...our heart survives
between hammers,
just as the tongue
between teeth is still
able to praise.

Rainer Maria Rilke,
The Duino Elegies

NINE

CARDIOVASCULAR SPECIAL STUDIES

Cardiovascular disease is the major cause of mortality in patients with ESRD. The burden of cardiovascular disease is greatest in older patients and those with diabetic nephropathy, two groups that have disproportionately contributed to the increasing incidence of ESRD in the U.S. As this trend of increasing older diabetic patients is expected to continue, it is also likely that the absolute burden of cardiovascular disease present in ESRD patients in the U.S. will mirror this increase as well. Figures 9.1–4 present data on the burden of cardiovascular disease at ESRD initiation and within the first year after initiation of treatment. These data provide a point of reference for the subsequent data presented in this chapter.

One mission of the Cardiovascular Special Studies Center is to provide insight on the impact of cardiovascular disease on morbidity and mortality in ESRD patients. Chapter Nine encompasses several discrete data analyses relating to this mission. Figures 9.5–10 present data on a relatively unexplored area, the burden of cardiovascular disease in pediatric ESRD patients. Figures 9.11–22 focus on the temporal trends relating to cardiovascular morbidity and mortality in incident Medicare eligible dialysis patients from 1991 to 1998.

One devastating consequence of cardiovascular disease is the dismal long-term survival of dialysis patients after AMI. Nearly three quarters of dialysis patients in the United States die within two years after an index myocardial infarction. As a population at a particularly high-risk for cardiovascular death, dialysis patients might potentially experience the largest absolute benefit in reduction of mortality with the implementation of therapeutic strategies that have shown benefits in the non-ESRD population. Figures 9.23–28 deal with one facet of AMI care, the use of diagnostic testing and therapeutic interventions during the years 1991 to 1998.

Adult ESRD patients suffer a large burden of cardiovascular disease, but this is more so in older and diabetic patients. As shown in Figures 9.11 and 9.12, patients who sustain AMI after initiation of dialysis tend to be older and are more likely to have diabetic nephropathy. There are also proportionally more white male patients in the AMI group than in the entire cohort of incident dialysis patients. The lower cardiovascular disease risk (including AMI) in black patients has been a consistent finding in the USRDS database (Herzog 1998), and is mirrored by the overall lower mortality rate in black patients. No definitive explanation for the lower cardiovascular risk has been advanced to date.

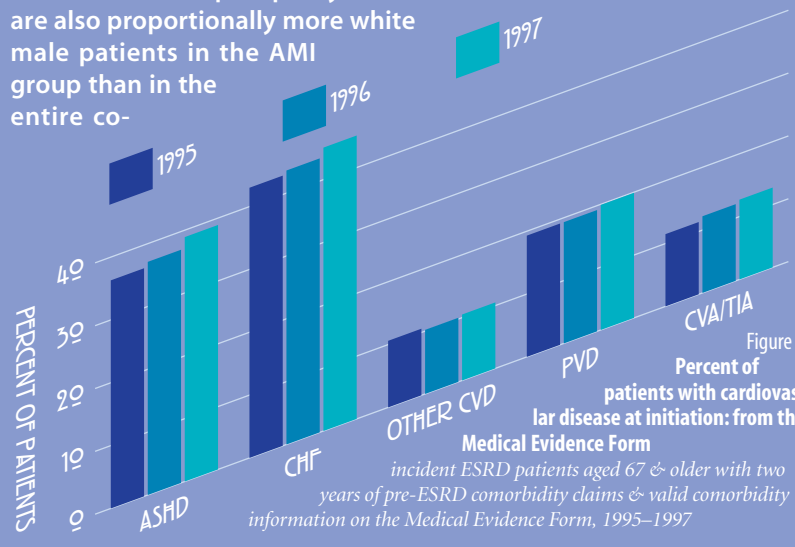


Figure 9.1
Percent of patients with cardiovascular disease at initiation: from the Medical Evidence Form
incident ESRD patients aged 67 & older with two years of pre-ESRD comorbidity claims & valid comorbidity information on the Medical Evidence Form, 1995–1997

As reported on the Medical Evidence form, atherosclerotic heart disease and congestive heart failure account for the greatest proportion of heart disease in patients with cardiovascular disease at initiation.

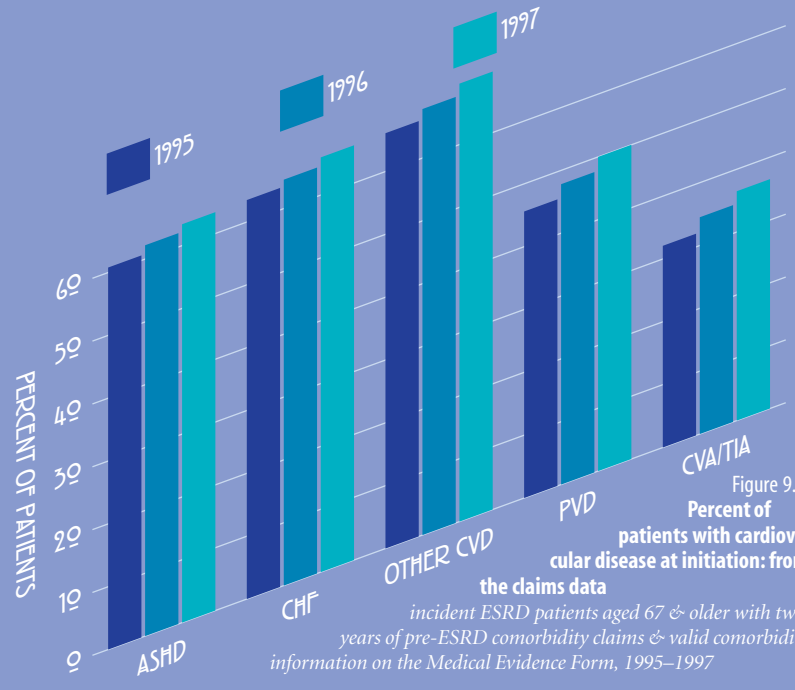


Figure 9.2
Percent of patients with cardiovascular disease at initiation: from the claims data
incident ESRD patients aged 67 & older with two years of pre-ESRD comorbidity claims & valid comorbidity information on the Medical Evidence Form, 1995–1997

Data are from Part A and Part B claims and from the REBUS file.

Rates of cardiovascular disease have not declined in incident patients 67 years and older. Figures 9.1 and 9.2 also show that cardiovascular comorbidity is more frequently identified from the claims data than from the Medical Evidence Form.

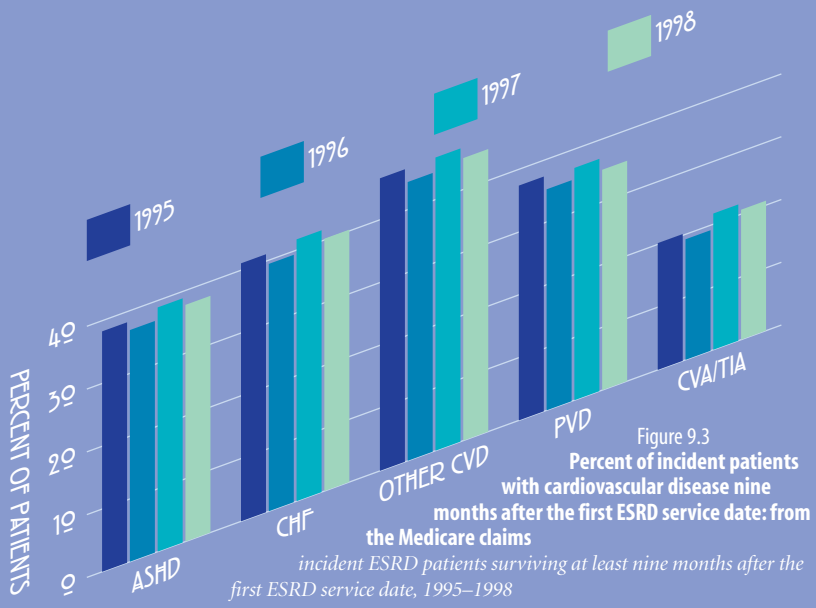


Figure 9.3
Percent of incident patients with cardiovascular disease nine months after the first ESRD service date: from the Medicare claims
incident ESRD patients surviving at least nine months after the first ESRD service date, 1995–1998

Data are from Part A and Part B claims and from the REBUS file.

Nearly 40% of incident patients had atherosclerotic heart disease (ASHD) and 40% had congestive heart failure in 1998.

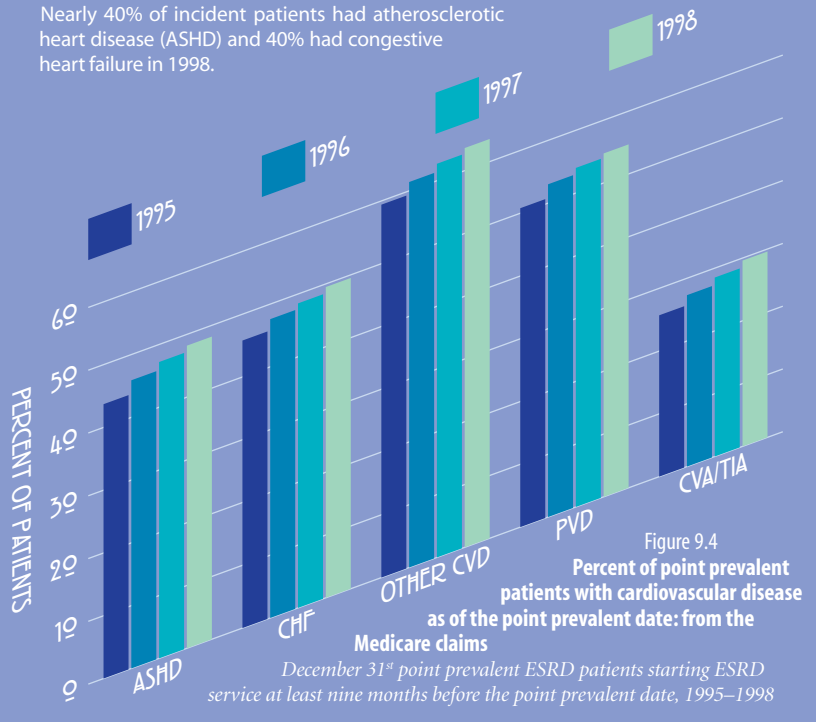


Figure 9.4
Percent of point prevalent patients with cardiovascular disease as of the point prevalent date: from the Medicare claims
December 31st point prevalent ESRD patients starting ESRD service at least nine months before the point prevalent date, 1995–1998

Data are from Part A and Part B claims and from the REBUS file.

The large burden of cardiovascular morbidity in prevalent ESRD patients has remained evident since 1995. Figures 9.3 and 9.4 show the greater number of prevalent patients, compared to incident patients, who have cardiovascular disease.

There has been an overall decline in all-cause mortality (fig 9.13), with approximately a 7–8% reduction in the first and second year and a 4.5% reduction in the third year compared to the base year of 1991. This decrease in the mortality rate is mirrored by the decrease in cardiac deaths occurring in the first, second, and third years after dialysis initiation. Compared to 1991, by 1998 there was a 9% reduction in the first-year cardiac death rate, and 7–8% reductions for the second and third years after dialysis initiation for 1996–1997. The cardiac death rate is highest in the third year of dialysis at 146 cardiac deaths per 1,000 patient years versus 134 in the first year (fig 9.14). Although there has been a decrease in the cardiac death rate over time, this is not reflected in the rate of AMI (fig 9.15). The highest rate occurs in the first year after dialysis initiation (approximately 7%) and is unchanged from 1991–1998.

Although there have been small reductions in the rate of cardiac arrest in the first year after dialysis initiation (119 events per 1,000 patient years in 1991 with a 4% reduction by 1998), there has been less than a 1% reduction in the second and third years of dialysis. The small rate of decline in cardiac arrest rates does not explain the somewhat larger decline in cardiac death rates. The minimal change noted in cardiac arrest rates over the 1991–1998 period should stimulate further interest in the potential underuse of interventions known to reduce the risk of cardiac death in non-ESRD patients.

There has been a steady increase in the rate of manifest peripheral vascular disease, as seen in the combined rate for major amputation and peripheral revascularization. The most striking increase has occurred in dialysis patients after the first year of initiation, with a 51% increase in the rate of peripheral vascular disease from 1991when there were approximately 84 events per 1,000 patient years (fig 9.20).

INCLUDED IN THIS CHAPTER ♦ Graphs of the incidence of cardiac disease in pediatric patients by age, gender, and race ♦ A graph showing rates of cardiac disease and death, and graphs of the demographic distribution of cardiac patients ♦ Graphs showing rates of all-cause mortality, cardiac death, AMI, coronary revascularization, new CVAs, new TIAs, cardiac arrests, amputations/peripheral revascularizations, all cardiovascular-related events, and all events ♦ Graphs showing the percent of AMI patients who receive stress tests, coronary angiography, resting echocardiography, lipid measurements, or coronary revascularization

Figure 9.5
Distribution of pediatric patients, by age & gender
incident Medicare dialysis patients, 1991–1996 combined

Figures 9.5–9.10 present data from a special analysis which studied the burden of cardiovascular disease on ESRD pediatric patients. This study was conducted by the Cardiovascular Special Studies Center of the USRDS.

The majority of pediatric ESRD patients are males aged 15–19 years old.

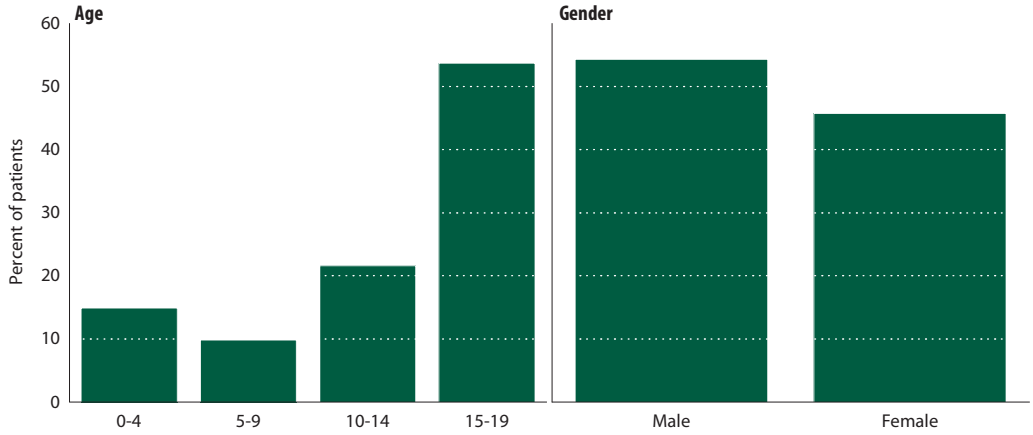


Figure 9.6
Distribution of pediatric patients, by race & primary diagnosis
incident Medicare dialysis patients, 1991–1996 combined

Approximately 60% of pediatric ESRD patients are white, and 32% are black.

The single largest cause of pediatric ESRD is glomerulonephritis, which accounts for more than 44% of the total.

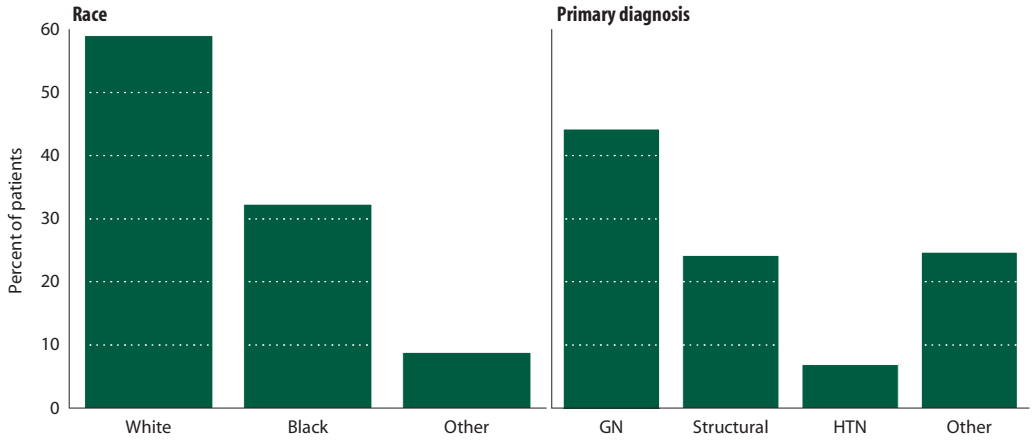
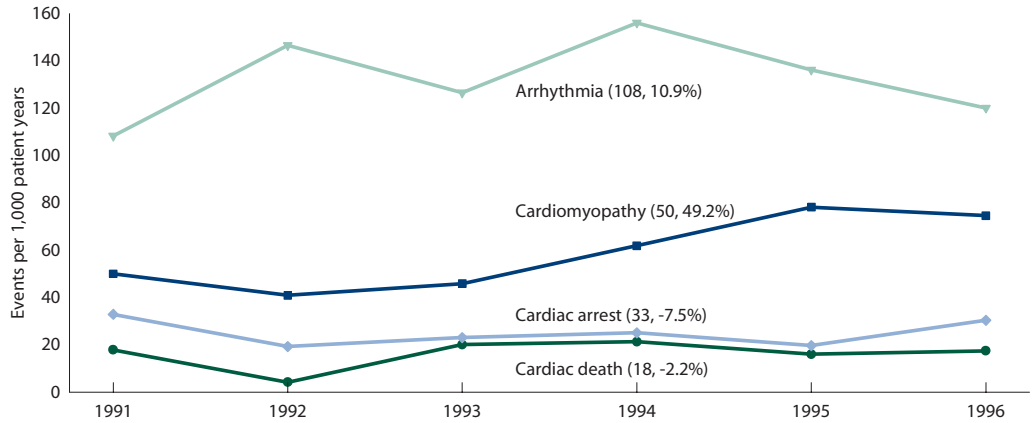


Figure 9.7
First three-year annual cardiac disease & death rates in pediatric patients
incident Medicare dialysis patients, adjusted by age, gender, race, & primary diagnosis

The number of deaths per 1,000 patient years in 1991, and the percent change in death rates from 1991 to 1996, are shown next to the lines.

There have been minimal changes in overall cardiac death rates over the period 1991–1995. There has, however, been a striking increase (49%) in the reported incidence of cardiomyopathy over the same period. The most common cardiac disorder in pediatric patients is arrhythmia.



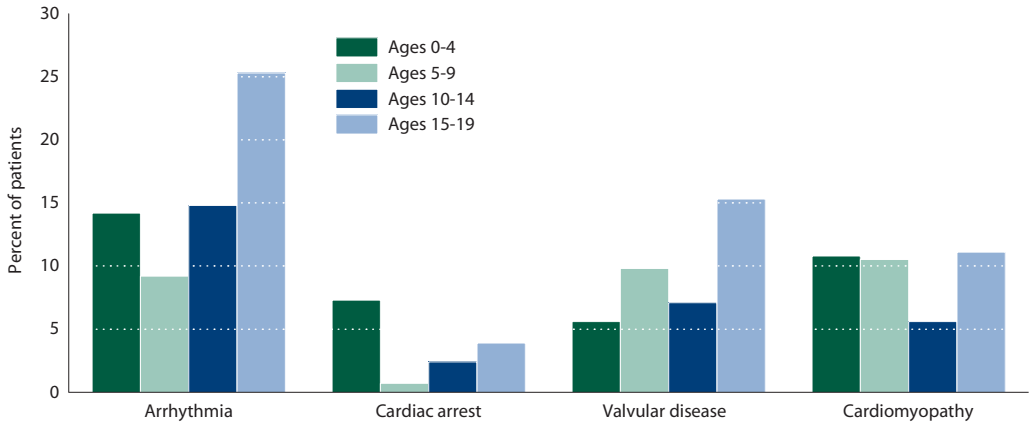


Figure 9.8
Incidence of cardiac disease in pediatric patients during a three-year follow-up, by age
incident Medicare dialysis patients, 1991–1996 combined

Patients aged 15–19 have the highest rates of arrhythmia (25.3%) and valvular disease (15.3%).

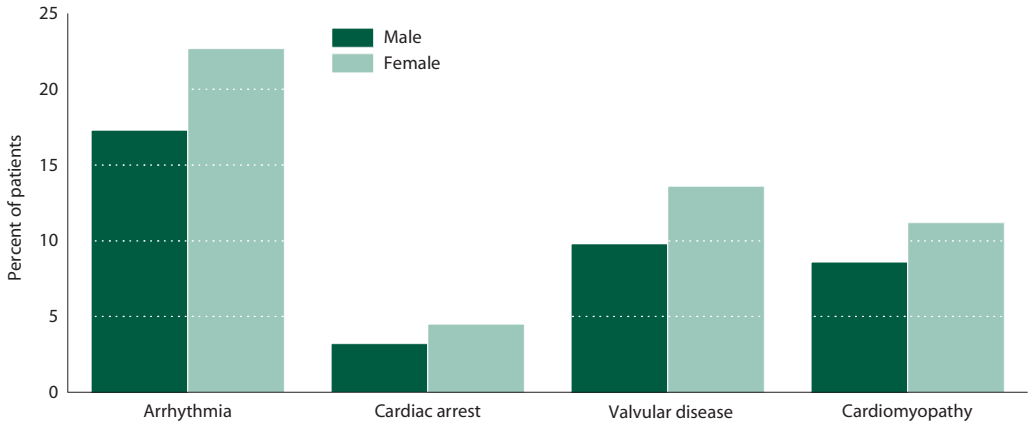


Figure 9.9
Incidence of cardiac disease in pediatric patients during a three-year follow-up, by gender
incident Medicare dialysis patients, 1991–1996 combined

The incidence of cardiac disease is higher in female children than in male children.

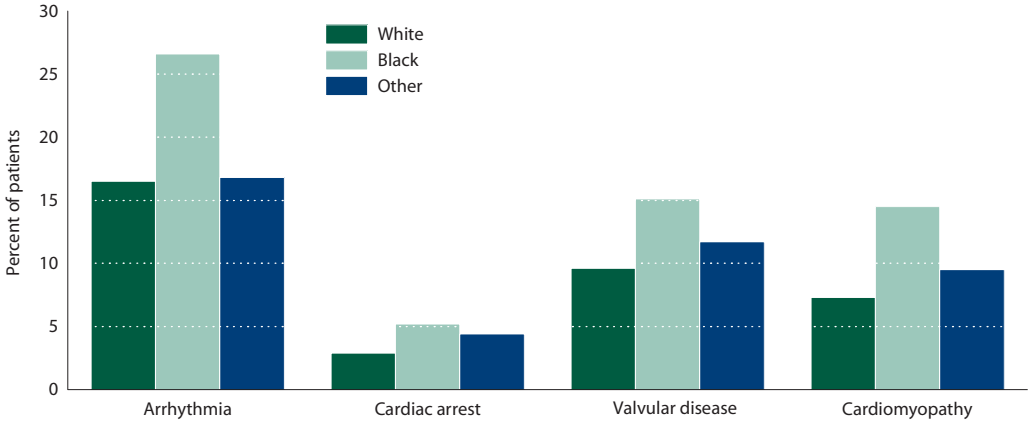


Figure 9.10
Incidence of cardiac disease in pediatric patients during a three-year follow-up, by race
incident Medicare dialysis patients, 1991–1996 combined

When compared to white pediatric ESRD patients, black pediatric ESRD patients have a higher incidence of arrhythmia, and cardiomyopathy, 26.6% and 14.5% respectively.

Figure 9.11
Distribution of cardiac patients, by age & gender
incident Medicare dialysis patients, 1991–1998 combined

Patients in this study group tended to be age 65 and older. The highest distribution of patients with AMI after initiation of dialysis occurred in males and patients in the 65–74 age group.

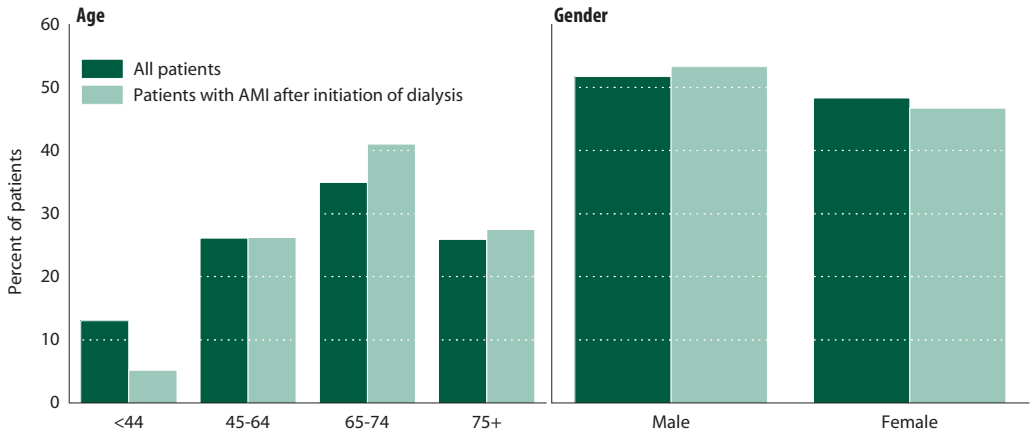


Figure 9.12
Distribution of cardiac patients, by race & primary diagnosis
incident Medicare dialysis patients, 1991–1998 combined

Compared to the entire cohort of incident Medicare dialysis patients, dialysis patients sustaining acute myocardial infarction are more likely to be white and to have diabetes as their primary cause of renal failure.

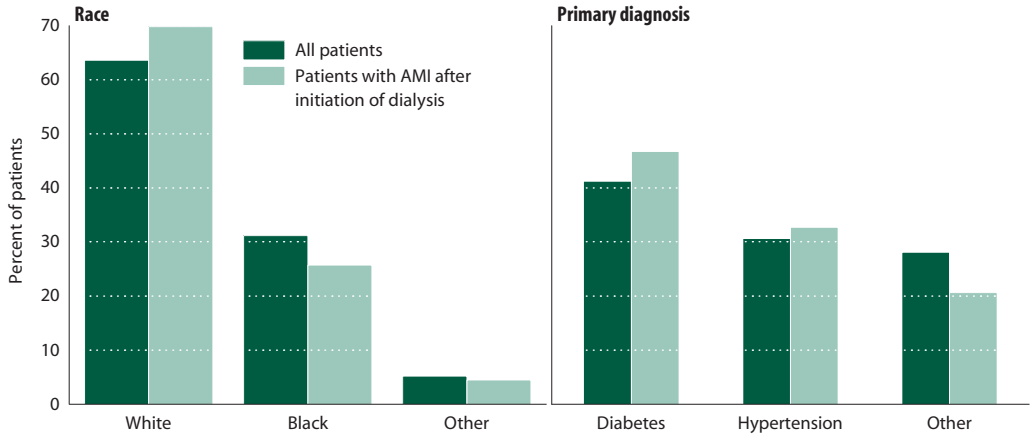
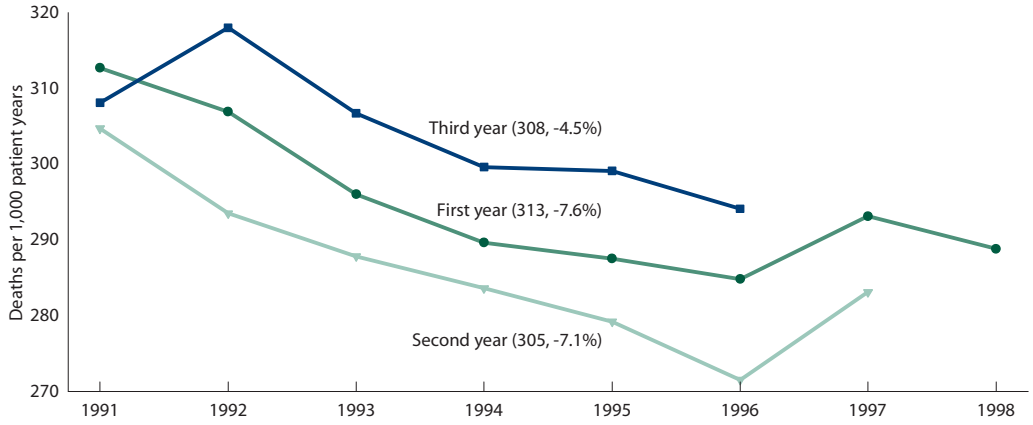


Figure 9.13
All-cause mortality rates
incident Medicare dialysis patients, 1991–1998 combined, adjusted for age, gender, race, & primary diagnosis

The number of deaths per 1,000 patient years in 1991, and the percent change in death rates from 1991 until the last year shown, are presented next to the lines.

Compared to the base year of 1991, there was an overall decrease in all-cause mortality rates between1991 and 1998, with a 7.6% reduction in the first year and a 7.1% reduction in the second year. These decreases are mirrored by decreases in cardiac death rates occurring in the first, second, and third years after dialysis initiation (fig 9.14).



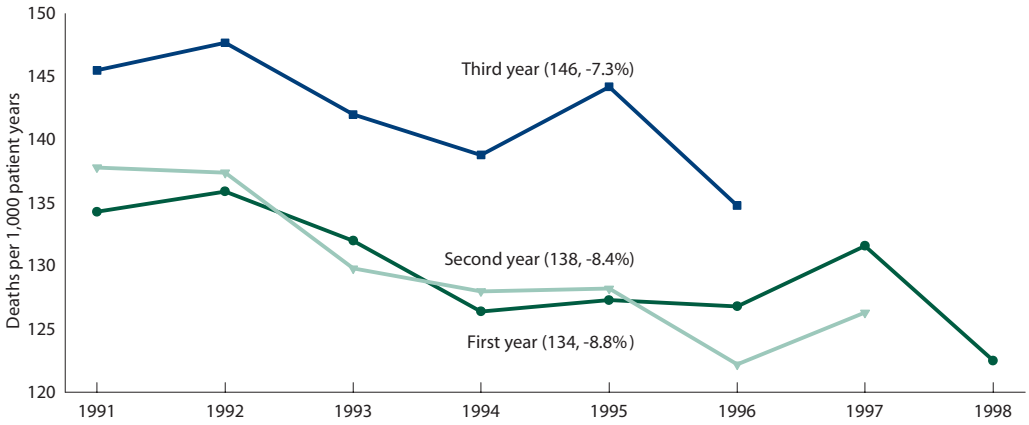


Figure 9.14
Cardiac death rates
incident Medicare dialysis patients, 1991–1998 combined, adjusted for age, gender, race, & primary diagnosis

The number of cardiac deaths per 1,000 patient years in 1991, and the percent change in death rates from 1991 until the last year shown, are presented next to the lines.

The cardiac death rate is highest in the third year of dialysis. There has been an overall decline in the rates of cardiac deaths over time.

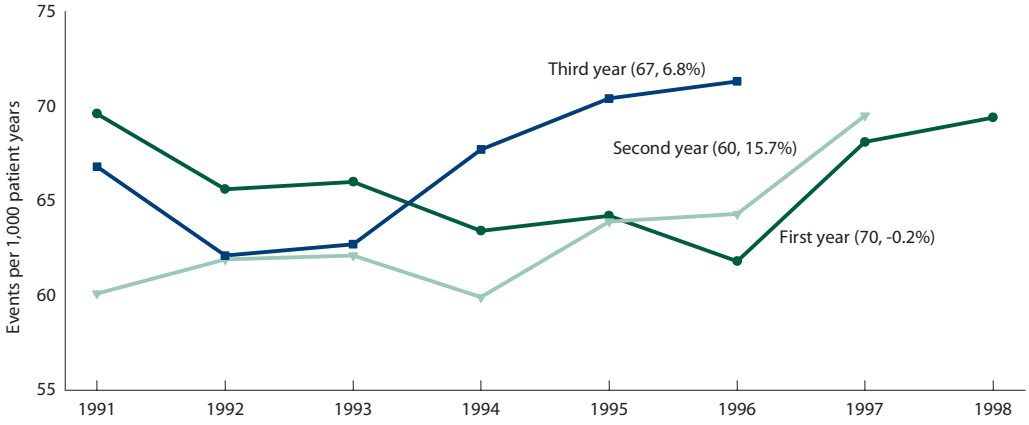


Figure 9.15
Acute myocardial infarction rates
incident Medicare dialysis patients, 1991–1998 combined, adjusted for age, gender, race, & primary diagnosis

The number of events per 1,000 patient years in 1991, and the percent change in event rates from 1991 until the last year shown, are presented next to the lines.

Although there has been a decrease in the cardiac death rate, this decrease is not reflected in the rate of myocardial infarction. The highest rate occurs in the first year after dialysis initiation (70 events per 1,000 patient years) and did not change from 1991–1998. Second- and third-year AMI rates increased during this period.

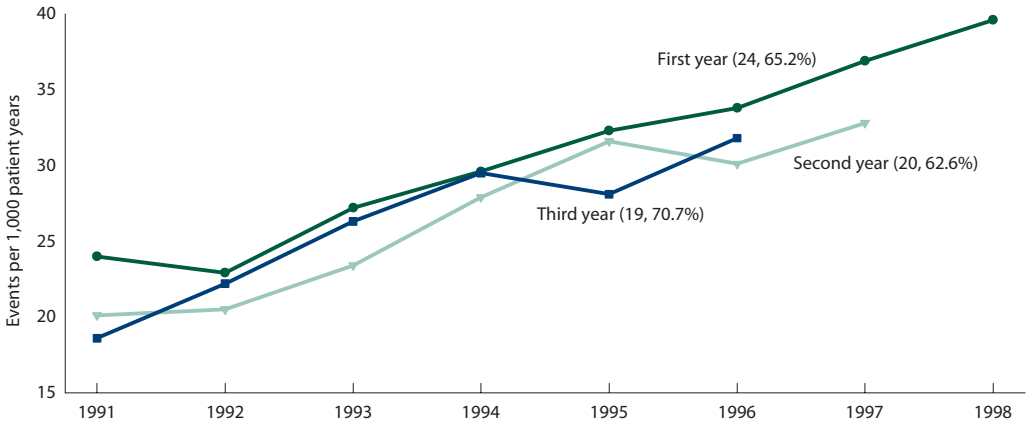


Figure 9.16
Coronary revascularization rates
incident Medicare dialysis patients, 1991–1998 combined, adjusted for age, gender, race, & primary diagnosis

The number of events per 1,000 patient years in 1991, and the percent change in event rates from 1991 until the last year shown, are presented next to the lines.

There was a large relative change in coronary revascularization rates during the period 1991–1998.

Figure 9.17
Rates of new cerebrovascular accidents
incident Medicare dialysis patients, 1991–1998 combined, adjusted for age, gender, race, & primary diagnosis

The number of events per 1,000 patient years in 1991, and the percent change in event rates from 1991 until the last year shown, are presented next to the lines.

In the first year after dialysis initiation, the risk of patients suffering a new AMI (fig 9.15) or cerebrovascular accident was approximately the same. During 1991–1998, however, rates of cerebrovascular accidents have increased more than rates of AMI.

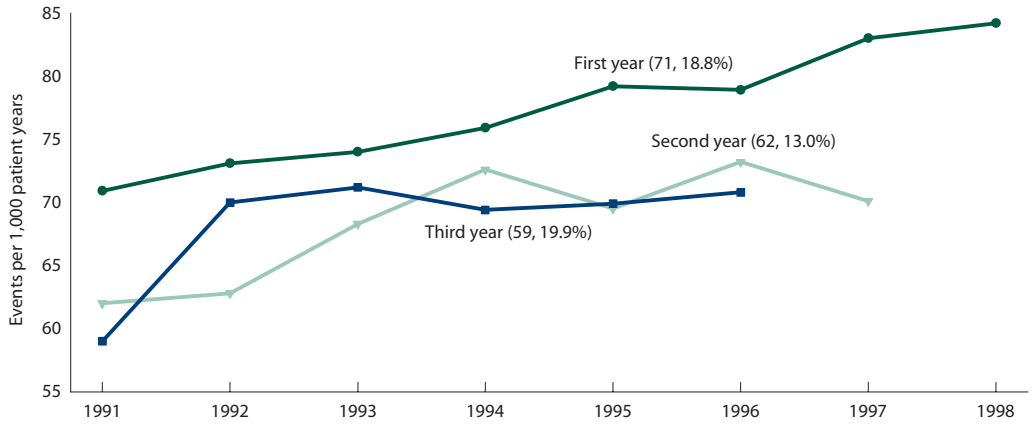


Figure 9.18
Rates of new transient-ischemic attacks
incident Medicare dialysis patients, 1991–1998 combined, adjusted for age, gender, race, & primary diagnosis

The number of events per 1,000 patient years in 1991, and the percent change in event rates from 1991 until the last year shown, are presented next to the lines.

As is the case with rates of new cerebrovascular accidents, rates of new transient ischemic attacks increased more than rates of AMI during the period 1991–1998.

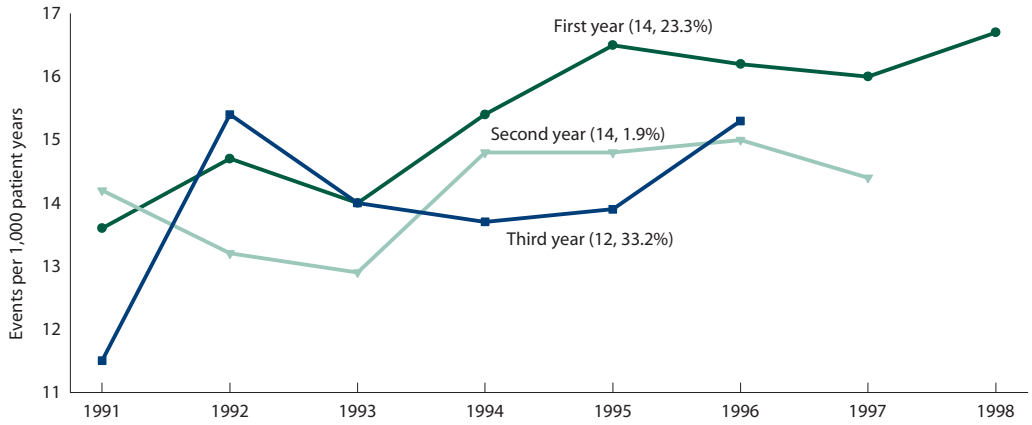
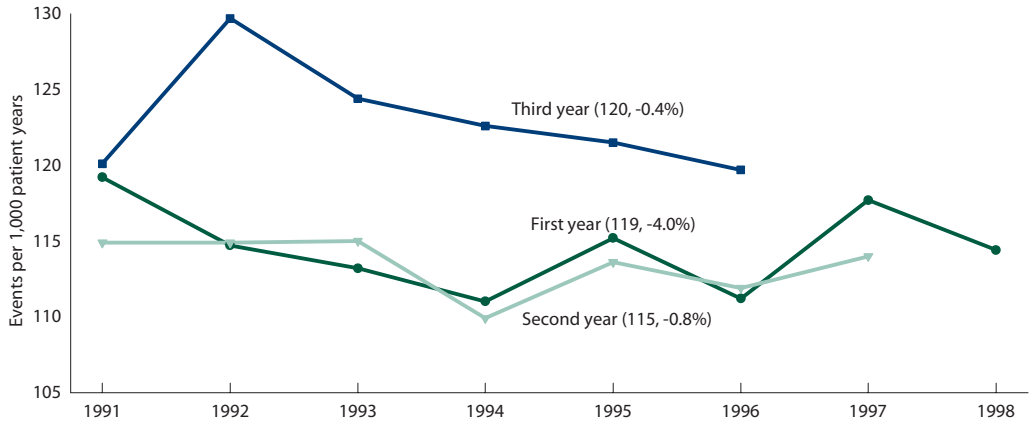


Figure 9.19
Cardiac arrest rates
incident Medicare dialysis patients, 1991–1998 combined, adjusted for age, gender, race, & primary diagnosis

The number of events per 1,000 patient years in 1991, and the percent change in event rates from 1991 until the last year shown, are presented next to the lines.

There were minimal reductions in cardiac arrest rates during the period 1991–1998.



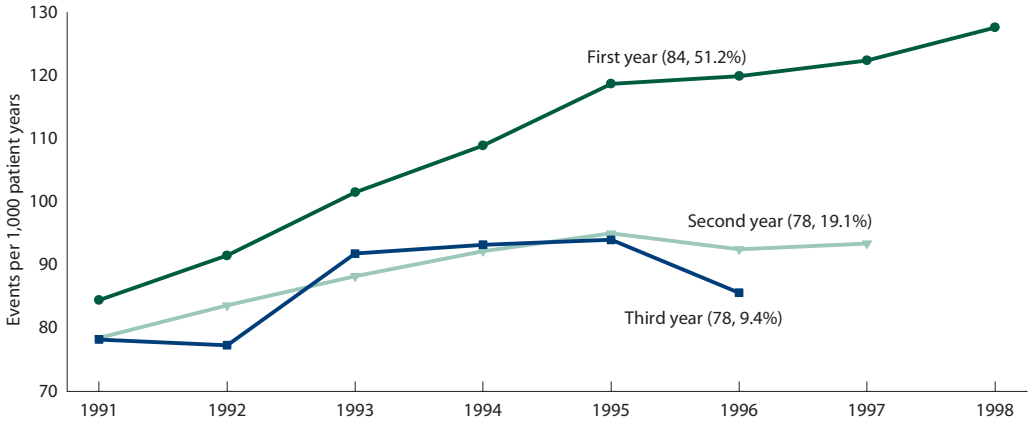


Figure 9.20
Rates of major amputations/ peripheral revascularizations
incident Medicare dialysis patients, 1991–1998 combined, adjusted for age, gender, race, & primary diagnosis

The number of events per 1,000 patient years in 1991, and the percent change in event rates from 1991 until the last year shown, are presented next to the lines.

Rates of peripheral vascular disease as manifested by major amputations or peripheral revascularization procedures are particularly striking in patients undergoing their first year of dialysis, with a 51% increase in reported incidence between 1991 and 1998.

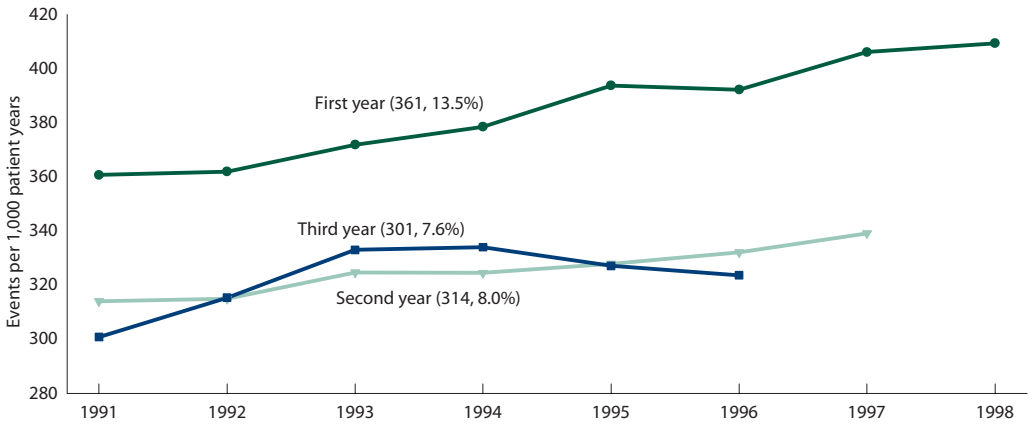


Figure 9.21
Rates of all events related to cardiovascular disease
incident Medicare dialysis patients, 1991–1998 combined, adjusted for age, gender, race, & primary diagnosis

The number of events per 1,000 patient years in 1991, and the percent change in event rates from 1991 until the last year shown are presented next to the lines.

Although the cardiac death rate has declined, reported cardiovascular comorbidity has increased. The increase in this combined event should be interpreted with caution as it reflects both the increase in the number of revascularization procedures and increases in disease incidence and use of therapeutic procedures.

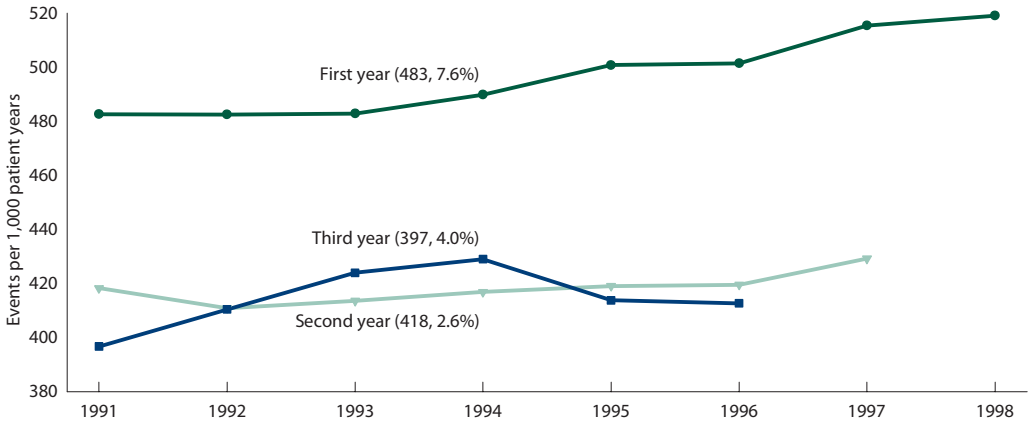


Figure 9.22
Rates of all events related to cardiovascular disease & of all-cause death
incident Medicare dialysis patients, 1991–1998 combined, adjusted for age, gender, race, & primary diagnosis

Events related to cardiovascular disease include acute AMI, new CVA, new TIA, cardiac arrest, major amputation, coronary revascularization, and peripheral revascularization.

The number of events per 1,000 patient years in 1991, and the percent change in event rates from 1991 until the last year shown, are presented next to the lines.

Figure 9.23
Stress tests in dialysis patients with acute myocardial infarction
incident Medicare dialysis patients with acute myocardial infarction, 1991–1998 combined

Non-invasive stress testing (stress electrocardiography, stress echocardiography, and stress nuclear imaging) are performed in a small proportion of the overall number of dialysis patients sustaining acute myocardial infarction. In 1998, fewer than 10% of these patients received non-invasive stress testing of any kind.

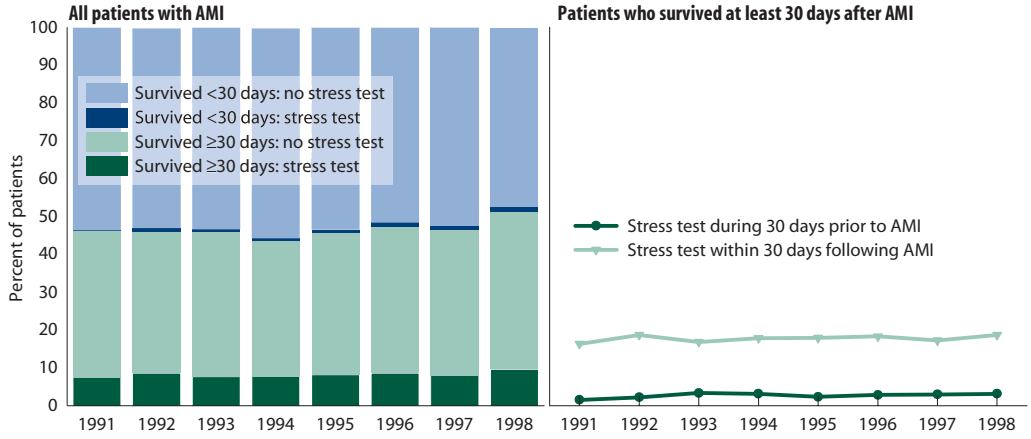


Figure 9.24
Coronary angiography in dialysis patients with acute myocardial infarction
incident Medicare dialysis patients with acute myocardial infarction, 1991–1998 combined

In 1998, fewer than 26% of the patients sustaining an acute myocardial infarction received coronary angiography. The use of coronary angiography is signficantly more frequent in those patients who survive at least 30 days following an AMI.

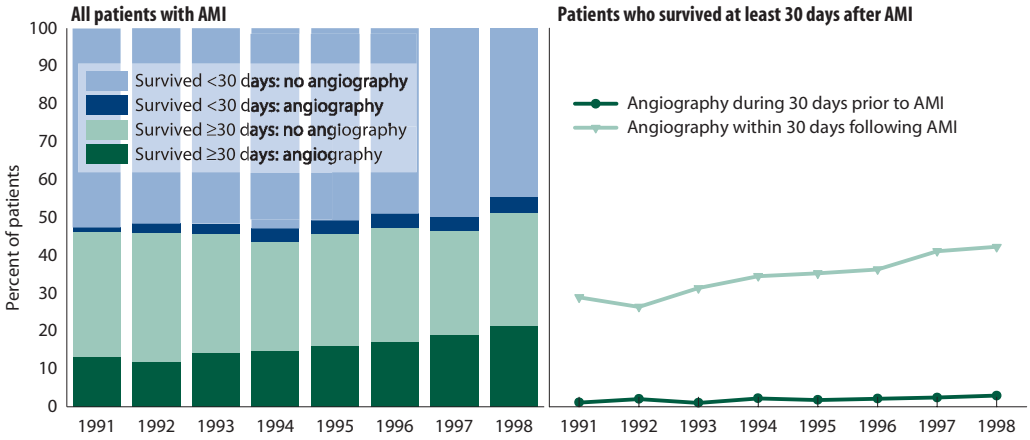
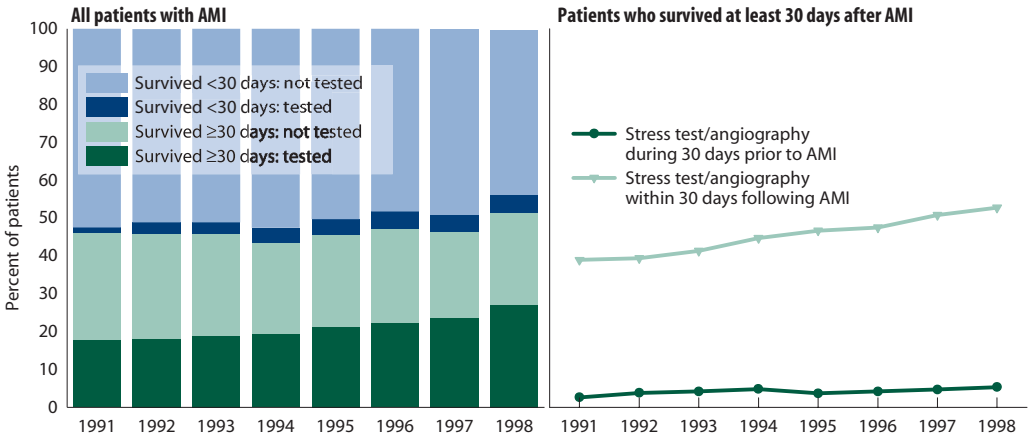


Figure 9.25
Stress tests or coronary angiography in dialysis patients with acute myocardial infarction
incident Medicare dialysis patients with acute myocardial infarction, 1991–1998 combined

About a third of all dialysis patients sustaining an AMI underwent either a non-invasive stress test or coronary angiography. More than 40% of these patients died less than 30 days after the AMI without any type of evaluation for ischemic heart disease. In patients who survived at least 30 days after AMI, close to one-half received some type of evaluation for ischemic heart disease.



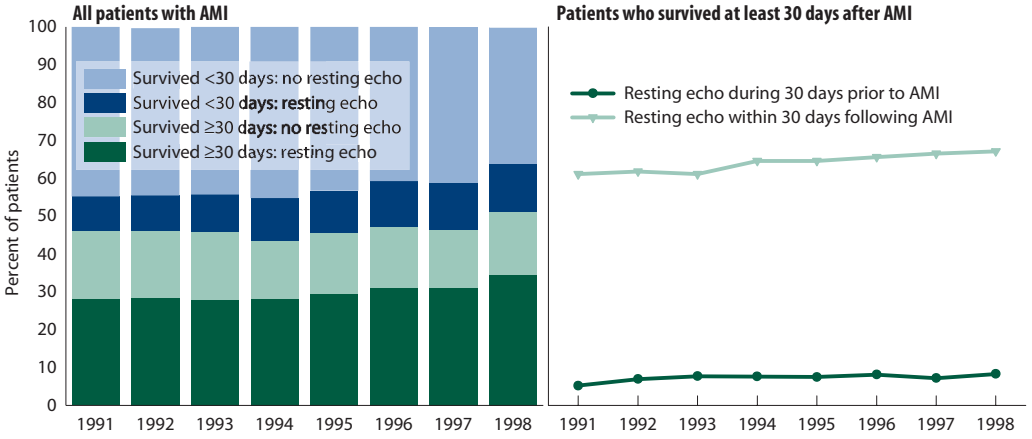


Figure 9.26
Resting echocardiography in dialysis patients with acute myocardial infarction
incident Medicare dialysis patients with acute myocardial infarction, 1991–1998 combined

In contrast to non-invasive stress testing or angiography, about half of the cohort of dialysis patients sustaining an acute myocardial infarction underwent resting echocardiography. About two-thirds of the patients who survived at least 30 days after an acute myocardial infarction received a resting echocardiogram.

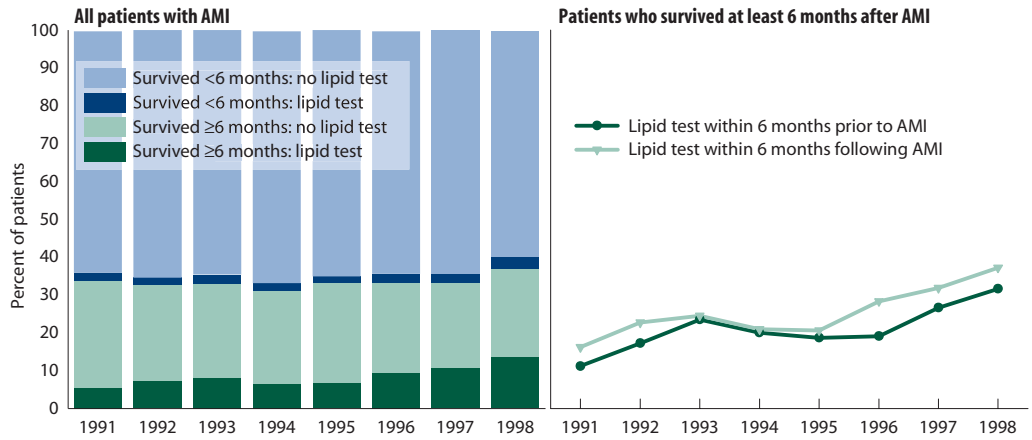


Figure 9.27
Lipid measurement in dialysis patients with acute myocardial infarction
incident Medicare dialysis patients with acute myocardial infarction, 1991–1998 combined

The occurrence of an acute myocardial infarction does not usually trigger a test for lipid measurement. Even in the most recent treatment year of 1998, only one-sixth of the patients had a lipid test of any type done within six months of the index AMI.

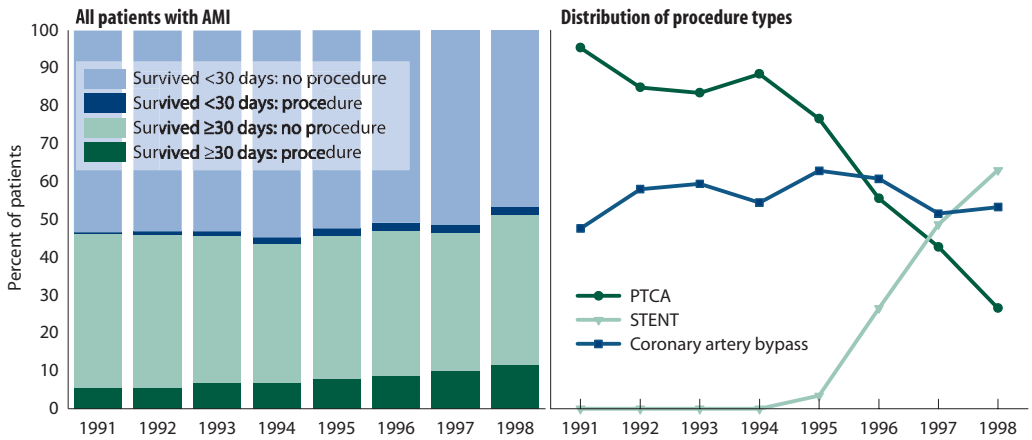


Figure 9.28
Coronary revascularization after coronary angiography in dialysis patients with acute myocardial infarction
incident Medicare dialysis patients with acute myocardial infarction, 1991–1998 combined

Approximately 13% of patients with an AMI in 1998 underwent a coronary revascularization procedure. The type of coronary revascularization has changed over time. The relative proportion of patients undergoing coronary artery bypass surgery has changed little since 1991; the major change has been the rapid proliferation of coronary artery stent use after 1995.