	32.72	32.53	33.74	33.68	32.76	34.73	36.47	33.06	0.8	
Vermont	29.89	25.28	24.74	24.12	28.44	21.69	26.52	26.90	-0.9	

- The 30-day readmission rate in New England increased at an annual rate of 0.5 percent per year between 2004 and 2011, with successive increases between 2006 and 2010.
- The readmission rate, however, fell by almost 1 percentage point from 2010 to 2011.
- Massachusetts and New Hampshire had the highest readmission rates in the region.
- Within the region, Connecticut and New Hampshire had the highest rates of increase in readmission rates between 2004 and 2011.

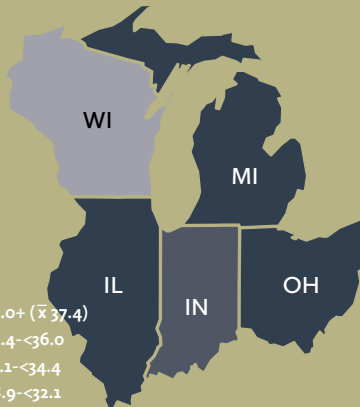
DIVISION 2 • MIDDLE ATLANTIC



	2004	2005	2006	2007	2008	2009	2010	2011	APC	
All	35.66	36.07	36.24	36.05	35.73	35.59	36.01	36.10	0.0	
New Jersey	37.07	37.40	37.50	36.58	36.85	36.35	36.32	36.49	-0.4	
New York	34.63	35.44	35.75	36.09	35.69	35.82	36.09	35.90	0.4	
Pennsylvania	35.98	35.91	35.91	35.51	34.98	34.73	35.60	36.08	-0.2	

- The 30-day readmission rate in the Middle Atlantic was 36.10 percent in 2011, the second highest among all U.S. Census Divisions.
- The readmission rate, however, was essentially unchanged between 2004 and 2011.
- Within the region, New Jersey had the highest readmission rate, at 36.10 percent in 2011, but had achieved a decline of 1 percentage point since a peak in 2005.
- In New York, readmission rates tended to increase between 2004 and 2011, although most of the increase occurred between 2004 and 2006.

DIVISION 3 • EAST NORTH CENTRAL



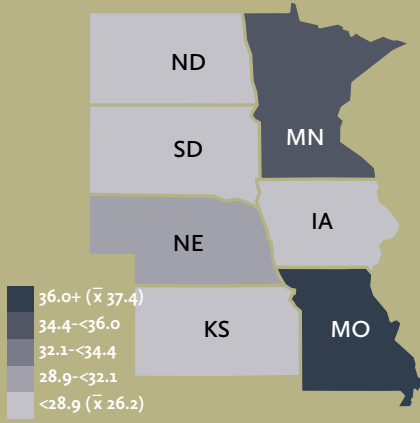
	2004	2005	2006	2007	2008	2009	2010	2011	APC	
All	35.57	36.10	36.26	36.40	36.13	35.91	36.83	36.52	0.3	
Illinois	37.12	37.60	37.72	38.92	37.68	37.52	38.43	37.34	0.1	
Indiana	31.69	32.24	31.67	32.60	33.64	34.29	35.56	35.39	1.8	
Michigan	36.74	37.28	37.72	37.76	37.74	37.80	37.86	37.69	0.3	
Ohio	35.99	36.63	36.57	35.82	35.93	34.57	36.54	36.88	0.0	
Wisconsin	31.10	31.43	32.68	31.25	30.47	31.82	30.31	30.20	-0.6	

- The 30-day readmission rate in the East North Central Division was 36.52 percent in 2011, the highest rate among all U.S. Census Divisions.
- Within the region, Illinois and Michigan had the highest readmission rates in 2011.
- Between 2004 and 2011, the readmission rate in Indiana increased by 1.8 percent per year, faster than rates of increase in all but two other states.
- The readmission rate in Wisconsin tended to decrease between 2004 and 2011.

HOSPITALIZATION

30-day readmission rates among live discharges on chronic dialysis

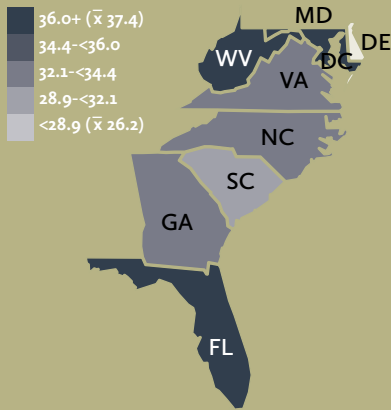
DIVISION 4 • WEST NORTH CENTRAL



	2004	2005	2006	2007	2008	2009	2010	2011	APC	
All	33.04	33.23	33.01	33.07	33.13	32.80	33.36	33.02	0.0	
Iowa	31.38	29.68	30.09	31.17	30.21	29.43	29.20	28.74	-0.9	
Kansas	31.21	32.64	30.57	31.91	29.86	31.29	31.18	28.46	-1.0	
Minnesota	33.61	34.79	34.90	32.94	34.32	33.55	34.41	34.68	0.1	
Missouri	35.57	36.12	35.07	36.04	36.10	35.54	36.26	36.27	0.2	
Nebraska	28.71	26.47	30.07	27.66	28.58	29.13	29.10	30.13	0.9	
North Dakota	26.58	25.25	30.40	27.95	29.99	26.13	29.02	28.84	1.1	
South Dakota	29.06	29.33	27.83	26.81	25.20	26.83	27.56	24.16	-2.1	

- The 30-day readmission rate in the West North Central Division was 33.02 percent in 2011, nearly unchanged from the rate in 2004.
- Within the region, Missouri had the highest readmission rate in 2011, at 36.27 percent.
- Readmission rates in Iowa, Kansas, and South Dakota tended to decrease between 2004 and 2011.

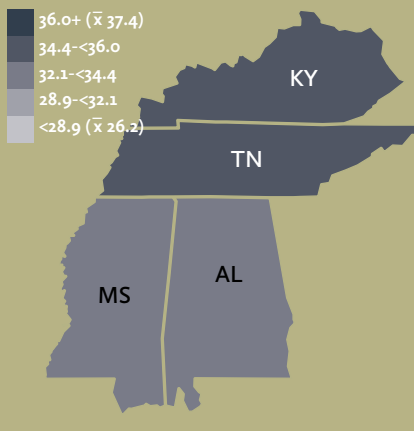
DIVISION 5 • SOUTH ATLANTIC



	2004	2005	2006	2007	2008	2009	2010	2011	APC	
All	34.85	34.71	34.81	34.52	34.42	34.66	35.29	35.06	0.1	
Delaware	31.97	32.65	32.94	33.75	30.32	31.32	33.41	33.24	0.2	
D.C.	38.82	36.92	34.16	33.84	35.85	35.97	34.37	35.11	-1.0	
Florida	35.39	35.75	36.41	36.55	36.23	36.75	37.07	37.05	0.6	
Georgia	33.12	33.47	32.95	31.66	32.03	32.24	32.93	32.89	-0.2	
Maryland	39.87	40.03	39.82	39.57	40.79	40.40	40.24	38.64	-0.1	
N Carolina	33.14	32.17	32.78	32.79	32.33	32.17	33.68	32.81	0.1	
S Carolina	31.71	33.12	31.73	31.25	29.83	29.66	31.08	31.95	-0.6	
Virginia	33.87	32.30	33.46	32.82	32.50	32.61	33.40	33.62	0.0	
West Virginia	38.87	38.39	38.66	38.81	36.12	38.46	40.17	41.24	0.7	

- Trends in 30-day readmission rates in the South Atlantic Division were heterogeneous. The readmission rate in West Virginia was 41.24 percent in 2011, the highest in the nation.

DIVISION 6 • EAST SOUTH CENTRAL

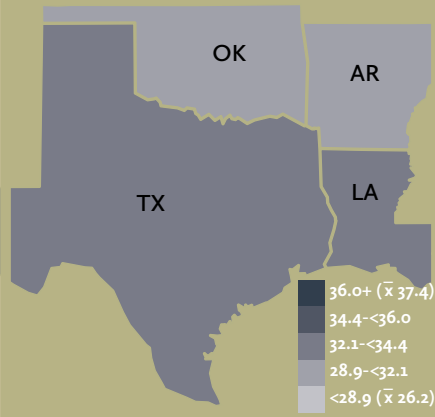


	2004	2005	2006	2007	2008	2009	2010	2011	APC	
All	34.40	33.72	33.95	33.68	34.39	33.72	34.35	34.01	0.0	
Alabama	33.67	32.49	33.01	32.41	32.11	31.51	31.81	32.64	-0.6	
Kentucky	36.52	35.88	35.62	33.65	35.25	35.42	36.81	35.32	-0.1	
Mississippi	32.66	31.54	32.07	33.06	34.88	33.29	33.72	33.40	0.8	
Tennessee	34.91	34.80	34.92	35.13	35.31	34.52	35.02	34.58	-0.1	

- The 30-day readmission rate in the East South Central Division was 34.01 percent in 2011, and was mostly unchanged between 2004 and 2011.
- In Alabama, the readmission rate decreased sharply between 2004 and 2009, but rebounded by more than 1 percentage point from 2009 to 2011.
- In Mississippi, the readmission rate increased by 0.8 percent per year between 2004 and 2011, although the rate in 2011 was well below its peak in 2008.

30-day readmission rates (%) among live discharges on chronic dialysis, overall & by U.S. Census Division (continued) APC, Annual Percent Change. Maps show 2011 rates.

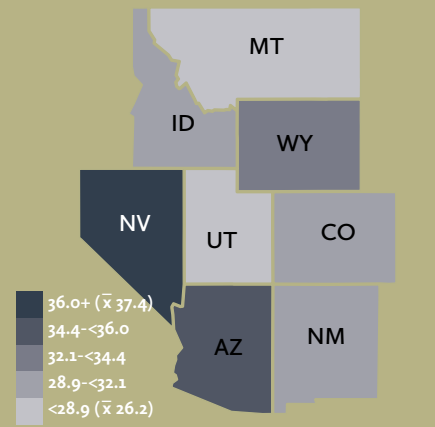
DIVISION 7 • WEST SOUTH CENTRAL



	2004	2005	2006	2007	2008	2009	2010	2011	APC	
All	34.01	34.03	33.03	32.17	32.86	32.00	32.27	33.10	-0.6	
Arkansas	35.24	35.16	33.22	32.61	33.26	32.18	32.23	31.69	-1.5	
Louisiana	36.27	34.85	35.23	32.81	34.00	32.93	33.22	34.23	-1.0	
Oklahoma	33.87	34.65	32.84	31.73	32.89	31.85	31.13	31.60	-1.3	
Texas	33.22	33.61	32.49	32.04	32.54	31.78	32.19	33.16	-0.3	

- The 30-day readmission rate in the West South Central region fell by 0.6 percent between 2004 and 2011, the most rapid rate of decline among all U.S. Census Divisions.
- Within the region, the readmission rate tended to decrease in all states.
- In Arkansas, the readmission rate decreased by 1.5 percent per year, faster than rates of decrease in all but three other states.
- In Texas, readmission rates increased between 2009 and 2011, reversing progress that had been made during earlier years.

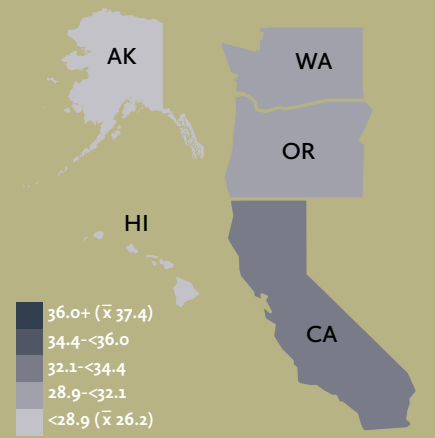
DIVISION 8 • MOUNTAIN



	2004	2005	2006	2007	2008	2009	2010	2011	APC	
All	31.67	31.40	31.55	31.08	31.74	32.09	33.31	32.72	0.7	
Arizona	33.97	32.92	34.61	33.82	33.33	34.98	36.50	35.95	1.1	
Colorado	31.59	31.69	30.34	30.55	28.50	29.16	31.31	30.69	-0.5	
Idaho	24.07	25.81	25.06	26.59	27.77	29.22	28.12	28.97	2.7	
Montana	28.52	27.67	26.51	26.06	25.10	25.89	24.50	23.00	-2.6	
Nevada	33.91	33.08	33.00	31.38	37.66	35.53	38.04	36.31	1.9	
New Mexico	30.96	30.88	29.35	30.13	30.35	28.23	29.11	29.09	-1.0	
Utah	23.92	26.53	29.76	27.53	27.98	27.48	26.22	26.49	0.5	
Wyoming	20.67	22.29	21.33	16.92	19.21	25.95	27.72	32.22	6.0	

- The 30-day readmission rate in the Mountain Division was 32.72 percent in 2011, following an average annual increase of 0.7 percent between 2004 and 2011.
- Readmission rates tended to increase in Arizona, Idaho, Nevada, Utah, and Wyoming.

DIVISION 9 • PACIFIC



	2004	2005	2006	2007	2008	2009	2010	2011	APC	
Pacific	33.22	33.56	32.56	32.40	32.27	32.43	33.56	33.12	0.0	
Alaska	29.77	31.10	28.57	25.06	26.99	22.46	19.10	21.59	-6.2	
California	34.02	34.42	33.56	33.35	33.11	33.29	34.30	33.89	-0.1	
Hawaii	24.95	25.83	25.41	26.76	25.35	24.79	27.78	25.78	0.6	
Oregon	31.22	32.34	29.01	29.35	28.91	27.74	31.09	29.08	-1.0	
Washington	30.94	30.25	29.55	29.35	29.77	30.94	31.89	32.05	0.8	

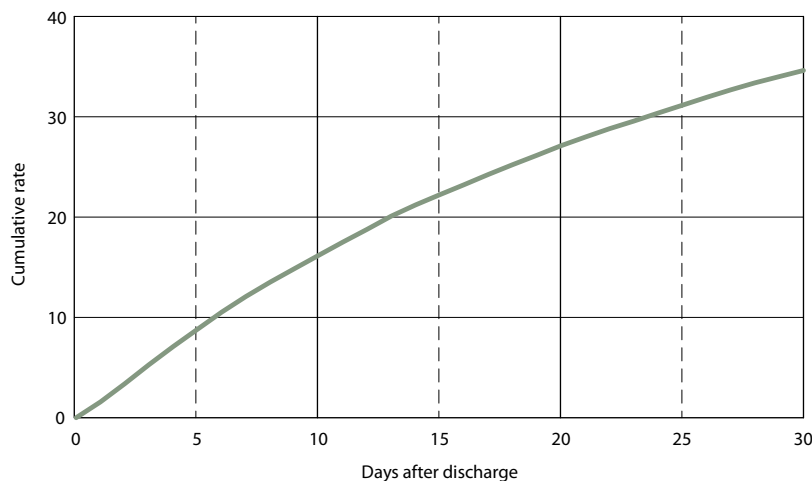
- The 30-day readmission rate in the Pacific Division was 33.12 percent in 2011, nearly unchanged from the corresponding rate in 2004.
- Readmission rates declined sharply in Alaska.
- Readmission rates tended to increase in Washington, after having reached a nadir of 29.35 percent in 2007.

HOSPITALIZATION

30-day readmission rate, by principal discharge diagnosis

Readmissions may occur either very shortly after discharge or several weeks later. The etiology of early versus late readmissions likely differs substantially. Very early readmissions may reflect inappropriately premature discharge or poor preparation for discharge. Readmission may, in fact, occur before the patient receives outpatient dialysis, as in the case of a patient discharged on Friday and not scheduled to dialyze until Monday. On the other hand, late readmissions may reflect poor adherence to newly prescribed medications or suboptimal treatment by dialysis providers, leading to recurrence of cardiovascular instability or worsening infection. ♦ In 2011, the cumulative readmission rate was 5.3 percent within three days after discharge and 12.1 percent within seven days. With each subsequent seven-day interval, the cumulative readmission rate decreased more slowly. ♦ Rates of both readmission and death during the 30 days following live discharge vary according to the principal discharge diagnosis. For discharges with cardiovascular disease, the 30-day readmission rate in 2011 was 35.4 percent; the corresponding rate for discharges with infection was 33.5 percent. ♦ Among discharges with cardiovascular disease, 30-day readmission is most likely for acute coronary syndrome, primarily due to higher risk of early readmission, as is consistent with worsening heart failure after myocardial infarction. Readmission is least likely for heart failure and cardiomyopathy. Risk of death within 30 days of discharge is also highest for acute coronary syndrome. ♦ Among discharges with infection, 30-day readmission is most likely for intestinal infection with *C. difficile* and for bacteremia and sepsis. For both categories, readmission rates within 10 days of discharge exceed 18 percent. The readmission rate is lowest for dialysis access infections. Risk of death within 30 days of discharge is highest for bacteremia and sepsis, at 4.2 percent. ♦ The rate of 30-day readmission is relatively high for acute respiratory failure and relatively low for dialysis access complications, excluding infection.

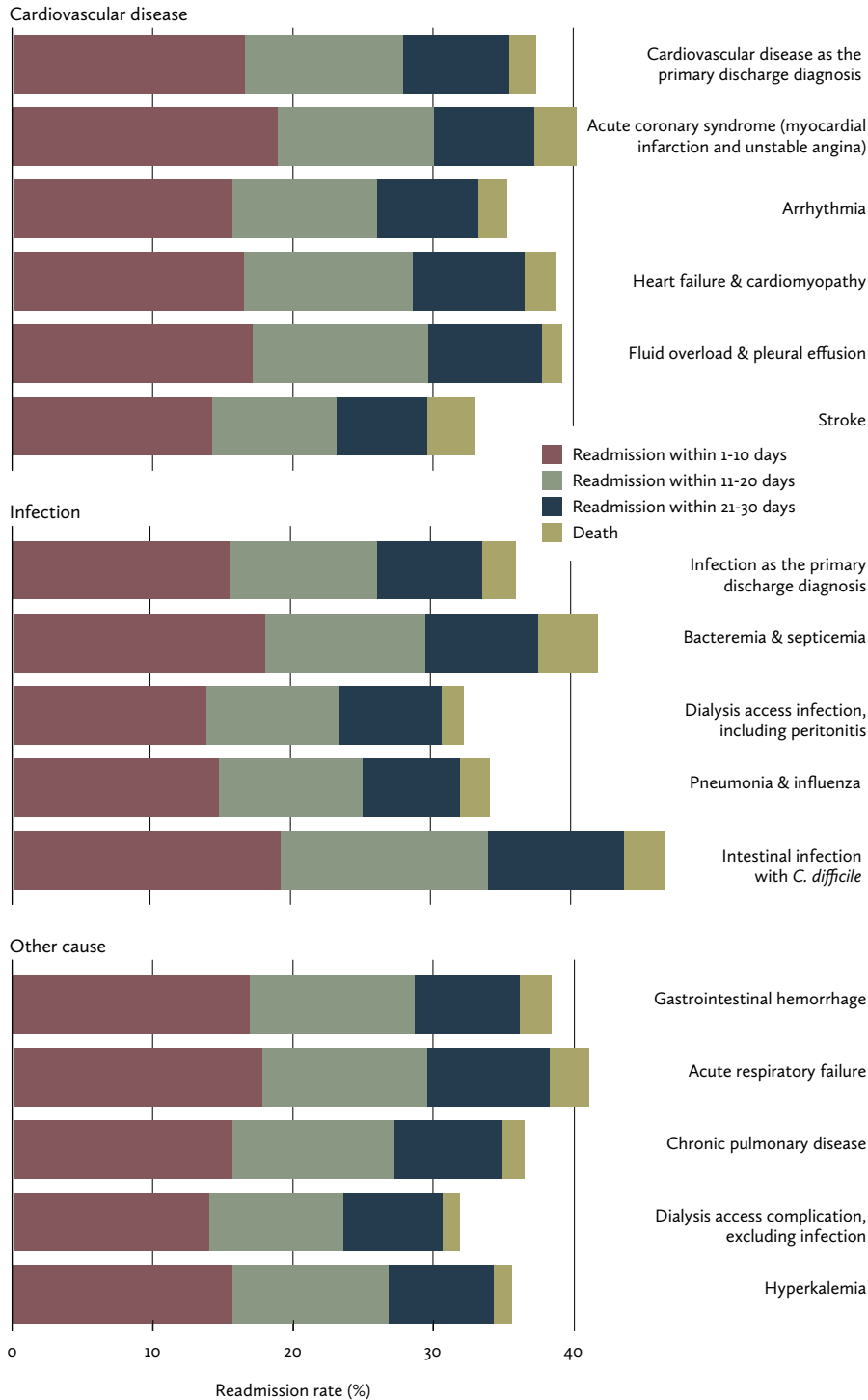
30-day readmission rate among live discharges on chronic dialysis, by days following discharge (2011)



Days after discharge		Cumulative rate	
0	0.0	16	23.2
1	1.6	17	24.3
2	3.4	18	25.2
3	5.3	19	26.2
4	7.1	20	27.1
5	8.8	21	28.0
6	10.5	22	28.8
7	12.1	23	29.6
8	13.5	24	30.4
9	14.9	25	31.2
10	16.2	26	31.9
11	17.5	27	32.7
12	18.8	28	33.4
13	20.1	29	34.0
14	21.2	30	34.6
15	22.2		

30-day readmission rate, by principal discharge diagnosis (2011)

30-day readmission rate among live discharges on chronic dialysis, by principal discharge diagnosis



HOSPITALIZATION

Major findings

1

Beginning around 2005, hospitalization rates among both incident and prevalent dialysis patients in freestanding facilities declined, with particularly strong gains in the East and West South Central regions. In some parts of the East North Central region, however, particularly Indiana and Michigan, hospitalization rates rose in recent years.

2

Across the dialysis patient population, hospitalization for principal diagnoses of cardiovascular disease has decreased, with clear declines in the incidence of admissions for acute coronary syndrome and stroke. For non-ischemic morbidity, however, gains have been more elusive. The rate of admission for arrhythmia has not changed, and the declining rate of admission for heart failure has been counteracted by an increasing rate of admission for fluid overload.

3

Hospitalization for infection is unchanged through 2011. During the first six months of dialysis, the admission rate actually increased between 2003 and 2010. Rates of admission for bacteremia and sepsis ostensibly increased in recent years, although this might have reflected a coding shift from admissions for dialysis access infections, which declined in frequency. And in recent years there has been a rapid increase in admissions for infection with *C. difficile*.

4

Seasonality is a common feature of hospital admissions for a number of diagnoses. Predictably, pneumonia and influenza exhibit marked seasonality, as do admissions for chronic pulmonary disease, presumably as a result of acute exacerbations of disease secondary to respiratory infection. But seasonality is also observed in less predictable places. Admissions for acute coronary syndrome and heart failure peak annually in winter months, while those for dialysis access infections peak in the summer months, possibly due to increased heat and humidity.

5

Readmission within 30 days of live discharge is very common among dialysis patients, and the likelihood of readmission within the first 10 days is especially high. The likelihood of 30-day readmission increased slightly between 2004 and 2011.

SMALL PICTURES digitalis (foxglove); medicinal use: cardiovascular disease treatment LARGE PICTURE arnica; medicinal use: pain relief, anti-inflammatory

Mortality



Emily Shanks, *Scene in a Russian Hospital: The Ear Inspection*, 1890s

MORTALITY

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Progress in reducing mortality is a core measure of success for dialysis providers. First-year mortality among patients in freestanding dialysis facilities has declined in successive incident cohorts since 2004. As with incidence and hospitalization, there is stark regional variation in early mortality rates, with a range from 32 deaths per 100 patient years in the East North Central Census Division to only 21 deaths in the Mountain Division. Moreover, while nearly all Census Divisions have achieved cumulative declines in first-year mortality of 11–20 percent from 2004 to 2011, one area, the East Central North Division, has made no progress. Likewise, within Divisions, some states have achieved large declines in first-year mortality, while in other states rates have tended to increase in recent years. In the future, to focus provider efforts on improving early outcomes, these disparities must be addressed by the integration of morbidity and mortality data with data regarding pre-dialysis care, initial vascular access technique, and the use of oral medications.

We subsequently present data regarding weekly and daily mortality rates during the first year of treatment in patients who initiated dialysis in freestanding facilities in either 2004 or 2011. Mortality rates are highly elevated immediately after initiation of outpatient dialysis, and only gradually decline during the first 26 weeks. Interestingly, very high early mortality risk is apparent not only in elderly and very elderly patients, but also in much younger patients. The juxtaposition of data from 2004 and 2011 nevertheless demonstrates clear progress in reducing mortality risk during the first year, with particularly large gains during the second and third months. Improvements in early mortality translate as well to longer expected remaining lifetimes for incident dialysis patients, which we describe here. Between cohorts of incident patients in 2004 and 2010, patients between the ages of 20 and 34 years achieved gains in life expectancy exceeding two years. Gains in older age brackets were smaller in magnitude, but still evident.

Rates of death in the prevalent dialysis patient population also show substantial and consistent reductions since 2003. Progress has been fairly consistent across the country, with cumulative declines among Census Divisions of 14–20 percent from 2004 to 2011. There are, however, several notable exceptions. In the East North Central Division, Indiana and Michigan had

the lowest average annual reductions in mortality rates, at 1.7 and 1.5 percent per year, respectively. With that same area also achieving the lowest reductions in first-year mortality rates, further investigation could help identify potential interventions to improve outcomes.

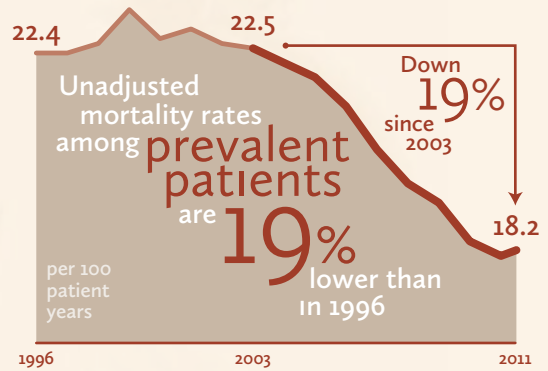
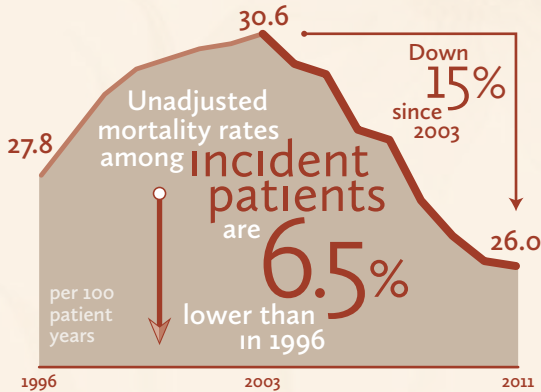
Data on the number of deaths among patients treated in freestanding dialysis facilities follow a clearly cyclical pattern, with counts highest during the first quarter of each year. Most interesting, however, is the divergence in the growth of counts of prevalent dialysis patients and deaths among them. Whereas patient counts have followed a nearly linear trajectory upward, counts of deaths have begun to grow much more slowly in recent years—an important observation that further demonstrates improving survival in the prevalent dialysis patient population. Moreover, the gains are not restricted to some demographic subgroups of the population, but have instead been broadly achieved in groups defined by age, race, sex, vintage, diabetic status, and dialytic modality. Between 2004 and 2011, expected remaining lifetimes increased by more than two years among prevalent patients age 20–44, and by at least one year among all non-elderly patients.

Sudden cardiac death remains the leading cause of death in the prevalent dialysis patient population, accounting for 27.5 percent of deaths. Of particular concern are data showing that it accounts for nearly 32 percent of deaths among younger adult patients, who are typically strong candidates for transplant. Further analyses of the causes of sudden cardiac death in this population require attention to dialysis bath composition, use of beta blockers (and the selection of particular agents for beta blockade, in light of differing pharmacokinetics), and use of potentially arrhythmogenic medications that might interfere with conduction.

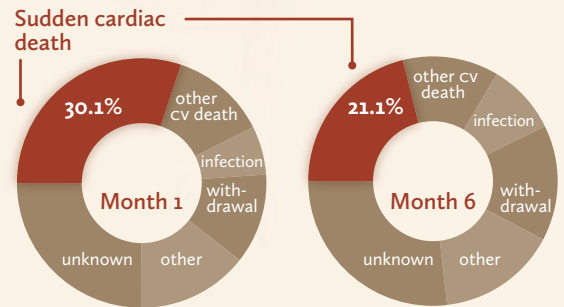
The cumulative impact of declining mortality in the dialysis population is substantial. The number of prevented deaths in a given year, relative to the mortality rate less than a decade ago, is reaching into the tens of thousands, an important accomplishment. Providers have made progress, but there are clearly additional gains possible, with opportunities to address major areas of morbidity.

MORTALITY

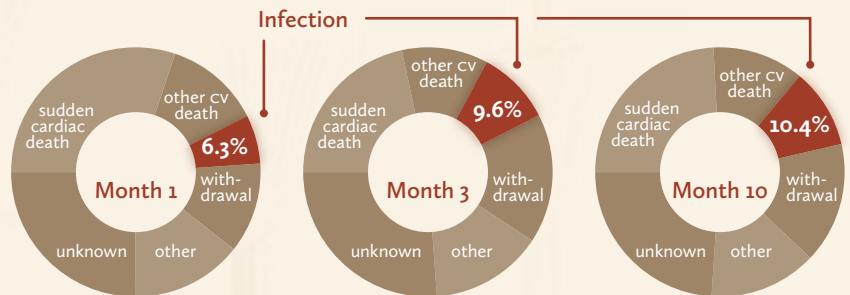
Progress in reducing mortality is a **core measure of success** for dialysis providers, and first-year mortality in freestanding facilities has **declined consistently** since 2004

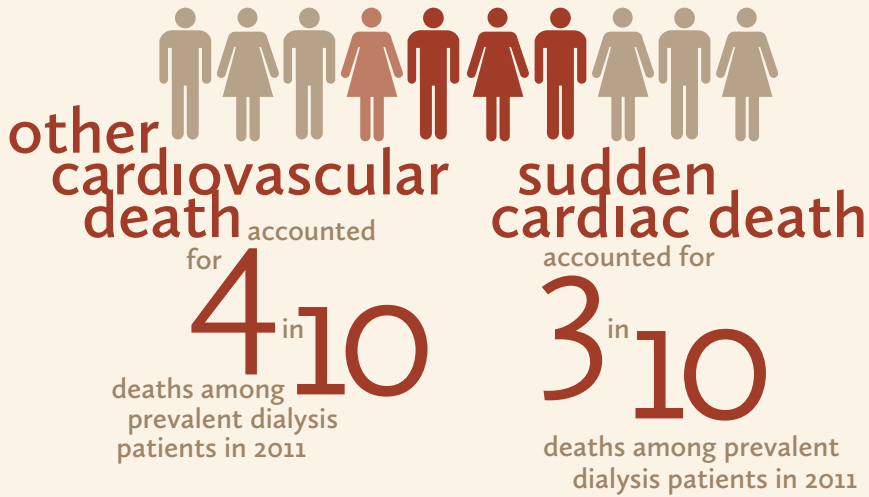


Among incident patients, the proportion of deaths caused by **sudden cardiac death** is **HIGHEST** in the **first month** of dialysis, and declines to its **LOWEST** level during the **sixth month**

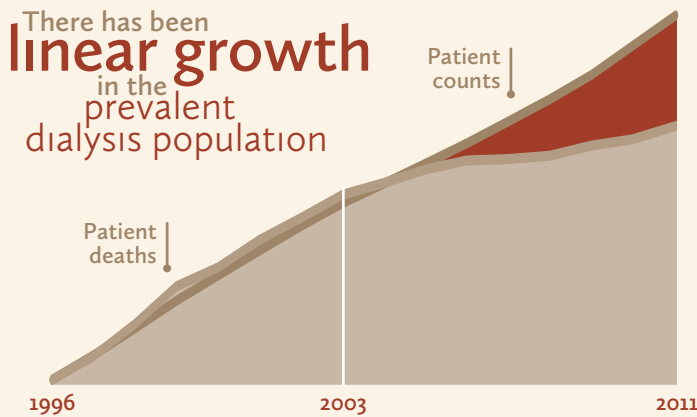


Infection accounts for a **growing percentage** of deaths during the **first year** after dialysis initiation





Mortality rates are consistently **highest** in **NEW ENGLAND** and **lowest** in the **PACIFIC STATES**



Counts of deaths began to **turn away** from this linear trend during the early 2000s, a manifestation of **improving survival**

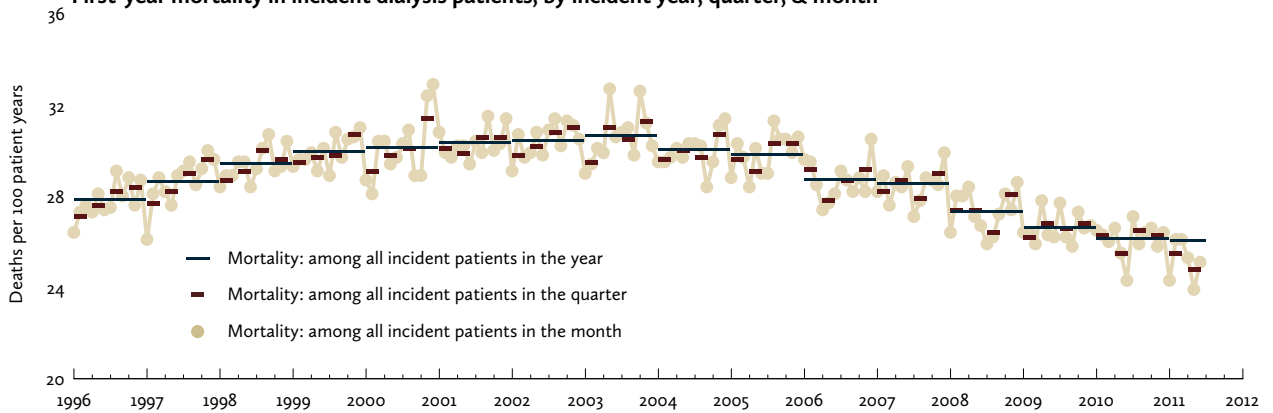
Among prevalent dialysis patients age 20–39, **expected remaining lifetimes** increased **2 to 3 years** between 2004 and 2011

MORTALITY

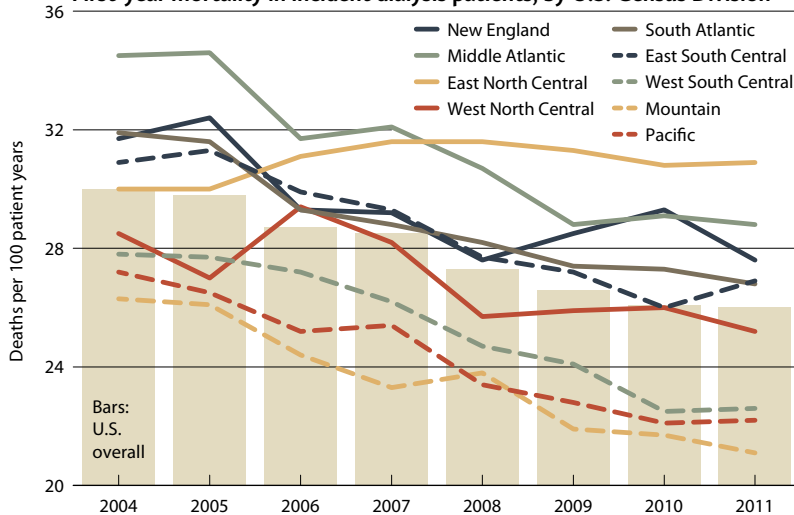
First-year mortality in incident dialysis patients, by U.S. Census Division

Relative to the 2003 cohort of incident patients in freestanding dialysis facilities, there have been continued declines in the first-year mortality rate of successive cohorts of incident patients. Among patients who initiated dialysis during the first half of 2011, the first-year mortality rate was 26.0 deaths per 100 patient-years, down 15 percent from 30.6 deaths per 100 patient-years among incident patients during 2003. There are exceptions to the national trend. There has been no improvement in the East North Central region. With hospitalization rates also high in this region, concerns arise about not only the quality of care in dialysis facilities themselves, but also the quality of care in the broader healthcare delivery system, suggesting the need for careful attention at both the macroscopic level of state government and the microscopic level of dialysis facilities.

First-year mortality in incident dialysis patients, by incident year, quarter, & month



First-year mortality in incident dialysis patients, by U.S. Census Division



Unadjusted mortality rates for incident dialysis patients have fallen

6.5%
since 1996

With the exception of the East North Central Census Division, first-year mortality has fallen

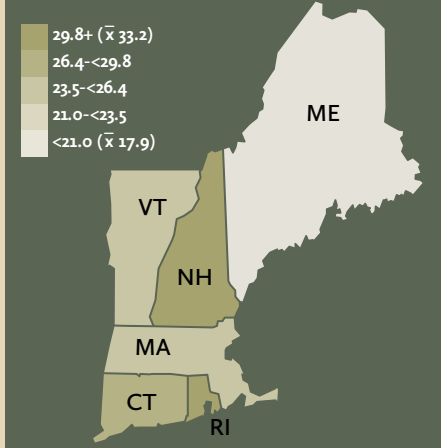
11-20%
since 2004

First-year mortality in incident dialysis patients, by U.S. Census Division

After first dialysis session in freestanding facility.

Deaths per 100 patient years; APC, Annual Percent Change. Maps show 2011 rates.

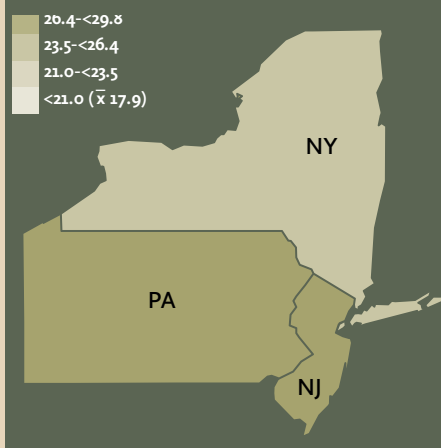
DIVISION 1 • NEW ENGLAND



	2004	2005	2006	2007	2008	2009	2010	2011	APC
All	31.7	32.4	29.3	29.2	27.6	28.5	29.3	27.6	-1.9
Connecticut	32.5	30.9	27.3	25.7	27.4	31.1	30.3	29.5	-0.4
Maine	28.8	30.7	22.0	26.1	25.6	21.4	21.7	19.1	-5.5
Mass.	30.6	31.9	30.9	30.1	26.9	26.3	30.1	25.9	-2.4
New Hamp.	29.2	30.2	28.4	31.6	33.3	29.3	21.0	33.4	-0.9
Rhode Island	39.3	43.2	35.0	35.2	28.3	35.6	34.5	31.1	-3.4
Vermont	0.0	.	.	0.0	0.0	50.9	49.4	23.5	.

- Between 2004 and 2011, first-year mortality rates decreased by 1.9 percent per year in New England. Leading the area was Maine, where rates fell by 5.5 percent per year, corresponding to a cumulative decline of more than 33 percent between 2004 and 2011.
- In Massachusetts, the most populous state, rates fell slightly more rapidly than in other states in the division. In neighboring Connecticut, however, rates decreased only modestly, due to a sudden increase between 2008 and 2010.

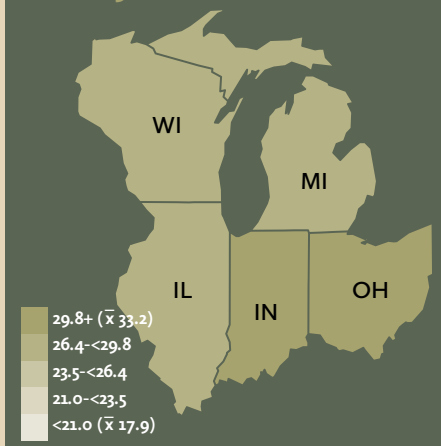
DIVISION 2 • MIDDLE ATLANTIC



	2004	2005	2006	2007	2008	2009	2010	2011	APC
All	34.5	34.6	31.7	32.1	30.7	28.8	29.1	28.8	-2.9
New Jersey	37.5	36.8	35.5	33.0	33.6	29.1	30.4	29.8	-3.7
New York	31.6	32.4	29.3	30.6	27.7	26.1	26.3	25.5	-3.5
Pennsylvania	35.5	35.4	31.9	33.2	32.3	31.5	31.5	32.0	-1.6

- Between 2004 and 2011, first-year mortality rates decreased by 2.9 percent per year in the Middle Atlantic division, albeit with little change since 2009.
- Leading the division was New Jersey, where rates decreased by 3.7 percent per year.
- In Pennsylvania, rates have been stable since 2008.

DIVISION 3 • EAST NORTH CENTRAL



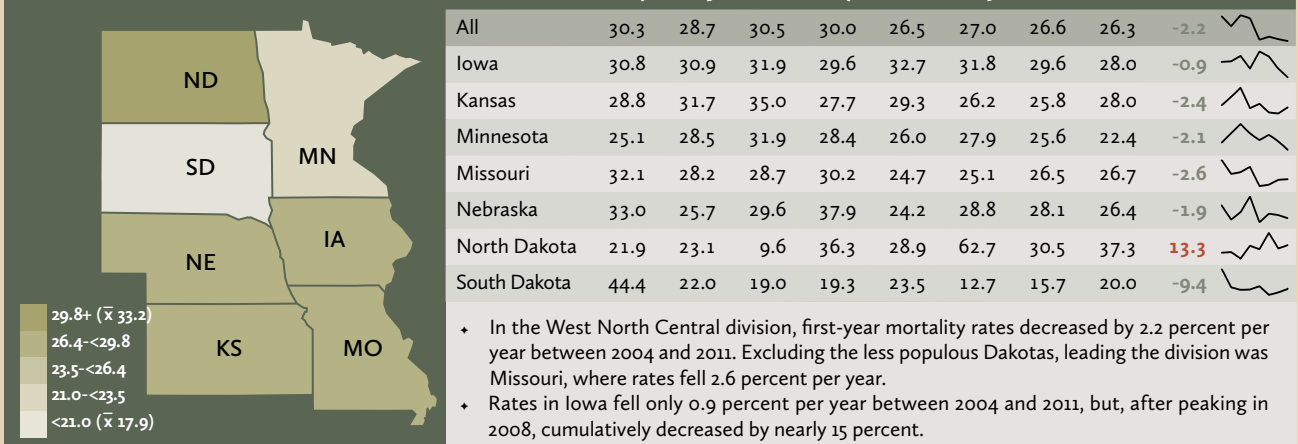
	2004	2005	2006	2007	2008	2009	2010	2011	APC
All	30.0	30.0	31.1	31.6	31.6	31.3	30.8	30.9	0.4
Illinois	29.4	27.9	30.6	31.0	32.3	31.1	30.6	29.5	0.7
Indiana	27.2	29.2	29.7	30.4	30.2	29.3	30.8	32.9	1.9
Michigan	29.1	32.2	30.7	28.8	31.9	28.8	28.8	28.2	-1.0
Ohio	31.8	30.9	32.3	35.6	33.1	34.8	33.1	33.8	1.1
Wisconsin	33.6	29.6	32.0	29.6	26.0	30.0	28.0	28.7	-2.0

- In the East North Central division, first-year mortality rates have increased 0.4 percent per year since 2004.
- In 2011, the rate was 30.9 deaths per 100 patient years, the highest among all U.S. Census Divisions.
- Rates increased most rapidly in Indiana, at a rate of 1.9 percent per year, and also rose in Ohio and Illinois.
- In Wisconsin, in contrast, rates have fallen 2.0 percent per year.

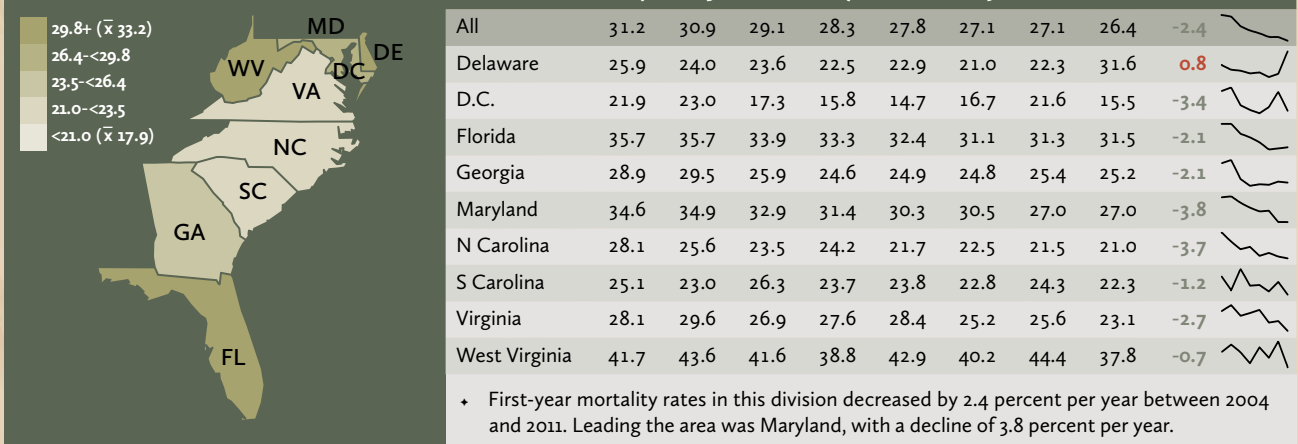
MORTALITY

First-year mortality in incident dialysis patients, by U.S. Census Division (continued)

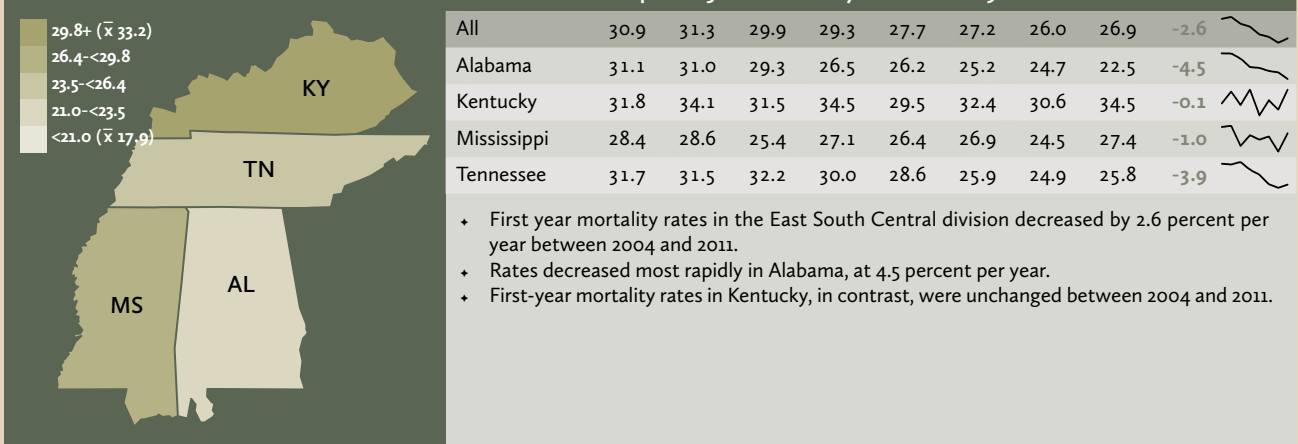
DIVISION 4 • WEST NORTH CENTRAL



DIVISION 5 • SOUTH ATLANTIC



DIVISION 6 • EAST SOUTH CENTRAL

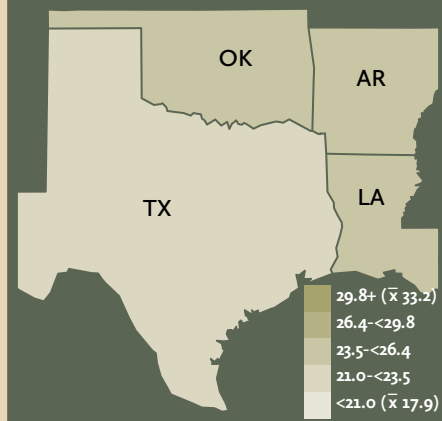


First-year mortality in incident dialysis patients, by U.S. Census Division (continued)

After first dialysis session in freestanding facility.

Deaths per 100 patient years; APC, Annual Percent Change. Maps show 2011 rates.

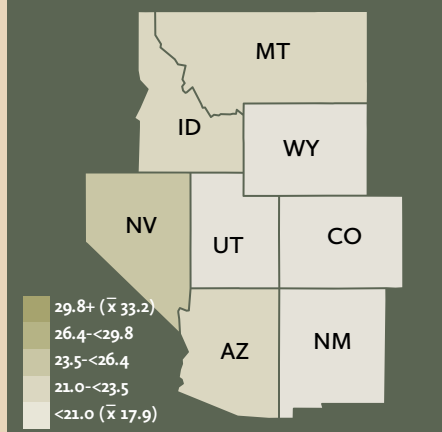
DIVISION 7 • WEST SOUTH CENTRAL



	2004	2005	2006	2007	2008	2009	2010	2011	APC
All	27.8	27.7	27.2	26.2	24.7	24.1	22.5	22.6	-3.4
Arkansas	35.6	34.9	32.8	30.8	30.0	30.1	23.6	24.9	-5.5
Louisiana	36.5	35.3	32.2	31.5	29.9	28.2	25.6	24.8	-5.5
Oklahoma	32.4	28.6	30.9	31.5	29.3	28.4	25.4	26.0	-2.9
Texas	23.8	24.8	25.0	23.7	22.2	21.9	21.2	21.4	-2.3

- Between 2001 and 2011, first-year mortality rates in the West South Central division decreased by 3.4 percent per year, the most rapid rate of decline among all U.S. Census Divisions.
- In both Arkansas and Louisiana, rates fell 5.5 percent per year.
- In the most populous state, Texas, rates declined more modestly, at 2.3 percent per year.

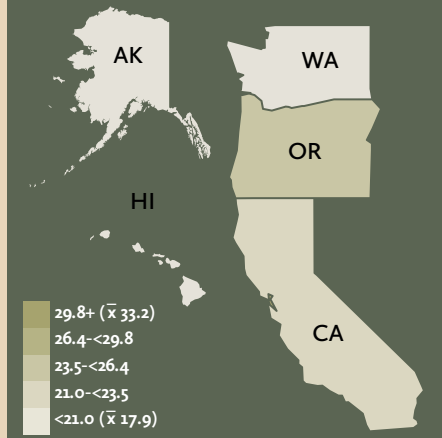
DIVISION 8 • MOUNTAIN



	2004	2005	2006	2007	2008	2009	2010	2011	APC
All	26.3	26.1	24.4	23.3	23.8	21.9	21.7	21.1	-3.2
Arizona	29.5	28.2	25.1	24.9	25.6	22.7	22.4	23.2	-3.6
Colorado	22.5	19.7	21.6	20.3	20.8	16.3	19.7	18.9	-2.4
Idaho	24.2	24.9	24.1	30.5	35.4	28.9	27.3	22.9	0.9
Montana	28.4	20.5	24.9	18.4	16.4	23.8	38.7	22.8	1.7
Nevada	32.6	32.6	28.7	25.2	23.3	22.3	21.0	23.5	-6.1
New Mexico	18.7	23.9	20.6	21.7	20.6	19.0	17.6	13.1	-5.0
Utah	18.7	22.8	23.4	15.1	18.7	29.9	22.8	20.6	2.0
Wyoming	12.7	19.5	24.6	14.3	23.8	12.2	27.8	17.0	2.7

- First-year mortality rates in the Mountain division fell by 3.2 percent per year between 2004 and 2011, and decreased most rapidly in Nevada and New Mexico.
- Rates increased in four states, albeit with substantial year-to-year variability.

DIVISION 9 • PACIFIC



	2004	2005	2006	2007	2008	2009	2010	2011	APC
Pacific	27.2	26.5	25.2	25.4	23.4	22.8	22.1	22.2	-3.2
Alaska	26.4	18.3	21.2	25.8	20.6	17.3	21.4	20.3	-2.2
California	27.3	26.1	25.5	25.2	23.4	22.9	22.3	22.6	-2.9
Hawaii	12.4	19.6	15.9	18.9	15.6	16.4	14.2	14.3	-0.8
Oregon	31.3	30.5	30.0	27.4	26.7	24.6	22.7	24.9	-4.3
Washington	27.7	30.3	25.1	28.9	25.3	24.0	23.5	20.6	-4.2

- First-year mortality rates in the Pacific division fell 3.2 percent per year between 2004 and 2011, and more than 4 percent per year in both Oregon and Washington.
- In the most populous state, California, rates decreased by nearly 3 percent per year.

MORTALITY

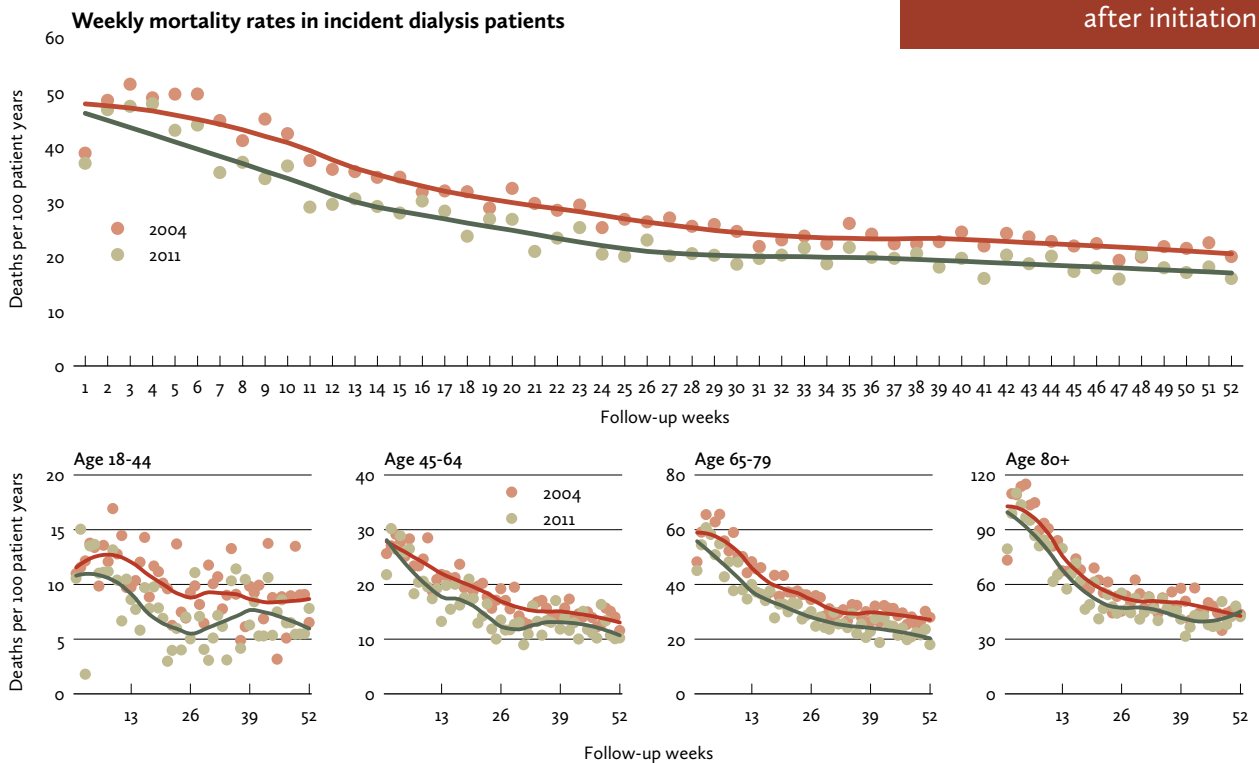
Weekly mortality rates in incident dialysis patients

After first dialysis session in a freestanding facility

Weekly mortality rates, as estimated from the date of the first dialysis session in a freestanding facility (a departure in methodology from that of the United States Renal Data System) and mathematically smoothed, declined between annual cohorts of incident patients in 2004 and 2011, with relatively larger improvements between weeks four and 12. Among incident patients in 2011, the rate of death was highest immediately, declined thereafter, and reached a steady state by week 28. Patterns are similar within strata defined by age, but with absolutely higher mortality rates associating with older age at dialysis initiation. ♦ Impressively, among elderly patients initiating dialysis in 2011, mortality rates declined immediately after the first week, rather than remaining elevated for several weeks before declining more sharply, as rates did among incident patients in 2004. ♦ Sudden cardiac death is the most frequently listed cause of death in dialysis patients, so attention should be focused on ultrafiltration, dialysate composition, and arrhythmias possibly induced by medication. Because incident patients often have residual renal function, however, decisions about ultrafiltration and dialysate composition must be carefully considered.

Mortality among incident dialysis patients is highest within the first

6 weeks
after initiation

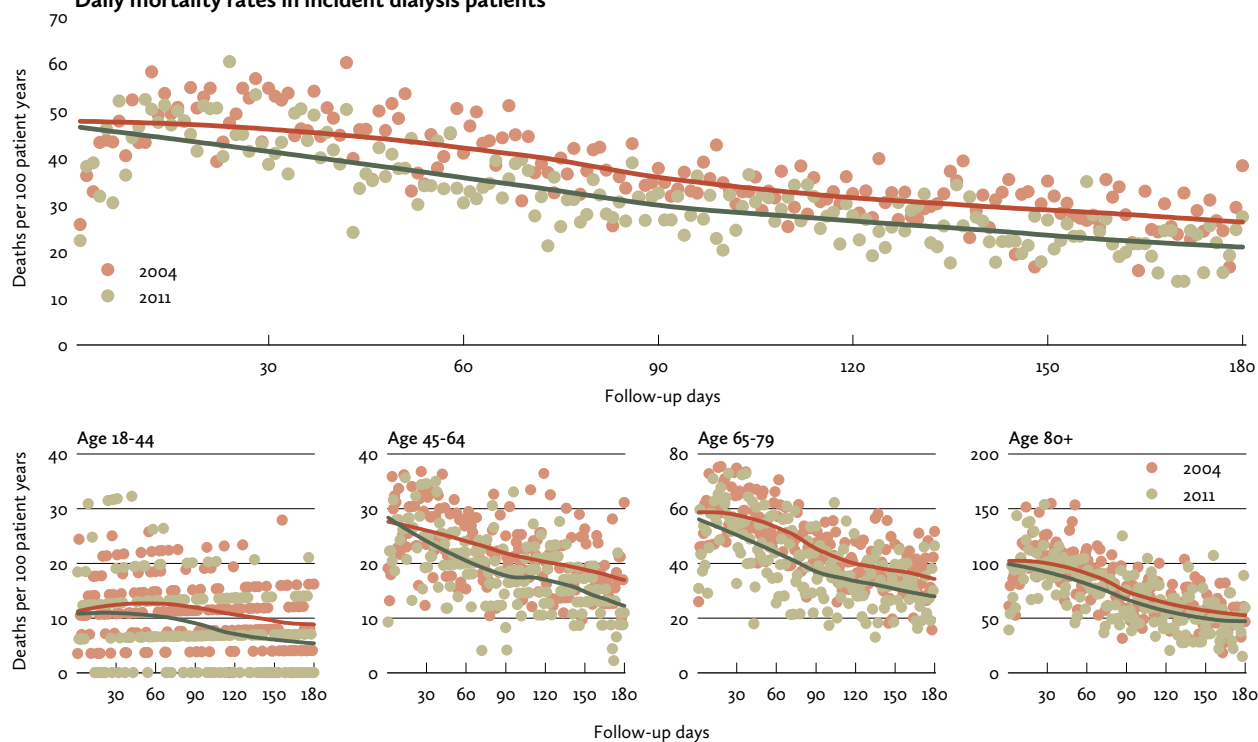


Daily mortality rates in incident dialysis patients

After first dialysis session in a freestanding facility

Daily mortality rates during the first 180 days after initiating dialysis in a freestanding facility are highly volatile, partially because these rates mix the influence of time since dialysis initiation with seasonality in mortality rates. Apart from smoothed trends in the rates, it is noteworthy that daily rates actually tend to increase during the first 14 days of dialysis. Possible causes of this escalation in risk should be explored. Within strata defined by age, there are large improvements in early mortality among incident patients age 65–79. Future reports should probe the timing of death with respect to days on or off dialysis, to occurrence before or after the dialysis session (in the case of death on days on dialysis), and to the day immediately after the interdialytic interval.

Daily mortality rates in incident dialysis patients

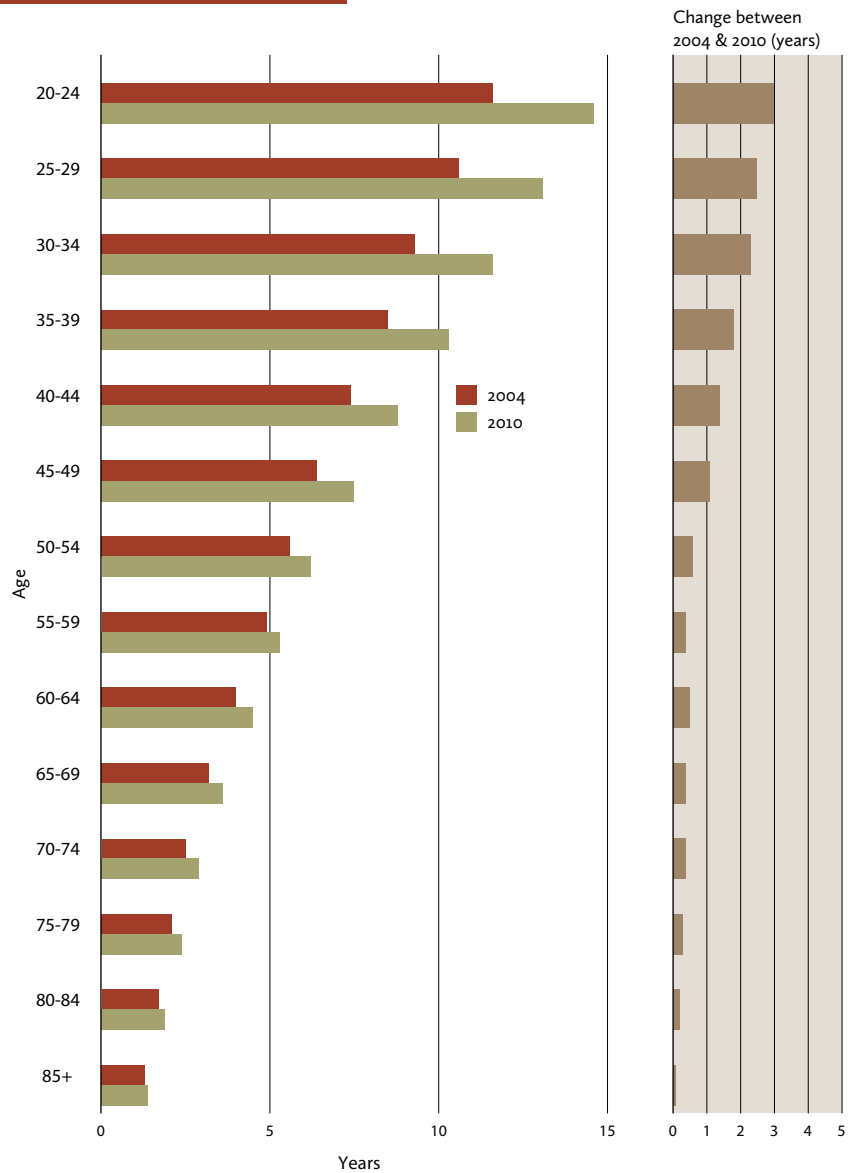


MORTALITY

Expected remaining lifetimes in incident dialysis patients

Expected remaining lifetimes at the date of dialysis initiation can be calculated in a variety of ways; here, lifetime is assumed to follow an exponential distribution, with rate equal to the mortality rate during the first year of dialysis. Because the mortality rate during the first year is less than rates during the second and third years (at minimum), the estimates of expected remaining lifetime displayed here are generally pessimistic. Nevertheless, recent declines in the first-year mortality rate among successive cohorts of incident dialysis patients translate into substantial improvements in expected remaining lifetime, including gains exceeding two years among patients age 20–34, gains of 1–2 years among patients age 35–49, and gains of 6–12 months among patients age 50–64. Among octogenarians and nonagenarians, in contrast, expected remaining lifetimes after initiation remain less than two years, and lengthened by less than three months between 2004 and 2010.

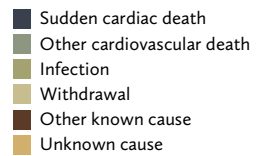
Among incident patients age 20–24, expected remaining lifetimes increased **3 years** between 2004 & 2010



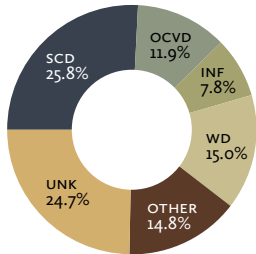
Distribution of causes of death during the first year of dialysis

According to the Death Notification Form; 2011.

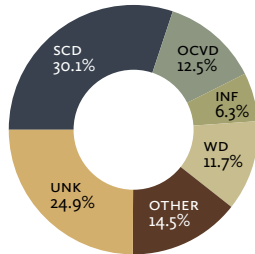
Among incident dialysis patients, the proportion of deaths caused by sudden death is highest in the first month of dialysis, at 30.1 percent, and declines to its lowest level during the sixth month, at 21.1 percent. Infection, in contrast, accounts for only 6.3 percent of deaths in the first month, but increases to 9.6 percent in the third month, and exceeds 10 percent in the tenth month. In future reports, causes of death will be assessed across seasons and within strata defined by age, dialytic modality, and preexisting comorbid conditions.



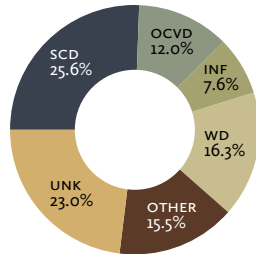
Months 1-3



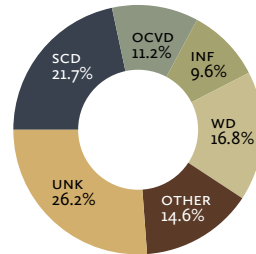
Month 1



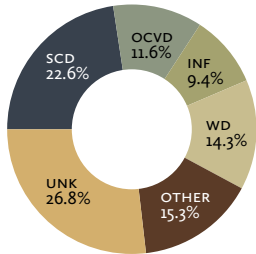
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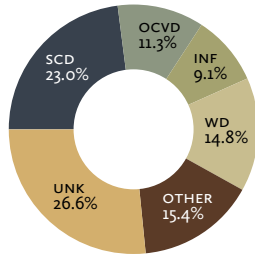
Month 3



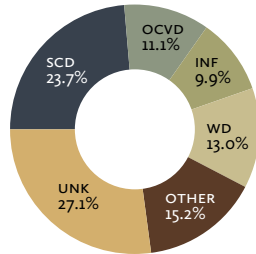
Months 4-6



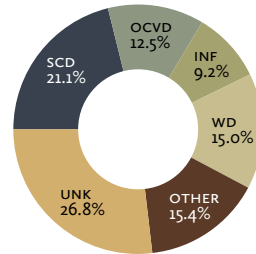
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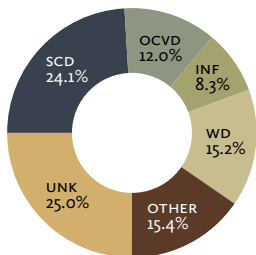
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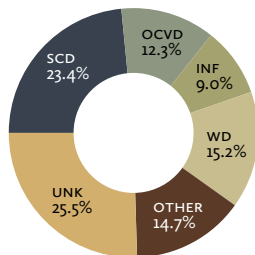
Month 6



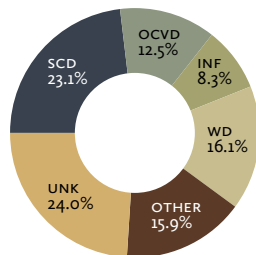
Months 7-9



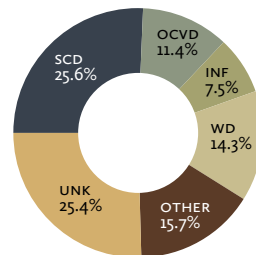
Month 7



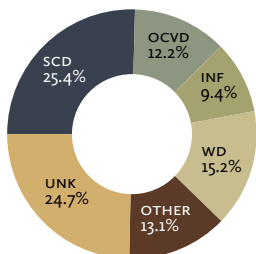
Month 8



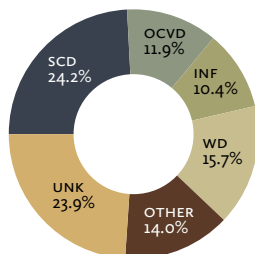
Month 9



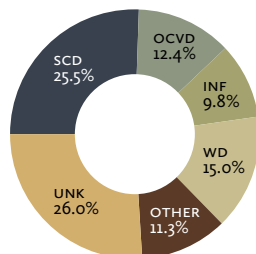
Months 10-12



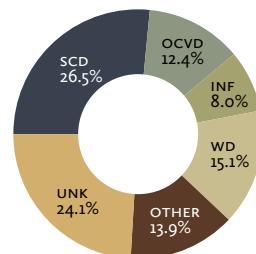
Month 10



Month 11



Month 12



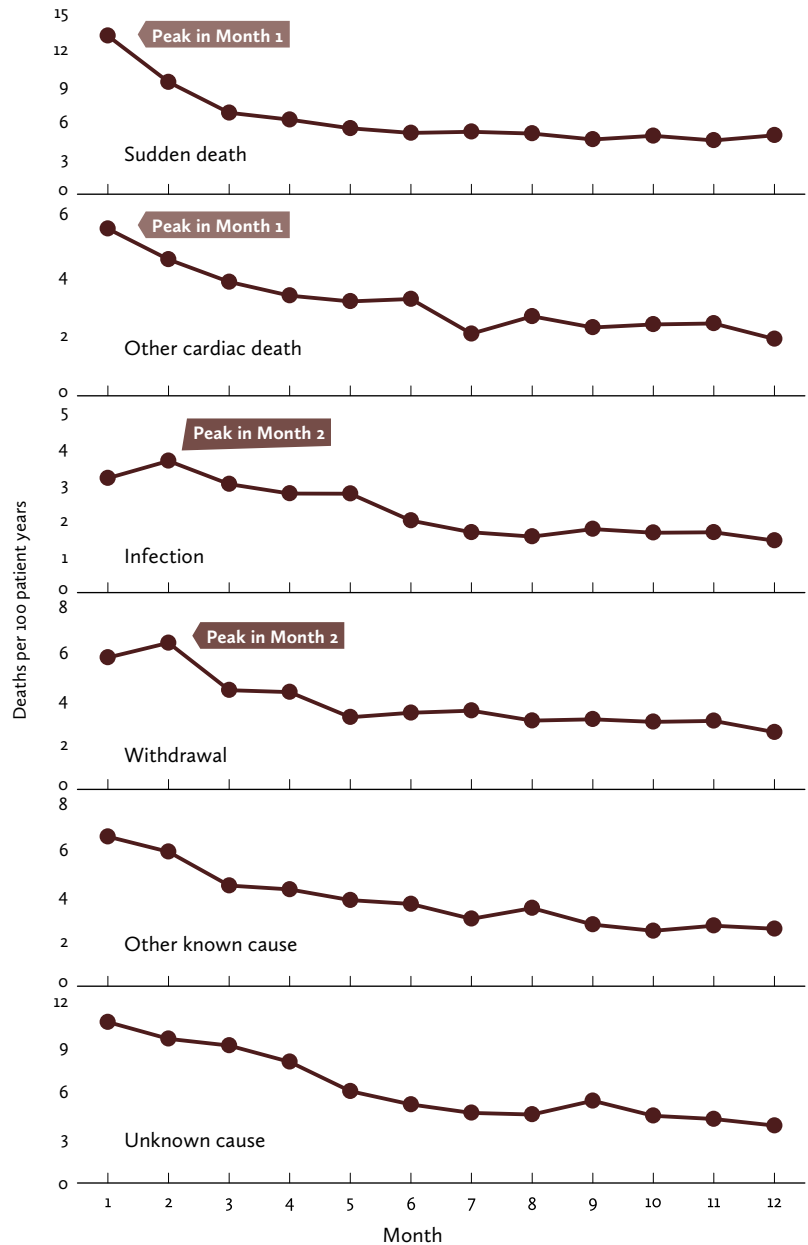
MORTALITY

Cause-specific mortality in incident dialysis patients

After first dialysis session in a freestanding facility. According to the Death Notification Form; 2011.

Rates of sudden death are highest in the first three months after the initiation of dialysis, suggesting a need for greater attention to factors which may engender this risk. Recent discussions have focused on concentrations of bicarbonate, calcium, magnesium, and potassium in the dialysate; each can prolong the QT interval in the cardiac cycle, predisposing patients to arrhythmias. Many medications received by dialysis patients also have the potential to prolong the QT interval, including some antibiotics, proton pump inhibitors, and psychotropic medications. ♦ In contrast to cardiovascular-related mortality, rates of death due to infection and subsequent to withdrawal both peak during the second month. In the former case, the latency may be attributable to infections in patients using venous catheters for vascular access at dialysis initiation. In the latter, the data raise important concerns about whether patients, especially the very elderly, are adequately prepared, both physically and mentally, for dialysis, and whether sufficient social support exists for patients who struggle with adapting to chronic dialysis.

Cause-specific mortality in incident dialysis patients



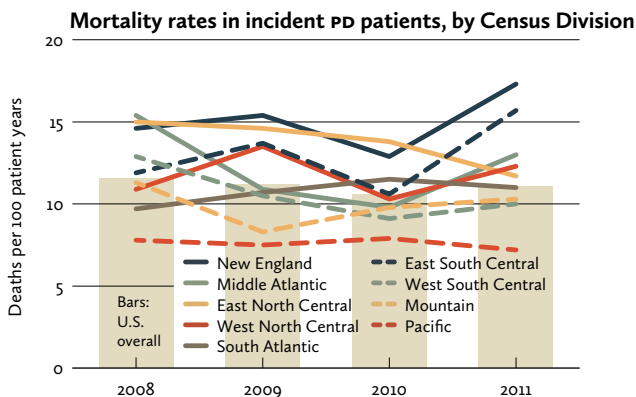
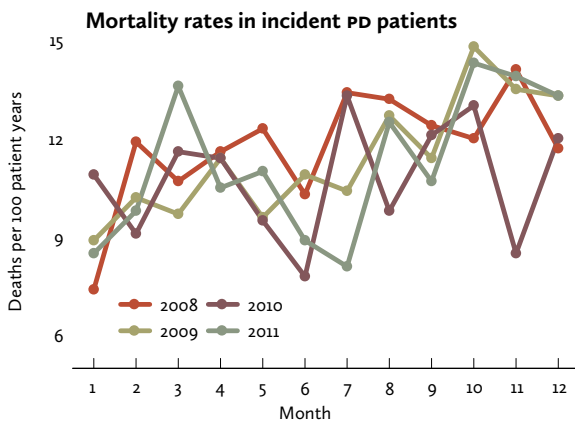
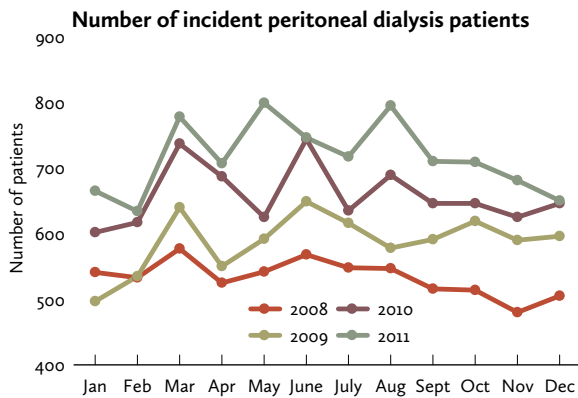
CODES FROM THE DEATH NOTIFICATION FORM (2746) + SUDDEN CARDIAC DEATH 28, 29 (without withdrawal as secondary cause of death). Other cardiovascular death 23, 25, 26, 27, 30, 31, 32, 36, 37 (without withdrawal as secondary cause of death). Infection 33, 34, 45, 46, 47, 48, 51, 52, 61, 62, 63, 70 (without withdrawal as secondary cause of death). Withdrawal 104 (as either primary or secondary cause of death).

Peritoneal dialysis in incident dialysis patients

On peritoneal dialysis within three months of dialysis initiation

Growth in the number of incident patients treated with peritoneal dialysis actually pre-dates the implementation of the ESRD Prospective Payment System in 2011, which created incentives for home dialysis, particularly among incident dialysis patients. ♦ Mortality rates during the first year after initiation of peritoneal dialysis exhibit considerable volatility throughout the year, although they tend to increase, possibly as a result of complications associated with the modality, including peritonitis. ♦ Regional variation in mortality rates among incident peritoneal dialysis patients is clear, with rates highest in the New England states and lowest in the Pacific division. Interestingly, in a number of Census Divisions, rates increased between 2010 and 2011, possibly an indication of nephrologists and dialysis providers struggling to manage larger numbers of peritoneal dialysis patients for the first time. In future reports, the health of the peritoneal dialysis population, along with that of its home-based counterpart, the home hemodialysis population, will be explored in detail.

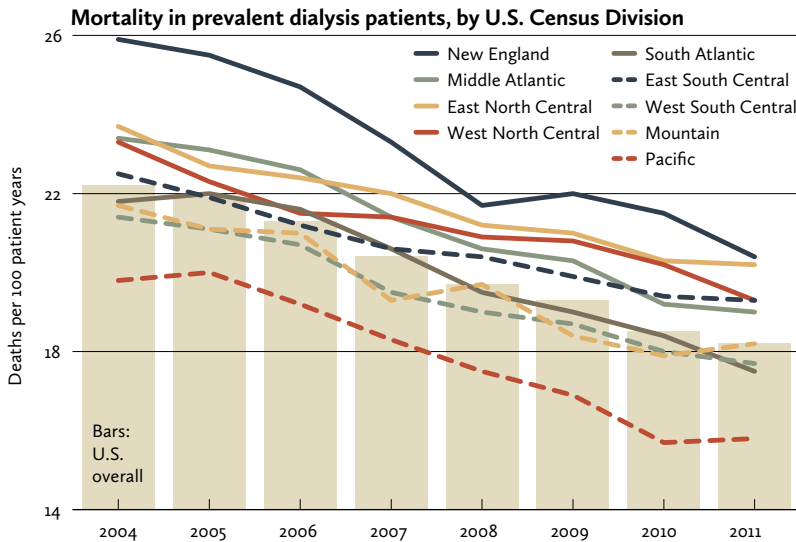
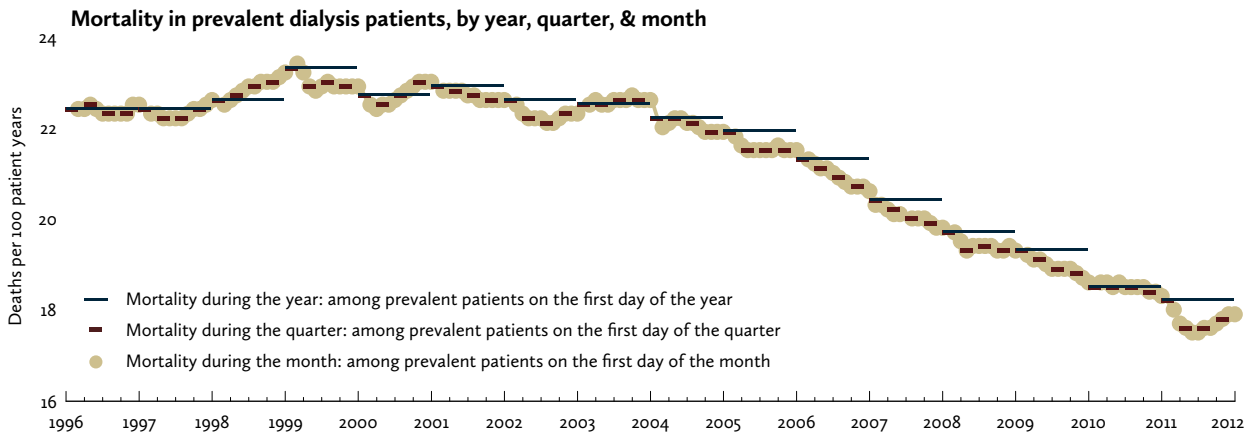
In the New England Census Division, the mortality rate among 2011 incident peritoneal dialysis patients was **17.3** deaths per patient year, compared to **11.1** in the U.S. as whole



MORTALITY

Mortality in prevalent dialysis patients, by U.S. Census Division

Relative to the 2003 cohort of prevalent patients in freestanding dialysis facilities, there have been continued declines in the mortality rate of successive patient cohorts. Among dialysis patients alive on January 1, 2011, the first-year mortality rate was 18.2 deaths per 100 patient years, down 19 percent from a rate of 22.5 among patients alive on January 1, 2003. ♦ In contrast to trends in first-year mortality, there are no exceptions to the national trend among Census Divisions. Mortality rates, however, have been consistently highest in the New England states and lowest in the Pacific division.



Unadjusted mortality rates for prevalent dialysis patients have fallen

19%
since 1996

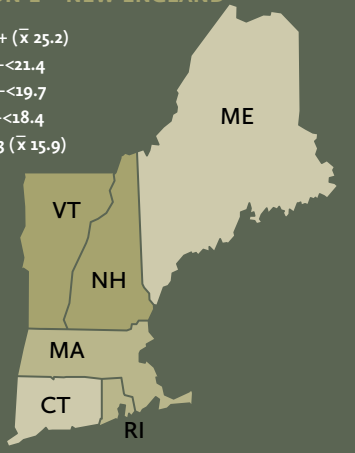
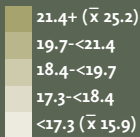
Across Census Divisions, mortality in the prevalent dialysis population has fallen

14-20%
since 2004

Mortality in prevalent dialysis patients, by U.S. Census Division

Deaths per 100 patient years among patients alive on January 1 of each year; APC, Annual Percent Change.
Maps show 2011 rates.

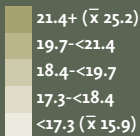
DIVISION 1 • NEW ENGLAND



	2004	2005	2006	2007	2008	2009	2010	2011	APC
All	25.9	25.5	24.7	23.3	21.7	22.0	21.5	20.4	-3.4
Connecticut	24.2	22.2	20.7	21.8	18.8	20.0	19.0	19.0	-3.2
Maine	23.2	28.5	27.2	22.0	21.2	23.3	25.4	18.4	-3.2
Mass.	26.4	26.1	25.5	23.4	23.2	21.8	22.0	20.6	-3.6
New Hamp.	33.8	27.1	29.7	26.9	26.2	24.2	23.8	26.2	-3.6
Rhode Island	25.6	30.5	28.9	27.4	21.2	27.8	24.6	20.1	-3.7
Vermont	24.5	27.2	0.0	0.0	.	0.0	5.5	37.7	.

- While mortality rates in New England fell by 3.4 percent per year between 2004 and 2011, the rate in 2011 of 20.4 deaths per 100 patient years was the highest among all U.S. Census Divisions.
- Rates fell by more than 3 percent per year between 2004 and 2011 in all states within the division, excluding Vermont.

DIVISION 2 • MIDDLE ATLANTIC



	2004	2005	2006	2007	2008	2009	2010	2011	APC
All	23.4	23.1	22.6	21.4	20.6	20.3	19.2	19.0	-3.2
New Jersey	23.6	23.3	23.7	21.0	21.4	20.9	19.1	19.7	-3.1
New York	21.2	20.9	19.7	19.6	18.7	18.8	16.9	17.2	-3.2
Pennsylvania	25.8	25.7	25.4	23.7	22.5	21.8	22.0	20.8	-3.3

- Mortality rates in the Middle Atlantic states fell by 3.2 percent per year between 2004 and 2011.
- Rates fell commensurately in New Jersey, New York, and Pennsylvania.
- In both New Jersey and New York, however, rates increased between 2010 and 2011.

DIVISION 3 • EAST NORTH CENTRAL



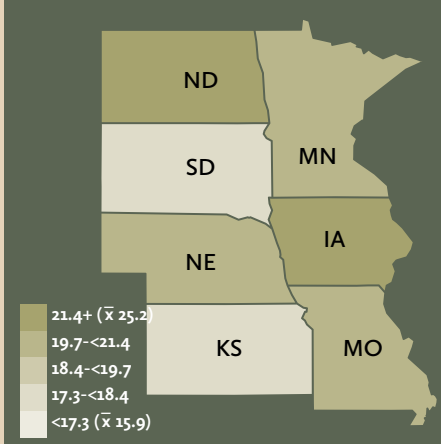
	2004	2005	2006	2007	2008	2009	2010	2011	APC
All	23.7	22.7	22.4	22.0	21.2	21.0	20.3	20.2	-2.2
Illinois	23.0	22.2	21.9	21.0	19.4	20.3	18.9	18.6	-3.0
Indiana	25.0	23.2	23.4	23.6	22.2	21.6	21.7	22.3	-1.7
Michigan	21.5	21.1	21.1	21.2	20.8	20.5	19.2	19.5	-1.5
Ohio	25.4	24.3	23.5	22.5	22.7	21.9	21.6	21.4	-2.3
Wisconsin	24.7	22.8	23.3	23.2	21.9	20.5	22.3	20.5	-2.2

- Between 2004 and 2011, mortality rates in the East North Central division fell by 2.2 percent per year, the lowest rate of decline among all U.S. Census Divisions.
- In Michigan, rates fell only 1.5 percent per year.
- In Indiana, rates increased between 2009 and 2011.
- In Illinois, in contrast, rates decreased by 3.0 percent per year between 2004 and 2011.

MORTALITY

Mortality in prevalent dialysis patients, by U.S. Census Division (continued)

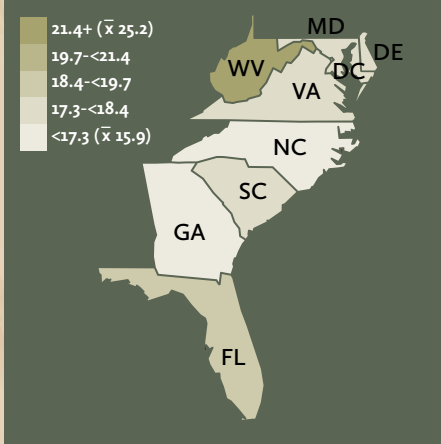
DIVISION 4 • WEST NORTH CENTRAL



	2004	2005	2006	2007	2008	2009	2010	2011	APC
All	24.7	23.2	22.9	22.4	22.3	21.7	21.3	20.3	-2.3
Iowa	26.8	27.7	25.8	24.9	25.7	24.3	25.6	22.4	-2.1
Kansas	24.9	23.4	22.2	21.2	24.5	19.3	21.7	17.9	-3.5
Minnesota	23.2	21.7	22.7	22.4	20.9	20.4	20.1	20.5	-1.9
Missouri	24.4	22.6	23.1	22.2	21.4	22.9	20.4	20.3	-2.2
Nebraska	27.3	23.2	21.2	24.1	21.7	21.0	22.7	21.3	-2.3
North Dakota	38.2	38.2	30.9	30.1	34.8	25.4	19.4	29.9	-6.4
South Dakota	19.5	26.8	18.9	15.3	22.4	16.1	20.8	17.5	-2.5

- Between 2004 and 2011, mortality rates in the West North Central division fell by 2.3 percent per year. Except for the less populous Dakotas, leading the division was Kansas, where rates fell by 3.5 percent per year.
- Lagging was Minnesota, where rates fell by 1.9 percent per year between 2004 and 2011.

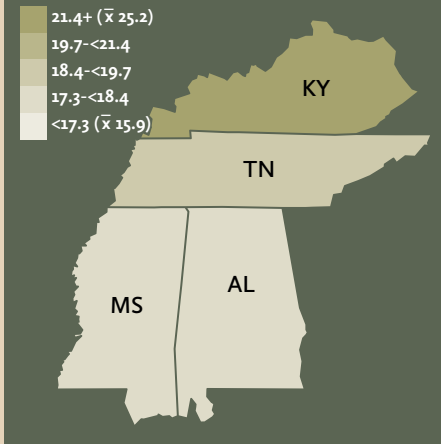
DIVISION 5 • SOUTH ATLANTIC



	2004	2005	2006	2007	2008	2009	2010	2011	APC
South Atlantic	21.7	21.9	21.3	20.5	19.3	19.0	18.4	17.5	-3.3
Delaware	21.4	20.4	21.5	21.1	17.2	18.3	15.7	18.0	-3.7
D.C.	17.3	19.3	17.6	14.4	14.8	13.2	12.9	12.9	-5.7
Florida	23.9	24.9	24.0	22.9	21.5	20.6	20.6	19.4	-3.4
Georgia	19.1	19.7	19.3	17.6	17.0	16.4	16.6	15.5	-3.3
Maryland	22.6	23.4	21.7	22.2	20.8	19.9	18.0	17.3	-4.1
N Carolina	20.3	19.2	19.4	18.9	18.1	18.0	17.2	16.4	-2.7
S Carolina	20.4	20.6	18.9	19.4	18.3	19.2	18.2	17.3	-2.1
Virginia	22.2	21.4	22.5	21.0	19.7	19.8	18.2	18.1	-3.1
West Virginia	30.3	27.6	27.2	27.6	25.8	27.8	26.7	25.0	-1.8

- Mortality rates fell 3.3 percent per year in the South Atlantic division, with relatively more rapid rates of decline in the District of Columbia, Maryland, and Delaware.

DIVISION 6 • EAST SOUTH CENTRAL



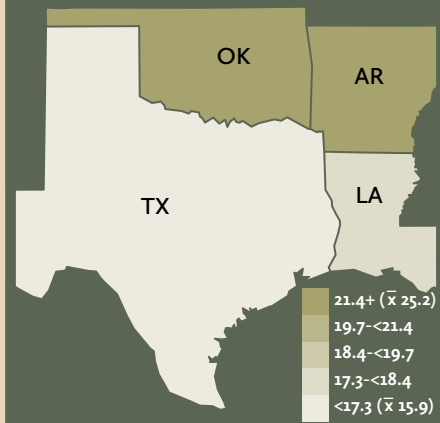
	2004	2005	2006	2007	2008	2009	2010	2011	APC
All	22.5	21.9	21.2	20.6	20.4	19.9	19.4	19.3	-2.2
Alabama	23.1	22.0	22.2	20.4	19.9	19.8	19.3	18.2	-3.2
Kentucky	25.7	22.6	23.5	23.2	22.9	22.9	24.2	23.9	-0.3
Mississippi	18.9	19.5	18.0	18.5	19.3	18.4	18.2	17.8	-0.8
Tennessee	23.1	23.4	21.3	20.8	20.4	19.3	17.9	18.8	-3.6

- Mortality rates decreased by 2.2 percent per year in the East South Central division.
- Leading the division was Tennessee, where rates fell 3.6 percent per year between 2004 and 2011.
- In Kentucky, rates have tended to increase since 2005, following a sharp decline between 2004 and 2005.

Mortality in prevalent dialysis patients, by U.S. Census Division (continued)

Deaths per 100 patient-years among patients alive on January 1 of each year; APC, Annual Percent Change.
Maps show 2011 rates.

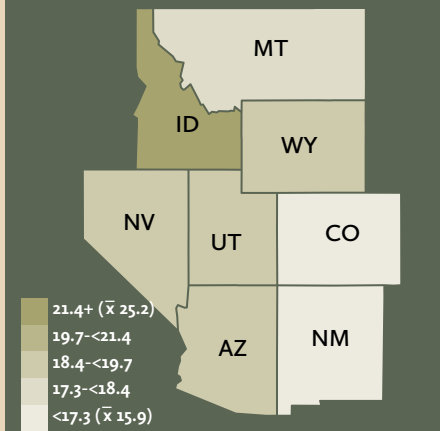
DIVISION 7 • WEST SOUTH CENTRAL



	2004	2005	2006	2007	2008	2009	2010	2011	APC
All	21.4	21.1	20.7	19.5	19.0	18.7	18.0	17.7	-2.9
Arkansas	26.6	25.4	24.1	24.0	22.9	22.7	20.8	22.1	-3.0
Louisiana	23.8	23.5	24.2	21.2	20.7	19.3	19.6	17.9	-4.2
Oklahoma	24.3	24.6	23.7	24.1	23.1	23.3	21.0	21.5	-2.1
Texas	19.9	19.7	19.2	18.2	17.8	17.7	17.0	16.8	-2.6

- Between 2004 and 2011, mortality rates in the West South Central division decreased by 2.9 percent per year.
- Leading the area was Louisiana, where rates fell 4.2 percent per year, one of the five most rapid rates of decline in the nation.
- In the most populous state, Texas, rates fell by 2.6 percent per year.
- Even in Oklahoma, where mortality rates have decreased more slowly, there was a sharp decline between 2009 and 2011.

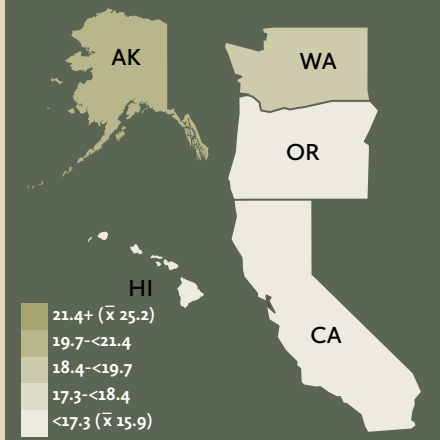
DIVISION 8 • MOUNTAIN



	2004	2005	2006	2007	2008	2009	2010	2011	APC
All	21.7	21.1	21.0	19.3	19.7	18.4	17.9	18.2	-2.9
Arizona	22.6	21.8	22.4	19.5	20.9	18.2	18.3	18.5	-3.3
Colorado	18.4	19.7	19.2	16.4	17.4	16.8	15.6	16.9	-2.5
Idaho	23.5	24.0	24.8	22.2	22.6	22.9	22.7	24.7	-0.2
Montana	19.5	18.1	19.0	23.1	24.4	20.4	17.9	18.1	-0.4
Nevada	25.1	23.2	21.7	21.8	21.1	18.5	17.6	18.5	-4.7
New Mexico	18.5	18.1	17.5	17.4	16.1	18.5	16.3	15.9	-1.8
Utah	24.5	20.6	21.4	22.3	20.7	19.5	23.3	19.5	-1.6
Wyoming	24.9	22.1	19.3	23.0	15.8	27.5	18.5	19.0	-2.5

- In the Mountain division, mortality rates fell by 2.9 percent per year between 2004 and 2011.
- While rates fell in every state in the division, the most rapid decline occurred in Nevada, at 4.7 percent per year. Rates changed relatively little in both Idaho and Montana.

DIVISION 9 • PACIFIC



	2004	2005	2006	2007	2008	2009	2010	2011	APC
All	19.8	20.0	19.2	18.3	17.5	16.9	15.7	15.8	-3.8
Alaska	16.4	25.6	21.8	19.8	20.5	19.2	16.0	19.7	-1.7
California	19.6	19.7	18.8	18.1	17.2	16.4	15.2	15.5	-4.0
Hawaii	18.7	15.0	17.5	15.0	16.4	15.9	16.1	14.8	-1.7
Oregon	22.2	25.2	23.1	22.6	21.6	20.0	18.4	16.6	-4.7
Washington	21.6	21.0	21.7	20.3	19.0	20.1	18.9	18.7	-2.2

- In the Pacific division, mortality rates fell by 3.8 percent per year, the most rapid rate of decline among all U.S. Census Divisions.
- In 2011, the rate of 15.8 deaths per 100 patient years was the lowest among all divisions.
- Leading the division was Oregon, where rates fell 4.7 percent per year.
- In the most populous state, California, rates fell 4.0 percent per year between 2004 and 2011.

MORTALITY

Counts of prevalent patients & patient deaths

The linear growth of the prevalent dialysis patient population is clear, but death counts began to turn away from linear trend deviated from the linear trend during the early 2000's, a manifestation of improving survival. The deceleration in the growth of death counts between 2000 and 2005 may reflect the growing use of arteriovenous fistulas, instead of venous catheters, as well as the growing use of cardiovascular medications with efficacy that had been established in the general population, including beta blockers, renin-angiotensin system inhibitors, and statins.

The number of prevalent dialysis patients reached

351,294

in 2011, up from

145,124
in 1996

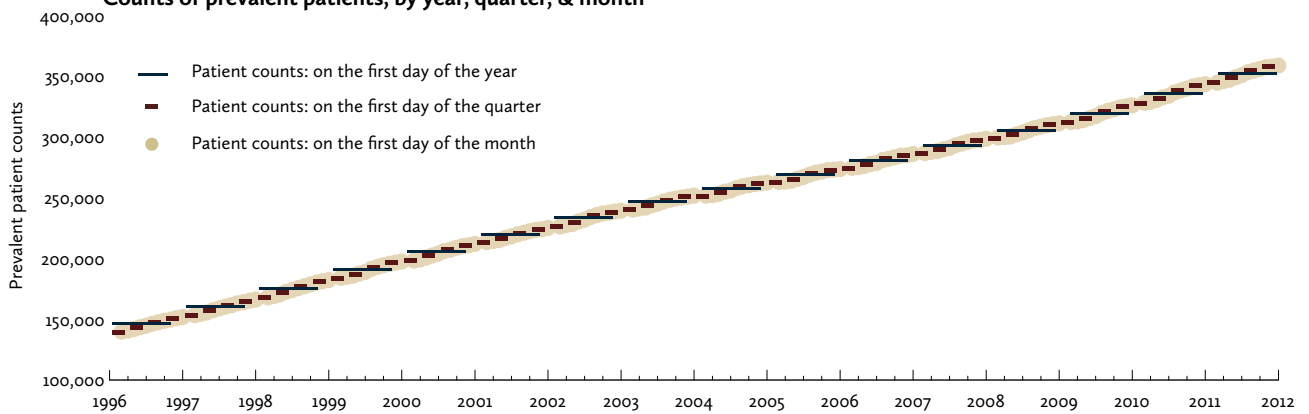
The average number of prevalent dialysis patient deaths per month reached

5,246

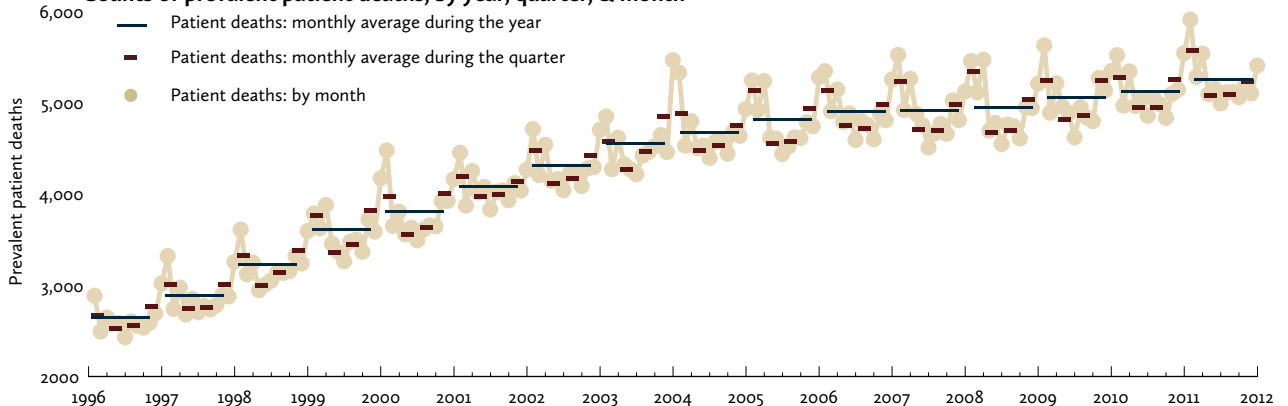
in 2011,
up from

2,633
in 1996

Counts of prevalent patients, by year, quarter, & month



Counts of prevalent patient deaths, by year, quarter, & month



Unadjusted mortality (deaths per 100 patient years) in prevalent dialysis patients

Between 2004 and 2011, mortality rates fell within all subgroups of prevalent dialysis patients—including strata defined by age, race, sex, vintage, diabetic status, and dialytic modality—demonstrating that progress was widespread and not unique to specific populations with putatively more modifiable risk. These data are an important demonstration, too, that risk can be reduced in all patient subgroups with continuous quality improvement efforts.

	2004	2005	2006	2007	2008	2009	2010	2011	APC	
Age										
18-44	8.4	8.3	8.0	7.6	7.2	7.1	6.6	6.3	-4.2	
45-64	16.8	16.2	16.1	15.2	14.6	14.2	13.6	13.3	-3.4	
65-79	29.2	28.9	27.7	26.5	25.8	25.2	24.1	23.7	-3.1	
80+	44.7	44.7	43.7	43.0	41.1	40.0	39.0	38.7	-2.4	
Race/ethnicity										
White/Non-Hispanic	28.9	28.7	28.3	27.3	26.6	25.9	25.4	25.2	-2.2	
White/Hispanic	18.1	17.8	16.8	15.7	14.9	15.0	14.2	14.0	-3.9	
Black/Af Am	17.8	17.5	17.1	16.2	15.6	15.2	14.4	14.0	-3.6	
Asian	16.3	16.4	15.7	15.7	14.8	15.0	14.3	14.0	-2.3	
Other/unknown	17.6	17.1	16.9	15.5	16.2	16.7	14.4	14.5	-2.6	
Sex										
Female	22.6	22.3	21.8	20.7	20.0	19.3	18.8	18.3	-3.2	
Male	21.8	21.5	21.0	20.2	19.5	19.2	18.4	18.1	-2.8	
Vintage										
< 1 yr	22.0	22.1	21.7	20.4	20.1	19.6	18.3	18.3	-3.0	
1-<3 yrs	21.8	21.6	21.0	20.0	19.0	18.6	17.9	17.6	-3.3	
3+ yrs	22.6	22.0	21.4	20.8	20.1	19.6	19.0	18.5	-2.9	
Diabetic status										
Non-diabetic	19.7	19.5	19.0	18.4	17.7	17.2	16.6	16.3	-2.9	
Diabetic	25.7	25.1	24.5	23.1	22.4	21.9	21.0	20.6	-3.3	
Modality										
Peritoneal dialysis	19.8	18.9	18.6	17.2	17.2	16.5	15.2	15.2	-3.9	
Hemodialysis	22.4	22.1	21.6	20.7	19.9	19.5	18.8	18.4	-3.0	

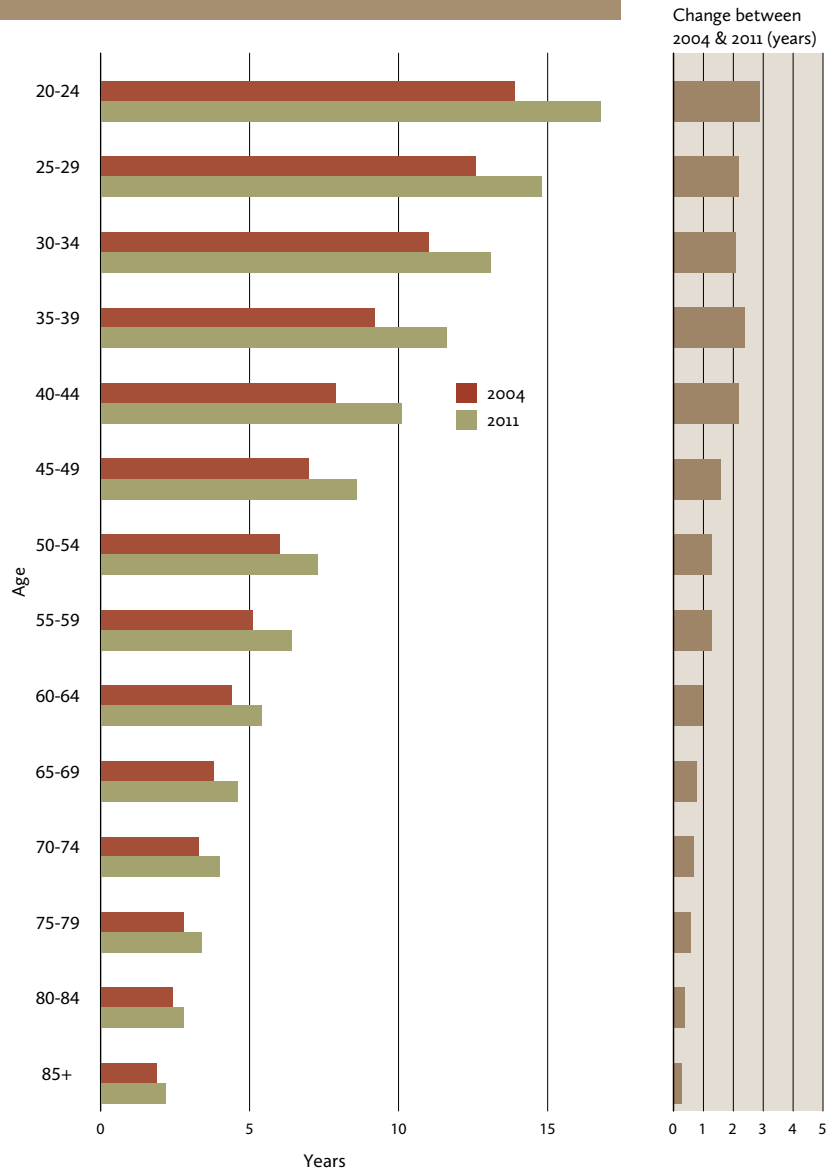
MORTALITY

Expected remaining lifetimes in prevalent dialysis patients

Between 2004 and 2011, expected remaining lifetimes in the prevalent dialysis population increased by more than two years among patients between age 20–44 years; by 1–2 years among patients age 45–64; and by 6–12 months among patients age 65–79. In the cohort of prevalent dialysis patients alive on January 1, 2011, expected remaining lifetimes exceeded two years even among octogenarians and nonagenarians.

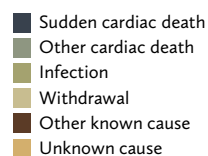
Among prevalent patients age 20–24, expected remaining lifetimes increased

2.9 years
between
2004 & 2011

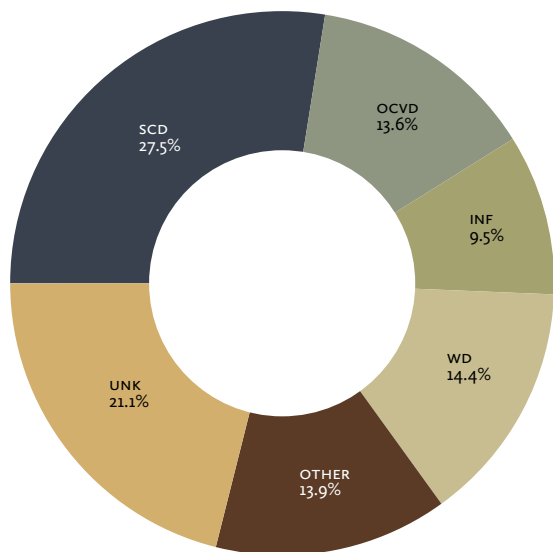


Cause of death in prevalent dialysis patients

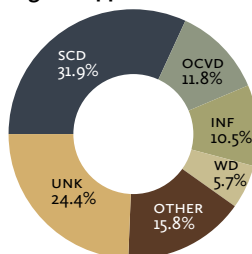
During 2011, sudden cardiac death (SCD) accounted for almost 28 percent of all deaths in the prevalent dialysis population, while cardiovascular death accounted for more than 41 percent, and withdrawal for more than 14 percent. Across age strata, however, distributions of causes of death varied, from a high share of SCD of almost 32 percent in patients age 18–44 to a low share of SCD of less than 23 percent in those age 80 or older. Varying more markedly were shares of death subsequent to withdrawal, which accounted for fewer than 6 percent of deaths among the youngest patients, but more than 22 percent among the oldest.



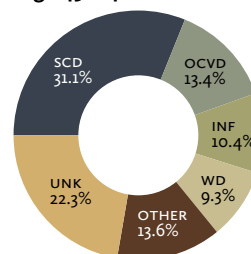
Overall



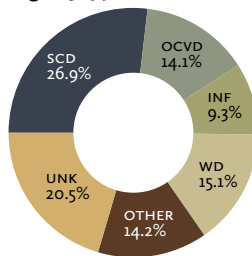
Age 18–44



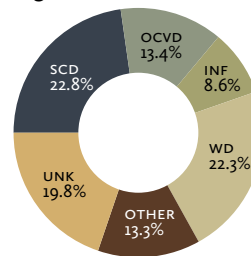
Age 45–64



Age 65–79



Age 80+

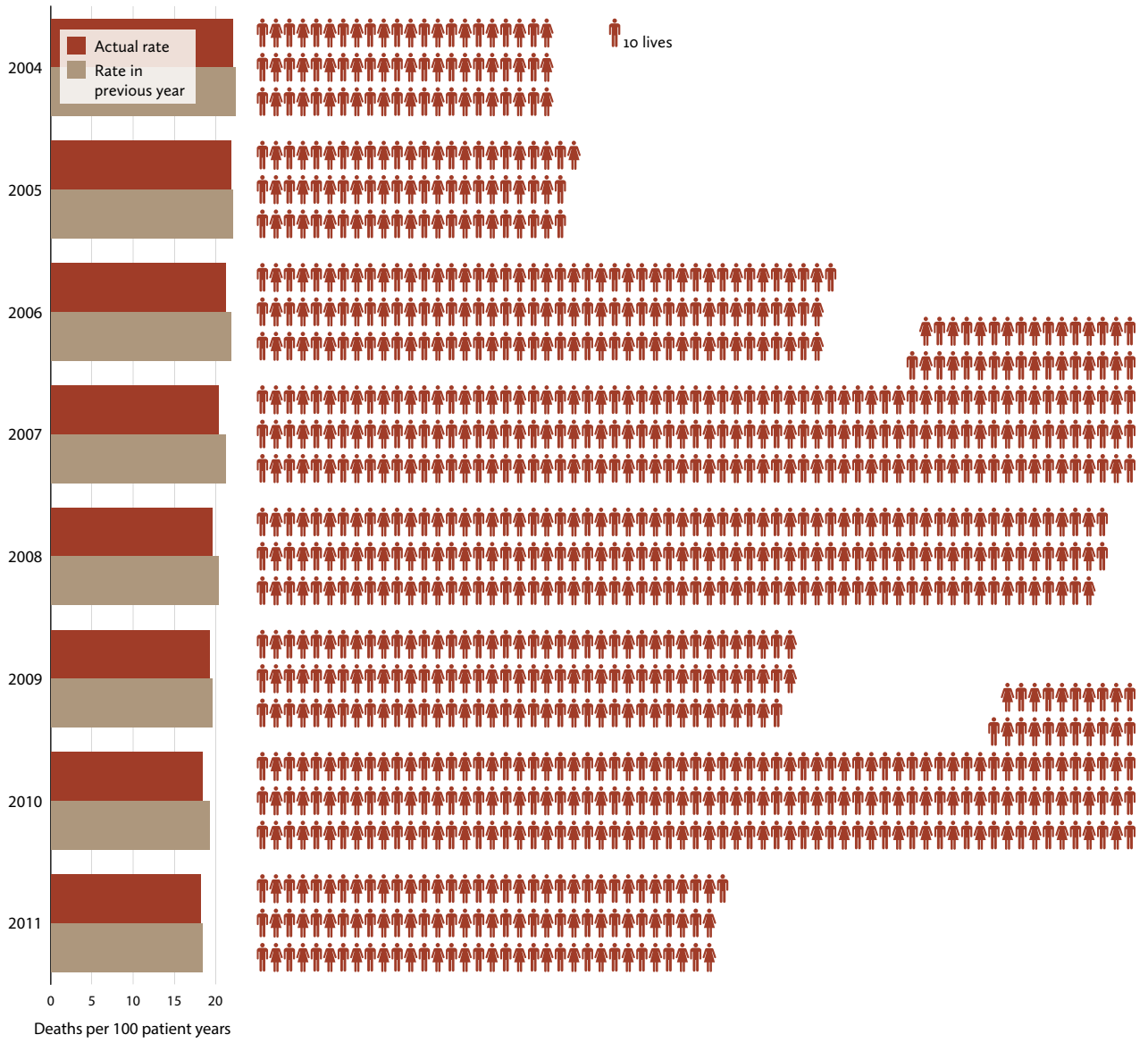


MORTALITY

Deaths prevented, as attributed to changes in prevalent dialysis mortality rates

	2004	2005	2006	2007	2008	2009	2010	2011
Number of patients	251,071	262,426	273,480	285,780	298,209	311,201	326,238	343,560
Number of deaths	48,336	49,892	50,732	51,078	51,649	52,821	53,497	55,309
Patient-years	217,851	228,015	237,641	249,933	261,939	273,908	288,625	303,956
N of deaths prevented, using prior year's rate	661	699	1,266	2,278	1,883	1,188	2,162	1,030
N of deaths prevented, using 2003 rate	661	1,391	2,716	5,135	7,264	8,784	11,418	13,054

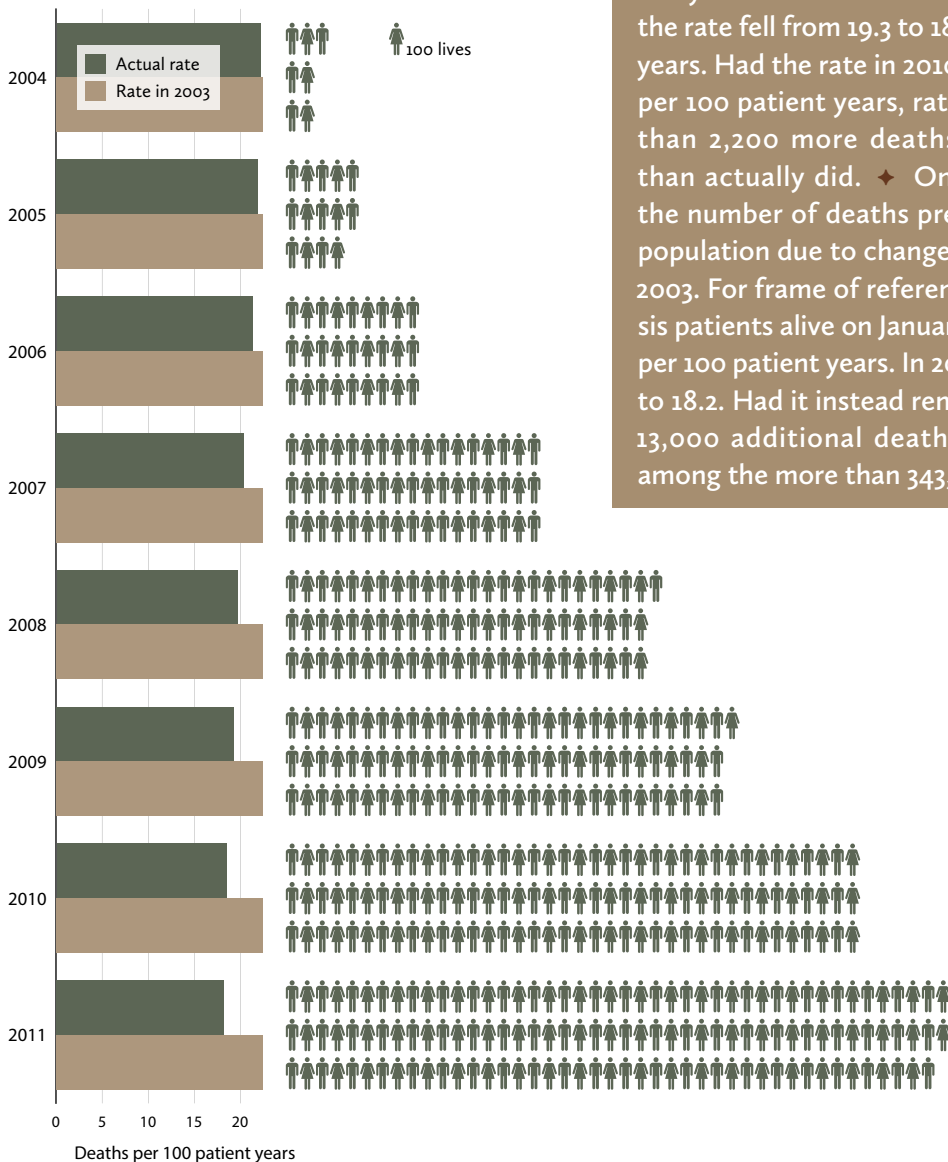
Number of deaths prevented, due to year-over-year changes in the death rate



Deaths prevented, as attributed to changes in prevalent dialysis mortality rates

Mortality rates make for good epidemiologic fodder, but no statistic more clearly demonstrates the human impact of declining mortality rates in the dialysis patient population than counts of deaths prevented. On the facing page we display the number of deaths prevented in the prevalent population due to year-over-year changes in mortality rates. Between 2009 and 2010, for example, the rate fell from 19.3 to 18.5 deaths per 100 patient years. Had the rate in 2010 remained at 19.3 deaths per 100 patient years, rather than declining, more than 2,200 more deaths would have occurred than actually did. ♦ On this page we illustrate the number of deaths prevented in the prevalent population due to changes in mortality rates since 2003. For frame of reference, the rate among dialysis patients alive on January 1, 2003 was 22.5 deaths per 100 patient years. In 2011, the rate had declined to 18.2. Had it instead remained at 22.5, more than 13,000 additional deaths would have occurred among the more than 343,000 prevalent patients.

Number of deaths prevented, due to cumulative changes in the death rate since 2003



MORTALITY

Major findings

1

Mortality rates have declined sharply among dialysis patients in freestanding facilities, evidenced by a 19 percent decrease in rates among prevalent patients between 2003 and 2011. But performance in some regions is lagging. In the East North Central region, for example, first-year mortality rates tended to increase in recent years.

2

Declining mortality rates during the first year of dialysis treatment have translated to measurable gains in expected remaining lifetime. Among incident patients age 20–34, expected remaining lifetimes increased by more than two years between 2004 and 2010. Gains among the elderly and especially the very elderly have been smaller in magnitude, but nonetheless apparent.

3

Cardiovascular death, specifically sudden cardiac death, remains the leading cause of death. During the first year of dialysis, however, rates of sudden cardiac death and other cardiovascular death are both highest during the first month and decrease thereafter, whereas rates of death due to infection and withdrawal both peak during the second month of dialysis.

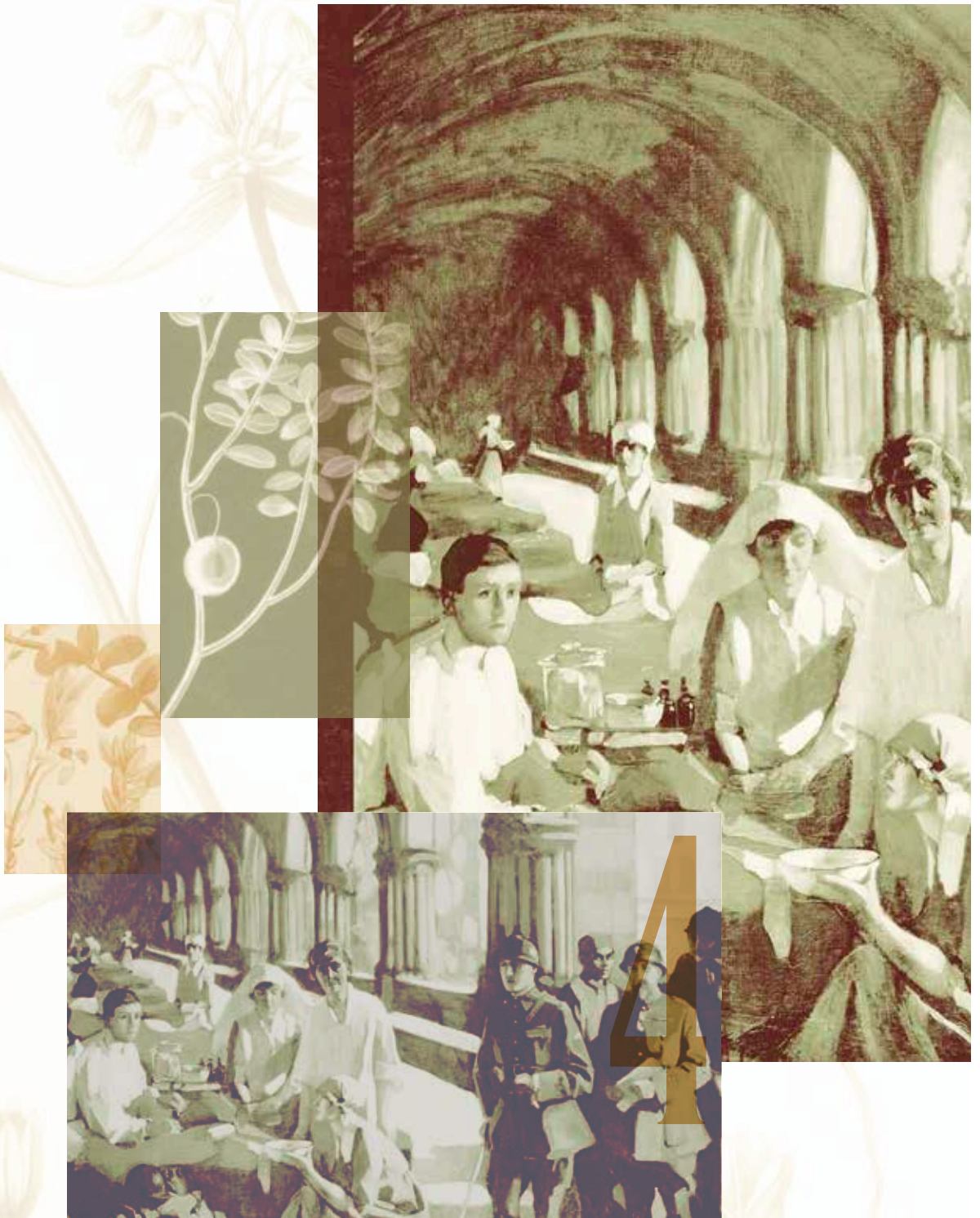
4

In incident patients on peritoneal dialysis, unadjusted mortality rates increased in many regions between 2010 and 2011, at the same time that use of the modality expanded. It is unknown whether this increase in mortality rates reflects a shift in case mix toward more comorbidity at initiation of peritoneal dialysis, or suboptimal training and ongoing care of peritoneal dialysis patients, particularly in programs that have limited experience with peritoneal dialysis.

5

Among prevalent dialysis patients between 2004 and 2011, mortality rates decreased in every subgroup defined by age, race, sex, vintage, diabetic status, and dialytic modality. Compared to the rate in 2003, the cumulative decline in rates during ensuing years resulted in more than 13,000 deaths prevented among patients receiving dialysis on January 1, 2011.

SMALL PICTURES cranberry; medicinal use: wounds, urinary disorders, diabetes **LARGE PICTURE** garlic; medicinal use: cardiovascular disease therapy, antibiotic



Norah Neilson-Gray, *The Scottish Women's Hospital: In the cloister of the Abbaye at Royaumont. Dr. Frances Ivens inspecting a French patient, 1920*

Assessment of the 5-Star Quality Rating System

ASSESSMENT OF THE Introduction 5-STAR QUALITY RATING SYSTEM

Comparison of rating from CMS methodology vs. rating based exclusively on standardized mortality ratio (SMR) & standardized hospitalization ratio (SHR) 125

Comparison of rating from CMS methodology vs. rating with 50 percent weight ascribed to standardized mortality ratio (SMR) & standardized hospitalization ratio (SHR) 127

Comparison of rating from CMS methodology vs. rating based exclusively on kt/v & hypercalcemia metrics 129

Comparison of rating from CMS methodology vs. rating based exclusively on fistula & catheter metrics. 131

Comparison of rating from CMS methodology vs. rating that reflects uncertainty in estimates of standardized outcome ratios . . . 133

Comparison of rating based exclusively on kt/v & hypercalcemia metrics vs. rating based exclusively on fistula & catheter metrics 135

Conclusions 136

The Centers for Medicare and Medicaid Services (CMS) calculates and publicly releases 5-star ratings in a wide variety of domains. Ratings for Medicare Part D plans, for instance, were released in 2006, with ratings for Medicare Part C (“Advantage”) plans and for nursing homes following in 2007 and 2008, respectively. Early in 2014, CMS introduced 5-star ratings for some physician groups. And by the middle of 2014, CMS announced its intention to soon release 5-star ratings for dialysis facilities, home health agencies, and hospitals on its Compare websites.

The appeal of a 5-star rating system is obvious, given the ubiquity of rating systems on consumer websites, but the devil is almost always in the details: algorithms to translate a variety of clinical, process, and patient-reported outcomes into a single score are invariably complex and very often sensitive to both data quality and statistical assumptions. Fundamentally, the question is simple: does a 5-star rating for a healthcare provider have meaning? Analyses in this section suggest that, in the case of dialysis facilities, the answer is far from simple, as it appears that a single rating per facility betrays the complexity of the underlying quality of care.

In the CMS methodology, the rating for each dialysis facility is based initially on three domains: standardized outcome measures, process outcomes, and vascular access, as shown on the next page. The first domain comprises three metrics: the standardized mortality ratio (SMR), the standardized hospitalization ratio (SHR), and the standardized transfusion ratio (STR). Process outcomes include two metrics: the percentage of patients receiving adequate dialysis (as quantified by kt/v) and the percentage with hypercalcemia. And the vascular access domain comprises two metrics: the percentage of patients receiving hemodialysis with an arteriovenous fistula access and the percentage receiving hemodialysis with a venous catheter for more than 90 days. All seven of these metrics are currently reported, albeit in a variety of formats, on the consumer-oriented Dialysis Facility Compare website, in datasets at Data.Medicare.gov, and in the Dialysis Facility Reports.

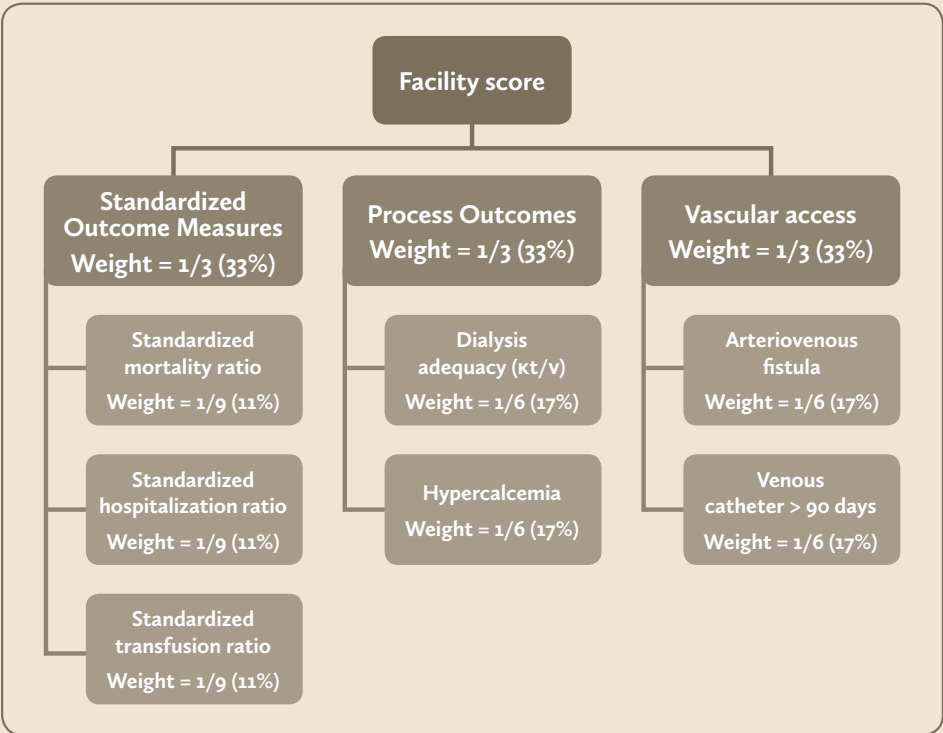
The CMS methodology combines the three domains and the seven constituent metrics in a specific manner. Each domain is weighted equally, i.e., standardized outcome measures, process outcomes, and vascular access are each assigned a weight of one-third (33 percent), as shown in the flowchart.

Within each domain, the constituent metrics are also weighted equally, i.e., for the summary of standardized outcome measures, the SMR, SHR, and STR are assigned sub-weights of one-third (33 percent); for the summary of process outcomes, dialysis adequacy and hypercalcemia are each assigned sub-weights of one-half (50 percent); and for the summary of vascular access, arteriovenous fistula use and long-term venous catheter use are each assigned sub-weights of one-half (50 percent). Simple multiplication of weights and sub-weights demonstrates that each of the seven metrics is assigned a specific weight, as shown.

These weights represent a strong assumption about what constitutes quality. They presume, for example, that rates of death, hospitalization, and red blood cell transfusion in a dialysis facility are equally important. They presume as well that each of the aforementioned rates is less important than the delivery of adequate dialysis, the incidence of hypercalcemia, and the use of each of fistulas and catheters for vascular access. Is this reasonable? The answer is in the eye of the beholder. If the beholder values some or all of the seven metrics in a way different from that of CMS, the 5-star rating that will be released to the public is misleading, if not worthless. Much about the nature of the 5-star rating system for dialysis facilities can be understood through the lens of alternative weights for the seven metrics. We explore this idea in the following pages.

A more detailed concern also surrounds the domain of standardized outcome measures. The SMR, SHR, and STR are each estimated from complex statistical models. Inherent in any such model is random error, typically quantified in

Standardized outcome ratios
Standardized mortality ratio
Standardized hospitalization ratio
Standardized transfusion ration
Process outcomes
Dialysis adequacy (κt/v)
Hypercalcemia
Vascular access
Arteriovenous fistula
Venous catheter > 90 days



ASSESSMENT OF THE

Introduction 5-STAR QUALITY RATING SYSTEM

the form of a 95 percent confidence interval. When sample size is small, as in the case of a dialysis facility patient population, confidence intervals can be quite wide. Thus, although a model may provide a point estimate of a standardized mortality ratio, it also provides a range of values that are plausible, or compatible with the observed data.

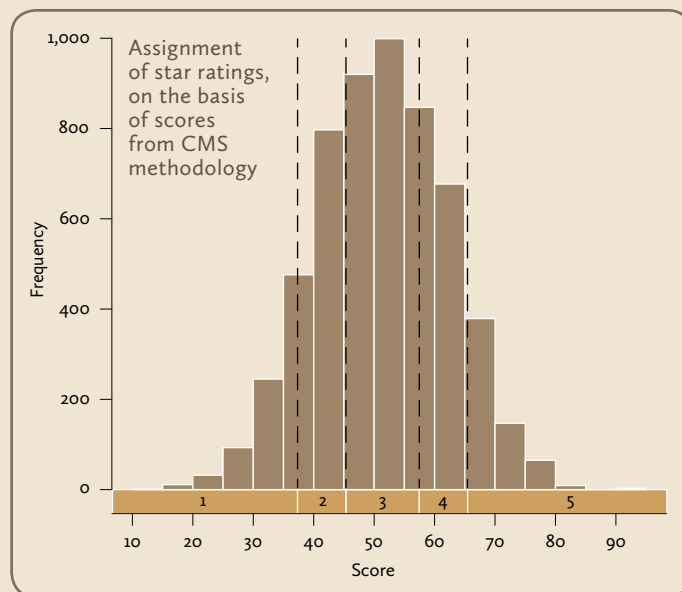
As a concrete example, we can imagine a standardized mortality ratio of 1.10 and an accompanying confidence interval that ranges from 0.90 to 1.25. Is the true SMR actually 1.10? Or is it 1.00? Or 1.20? The frank answer is that we do not know. The 5-star rating system for dialysis facilities, however, simply ignores the uncertainty in estimates of the SMR, SHR, and STRR, and supposes that the estimates themselves are the only values to consider in rating facilities. The practical consequence of this decision is that 5-star ratings will implicitly communicate to consumers a sense of certainty that is artificial. We also explore this idea.

There are other issues to consider as well, although they are not examined in this chapter. First, the process of rescaling each of the seven metrics into scores that can be combined with weights is not trivial. Briefly, with respect to each metric, facilities are initially ranked and ranks are then transformed with a mathematical function that produces scores that are normally distributed and bound between 0 and 100. Whether this makes any sense at all is questionable.

Again, concrete examples are helpful. We can imagine that SMRs of 0.80 and 1.20 are mapped to the 25th and 75th percentiles of the SMR score, and also imagine that hypercalcemia incidence proportions of 6 and 12 percent are likewise mapped to the 25th and 75th percentiles of the hypercalcemia score. Both of these differentials (i.e., SMR of 1.2 versus 0.8 and hypercalcemia incidence of 12 versus 6 percent) are scored identically by the 5-star rating system. Is it also true, however, that 50 percent (i.e., 1.2 divided by 0.8) excess mortality is as clinically important as 6 percent (i.e., 12 percent minus 6 percent) excess incidence of hypercalcemia? Second, after all scores are combined with weights, stars are assigned by ranking scores and categorizing rankings into only five groups. The lowest 10 percent of scores are assigned one star, the next 20 percent are assigned two stars, the middle 40 percent are assigned three stars, the next 20 percent are assigned four

stars, and the highest 10 percent are assigned five stars, as shown in the graph. These percentages are arbitrarily chosen, and deviate from percentages used in the 5-star rating system for nursing homes. Assignment only of whole numbers of stars sacrifices the granularity common on consumer websites, and clearly deviates from the 5-star rating systems for Medicare Parts C and D plans. Third, whether 5-star ratings for dialysis facilities exhibit meaningful correlation between successive years or instead vary randomly between one and five stars is unknown.

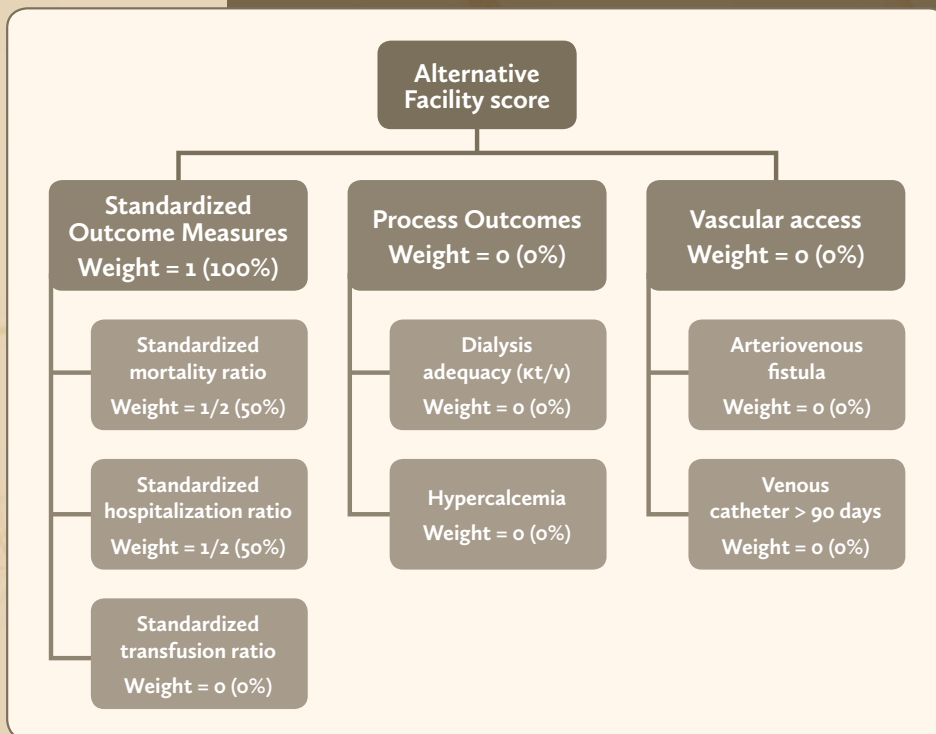
More generally, the methodology of the 5-star rating system begs the question of what the goal is. The system constructs create a parallel universe in which 30 percent of dialysis facilities are surmised to deliver low-quality care and another 30 percent to deliver high-quality care. Most troubling is that, no matter how much the facilities improve patient outcomes, the conception of this universe will persist, as variability in outcomes is inevitable and the methodology of the 5-star rating system transforms even small amounts of variability into ratings that range from one to five stars. Such is the nature of comparative ratings. Whether these ratings actually drive patient decisions or inspire quality improvement is an open question. Evidence that patients use Dialysis Facility Compare is weak. On the other hand, for providers—especially large dialysis organizations—efforts to improve star ratings are an exercise in futility, in the sense that any improvement in the rankings of a cluster of facilities necessarily results in the decline of the rankings of another cluster of facilities. An alternative scheme might instead concentrate on the absolute rates of outcomes and whether those rates are changing as time elapses, regardless of whether those rates are higher or lower than other facilities. In this scheme, assignment of stars might be made on the basis of progress toward a goal, such as a fixed percentage decline in the rate of death or hospitalization. That type of scheme essentially uses facilities as their own controls, thus largely obviating the need for complicated risk adjustment, which might not be satisfactorily accomplished with administrative data in the first place.



ASSESSMENT OF THE 5-STAR QUALITY RATING SYSTEM

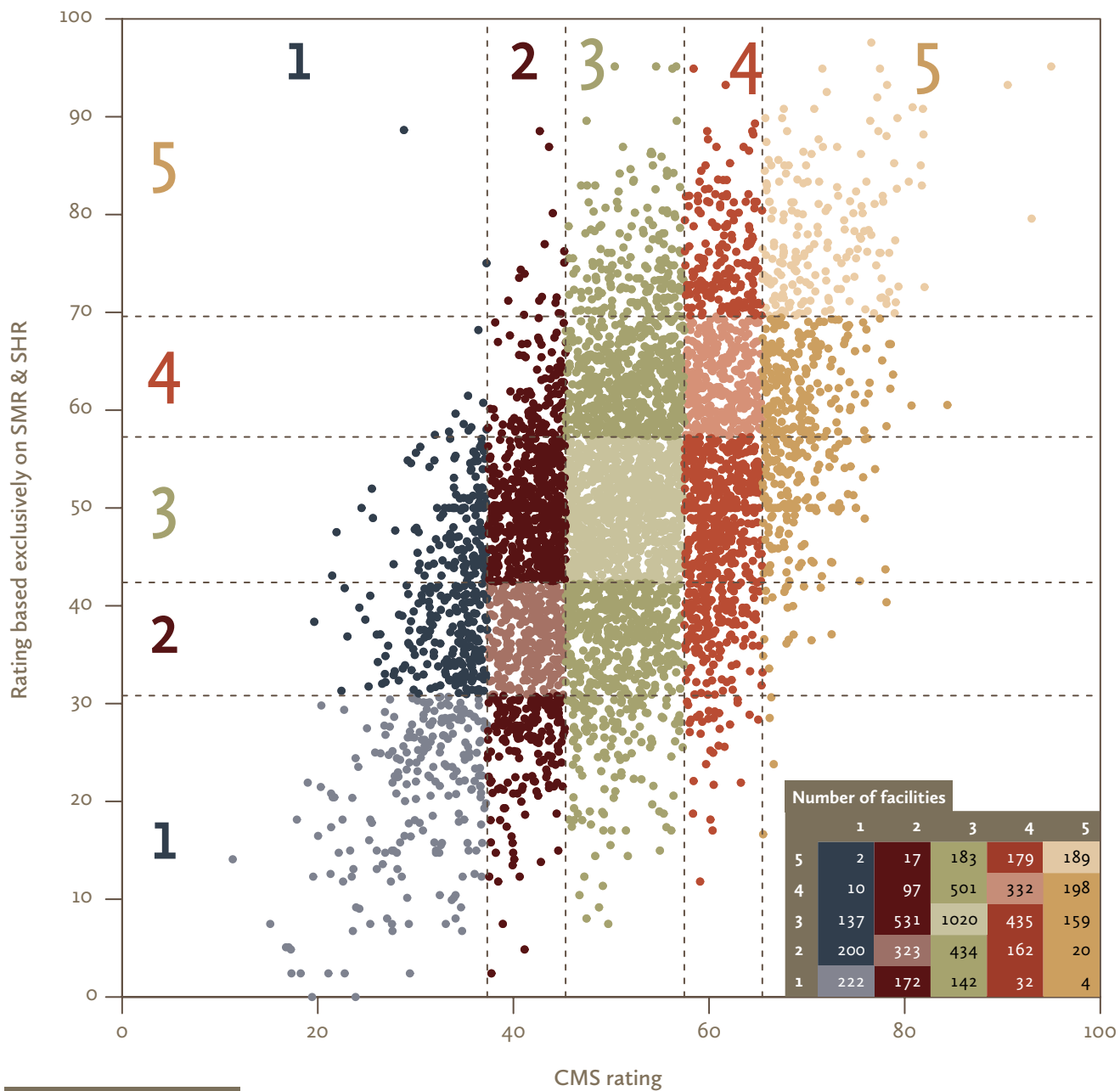
The 5-star rating system for dialysis facilities combines two major clinical outcomes, mortality and hospitalization, with red blood cell transfusion, process outcomes, and vascular access technique. ♦ In theory, process outcomes and vascular access technique are important only because of their presumed effects on major clinical outcomes. ♦ How would 5-star ratings for dialysis facilities appear if the standardized mortality ratio (SMR) and standardized hospitalization ratio (SHR) were the only constituent metrics? ♦ Here, we use public data from the July 2014 release of Dialysis Facility Compare to compile 5-star ratings according to CMS methodology and to an alternative methodology in which the SMR and SHR are each assigned 50 percent weight. ♦ Although there is a crude relationship between the ratings, there are substantial discrepancies, as only 37 percent of facilities are assigned equal numbers of stars by the contrasting approaches. ♦ Across the star categories, the percentages of facilities with equal numbers of stars by the contrasting approaches ranges between 28 and 45 (see table). ♦ Among the 571 facilities assigned only one star by the CMS methodology, 137 (24 percent) are assigned three stars by the alternative rating and 12 (2 percent) are assigned either four or five stars. On the other hand, among the 570 facilities assigned five stars by the CMS methodology, 159 (28 percent) are assigned

three stars by the alternative rating, while 24 (4 percent) are assigned either four or five stars.



Comparison of rating from CMS methodology vs. rating based exclusively on standardized mortality ratio (SMR) & standardized hospitalization ratio (SHR)

SMR & SHR weighted equally



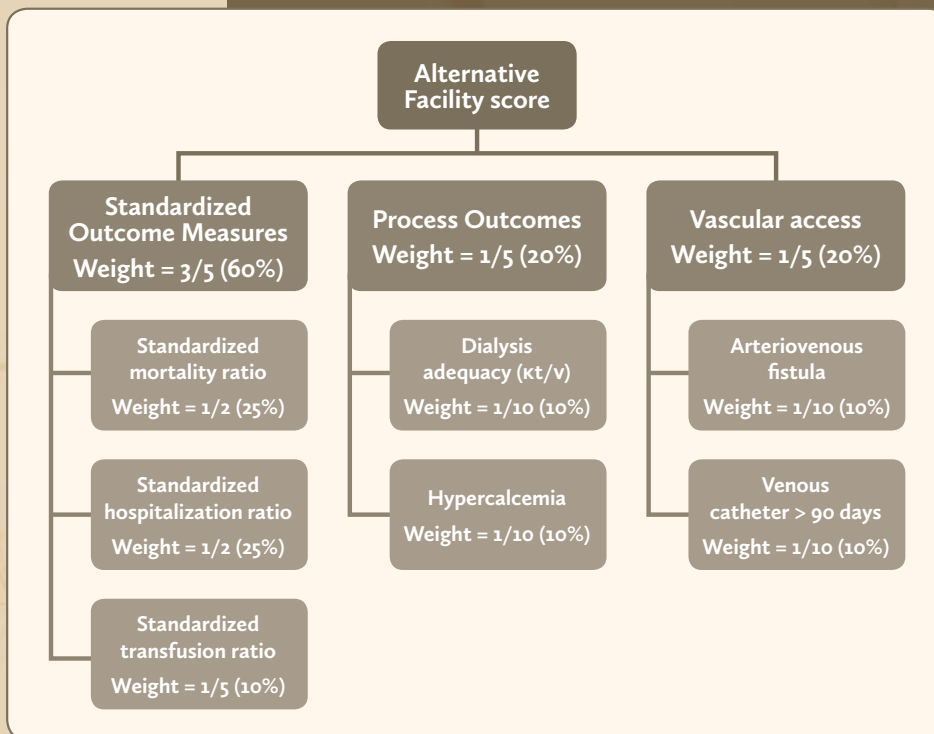
Movement from CMS rating

	1	2	3	4	5
Up	61.1%	56.6%	30.0%	15.7%	0.0%
Same	38.9%	28.3%	44.7%	29.1%	33.2%
Down	0.0%	15.1%	25.3%	55.2%	66.8%

ASSESSMENT OF THE 5-STAR QUALITY RATING SYSTEM

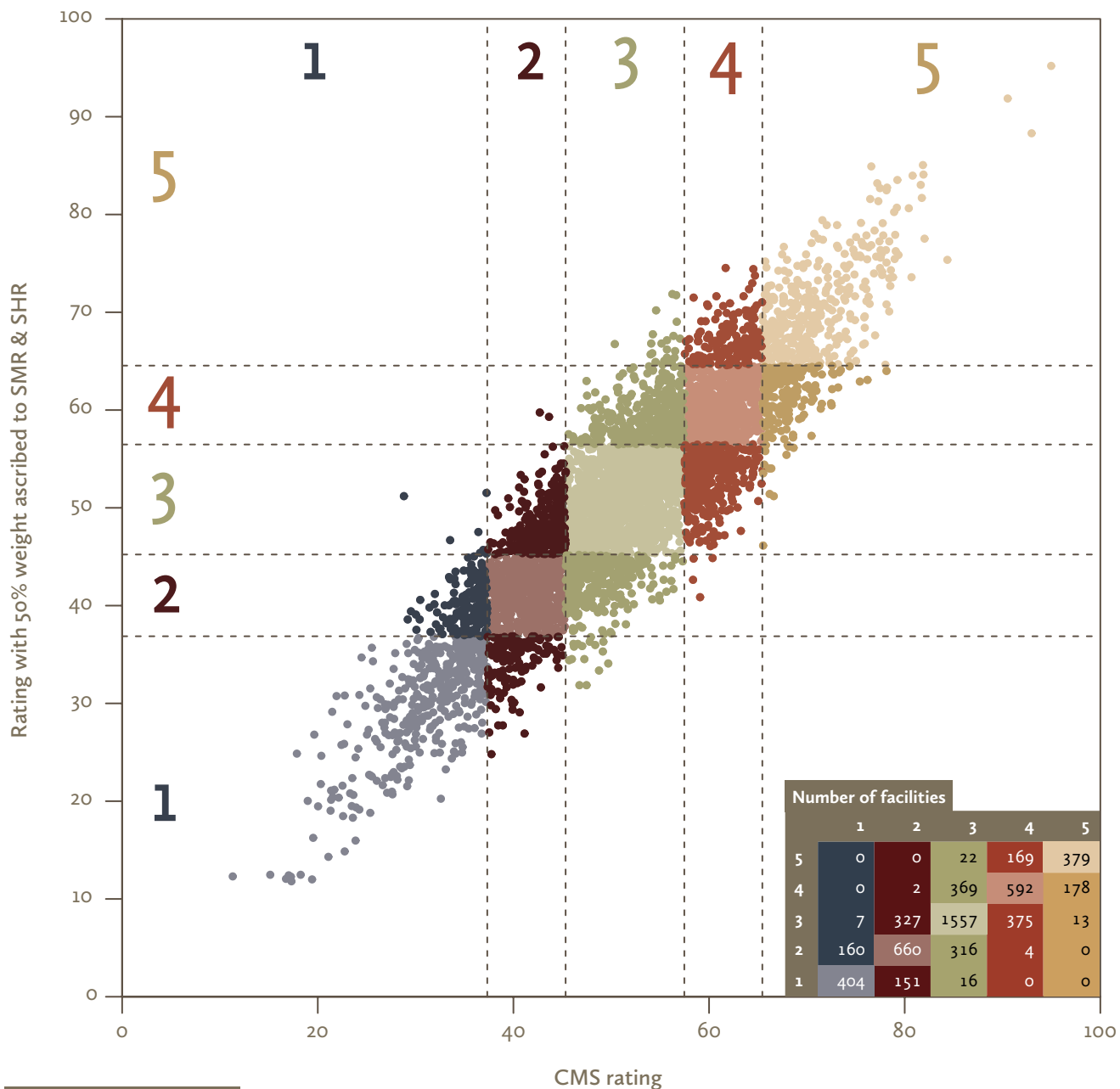
Between the guarded approach of CMS methodology—that is, equal weights for each domain—and the “all-in” approach in which all weights are attributed to major clinical outcomes, there are numerous ways to prioritize major clinical outcomes and, meanwhile, value process outcomes. ♦ Here we examine one such alternative, in which the standardized mortality ratio and standardized hospitalization ratio are each attributed 25 percent weights, while the five other metrics are each attributed 10 percent weights. ♦ The alternative methodology more closely resembles the CMS methodology, so the relationship between the ratings is unsurprisingly stronger, as 63 percent of facilities are assigned equal numbers of stars by the contrasting approaches. ♦ Extreme swings in star ratings are not apparent, as no facilities assigned one star by the CMS methodology are assigned either four or five stars by the alternative rating. Likewise, no facilities assigned five stars by the CMS methodology are assigned either one or two stars by the alternative rating. ♦ Deviations of one star between the contrasting approaches, however, are common. Almost 36 percent of facilities are assigned either one more or one less star by the alternative rating than by the CMS methodology, underscoring the uncertainty in ratings that

can be attributed to the inherently subjective prioritization of weights for domains and constituent metrics.



Comparison of rating from CMS methodology vs. rating with 50 percent weight ascribed to standardized mortality ratio (SMR) & standardized hospitalization ratio (SHR)

In CMS methodology, only 22 percent of weight is ascribed to SMR & SHR

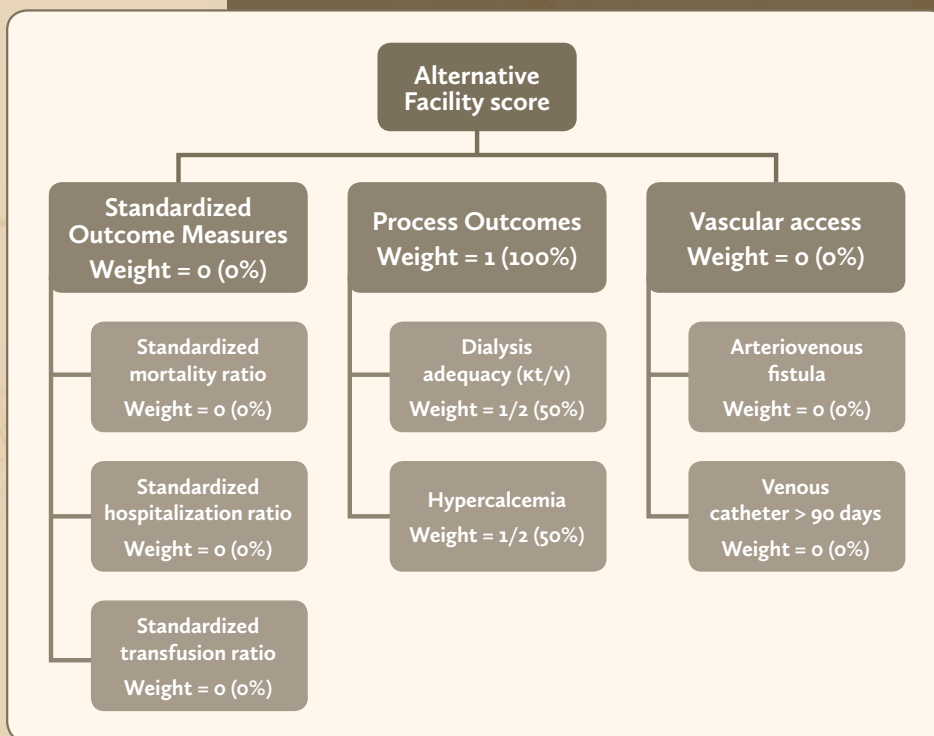


	1	2	3	4	5
Up	29.2%	28.9%	17.1%	14.8%	0.0%
Same	70.8%	57.9%	68.3%	51.9%	66.5%
Down	0.0%	13.2%	14.6%	33.2%	33.5%

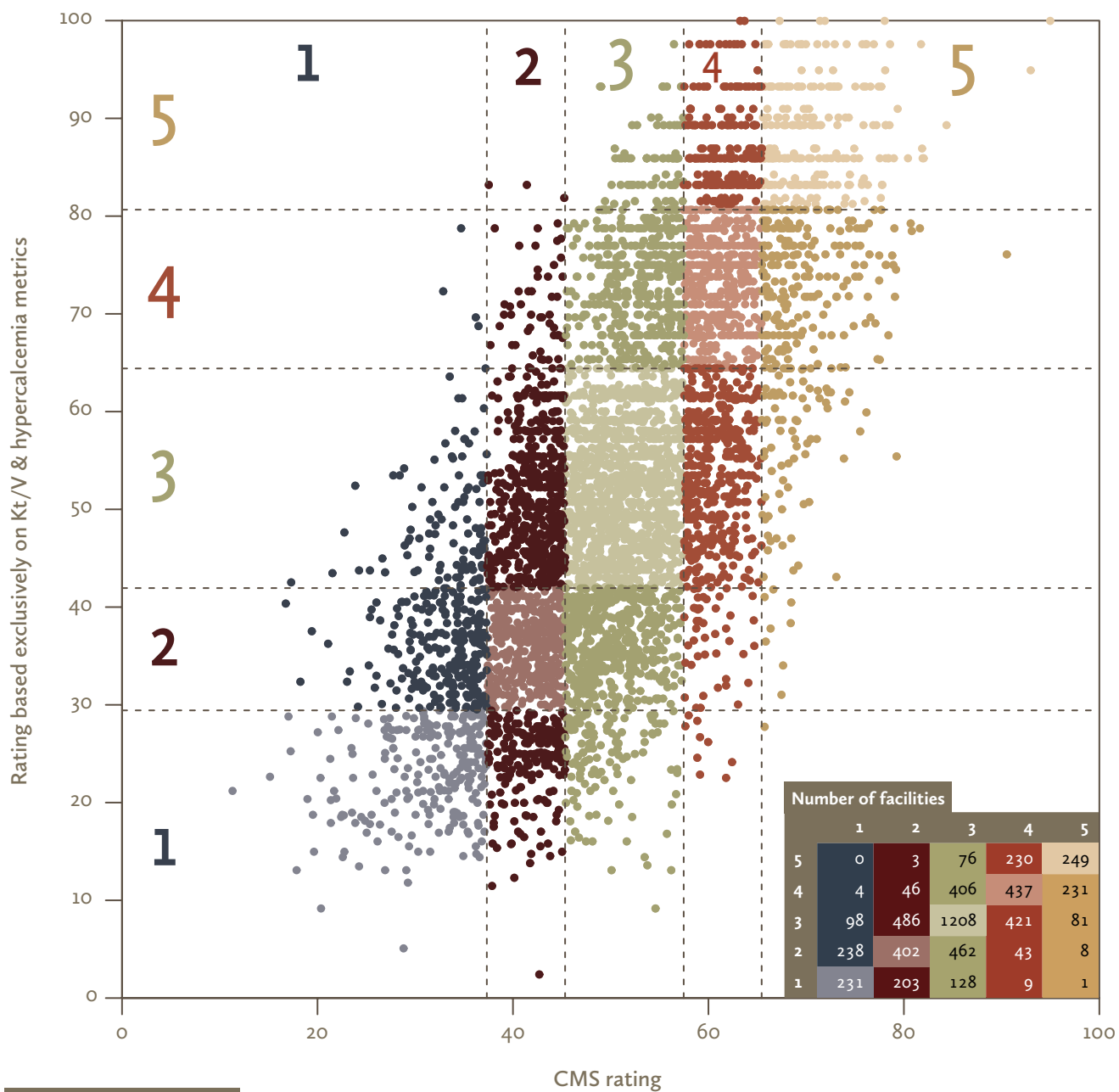
ASSESSMENT OF THE 5-STAR QUALITY RATING SYSTEM

The relative incidence of the major clinical outcomes of mortality and hospitalization might exclusively determine 5-star ratings for dialysis facilities, but the challenge with estimating relative incidence is design appropriate risk adjustment. ♦ Both the standardized mortality ratio and the standardized hospitalization ratio depend on adjustment for comorbid conditions present at dialysis initiation, as recorded on the Medical Evidence Report, but analyses presented earlier in this report cast considerable doubt on the validity of comorbidity data ascertained from this report. ♦ An alternative approach to rating dialysis facilities is to assign all weight to process outcomes, which facilities might be able to determine more directly. ♦ Here we use public data from the July 2014 release of Dialysis Facility Compare to compile 5-star ratings according to the CMS methodology and, likewise, to an alternative methodology in which the percentage of patients who receive adequate dialysis (as quantified by kt/v) and the incidence of hypercalcemia are each assigned 50 percent weight. ♦ There is a relationship between the ratings, but there is also considerable discordance. Roughly 44 percent of facilities are assigned equal numbers of stars by the contrasting approaches. ♦ Among facilities assigned one star by the CMS methodology, almost 60 percent are assigned two or more stars by the alternative rating. On the other hand, among facilities assigned five stars by the CMS methodology, more than 56 percent are assigned four or fewer stars by the alternative rating. ♦ Among facilities assigned two, three, or four stars by the CMS methodology, revisions by a margin of either one or two stars with the alternative rating are common.

margin of either one or two stars with the alternative rating are common.



Comparison of rating from cms methodology vs. rating based exclusively on kt/v & hypercalcemia metrics



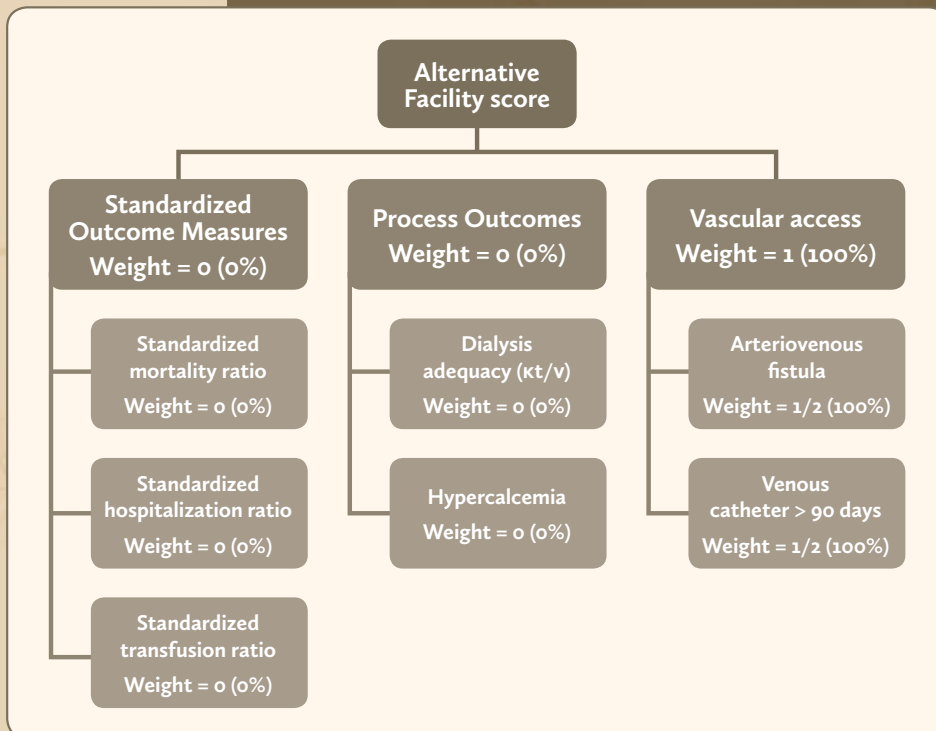
Movement from CMS rating

	1	2	3	4	5
Up	59.5%	46.9%	21.1%	20.2%	0.0%
Same	40.5%	35.3%	53.0%	38.3%	43.7%
Down	0.0%	17.8%	25.9%	41.5%	56.3%

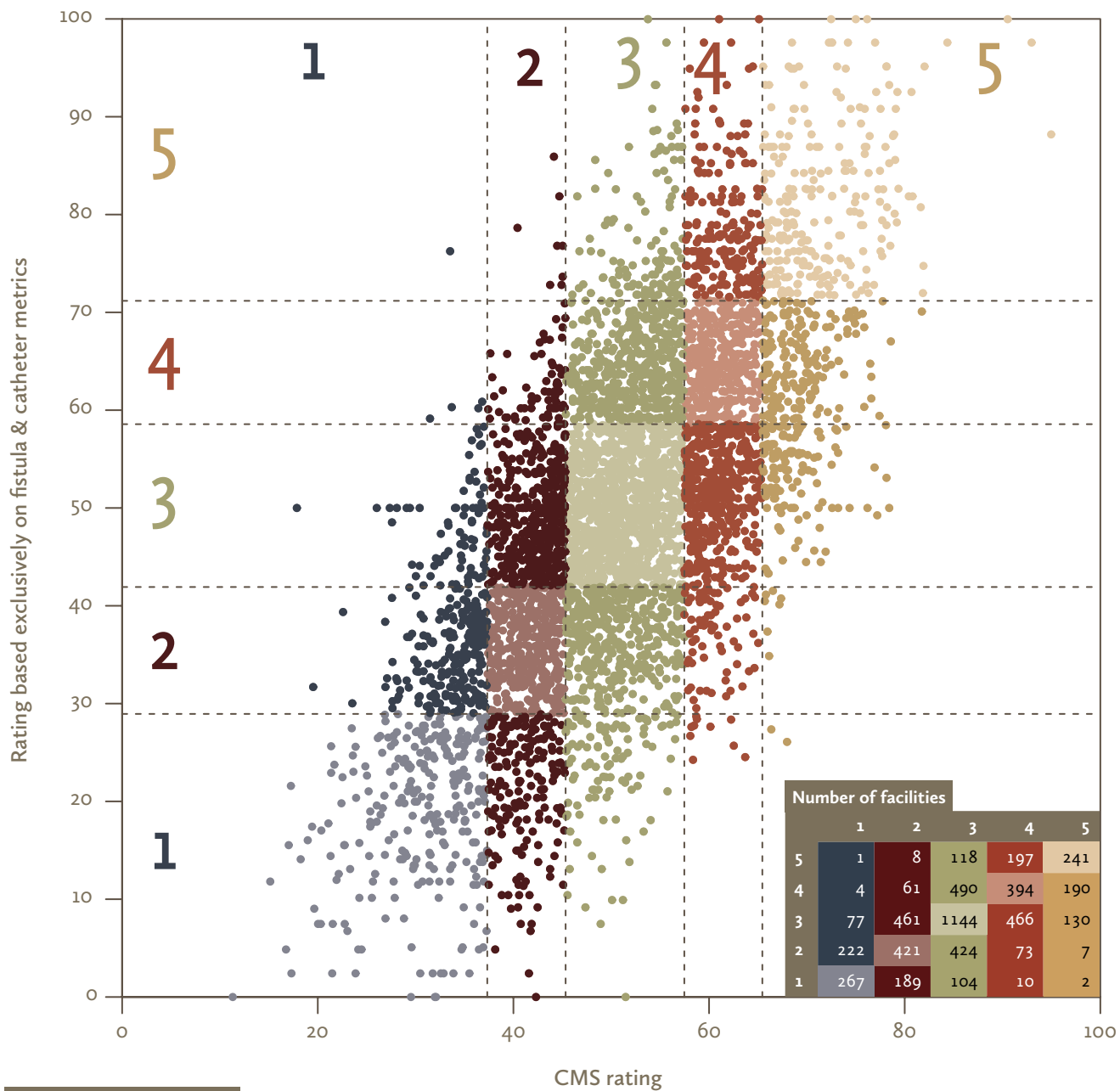
ASSESSMENT OF THE 5-STAR QUALITY RATING SYSTEM

Vascular access technique is strongly associated with major clinical outcomes in dialysis patients, and arteriovenous fistulas are widely regarded as the access modality of choice. The use of central venous catheters, moreover, is associated with increased risk of infection. ♦ Although dialysis facilities do not create accesses, the delivery of dialysis—by way of cannulation technique, blood flow rates, and infection control practices—may strongly influence access patency and the incidence of access complications. ♦ Another alternative approach to the rating of dialysis facilities is to assign all weight to vascular access technique, rather than major clinical outcomes or process outcomes. ♦ Here, we use public data from the July 2014 release of Dialysis Facility Compare to compile 5-star ratings according to the CMS methodology and to an alternative methodology in which the percentage of patients receiving hemodialysis with an arteriovenous fistula and the percentage receiving hemodialysis with a venous catheter for more than 90 days are each assigned a weight of 50 percent. ♦ In this scenario, slightly more than 43 percent of facilities are assigned equal numbers of stars by the contrasting approaches. ♦ Among facilities assigned one star by the CMS methodology, over 53 percent are assigned two or more stars by the alternative rating. On the other hand, among facilities assigned five stars by the CMS methodology, nearly 58 percent are assigned four or fewer stars by the alternative rating. ♦ Among facilities assigned two, three, or four stars by the CMS methodology, revisions by a margin of either one or two stars with the alternative rating are common.

margin of either one or two stars with the alternative rating are common.



Comparison of rating from CMS methodology vs. rating based exclusively on fistula & catheter metrics

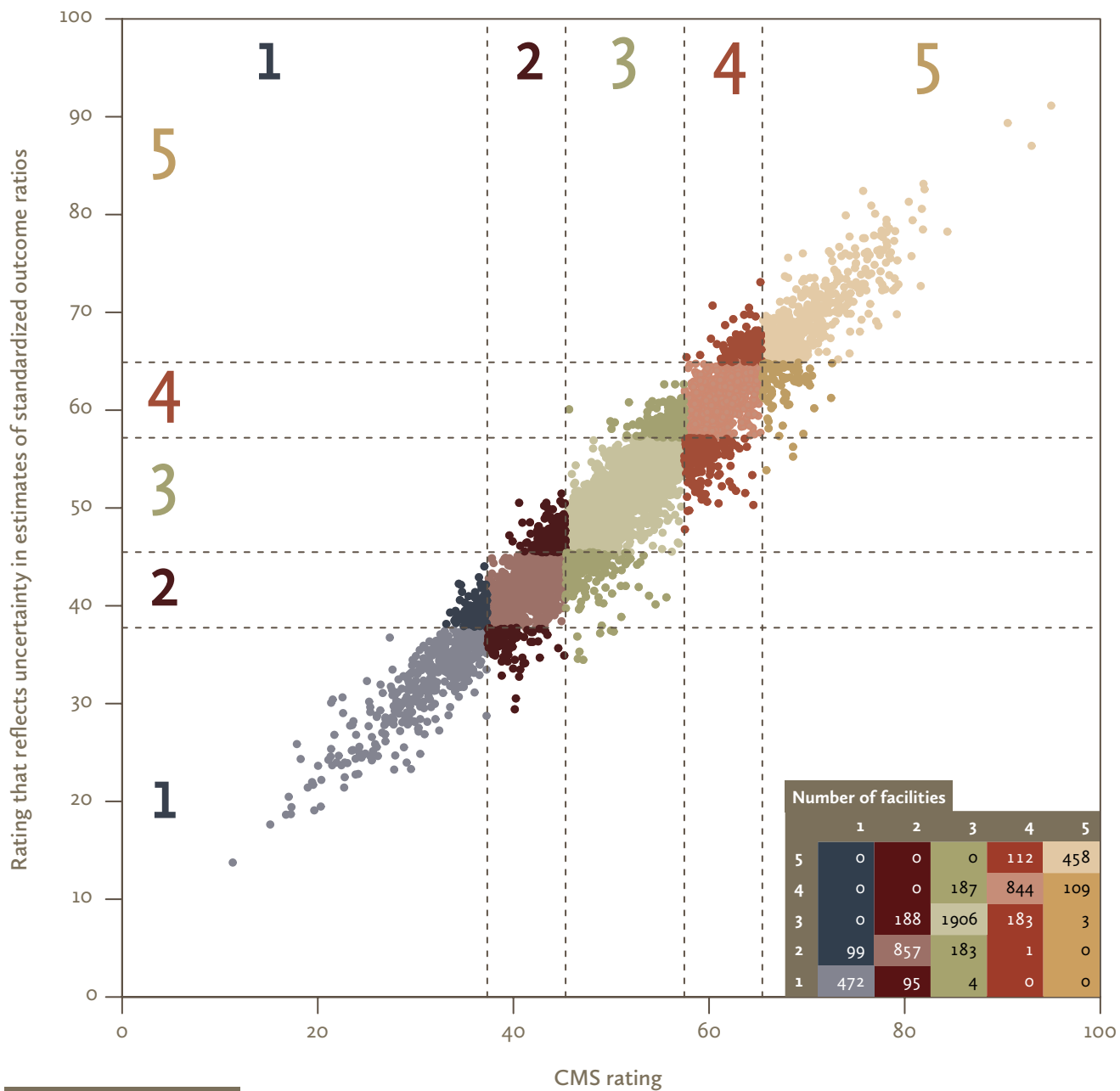


	1	2	3	4	5
Up	53.2%	46.5%	26.7%	17.3%	0.0%
Same	46.8%	36.9%	50.2%	34.6%	42.3%
Down	0.0%	16.6%	23.2%	48.2%	57.7%

ASSESSMENT OF THE 5-STAR QUALITY RATING SYSTEM

Estimates of standardized mortality, hospitalization, and transfusion ratios are accompanied by uncertainty, as expressed by corresponding 95 percent confidence intervals. ♦ One way to account for uncertainty is to take each standardized outcome measure and simulate an alternative value, by taking a random draw from a normal distribution with mean equal to the estimate of the measure and standard deviation equal to the standard error implied by the confidence interval. ♦ Here we use public data from the July 2014 release of Dialysis Facility Compare to compile 5-star ratings according to CMS methodology and likewise according to an alternative methodology in which the uncertainty of standardized outcome measures is accounted, but weights assigned to all three domains and the seven constituent metrics are left unchanged. ♦ Ratings assigned by the contrasting approaches are generally similar, but, nonetheless, discrepant ratings due to nothing other than statistical variation are apparent. ♦ In total, more than 20 percent of facilities are assigned unequal numbers of stars by the contrasting approaches, a clear indication that star ratings with no mention of uncertainty are inappropriate for release to the public. ♦ Although this criticism might be dismissed by claims that ratings with no mention of uncertainty are nonetheless “best estimates” of ratings, it is likely to be confusing to patients when facility ratings oscillate from year to year for no apparent reason.

Comparison of rating from CMS methodology vs. rating that reflects uncertainty in estimates of standardized outcome ratios

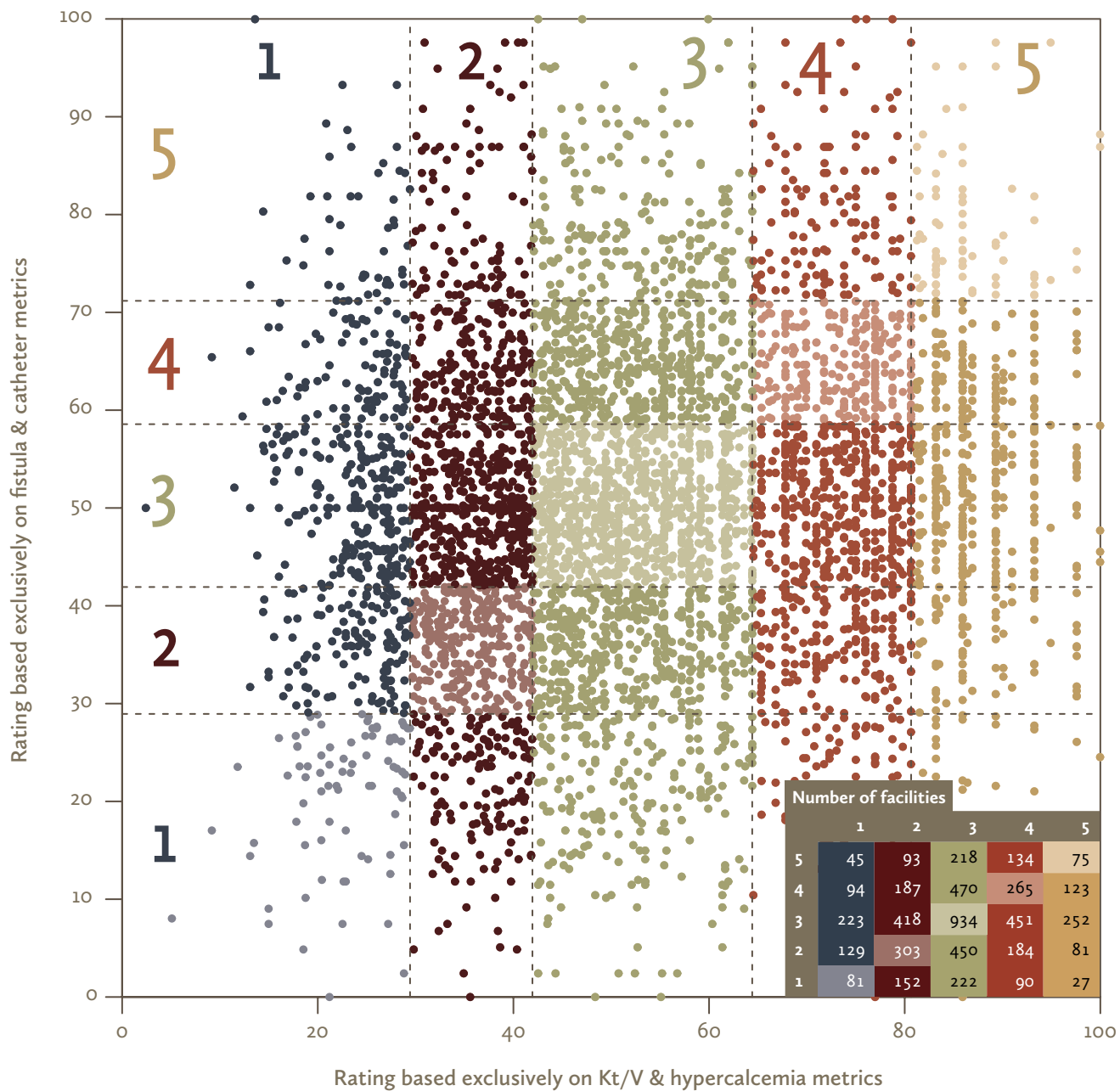


	1	2	3	4	5
Up	17.3%	16.5%	8.2%	9.8%	0.0%
Same	82.7%	75.2%	83.6%	74.0%	80.4%
Down	0.0%	8.3%	8.2%	16.1%	19.6%

ASSESSMENT OF THE 5-STAR QUALITY RATING SYSTEM

The domains of process outcomes and vascular access technique represent different dimensions of quality, but one might anticipate that facilities that deliver high-quality care tend to perform well in all dimensions. ♦ If facilities tend to perform very differently across multiple dimensions, then composite ratings may be mathematical abstractions, not useful indications of quality. ♦ Here we use public data from the July 2014 release of Dialysis Facility Compare to compile 5-star ratings in which all weight is assigned to process outcomes and alternative ratings in which all weight is assigned to vascular access technique (graphic). ♦ Ratings assigned by the contrasting approaches are very often discordant. Only 29 percent of facilities are assigned equal numbers of stars by the contrasting approaches. ♦ Numerous facilities assigned only one star with exclusive consideration of process outcomes are assigned either four or five stars with exclusive consideration of vascular access technique. Likewise, numerous facilities assigned five stars with exclusive consideration of process outcomes are assigned either one or two stars with exclusive consideration of vascular access technique. ♦ Between the ratings, discrepancies by a margin of two or more stars are common. ♦ Ultimately, these data suggest that composite ratings for dialysis facilities are not particularly useful, as they often blur very different levels of achievement in disparate domains.

Comparison of rating based exclusively on Kt/V & hypercalcemia metrics vs. rating based exclusively on fistula & catheter metrics



Movement from rating based exclusively on Kt/V & hypercalcemia metrics					
	1	2	3	4	5
Up	85.8%	60.5%	30.0%	11.9%	0.0%
Same	14.2%	26.3%	40.7%	23.6%	13.4%
Down	0.0%	13.2%	29.3%	64.5%	86.6%

ASSESSMENT OF THE 5-STAR QUALITY RATING SYSTEM

Ratings of providers and physicians have become an increasingly important feature of healthcare consumer information. The 5-Star Quality Rating System represents an initial attempt by CMS to consolidate a diverse set of seven metrics about dialysis facility performance into a single consumer-friendly score, expressed as anywhere from one to five stars. The design and methodology of this first foray into rating facilities, however, is clearly complicated by limitations.

Each of the seven constituent metrics by itself presents challenges. The standardized outcome ratios—for mortality, hospitalization, and transfusion—each depend on risk adjustment, which includes consideration of comorbidity as ascertained from the Medical Evidence (ME) Report. Data presented in the chapter on incidence suggest that the ME Report does not accurately capture comorbidity at incidence, at least in elderly patients. Even if the ME Report were a perfectly valid instrument, the question remains whether the recorded conditions are sufficient and timely descriptors of patient health, especially in unique subgroups, such as patients with little recorded health history at dialysis initiation or those transferring from one facility to another. In the domain of vascular access measures there is no risk adjustment. This may be problematic in terms of older and diabetic patients, in whom the preservation of arteriovenous fistulas may be difficult (due to the health of the peripheral vasculature) or not necessarily efficacious, as literature has begun to suggest may be true for very elderly patients. In the domain of other measures regarding dialysis adequacy and hypercalcemia, it is simply uncertain to what the degree the limited amount of variation among dialysis facilities correlates with meaningful differences in the quality of dialysis patient care and corresponding patient outcomes.

Challenges with the metrics are already known. In the case of star ratings, the difficulty with the whole may be more profound than the sum of the difficulties of the parts. The 5-Star Quality Rating System combines process measures and standardized outcome ratios with a mathematical function that places an implicit relative valuation

on each of the seven metrics. The conceptual difficulty is that each consumer may value metrics or domains in different ways than CMS values them. From this perspective, the convenience of a single rating for each dialysis facility is limited by the imposition of a value system that parties other than the payer may not hold. This is not a patient-centered system, despite its best intentions.

The Peer Kidney Care Initiative is devoted to improving the quality of dialysis patient care. The data throughout this inaugural Peer Report indicate that dialysis patient outcomes are varied. The clinical challenges that present in the first year of treatment are not the same as those presenting later. There are profound geographic differences in patient outcomes, so much so that it is difficult to accept the hypothesis that overarching health of local populations, conditions of the natural and economic environments, and capacity and capability of the healthcare delivery systems do not exert their influence on dialysis patient outcomes quite apart from the narrow scope of outpatient dialysis providers. There is profound seasonality of outcomes, with respect not only to infectious complications, but also to cardiovascular complications, respiratory complications, mortality, and even the very incidence of end-stage renal disease. The 5-Star Quality Rating System does not consider these issues in a rigorous manner, and thereby misses an opportunity to inspire meaningful improvements in the quality of dialysis patient care.

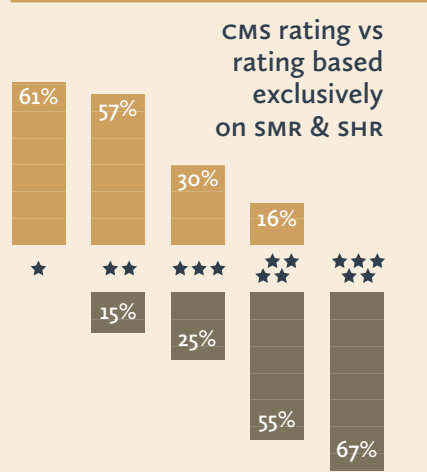
In the future, the Peer Kidney Care Initiative will further organize these and other data—including information about the incidence of acute care in the emergency department, the incidence and treatment of infection in all settings, and the health of the growing population of patients dialyzing at home—in a more rigorous framework, one that describes the quality of patient care in ways that consolidate information without imposing relative valuations on specific domains, so that all stakeholders in the community, including patients, physicians, providers, payers, and state and federal governments, may continue to realize improvements in care and outcomes.

Star Ratings with alternate approaches to defining quality

facilities receiving a higher rating with alternate method

CMS rating

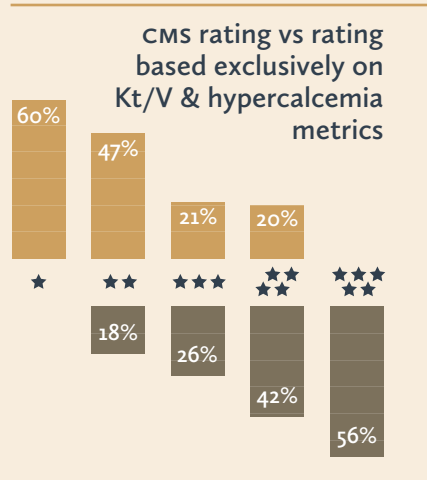
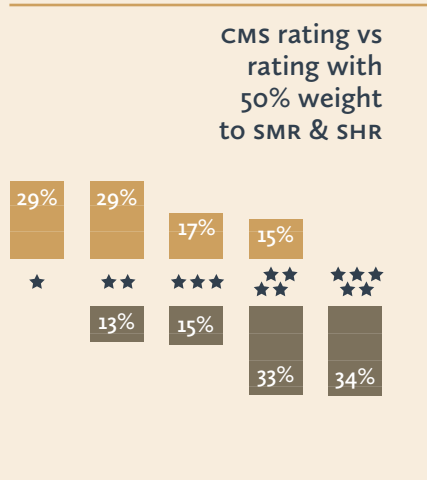
facilities receiving a lower rating with alternate method



facilities receiving a higher rating with alternate method

CMS rating

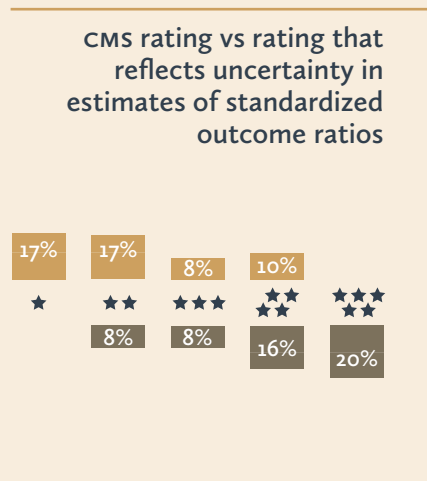
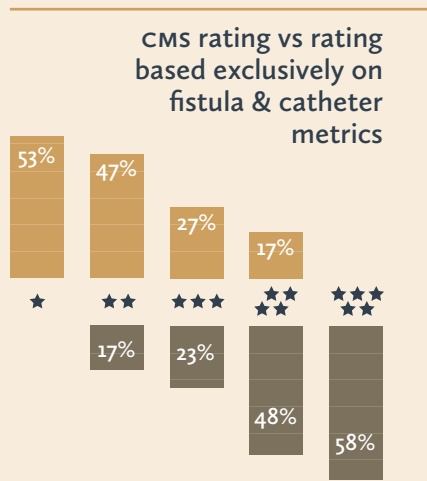
facilities receiving a lower rating with alternate method



facilities receiving a higher rating with alternate method

CMS rating

facilities receiving a lower rating with alternate method



ASSESSMENT OF THE 5-STAR QUALITY RATING SYSTEM

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