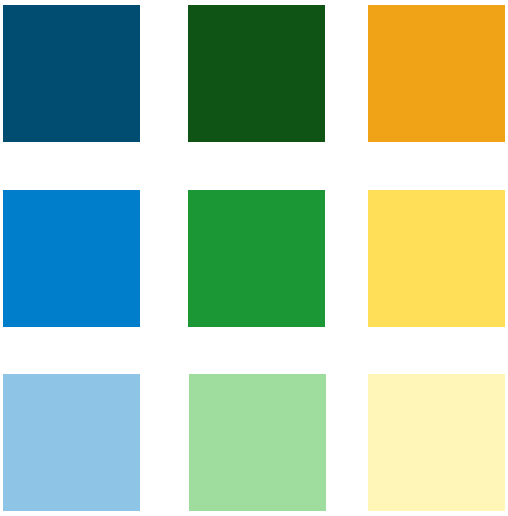
# Medicare Hospital Quality Chartbook 2012

## Performance Report on Outcome Measures



**Prepared by Yale New Haven Health Services Corporation**
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# Executive Summary

## *Background*

The 2012 edition of the Centers for Medicare and Medicaid Services (CMS) Hospital Quality Chartbook explores hospital performance on three quality measure sets:

- the publicly-reported mortality and readmission measures for acute myocardial infarction (AMI), heart failure, and pneumonia;
- complication and readmission measures following primary elective total hip and/or knee arthroplasty (THA/TKA); and
- a hospital-wide readmission measure.

CMS currently publicly reports the six measures in the first set and plans to begin publicly reporting the hip/knee and hospital-wide measures in 2013.[1]

## *Updates to the Report*

In addition to using updated years of data, this 2012 edition increases the Chartbook's scope by:

- Adding data for the hip/knee measures and the hospital-wide readmission measure
- Providing analyses responsive to questions raised by stakeholders

## *Highlights of the Chartbook*

**AMI, Heart Failure, and Pneumonia**

- ***Mortality Trends:*** The median annual risk-standardized mortality rate (RSMR) for AMI decreased by 0.7 percentage points from 2008 to 2010, while RSMRs for pneumonia and heart failure increased by 0.1 and 0.4 points, respectively.

- ***Readmission Trends:*** Median annual risk-standardized readmission rates (RSRRs) for AMI and heart failure declined slightly from 2008 to 2010 (by 0.5 and 0.3 points, respectively), but the median RSRR for pneumonia increased by 0.1 points in the same time period.

- ***Economic and Racial Disparities:*** Hospital performance on the mortality measures does not differ substantially based on hospital proportion of Medicaid or African-American patients. On the readmission measures, many hospitals serving high proportions of Medicaid and/or African-American patients perform well, but their overall performance appears slightly worse.

- ***Readmission Diagnoses and Timing:*** Hospitals classified as "better performing" have similar readmission diagnoses as "worse performing" hospitals, but delay the median time to readmission by about one day after hospitalization for heart failure and pneumonia. The timing of readmission for AMI does not vary across performance categories.

- ***Emergency Department and Observation Visits:*** Return-to-hospital rates after AMI, heart failure, and pneumonia remain high and stable. However, a small but increasing proportion of patients are kept under observation status and not readmitted.

- ***Monitoring Quality Improvement Efforts:*** Hospitals attempting to track their own performance using their same-hospital readmission rate may over- or under-estimate their readmission rate by as much as 5 percentage points.

**Hip/Knee Complication and Readmission Measures**

- ***Complication Trends:*** The median hospital complication rate after elective THA/TKA was 3.5% and ranged from 1.8% to 8.9% between 2008 and 2010.
- ***Readmission Trends:*** Similarly, between 2008 and 2010, the median hospital readmission rate after elective THA/TKA was 5.6%, with a range of 3.2% to 9.9%.
- ***Geographic Variation:*** Meaningful hospital-level variation in performance exists following THA/TKA. In contrast to the publicly reported AMI, heart failure, and pneumonia measures, however, complication and readmission rates after THA/TKA do not show regional variation.
- ***Economic and Racial Disparities:*** There is a wide range of performance among hospitals with high proportions of Medicaid and African-American patients. Those hospitals with high proportions of Medicaid or African-American patients can perform as well on the measures as hospitals with fewer such patients.

**Hospital-Wide Readmission Measure**

- ***Readmission Trends:*** The median risk-standardized hospital-wide readmission rate remained high (over 16%) and stable between 2008 and 2010.
- ***Geographic Variation:*** Both hospitals and regions show meaningful variation in rates of unplanned readmissions after hospitalization for any condition.
- ***Economic and Racial Disparities:*** On average, hospitals with the most Medicaid and African-American patients perform slightly worse on the hospital-wide readmission measure.

# What are Risk-Standardized Outcome Rates?

## *Measuring Key Hospital Outcomes*

The hospital outcome measures in this report include CMS's 30-day risk-standardized mortality rates (RSMRs), 30-day risk-standardized readmission rates (RSRRs), and risk-standardized complication rates (RSCRs) for Medicare fee-for-service (FFS) patients aged ≥65 admitted to the hospital for heart attack (acute myocardial infarction [AMI]), heart failure, pneumonia, and total hip and/or knee arthroplasty, as well as all conditions in the hospital-wide readmission measure. The National Quality Forum endorsed these measures. The AMI, heart failure, and pneumonia measures are publicly reported by CMS on the *Hospital Compare* website. The hip/knee and hospital-wide measures were referenced in the FY2013 IPPS/LTCH PPS Final Rule[1] and will be publicly reported starting next year.

## *Measured Outcomes*

The mortality measures assess death from any cause within 30 days of a hospitalization (regardless of whether the patient dies while still in the hospital or after discharge). The readmission measures assess readmissions for any reason within 30 days of discharge from a hospital stay; patients may have been readmitted to the same hospital or to a different hospital. Where relevant (in the AMI, hip/knee, and hospital-wide readmission measures), planned readmissions identified by clinical experts are excluded from the outcome.[2-4] The complication measure assesses the occurrence of significant medical and/or surgical complications within 7 to 90 days, depending on the complication, following hospitalization for total hip and/or knee arthroplasty.

## *Risk Adjustment*

To ensure accurate assessment of each hospital, the measures use statistical models to adjust for key differences in patient risk factors that are clinically relevant and have strong relationships with the outcome (e.g., age and patient comorbidities). For each patient, risk factors are obtained from Medicare claims extending 12 months prior to and including the index admission. The statistical models adjust for patient 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 index admission, are included in the risk adjustment.

## *Calculating the Risk-Adjusted Outcome*

The mortality, readmission, and complication measures use hierarchical logistic regression to create RSMRs, RSRRs, and RSCRs for each hospital. These measures are designed to adjust for case mix differences and account for random variation so that they reflect each hospital's quality.

The RSMRs/RSRRs/RSCRs are calculated as the ratio of the number of "predicted" outcomes (deaths, readmissions, or complications) over the number of "expected" outcomes, multiplied by the national mortality/readmission/complication rate. For each hospital, the "numerator" of the ratio is the number of deaths/readmissions/complications within the outcome ascertainment period (30 days for the mortality and readmission measures and 7-90 days for the complication measure, depending upon the complication) predicted on the basis of the hospital's performance with its observed case mix, and the "denominator" is the number of deaths/readmissions/complications expected on the basis of the nation's performance with that specific 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 a lower-than-expected mortality, readmission, or complication rate and better quality whereas a higher ratio indicates a higher-than-expected mortality, readmission, or complication rate and worse quality.

# Section A

# AMI, Heart Failure, and Pneumonia Mortality and Readmission

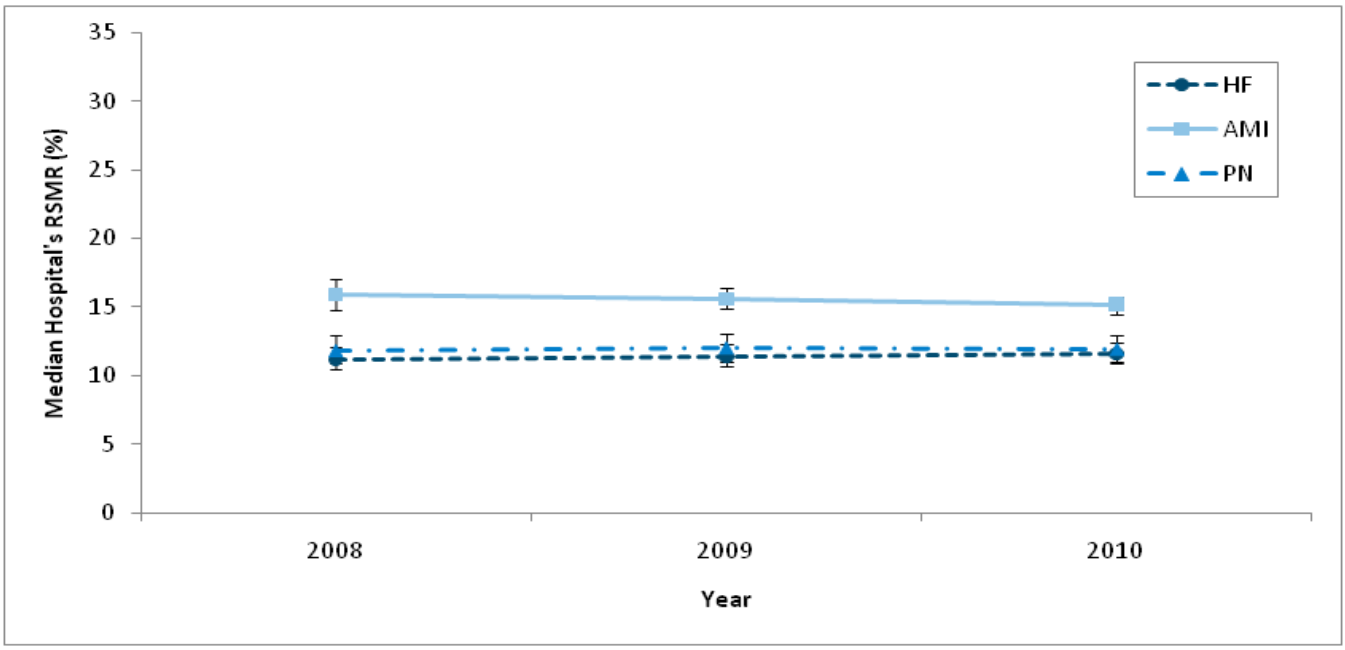
This section focuses on the acute myocardial infarction (AMI), heart failure, and pneumonia mortality and readmission measures that are publicly reported on *Hospital Compare*. Within this section, we analyze temporal trends (whether the rates are changing over time), distributions (how much variation exists in the rates), and geographic variation.

This section also addresses disparities in performance. Many stakeholders are concerned that hospitals caring for large numbers of poor or minority patients may not perform well on these outcome measures. We show how hospitals with high proportions of Medicaid patients or African-American patients perform on the measures.

Finally, this section responds to additional stakeholder concerns, including patterns of readmissions at better and worse performing hospitals, the unintended consequences of public reporting, and the possibilities of real-time internal quality tracking for hospitals. We analyze whether better-performing hospitals have different patterns and timing of readmissions; examine unintended consequences by showing the rate of emergency department visits or observation stays that are not associated with an inpatient readmission during the 30-day readmission window; and explore whether hospitals can effectively use raw same-hospital readmission rates to track risk-standardized readmission rates over time.

## Are mortality rates changing over time?

**Figure A.1. Trend in Median Hospital Risk-Standardized Mortality Rates, 2008-2010**




Hospital-level risk-standardized mortality rates (RSMRs) in the 30 days after hospital admission for AMI, heart failure and pneumonia have been publicly reported since 2007 for AMI and heart failure, and since 2008 for pneumonia. Starting in 2008, both VA hospitals and non-federal hospitals were included in public reporting for all three measures. To examine trends in RSMRs, we report median annual hospital-level RSMRs after admission for these three conditions from 2008 to 2010 (Figure A.1). Median RSMRs following AMI hospitalizations declined (by 0.7 percentage points over the three-year period), while rates after hospitalizations for pneumonia are relatively unchanged. In contrast, median RSMRs following hospitalization for heart failure increased by 0.4% between 2008 and 2010.

The median RSMR across U.S. hospitals in 2010 was 15.2% after hospitalization for AMI, 11.6% after hospitalization for heart failure, and 11.9% after hospitalization for pneumonia. Median RSMRs for AMI decreased by 0.7% from 2008 to 2010, but RSMRs for pneumonia were stable and RSMRs for heart failure actually increased by 0.4%.

**Table A.1. Trend in Median Hospital RSMRs**

| | Median (Range) of Hospital's RSMR (%) | | |
|---|---|---|---|
| | **2008** | **2009** | **2010** |
| **AMI** | 15.9 (11.1, 25.3) | 15.6 (11.6, 20.0) | 15.2 (11.6, 19.2) |
| **Heart Failure** | 11.2 (7.7, 17.8) | 11.4 (7.3, 17.2) | 11.6 (7.9, 17.1) |
| **Pneumonia** | 11.8 (6.8, 19.1) | 12.0 (7.9, 19.5) | 11.9 (7.3, 19.3) |

**Source Data and Population:** Condition-specific RSMR Measure Cohorts—January 2008-December 2010 (Appendix I).
**Notes**: 1) Veterans Health Administration (VA) hospitals are included in this analysis. 2) The results of hospitals with fewer than 25 cases of the condition in each year are not shown; however, these hospitals are included in the calculations. 3) The error bars on the graph represent the interquartile range. 4) For AMI, the total number of hospitals was 1,903 in 2008, 1,817 in 2009, and 1,782 in 2010. 5) For HF, the total number of hospitals was 3,127 in 2008, 3,031 in 2009, and 2,952 in 2010. 6) For pneumonia, the total number of hospitals was 3,726 in 2008, 3,514 in 2009, and 3,472 in 2010.

## AMI, Heart Failure, and Pneumonia

# Is there variation in mortality rates across different hospitals?

To examine the variation in risk-standardized mortality rates (RSMRs) after admission for AMI, heart failure, and pneumonia among U.S. hospitals (including VA hospitals), we report the distribution of RSMRs in Figure A.2a-c and Table A.2. Variation in RSMRs reflects differences in performance among U.S. hospitals, with wider distributions suggesting more variation and narrower distributions suggesting less variation in quality.

Hospital RSMRs for AMI, heart failure, and pneumonia showed similarly distributed performance: While the majority of hospitals had RSMRs clustered near the median, the range of RSMRs for all three conditions remains wide (greater than 10 absolute percentage points), suggesting substantial opportunity for improvement.

Hospitals continue to show meaningful variation in mortality rates after AMI, heart failure, and pneumonia.

**Table A.2. Distribution of Hospital RSMRs, 2008-2010**

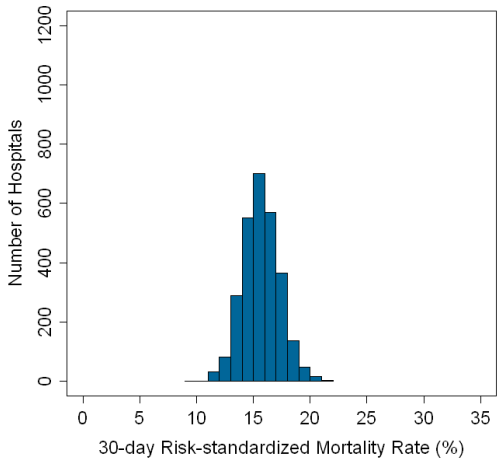
| | Distribution of RSMRs (%) | | |
|---|---|---|---|
| | **AMI** | **Heart Failure** | **Pneumonia** |
| **Maximum** | 21.5 | 17.6 | 20.2 |
| **90%** | 17.7 | 13.5 | 14.4 |
| **75%** | 16.7 | 12.5 | 13.1 |
| **Median (50%)** | 15.7 | 11.5 | 11.9 |
| **25%** | 14.6 | 10.5 | 10.8 |
| **10%** | 13.7 | 9.7 | 10.0 |
| **Minimum** | 10.0 | 6.5 | 6.8 |

**Source Data and Population:** Condition-specific RSMR Measure Cohorts—January 2008-December 2010 (Appendix I).

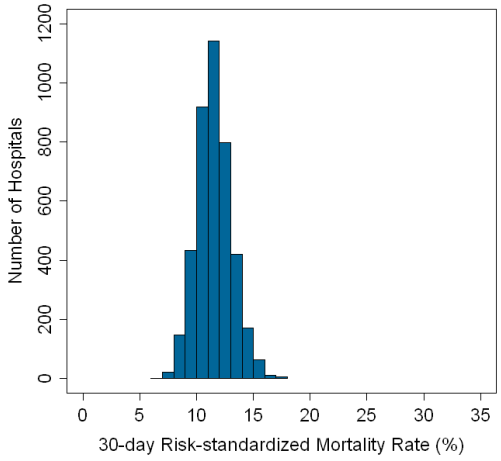
**Notes**: 1) Veterans Health Administration (VA) hospitals are included in this analysis. 2) The results of hospitals with fewer than 25 cases of the condition over the three-year period are not shown; however, these hospitals are included in the calculations. 3) The number of hospitals included for all three years was 2,796 for AMI; 4,132 for heart failure; and 4,493 for pneumonia.

**Figure A.2. Distribution of Hospital RSMRs, 2008-2010**

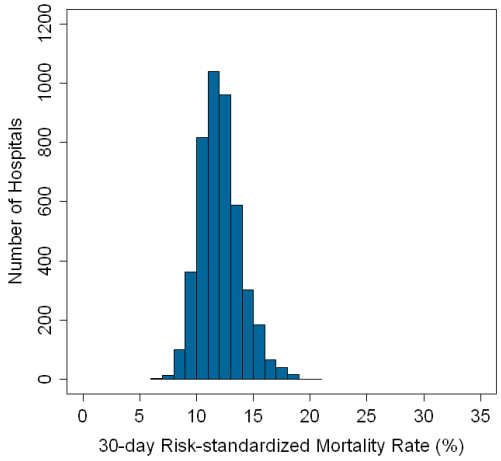
**a. AMI**




**b. Heart Failure**

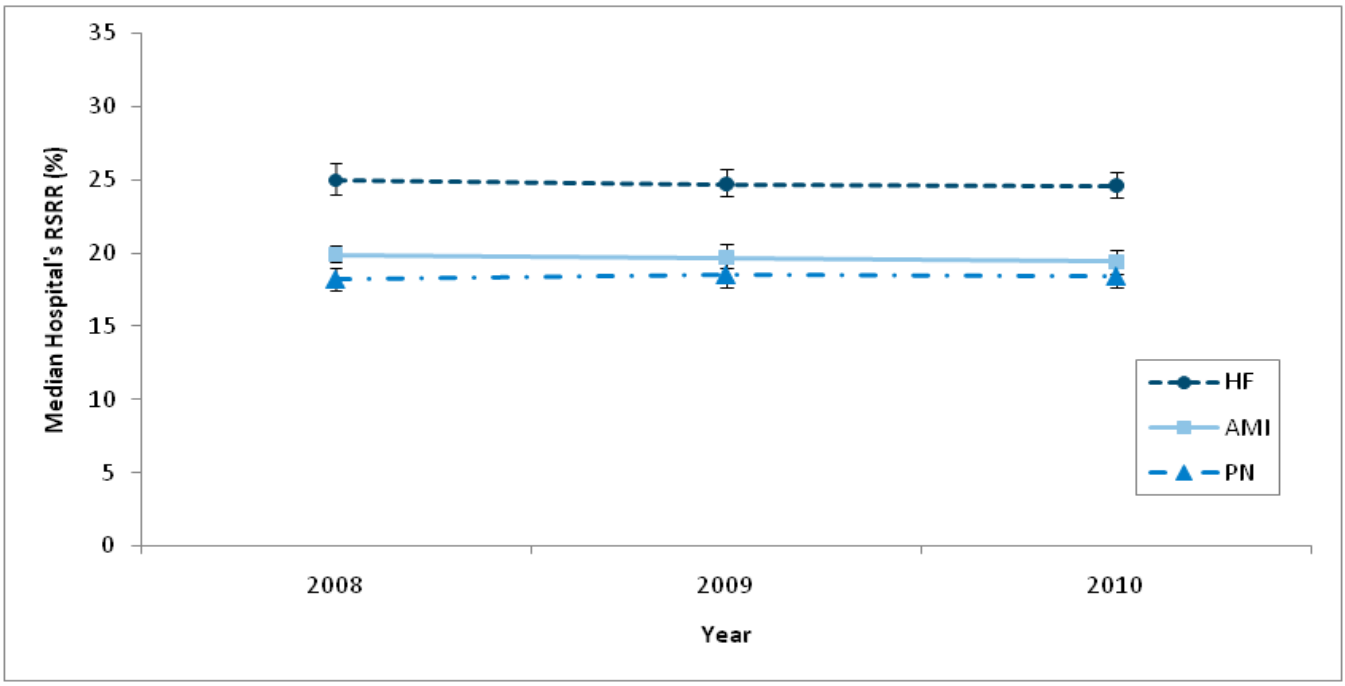



**c. Pneumonia**



## Are readmission rates changing over time?

**Figure A.3. Trend in Median Hospital Risk-Standardized Readmission Rates, 2008-2010**




Hospital-level 30-day risk-standardized readmission rates (RSRRs) after admissions for AMI, heart failure, and pneumonia were first publicly reported in 2009. Reducing readmissions remains a national healthcare priority; however, the impact of public reporting is unknown. Figure A.3 displays median annual hospital-level RSRRs for these three conditions from 2008 to 2010. This figure illustrates that there was a small decline in annual AMI and heart failure RSRRs between 2008 and 2010, without any noticeable change in pneumonia RSRRs.

In 2010, the median RSRR across U.S. hospitals was 19.4% after hospitalization for AMI, 24.6% after hospitalization for heart failure, and 18.4% after hospitalization for pneumonia. Between 2008 and 2010, there was a modest decrease in annual median RSRRs for both AMI and heart failure, while there was no clear trend in RSRRs for pneumonia.

**Table A.3. Trend in Median Hospital RSRRs**

| | Median (Range) of Hospital's RSRR (%) | | |
|---|---|---|---|
| | **2008** | **2009** | **2010** |
| **AMI** | 19.9 (16.9, 24.1) | 19.7 (15.7, 26.4) | 19.4 (15.4, 23.8) |
| **Heart Failure** | 24.9 (20.1, 32.7) | 24.7 (20.3, 31.5) | 24.6 (20.1, 30.8) |
| **Pneumonia** | 18.2 (14.1, 23.5) | 18.5 (14.4, 24.0) | 18.4 (14.9, 24.7) |

**Source Data and Population:** Condition-specific RSRR Measure Cohorts—January 2008-December 2010 (Appendix I).

**Notes**: 1) Veterans Health Administration (VA) hospitals are included in this analysis. 2) The results of hospitals with fewer than 25 cases of the condition in each year are not shown; however, these hospitals are included in the calculations. 3) The error bars on the graph represent the interquartile range. 4) For AMI, the total number of hospitals was 1,689 in 2008, 1,654 in 2009, and 1,652 in 2010. 5) For HF, the total number of hospitals was 3,332 in 2008, 3,241 in 2009, and 3,145 in 2010. 6) For pneumonia, the total number of hospitals was 3,801 in 2008, 3,618 in 2009, and 3,574 in 2010.

## Is there variation in readmission rates across hospitals?

To examine the variation in risk-standardized readmission rates (RSRRs) after admission for AMI, heart failure, and pneumonia among U.S. hospitals (including VA hospitals), we report the distribution of RSRRs in Figure A.4a-c and Table A.4. Variation in RSRRs reflects differences in performance among U.S. hospitals, with wider distributions suggesting more variation and narrower distributions suggesting less variation in quality.

Hospital performance for AMI, heart failure, and pneumonia were similarly distributed. While the majority of hospitals had RSRRs close to the national rate, the range of risk-standardized rates for all conditions remains wide (greater than 10 absolute percentage points), suggesting substantial opportunity for improvement.

Hospitals show meaningful variation in readmission rates after AMI, heart failure, and pneumonia.

**Table A.4. Distribution of Hospital RSRRs, 2008-2010**

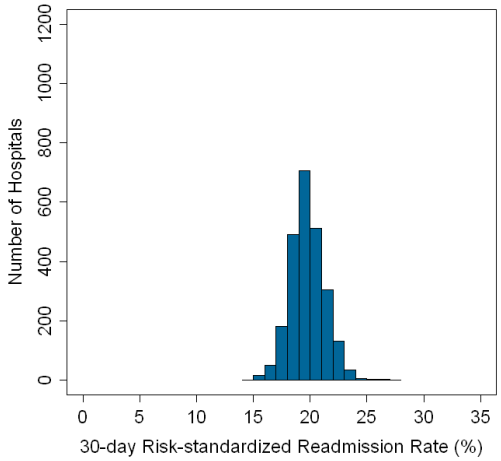
| | Distribution of RSRRs (%) | | |
|---|---|---|---|
| | **AMI** | **Heart Failure** | **Pneumonia** |
| **Maximum** | 27.1 | 33.7 | 26.1 |
| **90%** | 21.7 | 27.3 | 20.5 |
| **75%** | 20.7 | 26.0 | 19.4 |
| **Median (50%)** | 19.7 | 24.7 | 18.3 |
| **25%** | 18.8 | 23.6 | 17.4 |
| **10%** | 18.0 | 22.6 | 16.6 |
| **Minimum** | 14.8 | 18.8 | 13.5 |

**Source Data and Population:** Condition-specific RSRR Measure Cohorts—January 2008-December 2010 (Appendix I).

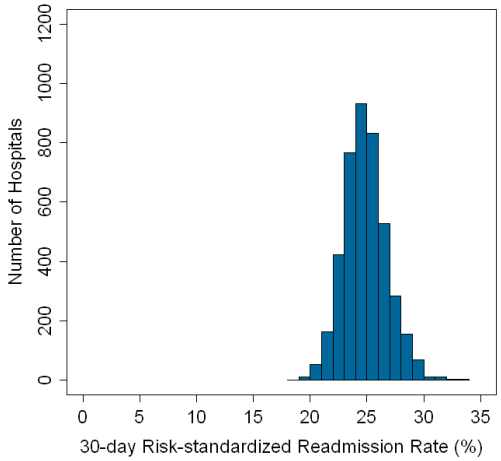
**Notes**: 1) Veterans Health Administration (VA) hospitals are included in this analysis. 2) The results of hospitals with fewer than 25 cases of the condition over the three-year period are not shown; however, these hospitals are included in the calculations. 3) The number of hospitals included for all three years was 2,445 for AMI; 4,246 for heart failure; and 4,517 for pneumonia.

**Figure A.4. Distribution of Hospital RSRRs, 2008-2010**

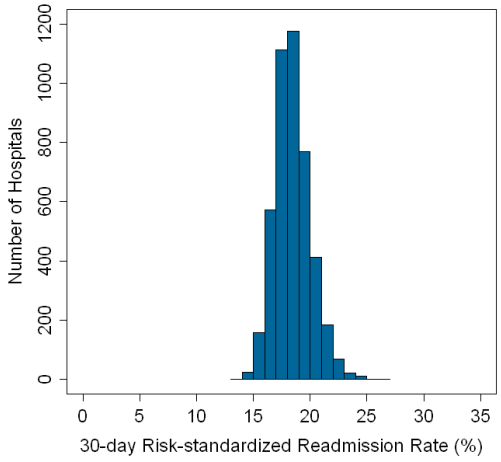
**a. AMI**




**b. Heart Failure**

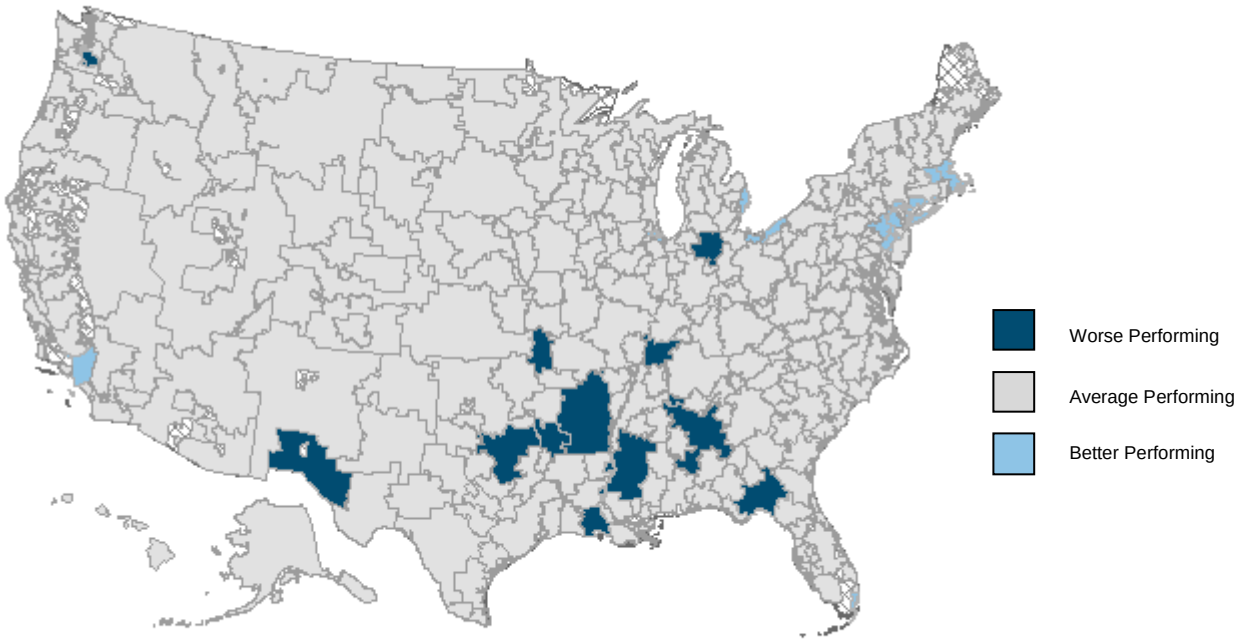



**c. Pneumonia**



## Do mortality rates for AMI vary across different regions of the U.S.?

**Figure A.5. Classification of HRRs by Risk-Standardized Mortality Rates for AMI, 2008-2010**




The above map (Figure A.5) shows that geographic variation in risk-standardized mortality rates (RSMRs) after hospitalization for AMI persists. The map is divided by Hospital Referral Region (HRR) and includes data for both non-federal and VA hospitals. The dark blue areas represent HRRs with RSMRs that are significantly worse than the national mortality rate, while the light blue areas represent those HRRs performing significantly better than the national mortality rate. The majority of HRRs perform similarly to the national rate, as represented by the grey areas. Table A.5 below displays those HRRs performing significantly better and worse than the national rate. The median RSMR for the better performing HRRs was 14.2%, while the median RSMR for the worse performing HRRs was 16.4%.

**Table A.5. Performance Status Compared to the National Rate for AMI RSMRs**

| Better Performing HRRs | | Worse Performing HRRs | |
|---|---|---|---|
| Allentown, PA | Manhattan, NY | Birmingham, AL | Tacoma, WA |
| Blue Island, IL | Melrose Park, IL | Dallas, TX | Tallahassee, FL |
| Boston, MA | Miami, FL | El Paso, TX | Texarkana, AR |
| Chicago, IL | Morristown, NJ | Fort Wayne, IN | |
| Cleveland, OH | New Haven, CT | Jackson, MS | |
| Detroit, MI | Philadelphia, PA | Joplin, MO | |
| East Long Island, NY | White Plains, NY | Lafayette, LA | |
| Hackensack, NJ | Worcester, MA | Little Rock, AR | |
| Los Angeles, CA | | Paducah, KY | |

**Source Data and Population:** AMI RSMR Measure Cohorts—July 2008-June 2011 (publicly reported RSMRs).
Notes: 1) Veterans Health Administration (VA) hospitals are included in this analysis. 2) The HRR ranking methodology can be found in Appendix IV.

## AMI, Heart Failure, and Pneumonia

# Do readmission rates for AMI vary across different regions of the U.S.?

**Figure A.6. Classification of HRRs by Risk-Standardized Readmission Rates for AMI, 2008-2010**

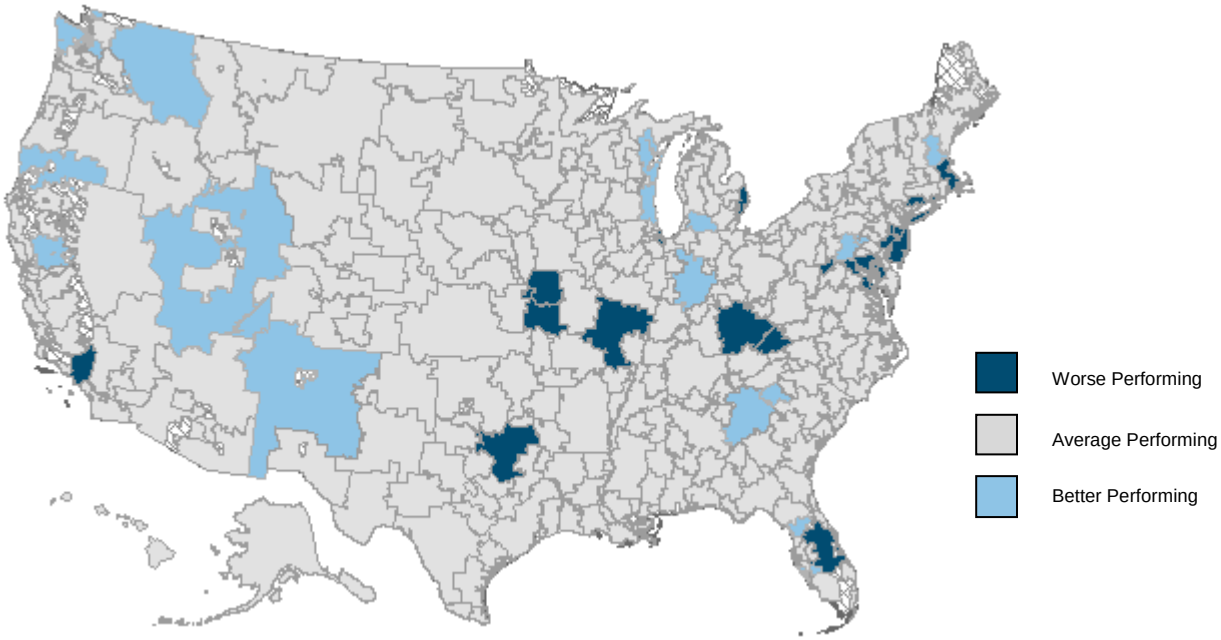



Figure A.6 displays geographic variation in risk-standardized readmission rates (RSRRs) after hospitalization for AMI in 2008 through 2011. The map is divided by Hospital Referral Region (HRR) and includes data for both non-federal and VA hospitals. The dark blue areas represent HRRs with RSRRs that are significantly worse than the national readmission rate, while the light blue areas represent those HRRs performing significantly better than the national rate. The majority of HRRs perform similarly to the national rate, as represented by the grey areas. Table A.6 below displays those HRRs performing better and worse than the national readmission rate. The median RSRR for the better performing HRRs was 18.6%, while the median RSRR for the worse performing HRRs was 20.6%.

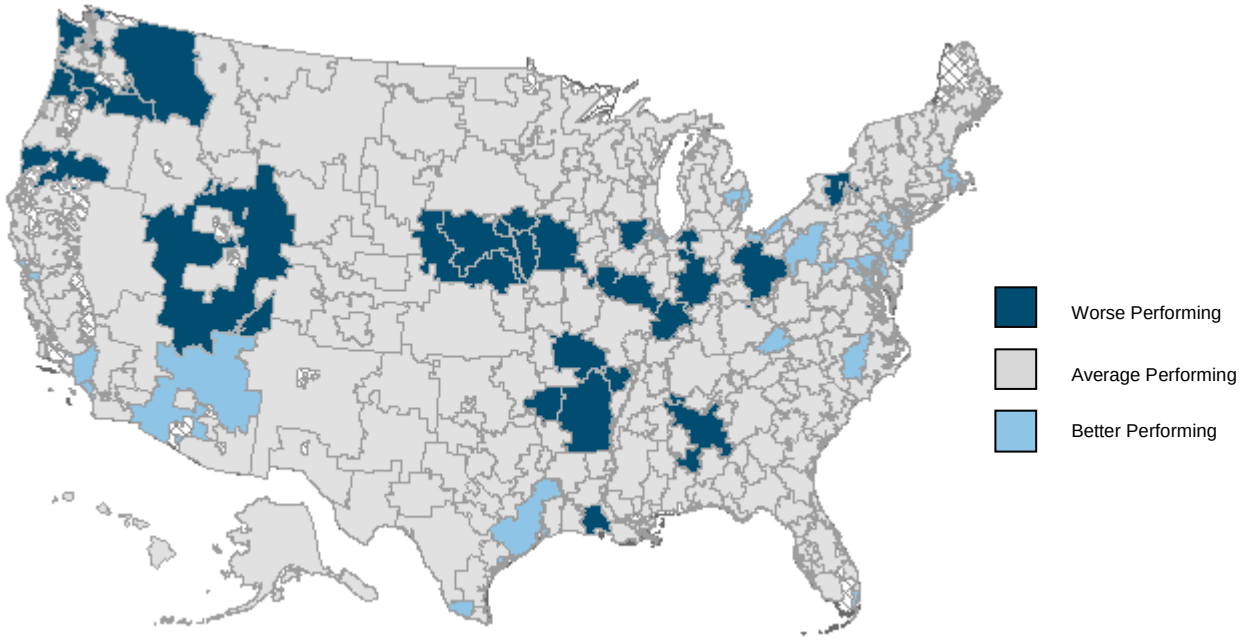
**Table A.6. Performance Status Compared to the National Rate for AMI RSRRs**

| Better Performing HRRs | | Worse Performing HRRs | |
|---|---|---|---|
| Albuquerque, NM | Salt Lake City, UT | Baltimore, MD | Lexington, KY |
| Atlanta, GA | Sarasota, Fl | Blue Island, IL | Los Angeles, CA |
| Green Bay, WI | Seattle, WA | Boston, MA | Manhattan, NY |
| Greenville, SC | Spokane, WA | Bronx, NY | Munster, IN |
| Harrisburg, PA | | Camden, NJ | New Brunswick, NJ |
| Indianapolis, IN | | Chicago, IL | New Haven, CT |
| Kalamazoo, MI | | Dallas, TX | Newark, NJ |
| Manchester, NH | | Detroit, MI | Orlando, FL |
| Medford, OR | | East Long Island, NY | Philadelphia, PA |
| Milwaukee, WI | | Hackensack, NJ | St. Louis, MO |
| Ocala, FL | | Kansas City, MO | Washington, DC |
| Sacramento, CA | | Kingsport, TN | |

**Source Data and Population:** AMI RSRR Measure Cohorts— July 2008-June 2011 (publicly reported RSRRs).
**Notes**: 1) Veterans Health Administration (VA) hospitals are included in this analysis. 2) The HRR ranking methodology can be found in Appendix IV.

## Do mortality rates for heart failure vary across different regions of the U.S.?

**Figure A.7. Classification of HRRs by Risk-Standardized Mortality Rates for Heart Failure, 2008-2010**




To examine whether hospital performance varies across the U.S., this map (Figure A.7) shows the geographic variation in risk-standardized mortality rates (RSMRs) after hospitalization for heart failure. The map is divided by Hospital Referral Region (HRR) and includes data for both non-federal and VA hospitals. The dark blue areas represent HRRs with RSMRs that are significantly worse than the national mortality rate, while the light blue areas represent those HRRs performing significantly better than the national rate. The grey areas represent HRRs with RSMRs following hospitalizations for heart failure that are similar to the national rate. Table A.7 below displays those HRRs performing better and worse than the national rate. The median RSMR for the better performing HRRs was 10.1%, while the median RSMR for the worse performing HRRs was 12.4%.

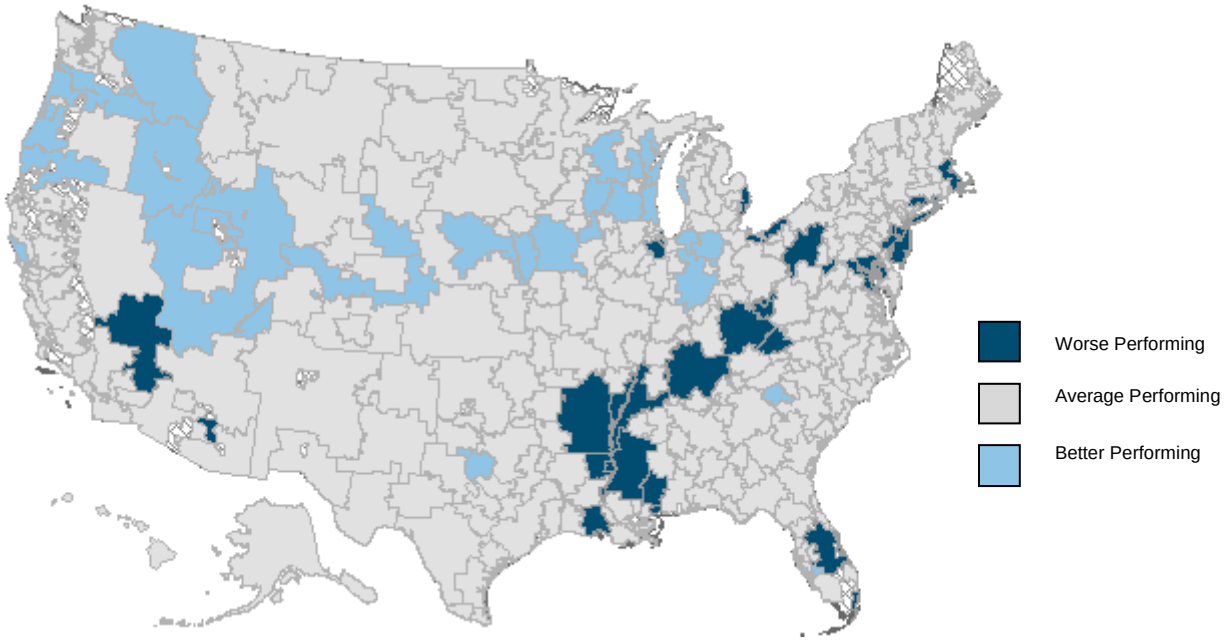
**Table A.7. Performance Status Compared to the National Rate for Heart Failure RSMRs**

| Better Performing HRRs | | Worse Performing HRRs | |
|---|---|---|---|
| Alameda County, CA | Manhattan, NY | Birmingham, AL | Seattle, WA |
| Allentown, PA | McAllen, TX | Columbus, OH | Sioux City, IA |
| Baltimore, MD | Melrose Park, IL | Des Moines, IA | South Bend, IN |
| Blue Island, IL | Miami, FL | Evansville, IN | Spokane, WA |
| Boston, MA | Munster, IN | Fort Smith, AR | Springfield, IL |
| Bronx, NY | Newark, NJ | Indianapolis, IN | Springfield, MO |
| Camden, NJ | Orange County, CA | Jonesboro, AR | |
| Chicago, IL | Philadelphia, PA | Lafayette, LA | |
| Cleveland, OH | Phoenix, AZ | Lincoln, NE | |
| Dearborn, MI | Pittsburgh, PA | Little Rock, AR | |
| Detroit, MI | Raleigh, NC | Medford, OR | |
| Flint, MI | Ridgewood, NJ | Omaha, NE | |
| Hackensack, NJ | Royal Oak, MI | Portland, OR | |
| Houston, TX | San Francisco, CA | Rochester, NY | |
| Kingsport, TN | Washington, DC | Rockford, IL | |
| Los Angeles, CA | | Salt Lake City, UT | |

**Source Data and Population:** Heart Failure RSMR Measure Cohorts— July 2008-June 2011 (publicly reported RSMRs).
**Notes**: 1) Veterans Health Administration (VA) hospitals are included in this analysis. 2) The HRR ranking methodology can be found in Appendix IV.

## Do readmission rates for heart failure vary across different regions of the U.S.?

**Figure A.8. Classification of HRRs by Risk-Standardized Readmission Rates for Heart Failure, 2008-2010**




To examine whether hospital performance varies across the U.S., Figure A.8 shows the geographic variation in risk-standardized readmission rates (RSRRs) after admission for heart failure. The map is divided by Hospital Referral Region (HRR) and includes data for both non-federal and VA hospitals. The dark blue areas represent HRRs with RSRRs that are significantly worse than the national rate; the light blue areas represent HRRs that are significantly better than the national rate; and grey areas represent HRRs that are similar to the national rate. Table A.8 lists HRRs performing better and worse than the national readmission rate. The median RSRR for better performing HRRs was 23.2%, while the median RSRR for worse performing HRRs was 26.1%.

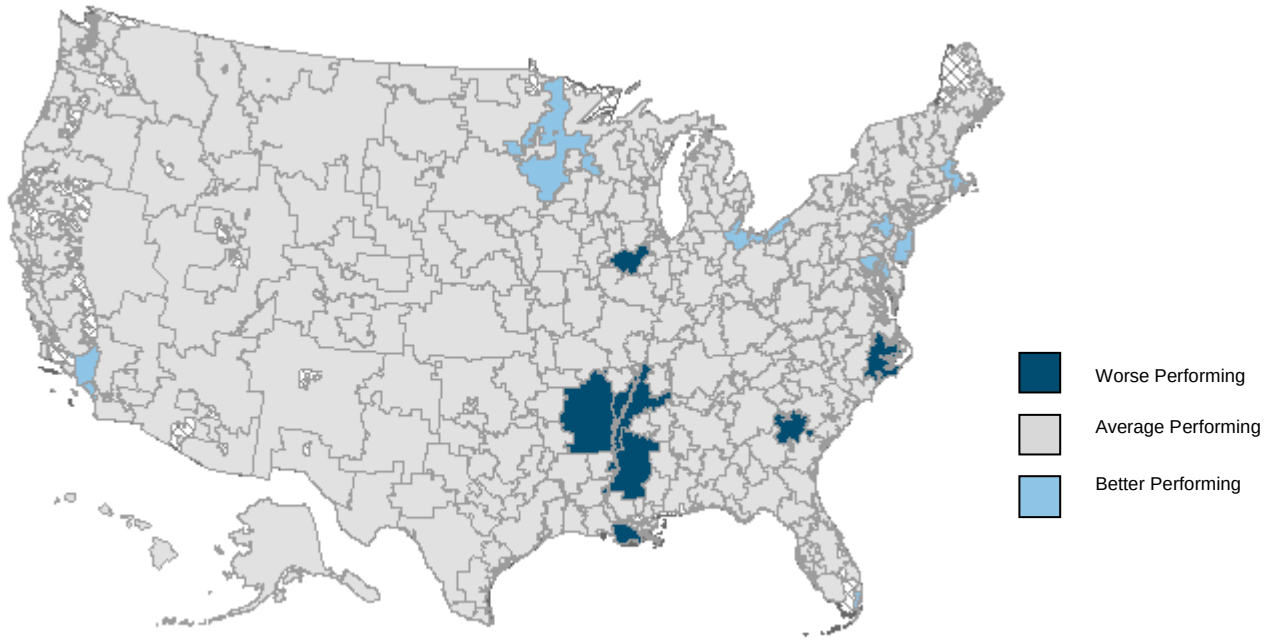
**Table A.8. Performance Status Compared to the National Rate for Heart Failure RSRRs**

| Better Performing HRRs | | Worse Performing HRRs | |
|---|---|---|---|
| Appleton, WI | Ogden, UT | Baltimore, MD | Las Vegas, NV |
| Boise, ID | Omaha, NE | Blue Island, IL | Lexington, KY |
| Cedar Rapids, IA | Portland, OR | Boston, MA | Little Rock, AR |
| Denver, CO | Salt Lake City, UT | Bronx, NY | Manhattan, NY |
| Des Moines, IA | Santa Rosa, CA | Camden, NJ | Memphis, TN |
| Eugene, OR | Sarasota, FL | Chicago, IL | Mesa, AZ |
| Fort Wayne, IN | South Bend, IN | Cleveland, OH | Miami, FL |
| Fort Worth, TX | Spokane, WA | Detroit, MI | Monroe, LA |
| Green Bay, WI | | East Long Island, NY | Nashville, TN |
| Greenville, SC | | Gulfport, MS | New Brunswick, NJ |
| Indianapolis, IN | | Hackensack, NJ | New Haven, CT |
| La Crosse, WI | | Hattiesburg, MS | Newark, NJ |
| Madison, WI | | Huntington, WV | Orlando, Fl |
| Marshfield, WI | | Jackson, MS | Philadelphia, PA |
| Medford, OR | | Joliet, IL | Pittsburg, PA |
| Milwaukee, WI | | Kingsport, TN | Takoma Park, MD |
| Muskegon, MI | | Lafayette, LA | Washington, DC |

**Source Data and Population:** Heart Failure RSRR Measure Cohorts—July 2008-June 2011 (publicly reported RSRRs).
**Notes**: 1) Veterans Health Administration (VA) hospitals are included in this analysis. 2) The HRR ranking methodology can be found in Appendix IV.

## Do mortality rates for pneumonia vary across different regions of the U.S.?

**Figure A.9. Classification of HRRs by Risk-Standardized Mortality Rates for Pneumonia, 2008-2010**




The above map (Figure A.9) shows that geographic variation in risk-standardized mortality rates (RSMRs) after admission for pneumonia persists. The map is divided by Hospital Referral Region (HRR) and includes data for both non-federal and VA hospitals. The dark blue areas represent HRRs with RSMRs that are significantly worse than the national rate, while the light blue areas represent those HRRs performing significantly better than the national rate. The majority of HRRs perform similarly to the national rate, as represented by the grey areas. Table A.9 displays those HRRs performing better and worse than the national rate. The median RSMR for the better performing HRRs was 10.6%, while the median RSMR for the worse performing HRRs was 13.4%.

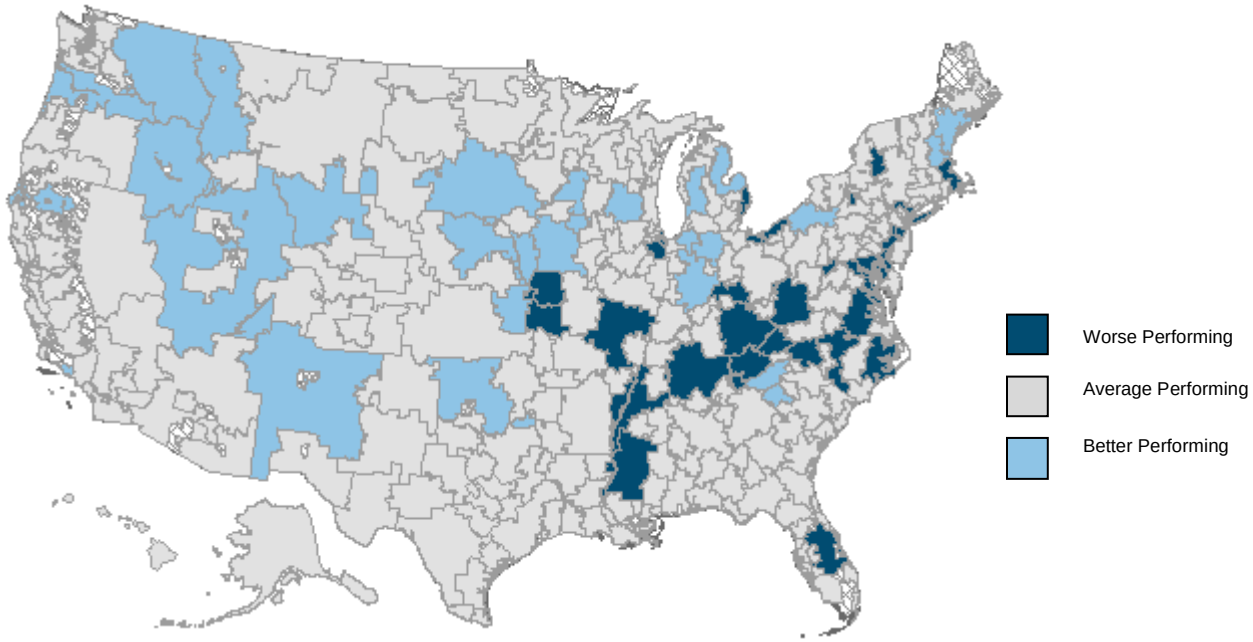
**Table A.9. Performance Status Compared to the National Rate for Pneumonia RSMRs**

| Better Performing HRRs | | Worse Performing HRRs |
|---|---|---|
| Allentown, PA | Manhattan, NY | Augusta, GA |
| Baltimore, MD | Miami, FL | Greenville, NC |
| Boston, MA | Minneapolis, MN | Houma, LA |
| Camden, NJ | Orange County, CA | Jackson, MS |
| Chicago, IL | Toledo, OH | Little Rock, AR |
| Cleveland, OH | | Memphis, TN |
| Los Angeles, CA | | Peoria, IL |

**Source Data and Population:** Pneumonia RSMR Measure Cohorts—July 2008-June 2011 (publicly reported RSMRs).
**Notes**: 1) Veterans Health Administration (VA) hospitals are included in this analysis. 2) The HRR ranking methodology can be found in Appendix IV.

## Do readmission rates for pneumonia vary across different regions of the U.S.?

**Figure A.10. Classification of HRRs by Risk-Standardized Readmission Rates for Pneumonia, 2008-2010**




To examine whether hospital performance varies across the U.S., this map (Figure A.10) shows the geographic variation in risk-standardized readmission rates (RSRRs) after admission for pneumonia. The map is divided by HRR and includes data for non-federal and VA hospitals. Dark blue, light blue, and grey areas represent HRRs that are significantly worse than, significantly better than, and similar to the national rate, respectively. Table A.10 displays those HRRs performing better and worse than the national rate. The median RSRR for the better performing HRRs was 17.3%, while the median RSRR for the worse performing HRRs was 19.7%.

**Table A.10. Performance Status Compared to the National Rate for Pneumonia RSRRs**

| Better Performing HRRs | | Worse Performing HRRs | |
|---|---|---|---|
| Albuquerque, NM | Rochester, MN | Baltimore, MD | Knoxville, TN |
| Asheville, NC | Saginaw, MI | Blue Island, IL | Lexington, KY |
| Boise, ID | Salt Lake City, UT | Boston, MA | Manhattan, NY |
| Casper, WY | Sioux Falls, SD | Bronx, NY | Memphis, TN |
| Des Moines, IA | South Bend, IN | Charleston, WV | Nashville, TN |
| Erie, PA | Spokane, WA | Chicago, IL | New Brunswick, NJ |
| Fort Wayne, IN | Topeka, KS | Cincinnati, OH | Newark, NJ |
| Grand Rapids, MI | Ventura, CA | Cleveland, OH | Orlando, FL |
| Greenville, SC | Waterloo, IA | Detroit, MI | Philadelphia, PA |
| Indianapolis, IN | | Durham, NC | Richmond, VA |
| Madison, WI | | East Long Island, NY | Royal Oak, MI |
| Manchester, NH | | Elmira, NY | St. Louis, MO |
| Missoula, MT | | Greenville, NC | Takoma Park, MD |
| Oklahoma City, OK | | Hackensack, NJ | Washington, DC |
| Omaha, NE | | Jackson, MS | White Plains, NY |
| Portland, ME | | Joliet, IL | Wilmington, DE |
| Portland, OR | | Kansas City, MO | Winston-Salem, NC |
| Redding, CA | | Kingsport, TN | |

**Source Data and Population:** Pneumonia RSRR Measure Cohorts—July 2008-June 2011 (publicly reported RSRRs).
**Notes**: 1) Veterans Health Administration (VA) hospitals are included in this analysis. 2) The HRR ranking methodology can be found in Appendix IV.

## How do hospitals caring for high proportions of Medicaid beneficiaries perform on the AMI mortality measure?

Some stakeholders are concerned that hospitals caring for large numbers of poor patients may not perform well on the outcome measures. We examined the performance of hospitals categorized by the proportion of the hospital's patients who have low socioeconomic status (SES), as defined by being enrolled in Medicaid. We compared hospitals in the lowest decile (those with less than or equal to 8% of patients in Medicaid) with those in the top decile (those with greater than or equal to 30% of patients in Medicaid).

Figure A.11 displays the distribution of RSMRs for these hospitals. The range of performance is very similar between hospital groups, despite differences in patient mix. The absolute difference in the median RSMR between the top and bottom deciles of hospitals based on patient SES is 0.4% (Table A.11). Only three hospitals with high proportions of Medicaid patients had RSMRs that fell above the range of the hospitals with the least Medicaid patients.

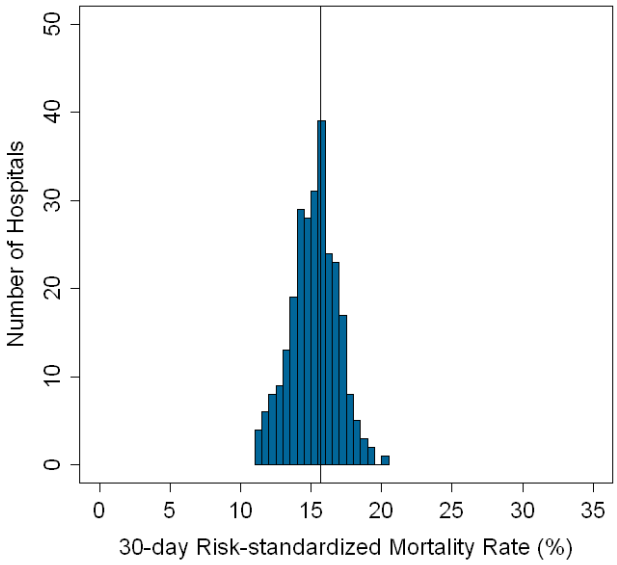
On the AMI mortality measure, the hospitals with the most Medicaid beneficiaries show a similar range of performance as hospitals with the fewest Medicaid beneficiaries, demonstrating that they can achieve high performance on the mortality measures.

**Table A.11. Distribution of Hospital RSMRs by Proportion of Medicaid Patients, 2008-2010**

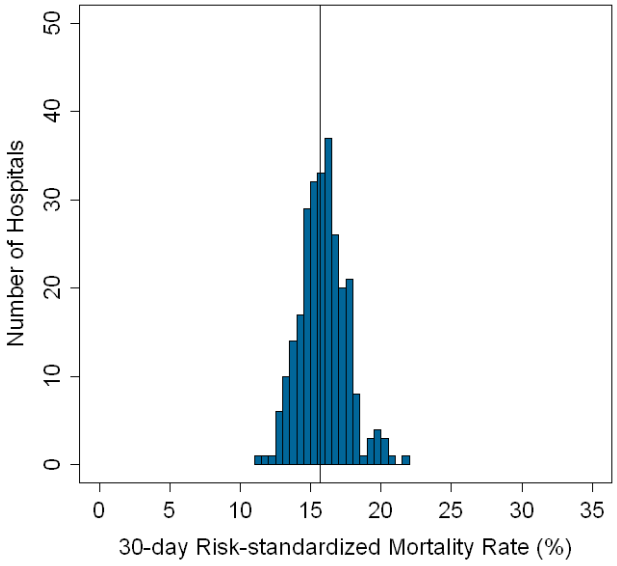
| | AMI RSMR (%) | |
|---|---|---|
| | **Low Proportion (≤8%) Medicaid Patients; n=269** | **High Proportion (≥30%) Medicaid Patients; n=269** |
| **Maximum** | 20.4 | 21.5 |
| **90%** | 17.2 | 17.8 |
| **75%** | 16.3 | 16.9 |
| **Median (50%)** | 15.4 | 15.8 |
| **25%** | 14.1 | 14.9 |
| **10%** | 12.8 | 13.7 |
| **Minimum** | 11.0 | 11.5 |

**Figure A.11. AMI RSMRs by Proportion of Medicaid Patients, 2008-2010**

**a. Hospitals with the Lowest Proportion (≤8%) Medicaid Beneficiaries**




**b. Hospitals with the Highest Proportion (≥30%) Medicaid Beneficiaries**




**Source Data and Population:** AMI RSMR Measure Cohorts—January 2008-December 2010 (Appendix I); 2009 American Hospital Association (AHA) data to derive Medicaid eligibility rate (Appendix III).

**Notes:** 1) Veterans Health Administration (VA) hospitals are not included in this analysis. 2) The results of hospitals with fewer than 25 cases of the condition over the three-year period are not shown; however, these hospitals are included in the calculations. 3) The vertical line on each histogram represents the median hospital RSMR.

## How do hospitals caring for high proportions of Medicaid beneficiaries perform on the heart failure mortality measure?

Figure A.12 displays the distribution of RSMRs after hospitalization for heart failure among U.S. hospitals categorized by the proportion of Medicaid patients cared for by the facility. Hospitals in the lowest decile (those with less than or equal to 7% of patients in Medicaid) are compared with those in the top decile (those with greater than or equal to 29% of patients in Medicaid). As these figures show, the range of performance is very similar between hospital groups despite differences in the patient mix. The difference in the median RSMR between the top and bottom deciles of hospitals based on patient SES is an absolute difference of 0.2% (Table A.12). No hospital with a high proportion of Medicaid patients had an RSMR that fell above the range of the hospitals with the lowest proportion of Medicaid patients. In the case of heart failure mortality, the best performing hospitals among those with many Medicaid patients in fact achieve better results than the best performing hospitals among those with few Medicaid patients.

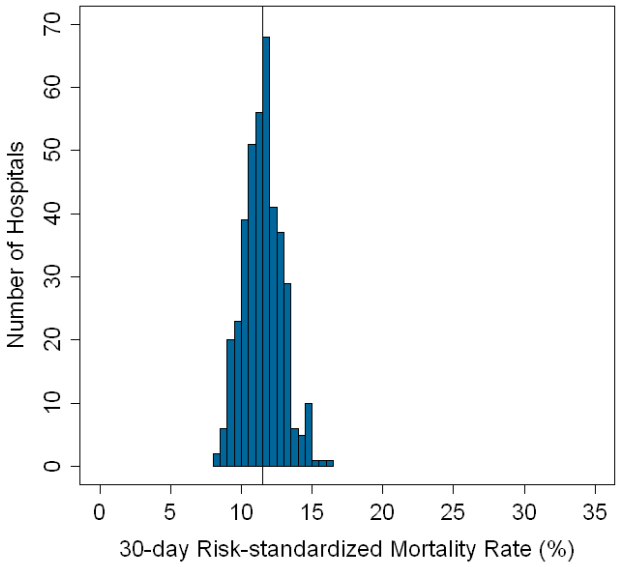
On the heart failure mortality measure, the hospitals with the most Medicaid beneficiaries show a similar or slightly better range of performance compared to hospitals with the fewest Medicaid beneficiaries.

**Table A.12. Distribution of Hospital RSMRs by Proportion of Medicaid Patients, 2008-2010**

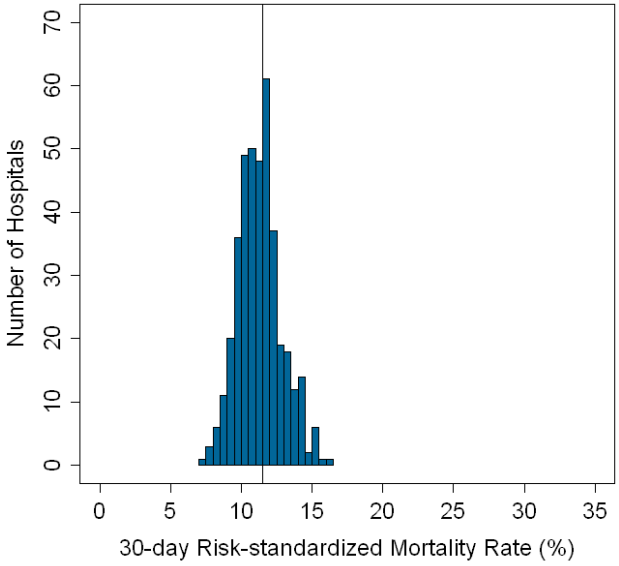
| | Heart Failure RSMR (%) | |
|---|---|---|
| | **Low Proportion (≤7%) Medicaid Patients; n=396** | **High Proportion (≥29%) Medicaid Patients; n=395** |
| **Maximum** | 16.4 | 16.1 |
| **90%** | 13.2 | 13.4 |
| **75%** | 12.4 | 12.2 |
| **Median (50%)** | 11.5 | 11.3 |
| **25%** | 10.6 | 10.3 |
| **10%** | 9.8 | 9.5 |
| **Minimum** | 8.2 | 7.3 |

**Figure A.12. Heart Failure RSMRs by Proportion of Medicaid Patients, 2008-2010**

**a. Hospitals with the Lowest Proportion (≤7%) Medicaid Beneficiaries**




**b. Hospitals with the Highest Proportion (≥29%) Medicaid Beneficiaries**




**Source Data and Population:** Heart Failure RSMR Measure Cohorts January 2008-December 2010 (Appendix I); 2009 American Hospital Association (AHA) data to derive Medicaid eligibility rate (Appendix III).

**Notes:** 1) Veterans Health Administration (VA) hospitals are not included in this analysis. 2) The results of hospitals with fewer than 25 cases of the condition over the three-year period are not shown; however, these hospitals are included in the calculations. 3) The vertical line on each histogram represents the median hospital RSMR.

## How do hospitals caring for high proportions of Medicaid beneficiaries perform on the pneumonia mortality measure?

Figure A.13 displays the distribution of RSMRs after hospitalization for pneumonia among U.S. hospitals categorized by the proportion of Medicaid patients cared for by the facility. The figures compare hospitals in the lowest decile (those with less than or equal to 6% of patients in Medicaid) against those in the highest decile (those with greater than or equal to 29% of patients in Medicaid). Despite differences in the patient mix, the range of performance is again very similar between hospital groups. The difference in median RSMR between the top and bottom decile of hospitals based on patient SES is an absolute difference of 0.2% (Table A.13). Only two hospitals with high proportions of Medicaid patients had RSMRs that fell above the range of the hospitals with the least Medicaid patients for the pneumonia measure. In fact, the best performing hospital on the pneumonia mortality measure in either of these two groups was one with a high proportion of Medicaid patients.

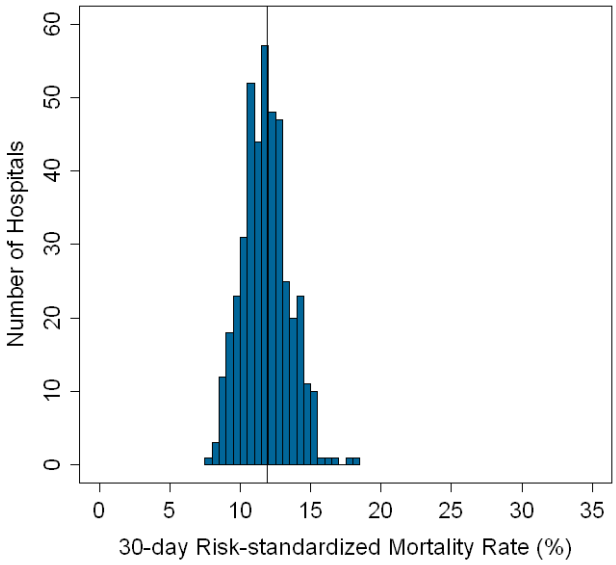
On the pneumonia mortality measure, the hospitals with the most Medicaid beneficiaries show a similar range of performance as hospitals with the fewest Medicaid beneficiaries.

**Table A.13. Distribution of Hospital RSMRs by Proportion of Medicaid Patients, 2008-2010**

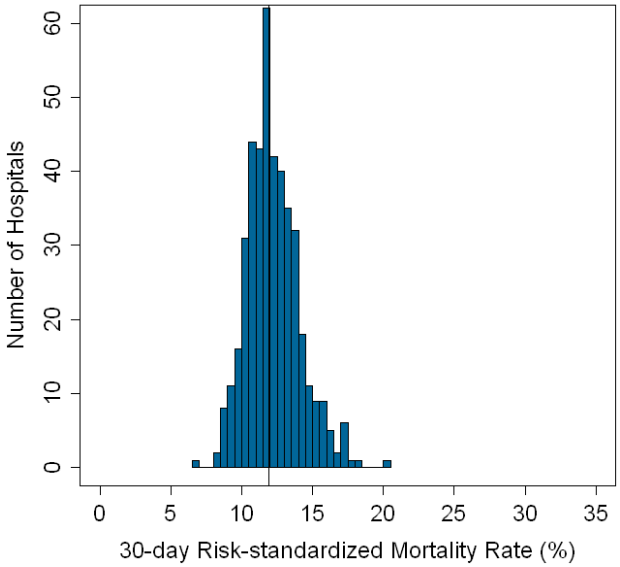
| | Pneumonia RSMR (%) | |
|---|---|---|
| | **Low Proportion (≤6%) Medicaid Patients; n=430** | **High Proportion (≥29%) Medicaid Patients; n=430** |
| **Maximum** | 18.4 | 20.2 |
| **90%** | 14.1 | 14.6 |
| **75%** | 12.9 | 13.3 |
| **Median (50%)** | 11.8 | 12.0 |
| **25%** | 10.7 | 10.9 |
| **10%** | 9.7 | 10.1 |
| **Minimum** | 7.7 | 6.9 |

**Figure A.13. Pneumonia RSMRs by Proportion of Medicaid Patients, 2008-2010**

**a. Hospitals with the Lowest Proportion (≤6%) Medicaid Beneficiaries**




**b. Hospitals with the Highest Proportion (≥29%) Medicaid Beneficiaries**




**Source Data and Population:** Pneumonia RSMR Measure Cohorts—January 2008-December 2010 (Appendix I); 2009 American Hospital Association (AHA) data to derive Medicaid eligibility rate (Appendix III).

**Notes:** 1) Veterans Health Administration (VA) hospitals are not included in this analysis. 2) The results of hospitals with fewer than 25 cases of the condition over the three-year period are not shown; however, these hospitals are included in the calculations. 3) The vertical line on each histogram represents the median hospital RSMR.

## How do hospitals caring for high proportions of Medicaid beneficiaries perform on the AMI readmission measure?

Stakeholders have expressed concern that hospitals caring for patients of low socioeconomic status (SES) may not be able to achieve low readmission rates due to patient factors that hospitals cannot influence, such as lack of access to medications or follow-up care. We examined hospital performance on the readmission measures after categorizing hospitals by the proportion of the hospital's patients of low SES, defined by being enrolled in Medicaid. We compared hospitals in the lowest decile (≤8% of patients in Medicaid) with those in the top decile (≥29% of patients in Medicaid). Figure A.14 displays the distribution of RSRRs. The difference in the median RSRR between the top and bottom decile of hospitals based on patient SES is an absolute difference of 0.7% (Table A.14). Overall the range of performance is similar between the hospital groups, demonstrating that many hospitals caring for poor populations achieve low readmission rates. Although the highest RSRRs are among hospitals with high proportions of Medicaid patients, only 11 of these hospitals have RSRRs above the range of the hospitals with the least Medicaid patients.

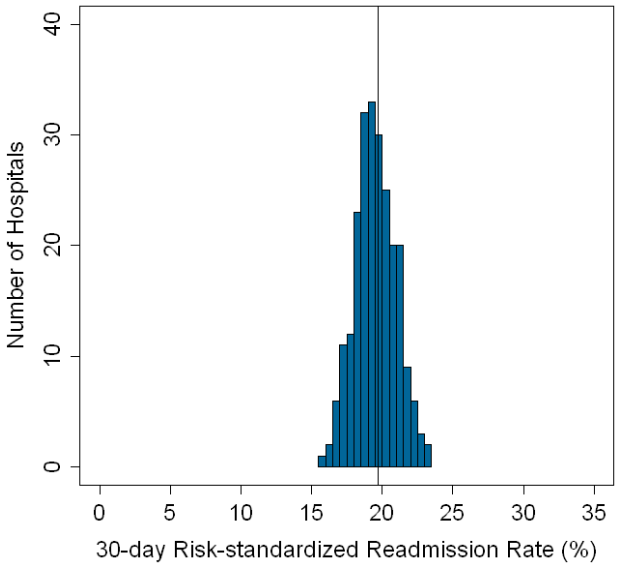
Hospitals caring for high proportions of Medicaid beneficiaries perform slightly worse on the AMI readmission measure than those caring for low proportions of Medicaid beneficiaries. Overall they show a largely overlapping range of performance as hospitals with the fewest Medicaid beneficiaries, and many hospitals achieve rates as low as those hospitals with the fewest Medicaid patients.

**Table A.14. Distribution of Hospital RSRRs by Proportion of Medicaid Patients, 2008-2010**

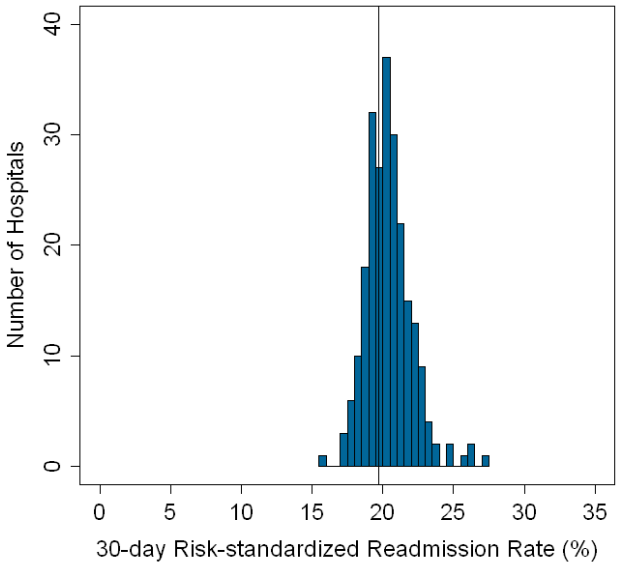
| | AMI RSRR (%) | |
|---|---|---|
| | **Low Proportion (≤8%) Medicaid Patients; n=235** | **High Proportion (≥29%) Medicaid Patients; n=235** |
| **Maximum** | 23.4 | 27.1 |
| **90%** | 21.4 | 22.5 |
| **75%** | 20.6 | 21.2 |
| **Median (50%)** | 19.5 | 20.2 |
| **25%** | 18.5 | 19.4 |
| **10%** | 17.7 | 18.7 |
| **Minimum** | 15.9 | 16.0 |

**Figure A.14. AMI RSRRs by Proportion of Medicaid Patients, 2008-2010**

**a. Hospitals with the Lowest Proportion (≤8%) Medicaid Beneficiaries**




**b. Hospitals with the Highest Proportion (≥29%) Medicaid Beneficiaries**




**Source Data and Population:** AMI RSRR Measure Cohorts—January 2008-December 2010 (Appendix I); 2009 American Hospital Association (AHA) data to derive Medicaid eligibility rate (Appendix III).

**Notes:** 1) Veterans Health Administration (VA) hospitals are not included in this analysis. 2) The results of hospitals with fewer than 25 cases of the condition over the three-year period are not shown; however, these hospitals are included in the calculations. 3) The vertical line on each histogram represents the median hospital RSRR.

## How do hospitals caring for high proportions of Medicaid beneficiaries perform on the heart failure readmission measure?

Figure A.15 displays the distribution of RSRRs after hospitalization for heart failure among U.S. hospitals categorized by the proportion of Medicaid patients cared for by the facility. Hospitals in the lowest decile had less than or equal to 6% Medicaid patients, while hospitals in the highest decile had greater than or equal to 29% Medicaid patients.

Again, the range of performance is similar between hospital groups, despite the difference in the patient mix. The difference in the median RSRR between the top and bottom decile of hospitals based on patient SES is an absolute difference of 0.7% (Table A.15). Many hospitals with high proportions of Medicaid patients achieve low readmission rates. However, ten hospitals with high proportions of Medicaid patients had RSRRs that were above the range of the hospitals with the fewest Medicaid patients.

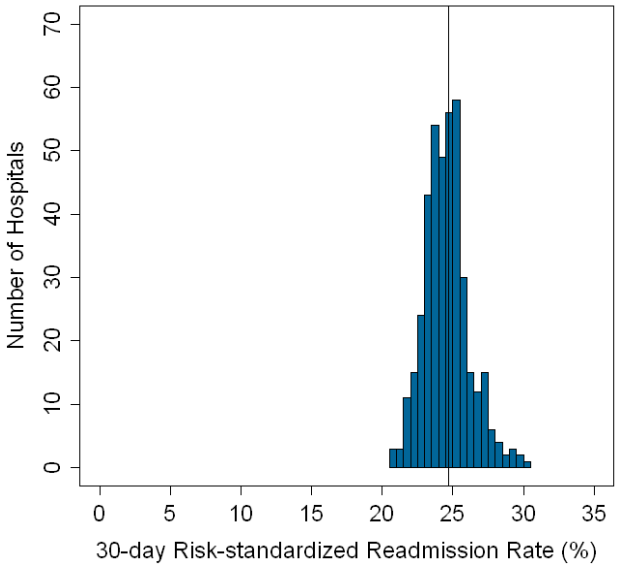
On the heart failure readmission measure, when comparing those hospitals with the highest proportion of patients from Medicaid with those with the lowest, the median performance of hospitals with the most Medicaid beneficiaries is slightly worse on the heart failure readmission measure; however, these hospitals show an overlapping range of performance with hospitals with the fewest Medicaid beneficiaries.

**Table A.15. Distribution of Hospital RSRRs by Proportion of Medicaid Patients, 2008-2010**

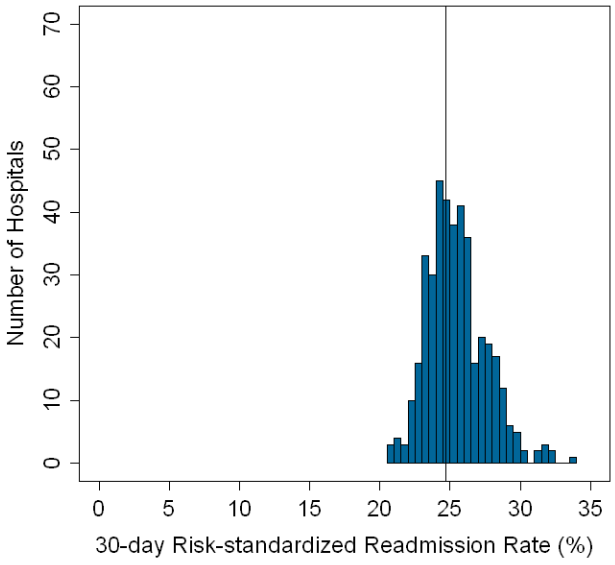
| | Heart Failure RSRR (%) | |
|---|---|---|
| | **Low Proportion (≤6%) Medicaid Patients; n=406** | **High Proportion (≥29%) Medicaid Patients; n=406** |
| **Maximum** | 30.3 | 33.7 |
| **90%** | 26.7 | 28.2 |
| **75%** | 25.4 | 26.6 |
| **Median (50%)** | 24.5 | 25.2 |
| **25%** | 23.5 | 23.1 |
| **10%** | 22.7 | 21.1 |
| **Minimum** | 20.5 | 20.6 |

**Figure A.15. Heart Failure RSRRs by Proportion of Medicaid Patients, 2008-2010**

**a. Hospitals with the Lowest Proportion (≤6%) Medicaid Beneficiaries**




**b. Hospitals with the Highest Proportion (≥29%) Medicaid Beneficiaries**




**Source Data and Population:** Heart Failure RSRR Measure Cohorts—January 2008-December 2010 (Appendix I); 2009 American Hospital Association (AHA) data to derive Medicaid eligibility rate (Appendix III).

**Notes:** 1) Veterans Health Administration (VA) hospitals are not included in this analysis. 2) The results of hospitals with fewer than 25 cases of the condition over the three-year period are not shown; however, these hospitals are included in the calculations. 3) The vertical line on each histogram represents the median hospital RSRR.

## How do hospitals caring for high proportions of Medicaid beneficiaries perform on the pneumonia readmission measure?

Figure A.16 displays the distribution of RSRRs after hospitalization for pneumonia among U.S. hospitals categorized by the proportion of Medicaid patients cared for by the facility. Hospitals in the lowest decile (those with less than or equal to 6% of patients in Medicaid) are compared with hospitals in the highest decile (those with greater than or equal to 29% of patients in Medicaid).

Like the other readmission measures, the range of performance on the pneumonia readmission measure is similar between hospital groups, despite the difference in the patient mix. The difference in the median RSRR between the top and bottom deciles of hospitals is an absolute difference of 0.8% (Table A.16). In addition, only two hospitals with low proportions of Medicaid patients performed better than the best performing hospital with a high proportion of Medicaid patients, showing the large amount of performance overlap between in the two groups.

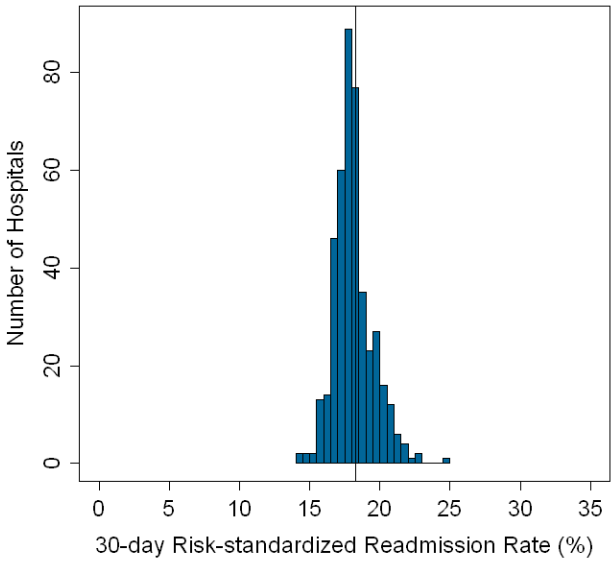
On the pneumonia readmission measure, overall the hospitals with the most Medicaid beneficiaries perform slightly worse than hospitals with the fewest Medicaid beneficiaries, but the two groups show a similar range of performance, indicating that both groups can perform well on the measures.

**Table A.16. Distribution of Hospital RSRRs by Proportion of Medicaid Patients, 2008-2010**

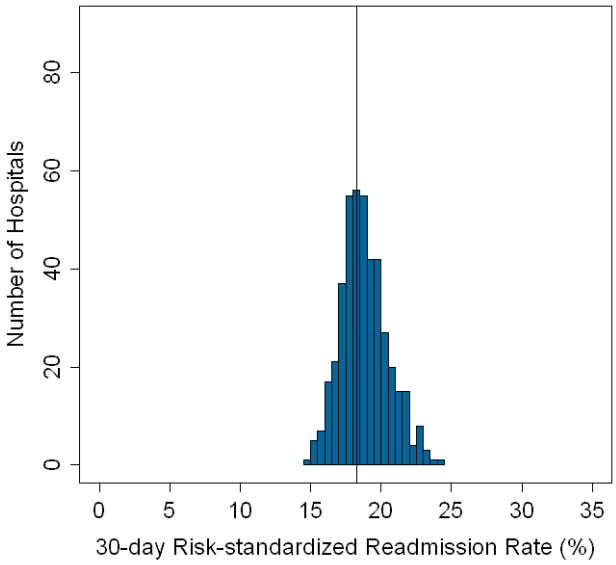
| | Pneumonia RSRR (%) | |
|---|---|---|
| | Low Proportion (≤6%) Medicaid Patients; n=432 | High Proportion (≥29%) Medicaid Patients; n=432 |
| **Maximum** | 24.6 | 24.1 |
| **90%** | 20.0 | 21.2 |
| **75%** | 18.7 | 19.9 |
| **Median (50%)** | 17.9 | 18.7 |
| **25%** | 17.3 | 17.7 |
| **10%** | 16.7 | 16.9 |
| **Minimum** | 14.0 | 14.5 |

**Figure A.16. Pneumonia RSRRs by Proportion of Medicaid Patients, 2008-2010**

**a. Hospitals with the Lowest Proportion (≤6%) Medicaid Beneficiaries**




**b. Hospitals with the Highest Proportion (≥29%) Medicaid Beneficiaries**




**Source Data and Population:** Pneumonia RSRR Measure Cohorts—January 2008-December 2010 (Appendix I); 2009 American Hospital Association (AHA) data to derive Medicaid eligibility rate (Appendix III).

**Notes:** 1) Veterans Health Administration (VA) hospitals are not included in this analysis. 2) The results of hospitals with fewer than 25 cases of the condition over the three-year period are not shown; however, these hospitals are included in the calculations. 3) The vertical line on each histogram represents the median hospital RSRR.

## How do hospitals caring for high proportions of African-American patients perform on the AMI mortality measure?

To examine potential disparities in outcomes among hospitals based on the racial makeup of the patients they serve, we examined hospitals' performance categorized by the proportion of the hospital's patients who are African-American. We compared hospitals in the lowest decile (those with 0% African-American patients) with those in the top decile (greater than or equal to 22% African-American patients) for the AMI mortality measure. Figure A.17 and Table A.17 display the distribution of RSMRs for the AMI mortality measure for these two groups of hospitals. The median RSMR of hospitals with the greatest proportion of African-American patients is 0.4 percentage points lower (better) than that of hospitals with the lowest proportion of African-American patients, and the range of performance is similar.

On the AMI mortality measure, hospitals with the most African-American patients show a similar range of performance and have slightly better outcomes compared to hospitals with the fewest African-American patients.

**Table A.17. Distribution of Hospital RSMRs by Proportion of African-American Patients, 2008-2010**

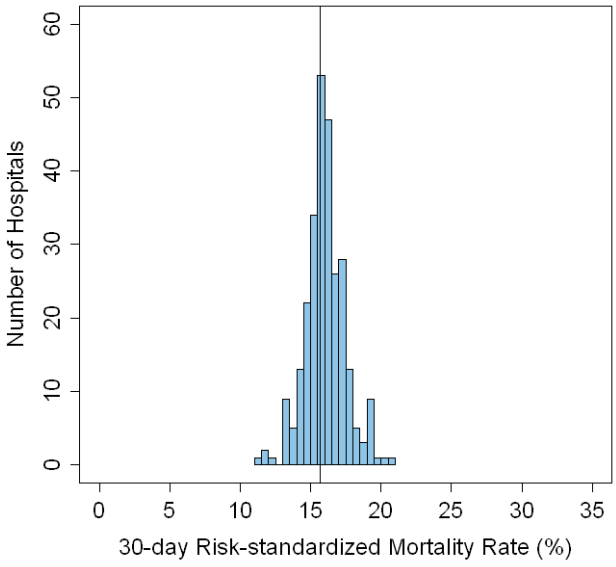
| | AMI RSMR (%) | |
|---|---|---|
| | **Low Proportion (0%) AA Patients; n=274** | **High Proportion (≥22%) AA Patients; n=273** |
| **Maximum** | 20.7 | 21.5 |
| **90%** | 17.8 | 17.6 |
| **75%** | 16.9 | 16.6 |
| **Median (50%)** | 16.0 | 15.6 |
| **25%** | 15.2 | 14.7 |
| **10%** | 14.4 | 13.7 |
| **Minimum** | 11.2 | 11.2 |

**Source Data and Population:** AMI RSMR Measure Cohorts—January 2008-December 2010 (Appendix I).

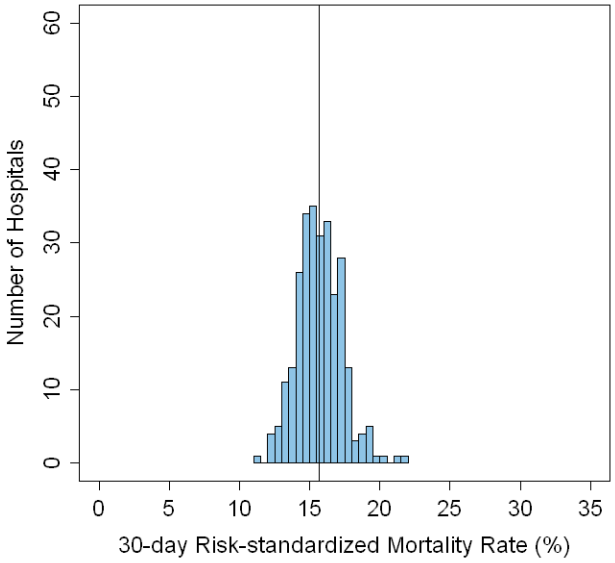
**Notes:** 1) Veterans Health Administration (VA) hospitals are not included in this analysis. 2) The results of hospitals with fewer than 25 cases of the condition over the three-year period are not shown; however, these hospitals are included in the calculations. 3) The vertical line on each histogram represents the median hospital RSMR.

**Figure A.17. AMI RSMRs by Proportion of African-American Patients, 2008-2010**

**a. Hospitals with the Lowest Proportion (0%) African-American Patients**




**b. Hospitals with the Highest Proportion (≥22%) African-American Patients**



## How do hospitals caring for high proportions of African-American patients perform on the heart failure mortality measure?

For the heart failure mortality measure, we examined the performance of hospitals categorized by the proportion of the hospital's patients who are African-American by comparing hospitals in the lowest decile (those with 0% African-American patients) with those in the top decile (≥23% African-American patients). Figure A.18 and Table A.18 display the distribution of RSMRs for these two groups of hospitals. The range of performance is similar between hospitals, despite differences in the patient mix. Indeed, for the heart failure mortality measure, the median RSMR of hospitals with the greatest proportion of African-American patients is 0.9 percentage points lower (better) than that with the lowest proportion of African-American patients, demonstrating that these hospitals can perform well on the measures.

On the heart failure mortality measure, the hospitals with the most African-American patients perform, on average, better than hospitals with the fewest African-American patients, although the two groups show a similar range of performance.

**Table A.18. Distribution of Hospital RSMRs by Proportion of African-American Patients, 2008-2010**

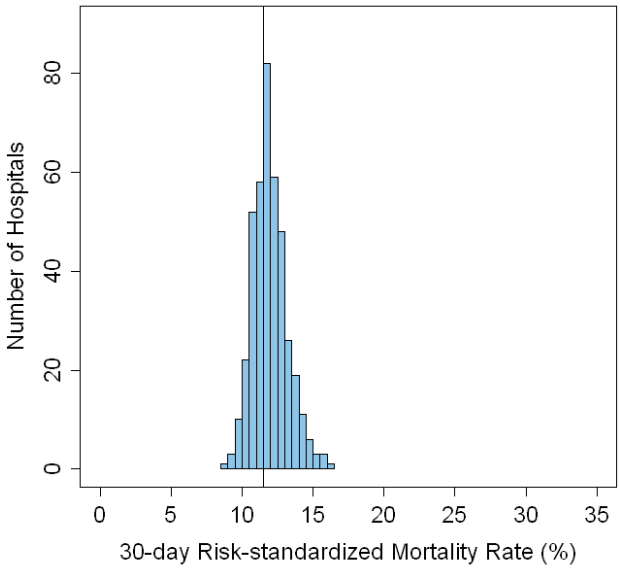
| | Heart Failure RSMR (%) | |
|---|---|---|
| | **Low Proportion (0%) AA Patients; n=404** | **High Proportion (≥23%) AA Patients; n=404** |
| **Maximum** | 16.5 | 14.9 |
| **90%** | 13.6 | 12.7 |
| **75%** | 12.6 | 12.0 |
| **Median (50%)** | 11.8 | 10.9 |
| **25%** | 11.1 | 9.9 |
| **10%** | 10.5 | 9.1 |
| **Minimum** | 8.9 | 6.5 |

**Source Data and Population:** Heart Failure RSMR Measure Cohorts—January 2008-December 2010 (Appendix I).

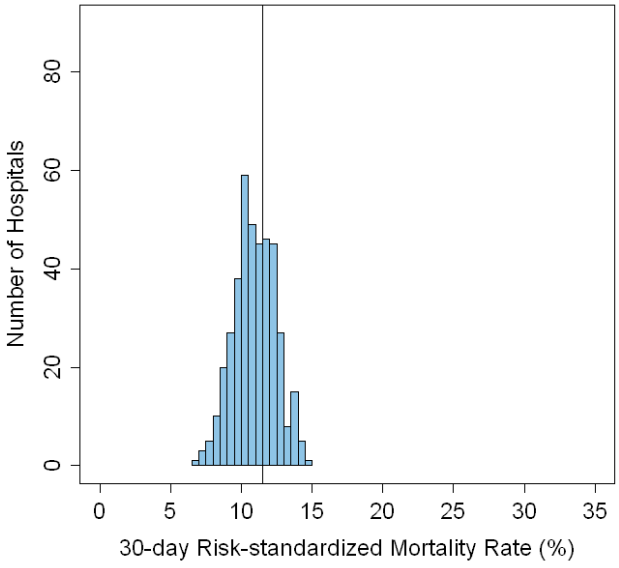
**Notes:** 1) Veterans Health Administration (VA) hospitals are not included in this analysis. 2) The results of hospitals with fewer than 25 cases of the condition over the three-year period are not shown; however, these hospitals are included in the calculations. 3) The vertical line on each histogram represents the median hospital RSMR.

**Figure A.18. Heart Failure RSMRs by Proportion of African-American Patients, 2008-2010**

**a. Hospitals with the Lowest Proportion (0%) African-American Patients**




**b. Hospitals with the Highest Proportion (≥23%) African-American Patients**



## How do hospitals caring for high proportions of African-American patients perform on the pneumonia mortality measure?

For the pneumonia mortality measure, we examined the performance of hospitals categorized by the proportion of the hospital's patients who are African-American by comparing hospitals in the lowest decile (those with 0% African-American patients) with those in the top decile (≥22 African-American patients).

Figure A.19 and Table A.19 display the distribution of RSMRs for these two groups of hospitals. The range of performance is similar between hospitals, despite differences in the patient mix, and there is no difference (0.0 absolute percentage points) between the median RSMR of hospitals with the greatest proportion of African-American patients and that of hospitals with the lowest proportion of African-American patients.

On the pneumonia mortality measure, the hospitals with the highest proportion of African-American patients show no difference in median performance and a similar overall range of performance as hospitals with the lowest proportion of African-American patients.

**Table A.19. Distribution of Hospital RSMRs by Proportion of African-American Patients, 2008-2010**

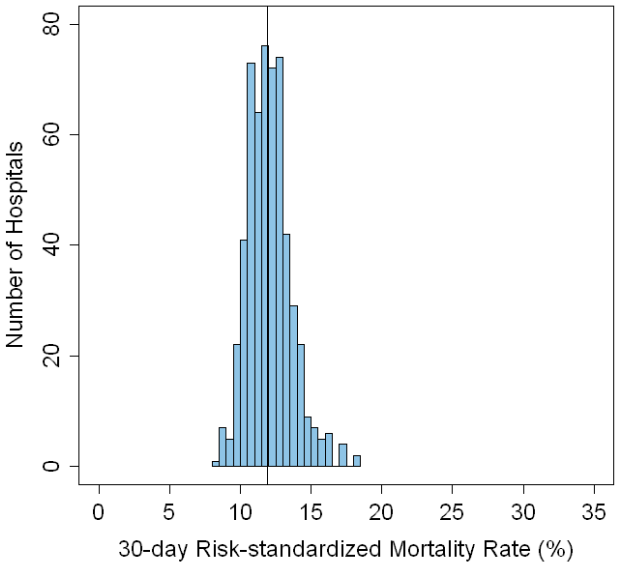
| | Pneumonia RSMR (%) | |
|---|---|---|
| | **Low Proportion (0%) AA Patients; n=561** | **High Proportion (≥22%) AA Patients; n=438** |
| **Maximum** | 18.2 | 18.7 |
| **90%** | 14.0 | 14.4 |
| **75%** | 12.9 | 13.2 |
| **Median (50%)** | 12.0 | 12.0 |
| **25%** | 11.0 | 11.0 |
| **10%** | 10.3 | 10.2 |
| **Minimum** | 8.5 | 7.4 |

**Source Data and Population:** Pneumonia RSMR Measure Cohorts—January 2008-December 2010 (Appendix I).

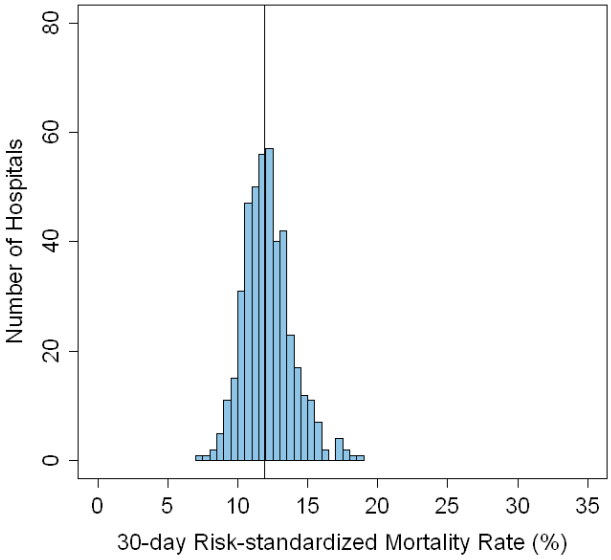
**Notes:** 1) Veterans Health Administration (VA) hospitals are not included in this analysis. 2) The results of hospitals with fewer than 25 cases of the condition over the three-year period are not shown; however, these hospitals are included in the calculations. 3) The vertical line on each histogram represents the median hospital RSMR.

**Figure A.19. Pneumonia RSMRs by Proportion of African-American Patients, 2008-2010**

**a. Hospitals with the Lowest Proportion (0%) African-American Patients**




**b. Hospitals with the Highest Proportion (≥22%) African-American Patients**



## How do hospitals caring for high proportions of African-American patients perform on the AMI readmission measure?

To examine potential disparities in outcomes among hospitals based on the racial makeup of the patients they serve, we examined hospitals' readmission measure performance categorized by the proportion of the hospital's patients who are African-American. Figure A.20 compares hospitals in the lowest decile (those with 0% African-American patients) with those in the top decile (≥22% African-American patients). The median RSRR for hospitals with high proportions of African-American patients is 1.2% higher than the median RSRR for hospitals with low proportions of African-American patients (Table A.20). The histograms demonstrate a wider distribution of RSRRs among hospitals with high proportions of African-American patients: substantial numbers of these hospitals achieve RSRRs below the national rate (left of the vertical line), but many also have higher RSRRs beyond the range for the hospitals with fewer such patients. These results suggest quite disparate performance among hospitals serving large proportions of African-American patients.

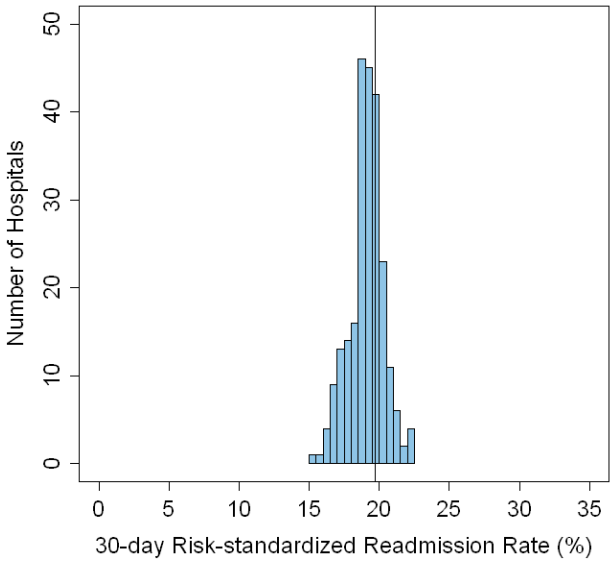
Hospitals with the greatest proportion of African-American patients perform slightly worse than hospitals with the fewest African-American patients. The wide range of performance among hospitals with high proportions of African-American patients illuminates the ability of such hospitals to achieve good RSRRs and the need to focus improvement efforts within those hospitals and their communities that are not achieving the same levels of success.

**Table A.20. Distribution of Hospital RSRRs by Proportion of African-American Patients, 2008-2010**

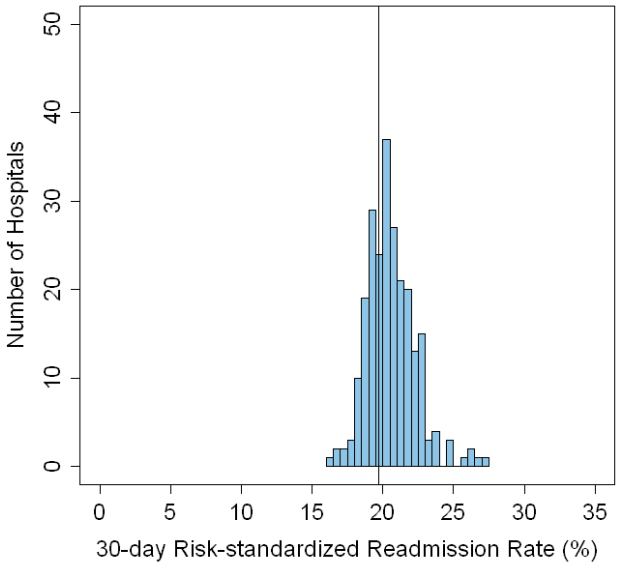
| | AMI RSRR (%) | |
|---|---|---|
| | **Low Proportion (0%); n=237** | **High Proportion (≥22%); n=238** |
| Maximum | 22.4 | 27.1 |
| 90% | 20.5 | 22.8 |
| 75% | 19.8 | 21.7 |
| Median (50%) | 19.2 | 20.4 |
| 25% | 18.5 | 19.3 |
| 10% | 17.3 | 18.7 |
| Minimum | 15.4 | 16.3 |

**Figure A.20. AMI RSRRs by Proportion of African-American Patients, 2008-2010**

**a. Hospitals with the Lowest Proportion (0%) African-American Patients**




**b. Hospitals with the Highest Proportion (≥22%) African-American Patients**




**Source Data and Population:** AMI RSRR Measure Cohorts—January 2008-December 2010 (Appendix I).

**Notes:** 1) Veterans Health Administration (VA) hospitals are not included in this analysis. 2) The results of hospitals with fewer than 25 cases of the condition over the three-year period are not shown; however, these hospitals are included in the calculations. 3) The vertical line on each histogram represents the median hospital RSRR.

## How do hospitals caring for high proportions of African-American patients perform on the heart failure readmission measure?

We examined the performance of hospitals categorized by the proportion of the hospital's patients who are African-American by comparing hospitals in the lowest decile (those with 0% African-American patients) with those in the top decile (≥23% African-American patients). Figure A.21 and Table A.21 display the distribution RSRRs after hospitalization for heart failure among these hospitals. Similar to AMI RSRRs, the median heart failure RSRR for hospitals with high proportions of African-American patients is 1.4% higher than the median RSRR for hospitals with low proportions of African-American patients. Again, the wide range of performance among hospitals with high proportions of African-American patients demonstrates both that many hospitals successfully achieve low RSRRs, and that the worst performing hospitals in this group have substantially higher RSRRs than the highest RSRRs among hospitals with few African-American patients.

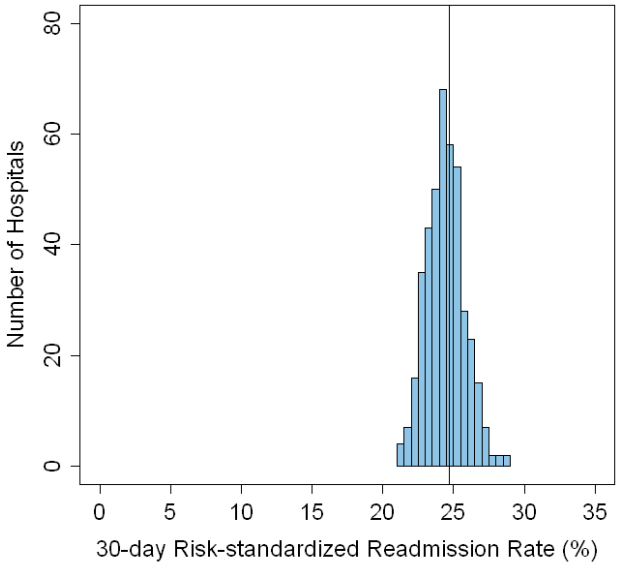
On the heart failure readmission measure, hospitals with the greatest proportion of African-American patients perform slightly worse overall than hospitals with the fewest African-American patients. The wide range of performance among hospitals with high proportions of African-American patients illuminates both the ability of such hospitals to achieve low RSRRs and the need to focus improvement efforts within those hospitals and their communities that are not achieving the same levels of success.

**Table A.21. Distribution of Hospital RSRRs by Proportion of African-American Patients, 2008-2010**

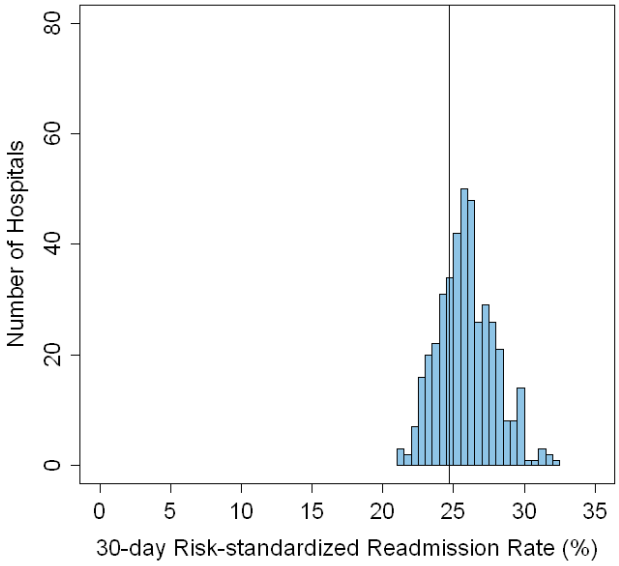
| | Heart Failure RSRR (%) | |
|---|---|---|
| | **Low Proportion (0%) AA Patients; n=414** | **High Proportion (≥23%) AA Patients; n=415** |
| **Maximum** | 28.8 | 32.2 |
| **90%** | 26.1 | 28.4 |
| **75%** | 25.3 | 27.2 |
| **Median (50%)** | 24.4 | 25.8 |
| **25%** | 23.5 | 24.6 |
| **10%** | 22.7 | 23.3 |
| **Minimum** | 21.1 | 21.1 |

**Figure A.21. Heart Failure RSRRs by Proportion of African-American Patients, 2008-2010**

**a. Hospitals with the Lowest Proportion (0%) African-American Patients**




**b. Hospitals with the Highest Proportion (≥23%) African-American Patients**




**Source Data and Population:** Heart Failure RSRR Measure Cohorts—January 2008-December 2010 (Appendix I).

**Notes:** 1) Veterans Health Administration (VA) hospitals are not included in this analysis. 2) The results of hospitals with fewer than 25 cases of the condition over the three-year period are not shown; however, these hospitals are included in the calculations. 3) The vertical line on each histogram represents the median hospital RSRR.

## How do hospitals caring for high proportions of African-American patients perform on the pneumonia readmission measure?

Again, we examined the performance of hospitals categorized by the proportion of the hospital's patients who are African-American by comparing hospitals in the lowest decile (those with 0% African-American patients) with those in the top decile (≥22% African-American patients). Figure A.22 and Table A.22 display the distribution of RSRRs after hospitalization for pneumonia among these hospitals. Similar to the other readmission measures, the median RSRR for hospitals with high proportions of African-American patients is 1.2% higher than the median RSRR for hospitals with low proportions of African-American patients. Again, the wide range of performance among hospitals with high proportions of African-American patients demonstrates both that many hospitals successfully achieve low RSRRs but also that the worst performing hospitals in this group have substantially higher RSRRs than the highest RSRRs among hospitals with few African-American patients.

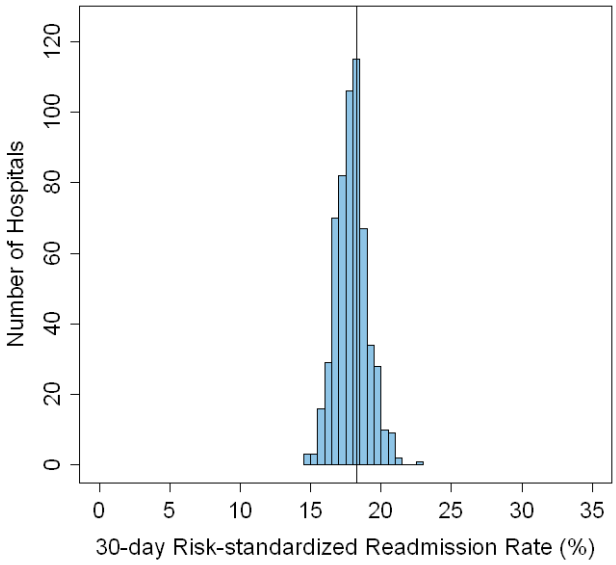
On the pneumonia readmission measure, hospitals with the most African-American patients perform slightly worse overall than hospitals with the fewest African-American patients. The wide range of performance among hospitals with high proportions of African-American patients illuminates both the ability of such hospitals to achieve low RSRRs and the need to focus improvement efforts within those hospitals and their communities that are not achieving the same levels of success.

**Table A.22. Distribution of Hospital RSRRs by Proportion of African-American Patients, 2008-2010**

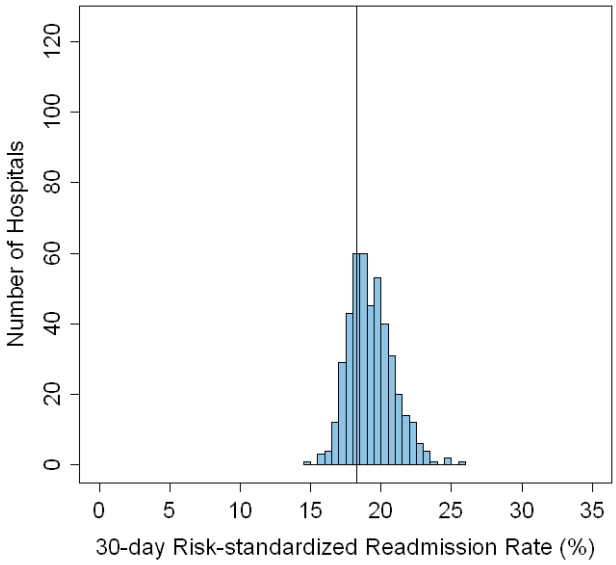
| | Pneumonia RSRR (%) | |
|---|---|---|
| | Low Proportion (0%) AA Patients; n=575 | High Proportion (≥22%) AA Patients; n=441 |
| **Maximum** | 22.9 | 25.5 |
| **90%** | 19.4 | 21.3 |
| **75%** | 18.5 | 20.3 |
| **Median (50%)** | 17.9 | 19.1 |
| **25%** | 17.2 | 18.2 |
| **10%** | 16.6 | 17.4 |
| **Minimum** | 14.6 | 14.8 |

**Figure A.22. Pneumonia RSRR by Proportion of African-American Patients, 2008-2010**

**a. Hospitals with the Lowest Proportion (0%) African-American Patients**




**b. Hospitals with the Highest Proportion (≥22%) African-American Patients**




**Source Data and Population:** Pneumonia RSRR Measure Cohorts—January 2008-December 2010 (Appendix I).

**Notes:** 1) Veterans Health Administration (VA) hospitals are not included in this analysis. 2) The results of hospitals with fewer than 25 cases of the condition over the three-year period are not shown; however, these hospitals are included in the calculations. 3) The vertical line on each histogram represents the median hospital RSRR.

## Does risk adjusting for socioeconomic status change hospital profiling on the AMI, heart failure, and pneumonia readmission measures?

Many stakeholders have asked CMS to consider risk-adjusting for socioeconomic status (SES). Including a marker of SES in the risk-adjustment model would obscure disparities, rather than illuminate them, and CMS has not supported this approach. To address this concern, the analysis below examines whether including a measure of socioeconomic status (SES) in the risk-adjustment model alters hospitals' performance on the publicly reported AMI, heart failure, and pneumonia readmission measures.

We defined our SES risk variable as whether or not an individual patient was enrolled in Medicaid ("dual eligible") and ran the model with and without this risk variable. To understand the impact of including this variable in the risk adjustment on hospital performance, we categorized hospitals into quintiles by the proportion of the hospital's patients who are dual eligible. We then compared hospitals' RSRRs with and without including the SES risk variable (patient-level dual eligible status) in the risk model (Table A.23).

The greatest difference in median RSRRs with and without adjusting for SES was 0.2 absolute percentage points for those hospitals with the highest proportion of dual eligible patients on the heart failure readmission measure. All other comparisons showed a 0.1 percentage point difference or less for the median hospital rate between the model that included SES in risk adjustment versus the model that did not.

Figure A.23a-c displays the RSRRs produced with and without SES in the risk model for the AMI, heart failure, and pneumonia measures, respectively. When SES was included as a risk-adjustment variable in the models, hospital performance changed very little. Although there was little overall change in RSRRs, including SES in the risk adjustment very slightly decreases RSRRs for those hospitals serving high proportions of low SES patients while simultaneously increasing RSRRs for those serving few low SES patients.

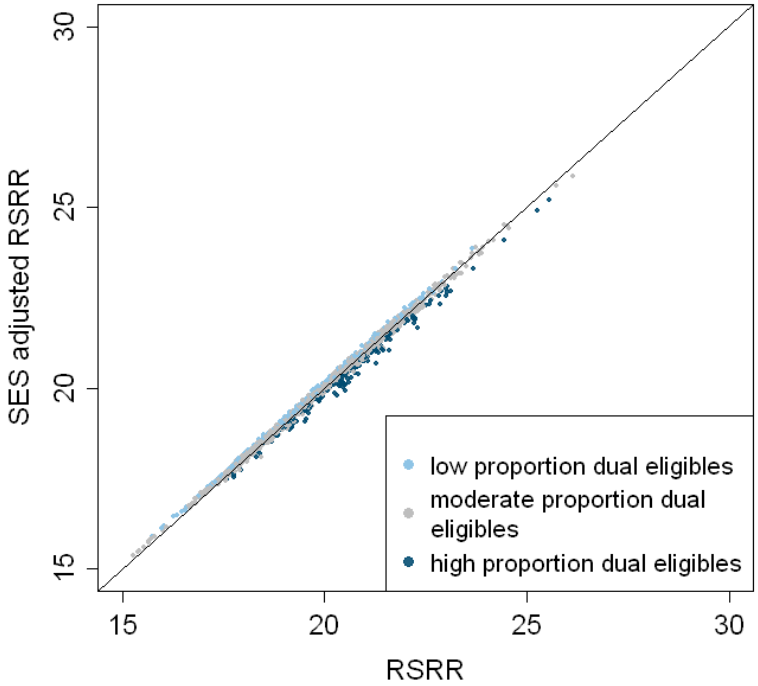
Risk adjustment for SES does not make a meaningful change in the assessment of hospitals' performance on the publicly reported AMI, heart failure, and pneumonia readmission measures.

**Table A.23. Comparison of RSRRs With and Without Risk Adjustment for SES**

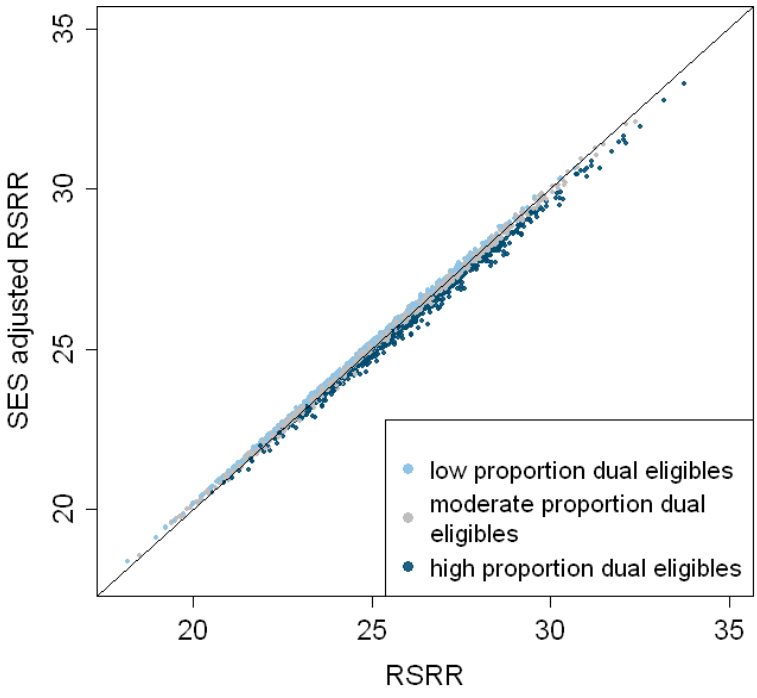
| | AMI | | Heart Failure | | Pneumonia | |
|---|---|---|---|---|---|---|
| | RSRR without SES (%) | RSRR with SES (%) | RSRR without SES (%) | RSRR with SES (%) | RSRR without SES (%) | RSRR with SES (%) |
| **Median hospital with a low proportion of dual eligible patients** | 19.5 | 19.6 | 24.3 | 24.4 | 18.1 | 18.1 |
| **Median hospital with a moderate proportion of dual eligible patients** | 19.8 | 19.8 | 24.6 | 24.6 | 18.2 | 18.2 |
| **Median hospital with a high proportion of dual eligible patients** | 20.2 | 20.1 | 25.5 | 25.3 | 18.7 | 18.6 |

**Figure A.23. Risk-Standardized Readmission Rates vs. SES-Adjusted Risk-Standardized Readmission Rates**

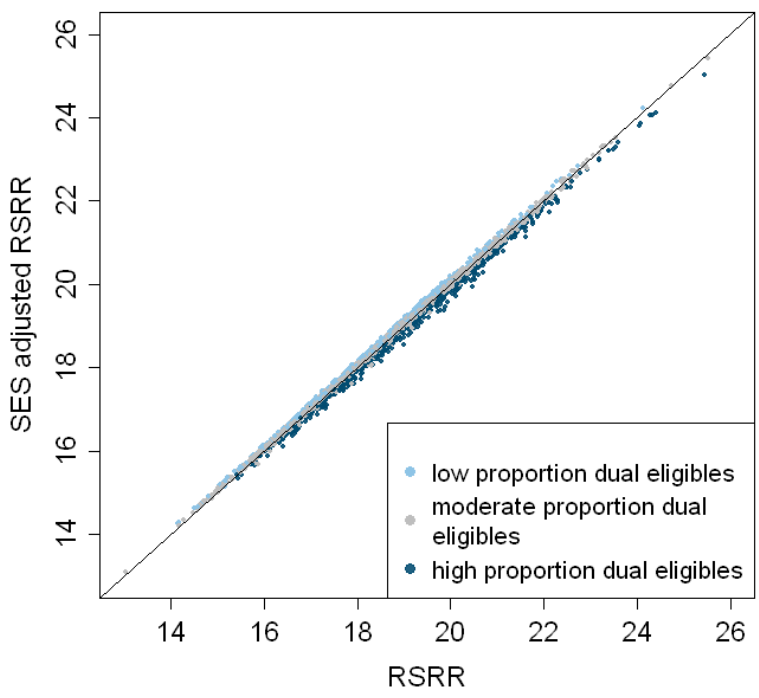
**a. AMI**




**b. Heart Failure**




**c. Pneumonia**




**Source Data and Population:** Measure-Specific RSRR Measure Cohorts—January 2008-December 2010 (Appendix I).

**Notes:** 1) Veterans Health Administration (VA) hospitals are not included in this analysis. 2) The results of hospitals with fewer than 25 cases of the condition over the three-year period are not shown; however, these hospitals are included in the calculations. 3) For AMI, hospitals in the lowest quintile had fewer than 8.3% dual eligible patients, while those in the top quintile had over 40.9% dual eligible patients. 4) For heart failure, hospitals in the lowest quintile had fewer than 12.3% dual eligible patients, while those in the top quintile had over 38.9% dual eligible patients. 5) For pneumonia, hospitals in the lowest quintile had fewer than 13.6% dual eligible patients, while those in the top quintile had over 40.1% dual eligible patients.

## Do the readmission diagnoses after hospitalizations for AMI, heart failure, and pneumonia differ among better and worse performing hospitals?

The AMI, heart failure, and pneumonia readmission measures are designed to encourage hospitals to lower the risk of readmission for all causes. It is unknown whether hospitals with low readmission rates succeed by lowering certain types of readmissions. Principal discharge diagnosis ICD-9 codes for all first readmissions within 30 days of discharge from a hospitalization for AMI, heart failure, and pneumonia during July 2008-June 2011 were identified, grouped into 30 clinically coherent categories of discharge diagnoses based upon the CMS Condition Categories, and ranked in order of decreasing frequency.

The tables below and the figures on the facing page show the most common categories of primary discharge diagnosis for readmissions after hospitalization for AMI, heart failure, and pneumonia. The vertical axis of the figure displays the percent of readmissions while the horizontal axis lists the most common diagnostic categories for readmissions according to hospital performance category. Among the five most common discharge diagnostic categories for readmissions, the proportion of readmissions with that diagnostic category is noted for hospitals that performed better (light blue), worse (dark blue), and no different than the national readmission rate (medium blue). Figure A.24 provides the most common diagnostic categories for readmissions after AMI, heart failure and pneumonia, respectively. There were no obvious differences in the readmission diagnostic categories after AMI, heart failure, or pneumonia among the three performance categories. The "Other" category—which consisted of the remaining 25 categories of diagnoses, each representing less than 5% of readmissions, and is shown at the far right of each figure—comprised over half of all readmissions after AMI, heart failure, and pneumonia. More comprehensive and systematic approaches to reducing readmissions are likely to have greater impact on readmission rates than condition-specific interventions.

The diagnoses for which patients are being readmitted after AMI, heart failure, and pneumonia do not differ across hospital performance categories. Better performing hospitals have reduced readmissions across all diagnosis categories, suggesting systematic approaches to reducing readmissions may have a greater impact on readmission rates than condition-specific interventions.

**Table A.24. Weighted Proportions of Top Five Readmission Diagnoses**

| | Proportion of Patients Readmitted (%) | | | | | |
|---|---|---|---|---|---|---|
| **AMI** | Heart Failure | AMI | Arrhythmias | Renal Disorders | Pneumonia | Other |
| Better | 21 | 8 | 7 | 4 | 4 | 55 |
| Average | 20 | 10 | 5 | 5 | 5 | 55 |
| Worse | 20 | 9 | 5 | 6 | 4 | 57 |
| **Heart Failure** | Heart Failure | Renal Disorders | Pneumonia | Arrhythmias | Septicemia/ Shock | Other |
| Better | 35 | 8 | 5 | 5 | 4 | 44 |
| Average | 36 | 8 | 5 | 4 | 4 | 43 |
| Worse | 37 | 8 | 4 | 4 | 4 | 44 |
| **Pneumonia** | Pneumonia | Heart Failure | COPD/ Asthma | Septicemia/ Shock | Renal Disorders | Other |
| Better | 21 | 9 | 7 | 7 | 5 | 52 |
| Average | 22 | 9 | 8 | 7 | 5 | 49 |
| Worse | 21 | 9 | 7 | 7 | 5 | 50 |

# AMI, Heart Failure, and Pneumonia

**Figure A.24.a. Top 5 Readmission Diagnoses for AMI**

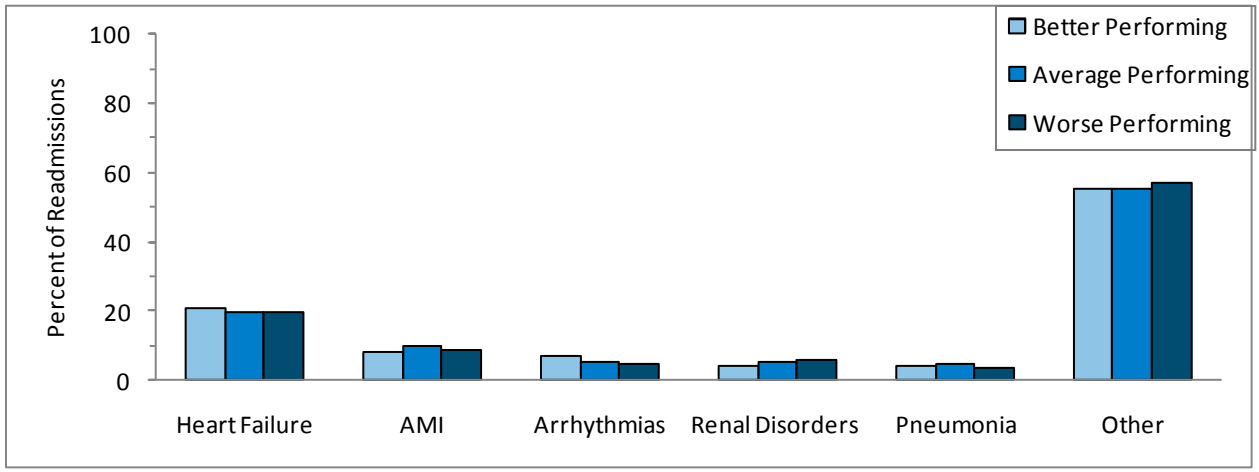



**Figure A.24.b. Top 5 Readmission Diagnoses for Heart Failure**

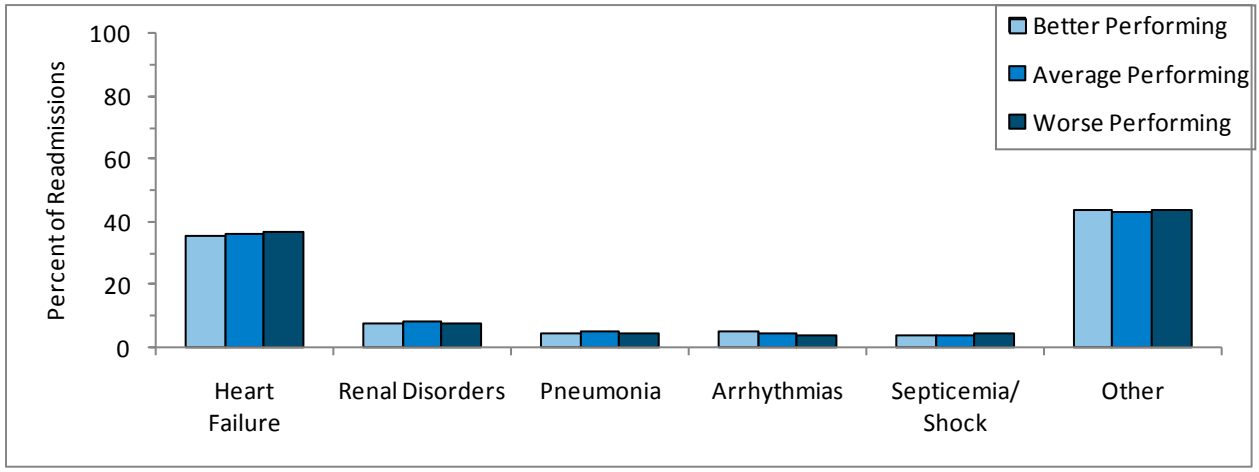
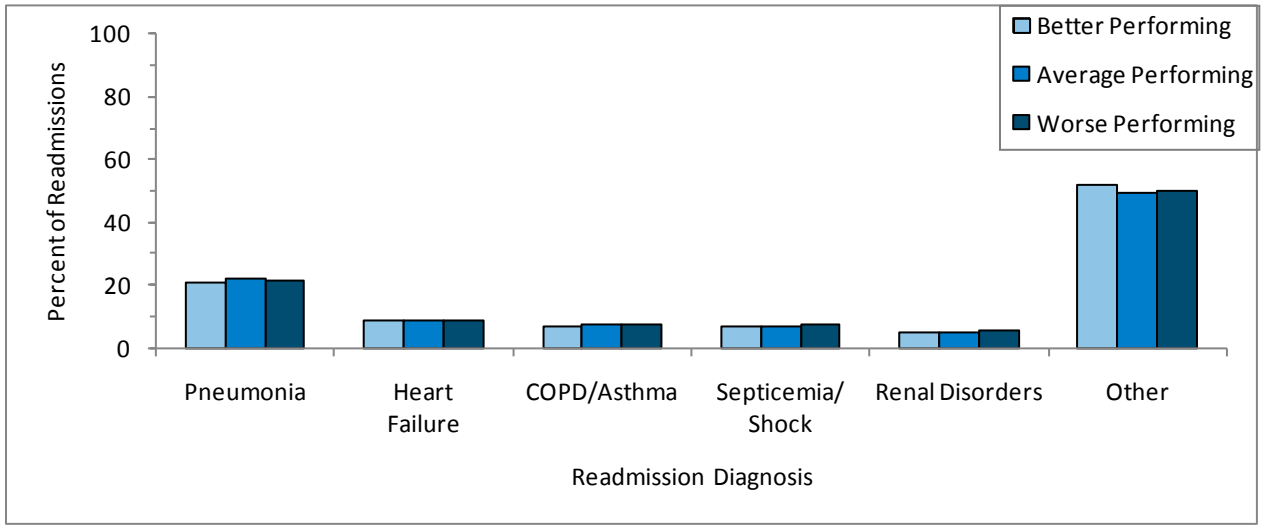



**Figure A.24.c. Top 5 Readmission Diagnoses for Pneumonia**




**Source Data and Population:** Condition-specific RSRR Measure Cohorts—July 2008-June 2011 (publicly reported RSRRs).
**Notes**: 1) Veterans Health Administration (VA) hospitals are included in this analysis. 2) The results of hospitals with fewer than 25 cases and hospitals whose rates were not publicly reported are excluded from the calculations. However, these hospitals are included in the performance categorization calculation. 3) The number of hospitals included for all three years was 2,386 for AMI; 4,159 for heart failure; and 4,427 for pneumonia.

## Do median times to readmission after AMI, heart failure, and pneumonia hospitalizations differ among better and worse performing hospitals?

Better performing hospitals may be able to delay readmissions, keeping patients out of the hospital longer than worse performing hospitals. These pages study whether this is true by analyzing the median time between discharge and readmission for all readmissions after hospitalization for AMI, heart failure, and pneumonia in July 2008-June 2011.

As Figure A.25 shows, there were no statistically significant differences in the median times to readmission between the better, average, and worse performing hospitals for the AMI measure (the dark blue diamonds in the figure indicate the median time to readmission, while the bars show the interquartile range). For the heart failure measure, the better performing hospitals had longer median time to readmission by a small but statistically significant amount as compared with worse performing hospitals. And for the pneumonia measure, both better performing hospitals and average performing hospitals showed statistically significant longer median times to readmission than worse performing hospitals. However, the figures show that for all three measures there was still a large amount of overlap in the range of timing across performance categories.

Median time to readmission did not vary by hospital performance category for patients with AMI. However, better performing hospitals had longer median times to readmission (by about one day) after pneumonia and heart failure compared to worse performing hospitals, despite significant overlap in the range of days. Understanding how these hospitals achieve this may provide additional insight into how hospitals can reduce readmissions.

**Table A.25. Distribution of Timing of Readmission (Days) by Hospital Performance Category**

**a. AMI**

| | Number of Days to Readmission | | |
|---|---|---|---|
| | **Better Performing** | **Average Performing** | **Worse Performing** |
| **Maximum** | 29.8 | 29.1 | 29.8 |
| **75%** | 18.6 | 18.2 | 18.1 |
| **Median (50%)** | 9.8 | 10.2 | 9.9 |
| **25%** | 4.4 | 4.7 | 4.6 |
| **Minimum** | 0.8 | 1.0 | 0.6 |

**b. Heart Failure**

| | **Better Performing** | **Average Performing** | **Worse Performing** |
|---|---|---|---|
| **Maximum** | 29.9 | 29.7 | 30.0 |
| **75%** | 20.5 | 20.1 | 19.9 |
| **Median (50%)** | 12.9 | 12.3 | 12.1 |
| **25%** | 6.4 | 6.1 | 6.0 |
| **Minimum** | 0.7 | 0.9 | 0.6 |

**c. Pneumonia**

| | **Better Performing** | **Average Performing** | **Worse Performing** |
|---|---|---|---|
| **Maximum** | 29.8 | 29.4 | 29.9 |
| **75%** | 20.6 | 19.7 | 19.1 |
| **Median (50%)** | 12.9 | 11.9 | 11.2 |
| **25%** | 6.7 | 5.8 | 5.5 |
| **Minimum** | 0.8 | 1.0 | 0.7 |

**Figure A.25.a. Median Time to Readmission after AMI**

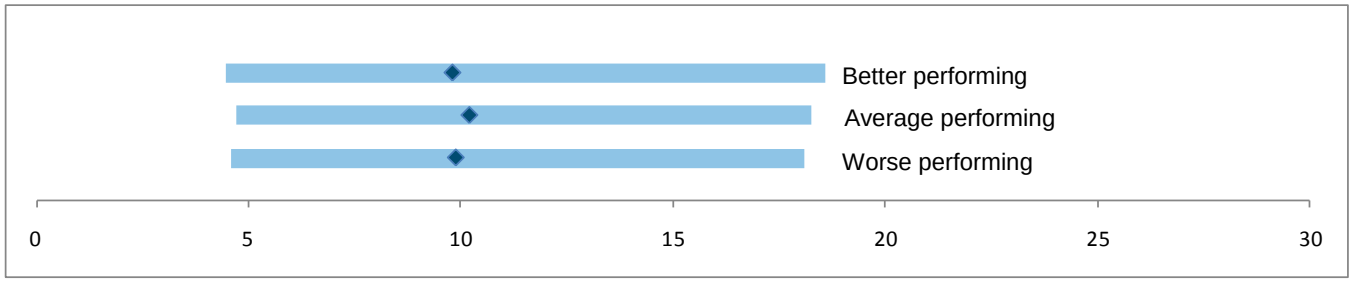



**Figure A.25.b. Median Time to Readmission after Heart Failure**

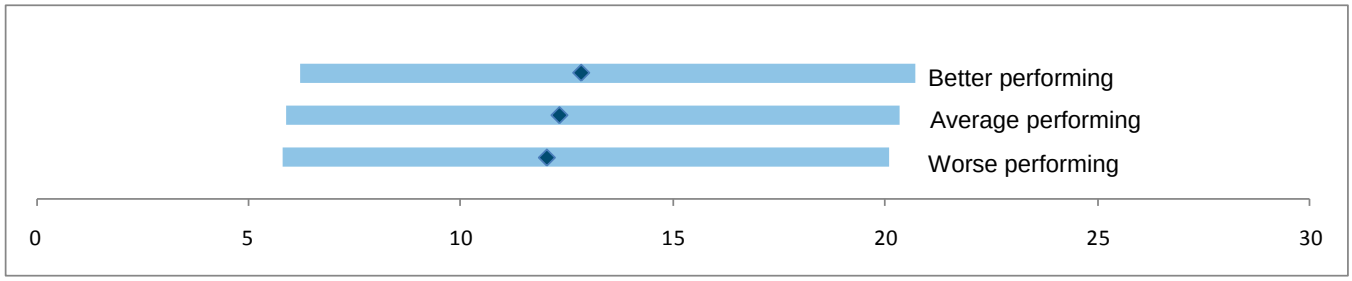
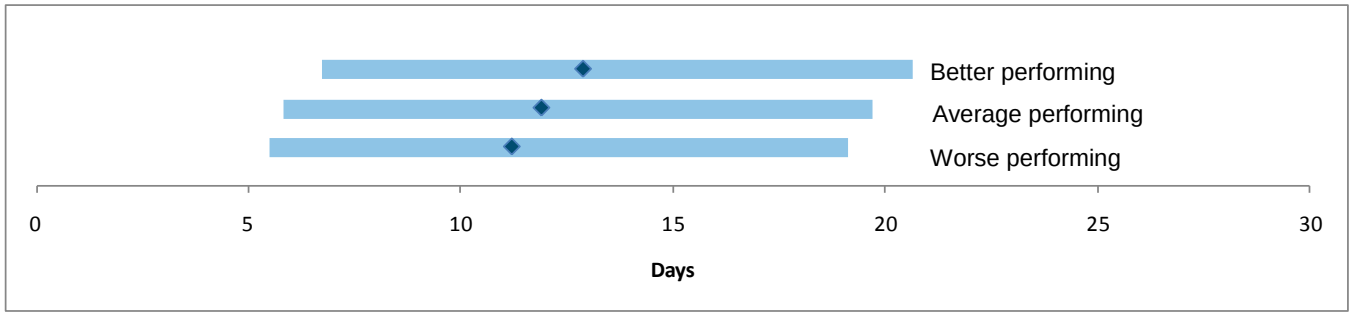



**Figure A.25.c. Median Time to Readmission after Pneumonia**

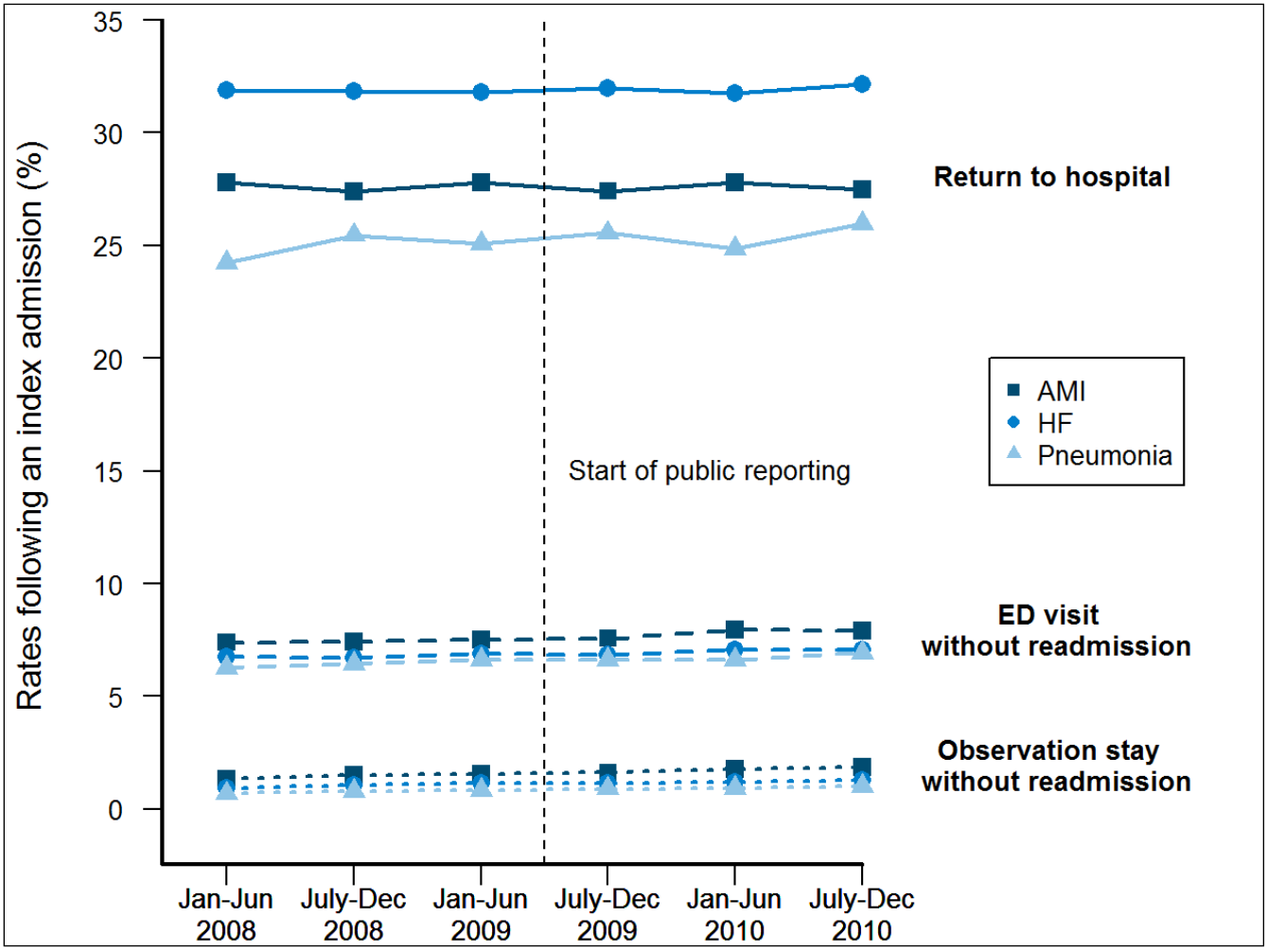



**Source Data and Population:** Condition-specific RSRR Measure Cohorts—July 2008-June 2011 (publicly reported RSRRs).

**Notes**: 1) Veterans Health Administration (VA) hospitals are included in this analysis. 2) The results of hospitals with fewer than 25 cases and hospitals whose rates were not publicly reported are excluded from the calculations. 3) The number of hospitals included for all three years was 2,386 for AMI; 4,159 for heart failure; and 4,427 for pneumonia.

## Did the start of public reporting impact return-to-hospital rates after hospitalizations for AMI, heart failure, and pneumonia?

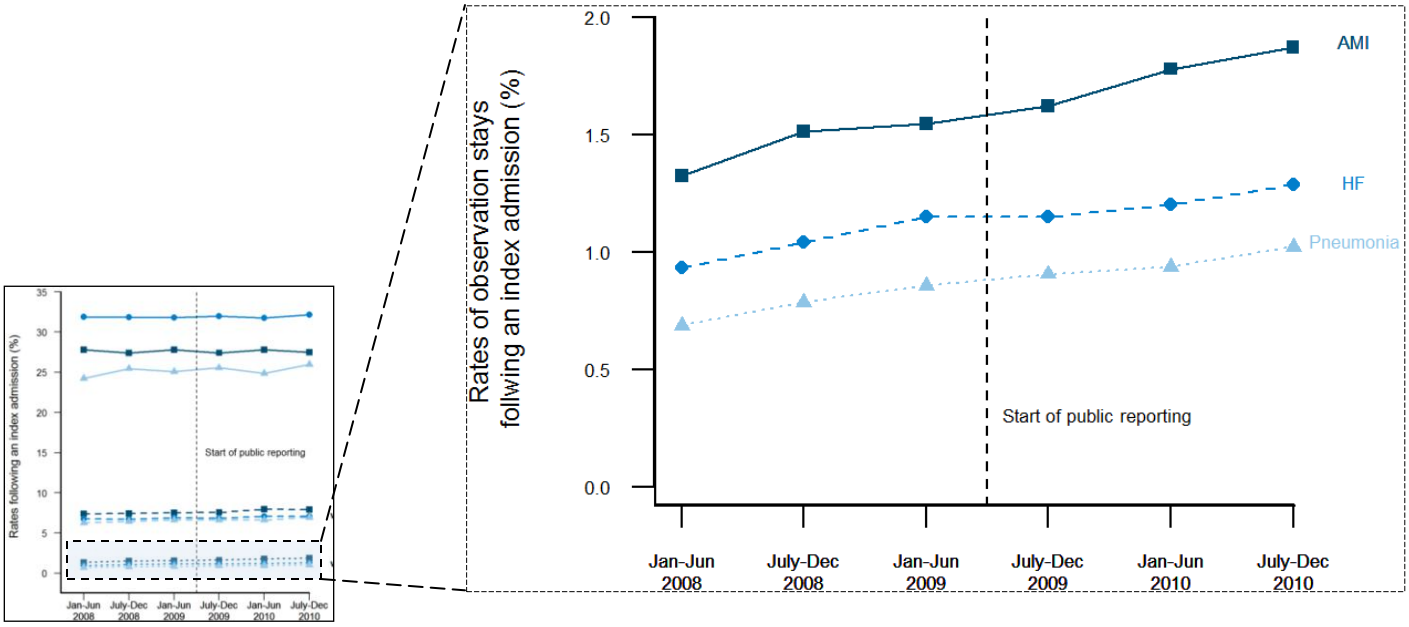
**Figure A.26. Trend in Median Overall Return-to-Hospital Rates, ED Visit Rates, and Observation Stay Rates, 2008-2010**




Surveillance of the currently publicly reported readmission measures includes monitoring for changes in all return-to-hospital events, including emergency department (ED) visits and observation stays. CMS currently does not count ED visits and observation stays as outcomes in the readmission measures. Some stakeholders are concerned that publicly reporting readmission rates may have the unintended consequence of discouraging necessary admissions or shifting patients from inpatient admissions to lower-acuity settings. For each six-month interval from 2008-2010, we calculated hospital-level return-to-hospital rates, which represent the proportion of patients in each of the three readmission measures who returned to the hospital for an ED visit, observation stay, or inpatient readmission within 30 days of discharge from their index admission. Return-to-hospital rates remained high and stable across all conditions, and, over the three-year period, an average of 27.6% of AMI patients, 31.9% of heart failure patients, and 25.1% of pneumonia patients returned to the hospital within 30 days of discharge. A substantial proportion of patients who returned to the hospital (28.6% for AMI, 22.2% for heart failure, and 26.7% for pneumonia) had an ED visit or observation stay, but were never readmitted for inpatient care. Rates of both ED visits and observation stays not associated with readmission increased steadily, if modestly, during the same period (see next page). For complete tables, see Appendix II.

## Did the use of observation stays after hospitalization for AMI, heart failure, and pneumonia change with the start of public reporting?

**Figure A.27. Trend in Median Observation Stay Rates, 2008-2010**




Observation stays are a subset of return-to-hospital events that have recently garnered significant media attention.[5] CMS defines observation stays as services furnished by a hospital which are reasonable and necessary to determine the need for a possible inpatient admission.[6] CMS currently does not count these events as outcomes in the publicly reported readmission measures. Although CMS has noted an overall increase in observation stay utilization in recent years,[7] observation stay trends related to hospitalization for AMI, heart failure, and pneumonia have not been specifically examined. There appears to be a slight increase in the number of observation stays without readmission over the past three years following a hospitalization for AMI, heart failure, or pneumonia. However, this increase seems to have begun prior to public reporting.

Return-to-hospital rates after hospitalizations for AMI, heart failure, and pneumonia were stable from 2008 to 2010. Public reporting is not associated with a change in return-to-hospital rates.

Unlike return-to-hospital rates, rates of observation stays after hospitalizations for AMI, heart failure, and pneumonia increased by 0.5%, 0.4%, and 0.3% respectively between 2008 and 2010. The start of public reporting in July 2009 is not associated with a change in observation stay utilization.

**Source Data and Population:** Condition-specific RSRR Measure Cohorts—January 2008-December 2010 (Appendix I).

**Notes**: 1) Veterans Health Administration (VA) hospitals are included in this analysis. 2) The results of hospitals with fewer than 25 cases of the condition in each year are not shown; however, these hospitals are included in the calculations. 3) For AMI, the total number of hospitals was 1,903 in 2008, 1,817 in 2009, and 1,782 in 2010. 4) For HF, the total number of hospitals was 3,127 in 2008, 3,031 in 2009, and 2,952 in 2010. 5) For pneumonia, the total number of hospitals was 3,726 in 2008, 3,514 in 2009, and 3,472 in 2010. 6) For additional tables, see Appendix II. 7) For references, see Appendix VI.

## What proportion of readmissions after heart failure are to the same hospital as the index admission?

Public reporting has motivated hospitals to focus their quality improvement efforts on lowering readmission rates. However, monitoring trends in readmission rates is challenging. One possible approach is for hospitals to track readmissions to their institution (i.e., same-hospital readmission rate). This information is readily available to hospitals, but its use for quality improvement assumes both that most readmissions are to the same hospital and that the underlying relationship with all-hospital readmission rates and risk-standardized readmission rates is consistent over time. To inform hospitals' use of the same-hospital readmission rate, we explored these assumptions.

Figure A.28 shows that, across hospitals, 79% of readmissions after heart failure are to the same hospital (vertical red line), but there is meaningful variation in the proportion of same-hospital readmission rates across U.S. hospitals.

In addition, there is only modest correlation from year to year in the proportion of a hospital's readmissions that return to the same hospital (Table A.26). That is, when a hospital's ratio of same- to all-hospital readmission rates in 2009 is compared to its ratio in 2010, the Spearman correlation coefficient is only 0.40, which is considered a fair correlation. The correlation was significantly lower for small volume hospitals than for large volume hospitals (0.29 compared to 0.55).

The proportion of patients readmitted to the same institution varies meaningfully across hospitals. The proportion of readmissions to the same institution is also not consistent from year to year. Therefore, the same hospital readmission rate is not an accurate proxy for the all-hospital readmission rate.

Focusing exclusively on readmissions to the same hospital as the index admission may provide hospitals with an inaccurate picture of their readmission rates.

**Figure A.28. Distribution of the Proportion of Heart Failure Readmissions that are to the Same Hospital as the Index Admission, 2008-2010**

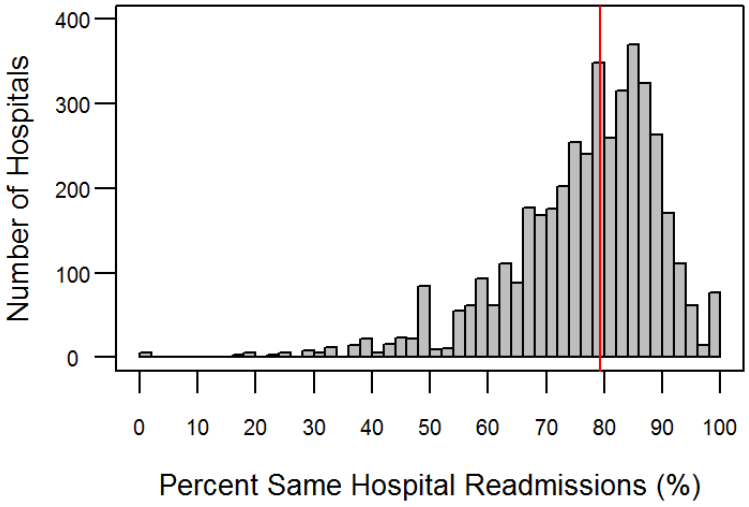



**Table A.26. Spearman Correlation Coefficients for the Proportion of Same-Hospital Readmissions for Heart Failure in 2009 vs. 2010**

| | Volume Cutoff | | |
|---|---|---|---|
| | Overall | 25-100 | >100 |
| **Number of Hospitals** | 3,286 | 1,728 | 1,558 |
| **Spearman Correlation Coefficient** | 0.40 | 0.29 | 0.55 |

**Source Data and Population:** Heart Failure RSRR Measure Cohort—January 2008-December 2010 (Appendix I).

**Notes:** 1) The results show data for Medicare FFS beneficiaries aged ≥65 years discharged following an admission for heart failure. 2) Veterans Health Administration (VA) hospitals are included in this analysis. 3) The results of hospitals with fewer than 25 cases of the condition over the three-year period are not shown. 4) The number of hospitals included was 4,628. 5) The Spearman correlation coefficient assesses how well the relationship between two variables can be described.

## Can hospitals use changes in same-hospital readmission rates to monitor changes in overall heart failure readmission rates?

Many hospitals track readmissions to their own institution, that is, their same-hospital readmission rate (SHRR), as a way of assessing whether their readmission rate is improving. However, because patients may be admitted to a different hospital, changes in the SHRR may not accurately represent changes in the all-hospital readmission rate (AHRR). We examined the differences between the change in the SHRR over one year compared to the change in the AHRR over the same period.

Figure A.29 and Figure A.30 show the distribution of absolute differences in hospitals' heart failure readmission rates using these two perspectives at large and small volume hospitals. For hospitals in the center (at zero), the change in their SHRR exactly predicts the change in their AHRR. However, for hospitals to both the right (dark blue shading) and left (light blue shading) of zero, the change in SHRR over- or under-estimates the true change in their readmission rate by two or more percentage points. For example, a -5 percentage point difference between the change in AHRR and the change in SHRR could represent a hospital whose SHRR improved by 10 percentage points, but whose AHRR improved by only 5 percentage points. We found that one-third of hospitals (34%) would under- or overestimate the change in their AHRR by at least two percentage points, and 4% would be off by ≥5 percentage points.

This inaccuracy is particularly striking at low volume hospitals (Figure A.30). Using SHRR most (63%) would under- or overestimate their true all-hospital readmission rate by at least two percentage points and 26% would be off by ≥5 percentage points.

Changes in same-hospital readmission rates are not representative of changes in all-hospital readmission rates, particularly among low volume hospitals. Focusing exclusively on readmissions to the same hospital as the index admission may provide hospitals with a misleading picture of the effect of quality improvement initiatives.

**Figure A.29. Differences in Absolute Changes in Hospitals' Raw Heart Failure Readmission Rates at Large Hospitals (>100 Heart Failure Admissions) from 2009 to 2010, As Assessed by Same-Hospital and All-Hospital Readmissions**

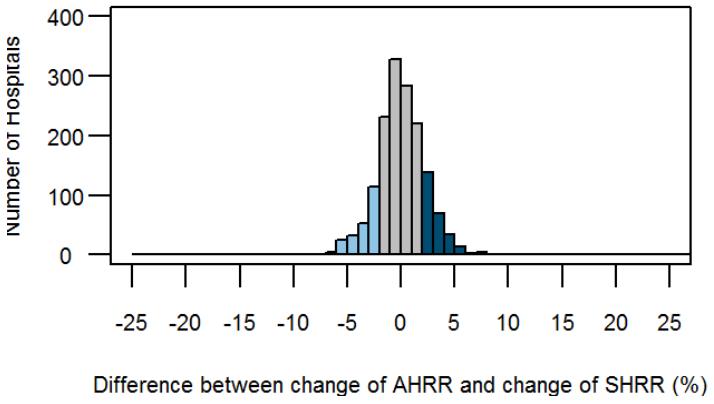
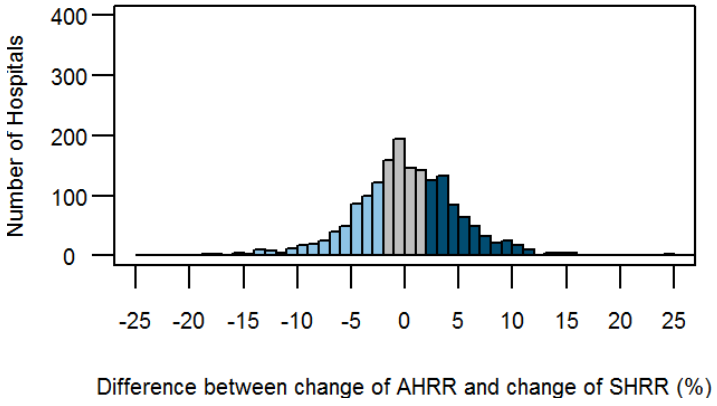



**Figure A.30. Difference in Absolute Changes in Raw Readmission Rates at Small Hospitals (25-100 Heart Failure Admissions) from 2009 to 2010**




**Source Data and Population:** Heart Failure RSRR Measure Cohort—January 2009-December 2010 (Appendix I).

**Notes:** 1) The results show data for Medicare FFS beneficiaries aged ≥65 years discharged following an admission for heart failure. 2) Veterans Health Administration (VA) hospitals are included in this analysis. 3) The results of hospitals with fewer than 25 cases of the condition in 2009 are not shown. 4) The number of hospitals included was 1,558 in Figure A.29 and 1,728 in Figure A.30.

## Can hospitals use their same-hospital readmission rates to anticipate their performance on the publicly reported readmission measures?

Because hospitals cannot independently calculate their risk-standardized readmission rates (RSRRs), they have limited ability to anticipate their performance on publicly reported measures. We investigated whether hospitals can use information about same-hospital readmissions (SHRRs) to anticipate their RSRRs.

Figure A.31 shows the relationship between RSRR (vertical axis) and SHRR (horizontal axis) for small volume hospitals (25 to 99 cases per reporting period, light blue), moderate volume hospitals (100 to 200 cases, gray), and large volume hospitals (>200 cases, dark blue). The horizontal dotted line represents the overall median hospital RSRR. RSRR and SHRR are correlated, but the correlation is not strong enough to allow most hospitals to precisely estimate their RSRR using their SHRR.

Figure A.32 shows the relationship between RSRR and all-hospital readmission rate. The correlation is much stronger than that with SHRR across volume strata and would, if available, allow hospitals to better anticipate their RSRR.

Even for large volume hospitals, the relationship between same-hospital readmission rate and RSRR is not tightly correlated.

**Figure A.31. Correlation of Raw Same-Hospital Readmission Rate (SHRR) with RSRR, Stratified by Volume of Heart Failure Index Admissions**

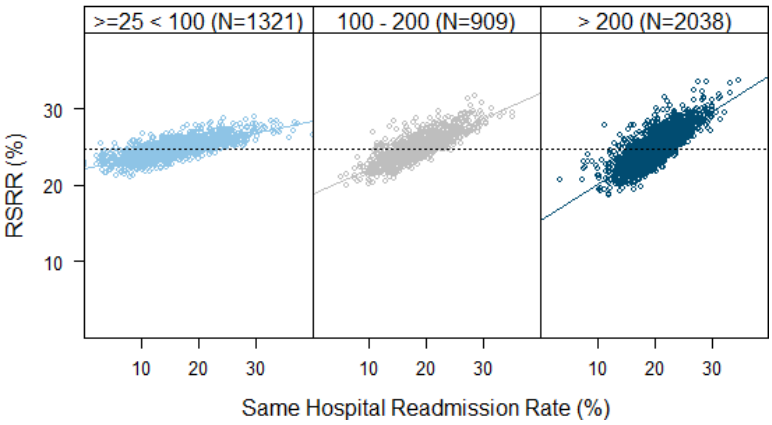
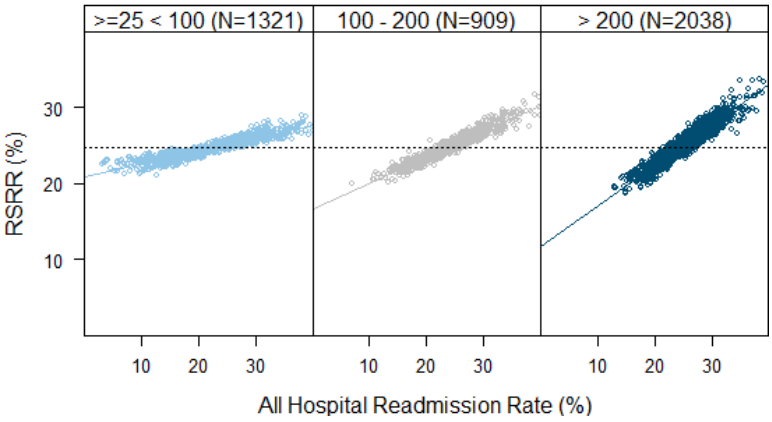



**Figure A.32. Correlation of Raw All-Hospital Readmission Rate with RSRR, Stratified by Volume of Heart Failure Index Admissions**




**Source Data and Population:** Heart Failure RSRR Measure Cohort—January 2008-December 2010 (Appendix I).

**Notes:** 1) The results show data for Medicare FFS beneficiaries aged ≥65 years discharged following an admission for heart failure. 2) Veterans Health Administration (VA) hospitals are included in this analysis. 3) The results of hospitals with fewer than 25 cases of the condition over the three-year period are not shown.

# Section B

# Hip and Knee Arthroplasty Complications and Readmissions

This section focuses on two measures of hospital quality after patients have primary elective total hip arthroplasty and/or total knee arthroplasty (THA/TKA, also known as hip or knee replacement surgery). CMS plans to publicly report these measures on *Hospital Compare* starting in 2013.[1] The measures report rates of complications (including AMI, pulmonary embolism, pneumonia, sepsis or shock, surgical site infection, bleeding at the surgical site, or dying) and readmissions after THA/TKA. We analyze temporal trends in the measures (whether the rates are changing over time), distributions (how much variation exists in the rates), geographic variation, and disparities (how hospitals with high proportions of Medicaid patients or African-American patients perform on the measures).

## Are the rates of complication and readmission after elective total hip and knee arthroplasty changing over time?

Total hip arthroplasty and total knee arthroplasty (THA/TKA), also known as hip or knee replacement, are common elective surgeries performed on over 600,000 Americans each year. CMS developed measures, recently endorsed by the National Quality Forum, to assess complication and readmission rates following elective THA/TKA. Figure B.1 displays median annual hospital-level, risk-standardized 30-day complication rates (RSCRs) after THA/TKA from 2008 to 2010. The complications measured included AMI, pneumonia, or sepsis/septicemia during the index hospitalization or within 7 days of admission; surgical site bleeding, pulmonary embolism or death during the index hospitalization or within 30 days of admission; or mechanical complications, periprosthetic joint or wound infection during the index hospitalization or within 90 days of admission. While the median rates of complication were ≤5%, they were not negligible for an elective procedure (Table B.1-2).

Figure B.2 displays median annual hospital-level, risk-standardized 30-day readmission rates (RSRRs) after THA/TKA over the same time period. Although readmission rates are low, given the volume of these procedures nationally, 50,990 patients were readmitted to the hospital following an elective THA or TKA between 2008 and 2010.

Median complication and readmission rates after elective total hip and knee arthroplasty remained in excess of 3.4% and 5.5%, respectively, between 2008 and 2010.

**Table B.1-2. Median Hospital One-Year RSCRs and RSRRs for Total Hip Arthroplasty and Total Knee Arthroplasty**

| | Median (Range) of Hospital's RCRR/RSRR (%) | | |
|---|---|---|---|
| | **2008** | **2009** | **2010** |
| **RSCR** | 3.6 (1.8, 7.7) | 3.5 (1.9, 6.4) | 3.4 (1.8, 8.1) |
| **RSRR** | 5.8 (3.6, 9.3) | 5.6 (3.8, 9.5) | 5.5 (3.7, 8.4) |

**Figure B.1. Trend in Median Hospital RSCRs, 2008-2010**

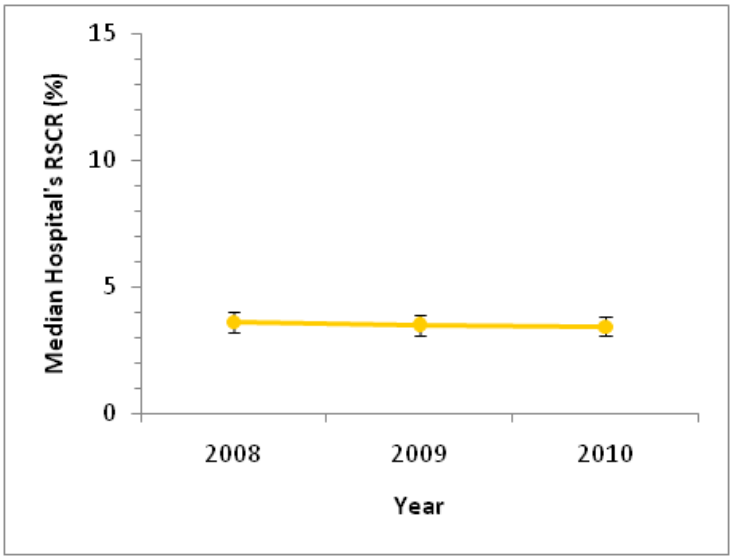
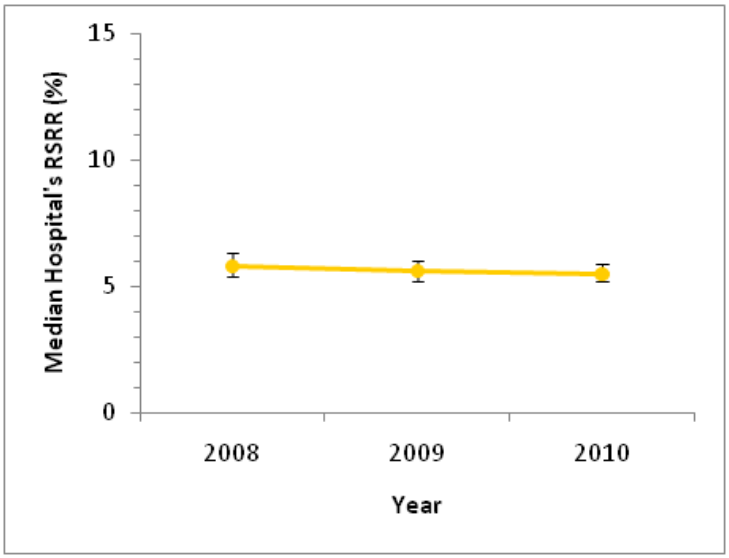



**Figure B.2. Trend in Median Hospital RSRRs, 2008-2010**




**Source Data and Population:** Hip/Knee Measure Cohorts—January 2008-December 2010 (Appendix I).

**Notes**: 1) Veterans Health Administration (VA) hospitals are not included in this analysis. 2) The results of hospitals with fewer than 25 cases of the condition in each year are not shown; however, these hospitals are included in the calculations. 3) The error bars on the graph represent the interquartile range. 4) For hip/knee complications, the total number of hospitals was 2,143 in 2008, 2,174 in 2009, and 2,181 in 2010. 5) For hip/knee readmissions, the total number of hospitals was 2,149 in 2008, 2,184 in 2009, and 2,195 in 2010.

## Hip/Knee Complications and Readmissions

# Do the rates of complication and readmission after elective total hip and knee arthroplasty vary across hospitals?

Without national outcomes quality measures for elective total hip and knee arthroplasty (THA/TKA), patients, hospitals and healthcare providers cannot adequately evaluate hospital performance. CMS's complication and readmissions measures provide important information to inform quality improvement efforts in orthopedics. These figures and Table B.3-4 below display distributions of risk-standardized complication rates (RSCRs) and risk-standardized readmission rates (RSRRs) after admission for THA/TKA among U.S. hospitals. Variation in these rates reflects differences in performance among U.S. hospitals, with wider distributions suggesting more variation.

Hospital RSCRs and RSRRs after admission for THA/TKA were similarly distributed across hospitals. While the majority of hospitals had RSCRs and RSRRs close to the median, the range of risk-standardized rates for both outcomes remains wide, suggesting substantial opportunity for improvement.

Hospitals show meaningful variation in rates of complication and readmission after elective total hip and knee arthroplasty, with the highest rates approximately three times higher than the lowest.

**Table B.3-4. Distribution of Hospital RSCRs and RSRRs, 2008-2010**

| | RSCR (%) | RSRR (%) |
|---|---|---|
| **Maximum** | 8.9 | 9.9 |
| **90%** | 4.5 | 7.1 |
| **75%** | 4.0 | 6.2 |
| **Median (50%)** | 3.5 | 5.6 |
| **25%** | 3.1 | 5.2 |
| **10%** | 2.8 | 4.1 |
| **Minimum** | 1.8 | 3.2 |

**Source Data and Population:** Hip/Knee Measure Cohorts—January 2008-December 2010 (Appendix I).

**Notes**: 1) Veterans Health Administration (VA) hospitals are not included in this analysis. 2) The results of hospitals with fewer than 25 cases of the condition in each year are not shown; however, these hospitals are included in the calculations. 3) The number of hospitals included for all three years was 2,830 for hip/knee complications and 2,835 for hip/knee readmissions.

**Figure B.3. Distribution of Hospital RSCRs, 2008-2010**

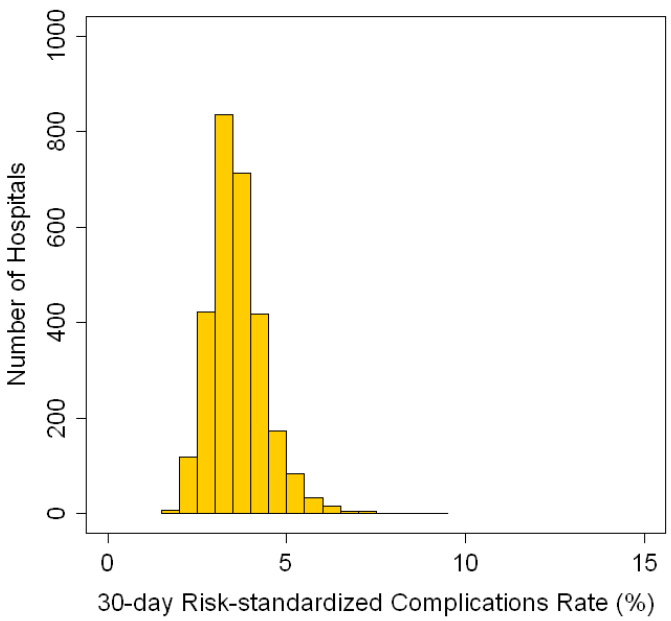
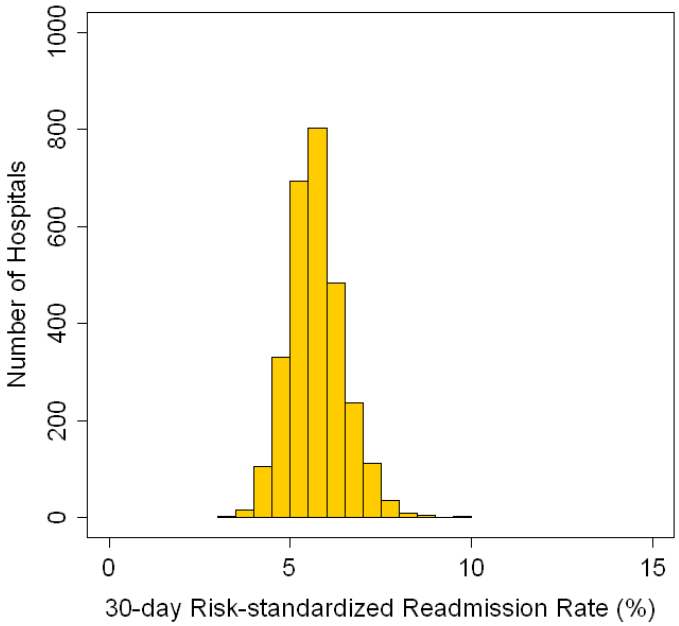
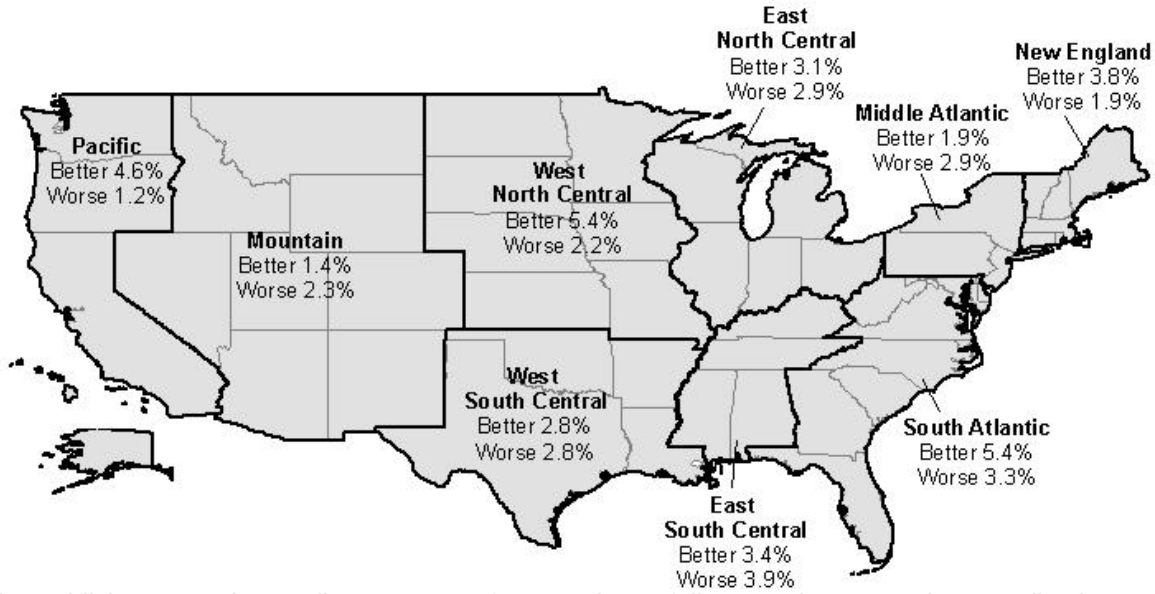



**Figure B.4. Distribution of Hospital RSRRs, 2008-2010**



## Do complication rates after hip and knee arthroplasty vary across different regions of the U.S.?

**Figure B.5. Regional Hospital Performance on Total Hip and Knee Arthroplasty Complication Measure, 2008-2010**




Unlike the publicly reported mortality measures for AMI, heart failure, and pneumonia, complication rates after THA/TKA do not vary at the Hospital Referral Region (HRR) level. To show the national variation in THA/TKA complication rates, we report the proportion of hospitals that were statistically better or worse performing than the national complication rate for the nine Census divisions in the U.S. (Figure B.5 and Table B.5). The complications measured included AMI, pneumonia, or sepsis/septicemia within seven days of admission; surgical site bleeding, pulmonary embolism, or death within 30 days of admission; or mechanical complications or periprosthetic joint or wound infection within 90 days of admission. While variation in performance on the complication measure after total hip and knee arthroplasty appears to vary more at the hospital level than at a regional level, some areas have a greater proportion of high performing hospitals than others. Of 2,832 hospitals included in the measure, 3.6% performed better than the national rate of 3.6%, and 2.7% performed worse. While some areas showed equal numbers of better and worse performing hospitals, some regions had a skewed performance distribution. The Pacific, West North Central, East North Central, South Atlantic, and New England divisions all had a greater number of better performing hospitals than worse performing hospitals.

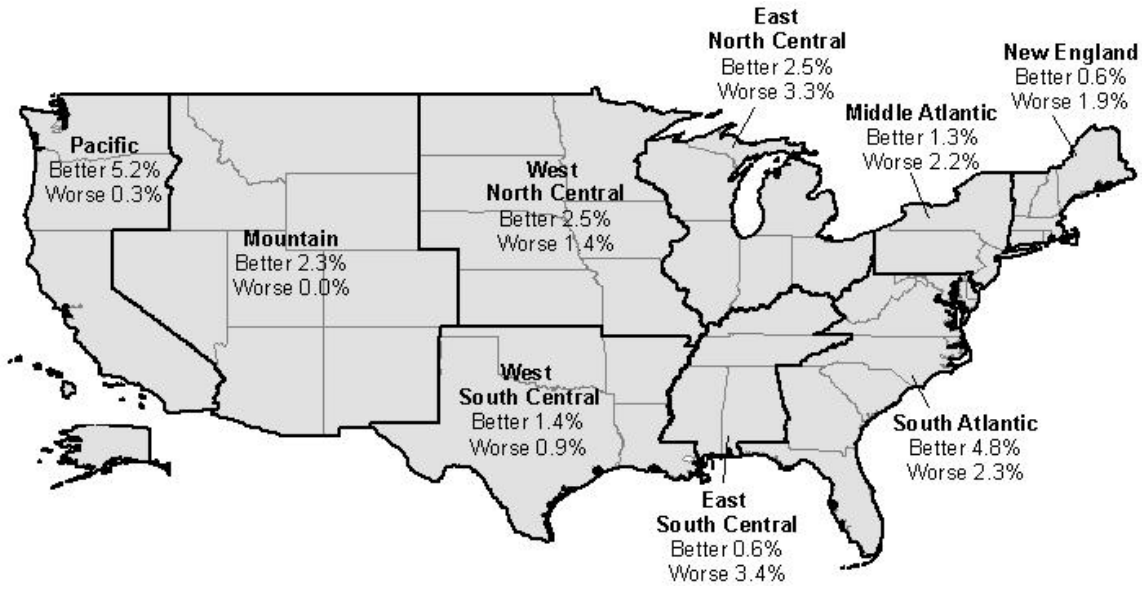
**Table B.5. Performance Status Compared to the U.S. National Rate for Hip/Knee RSCRs**

| | | Better than U.S. National Rate | | Worse than U.S. National Rate | |
|---|---|---|---|---|---|
| **Division** | **Total Number of Hospitals** | **Number of Hospitals** | **Percent Better in Region (%)** | **Number of Hospitals** | **Percent Worse in Region (%)** |
| **New England** | 159 | 6 | 3.8 | 3 | 1.9 |
| **Middle Atlantic** | 316 | 6 | 1.9 | 9 | 2.9 |
| **South Atlantic** | 481 | 26 | 5.4 | 16 | 3.3 |
| **East North Central** | 520 | 16 | 3.1 | 15 | 2.9 |
| **East South Central** | 178 | 6 | 3.4 | 7 | 3.9 |
| **West North Central** | 276 | 15 | 5.4 | 6 | 2.2 |
| **West South Central** | 353 | 10 | 2.8 | 10 | 2.8 |
| **Mountain** | 221 | 3 | 1.4 | 5 | 2.3 |
| **Pacific** | 328 | 15 | 4.6 | 4 | 1.2 |

**Source Data and Population:** Hip/Knee Measure Cohorts—January 2008-December 2010 (Appendix I).
**Notes**: 1) Veterans Health Administration (VA) hospitals are not included in this analysis. 2) Census divisions are defined by the U.S. Census Bureau.

## Do readmission rates after hip and knee arthroplasty vary across different regions of the U.S.?

**Figure B.6. Regional Hospital Performance on Total Hip and Knee Arthroplasty Readmission Measure, 2008-2010**




Unlike the publicly reported readmission measures for AMI, heart failure, and pneumonia, readmission rates after THA/TKA do not vary at the Hospital Referral Region (HRR) level. To show the national variation in THA/TKA readmissions, we report the proportion of hospitals that were statistically better or worse performing than the national readmission rate after THA/TKA for the nine Census divisions in the U.S. (Figure B.6 and Table B.6). Of 2,836 hospitals included in the measure, 2.7% performed better than the national rate of 5.7%, and 1.8% performed worse than the national rate. In comparison to the companion THA/TKA complication measure, more divisions had an excess of either better or worse performing hospitals. Four divisions (New England, Middle Atlantic, East North Central, and East South Central) had more hospitals that performed worse than the national rate than hospitals that performed better. The remaining divisions all had more hospitals that performed better than hospitals that performed worse than the national rate. The Pacific division had only one hospital with a risk-standardized readmission rate (RSRR) statistically worse than the national rate and had 17 hospitals with RSRRs significantly better than the national rate.

**Table B.6. Performance Status Compared to the National Rate for Hip/Knee RSRRs**

| | | Better than U.S. National Rate | | Worse than U.S. National Rate | |
|---|---|---|---|---|---|
| **Division** | **Total Number of Hospitals** | **Number of Hospitals** | **Percent (%)** | **Number of Hospitals** | **Percent (%)** |
| **New England** | 159 | 1 | 0.6 | 3 | 1.9 |
| **Middle Atlantic** | 315 | 4 | 1.3 | 7 | 2.2 |
| **South Atlantic** | 483 | 23 | 4.8 | 11 | 2.3 |
| **East North Central** | 519 | 13 | 2.5 | 17 | 3.3 |
| **East South Central** | 179 | 1 | 0.6 | 6 | 3.4 |
| **West North Central** | 278 | 7 | 2.5 | 4 | 1.4 |
| **West South Central** | 353 | 5 | 1.4 | 3 | 0.9 |
| **Mountain** | 221 | 5 | 2.3 | 0 | 0.0 |
| **Pacific** | 329 | 17 | 5.2 | 1 | 0.3 |

**Source Data and Population:** Hip/Knee Measure Cohorts—January 2008-December 2010 (Appendix I).
**Notes**: 1) Veterans Health Administration (VA) hospitals are not included in this analysis. 2) Census divisions are defined by the U.S. Census Bureau.

## How do hospitals caring for high proportions of Medicaid beneficiaries perform on the hip/knee complication measure?

Some stakeholders are concerned that hospitals caring for large numbers of poor patients may not be able to perform well on the outcome measures. We examined the performance of hospitals categorized by the proportion of the hospital's patients who have low socioeconomic status (SES), as defined by being enrolled in Medicaid. We compared hospitals in the lowest decile (those with less than or equal to 7% of patients in Medicaid) with those in the top decile (greater than or equal to 28% of patients in Medicaid).

Figure B.7 and Table B.7 display the distribution of risk-standardized complication rates (RSCRs) for these hospitals. The range of performance is very similar between hospital groups, despite differences in patient mix. The absolute difference in the median RSCR between the top and bottom deciles of hospitals based on patient SES is 0.2%. Only two hospitals with high proportions of Medicaid patients had RSCRs that fell above the range of the hospitals with the least Medicaid patients.

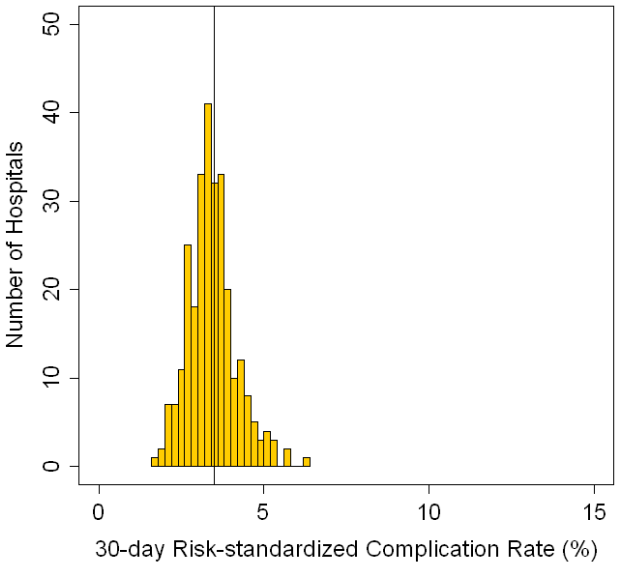
On the hip/knee complication measure, hospitals with the most Medicaid beneficiaries show a similar range of performance as hospitals with the fewest Medicaid beneficiaries, demonstrating that these hospitals can perform well on the measures.

**Table B.7. Distribution of Hospital RSCRs by Proportion of Medicaid Patients, 2008-2010**

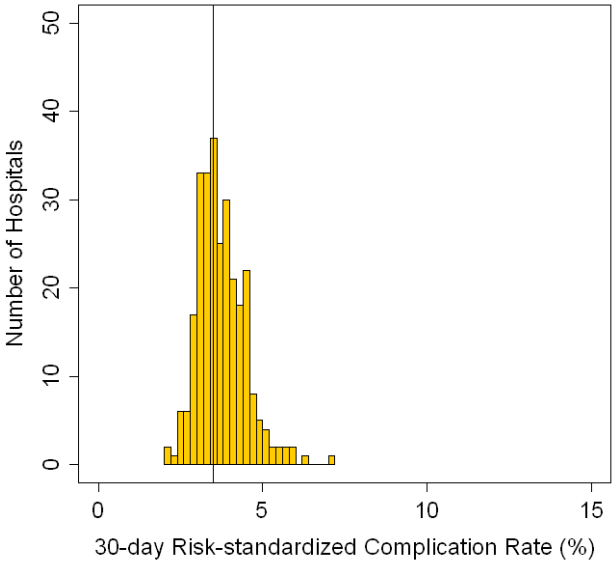
| | RSCR (%) | |
|---|---|---|
| | **Low Proportion (≤7%) Medicaid Patients; n=278** | **High Proportion (≥28%) Medicaid Patients; n=278** |
| **Maximum** | 6.2 | 7.1 |
| **90%** | 4.4 | 4.6 |
| **75%** | 3.8 | 4.1 |
| **Median (50%)** | 3.4 | 3.6 |
| **25%** | 3.0 | 3.2 |
| **10%** | 2.6 | 3.0 |
| **Minimum** | 1.7 | 2.0 |

**Figure B.7. Hip/Knee RSCRs by Proportion of Medicaid Patients, 2008-2010**

**a. Hospitals with the Lowest Proportion (≤7%) Medicaid Beneficiaries**




**b. Hospitals with the Highest Proportion (≥28%) Medicaid Beneficiaries**




**Source Data and Population**: Hip/Knee RSCR Measure Cohorts—January 2008-December 2010 (Appendix I); 2009 American Hospital Association (AHA) data to derive Medicaid eligibility rate (Appendix III).
**Notes**: 1) Veterans Health Administration (VA) hospitals are not included in this analysis. 2) The results of hospitals with fewer than 25 cases of the condition over the three-year period are not shown; however, these hospitals are included in the calculations. 3) The vertical line on each histogram represents the median hospital RSCR.

## How do hospitals caring for high proportions of Medicaid beneficiaries perform on the hip/knee readmission measure?

Figure B.8 and Table B.8 display the distribution of RSRRs after hospitalization for total hip arthroplasty or total knee arthroplasty (THA/TKA) among U.S. hospitals, categorized by the proportion of Medicaid patients cared for by the facility. The figures compare hospitals with the lowest proportions (≤7%) of Medicaid patients with hospitals that had the highest proportions (≥28%) of Medicaid patients.

Despite differences in patient mix, the range of performance is similar between hospital groups. The absolute difference in the median risk-standardized readmission rate (RSRR) between the top and bottom deciles of hospitals based on patient SES is only 0.1%. In addition, only four of the 279 hospitals with high proportions of Medicaid patients had RSRRs that fell above the range of the hospitals with the smallest proportion of Medicaid patients.

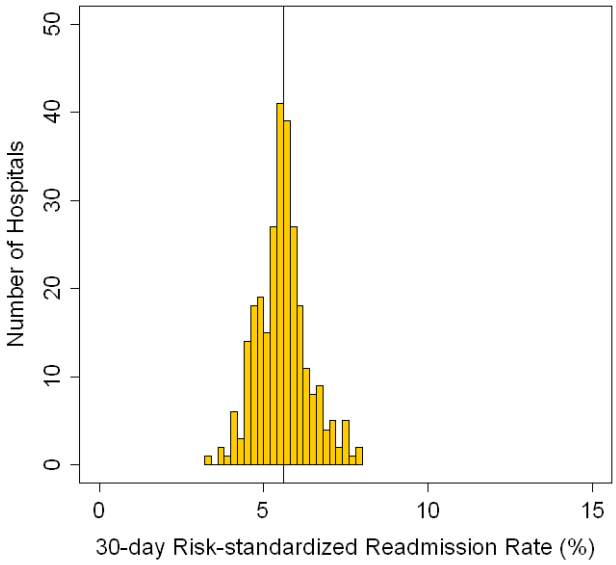
On the hip/knee readmission measure, hospitals with the highest proportion of Medicaid beneficiaries show a similar median and range of performance as hospitals with the smallest proportion of Medicaid beneficiaries.

**Table B.8. Distribution of Hospital RSRRs by Proportion of Medicaid Patients, 2008-2010**

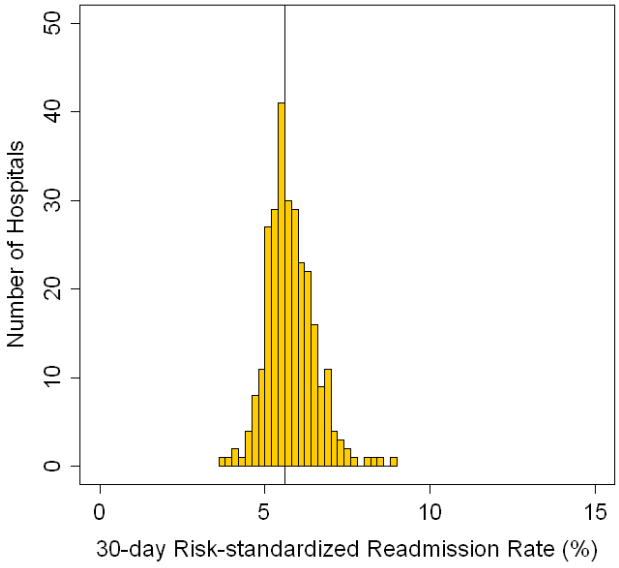
| | RSRR (%) | |
|---|---|---|
| | **Low Proportion (≤7%) Medicaid Patients; n=278** | **High Proportion (≥28%) Medicaid Patients; n=279** |
| **Maximum** | 8.0 | 8.8 |
| **90%** | 6.6 | 6.7 |
| **75%** | 6.0 | 6.3 |
| **Median (50%)** | 5.6 | 5.7 |
| **25%** | 5.1 | 5.3 |
| **10%** | 4.6 | 5.0 |
| **Minimum** | 3.4 | 3.8 |

**Figure B.8. Hip/Knee RSRRs by Proportion of Medicaid Patients, 2008-2010**

**a. Hospitals with the Lowest Proportion (≤7%) Medicaid Beneficiaries**




**b. Hospitals with the Highest Proportion (≥28%) Medicaid Beneficiaries**




**Source Data and Population**: Hip/Knee RSRR Measure Cohorts—January 2008-December 2010 (Appendix I); 2009 American Hospital Association (AHA) data to derive Medicaid eligibility rate (Appendix III).

**Notes**: 1) Veterans Health Administration (VA) hospitals are not included in this analysis. 2) The results of hospitals with fewer than 25 cases of the condition over the three-year period are not shown; however, these hospitals are included in the calculations. 3) The vertical line on each histogram represents the median hospital RSRR.

## How do hospitals caring for high proportions of African-American patients perform on the hip/knee complication measure?

To examine potential disparities in outcomes among hospitals based on the racial makeup of the patients they serve, we analyzed hospitals' performance categorized by the proportion of the hospital's patients who are African-American. We compared hospitals in the lowest decile (those with 0% African-American patients) with those in the top decile (≥19% African-American patients) for the hip/knee complication measure. Figure B.9 and Table B.9 display the distribution of RSCRs for these two groups of hospitals. The range of performance is similar between hospitals, despite differences in patient mix. The median RSCR of hospitals with the greatest proportion of African-American patients is 0.3 percentage points higher than that of hospitals with the lowest proportion of African-American patients. The histograms demonstrate a wider distribution of results among hospitals with high proportions of African-American patients; while substantial numbers of these hospitals achieve RSCRs below the national average (left of the vertical line), many also have high RSCRs beyond the range for the hospitals with fewer such patients.

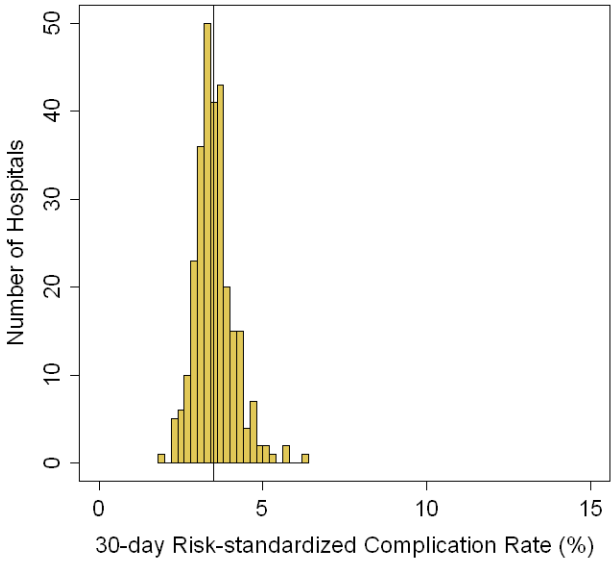
Hospitals with the highest proportion of African-American patients perform slightly worse on the hip/knee complication measure than hospitals with the fewest African-American patients. The wide range of performance among hospitals with high proportions of African-American patients illustrates both the ability of these hospitals to achieve good outcomes and the need to focus improvement efforts within those hospitals and communities that are not achieving the same levels of success.

**Table B.9. Distribution of Hospital RSCRs by Proportion of African-American Patients, 2008-2010**

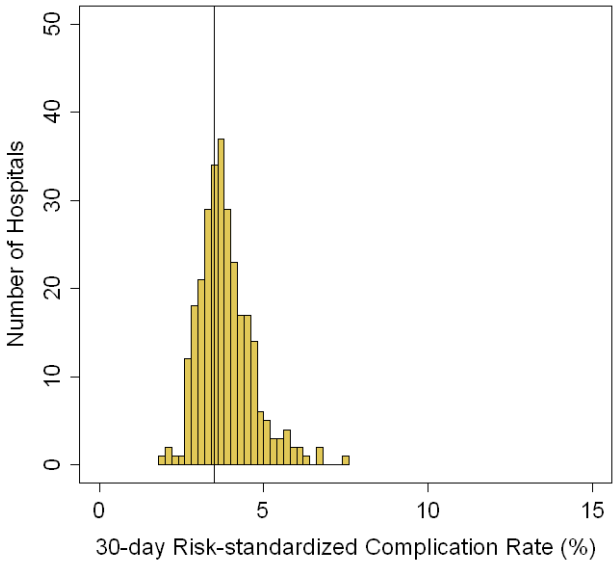
| | RSCR (%) | |
|---|---|---|
| | **Low Proportion (0%); n=284** | **High Proportion (≥19%); n=285** |
| **Maximum** | 6.2 | 7.4 |
| **90%** | 4.3 | 4.8 |
| **75%** | 3.8 | 4.3 |
| **Median (50%)** | 3.4 | 3.7 |
| **25%** | 3.2 | 3.3 |
| **10%** | 2.9 | 2.9 |
| **Minimum** | 2.0 | 2.0 |

**Figure B.9. Hip/Knee RSCRs by Proportion of African-American Patients, 2008-2010**

**a. Hospitals with the Lowest Proportion (0%) African-American Patients**




**b. Hospitals with the Highest Proportion (≥19%) African-American Patients**




**Source Data and Population**: Hip/Knee RSCR Measure Cohorts—January 2008-December 2010 (Appendix I).

**Notes**: 1) Veterans Health Administration (VA) hospitals are not included in this analysis. 2) The results of hospitals with fewer than 25 cases of the condition over the three-year period are not shown; however, these hospitals are included in the calculations. 3) The vertical line on each histogram represents the median hospital RSCR.

## How do hospitals caring for high proportions of African-American patients perform on the hip/knee readmission measure?

Similar to the preceding analysis, to examine potential disparities in performance on the hip/knee readmission measure, we analyzed the performance of hospitals categorized by the proportion of the hospital's patients who are African-American. We compared hospitals in the lowest decile (those with 0% African-American patients) with those in the top decile (≥19% African-American patients). Figure B.10 and Table B.10 display the distribution of RSRRs for these two groups of hospitals. The median RSRR of hospitals with the greatest proportion of African-American patients is 0.4 percentage points higher than that of hospitals with the lowest proportion of African-American patients. The histograms demonstrate a wider distribution of results among hospitals with high proportions of African-American patients; while substantial numbers of these hospitals achieve RSRRs below the national average (left of the vertical line), many also have high RSRRs beyond the range for the hospitals with fewer such patients.

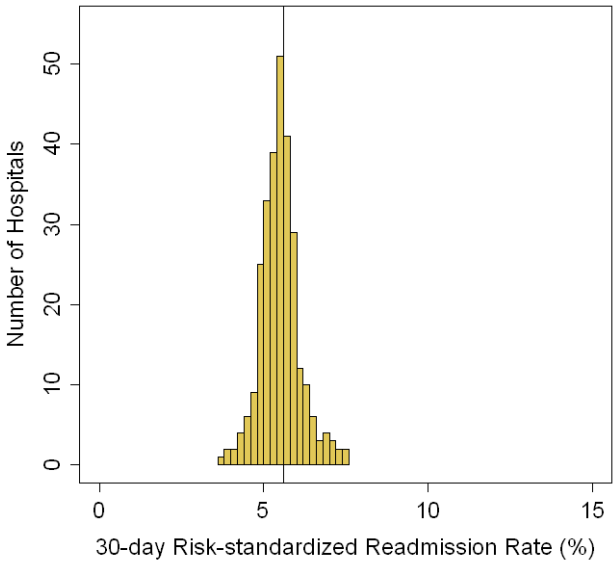
Hospitals with the greatest proportion of African-American patients perform slightly worse on the hip/knee readmission measure than hospitals with the fewest African-American patients. The wide range of performance among hospitals with high proportions of African-American patients illustrates both the ability of these hospitals to achieve good outcomes and the need to focus improvement efforts within those hospitals and communities that are not achieving the same levels of success.

**Table B.10. Distribution of Hospital RSRRs by Proportion of African-American Patients, 2008-2010**

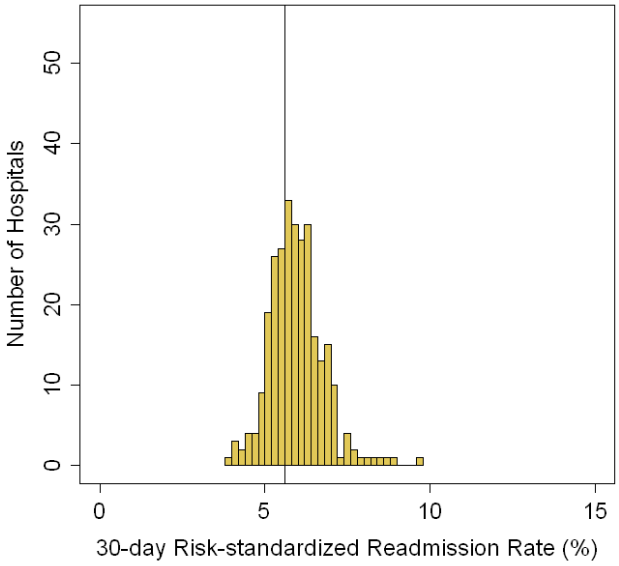
| | RSRR (%) | |
|---|---|---|
| | **Low Proportion (0%) AA Patients; n=284** | **High Proportion (≥19%) AA Patients; n=284** |
| **Maximum** | 7.5 | 9.7 |
| **90%** | 6.2 | 7.0 |
| **75%** | 5.8 | 6.4 |
| **Median (50%)** | 5.5 | 5.9 |
| **25%** | 5.2 | 5.4 |
| **10%** | 4.8 | 5.1 |
| **Minimum** | 3.8 | 3.8 |

**Figure B.10. Hip/Knee RSRRs by Proportion of African-American Patients, 2008-2010**

**a. Hospitals with the Lowest Proportion (0%) African-American Patients**




**b. Hospitals with the Highest Proportion (≥19%) African-American Patients**




**Source Data and Population**: Hip/Knee RSRR Measure Cohorts—January 2008-December 2010 (Appendix I).
**Notes**: 1) Veterans Health Administration (VA) hospitals are not included in this analysis. 2) The results of hospitals with fewer than 25 cases of the condition over the three-year period are not shown; however, these hospitals are included in the calculations. 3) The vertical line on each histogram represents the median hospital RSRR.

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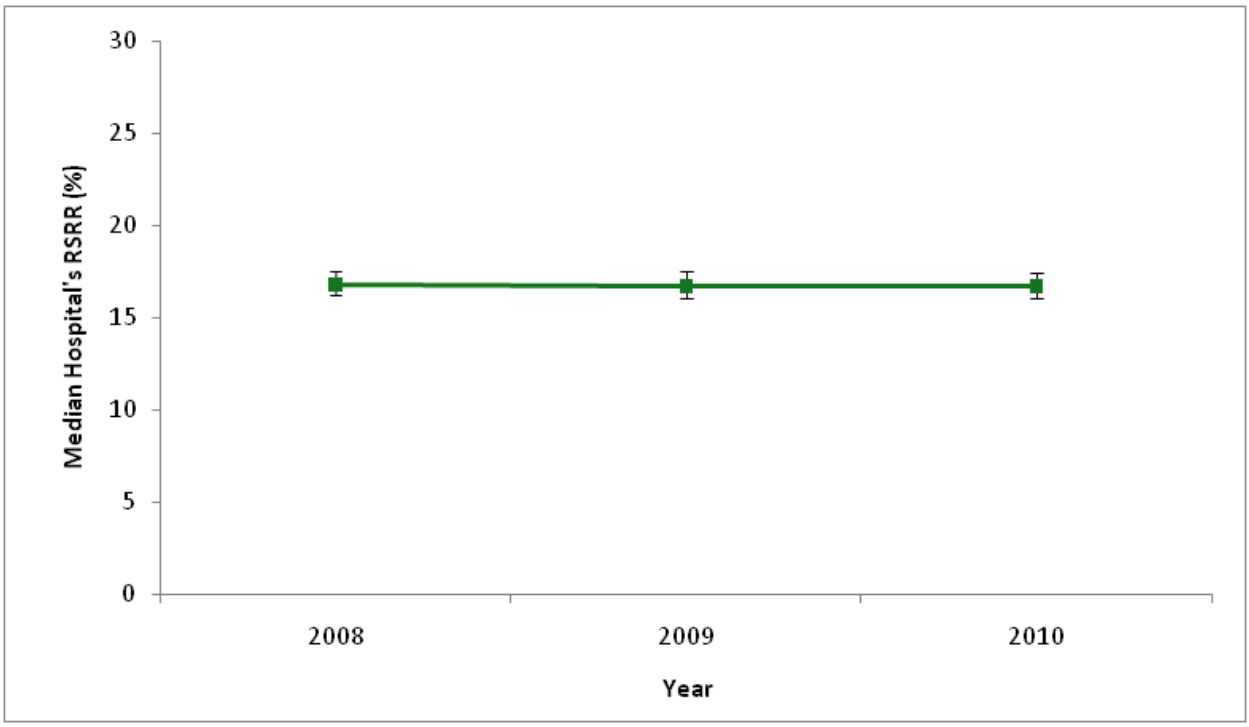
# Section C

# Hospital-Wide Readmission

This section focuses on a hospital-level, risk-standardized rate of unplanned hospital-wide readmission within 30 days of discharge. CMS plans to publicly report this hospital-wide readmission measure on *Hospital Compare* starting in 2013.[1] We analyze temporal trends (whether the rates are changing over time), distributions (how much variation exists in the rates), geographic trends, and disparities (how hospitals with high proportions of Medicaid patients or African-American patients perform on the measures).

## Is the rate of unplanned readmissions after admission to the hospital for any condition changing over time?

**Figure C.1. Trend in Median Hospital-Wide Risk-Standardized Readmission Rates, 2008-2010**




Studies[8-32] have shown that readmissions within 30 days are related to quality of care, that certain interventions have been able to reduce 30-day readmission rates for a variety of specific conditions, and that high and variable readmission rates indicate opportunity for improvement. Given this data, we present results for the recently National Quality Forum-endorsed all-condition 30-day readmission quality outcome measure. Figure C.1 displays national trends in median hospital-wide risk-standardized readmission rates (RSRRs) within 30 days of discharge for any condition between 2008 and 2010. The measure assesses unplanned all-cause 30-day readmission and does not count planned readmissions in the measure outcome, since they do not represent a quality signal. The hospital-wide RSRR is a summary score, derived from the results of five different models, one for each of the following specialty cohorts: medicine, surgery/gynecology, cardiorespiratory, cardiovascular, and neurology. The measure uses one year of data to assess hospital performance.

Unplanned median readmission rates after admission to the hospital for any condition remained high (over 16%) and stable between 2008 and 2010.

**Table C.1. Trend in Median Hospital RSRRs**

| | 2008 | 2009 | 2010 |
|---|---|---|---|
| **RSRR (%)** | 16.8 | 16.7 | 16.7 |
| **Range** | (11.4, 23.7) | (11.3, 23.1) | (11.3, 23.2) |

**Source Data and Population:** Hospital-Wide RSRR Measure Cohorts—January 2008-December 2010 (Appendix I).
**Notes**: 1) Veterans Health Administration (VA) hospitals are not included in this analysis. 2) The results of hospitals with fewer than 25 readmissions are not shown; however, these hospitals are included in the calculation. 3) The error bars on the graph represent the interquartile range. 4) The total number of hospitals was 4,725 in 2008, 4,699 in 2009, and 4,685 in 2010. 5) For a list of planned readmissions excluded from the measure outcome, see Table 1 in the Final Technical Report.[4] 6) For references, see Appendix VI.

## Hospital-Wide Readmission

# Does the rate of unplanned hospital-wide readmission vary across hospitals?

**Figure C.2. Distribution of Hospital-Wide Risk-Standardized Readmission Rates, 2010**

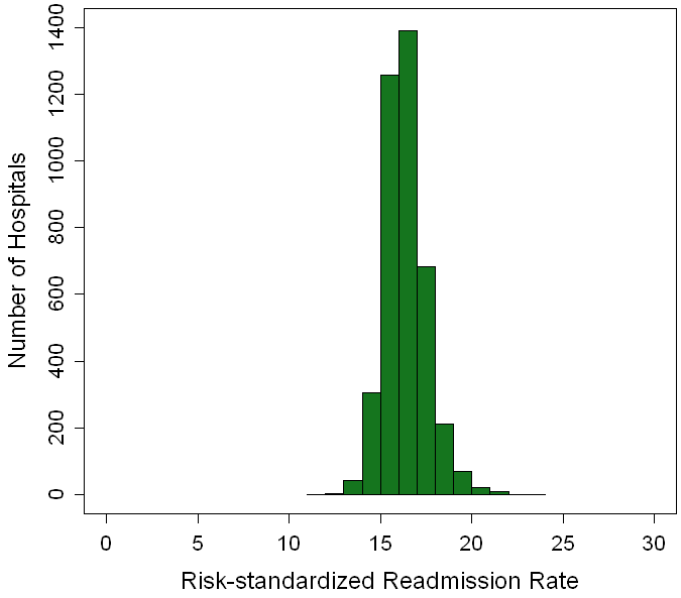



**Table C.2. Distribution of Hospital-Wide Risk-Standardized Readmission Rates, 2010**

| | RSRR (%) |
|---|---|
| **Maximum** | 23.2 |
| **90%** | 18.2 |
| **75%** | 17.4 |
| **Median (50%)** | 16.7 |
| **25%** | 16.1 |
| **10%** | 15.6 |
| **Minimum** | 11.3 |

Figure C.2 and Table C.2 above display the distribution of risk-standardized readmission rates (RSRRs) among U.S. hospitals after admission to the hospital for any condition in 2010. Variation in RSRRs reflects differences in performance among U.S. hospitals, with wider distributions suggesting more variation and narrower distributions suggesting less variation.

Hospital-wide RSRRs were distributed over a range of approximately 12 absolute percentage points, indicating fairly wide performance variation among U.S. hospitals. While the majority of hospitals' rates fell close to the median, the wide range of risk-standardized rates suggests substantial opportunity for improvement.

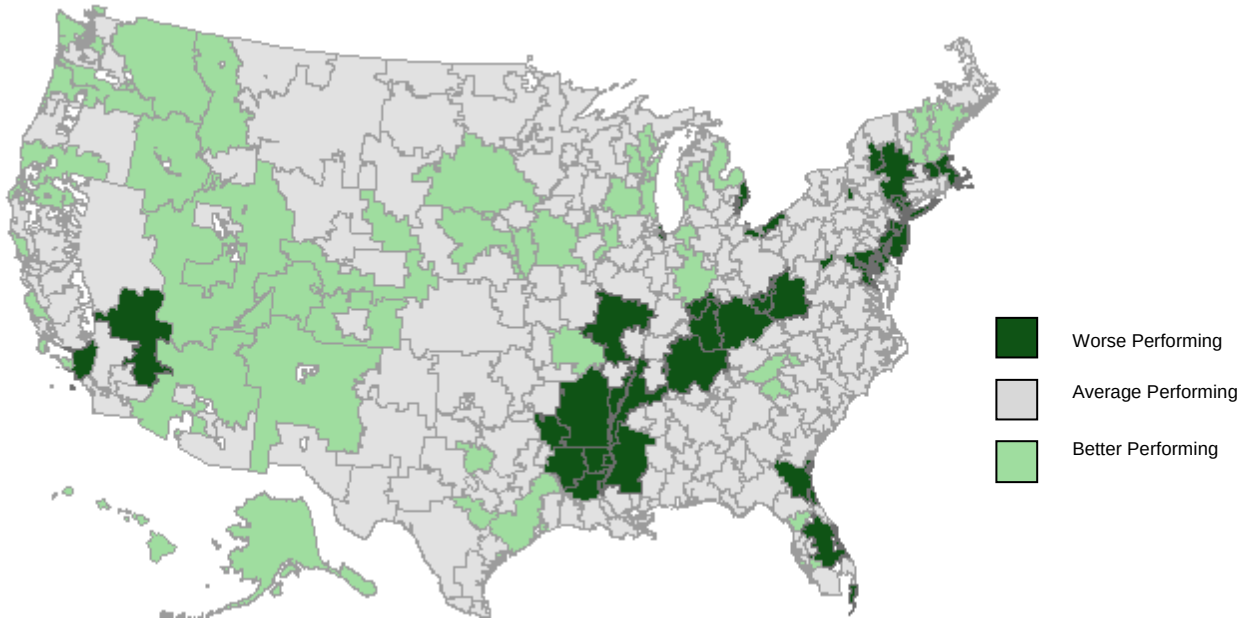
Hospitals show meaningful variation in rates of unplanned readmissions after hospitalization for any condition.

**Source Data and Population:** Hospital-Wide RSRR Measure Cohort—Calendar Year 2010 (Appendix I).

**Notes:** 1) Veterans Health Administration (VA) hospitals are not included in this analysis. 2) The results of hospitals with fewer than 25 readmissions are not shown; however, these hospitals are included in the calculation. 3) The number of hospitals included was 4,685. 4) For a list of planned readmissions excluded from the measure outcome, see Table 1 in the Final Technical Report.[4]

## Does the rate of risk-standardized hospital-wide readmission vary across different regions of the U.S.?

**Figure C.3. Classification of HRRs by RSRRs for Hospital-Wide Readmission, 2010**




The map shows the geographic variation in risk-standardized unplanned readmission rates (RSRRs) among U.S. hospitals after hospitalization for any condition in 2010 (Figure C.3). The map is divided by Hospital Referral Region (HRR). The dark green areas represent HRRs with RSRRs significantly worse than the national readmission rate, while the light green areas represent those HRRs performing significantly better than the national rate. The grey areas represent HRRs with hospital-wide RSRRs that are similar to the national rate. Table C.3 below displays those HRRs performing better and worse than the national rate. The median RSRR for the better performing HRRs was 16.0%, while the median RSRR for the worse performing HRRs was 17.4%.

**Table C.3. Performance Status Compared to the National Rate for Hospital-Wide RSRRs**

| Better Performing HRRs | | | Worse Performing HRRs | | |
|---|---|---|---|---|---|
| Albuquerque, NM | Hickory, NC | Portland, OR | Albany, NY | Huntington, WV | New Brunswick, NJ |
| Anchorage, AK | Honolulu, HI | Provo, UT | Alexandria, LA | Jackson, MS | Newark, NJ |
| Appleton, WI | Houston, TX | Redding, CA | Baltimore, MD | Jacksonville, FL | Orlando, FL |
| Asheville, NC | Indianapolis, IN | Saginaw, MI | Blue Island, IL | Las Vegas, NV | Philadelphia, PA |
| Austin, TX | Lebanon, NH | Salinas, CA | Boston, MA | Lexington, KY | Ridgewood, NJ |
| Boise, ID | Madison, WI | Salt Lake City, UT | Bronx, NY | Little Rock, AR | Royal Oak, MI |
| Cedar Rapids, IA | Manchester, NH | Santa Barbara, CA | Camden, NJ | Los Angeles, CA | Shreveport, LA |
| Colorado Springs, CO | Medford, OR | Santa Rosa, CA | Charleston, WV | Louisville, KY | St. Louis, MO |
| Davenport, IA | Milwaukee, WI | Sarasota, FL | Chicago, IL | Manhattan, NY | Takoma Park, MD |
| Denver, CO | Missoula, MT | Seattle, WA | Cleveland, OH | Memphis, TN | Texarkana, AR |
| Des Moines, IA | Muskegon, MI | Sioux Falls, SD | Dearborn, MI | Miami, FL | Washington, DC |
| Fort Worth, TX | Ocala, FL | South Bend, IN | Detroit, MI | Monroe, LA | White Plains, NY |
| Grand Junction, CO | Omaha, NE | Spokane, WA | East Long Island, NY | Munster, IN | Wilmington, DE |
| Grand Rapids, MI | Phoenix, AZ | Springfield, MO | Elmira, NY | Nashville, TN | Worcester, MA |
| Green Bay, WI | Portland, ME | Ventura, CA | Hackensack, NJ | | |
| Greenville, SC | | | | | |

**Source Data and Population:** Hospital-Wide RSRR Measure Cohort—Calendar Year 2010 (Appendix I).

**Notes**: 1) Veterans Health Administration (VA) hospitals are not included in this analysis. 2) The HRR ranking methodology can be found in Appendix IV.

## How do hospitals caring for high proportions of Medicaid beneficiaries perform on the hospital-wide readmission measure?

Some stakeholders have expressed concern that hospitals caring for large numbers of poor patients may not be able to achieve low readmission rates due to patient factors that hospitals cannot influence, such as lack of access to medications or follow-up care.

We examined the performance of hospitals categorized by the proportion of the hospital's patients who have low socioeconomic status (SES), as defined by enrollment in Medicaid. We compared hospitals in the lowest decile (those with ≤5% of patients in Medicaid) with those in the top decile (≥30% of patients in Medicaid) and display the distribution of risk-standardized readmission rates (RSRRs) for these two groups of hospitals. The range of performance differs somewhat for the two groups of hospitals, with the hospitals caring for the highest proportion of Medicaid patients demonstrating slightly higher RSRRs overall. The absolute difference in the median RSRR between the top and bottom deciles of hospitals based on patient SES is 0.6%.

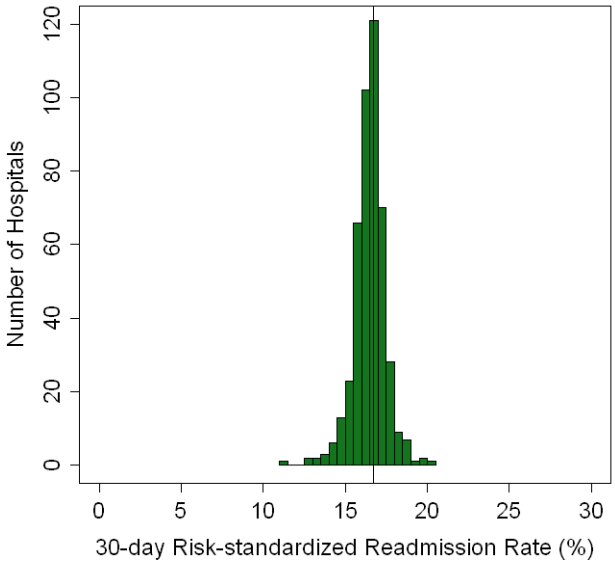
On the hospital-wide readmission measure, hospitals with the highest proportion of Medicaid beneficiaries perform slightly worse overall. However, most hospitals with high proportions of Medicaid patients achieve readmission rates comparable to those with fewer Medicaid patients, demonstrating that these hospitals can and do perform well on the measure.

**Table C.4. Distribution of Hospital RSRRs by Proportion of Medicaid Patients, 2010**

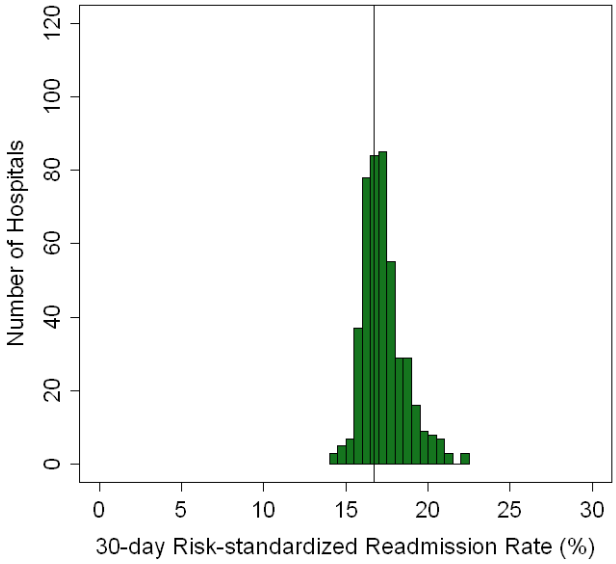
| | RSRR (%) | |
|---|---|---|
| | **Low Proportion (≤5%) Medicaid Patients; n=457** | **High Proportion (≥30%) Medicaid Patients; n=458** |
| **Maximum** | 20.4 | 22.1 |
| **90%** | 17.5 | 19.0 |
| **75%** | 17.0 | 17.9 |
| **Median (50%)** | 16.5 | 17.1 |
| **25%** | 16.0 | 16.4 |
| **10%** | 15.4 | 15.9 |
| **Minimum** | 11.3 | 14.1 |

**Figure C.4. Hospital-Wide RSRRs by Proportion of Medicaid Patients, 2010**

**a. Hospitals with the Lowest Proportion (≤5%) Medicaid Beneficiaries**




**b. Hospitals with the Highest Proportion (≥30%) Medicaid Beneficiaries**




**Source Data and Population:** Hospital-Wide RSRR Measure Cohort—Calendar Year 2010 (Appendix I); 2009 American Hospital Association (AHA) data to derive Medicaid eligibility rate (Appendix III).

**Notes**: 1) Veterans Health Administration (VA) hospitals are not included in this analysis. 2) The results of hospitals with fewer than 25 cases of the condition over the three-year period are not shown; however, these hospitals are included in the calculations. 3) The vertical line on each histogram represents the median hospital RSRR.

## How do hospitals caring for high proportions of African-American patients perform on the hospital-wide readmission measure?

To further examine potential disparities in performance on the hospital-wide readmission measure, we analyzed the performance of hospitals categorized by the proportion of the hospital's patients who are African-American. We compared hospitals in the lowest decile (0% African-American patients) with those in the top decile (≥22% African-American patients). Figure C. and Table C. display the distribution of RSRRs for these two groups of hospitals. The median RSRR of hospitals with the greatest proportion of African-American patients is 0.9 percentage points higher than that of hospitals with the lowest proportion of African-American patients. The histograms demonstrate a wider distribution of results among hospitals with high proportions of African-American patients; substantial numbers of these hospitals achieve RSRRs below the national rate, but many also have high RSRRs beyond the range for the hospitals with fewer such patients. These results suggest quite disparate performance among hospitals serving large proportions of African-American patients.

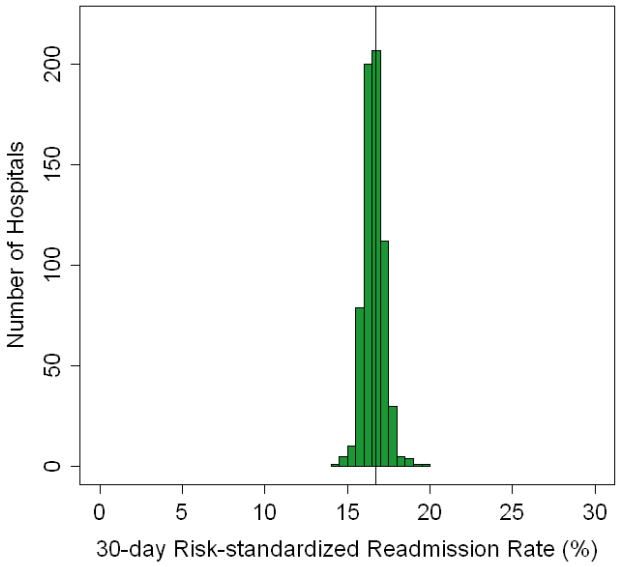
Hospitals with the most African-American patients perform on average slightly worse on the hospital-wide readmission measure than do hospitals with the fewest African-American patients. Hospitals with high proportions of African-American patients show a wider range of performance, illuminating both the ability of such hospitals to achieve good outcomes and the need to focus improvement efforts on hospitals and communities that are not achieving the same levels of success.

**Table C.5. Distribution of Hospital RSRRs by Proportion of African-American Patients, 2010**

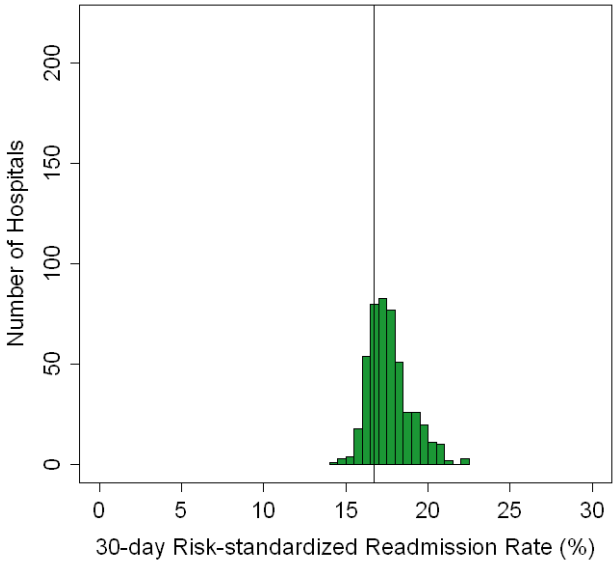
| | RSRR (%) | |
|---|---|---|
| | **Low Proportion (0%); n=655** | **High Proportion (≥22%); n=469** |
| **Maximum** | 19.9 | 22.3 |
| **90%** | 17.3 | 19.5 |
| **75%** | 17.0 | 18.3 |
| **Median (50%)** | 16.6 | 17.5 |
| **25%** | 16.2 | 16.7 |
| **10%** | 15.9 | 16.2 |
| **Minimum** | 14.4 | 14.1 |

**Figure C.5. Hospital-Wide RSRRs by Proportion of African-American Patients, 2010**

**a. Hospitals with the Lowest Proportion (0%) African-American Patients**




**b. Hospitals with the Highest Proportion (≥22%) African-American Patients**




**Source Data and Population:** Hospital-Wide RSRR Measure Cohort—Calendar Year 2010 (Appendix I).

**Notes:** 1) Veterans Health Administration (VA) hospitals are not included in this analysis. 2) The results of hospitals with fewer than 25 cases of the condition over the three-year period are not shown; however, these hospitals are included in the calculations. 3) The vertical line on each histogram represents the median hospital RSRR.

# Appendices

# Appendix I. Measure Cohorts

## *A. AMI, Heart Failure, and Pneumonia Mortality and Readmission*

### Cohort Definition

The AMI, heart failure, and pneumonia mortality and readmission measures include admissions for Medicare fee-for-service (FFS) and VA beneficiaries aged 65 years and older who were discharged from non-federal acute care hospitals or VA hospitals with a principal discharge diagnosis of AMI, heart failure, or pneumonia. CMS FFS beneficiaries with an index admission at a non-federal hospital are included if they have been enrolled in Part A and Part B Medicare for the 12 months prior to and including the date of the index admission to ensure a full year of administrative data for risk adjustment. (This requirement is dropped for patients with an index admission within a VA hospital.) An *index admission* is the hospitalization considered for the mortality or readmission outcome. For the mortality measures only, for patients with more than one admission in a given year for a given condition, only one index admission for that condition is randomly selected for inclusion in the cohort.

The measures were developed using Medicare FFS administrative data but are designed for and have been tested for use in all-payer claims datasets.

### ICD-9 Codes Defining AMI, Heart Failure, and Pneumonia

The specific ICD-9-CM codes meeting the inclusion criteria for AMI, heart failure, and pneumonia are as follows:

For the AMI measure: 410.00, 410.01, 410.10, 410.11, 410.20, 410.21, 410.30, 410.31, 410.40, 410.41, 410.50, 410.51, 410.60, 410.61, 410.70, 410.71, 410.80, 410.81, 410.90, and 410.91

For the heart failure measure: 402.01, 402.11, 402.91, 404.01, 404.03, 404.11, 404.13, 404.91, 404.93, 428.0, 428.1, 428.20, 428.21, 428.22, 428.23, 428.30, 428.31, 428.32, 428.33, 428.40, 428.41, 428.42, 428.43, and 428.9

For the pneumonia measure: 480.0, 480.1, 480.2, 480.3, 480.8, 480.9, 481, 482.0, 482.1, 482.2, 482.30, 482.31, 482.32, 482.39, 482.40, 482.41, 482.42, 482.49, 482.81, 482.82, 482.83, 482.84, 482.89, 482.9, 483.0, 483.1, 483.8, 485, 486, 487.0, and 488.11

### Exclusion Criteria

*Mortality Measures*

The AMI, heart failure, and pneumonia mortality measures exclude index admissions:

- for patients discharged alive on the day of admission or the following day who did not 1) transfer to another acute care hospital or 2) leave against medical advice;
- for patients transferred in from another acute care hospital or VA hospital;
- for patients with inconsistent or unknown vital status or other unreliable data (e.g., date of death precedes date of admission);
- for patients enrolled in the Medicare and/or VA hospice programs any time in the 12 months prior to the index hospitalization or who enrolled in the hospice program on the first day of the index admission;
- for patients who were discharged against medical advice (AMA);
- that were 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 and so it is only applicable to the three-year combined data. It only happens when two randomly selected admissions occur during the transition months (December and January for calendar-year data) and the patient subsequently dies; and

- for hospitalizations that were not randomly selected from a patient's multiple admissions in a year (because AMI, heart failure, and pneumonia patients commonly have multiple admissions in a year, the measures include one randomly selected admission per patient per year per condition).

*Readmission Measures*

The AMI, heart failure, and pneumonia readmission measures exclude index admissions:

- for patients without at least 30 days post-discharge enrollment in FFS Medicare (applies only to patients who have index admissions in non-VA hospitals);
- for patients who died during the index hospitalization;
- for patients who were discharged AMA;
- that ended in a transfer to another acute care facility; and
- that occurred within 30 days of discharge from an index admission (no admission is considered both an index admission and a readmission within the same measure).

Additionally, for AMI patients only, the measure excludes same-day discharges (i.e., identical admission and discharge dates), as such patients are unlikely to have had a clinically significant AMI.

## *B. Hip and Knee Arthroplasty Complication and Readmission*

### Cohort Definition

The hip/knee complication and readmission measures include admissions for Medicare FFS patients aged 65 years and older who were discharged from non-federal acute care hospitals after elective primary total hip arthroplasty (THA) and/or total knee arthroplasty (TKA), defined by ICD-9 codes 81.51 and 81.54, respectively. Beneficiaries are included if they have been enrolled in Medicare FFS for the 12 months prior to and including the date of the index admission to ensure a full year of administrative data for risk adjustment.

### Exclusion Criteria

*Complication Measure*

The hip/knee complication measure excludes index admissions:

- with a femur, hip or pelvic fracture coded in the principal discharge diagnosis field for the index admission;
- for patients undergoing partial hip arthroplasty procedures with a concurrent THA/TKA;
- for patients undergoing revision procedures with a concurrent THA/TKA;
- for patients undergoing resurfacing procedures with a concurrent THA/TKA;
- with a mechanical complication coded in the principal discharge diagnosis field for the index admission;
- with a malignant neoplasm of the pelvis, sacrum, coccyx, lower limbs, or bone/bone marrow or a disseminated malignant neoplasm coded in the principal discharge diagnosis field for the index admission;
- with a procedure code for removal of implanted devices/prostheses;
- for patients who were transferred in to the index hospital;
- for patients who left the hospital against medical advice (AMA);
- with more than two THA/TKA procedures codes during the index hospitalization; and
- for hospitalizations that were not randomly selected from a patient's multiple admissions in a year.

For ICD-9 codes defining the measure exclusions, please refer to the Measure Methodology Report.[33]

*Readmission Measure*

The hip/knee readmission measure excludes index admissions:

- with a femur, hip or pelvic fracture coded in the principal discharge diagnosis field for the index admission;
- for patients undergoing partial hip arthroplasty procedures with a concurrent THA/TKA;
- for patients undergoing revision procedures with a concurrent THA/TKA;
- for patients undergoing resurfacing procedures with a concurrent THA/TKA;
- with a mechanical complication coded in the principal discharge diagnosis field for the index admission;
- with a malignant neoplasm of the pelvis, sacrum, coccyx, lower limbs, or bone/bone marrow or a disseminated malignant neoplasm coded in the principal discharge diagnosis field for the index admission;
- with a procedure code for removal of implanted devices/prostheses;
- for patients without at least 30 days post-discharge enrollment in Medicare FFS;
- for patients who were transferred in to the index hospital;
- for patients who were admitted for the index procedure and subsequently transferred to another acute care facility;
- for patients who left the hospital AMA;
- with more than two THA/TKA procedures codes during the index hospitalization; and
- for patients who died during the index admission.

For ICD-9 codes defining the measure exclusions, please refer to the Measure Methodology Report.[3]

## *C. Hospital-Wide Readmission*

### Cohort Definition

The cohort includes hospitalizations for Medicare fee-for-service (FFS) beneficiaries aged 65 and older who were hospitalized at a non-federal short-stay acute care hospital or critical access hospital who were not discharged to another acute care hospital and who were alive upon discharge. Beneficiaries are included if they have been enrolled in Part A Medicare for the 12 months prior to and including the date of the index admission to ensure a full year of administrative data for risk adjustment

### Exclusion Criteria

The hospital-wide readmission measure excludes admissions for patients:

- without at least 30 days of post-discharge enrollment in Medicare FFS Part A;
- who were admitted to a PPS-exempt cancer hospital;
- who were discharged against medical advice (AMA);
- who were admitted for receipt of medical treatment for cancer (see Technical Report)[4];
- who were admitted for treatment of primary psychiatric disease (see Technical Report)[4]; and
- who were admitted for “rehabilitation care; fitting of prostheses and adjustment devices” (AHRQ CCS 254).

## *D. Inclusion of Veterans Administration Hospital Patients in Cohorts*

Currently, Veterans Administration (VA) patients are only included in the publicly reported mortality and readmission measures for AMI, heart failure and pneumonia. All Chartbook analyses on the publicly reported measures include VA patients, with the exception of those analyses examining race and socioeconomic status, as this information is not available for VA patients. VA patients are not included in any of the analyses reported for the complication and readmission measures for patients undergoing primary elective total hip and/or knee arthroplasty, or the hospital-wide readmission measure.

# Appendix II. Additional Tables

## *Returns to the Hospital*

For Appendix Table II.1, Appendix Table II.2, and Appendix Table II.3, we calculated hospital-level overall return-to-hospital rates for each readmission measure (AMI, heart failure, and pneumonia) by dividing the number of return-to-hospital events (emergency department visits, observation stays, and readmissions) by the number of index admissions. The tables below also include the rates of emergency department (ED) visits alone and of observation stays alone, as shown in Figure A.26 and Figure A.27.

**Appendix Table II.1. Trend in Median Return-to-Hospital Rates, ED Visit Rates, and Observation Stay Rates: AMI**

| | Number of Index Admissions | 30-day Return-to-Hospital Rate | ED Visit without Readmission | Observation Stay without Readmission |
|---|---|---|---|---|
| Jan 2008-Jun 2008 | 98,415 | 27.8% | 7.4% | 1.3% |
| Jul 2008-Dec 2008 | 90,659 | 27.4% | 7.4% | 1.5% |
| Jan 2009-Jun 2009 | 90,898 | 27.8% | 7.5% | 1.5% |
| Jul 2009-Dec 2009 | 87,412 | 27.4% | 7.6% | 1.6% |
| Jan 2010-Jun 2010 | 89,286 | 27.8% | 7.9% | 1.8% |
| Jul 2010-Dec 2010 | 86,829 | 27.5% | 7.9% | 1.9% |

**Appendix Table II.2. Trend in Median Return-to-Hospital Rates, ED Visit Rates, and Observation Stay Rates: Heart Failure**

| | Number of Index Admissions | 30-day Return-to-Hospital Rate | ED Visit without Readmission | Observation Stay without Readmission |
|---|---|---|---|---|
| Jan 2008-Jun 2008 | 237,851 | 31.9% | 6.8% | 0.9% |
| Jul 2008-Dec 2008 | 211,284 | 31.9% | 6.7% | 1.0% |
| Jan 2009-Jun 2009 | 235,412 | 31.8% | 6.9% | 1.2% |
| Jul 2009-Dec 2009 | 213,140 | 32.0% | 6.8% | 1.1% |
| Jan 2010-Jun 2010 | 231,798 | 31.8% | 7.0% | 1.2% |
| Jul 2010-Dec 2010 | 207,651 | 32.2% | 7.1% | 1.3% |

**Appendix Table II.3. Trend in Median Return-to-Hospital Rates, ED Visit Rates, and Observation Stay Rates: Pneumonia**

| | Number of Index Admissions | 30-day Return-to-Hospital Rate | ED Visit without Readmission | Observation Stay without Readmission |
|---|---|---|---|---|
| Jan 2008-Jun 2008 | 239,519 | 24.3% | 6.3% | 0.7% |
| Jul 2008-Dec 2008 | 165,855 | 25.5% | 6.4% | 0.8% |
| Jan 2009-Jun 2009 | 204,782 | 25.1% | 6.6% | 0.9% |
| Jul 2009-Dec 2009 | 167,683 | 25.6% | 6.6% | 0.9% |
| Jan 2010-Jun 2010 | 202,493 | 24.9% | 6.6% | 0.9% |
| Jul 2010-Dec 2010 | 166,246 | 26.0% | 6.9% | 1.0% |

## Appendix III. Other Data Sources

1) American Hospital Association (AHA) Annual Survey Database Fiscal Year 2009
    - This data was used to determine the proportion of Medicaid beneficiaries at each hospital.

2) Medicare Part A Inpatient Claims 2008-2010
    - This data was used to determine the proportion of African-American patients at each hospital.

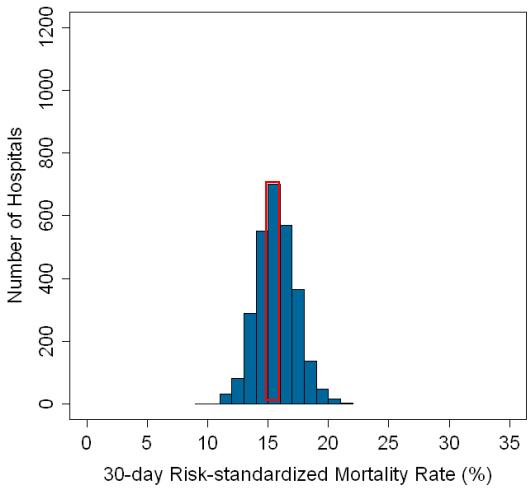
## Appendix IV. Hospital Referral Region (HRR) Measure Methodology

The geographic distribution of RSMRs and RSRRs was reported using the Hospital Referral Region (HRR) for each hospital based on the definition of HRRs produced by the Dartmouth Atlas of Health Care project. HRRs are categorizations of regional market areas for tertiary medical care defined by at least one hospital that performs both major cardiovascular procedures and neurosurgery.

HRR-level risk-standardized mortality/readmission/complication rates were calculated as a weighted average of hospital risk-standardized rate with each HRR with the inverse of the variance of hospital risk-standardized rate as the weight. The variance of the each hospital risk-standardized rate is estimated using the bootstrap simulation results. To further categorize at the HRR level, a linear mixed effect model using the HRR risk-standardized rate as the dependent variable, and HRR as the unit for the random intercept with no other covariates, was run. If the random effect estimate of the HRR is less/greater than 0 and the corresponding t-test p-value is less than 0.05, then the HRR is categorized as better/worse performing; otherwise the HRR is categorized as “average performing.”

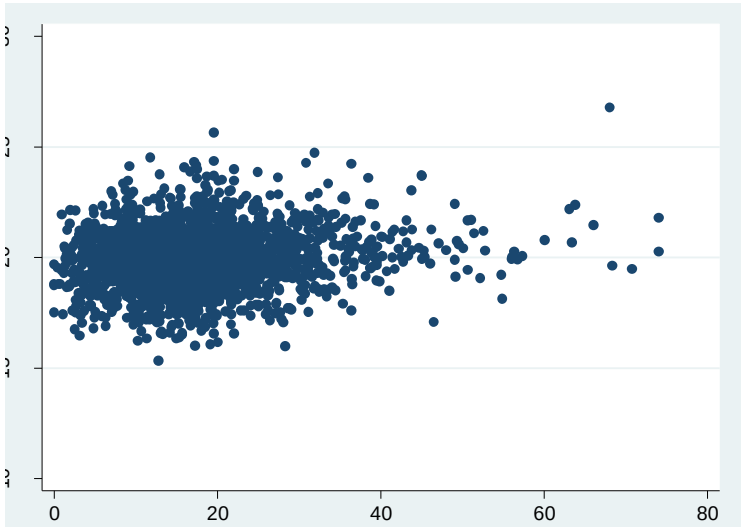
# Appendix V. Figure Explanations

## *Histograms*




A histogram shows the range of values a variable has across a unit of observation. In the Chartbook, a histogram typically shows the range of values for the variable across hospitals. Each bar is the number of units of observation that have values between the left and right border of the bar. For example, in the histogram above there were a little more than 700 hospitals that had a risk-standardized mortality rate between 15 and 16%.

## *Scatterplots*




A scatterplot shows the value of two variables for each observation. Scatterplots provide a range of information, but their most useful function is to show how the variable on the horizontal axis relates to the variable on the vertical axis across all units of observation. For example, if the horizontal axis represents weight and the vertical axis represents height, then the figure above would show that, as weight increases, height stays mostly constant.

## Appendix VI. References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