Medicare Hospital Quality Chartbook 2010

Performance Report on Outcomes Measures for Acute Myocardial Infarction, Heart Failure, and Pneumonia

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Figures and Tables

Executive Summary

The 2010 edition of the Centers for Medicare and Medicaid Services (CMS) Hospital Quality Performance Update presents analyses that provide insights into hospital performance on the publicly reported outcomes measures for patients with acute myocardial infarction (AMI), heart failure, and pneumonia. We provide information about recent trends in hospital performance and variation in outcomes by hospital characteristics, location, patient disparities, and cost. The focus is on hospital achievement as measured by two patient outcomes, 30-day risk-standardized mortality and readmission rates, which convey information about the quality of care from a national perspective. Highlights of the report include the following:

National Trends and Distributions

- There is variation in hospital-level outcomes for AMI, heart failure, and pneumonia across the country. Shifting performance toward better care and outcomes has the potential to avert thousands of deaths and readmissions.
- In the period just preceding public reporting (2006 - 2008) there were no notable reductions in the nation's risk-standardized readmission rates for AMI, heart failure, and pneumonia.
- Hospital performance for 30-day mortality does not dictate the performance for 30-day readmission. The quality being assessed by these two measures is distinct, and a substantial proportion of hospitals do well on both measures.

Disparities

- In comparison to the national average, hospitals with high proportions of African-American patients do not have worse 30-day risk-standardized mortality rates for AMI, heart failure, and pneumonia.
- In comparison to the national average, hospitals with high proportions of African-American patients do have slightly worse 30-day risk-standardized readmission rates for AMI, heart failure, and pneumonia.
- In comparison to the national average, hospitals with high proportions of low income patients do not have worse 30-day risk-standardized mortality or readmission rates for AMI, heart failure, and pneumonia.
- Compared to non-safety net hospitals, safety net hospitals have slightly higher 30-day risk-standardized mortality rates. However, there is substantial overlap in their performance, and many safety net hospitals have excellent performance.
- Safety net hospitals and non-safety net hospitals did not differ in 30-day risk-standardized readmission rates.

Outcomes by Hospital Characteristics

- Teaching hospitals have slightly lower 30-day risk-standardized mortality rates than non-teaching hospitals. However, there is substantial overlap in their performance, and many non-teaching hospitals have excellent performance.
- Teaching hospitals and non-teaching hospitals did not differ in 30-day risk-standardized readmission rates.

Outcomes by Region

- There is marked variation in 30-day risk-standardized mortality and readmission rates by region. We highlight better and worse performing hospital referral regions (HRRs) for each condition and outcome, in comparison to the national rates. We also highlight hospital referral regions that do better or worse than the national average on more than one condition and measure. In comparison to the national average:
- 1 HRR was a worse performer on mortality for all three conditions.
- 4 HRRs were better performers on mortality for all three conditions.
- 15 HRRs were worse performers on readmission for all three conditions.
- 6 HRRs were better performers on readmission for all three conditions.

Resource Utilization / Cost

- Lengths of stay for AMI, heart failure, and pneumonia have been stable over the past 3 years. The lengths of stay do vary by region.
- The use of skilled nursing facilities (SNFs) for patients with AMI, heart failure, and pneumonia varies markedly by hospitals, and there has been a recent increase in discharges to SNFs for heart failure and pneumonia.
- Hospitals that make high use of SNFs were not associated with lower 30-day risk-standardized readmission rates.
- Payments for AMI vary substantially by hospital, suggesting that there are opportunities to decrease cost.
- Risk-standardized payment is not associated with the 30-day risk-standardized mortality rate, suggesting that cost could be decreased without reducing quality.

There is much variation in performance among the nation's hospitals. Hospital type does not predict performance well. The race and income of hospital patient populations are also not strong predictors of performance. Readmission rates prior to public reporting were not changing appreciably. Costs also vary and are not associated with quality. Regional differences are quite notable. There is much opportunity for improvement based on the performance on critical patient outcomes currently being achieved by many of the nation's hospitals.

What are Risk-Standardized Mortality Rates (RSMRs) and Risk-Standardized Readmission Rates (RSRRs)?

Hospital Outcome of Care Measures

The hospital outcome measures used in this report include CMS' 30-day Risk-Standardized Mortality Rates (RSMRs) and 30-day Risk-Standardized Readmission Rates (RSRRs) for Medicare fee for service (FFS) patients admitted to the hospital for heart attack (acute myocardial infarction or AMI), heart failure, or pneumonia. These mortality and readmission measures were endorsed by the National Quality Forum and are publicly reported by CMS on the Web site, **Hospital Compare**. This box provides a brief overview of how the rates are calculated. A full description of the measures is available in several reports on the QualityNet Web site (Mortality Reports and Readmission Reports).

Patients Included in the Measures

The measures include admissions for Medicare FFS beneficiaries aged ≥65 at non-federal acute care hospitals discharged with a principal discharge diagnosis of AMI, heart failure, or pneumonia and with a complete claims history for the 12 months prior to the date of admission. The measures exclude certain admissions for patients, including those who were discharged against medical advice. The detailed inclusion and exclusion criteria for each measure are in Appendix A.

Measured Outcomes

The mortality rates assess death from any cause within 30 days of an index admission (regardless of whether the patient dies while still in the hospital or after discharge). The readmission rates assess readmissions for any reason within 30 days of discharge from a hospital stay. Patients may have been readmitted to the same hospital, to a different hospital, or to an acute care facility. The AMI measure, however, does not count admissions for certain procedures that may be part of planned follow-up care as a readmission.

Risk-Adjustment

To level the playing field across hospitals, the measures adjust for key differences in patient risk factors that are clinically relevant and have strong relationships with the outcome (e.g. demographic factors, patient comorbidities). For each patient, covariates are obtained from Medicare claims extending 12 months prior and including the index admission. The models seek to adjust for case differences based on the clinical status of the patient at the time of admission. Accordingly, only comorbidities that convey information about the patient at that time or in the 12 months prior, and not complications that arise during the course of the hospitalization, are included in the risk-adjustment.

Calculating the RSMRs and RSRRs

The mortality and readmission measures use hierarchical logistic regression to create RSMRs and RSRRs at the hospital level that reflect hospital quality.

The RSMRs/RSRRs are calculated as the ratio of the number of "predicted" to the number of "expected" deaths/readmissions, multiplied by the national unadjusted mortality/readmission rate. For each hospital, the "numerator" of the ratio is the number of deaths/readmissions within 30 days predicted on the basis of the hospital's performance with its observed case mix, and the "denominator" is the number of deaths/readmissions expected on the basis of the nation's performance with that hospital's case mix. This approach is analogous to a ratio of "observed" to "expected" used in other types of statistical analyses. It conceptually allows for a comparison of a particular hospital's performance given its case-mix to an average hospital's performance with the same case-mix. Thus a lower ratio indicates lower-than-expected mortality (or readmission) and better quality and a higher ratio indicates higher-than-expected mortality (or readmission) and worse quality.

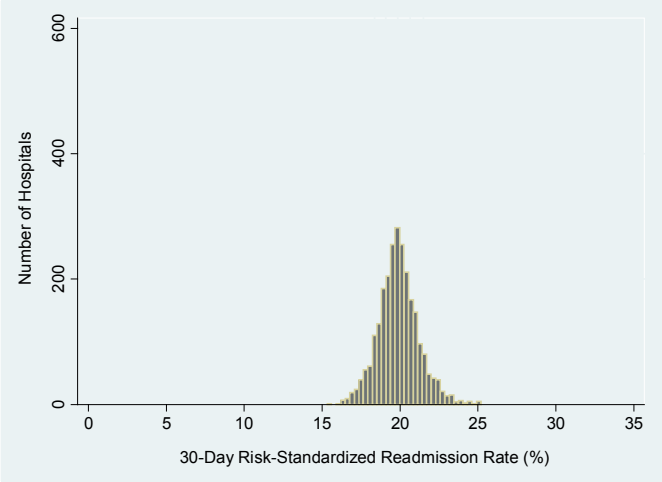
National Crude Rates, 2006-2008 (%)

National Rate	AMI	Heart Failure	Pneumonia
Mortality	15.8	10.9	11.4
Readmission	19.9	24.6	18.2

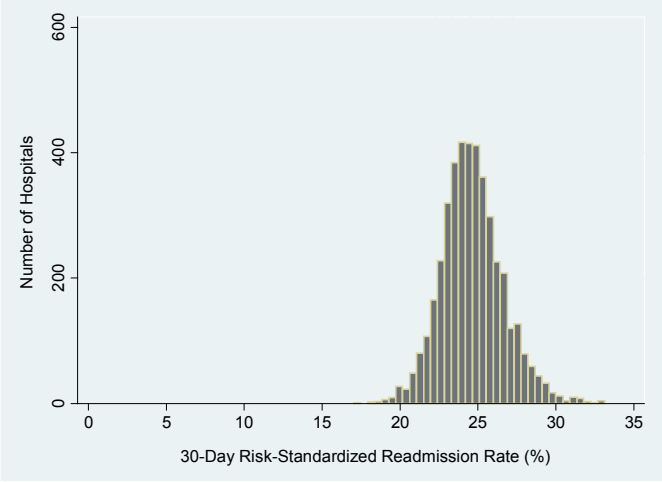
There is Variation in 30-Day Readmission Rates Across Hospitals

Fig. 1.1 Distribution of Hospital RSRRs, 2006-2008
Medicare FFS beneficiaries aged ≥65 years

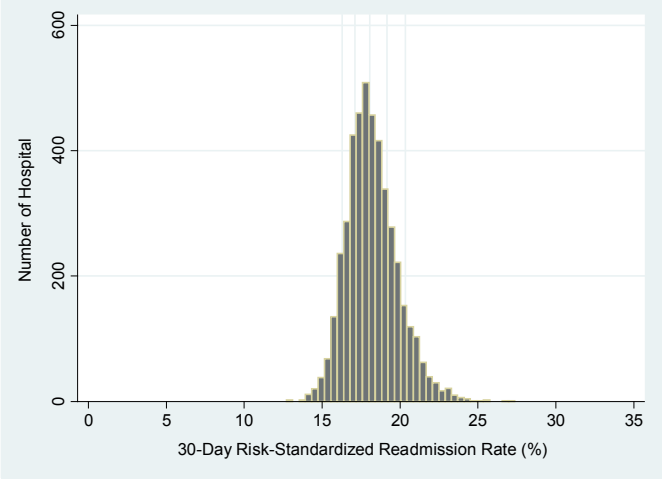
a. AMI



b. Heart failure



c. Pneumonia



Variations in risk-standardized readmission rates (RSRRs) reflect differences in hospital quality of care. The figures and the table below show the distribution of the hospital RSRRs for AMI, heart failure, and pneumonia.

Table 1.1 Distribution of Hospital RSRRs, 2006-2008 (%)

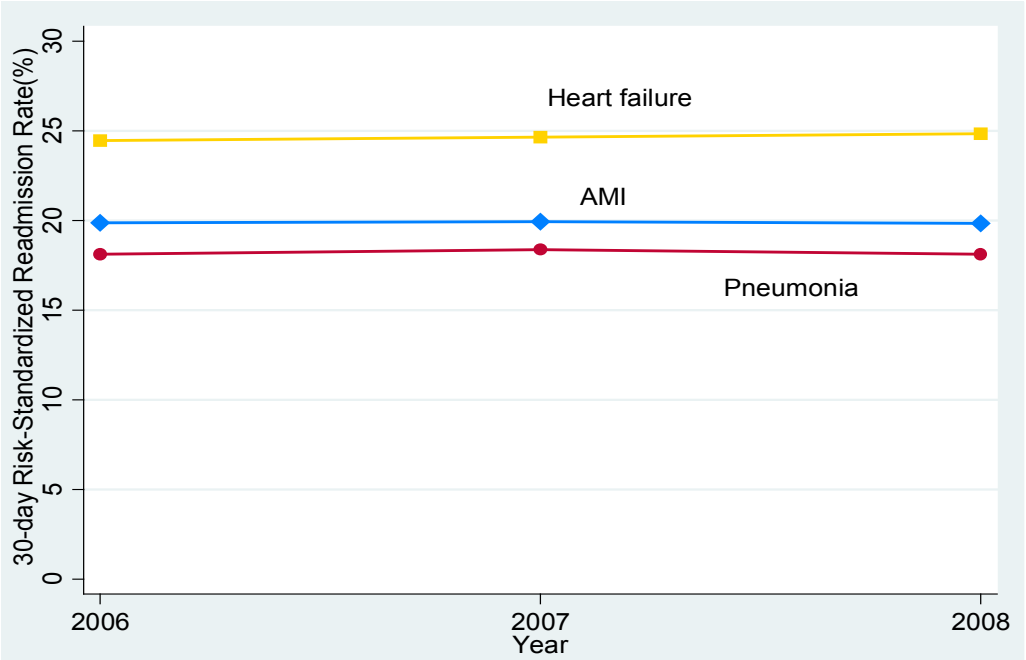
	AMI	Heart failure	Pneumonia
Minimum	15.3	17.0	12.7
10%	18.4	22.3	16.3
25%	19.1	23.4	17.1
Median (50%)	19.9	24.5	18.1
75%	20.7	25.8	19.2
90%	21.5	27.2	20.4
Maximum	25.2	33.2	27.4

A 20% reduction in the national readmission rate would prevent approximately 7,000 readmissions per year for AMI, 22,000 for heart failure, and 14,000 for pneumonia.

Source Data and Population: Condition-specific RSRR Measure Cohorts—January 2006-December 2008 (Appendix A.II).
Notes: 1) The results of hospitals with fewer than 25 cases of the condition over the three-year period are not shown, however these hospitals have been included in RSRR calculations. 2) Total number of hospitals included in the analysis for: AMI = 2,541; HF = 4,260; and pneumonia = 4,475.

Pre-Public Reporting Readmission Rates Were High and Stable

Figure 1.2 Trend in Median Hospital RSRRs, 2006-2008
Medicare FFS beneficiaries aged ≥65 years



Source Data and Population: Condition-specific RSRR Measure Cohorts—January 2006-December 2008 (Appendix A.II).
Notes: 1) The results of hospitals with fewer than 25 cases of the condition in each year are not shown, however these hospitals have been included in RSRR calculations. 2) For AMI, the total number of hospitals was 2,450 in 2006, 1,652 in 2007, and 1,668 in 2008. 3) For HF, the total number of hospitals was 4,177 in 2006, 4,115 in 2007, and 4,061 in 2008. 4) For pneumonia, the total number of hospitals was 4,407 in 2006, 4,351 in 2007, and 4,351 in 2008.

Tracking whether hospital-level risk-standardized readmission rates (RSRRs) have changed over time is important to help monitor whether recent efforts to improve quality of care and reduce readmissions have been effective. The above figure and the table below show the trend in 30-day RSRRs from 2006 to 2008. Public reporting of readmission outcomes began only in 2009.

The lack of improvement during the pre-public reporting period suggests absent or ineffective strategies for preventing readmissions.

Whether public reporting will affect these rates remains to be seen.

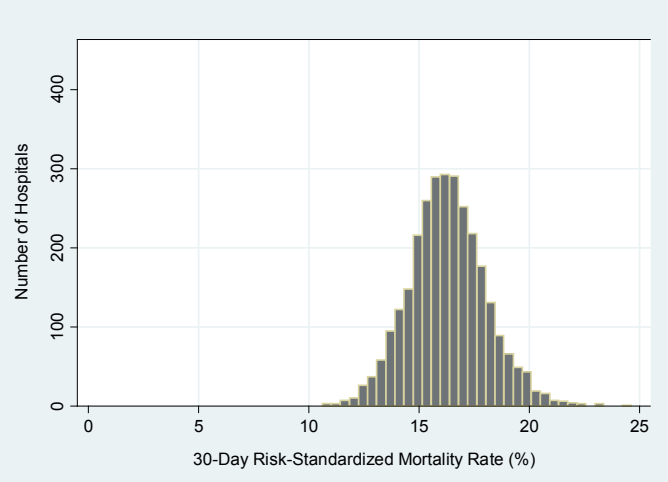
Table 1.2 Trend in Hospital RSRRs (%)

	2006		2007		2008	
Condition	**Median**	**Range**	**Median**	**Range**	**Median**	**Range**
AMI	19.9	15.6 - 24.4	19.9	16.9 - 23.7	19.8	16.9 - 24.0
Heart failure	24.4	18.8 - 30.7	24.6	18.5 - 31.2	24.8	20.2 - 31.7
Pneumonia	18.0	13.9 - 26.8	18.3	14.6 - 24.3	18.1	14.0 - 23.3

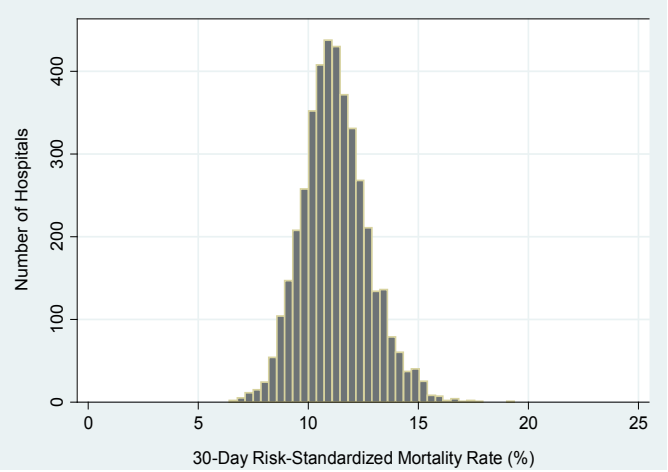
There Is Variation in 30-Day Mortality Rates Across Hospitals

Figure 1.3 Distribution of Hospital RSMRs, 2006-2008
Medicare FFS beneficiaries aged ≥65 years

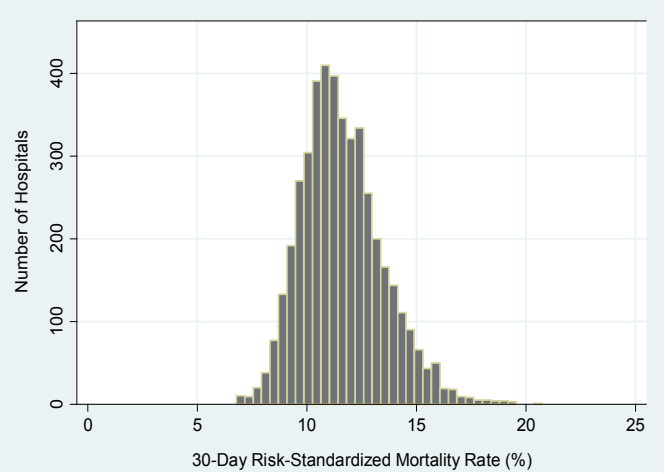
a. AMI



b. Heart failure



c. Pneumonia



Variation in risk-standardized mortality rates (RSMRs) reflects differences in hospital quality of care. The figures and table indicate a wide distribution of hospital RSMRs for AMI, heart failure, and pneumonia.

Table 1.3 Distribution of Hospital RSMRs, 2006-2008 (%)

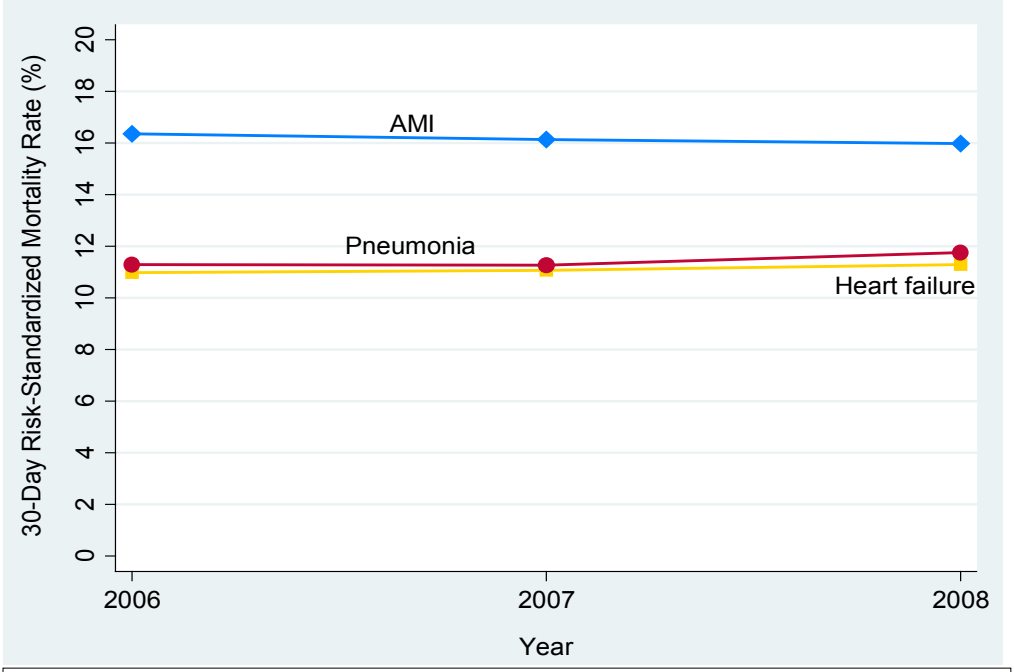
	AMI	Heart Failure	Pneumonia
Minimum	10.6	6.4	6.8
10%	14.1	9.4	9.4
25%	15.2	10.2	10.3
50% (Median)	16.3	11.1	11.4
75%	17.4	12.1	12.7
90%	18.5	13.2	14.1
Maximum	24.6	19.4	20.7

A 10% reduction in national average RSMR could save approximately 3,000 lives for AMI and 4,000 lives for heart failure and for pneumonia, suggesting substantial opportunities for improvement.

Source Data and Population: Condition-specific RSMR Measure Cohorts—January 2006-December 2008 (Appendix A.I).
Notes: 1) The results of hospitals with fewer than 25 cases of the condition over the three-year period are not shown, however these hospitals have been included in RSMR calculations. 2) Total number of hospitals included in the analysis for: AMI = 2,943; HF = 4,175; and pneumonia = 4,453.

Risk-Standardized Mortality Rates Changed Slightly in Recent Years

Figure 1.4 Trend in Median Hospital RSMRs, 2006-2008
Medicare FFS beneficiaries aged ≥65 years



Source Data and Population: Condition-specific RSMR Measure Cohorts—January 2006-December 2008 (Appendix A.I).
Notes: 1) The results of hospitals with fewer than 25 cases of the condition in each year are not shown, however these hospitals have been included in RSMR calculations. 2) For AMI, the total number of hospitals was 2,022 in 2006, 1,944 in 2007, and 1,879 in 2008. 3) For HF, the total number of hospitals was 3,269 in 2006, 3,121 in 2007, and 3,071 in 2008. 4) For pneumonia, the total number of hospitals was 3,747 in 2006, 3,638 in 2007, 3,657 in 2008.

In the period prior to public reporting of outcome measures by CMS (before June 2008), mortality rate trends for AMI, heart failure, and pneumonia differed. Mortality rates for AMI continued to decline, a trend that has been previously documented since the mid-1990s.[1] Heart failure mortality rates remained relatively constant, a lack of change also previously reported since 1994.[2] Meanwhile, mortality rates for pneumonia increased slightly.

If the slight increase in pneumonia mortality rates is sustained, it will become important to understand why.

Table 1.4 Trend in Hospital RSMRs (%)

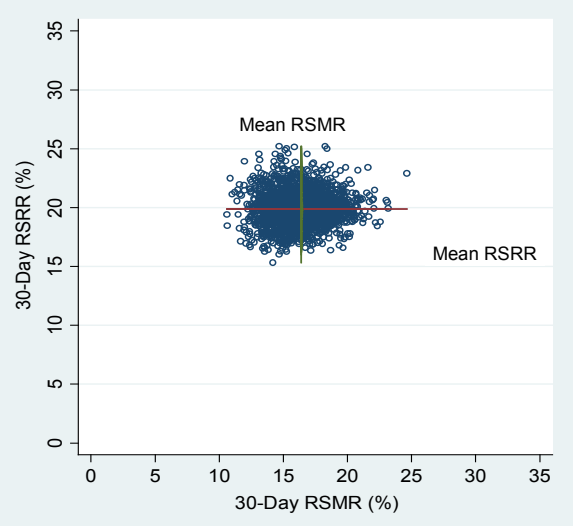
	2006		2007		2008	
Condition	**Median**	**Range**	**Median**	**Range**	**Median**	**Range**
AMI	16.4	11.7 - 22.1	16.1	11.7 - 21.3	16.0	11.1 - 25.2
Heart failure	11.0	7.0 - 17.5	11.1	7.5 - 17.0	11.3	7.8 - 17.0
Pneumonia	11.3	7.2 - 18.2	11.3	6.7 - 18.8	11.8	6.7 - 18.6

1. Chen, J; Circulation. 2010;121:1322-1328.
2. Bueno, H; JAMA. 2010;303:2141-2147.

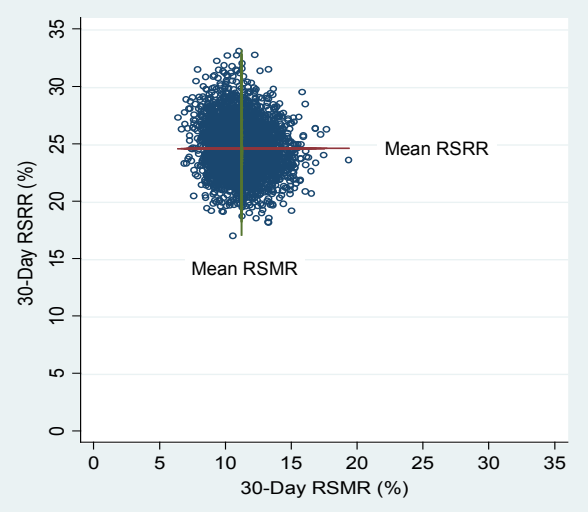
There Is No Association Between Hospital Readmission and Mortality Rates

Figure 1.5 Scatterplot of Hospital RSRR by RSMR, 2006-2008
Medicare FFS beneficiaries aged ≥65 years

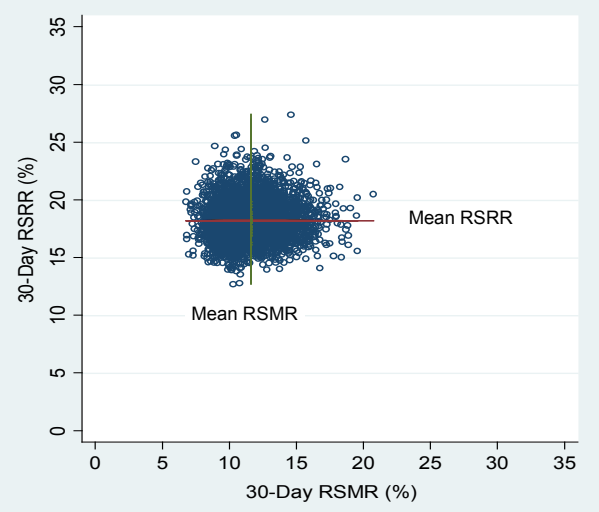
a. AMI



b. Heart failure



c. Pneumonia



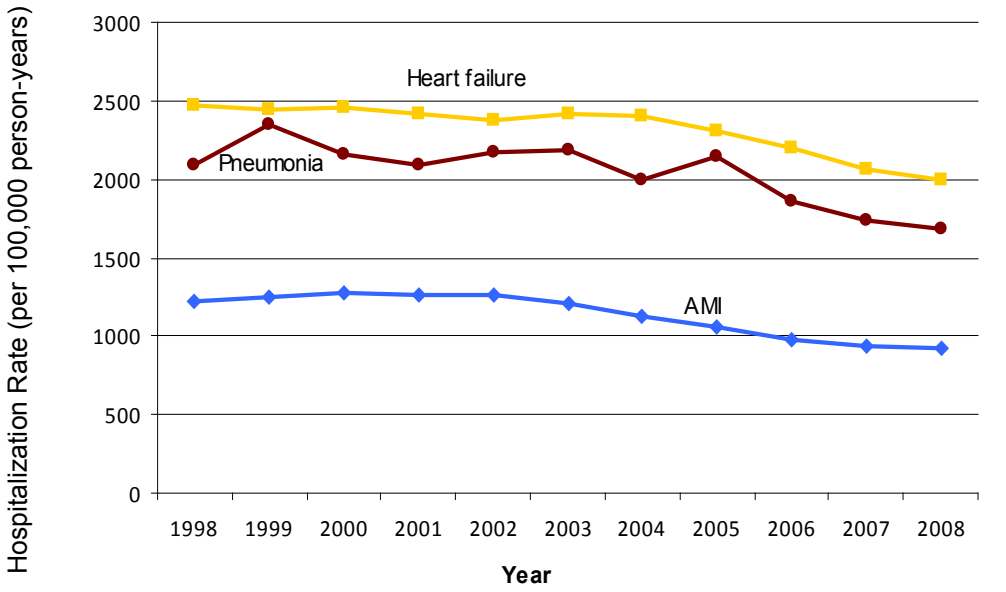
Hospital performance on mortality and readmission represent different aspects of quality. There has been public concern whether achieving better mortality outcome could compromise hospital performance on readmission. The figures show absence of a consistent association between RSMR and RSRR for AMI, heart failure, and pneumonia. A subset of hospitals (in lower left quadrants) has low mortality and low readmission rates, demonstrating that it is possible to achieve high performance on both measures.

The lack of consistent association between performance on readmission and mortality measures supports publicly reporting both measures. Quality initiatives should focus on achieving excellence on both clinical outcomes.

Source Data and Population: Condition-specific RSMR Measure Cohorts—January 2006-December 2008 (RSMR) (Appendix A.I); Condition-specific RSRR Measure Cohorts—January 2006-December 2008 (RSRR) (Appendix A.II).
Notes: 1) The results of hospitals with fewer than 25 cases of the condition over the three-year period are not shown, however these hospitals have been included in RSMR and RSRR calculations. 2) Total number of hospitals included in the analysis for: AMI = 4,485; HF = 4,756; and pneumonia = 4,798. 3) The lines indicate the division of the plot into quadrants. 4) Hospitals not present in both RSMR and RSRR cohorts for the same condition were not considered in the analysis.

Hospitalization Rates for AMI, Heart Failure, and Pneumonia Declined Over the Past Decade

Figure 1.6 Trend in Hospitalization Rates, 1998-2008
Medicare beneficiaries aged ≥65 years



Source Data and Population: 1998-2008 Condition-specific Inpatient Admissions from Medicare Database (Appendix A.III).
Notes: 1) For each year, the numerator of the rate is the number of hospitalizations that occurred for the given condition during the year, and the denominator is the total number of person-years of enrollment for Medicare FFS beneficiaries aged ≥65 years. In calculating the denominator, if a beneficiary dies (or switches to managed care) in August, for example, their contribution is 7/12 to the person-year; on the other hand, if a beneficiary becomes eligible for FFS (or switches from managed care to FFS) in August, their contribution is 5/12 to the person-year.

Tracking quality improvement requires examining not only outcomes for hospitalized patients but also hospitalization rates, since the quality of health care influences both whether patients need to be hospitalized and how they fare once admitted. The conditions that are publicly reported had a remarkable decrease in hospitalization rates over the 11 years that spanned 1998-2008. Assuming that this decrease is relevant to all Medicare beneficiaries, there were approximately 100,000 fewer hospitalizations in 2008 than in 1998, per each condition. The reduction in hospitalizations may reflect better prevention and treatment, a healthier cohort of older patients, and/or changing thresholds for admissions at the nation's hospitals.

Table 1.5 Change in Hospitalization Rates, 1998-2008

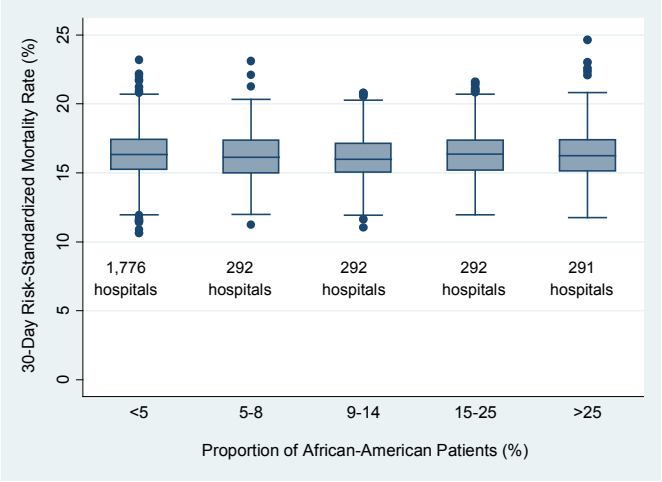
Condition	Hospitalization rate per 100,000 person-years 1998	2008	Change
AMI	1,217	922	-24%
Heart failure	2,477	1,996	-19%
Pneumonia	2,095	1,678	-20%

Despite the fact that AMI, heart failure, and pneumonia continue to be among the most common causes of morbidity/mortality in the elderly, the rates of hospitalization for these conditions have substantially decreased over the past decade.

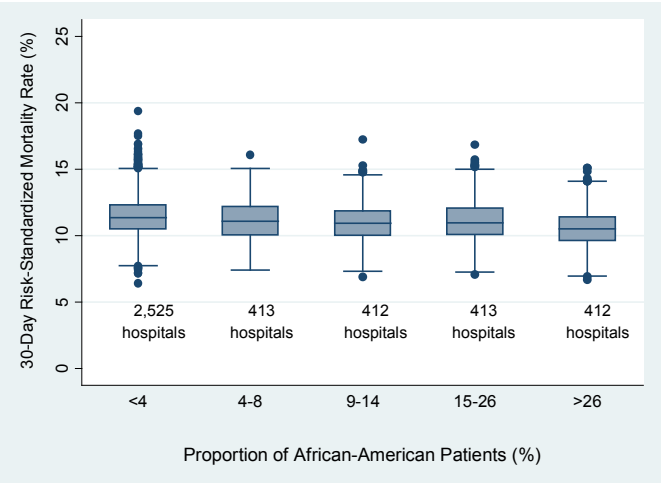
Hospital Mortality Rates for AMI, HF, and Pneumonia Do Not Differ Across Hospitals Treating Various Proportions of African-American Patients

Figure 2.1 RSMR by Proportion of African-American Patients in the Hospital, 2006-2008
Medicare FFS beneficiaries aged ≥65 years

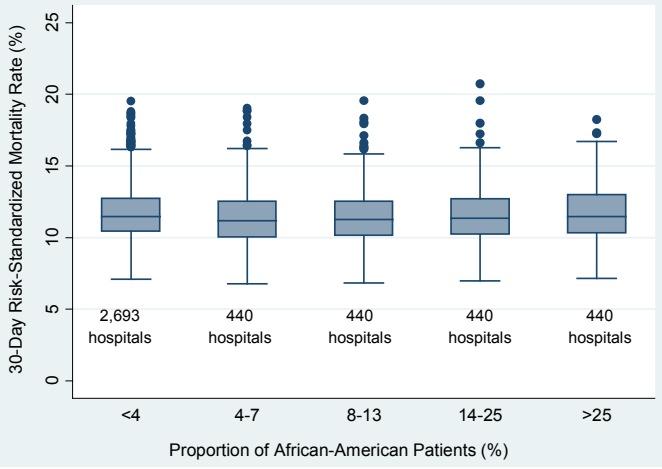
a. AMI



b. Heart failure



c. Pneumonia



Prior research has suggested that racial disparities in health outcomes may be partly explained by the concentration of African-American patients at hospitals with lower quality of care. We compared hospital-level mortality rates (including all patients) among hospitals treating various percentages of African-American patients and found no difference. These hospitals have largely overlapping distributions of RSMR for all three conditions. (Interpretation of box-and-whisker plot is discussed in Appendix B).

Table 2.1 RSMR by Proportion of African-American Patients in the Hospital, 2006-2008 (%)

	Hospitals with Lowest Proportion of AA		Hospitals with Highest Proportion of AA	
Condition	**Median**	**Range**	**Median**	**Range**
AMI	16.3	10.6 – 23.2	16.2	11.8 – 24.6
Heart failure	11.3	6.4 – 19.4	10.5	6.7 – 15.1
Pneumonia	11.5	7.1 – 19.5	11.5	7.1 – 18.2

Hospitals with a disproportionate share of African-American patients can perform at least as well as other hospitals on mortality measures.

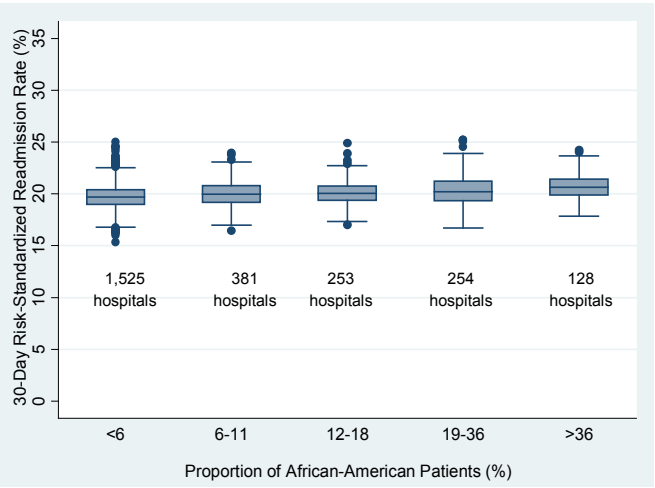
Source Data and Population: Condition-specific RSMR Measure Cohorts—January 2006-December 2008 (RSMR) (Appendix A.I); 2008 Inpatient Admissions from Medicare Database (Proportion of African-American patients) (Appendix A.III).
Notes: 1) The results of hospitals with fewer than 25 cases of the condition over the three-year period are not shown, however these hospitals have been included in RSMR calculations. 2) Total number of hospitals included in the analysis for: AMI = 2,943; HF = 4,175; and pneumonia = 4,453. 3) Interpretation of box-and-whisker plot is discussed in Appendix B.

Hospitals Treating Higher Proportion of African-American Patients Have Higher Readmission Rates for AMI, Heart Failure, and Pneumonia

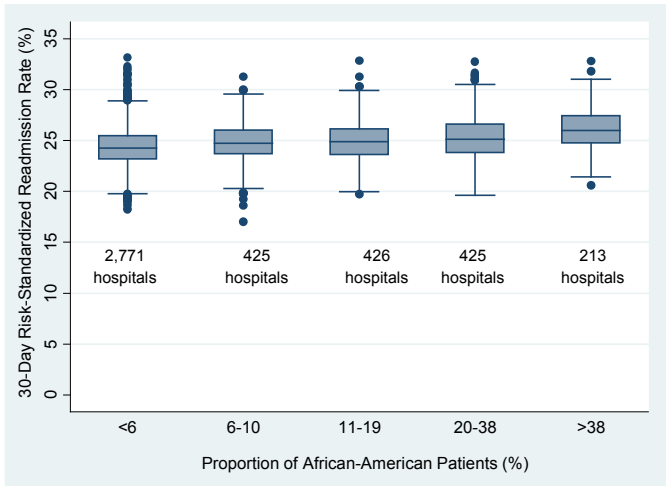
Figure 2.2 RSRR by Proportion of African-American Patients in the Hospital, 2006-2008

Medicare FFS beneficiaries aged ≥65 years

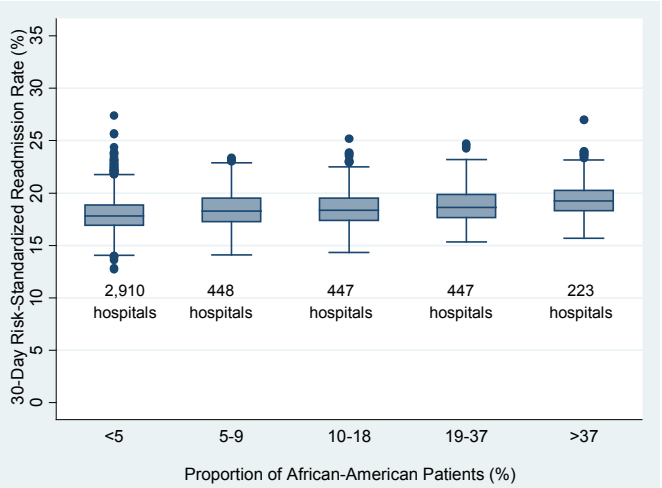
a. AMI



b. Heart failure



c. Pneumonia



Hospitals treating a high proportion of African-American patients, particularly those hospitals where African-Americans constitute greater than 19% of admissions, have higher RSRRs for AMI, heart failure, and pneumonia (rates include all patients). However, as shown in the figures, regardless of hospital proportion of African-American patients, RSRR distributions are wide and similar across hospitals. (Interpretation of box-and-whisker plot is discussed in Appendix B).

Table 2.2 RSRR by Proportion of African-American Patients in the Hospital, 2006-2008 (%)

	Hospitals with Lowest Proportion of AA		Hospitals with Highest Proportion of AA	
Condition	**Median**	**Range**	**Median**	**Range**
AMI	19.7	15.3 – 25.0	20.7	17.9 – 24.2
Heart failure	24.3	18.2 – 33.2	26.0	20.6 – 32.8
Pneumonia	17.8	12.7 – 27.4	19.2	15.7 – 27.0

Hospitals treating more than approximately 20% of African-American patients are worse performers in readmission measures.

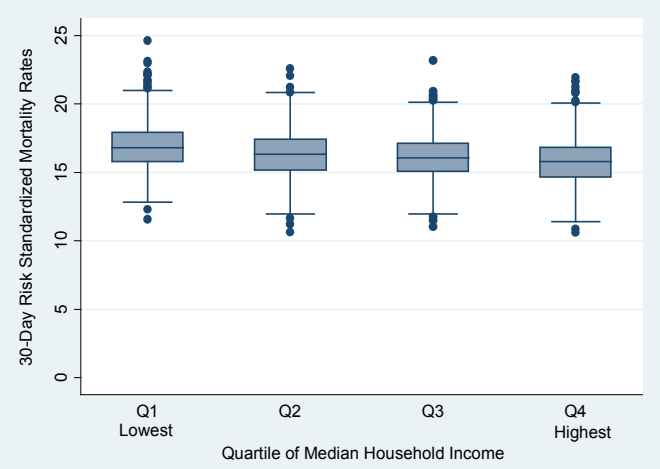
Future work is needed to understand what accounts for higher readmission rates at hospitals treating the largest proportions of African-Americans.

Source Data and Population: Condition-specific RSRR Measure Cohorts—January 2006-December 2008 (RSRR) (Appendix A.II); 2008 Inpatient Admissions from Medicare Database (Proportion of African-American patients) (Appendix A.III).
Notes: 1) The results of hospitals with fewer than 25 cases of the condition over the three-year period are not shown, however these hospitals have been included in RSRR calculations. 2) Total number of hospitals included in the analysis for: AMI = 2,541; HF = 4,260; and pneumonia = 4,475. 3) Interpretation of box-and-whisker plot is discussed in Appendix B.

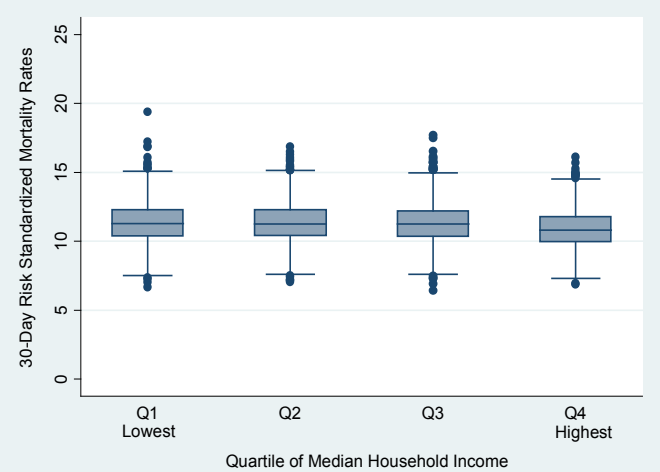
Are Hospitals with a High Proportion of Lower Income Patients More Likely to Perform Poorly on Mortality Measures?

Fig 2.3 RSMR by Income Quartiles, 2006-2008
Medicare FFS beneficiaries aged ≥65 years

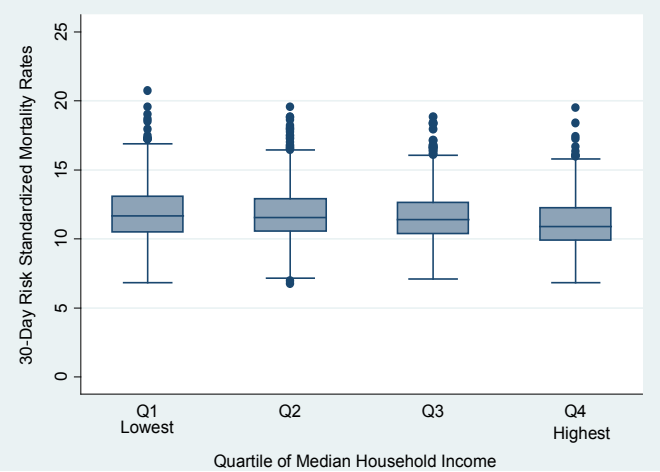
a. AMI



b. Heart failure



c. Pneumonia



Less educated and more economically disadvantaged patients are more likely to experience worse outcomes. We examined whether hospitals which care for a disproportionately larger proportion of patients with lower income perform worse with respect to RSMR for AMI, heart failure, and pneumonia. Hospitals with a higher proportion of lower income patients had higher median mortality rates. However, there was substantial overlap in hospital RSMR distributions in all income quartiles. (Interpretation of box-and-whisker plot is discussed in Appendix B).

Table 2.3 RSMR by Income Quartiles, 2006-2008 (%)

	Lowest Income Quartile		Highest Income Quartile	
Condition	**Median**	**Range**	**Median**	**Range**
AMI	16.8	11.6 - 24.6	15.8	10.6 - 22.0
Heart failure	11.3	6.7 - 19.4	10.8	6.9 - 16.1
Pneumonia	11.7	6.8 - 20.7	10.9	6.8 - 19.5

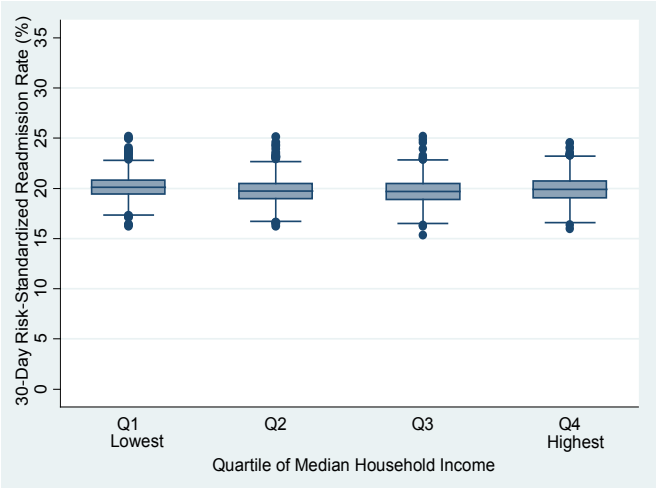
The wide variation in performance within each income quartile and substantial overlap among hospitals in all four income quartiles suggest that hospitals with a high proportion of lower income patients can do well on the measure.

Source Data and Population: Condition-specific RSMR Measure Cohorts—January 2006-December 2008 (RSMR) (Appendix A.I); 2008 Inpatient Admissions from Medicare Database (Appendix A.III) and Census 2000 data (Quartiles of income) (Appendix A.IV).
Notes: 1) The results of hospitals with fewer than 25 cases of the condition over the three-year period are not shown, however these hospitals have been included in RSMR calculations. 2) Income quartiles are estimated using median income level of patients' zip codes based on 2000 Census data. 3) Total number of hospitals included in the analysis for: AMI = 2,943; HF = 4,175; and pneumonia = 4,453. 4) Interpretation of box-and-whisker plot is discussed in Appendix B.

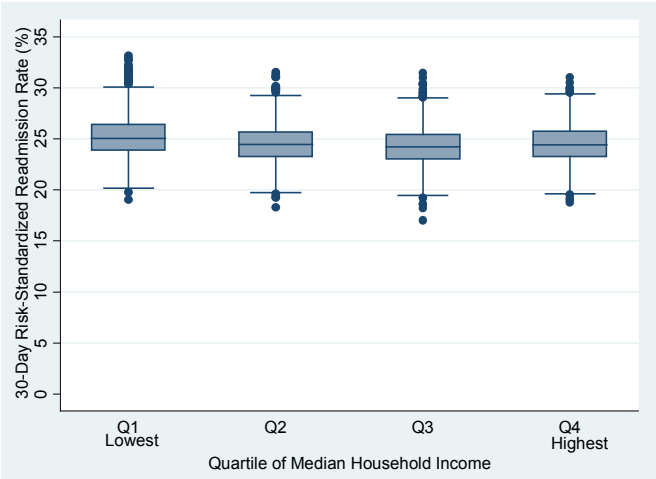
Are Hospitals with a High Proportion of Lower Income Patients More Likely to Perform Poorly on Readmission Measures?

Figure 2.4 RSRR by Income Quartiles, 2006-2008
Medicare FFS beneficiaries aged ≥65 years

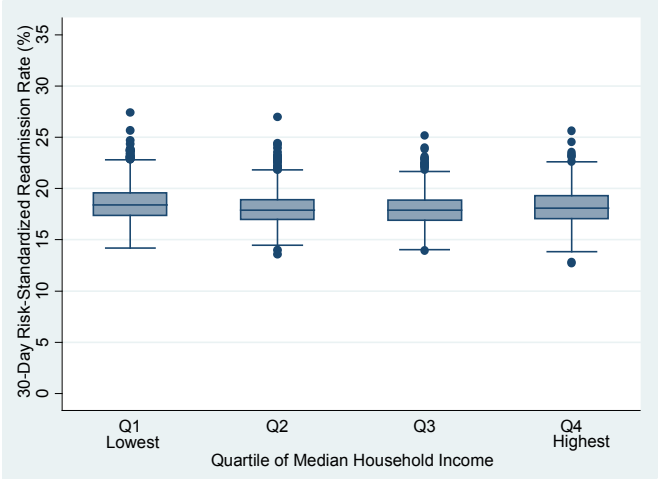
a. AMI



b. Heart failure



c. Pneumonia



Prior research has shown that less educated and more economically disadvantaged patients have less stable access to medical care and may be more likely to be readmitted to a hospital after discharge. We examined whether hospitals treating a larger proportion of patients with lower income perform worse with respect to RSRR for AMI, heart failure, and pneumonia. Hospitals with a higher proportion of lower income patients had slightly higher readmission rates in particular for heart failure and pneumonia. However, there was substantial overlap in hospital RSRR distributions in all income quartiles. (Interpretation of box-and-whisker plot is discussed in Appendix B).

Table 2.4 RSRR by Income Quartiles, 2006-2008 (%)

	Lowest Income Quartile		Highest Income Quartile	
Condition	**Median**	**Range**	**Median**	**Range**
AMI	20.1	16.3 — 25.2	19.9	16.0 — 24.6
Heart failure	25.0	19.0 — 33.2	24.4	18.8 — 31.0
Pneumonia	18.4	14.2 — 27.4	18.1	12.7 — 25.6

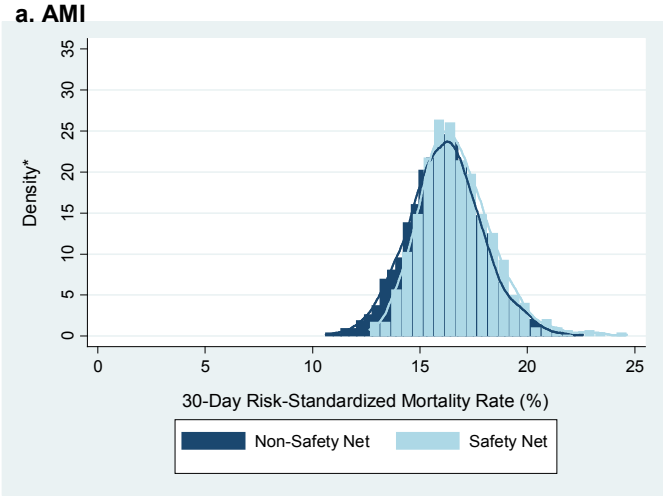
The wide variation in performance within each income quartile and the substantial overlap among hospital RSRR distribution in all four quartiles suggest that hospitals with a higher share of lower income patients can perform at least as well on readmission measures.

Source Data and Population: Condition-specific RSRR Measure Cohorts—January 2006-December 2008 (RSRR) (Appendix A.II); 2008 Inpatient Admissions from Medicare Database (Appendix A.III) and Census 2000 data (Quartiles of income) (Appendix A.IV).
Notes: 1) The results of hospitals with fewer than 25 cases of the condition over the three-year period are not shown, however these hospitals have been included in RSRR calculations. 2) Income quartiles are estimated using median income level of patients' zip codes based on 2000 Census data. 3) Total number of hospitals included in the analysis for: AMI = 2,541; HF = 4,260; and pneumonia = 4,475. 4) Interpretation of box-and-whisker plot is discussed in Appendix B.

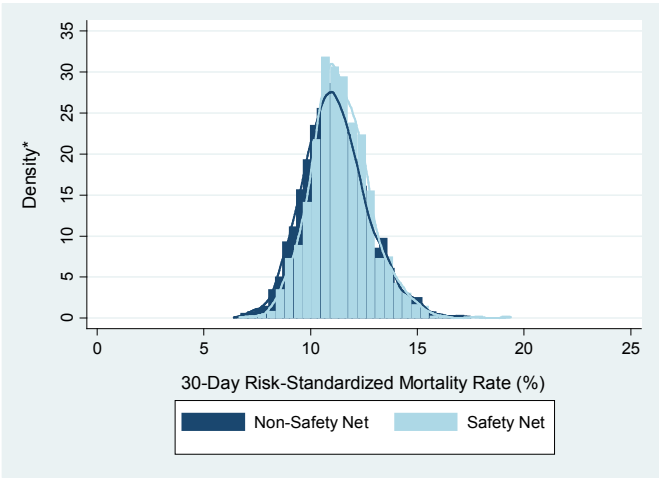
Does Safety Net Status Impact Hospital Mortality Rates?

Figure 2.5 RSMR by Hospital Safety Net Status, 2006-2008*
Medicare FFS beneficiaries aged ≥65 years

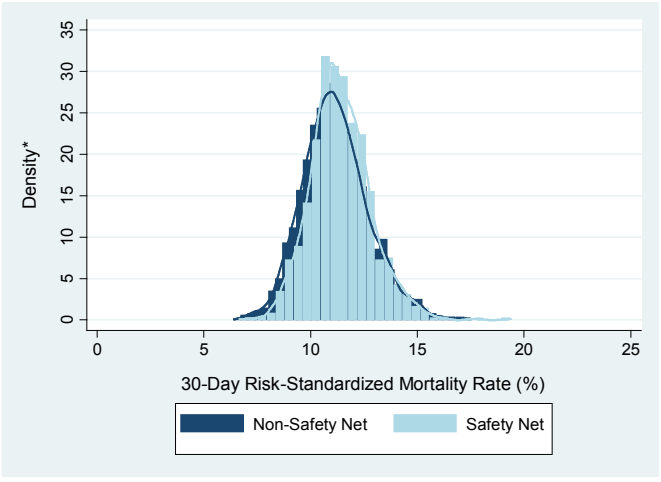
a. AMI



b. Heart failure



c. Pneumonia



* The y-axis represents density instead of number of hospitals to facilitate comparison between the two types of hospitals with different sample sizes.

Safety net hospitals provide care for vulnerable and financially disadvantaged populations and constitute approximately 25-30% of all hospitals. We compared safety net and non-safety net hospitals' performance for RSMRs. The 30-day mortality rates are slightly higher for safety net hospitals. However there is a substantial overlap in RSMR distribution between these two types of hospitals.

Table 2.5 RSMR by Hospital Safety Net Status, 2006-2008 (%)

	Safety Net		Non-Safety Net	
Condition	**Median**	**Range**	**Median**	**Range**
AMI	16.5	11.6 - 24.6	16.2	10.6 - 22.6
Heart failure	11.3	6.7 - 19.4	11.1	6.4 - 17.5
Pneumonia	11.6	6.8 - 19.6	11.3	6.8 - 20.7

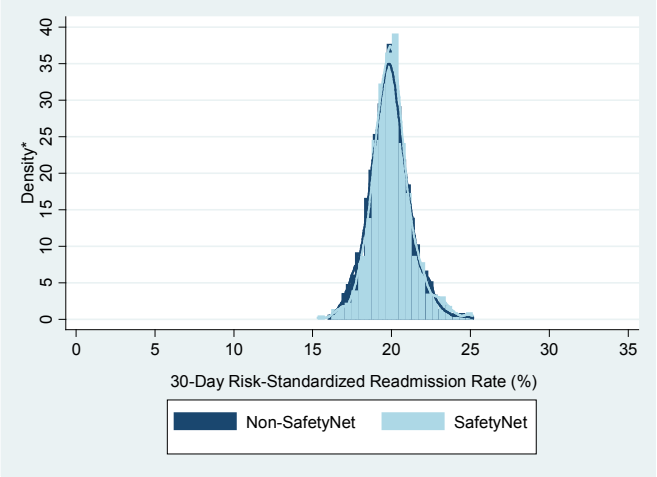
Safety net hospitals have a similar range of performance as non-safety net hospitals on mortality measures despite caring for a large number of vulnerable patients.

Source Data and Population: Condition-specific RSMR Measure Cohorts—January 2006-December 2008 (RSMR) (Appendix A.I); American Hospital Association 2008 Annual Survey data (Safety net status) (Appendix A.IV).
Notes: 1) The results of hospitals with fewer than 25 cases of the condition over the three-year period are not shown, however these hospitals have been included in RSMR calculations. 2) Safety net hospitals are defined as those committed to caring for populations without stable access to care, specifically public hospitals or private hospitals with a Medicaid caseload greater than one standard deviation above their respective state's mean private hospital Medicaid caseload. 3) Total number of hospitals included in the analysis for: AMI = 2,238; HF = 2,851; and pneumonia = 2,851. 4) For AMI, number of safety net hospitals = 677 and number of non-safety net hospitals = 2,180. 5) For HF, number of safety net hospitals = 1,187 and number of non-safety net hospitals = 2,848. 6) For pneumonia, number of safety net hospitals = 1,346 and number of non-safety net hospitals = 2,960.

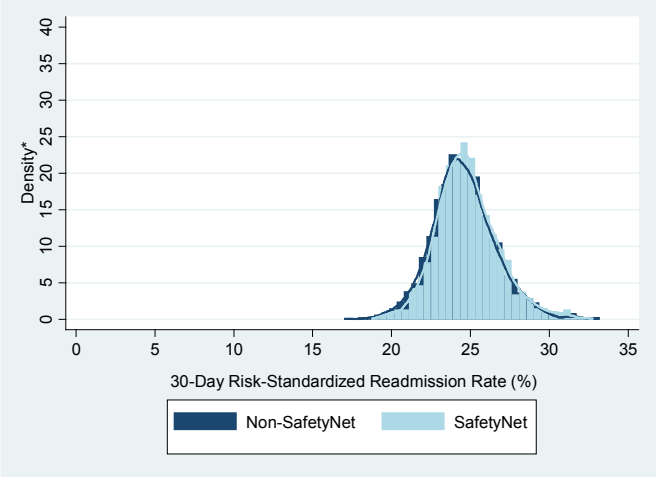
Does Safety Net Status Impact Hospital Readmission Rates?

Figure 2.6 RSRR by Hospital Safety Net Status, 2006-2008*
Medicare FFS beneficiaries aged ≥65 years

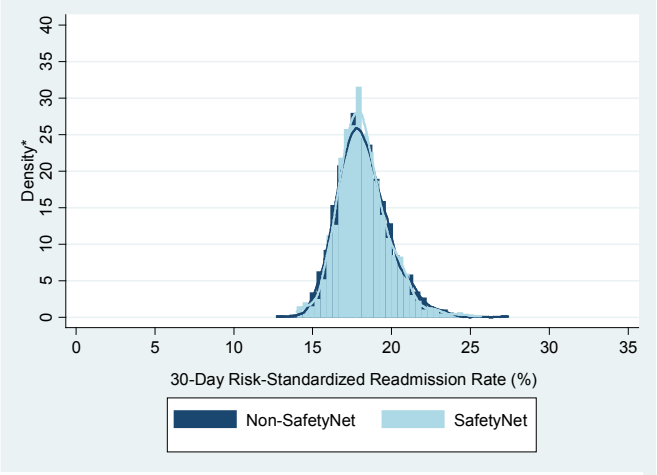
a. AMI



b. Heart failure



c. Pneumonia



* The y-axis represents density instead of number of hospitals to facilitate comparison between the two types of hospitals with different sample sizes.

Safety net hospitals provide care within communities for individuals without stable access to care, including vulnerable and financially disadvantaged populations, and constitute approximately 25-30% of all hospitals. As these populations are more likely to be readmitted, safety net hospitals may have higher readmission rates. We compared readmission rates between safety net and non-safety net hospitals and found a virtually perfect overlap in RSRR distribution between these two types of hospitals.

Table 2.6 RSRR by Hospital Safety Net Status, 2006-2008 (%)

	Safety Net		Non-Safety Net	
Condition	**Median**	**Range**	**Median**	**Range**
AMI	20.0	15.3 - 25.2	19.8	16.0 - 25.2
Heart failure	24.7	18.8 - 32.8	24.5	17.0 - 33.2
Pneumonia	18.0	14.0 - 25.7	18.1	12.7 - 27.4

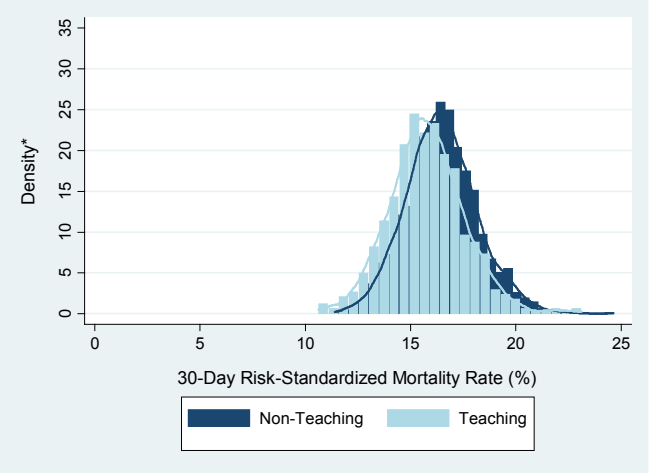
There is no indication that quality of care relating to readmission varies by safety net status.

Source Data and Population: Condition-specific RSRR Measure Cohorts—January 2006–December 2008 (RSRR) (Appendix A.II); American Hospital Association 2008 Annual Survey data (Safety-net status) (Appendix A.IV).
Notes: 1) The results of hospitals with fewer than 25 cases of the condition over the three-year period are not shown, however these hospitals have been included in RSRR calculations. 2) Safety net hospitals are defined as those committed to caring for populations without stable access to care, specifically public hospitals or private hospitals with a Medicaid caseload greater than one standard deviation above their respective state's mean private hospital Medicaid caseload. 3) Total number of hospitals included in the analysis for: AMI = 2,463; HF = 4,111; and pneumonia = 4,328. 4) For AMI, number of safety net hospitals = 546 and number of non-safety net hospitals = 1,917. 5) For HF, number of safety net hospitals = 1,227 and number of non-safety net hospitals = 2,884. 6) For pneumonia, number of safety net hospitals = 1,355 and number of non-safety net hospitals = 2,973.

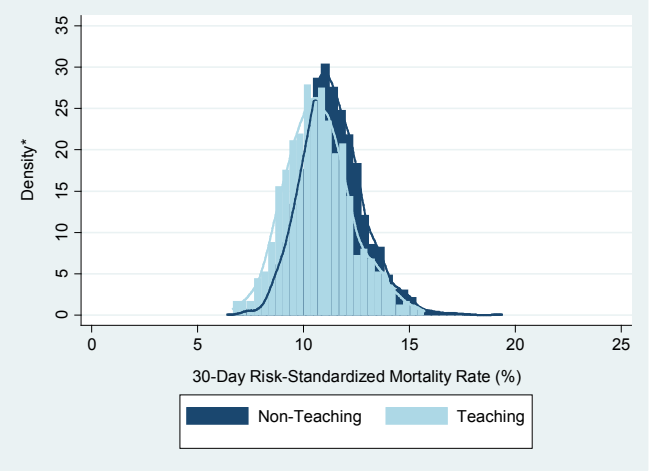
Teaching and Non-Teaching Hospitals Show a Similar Range of Performance in RSMR

Figure 3.1 RSMR by Hospital Teaching Status, 2006-2008*
Medicare FFS beneficiaries aged ≥65 years

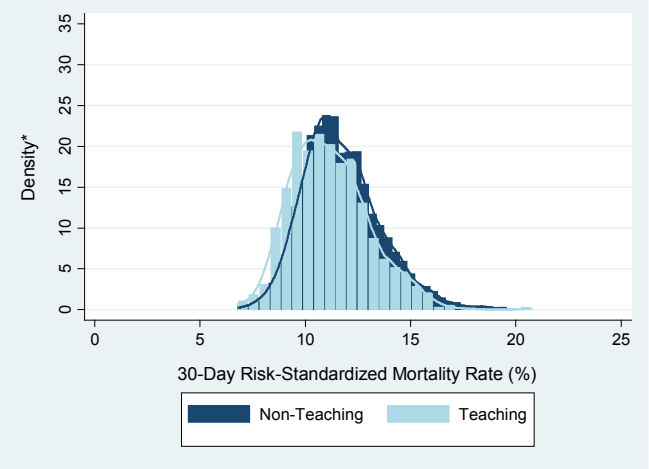
a. AMI



b. Heart failure



c. Pneumonia



* The y-axis represents density instead of number of hospitals to facilitate comparison between the two types of hospitals with different sample sizes.

Teaching hospitals may have a different approach to patient care than non-teaching hospitals, which may in turn impact mortality rates. When comparing RSMRs between teaching and non-teaching hospitals, we found that teaching hospitals achieved slightly lower mortality rates for all three conditions. However, there was a substantial overlap in the RSMR distribution between these two types of hospitals.

Table 3.1 RSMR by Hospital Teaching Status, 2006-2008 (%)

	Teaching		Non-Teaching	
Condition	**Median**	**Range**	**Median**	**Range**
AMI	15.8	10.6 - 23.1	16.4	11.4 – 24.6
Heart failure	10.7	6.7 - 15.7	11.3	6.4 – 19.4
Pneumonia	11.1	6.8- 20.7	11.5	6.8 – 19.6

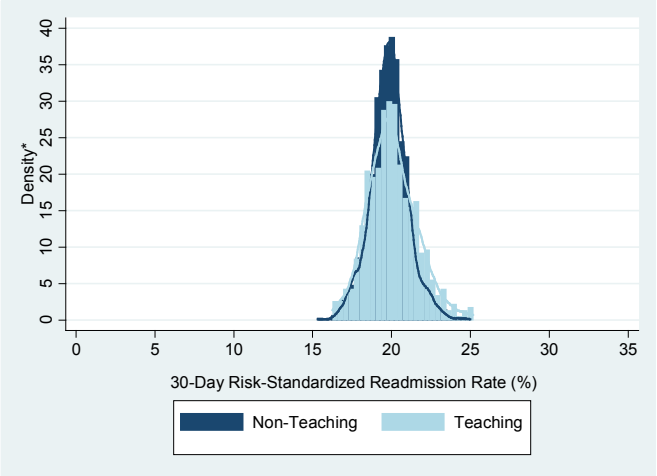
Our analysis suggests that non-teaching hospitals can perform as well as teaching hospitals on the mortality measure.

Source Data and Population: Condition-specific RSMR Measure Cohorts—January 2006-December 2008 (RSMR) (Appendix A.I); American Hospital Association 2008 Annual Survey data (Teaching status) (Appendix A.IV).
Notes: 1) The results of hospitals with fewer than 25 cases of the condition over the three-year period are not shown, however these hospitals have been included in RSMR calculations. 2) Total number of hospitals included in the analysis for: AMI = 2,847; HF = 4,025; and pneumonia = 4,297. 3) For AMI, number of teaching hospitals = 715 and number of non-teaching hospitals = 2,132. 4) For HF, number of teaching hospitals = 751 and number of non-teaching hospitals = 3,274. 5) For pneumonia, number of teaching hospitals = 757 and number of non-teaching hospitals = 3,540.

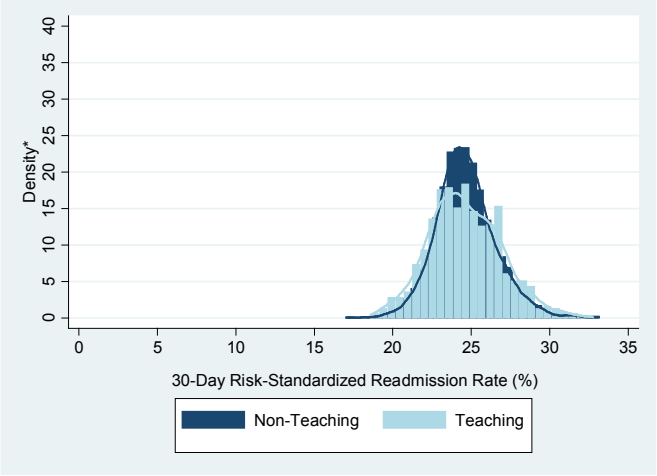
There Is No Difference Between Teaching and Non-Teaching Hospitals in Terms of Readmission Rates

Figure 3.2 RSRR by Hospital Teaching Status, 2006-2008*
Medicare FFS beneficiaries aged ≥65 years

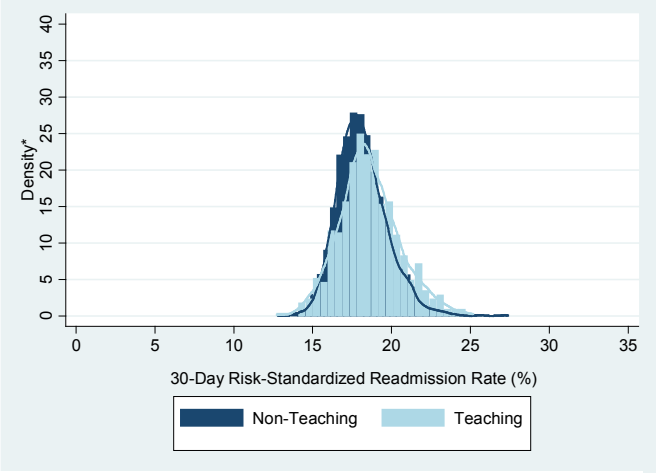
a. AMI



b. Heart failure



c. Pneumonia



* The y-axis represents density instead of number of hospitals to facilitate comparison between the two types of hospitals with different sample sizes.

Teaching hospitals may approach patient care differently than non-teaching hospitals, which may in turn impact readmission rates. We compared 30-day RSRRs between teaching and non-teaching hospitals for AMI, heart failure, and pneumonia and found a substantial overlap in RSRR distribution between these two types of hospitals.

Table 3.2 RSRR by Hospital Teaching Status, 2006-2008 (%)

	Teaching		Non-Teaching	
Condition	**Median**	**Range**	**Median**	**Range**
AMI	19.9	16.3 – 25.2	19.9	15.3 – 25.0
Heart failure	24.5	18.6 – 32.8	24.5	17.0 – 33.2
Pneumonia	18.5	12.7 – 25.2	18.0	12.8 – 27.4

Teaching and non-teaching hospitals have a similar range of performance on 30-day readmission measures for all three conditions.

Source Data and Population: Condition-specific RSRR Measure Cohorts—January 2006-Decemeber 2008 (RSRR) (Appendix A.II); American Hospital Association 2008 Annual Survey data (Teaching status) (Appendix A.IV).
Notes: 1) The results of hospitals with fewer than 25 cases of the condition over the three-year period are not shown, however these hospitals have been included in RSRR calculations. 2) Total number of hospitals included in the analysis for: AMI = 2,463; HF = 4,111; and pneumonia = 4,328. 3) For AMI, number of teaching hospitals = 700 and number of non-teaching hospitals = 1,763. 4) For HF, number of teaching hospitals = 761 and number of non-teaching hospitals = 3,350. 5) For pneumonia, number of teaching hospitals = 765 and number of non-teaching hospitals = 3,563.

Methodology for Regional Variation in Outcomes

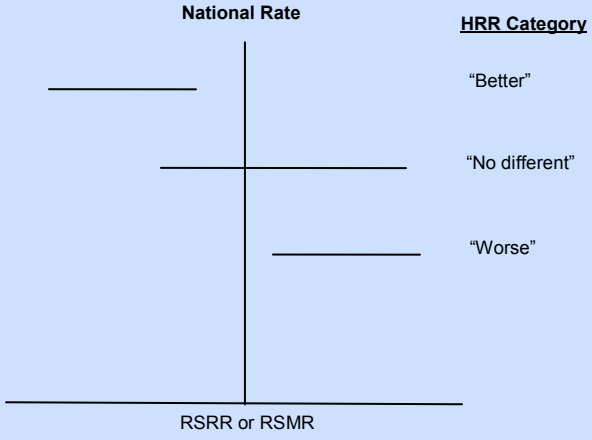
Definition of Hospital Referral Region

Hospital referral regions (HRRs) represent regional health care markets for tertiary medical care that generally requires the services of a major referral center. HRRs were defined in the Dartmouth Atlas of Health Care, 1999, by documenting where patients were referred for major cardiovascular surgical procedures and for neurosurgery. Each HRR contains at least one city where both major cardiovascular procedures and neurosurgery are performed.

HRR Ranking Methodology

For ranking HRRs based on outcomes, hospital-level RSMRs or RSRRs are aggregated to the HRR level. The variances of hospital estimated rates are calculated from the results of a bootstrapping simulation. The inverse of the variance is used to weight the hospital level results before averaging them at HRR level. Hospitals with larger sample sizes, which usually have small variances of the estimated rates and therefore more precise estimates, lend more weight to the average. For assigning whether an HRR is significantly different than the national rate, we used a 2-level (hospital and HRR) hierarchical linear model with hospital RSMR or RSRR as the dependent variable and an HRR-level random intercept in the model.

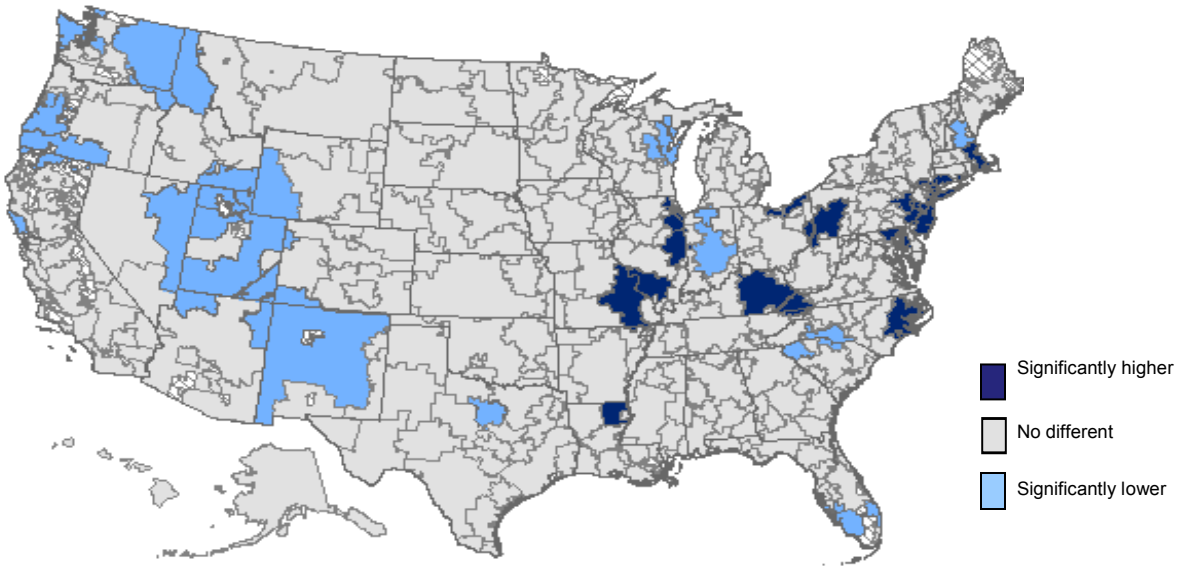
The intercept of each specific HRR was compared with the overall intercept to see if the 95% interval estimate for the RSMR or RSRR for the specific HRR includes the estimate of the overall intercept.



National Rate (%)	AMI	Heart failure	Pneumonia
RSMR	16.3	11.3	11.7
RSRR	19.9	24.6	18.3

Regional Variation in Hospital Readmission Rates for AMI

Figure 4.1 Classification of HRRs by AMI RSRR, 2006-2008
Medicare FFS beneficiaries aged ≥65 years



Source Data and Population: AMI RSRR Measure Cohort—July 2006-June 2008—publicly reported RSRRs (Appendix A.II).
Notes: 1) The HRRs are classified as being significantly higher, no different, or significantly lower than the unadjusted national average. 2) Total number of hospitals included in the analysis = 4,099.

Hospital referral regions (HRRs) with AMI RSRRs significantly lower than the national average (better performers) are predominantly in sections of the West (Pacific and Mountain), East North Central, and the South Atlantic regions. HRRs with RSRRs significantly higher than the national average (worse performers) are mostly in sections of the Midwest and Northeast regions.

Table 4.1a Better-performing HRRs (Lowest RSRRs), 2006-2008

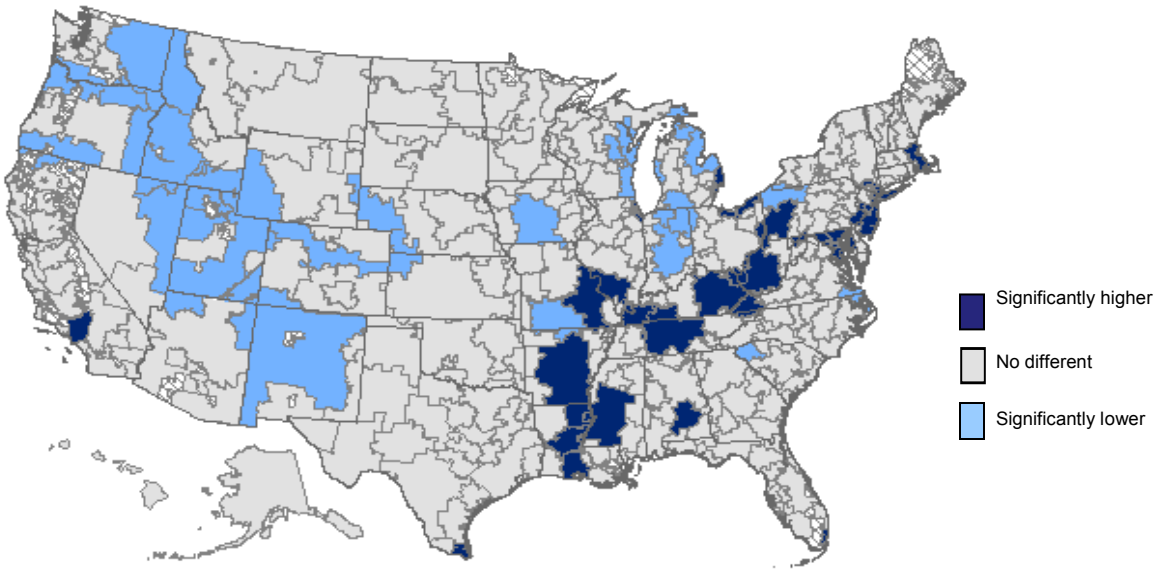
HRR	Mean RSRR (%)
Sarasota, FL	17.3
Greenville, SC	18.2
Santa Rosa, CA	18.2
Ogden, UT	18.2
Fort Myers, FL	18.5
Seattle, WA	18.6
Medford, OR	18.6
Manchester, NH	18.8
South Bend, IN	18.8
Appleton, WI	18.8
Green Bay, WI	18.9
Indianapolis, IN	18.9
Charlotte, NC	18.9
Eugene, OR	19.1
Spokane, WA	19.2
Salt Lake City, UT	19.2
Albuquerque, NM	19.2
Fort Worth, TX	19.3
Fort Lauderdale, FL	19.4

Table 4.1b Worse-performing HRRs (Highest RSRRs), 2006-2008

HRR	Mean RSRR (%)	HRR	Mean RSRR (%)
Blue Island, IL	22.1	White Plains, NY	20.8
Manhattan, NY	21.7	Camden, NJ	20.8
Bronx, NY	21.4	Urbana, IL	20.8
Joliet, IL	21.3	Philadelphia, PA	20.8
New Brunswick, NJ	21.3	Kingsport, TN	20.7
Elgin, IL	21.3	Allentown, PA	20.7
East Long Island, NY	21.2	St. Louis, MO	20.6
New Haven, CT	21.1	Greenville, NC	20.6
Newark, NJ	21.0	Melrose Park, IL	20.5
Monroe, LA	21.0	Boston, MA	20.5
Baltimore, MD	21.0	Cleveland, OH	20.4
Chicago, IL	21.0	Lexington, KY	20.3
Hackensack, NJ	21.0	Pittsburgh, PA	20.3

Regional Variation in Hospital Readmission Rates for Heart Failure

Figure 4.2 Classification of HRRs by Heart Failure RSRR, 2006-2008
Medicare FFS beneficiaries aged ≥65 years



Source Data and Population: HF RSRR Measure Cohort—July 2006-June 2008—publicly reported RSRRs (Appendix A.II).
Notes: 1) The HRRs are classified as being significantly higher, no different, or significantly lower than the unadjusted national average. 2) Total number of hospitals included in the analysis = 4,196.

Hospital referral regions (HRRs) with HF RSRRs significantly lower than the national average (better performers) are predominantly in sections of the West (Pacific and Mountain) and East North Central regions. HRRs with RSRRs significantly higher than the national average (worse performers) are mostly in sections of the Midwest and Middle Atlantic regions.

Table 4.2a Better-performing HRRs (Lowest RSRRs), 2006-2008

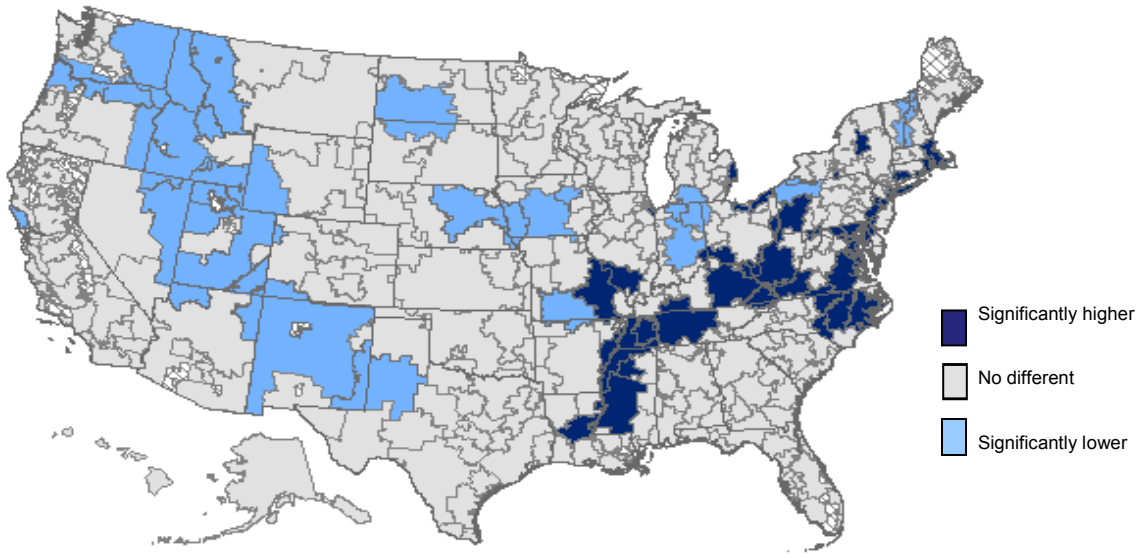
HRR	Mean RSRR (%)
Ogden, UT	21.1
Greenville, SC	21.7
Muskegon, MI	21.7
Petoskey, MI	22.1
Salt Lake City, UT	22.2
South Bend, IN	22.2
Green Bay, WI	22.5
Appleton, WI	22.5
Erie, PA	22.7
Medford, OR	22.8
Spokane, WA	22.9
Fort Wayne, IN	23.0
Kalamazoo, MI	23.1
Springfield, MO	23.2
Boise, ID	23.3
Albuquerque, NM	23.4
Denver, CO	23.4
Indianapolis, IN	23.4
Norfolk, VA	23.4
Portland, OR	23.5
Milwaukee, WI	23.7
Des Moines, IA	23.8
Saginaw, MI	23.9

Table 4.2b Worse-performing HRRs (Highest RSRRs), 2006-2008

HRR	Mean RSRR (%)	HRR	Mean RSRR (%)
Bronx, NY	28.3	Monroe, LA	25.9
Manhattan, NY	27.9	St. Louis, MO	25.8
New Brunswick, NJ	27.8	Paducah, KY	25.7
Takoma Park, MD	27.2	White Plains, NY	25.7
Huntington, WV	27.0	Cleveland, OH	25.7
Chicago, IL	27.0	Boston, MA	25.6
Blue Island, IL	27.0	Miami, FL	25.6
Newark, NJ	27.0	Camden, NJ	25.6
Hackensack, NJ	26.8	Nashville, TN	25.5
Baltimore, MD	26.6	Little Rock, AR	25.4
Evanston, IL	26.6	Washington, DC	25.4
Harlingen, TX	26.6	Kingsport, TN	25.4
Lafayette, LA	26.4	Charleston, WV	25.4
Philadelphia, PA	26.2	Jackson, MS	25.3
East Long Island, NY	26.2	Montgomery, AL	25.3
Alexandria, LA	26.1	Lexington, KY	25.2
Detroit, MI	26.0	Los Angeles, CA	25.0
Pittsburgh, PA	26.0		

Regional Variation in Hospital Readmission Rates for Pneumonia

Figure 4.3 Classification of HRRs by Pneumonia RSRR, 2006-2008
Medicare FFS beneficiaries aged ≥65 years



Source Data and Population: Pneumonia RSRR Measure Cohort—July 2006-June 2008—publicly reported RSRRs (Appendix A.II).
Notes: 1) The HRRs are classified as being significantly higher, no different, or significantly lower than the unadjusted national average. 2) Total number of hospitals included in the analysis = 4,200.

Hospital referral regions (HRRs) with pneumonia RSRRs significantly lower than the national average (better performers) are predominantly in sections of the West and North Central regions. HRRs with RSRRs significantly higher than the national average (worse performers) are mostly in sections of the East/North Central and Northeast regions.

Table 4.3a Better-performing HRRs (Lowest RSRRs), 2006-2008

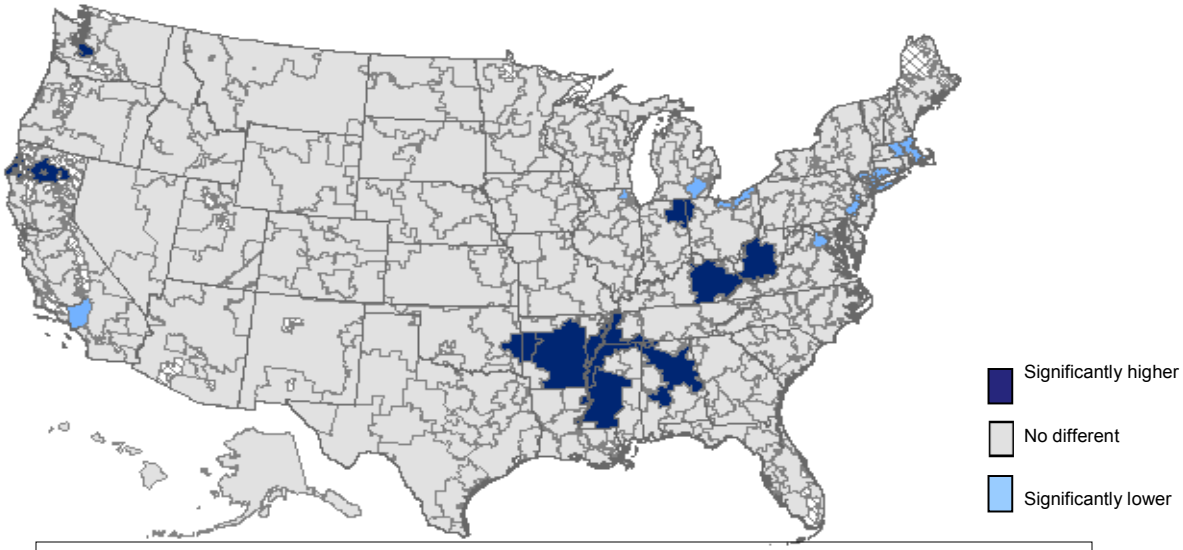
HRR	Mean RSRR (%)
Ogden, UT	15.5
Santa Rosa, CA	16.4
Salt Lake City, UT	16.4
Albuquerque, NM	16.6
Boise, ID	16.6
Waterloo, IA	16.7
Fort Wayne, IN	16.8
South Bend, IN	16.9
Bismarck, ND	16.9
Portland, OR	17.0
Springfield, MO	17.1
Kalamazoo, MI	17.1
Erie, PA	17.1
Missoula, MT	17.2
Spokane, WA	17.2
Lubbock, TX	17.2
Indianapolis, IN	17.2
Lebanon, NH	17.2
Des Moines, IA	17.6
Omaha, NE	17.8

Table 4.3b Worse-performing HRRs (Highest RSRRs), 2006-2008

HRR	Mean RSRR (%)	HRR	Mean RSRR (%)
Bronx, NY	22.2	Lexington, KY	19.4
Blue Island, IL	20.8	Huntington, WV	19.3
New Brunswick, NJ	20.7	Roanoke, VA	19.3
Chicago, IL	20.5	Raleigh, NC	19.3
Manhattan, NY	20.3	Richmond, VA	19.3
Elmira, NY	20.3	Durham, NC	19.3
Takoma Park, MD	20.3	Jackson, MS	19.2
East Long Island, NY	20.0	St. Louis, MO	19.2
New Haven, CT	20.0	Cincinnati, OH	19.2
Hackensack, NJ	19.9	Philadelphia, PA	19.1
Newark, NJ	19.9	Greenville, NC	19.1
Oxford, MS	19.8	Nashville, TN	19.1
Kingsport, TN	19.8	Boston, MA	19.1
Alexandria, LA	19.7	Charleston, WV	19.0
Wilmington, DE	19.7	Jackson, TN	18.8
Baltimore, MD	19.6	Cleveland, OH	18.8
Washington, DC	19.5	Pittsburgh, PA	18.8
Detroit, MI	19.5	Memphis, TN	18.8
Providence, RI	19.4		

Regional Variation in Hospital Mortality Rates for AMI

Figure 4.4 Classification of HRRs by AMI RSMR, 2006-2008
Medicare FFS beneficiaries aged ≥65 years



Source Data and Population: AMI RSMR Measure Cohort—July 2006-June 2008—publicly reported RSMRs (Appendix A.I).
Notes: 1) The HRRs are classified as being significantly higher, no different, or significantly lower than the unadjusted national average. 2) Total number of hospitals included in the analysis = 4,569.

Hospital referral regions (HRRs) with AMI RSMRs significantly lower than the national average (better performers) are predominantly in Mid-Atlantic and Northeast states. HRRs with RSMRs significantly higher than the national average (worse performers) are mostly in sections of the South (East South Central) and the Midwest (East North Central) regions.

Table 4.4a Better-performing HRRs (Lowest RSMRs), 2006-2008

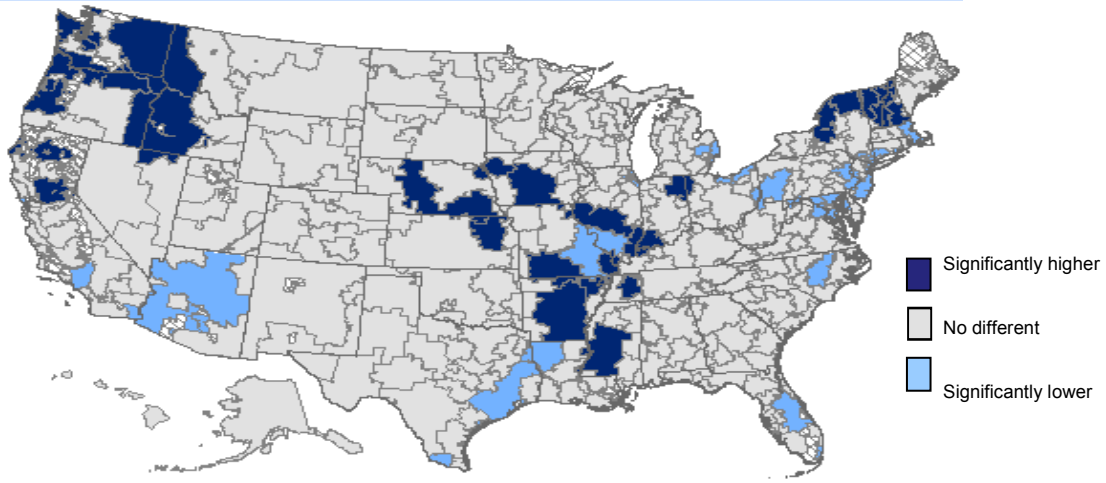
HRR	Mean RSMR (%)
Hackensack, NJ	13.2
Worcester, MA	13.5
Bridgeport, CT	13.8
Elgin, IL	13.9
New Haven, CT	14.3
Manhattan, NY	14.4
Arlington, VA	14.4
Ann Arbor, MI	14.6
Boston, MA	14.8
White Plains, NY	14.9
Los Angeles, CA	15.0
Chicago, IL	15.0
East Long Island, NY	15.1
Cleveland, OH	15.1
Philadelphia, PA	15.3

Table 4.4b Worse-performing HRRs (Highest RSMRs), 2006-2008

HRR	Mean RSMR (%)
Tacoma, WA	19.0
Fort Smith, AR	17.8
Redding, CA	17.8
Memphis, TN	17.1
Fort Wayne, IN	17.0
Little Rock, AR	16.9
Charleston, WV	16.8
Birmingham, AL	16.7
Lexington, KY	16.6
Jackson, MS	16.6

Regional Variation in Hospital Mortality Rates for Heart Failure

Figure 4.5 Classification of HRRs by Heart Failure RSMR, 2006-2008
Medicare FFS beneficiaries aged ≥65 years



Source Data and Population: HF RSMR Measure Cohort—July 2006-June 2008—publicly reported RSMRs (Appendix A.I).
Notes: 1) The HRRs are classified as being significantly higher, no different, or significantly lower than the unadjusted national average. 2) Total number of hospitals included in the analysis = 4,743

Hospital referral regions (HRRs) with HF RSMRs significantly lower than the national average (better performers) are predominantly in sections of the Southwest, South, and Midwest, as well as in Mid-Atlantic and Northeast states. HRRs with RSMRs significantly higher than the national average (worse performers) are mostly in sections of the Northwest, Northeast, and Midwest.

Table 4.5a Better-performing HRRs (Lowest RSMRs), 2006-2008

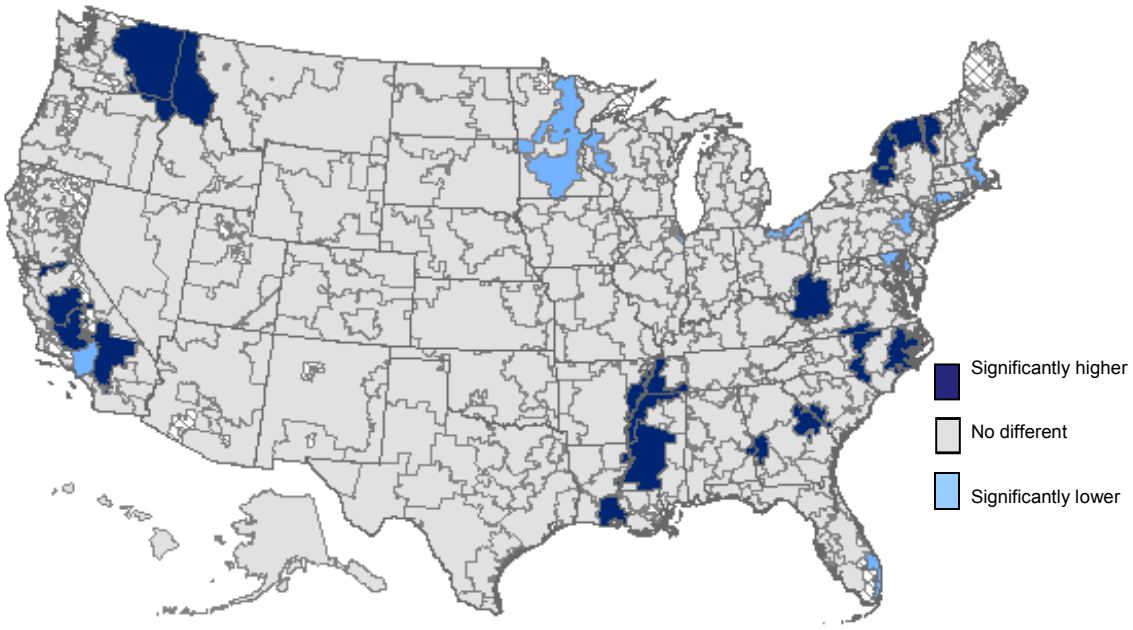
HRR	Mean RSMR (%)	HRR	Mean RSMR (%)
Munster, IN	7.9	Miami, FL	9.8
Manhattan, NY	8.9	Evanston, IL	9.8
Chicago, IL	9.0	White Plains, NY	9.8
Flint, MI	9.0	Philadelphia, PA	9.8
Blue Island, IL	9.1	New Haven, CT	10.0
Bronx, NY	9.3	Washington, DC	10.1
Allentown, PA	9.3	Baltimore, MD	10.1
McAllen, TX	9.3	Raleigh, NC	10.1
Boston, MA	9.4	Houston, TX	10.1
Cleveland, OH	9.4	Arlington, VA	10.1
Melrose Park, IL	9.5	Orlando, FL	10.2
Shreveport, LA	9.5	Camden, NJ	10.2
Hackensack, NJ	9.5	San Francisco, CA	10.3
Los Angeles, CA	9.6	Pittsburgh, PA	10.4
Newark, NJ	9.6	Phoenix, AZ	10.5
Detroit, MI	9.7	St. Louis, MO	10.6
Mesa, AZ	9.8		

Table 4.5b Worse-performing HRRs (Highest RSMRs), 2006-2008

HRR	Mean RSMR (%)
Tacoma, WA	13.7
Redding, CA	13.3
Jonesboro, AR	12.9
Cape Girardeau, MO	12.8
Springfield, IL	12.3
Burlington, VT	12.3
Little Rock, AR	12.2
Sioux City, IA	12.2
Lebanon, NH	12.2
Portland, OR	12.2
Boise, ID	12.1
Eugene, OR	12.1
Sacramento, CA	12.0
Springfield, MO	12.0
Fort Wayne, IN	11.9
Des Moines, IA	11.9
Topeka, KS	11.9
Manchester, NH	11.9
Syracuse, NY	11.9
Jackson, TN	11.9
Seattle, WA	11.9
Spokane, WA	11.9
Evansville, IN	11.8
Jackson, MS	11.8
Lincoln, NE	11.5

Regional Variation in Hospital Mortality Rates for Pneumonia

Figure 4.6 Classification of HRRs by Pneumonia RSMR, 2006-2008
Medicare FFS beneficiaries aged ≥65 years



Source Data and Population: Pneumonia RSMR Measure Cohort—July 2006-June 2008—publicly reported RSMRs (Appendix A.I).
Notes: 1) The HRRs are classified as being significantly higher, no different, or significantly lower than the unadjusted national average. 2) Total number of hospitals included in the analysis = 4,788.

Hospital Referral Regions (HRRs) with pneumonia RSMRs significantly lower than the national average (better performers) are predominantly in areas of the Upper Midwest and Northeast. HRRs with RSMRs significantly higher than the national average (worse performers) are mainly in sections of the Northwest, Southern California, South, and South Atlantic.

Table 4.6a Better-performing HRRs (Lowest RSMRs), 2006-2008

HRR	Mean RSMR (%)
Blue Island, IL	9.5
Allentown, PA	9.5
New Haven, CT	9.7
Boston, MA	9.8
Miami, FL	9.9
Manhattan, NY	9.9
Cleveland, OH	10.1
Los Angeles, CA	10.2
Fort Lauderdale, FL	10.3
Chicago, IL	10.3
Baltimore, MD	10.4
Minneapolis, MN	10.5

Table 4.6b Worse-performing HRRs (Highest RSMRs), 2006-2008

HRR	Mean RSMR (%)
Stockton, CA	14.8
Columbus,GA	14.6
Bakersfield, CA	14.4
Greenville, NC	13.7
Fresno, CA	13.6
Augusta, GA	13.3
Burlington, VT	13.1
Memphis, TN	12.9
Durham, NC	12.8
San Bernardino, CA	12.5
Lafayette, LA	12.5
Syracuse, NY	12.5
Spokane, WA	12.4
Jackson, MS	12.3
Charleston, WV	12.1

How Do HRRs Perform in Outcome Measures Across Conditions: AMI, Heart Failure, and Pneumonia?

30-Day Risk-Standardized Readmission Rates, 2006-2008

There were 15 hospital referral regions (HRRs) that were worse performers for all three conditions and 6 regions that were better performers for all three conditions, in comparison to the national average.

Table 4.7a Performance Status Compared to the National Average for RSRRs Across Conditions

Worse-performing HRRs		Better-performing HRRs
Baltimore, MD	Lexington, KY	Albuquerque, NM
Blue Island, IL	Manhattan, NY	Indianapolis, IN
Boston, MA	New Brunswick, NJ	Ogden, UT
Bronx, NY	Newark, NJ	Salt Lake City, UT
Chicago, IL	Philadelphia, PA	South Bend, IN
Cleveland, OH	Pittsburgh, PA	Spokane, WA
East Long Island, NY	St. Louis, MO	
Kingsport, TN		

30-Day Risk-Standardized Mortality Rates, 2006-2008

There was only 1 region that performed worse than the national average for all three conditions and 4 regions that performed better for all three conditions.

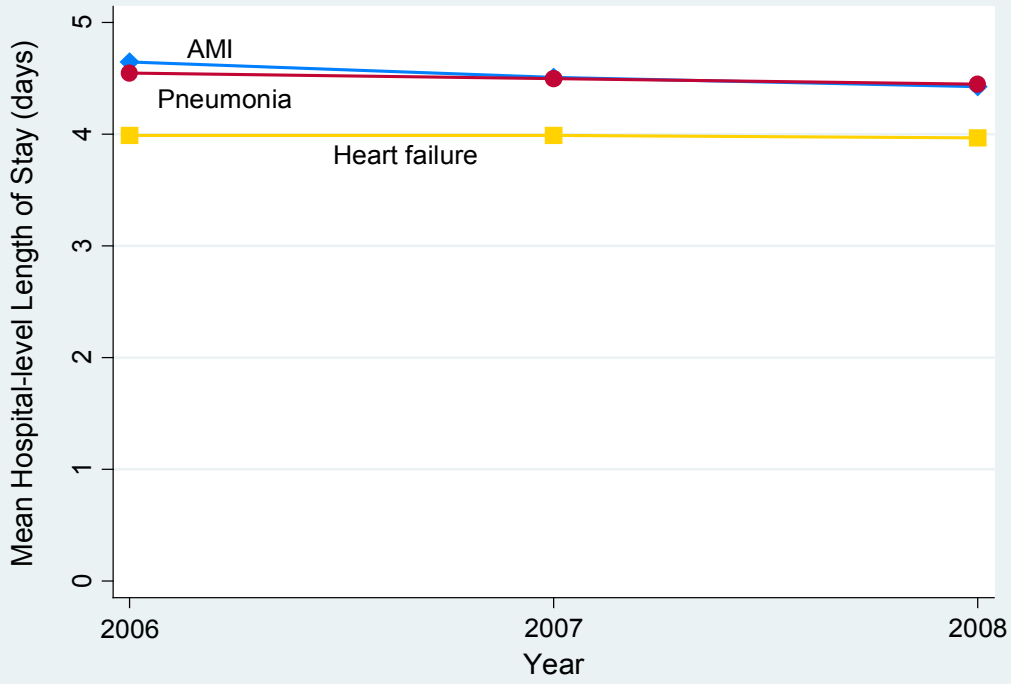
Table 4.7b Performance Status Compared to the National Average for RSMRs Across Conditions

Worse-performing HRRs	Better-performing HRRs
Jackson, MS	Los Angeles, CA
	New Haven, CT
	Boston, MA
	Cleveland, OH

The large number of HRRs that were worse performers for readmission in all three conditions indicates a strong need for quality improvement initiatives toward better coordination of care in these regions.

Length of Stay for AMI, Heart Failure, and Pneumonia Were Stable from 2006 to 2008

Figure 5.1 Trend in Mean Length of Stay, 2006-2008
Medicare FFS beneficiaries aged ≥65 years



Source Data and Population: 2006-2008 Condition-specific Inpatient Admissions from Medicare Database (Appendix A.III).
Notes: 1) The results of hospitals with fewer than 25 cases of the condition in each year are not shown, however these hospitals have been included in length of stay calculations. 2) For AMI, the total number of hospitals was 1,839 in 2006, 1,810 in 2007, and 1,782 in 2008. 3) For HF, the total number of hospitals was 3,600 in 2006, 3,488 in 2007, and 3,409 in 2008. 4) For pneumonia, the total number of hospitals was 3,919 in 2006, 3,840 in 2007, and 3,856 in 2008.

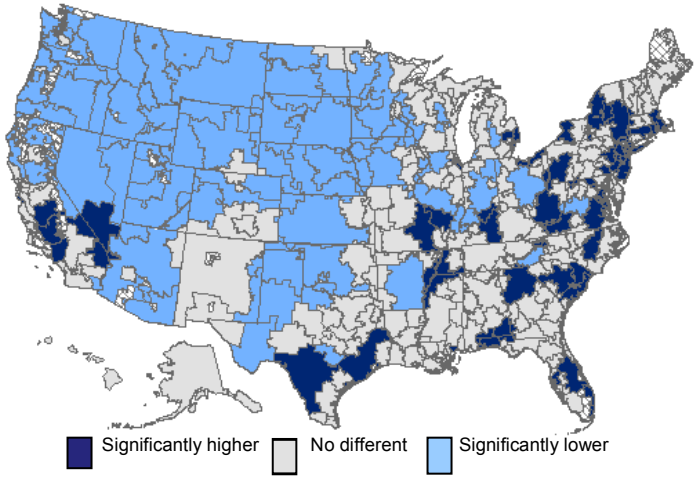
Tracking trends in hospitalization length of stay (LOS) improves our understanding of treatment patterns and costs. The figure shows that hospital-level average LOS remained constant between 2006 and 2008, at approximately 4 days for heart failure and 4.5 days for both AMI and pneumonia.

In the recent period before the health care reform, there were no major changes in length of stay for these three conditions.

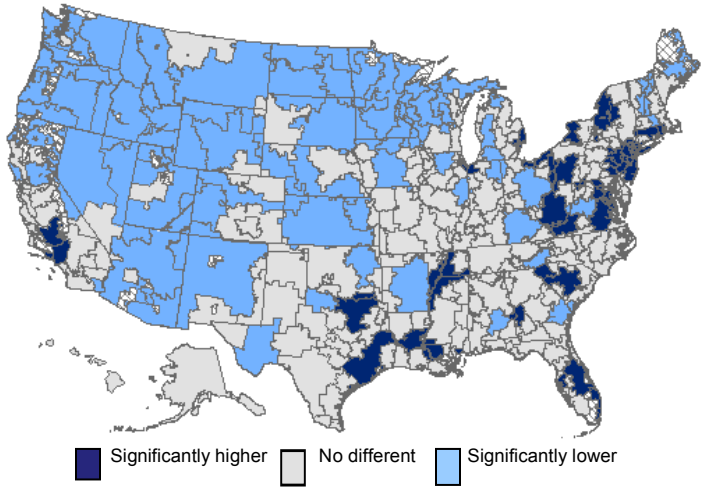
Hospital Median Length of Stay Varies Across Regions

Figure 5.2 Classification of HRRs by LOS, 2006-2008
Medicare FFS beneficiaries aged ≥65 years

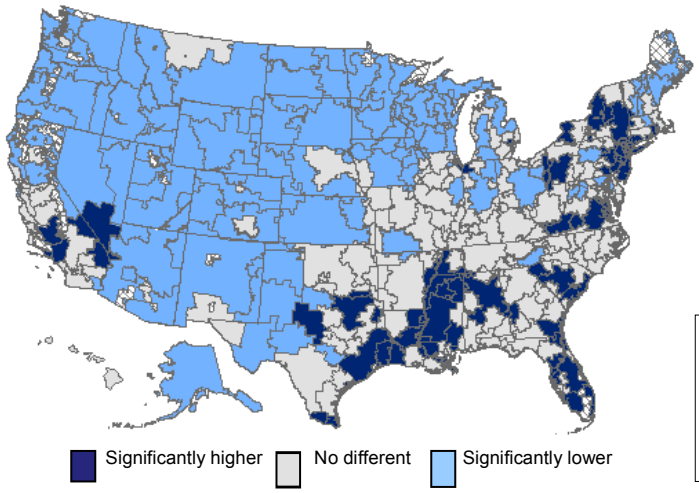
a. AMI



b. Heart Failure



c. Pneumonia



Exploring regional variation in length of stay (LOS) provides information on hospital patterns of care and transition to home or other care settings. The maps illustrating hospital median LOS for AMI, heart failure, and pneumonia are very similar. Hospital referral regions (HRRs) with LOS significantly lower than the national estimate are predominantly in the Western and North-Central areas of the U.S. HRRs with LOS significantly higher than the national estimate are mainly in Eastern and South-Central areas of the U.S.

Table 5.1 Average LOS by HRR Category (day)

Condition	Significantly higher	No different	Significantly lower
AMI	4.98	4.21	3.60
Heart failure	4.71	4.05	3.51
Pneumonia	5.15	4.59	3.99

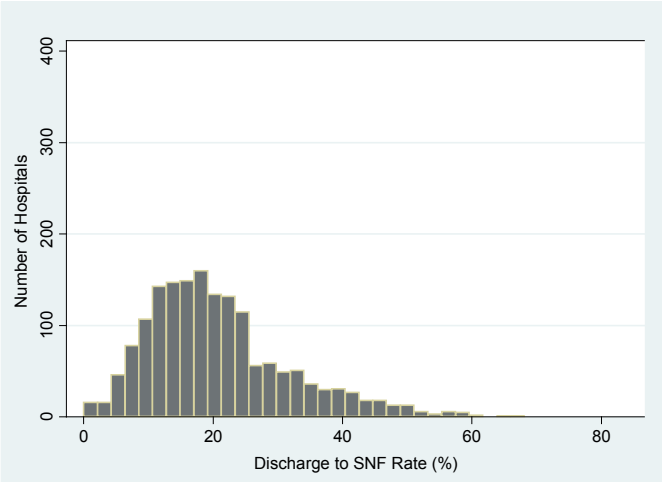
There appears to be tendencies among HRRs toward similar levels of performance in LOS.

Source Data and Population: 2006-2008 Condition-specific Inpatient Admissions from Medicare Database (Appendix A.III).
Notes: 1) The HRRs are classified as being significantly higher, no different, or significantly lower than the national average median LOS. 2) Total number of hospitals included in the analysis for: AMI = 4,584; HF = 4,804; and pneumonia = 4,836.

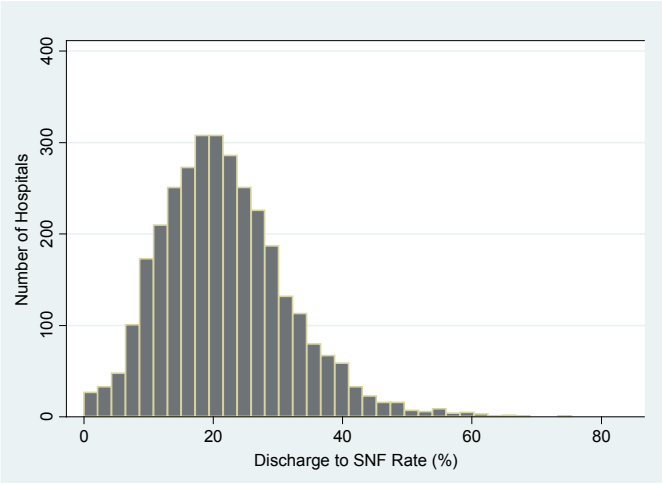
Hospitals Vary Markedly in the Percentage of Patients Discharged to Skilled Nursing Facilities

Figure 5.3 Distribution of Rate of Discharge to SNFs, 2008
Medicare FFS beneficiaries aged ≥65 years

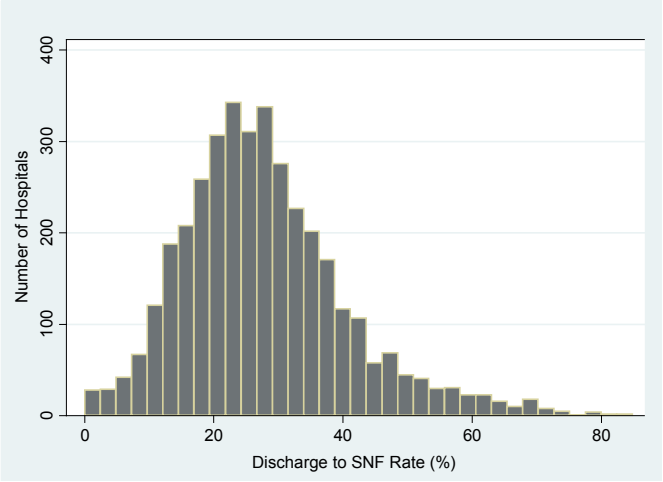
a. AMI



b. HF



c. Pneumonia



Discharging patients to skilled nursing facilities (SNFs) is one hospital discharge strategy that may impact length of stay, quality of care, and costs. The figures and the table illustrate the distribution of rate of discharge to skilled nursing facilities at the hospital level. The results show a wide variation in rates across the country for all three conditions.

Table 5.2 Distribution of Rate of Discharge to SNFs, 2008 (%)

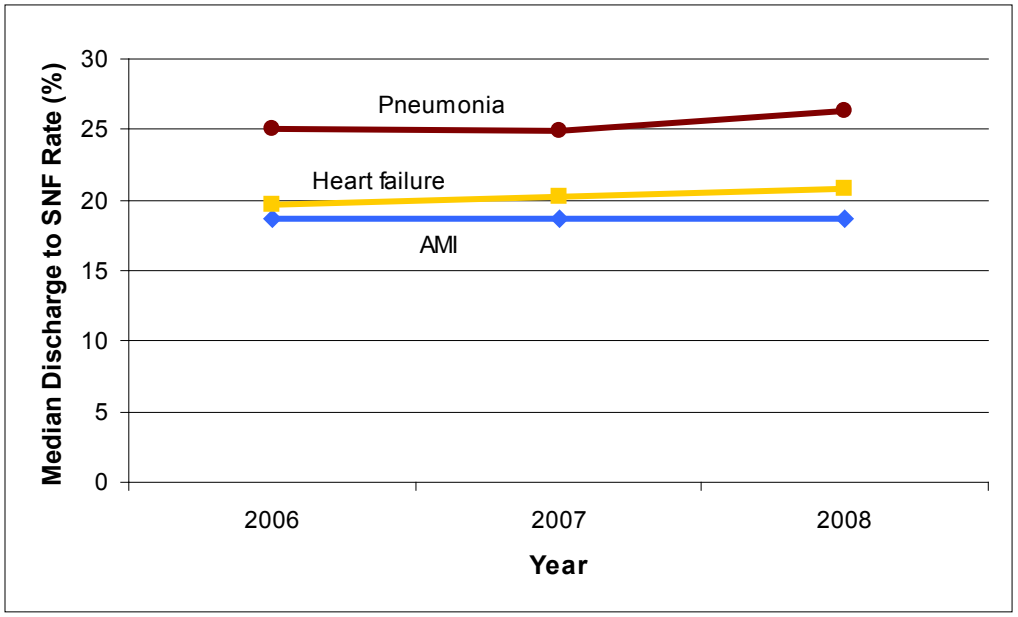
	AMI	HF	Pneumonia
Minimum	0.0	0.0	0.0
10%	8.7	10.0	13.4
25%	12.9	14.9	19.3
Median (50%)	18.7	20.8	26.4
75%	25.8	27.6	34.4
90%	37.0	34.8	44.0
Maximum	68.1	75.4	84.8

The decision to send patients to skilled nursing facilities varies markedly among hospitals. The 75th percentile is nearly double the 25th percentile demonstrating that some hospitals are sending twice as many patients to skilled nursing facilities. Further research is required to explore whether this strategy benefits patients.

Source Data and Population: Condition-specific RSRR Measure Cohorts—January 2008-December 2008 (Appendix A.II).
Notes: 1) The results of hospitals with fewer than 25 cases of the condition are not shown, however these hospitals have been included in the discharge to SNF rate calculations. 2) Total number of hospitals included in the analysis for: AMI = 1,668; HF = 3,260; and pneumonia = 3,727.

Rates of Discharge to Skilled Nursing Facilities Increased for Heart Failure and Pneumonia but Remained Unchanged for AMI

Figure 5.4 Trend in Rate of Discharge to SNFs, 2006-2008
Medicare FFS beneficiaries aged ≥65 years



Rate of discharge to skilled nursing facilities (SNFs) reflects one aspect of coordination of care across settings. SNF care is expensive but on the other hand may reduce hospital length of stay. The figure above shows a slight increase in rate of discharge to skilled nursing facilities for pneumonia and heart failure.

Rates of discharge to skilled nursing facilities are high, and there is no indication of decline. It is imperative to explore whether discharge to skilled nursing facilities is an appropriate use of available resources.

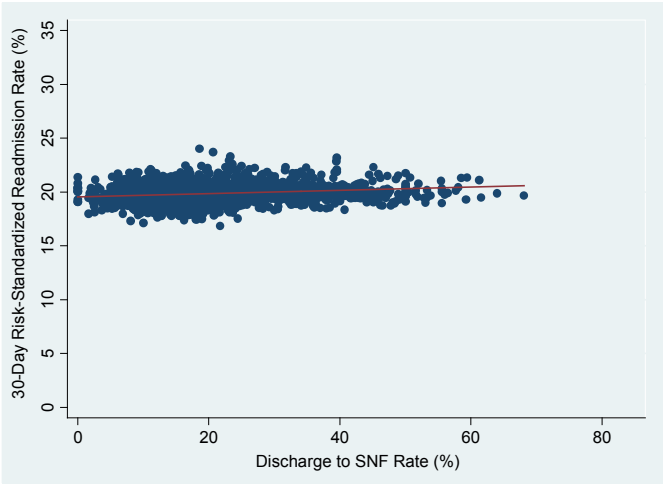
Table 5.3 Rate of Discharge to SNFs (%)

	2006		2007		2008	
Condition	**Median**	**Range**	**Median**	**Range**	**Median**	**Range**
AMI	18.7	0.0 - 72.6	18.6	0.0 - 69.4	18.7	0.0 - 68.1
Heart failure	19.6	0.0 - 80.0	20.2	0.0 - 76.9	20.8	0.0 - 75.4
Pneumonia	25.0	0.0 - 86.1	24.9	0.0 - 90.0	26.4	0.0 - 84.8

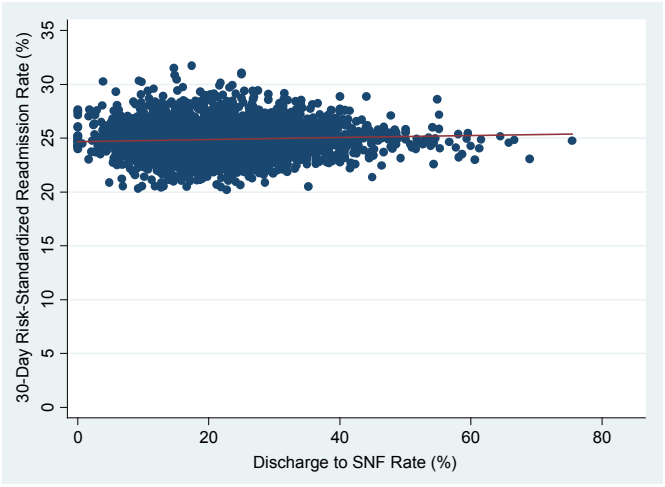
Higher Rates of Discharge to Skilled Nursing Facilities Are Not Associated with Lower Readmission Rates

Figure 5.5 Scatterplot of Hospital RSRRs by Rate of Discharge to SNFs
Medicare FFS beneficiaries aged ≥65 years

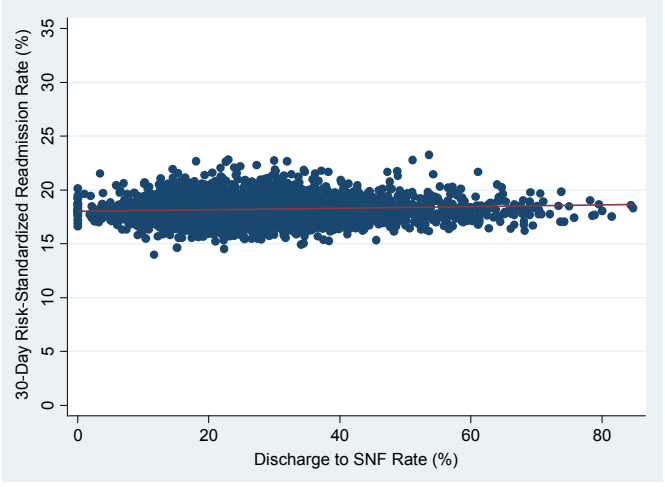
AMI



Heart failure



Pneumonia



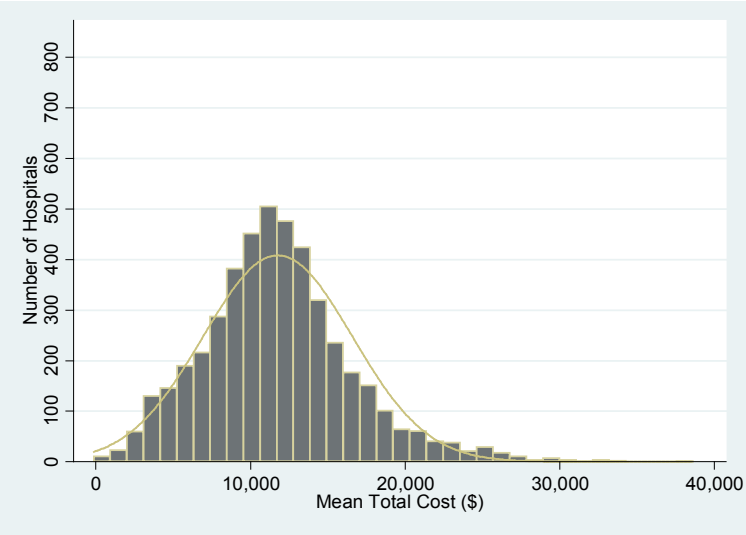
Hospital discharge to skilled nursing facilities (SNFs) provides patients with ongoing medical and nursing care and therefore might be expected to be associated with lower readmission rates to the hospital. The figures, however, show an absence of association between hospitals' rate of discharge to SNFs and 30-day risk-standardized readmission rates for all three conditions.

Discharge to skilled nursing facilities appears not to be an effective strategy for lowering readmission rates.

Source Data and Population: Condition-specific RSRR Measure Cohorts—January 2006-December 2008 (Appendix A.II).
Notes: 1) The results of hospitals with fewer than 25 cases of the condition over the three-year period are not shown, however these hospitals have been included in RSRR and discharge to SNF rate calculations. 2) Total number of hospitals included in the analysis for: AMI = 1,668; HF = 3,260; and pneumonia = 3,727. 3) The red line represents the regression line.

There Is Substantial Variation in Medicare Payments for AMI

Figure 5.6 Distribution of Inpatient, Hospital-level Total Payments in AMI
Medicare FFS beneficiaries aged ≥65 years

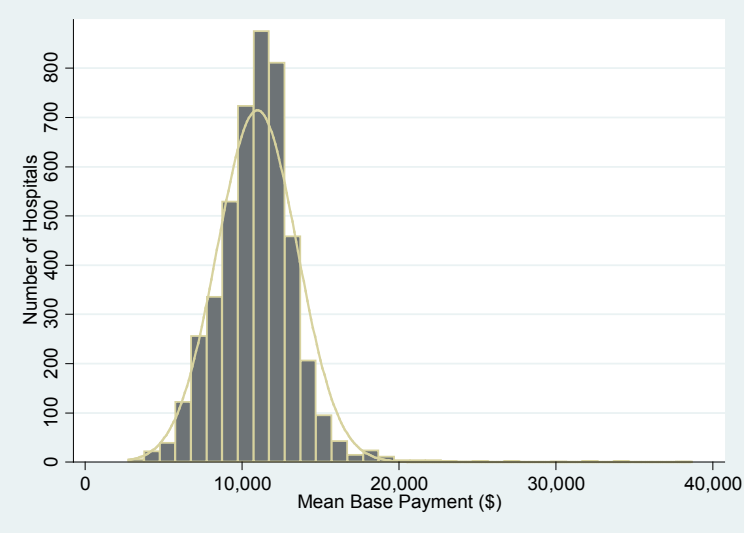


Source Data and Population: 2006-2008 AMI Inpatient Admissions from Medicare Database (Appendix A.III).
Notes: Total payment reflects the patient-level reimbursement to acute care hospitals for an AMI hospitalization. Payments for patients transferred between acute care hospitals are assigned to the initial or index hospital (Appendix C).

Medicare payments to hospitals under the Inpatient Prospective Payment System are based on diagnosis related group (DRG) codes and additional modifications driven by cost-of-living and policy adjustments such as indirect medical education and disproportionate share. Variation observed in total payments to hospitals is partly due to price differences embedded in these additional modifications (figure 5.6).

However, after accounting for these additional modifications by examining only the base payment based on DRG codes, significant variation in payments is still seen (figure 5.7).

Figure 5.7 Distribution of Inpatient, Hospital-level Base Payments in AMI
Medicare FFS beneficiaries aged ≥65 years

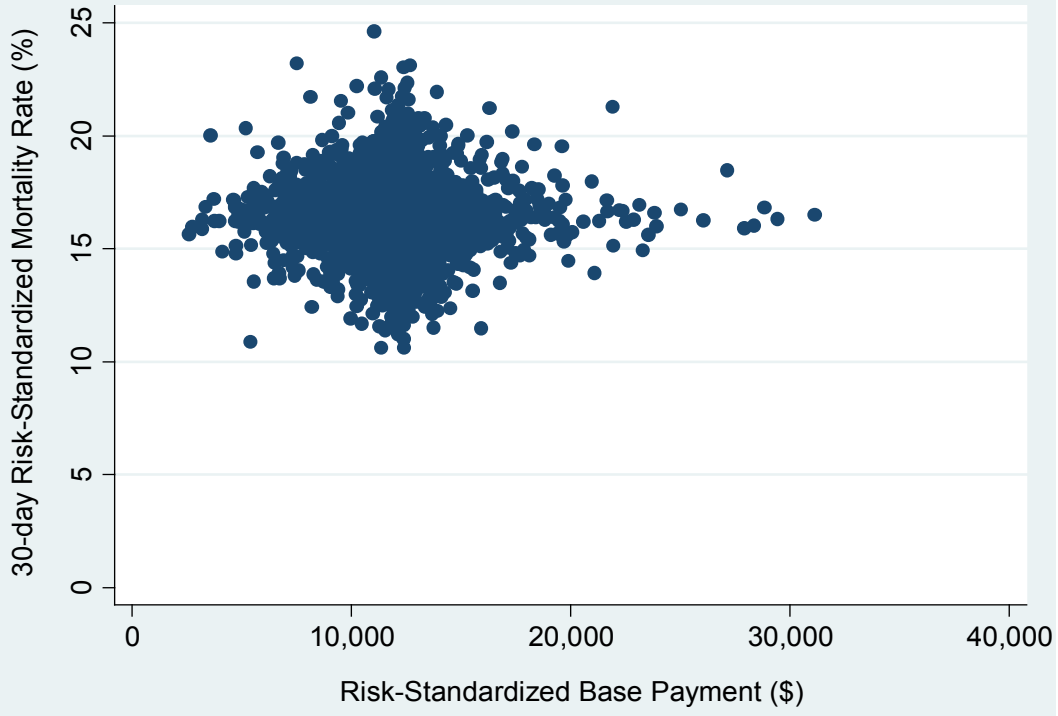


Source Data and Population: 2006-2008 AMI Inpatient Admissions from Medicare Database (Appendix A.III).
Notes: Base payment reflects a standardized payment for the DRG specified for each AMI hospitalization. This base payment excludes the wage index adjustment and the additional policy adjustments such as indirect medical education and disproportionate share. Payments for transfers between acute care hospitals are assigned to the initial or index hospital. (Appendix C)

After controlling for price differences, considerable variation in hospital payments is still observed.

Some Hospitals Are Achieving Better Outcomes and Lower Costs in AMI Care

Figure 5.8 Hospital Risk-Standardized Base Payment vs. 30-RSMR in AMI
Medicare FFS beneficiaries aged ≥65 years



Source Data and Population: 2006-2008 AMI Inpatient Admissions from Medicare Database (Appendix A.III).
Notes: Risk-standardized Base payment reflects a risk-standardized payment for the DRG specified for each AMI hospitalization. This base payment excludes the wage index adjustment and the additional policy adjustments such as indirect medical education and disproportionate share. Payments for transfers between acute care hospitals are assigned to the initial or index hospital. The risk-standardized payment measure models a patient's predicted payment given the demographic and clinical characteristics while taking into account a hospital-specific effect (Appendix C).

Comparing hospital RSMR and risk-standardized base payment does not reveal a consistent association. After controlling for price differences as well as severity of illness, there are hospitals that perform well in neither, one, or both metrics of mortality and cost. It is important to note that there is a subset of hospitals that achieve lower than average mortality rates with below average costs.

Accounting for price differences and severity of illness between institutions can help identify hospitals that appear to maximize value in patient care.

Further study of high performing hospitals can guide efforts toward efficient, high-quality care.

Appendix A—Chartbook Cohorts

I. RSMR Measure Cohort

Cohort Definition[1]

The cohort includes admissions for Medicare fee-for-service (FFS) beneficiaries aged ≥65 years discharged from non-federal acute care hospitals with a principal discharge diagnosis of AMI, HF, or pneumonia and with a complete claims history for 12 months prior to admission. For patients with more than one admission in a specific year for any given diagnosis, only one admission was randomly selected to keep in the cohort and others were excluded. The data set includes hospitalizations with discharge dates between January 1, 2006 and December 31, 2008.

ICD-9 codes defining AMI, HF and pneumonia

i) *Acute Myocardial Infarction (AMI)*

410.00	AMI (anterolateral wall) – episode of care unspecified
410.01	AMI (anterolateral wall) – initial episode of care
410.10	AMI (other anterior wall) – episode of care unspecified
410.11	AMI (other anterior wall) – initial episode of care
410.20	AMI (inferolateral wall) – episode of care unspecified
410.21	AMI (inferolateral wall) – initial episode of care
410.30	AMI (inferoposterior wall) – episode of care unspecified
410.31	AMI (inferoposterior wall) – initial episode of care
410.40	AMI (other inferior wall) – episode of care unspecified
410.41	AMI (other inferior wall) – initial episode of care
410.50	AMI (other lateral wall) – episode of care unspecified
410.51	AMI (other lateral wall) – initial episode of care
410.60	AMI (true posterior wall) – episode of care unspecified
410.61	AMI (true posterior wall) – initial episode of care
410.70	AMI (subendocardial) – episode of care unspecified
410.71	AMI (subendocardial) – initial episode of care
410.80	AMI (other specified site) – episode of care unspecified
410.81	AMI (other specified site) – initial episode of care
410.90	AMI (unspecified site) – episode of care unspecified
410.91	AMI (unspecified site) – initial episode of care

[1]2010 Measures Maintenance Technical Report: Acute Myocardial Infarction, Heart Failure, and Pneumonia 30-Day Risk-Standardized Mortality Measures. Available at http://qualitynet.org/dcs/ContentServer?c=Page&pagename=QnetPublic%2FPage%2FQnetTier3&cid=1163010421830 (Accessed May 12, 2010)

Appendix A—Chartbook Cohorts

I. **RSMR Measure Cohort (cont.)**

ii) *Heart Failure (HF)*

402.01	Hypertensive heart disease, malignant, with heart failure
402.11	Hypertensive heart disease, benign, with heart failure
402.91	Hypertensive heart disease, unspecified, with heart failure
404.01	Hypertensive heart and chronic kidney disease, malignant, with heart failure and with chronic kidney disease stage I through stage IV, or unspecified
404.03	Hypertensive heart and chronic kidney disease, malignant, with heart failure and with chronic kidney disease stage V or end stage renal disease
404.11	Hypertensive heart and chronic kidney disease, benign, with heart failure and with chronic kidney disease stage I through stage IV, or unspecified
404.13	Hypertensive heart and chronic kidney disease, benign, with heart failure and chronic kidney disease stage V or end stage renal disease
404.91	Hypertensive heart and chronic kidney disease, unspecified, with heart failure and with chronic kidney disease stage I through stage IV, or unspecified
404.93	Hypertensive heart and chronic kidney disease, unspecified, with heart failure and chronic kidney disease stage V or end stage renal disease
428.0	Congestive heart failure, unspecified
428.1	Left heart failure
428.20	Unspecified systolic heart failure
428.21	Acute systolic heart failure
428.22	Chronic systolic heart failure
428.23	Acute on chronic systolic heart failure
428.30	Unspecified diastolic heart failure
428.31	Acute diastolic heart failure
428.32	Chronic diastolic heart failure
428.33	Acute on chronic diastolic heart failure
428.40	Unspecified combined systolic and diastolic heart failure
428.41	Acute combined systolic and diastolic heart failure
428.42	Chronic combined systolic and diastolic heart failure
428.43	Acute on chronic combined systolic and diastolic heart failure
428.9	Heart failure, unspecified

Appendix A—Chartbook Cohorts

l. **RSMR Measure Cohort (cont.)**

iii) *Pneumonia*

480.0	Pneumonia due to adenovirus
480.1	Pneumonia due to respiratory syncytial virus
480.2	Pneumonia due to parainfluenza virus
480.3	Pneumonia due to SARS associated coronavirus
480.8	Viral pneumonia: pneumonia due to other virus not elsewhere classified
480.9	Viral pneumonia unspecified
481	Pneumococcal pneumonia [streptococcus pneumoniae pneumonia]
482.0	Pneumonia due to klebsiella pneumoniae
482.1	Pneumonia due to pseudomonas
482.2	Pneumonia due to hemophilus influenzae (h. influenzae)
482.30	Pneumonia due to streptococcus unspecified
482.31	Pneumonia due to streptococcus group a
482.32	Pneumonia due to streptococcus group b
482.39	Pneumonia due to other streptococcus
482.40	Pneumonia due to staphylococcus unspecified
482.41	Pneumonia due to staphylococcus aureus
482.49	Other staphylococcus pneumonia
482.81	Pneumonia due to anaerobes
482.82	Pneumonia due to escherichia coli [e.coli]
482.83	Pneumonia due to other gram negative bacteria
482.84	Pneumonia due to legionnaires' disease
482.89	Pneumonia due to other specified bacteria
482.9	Bacterial pneumonia unspecified
483.0	Pneumonia due to mycoplasma pneumoniae
483.1	Pneumonia due to chlamydia
483.8	Pneumonia due to other specified organism
485	Bronchopneumonia organism unspecified
486	Pneumonia organism unspecified
487.0	Influenza with pneumonia

Appendix A—Chartbook Cohorts

I. **RSMR Measure Cohort (cont.)**

Exclusion Criteria

The following patient admissions are excluded:

- discharged on the day of admission or the following day and did not die or get transferred;
- transferred from another acute care hospital;
- transferred without the same qualifying principal diagnosis at both hospitals;
- with inconsistent or unknown mortality status or other unreliable data (e.g. date of death precedes admission date);
- enrolled in the Medicare Hospice program any time in the 12 months prior to the index hospitalization including the first day of the index admission;
- discharged alive and against medical advice (AMA);
- not the first hospitalization in the 30 days prior to a patient's death. This exclusion criterion is applied after one admission per patient per year is randomly selected. It *only* applies when two randomly selected admissions occur during the transition months (December and January for calendar-year data), and the patient subsequently dies. For example: a patient is admitted on December 18th, 2006 and readmitted on January 2nd, 2007; the patient dies on January 15th, 2007. If both of these admissions are randomly selected for inclusion (one for the 2006 calendar year time period and the other for the 2007 calendar year time period), the January 2, 2007 admission will be excluded to avoid assigning the death to two admissions (one in 2006 and one in 2007).

Full details of the development of the risk-standardization model for the mortality measures are available at: 2010 Measures Maintenance Technical Report: Acute Myocardial Infarction, Heart Failure, and Pneumonia 30-Day Risk-Standardized Mortality Measures.

Appendix A—Chartbook Cohorts

II. RSRR Measure Cohort

Cohort Definition[2]

The cohort includes admissions for Medicare fee-for-service (FFS) beneficiaries aged ≥65 years discharged from non-federal acute care hospitals with a principal discharge diagnosis of AMI, HF, or pneumonia and with a complete claims history for 12 months prior to admission date. The data set includes hospitalizations with discharge dates between January 1, 2006 and December 31, 2008.

ICD-9 codes defining AMI, HF, and pneumonia

ICD-9 codes are exactly the same for RSMR and RSRR measure cohorts. Refer to RSMR Measure Cohort for lists of ICD-9 codes defining AMI, HF, and pneumonia.

Exclusion Criteria

The following patient admissions are excluded:

- with an in-hospital death;
- without at least 30 days post-discharge enrollment in FFS Medicare;
- transferred to another acute care facility;
- discharged against medical advice (AMA);
- for AMI only: same-day discharges (admission and discharge date equal);
- with additional admissions within 30 days of discharge from an index admission (no admission can be considered both an index admission and a readmission, so additional admissions within 30 days of discharge from an index admission can only be considered as potential readmissions).

Full details of the development of the risk-standardization model for the readmission measures are available at: 2010 Measures Maintenance Technical Report: Acute Myocardial Infarction, Heart Failure, and Pneumonia 30-Day Risk-Standardized Readmission Measures.

[2]2010 Measures Maintenance Technical Report: Acute Myocardial Infarction, Heart Failure, and Pneumonia 30-Day Risk-Standardized Readmission Measures. Available at http://qualitynet.org/dcs/ContentServer?c=Page&pagename=QnetPublic%2FPage%2FQnetTier3&cid=1219069855841 (Accessed May 12, 2010)

Appendix A—Chartbook Cohorts

III. Condition-specific Inpatient Admissions from Medicare Database

Cohort Definition

The cohort includes admissions for Medicare fee-for-service beneficiaries with FFS enrollment status at the time of admission aged ≥65 years discharged from non-federal acute care hospitals. The data set is derived from linking the Medicare Part A Inpatient Claims data (MEDPAR) with the Medicare Denominator file for each year. We obtain the FFS status for the admissions from Medicare's Denominator file. The ICD-9 codes defining AMI, HF, and pneumonia are listed under the RSMR Measure Cohort.

IV. Other Data Sources

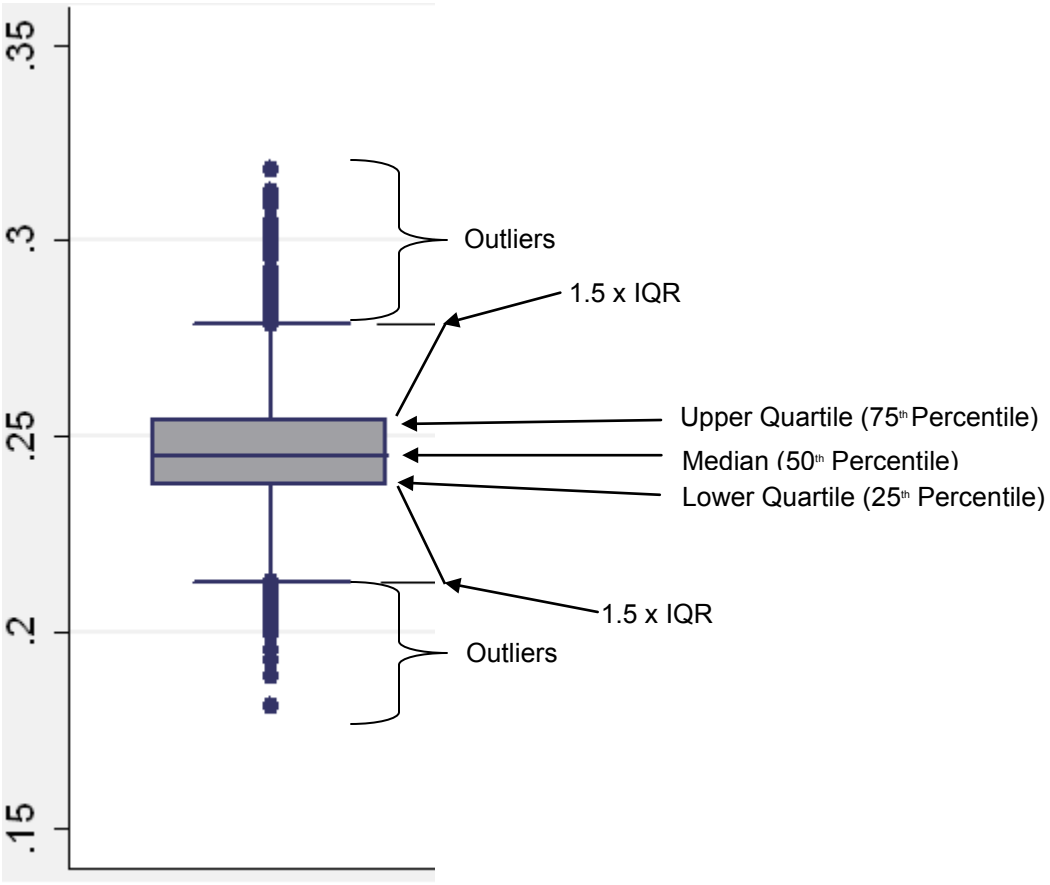
1) Census 2000 data[3]
- ♦ Five digit zip code level data was downloaded.
- ♦ This data was used to estimate quartiles of median household income as a measure of socio-economic status (SES).

2) American Hospital Association (AHA) Annual Survey Database Fiscal Year 2008[4]
- ♦ This data was used to determine teaching status, safety net status, urban location, and census regions of hospitals.

[3] http://factfinder.census.gov/home/saff/main.html?_lang=en

[4] http://www.ahadata.com/ahadata/html/AHASurvey.html

Appendix B—Box-and-Whisker Plots



A box-and-whisker plot graphically displays the distribution of a variable. The line in the shaded box represents the median value. The shaded box, bounded by the upper (75th) and lower (25th) quartiles, represents the interquartile range (IQR). The lines, or "whiskers", extending from either end of the box are equal to 1.5 times the IQR (the 75th percentile minus the 25th percentile). All data points beyond the whiskers are considered outliers. These outliers are represented by individual dots.

Appendix C—Methodology for Risk-Standardized Base Payment

Payment Data

Base payment data for each admission is calculated using the Diagnosis Related Group-specific weight[1] multiplied by the operating base payment for the given year.[5] Base payments for patients who are transferred between acute care hospitals are assigned to the first hospital that admitted the patient. We calculated the risk-standardized base payment using a hierarchical generalized linear model (HGLM) that adjusts for the same clinical covariates used in the risk-standardization for the AMI RSMR measure.

[5] http://www.cms.gov/AcuteInpatientPPS/