100 TOP HOSPITALS®: CARDIOVASCULAR BENCHMARKS, 2009 STUDY

11TH EDITION

100
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TOP HOSPITALS
CARDIOVASCULAR

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Thomson Reuters 100 Top Hospitals®: Cardiovascular Benchmarks, 2009 Study
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INTRODUCTION

With cardiovascular disease the longstanding number-one killer in the United States[1], cardiovascular services are among the highest profile of all hospital service lines. More than 1,000 hospitals perform open-heart surgery, and thousands more offer medical cardiovascular programs. The Thomson Reuters 100 Top Hospitals®: Cardiovascular Benchmarks study has provided hospital executives, physicians, and cardiovascular service line managers with annual intelligence reflecting the rapid improvement of cardiovascular outcomes and new targets for raising the bar on performance.

THE 2009 STUDY

Now in its 11th year, the 100 Top Hospitals: Cardiovascular Benchmarks study identifies hospitals that are setting benchmark levels of performance for cardiovascular services throughout the nation. The objective of this study, part of the 100 Top Hospitals initiative originally developed in 1993, is to identify the top cardiovascular hospitals in the United States using empirical findings from publicly available performance data. In performing this study, we acknowledge high-performing cardiovascular clinical and management teams and seek to determine what drives their performance.

Cardiovascular hospitals are providing real value to their communities. This year's 100 Top Hospitals: Cardiovascular Benchmarks winners show:

- A full 12% lower cost in treating cardiovascular patients while providing higher quality care.
- Significantly lower 30-day mortality rates than peer hospitals.
- Significantly lower readmission rates within 30 days for patients with heart failure and heart attacks, and the same rate of readmissions for open-heart surgery.
- Better clinical efficiency, with patients returning to daily life an average two-thirds of a day earlier than in peer hospitals.
- Mortality rates for cardiovascular care across all hospitals are declining so much that *97 percent of cardiovascular patients who receive inpatient care are surviving, and more than 99 percent are complication-free*.

For more details, including complete hospital reporting data on this year's Cardiovascular Benchmarks winning hospitals, please see the Findings section of this document.

A DIRECTION FOR POSITIVE CHANGE

The ultimate goal of the Thomson Reuters 100 Top Hospitals®: Cardiovascular Benchmarks study is to provide guidelines to improve the standard of care in cardiology. By identifying hospitals that display superior performance in the clinical management of cardiovascular disease, we offer the healthcare industry a direction for positive change and information to help decrease the variations in quality and financial performance that continue to plague healthcare today.

Throughout the life of the 100 Top Hospitals program, we have worked to ensure that the measures and methodology we use are fair, consistent, and telling. We continually test the validity of our performance measures and data sources. As a part of our own internal performance improvement process, we welcome comments from hospitals and physicians. To submit comments, visit www.100tophospitals.com and click Contact Us.

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METHODOLOGY

The 100 Top Hospitals®: Cardiovascular Benchmarks is a quantitative study that uses a balanced scorecard approach, based on publicly available data, to identify the top cardiovascular hospitals in the United States. This study focuses on short-term, acute care, nonfederal U.S. hospitals that treat a broad spectrum of cardiology patients. It includes patients requiring medical management only, as well as those who receive invasive or surgical procedures. Because multiple measures are used, a hospital must provide all forms of cardiovascular care, including open-heart surgery, to be included in the study.

OVERVIEW

The main steps we take in selecting the 100 Top Hospitals Cardiovascular winners are:

- Building the database of hospitals, including special selection and exclusion criteria
- Classifying hospitals into comparison groups
- Scoring hospitals on a set of weighted performance measures
- Determining the 100 Top Hospitals Cardiovascular performers by ranking hospitals relative to their comparison group

The following document is intended to be an overview of these steps. To request more detailed information on any of the study concepts outlined here, please email us at healthcare.pubs@thomsonreuters.com or call +1 800 568 3282.

BUILDING THE DATABASE OF HOSPITALS

Primary Data Sources

The data used in the 100 Top Hospitals: Cardiovascular Benchmarks study come from two primary sources: the publicly available Medicare Provider Analysis and Review (MedPAR) data set and the Medicare Cost Report. Several other data sources are also used. Core measures data are from the Centers for Medicare and Medicaid Services (CMS) Hospital Compare data set. Residency program information, used in classifying teaching hospitals, is from the American Medical Association (for Accreditation Council for Graduate Medical Education (ACGME)-accredited programs) and the American Osteopathic Association (AOA).

The MedPAR data set is used for patient-level medical record information for the calculation of mortality, complications, and length of stay. It is also used for patient-level charge data in estimating cost per adjusted discharge. This data set contains information on the approximately 12 million Medicare patients who are discharged from the nation's acute care hospitals annually.

We used the most recent two years of MedPAR data available, 2007 and 2008, in this study.* We ran the 2008 data with a 2007 grouper so that the DRGs that were valid in 2007 could be used. To be included in the study, a hospital must have both years of data available.

We use Medicare cost reports to create our proprietary database, which contains hospital-specific demographic information, as well as hospital-specific all-payer cost and charge data. These data are applied to MedPAR patient-level records to estimate cost for the study's cost measures. For this study, we used 2008 cost report data to determine the ratio of cost to charges, whenever available. The Medicare Cost Report is filed annually by every U.S. hospital that participates in the Medicare program. Hospitals are required to submit cost reports in order to receive reimbursement from Medicare. It should be noted, however, that cost report data include services for all patients, not just Medicare beneficiaries. However, Medicare managed care (HMO) beneficiary information is not currently available.

We and many others in the healthcare industry have used the MedPAR and Medicare Cost Report databases for many years. We believe they are accurate and reliable sources for the types of analyses performed in this study. Medicare data are highly representative of the cardiovascular patients included in this study. In fact, Medicare inpatients usually represent about two-thirds of all patients undergoing medical treatment for acute myocardial infarction or experiencing heart failure, and about half of all patients undergoing percutaneous coronary intervention or coronary artery bypass graft surgery. Furthermore, many previous academic and economic studies of healthcare in the United States have been based on the assumption that Medicare data are representative of the all-payer activity at hospitals.

Hospitals and Patient Groups Included

The focus of this study is hospitals that perform open-heart surgery. To build such a database, we included all hospitals that had, in the 2007 and 2008 data years combined, at least 30 unique cases[2] in each of the groups described below.

Acute Myocardial Infarction (AMI) patients in Diagnosis Related Groups (DRGs) 121–123 with the following ICD-9-CM codes as primary diagnosis only:

- 410.01 Acute myocardial infarction of anterolateral wall, initial episode of care
- 410.11 Acute myocardial infarction of other anterior wall, initial episode of care
- 410.21 Acute myocardial infarction of inferolateral wall, initial episode of care
- 410.31 Acute myocardial infarction of inferoposterior wall, initial episode of care
- 410.41 Acute myocardial infarction of other inferior wall, initial episode of care
- 410.51 Acute myocardial infarction of other lateral wall, initial episode of care
- 410.61 Acute myocardial infarction, true posterior wall infarction, initial episode of care
- 410.71 Acute myocardial infarction, subendocardial infarction, initial episode of care
- 410.81 Acute myocardial infarction of other specified sites, initial episode of care
- 410.91 Acute myocardial infarction, unspecified site, initial episode of care

The AMI group is restricted to non-surgical patients.

Heart Failure (HF)† patients in DRG 127 with the following ICD-9-CM code as primary diagnosis only:

- 398.91 Rheumatic heart failure
- 402.01 Malignant hypertensive heart disease
- 402.11 Benign hypertensive heart disease
- 402.91 Unspecified hypertensive heart disease
- 404.01 Malignant hypertensive heart and renal disease
- 404.03 Malignant hypertensive heart and renal disease with renal failure
- 404.11 Benign hypertensive heart and renal disease
- 404.13 Benign hypertensive heart and renal disease with renal failure
- 404.91 Unspecified hypertensive heart and renal disease
- 404.93 Unspecified hypertensive heart and renal disease with renal failure
- 428.0 Unspecified congestive heart failure
- 428.1 Left heart failure
- 428.20 Unspecified systolic heart failure
- 428.21 Acute systolic heart failure
- 428.22 Chronic systolic heart failure

*The MedPAR data years quoted in 100 Top Hospitals® are federal fiscal years — a year that begins on October 1 of each calendar year and ends on September 30 of the following calendar year. Federal fiscal years are identified by the year in which they end (e.g., fiscal year 2008 begins in 2007 and ends in 2008).

†In previous studies, we referred to this patient category as congestive heart failure (CHF).

- 428.23 Acute on chronic systolic heart failure
- 428.30 Unspecified diastolic heart failure
- 428.31 Acute diastolic heart failure
- 428.32 Chronic diastolic heart failure
- 428.33 Acute on chronic diastolic heart failure
- 428.40 Unspecified combined systolic and diastolic heart failure
- 428.41 Acute combined systolic and diastolic heart failure
- 428.42 Chronic combined systolic and diastolic heart failure
- 428.43 Acute on chronic combined systolic and diastolic heart failure
- 428.9 Unspecified heart failure

The HF category is restricted to non-surgical patients.

Percutaneous Coronary Intervention (PCI) patients with any (primary or secondary) of the following ICD-9-CM procedure codes:

- 00.66 PTCA or coronary atherectomy
- 36.06 Insertion of coronary artery stent(s)
- 36.07 Insertion of drug-eluting coronary artery stent(s)

Patients with the 36.06 or 36.07 codes are excluded if they also have the procedure code 36.03 (open chest coronary artery angioplasty).

Coronary Artery Bypass Graft (CABG) patients in DRGs 106, 547, 548, 549, and 550 with any (primary or secondary) of the following ICD-9-CM procedure codes:

- 36.10 Aortocoronary bypass, unspecified number of arteries
- 36.11 Aortocoronary bypass, one coronary artery
- 36.12 Aortocoronary bypass, two coronary arteries
- 36.13 Aortocoronary bypass, three coronary arteries
- 36.14 Aortocoronary bypass, four or more coronary arteries
- 36.15 Single internal mammary-coronary artery bypass
- 36.16 Double internal mammary-coronary artery bypass
- 36.17 Abdominal-coronary artery bypass
- 36.19 Other bypass anastomosis for heart revascularization

When a patient record has both PCI and CABG procedures, we place them into the CABG group for all performance measures. This is a change from previous years of the study — when a patient record could fall into both groups.

To be sure that we also included purely medical (not surgical) patients, the AMI and HF groups explicitly exclude patients who also had a PCI and/or CABG procedure.

The following case exclusions were applied to all hospital records when calculating the study measures:

- Patients who were discharged to another short-term facility (this is done to avoid double-counting)‡
- Patients who were not at least 65 years old

Hospitals Excluded

After building the database of cardiovascular hospitals, we excluded a number of hospitals that would have skewed the study results. Excluded from the study were:

- Specialty hospitals, other than cardiac hospitals (e.g., critical access hospitals, children's, women's, psychiatric, substance abuse, rehabilitation, and long-term acute care hospitals)
- Hospitals with fewer than 25 acute care beds
- Federally-owned hospitals
- Non-U.S. hospitals (such as those in Puerto Rico, Guam, and the Virgin Islands)
- Hospitals with Medicare average lengths of stay longer than 30 days
- Hospitals with overall mortality rates (number of deaths divided by total discharges) of less than 1 percent
- Hospitals that do not have both 2007 and 2008 Medicare claims
- Hospitals missing data for calculation of one or more performance measures
- Hospitals for which a Medicare Cost Report was not available for any year from 2005 through 2008

‡We included these cases when determining the Procedure Volume Threshold Measure count for a hospital.

CLASSIFYING HOSPITALS INTO COMPARISON GROUPS

Bed size, teaching status, and residency/fellowship program involvement have a profound effect on the types of patients a hospital treats and the scope of services it provides. When analyzing the performance of an individual hospital, it is crucial to evaluate it against other similar hospitals. To address this, we assigned each hospital to one of three comparison groups according to its teaching and residency program status.

Our formula for defining the cardiovascular hospital comparison groups includes each hospital's bed size, residents-to-beds ratio, and involvement in graduate medical education (GME) programs accredited by either the Accreditation Council for Graduate Medical Education[3] or the American Osteopathic Association.[4]

We define the groups as follows:

Teaching Hospitals With Cardiovascular Residency[§] Programs

Must be involved in a cardiovascular residency program accredited by the ACGME or the AOA

AND

Must meet *any two of the following three* criteria:

1. 200 or more acute care beds in service
2. an intern-resident-per-bed ratio of at least 0.03
3. involvement in at least three accredited GME programs overall

Cardiovascular residency programs include any of the following:

- Cardiology
- Cardiothoracic surgery
- Cardiovascular disease
- Cardiovascular medicine
- Interventional cardiology
- Thoracic surgery

Clinical cardiac electrophysiology and cardiovascular radiology residency programs are not included.

Teaching Hospitals Without Cardiovascular Residency Programs

There is *no* involvement in a cardiovascular residency program.

Must meet *any two of the following three* criteria:

1. 200 or more acute care beds in service
2. an intern-resident-per-bed ratio of at least 0.03
3. involvement in at least three accredited GME programs overall

Community Hospitals

Must meet *both* of the following criteria:

1. 25 or more acute care beds in service
2. not classified as a teaching hospital per definitions above

Bed size and number of interns/residents (full-time equivalents) are taken from each hospital's Medicare Cost Report for the most current year available.

The final 2009 study group, after exclusions, included 971 hospitals, as follows:

- 167 Teaching Hospitals With Cardiovascular Residency Programs
- 275 Teaching Hospitals Without Cardiovascular Residency Programs
- 529 Community Hospitals

SCORING HOSPITALS ON WEIGHTED PERFORMANCE MEASURES

We developed eight categories of clinical quality practices and efficiency of operations that we believe constitute the most reliable, scientific way possible to produce benchmarks for superior hospital performance. We also believe that using publicly available data for all hospitals supports this goal. The performance categories, listed below, are described in detail on the following pages.

1. Risk-Adjusted Medical Patient Mortality (includes AMI and HF mortality indices)
2. Risk-Adjusted Surgical Patient Mortality (includes PCI and CABG mortality indices)
3. Risk-Adjusted Complications (includes post-operative hemorrhage and post-operative infection indices)
4. Core Measures Score (includes AMI and HF core measures)
5. Percentage of CABG Patients With Internal Mammary Artery Use
6. Procedure Volume Threshold (for PCI and CABG)
7. Severity-Adjusted Average Length of Stay
8. Severity- and Wage-Adjusted Cost per Case

[§]All references to residency programs also include fellowship programs.

MEASURE: RISK-ADJUSTED MEDICAL PATIENT (AMI AND HF) MORTALITY INDEX

WHY WE INCLUDE THIS ELEMENT	CALCULATION	SCORING METHODOLOGY/ NOTES	FAVORABLE VALUES ARE
While all hospitals have patient deaths, this measure shows where deaths occurred that would not have been expected, considering a patient's medical condition.	To be eligible for this measure, a patient had to fall into the AMI or HF groups. The Risk-Adjusted Medical Mortality Index is the number of actual deaths, divided by the number expected. In the 2009 study, we normalized the index based on the observed and expected deaths for each comparison group and for each patient group (AMI, HF). Expected deaths are based on our statistical model for predicting the likelihood of a patient's death based on their medical record (age, sex, presence of complicating diagnoses, and other characteristics) and factors associated with the hospital (teaching status, geographic location, and size). See the Appendix for details. The reference value for this index is 1.00; a value of 1.15 indicates 15 percent more events than predicted, and a value of 0.85 indicates 15 percent fewer.	We used two years of MedPAR data (2007 and 2008) to reduce the influence of chance fluctuation. We based the scoring for each patient group (AMI, HF) on the difference between observed and expected deaths, expressed in normalized standard deviation units (z-score). Normalization was done by comparison group. Hospitals with the fewest deaths, relative to the number expected, received the highest scores. Hospitals with values that were high statistical outliers, based on a normalized z-score greater than or equal to 1.64 (90 percent confidence), were not eligible to be benchmark hospitals. The AMI measure and the HF measure each received ¼ weight in the final overall ranking process.	Lower

MEASURE: RISK-ADJUSTED SURGICAL PATIENT (PCI AND CABG) MORTALITY INDEX

WHY WE INCLUDE THIS ELEMENT	CALCULATION	SCORING METHODOLOGY/ NOTES	FAVORABLE VALUES ARE
While all hospitals have mortalities, this measure shows where deaths occurred that would not have been expected, considering patient condition.	To be eligible for this measure, a patient had to fall into either the PCI or CABG group. Mortality was defined as a discharge status of "Died." The Risk-Adjusted Surgical Mortality Index is the number of actual deaths, divided by the number expected. In the 2009 study, we normalized the index based on the observed and expected deaths for each comparison group and for each patient group (PCI, CABG). Expected deaths are based on our statistical model for predicting the likelihood of a patient's death based on the patient's medical record (age, sex, presence of complicating diagnoses, and other characteristics) and factors associated with the hospital (teaching status, geographic location, and size). See the Appendix for details. The reference value for this index is 1.00; a value of 1.15 indicates 15 percent more events than predicted, and a value of 0.85 indicates 15 percent fewer.	We used two years of MedPAR data (2007 and 2008) to reduce the influence of chance fluctuation. We based the scoring for each patient group (PCI, CABG) on the difference between observed and expected deaths, expressed in normalized standard deviation units (z-score). Normalization was done by comparison group. Hospitals with the fewest deaths, relative to the number expected, received the highest scores. Hospitals with values that were high statistical outliers, based on a normalized z-score greater than or equal to 1.64 (90 percent confidence), were not eligible to be benchmark hospitals. The PCI measure and the CABG measure each received ¼ weight in the final overall ranking process.	Lower

MEASURE: RISK-ADJUSTED COMPLICATIONS: POST-OPERATIVE HEMORRHAGE INDEX			
WHY WE INCLUDE THIS ELEMENT	**CALCULATION**	**SCORING METHODOLOGY/ NOTES**	**FAVORABLE VALUES ARE**
A high percentage could indicate poor execution of surgery.	Patients with CABG or PCI were eligible to be included in this measure. To calculate this measure, the number of cases that develop hemorrhage or hematoma complications requiring a post-operative procedure for control, is divided by the number of expected cases. In the 2009 study, we normalized the index based on the observed and expected complications for each comparison group and for each patient group (PCI, CABG). The Agency for Healthcare Research and Quality (AHRQ) model for post-operative hemorrhage or hematoma was used to calculate this measure. This is a risk-adjusted methodology for predicting the likelihood of a patient experiencing a post-operative hemorrhage, based on the patient's age, sex, diagnosis, and other complicating conditions. For our definition of post-operative hemorrhage and details on AHRQ's model, please see the Appendix. The reference value for this index is 1.00; a value of 1.15 indicates 15 percent more events than predicted, and a value of 0.85 indicates 15 percent fewer.	We used two years of MedPAR data (2007 and 2008) to reduce the influence of chance fluctuation. We based the scoring on the difference between the observed and expected number of patients with hemorrhagic complications, expressed in normalized standard deviation units (z-score). Normalization was done by comparison group and patient group. Hospitals with the fewest observed complications, relative to the number of complications expected, received the highest scores. Hospitals with values that were high statistical outliers, based on a normalized z-score greater than or equal to 1.64 (90 percent confidence), were not eligible to be benchmark hospitals. The Post-Operative Hemorrhage measure received ½ weight in the final overall ranking process.	Lower

MEASURE: RISK-ADJUSTED COMPLICATIONS: POST-OPERATIVE INFECTION INDEX

WHY WE INCLUDE THIS ELEMENT	CALCULATION	SCORING METHODOLOGY/ NOTES	FAVORABLE VALUES ARE
Although some post-operative infections are unavoidable, this measure shows where infections occurred that would not have been expected, considering patient condition.	Patients with CABG and PCI were eligible for this measure. To calculate this measure, the number of cases at the hospital that develop post-operative infections is divided by the number expected. In the 2009 study, we normalized the index based on the observed and expected complications for each comparison group and for each patient group (PCI and CABG). The AHRQ model for post-operative sepsis was used to calculate this measure. This is a risk-adjusted methodology for predicting the likelihood of a patient experiencing a post-operative infection, based on the patient's age, sex, diagnosis, and other complicating conditions. For our definition of post-operative infection and details on AHRQ's model, please see the Appendix. The reference value for this index is 1.00; a value of 1.15 indicates 15 percent more events than predicted, and a value of 0.85 indicates 15 percent fewer.	We used two years of MedPAR data (2007 and 2008) to reduce the influence of chance fluctuation. We based the scoring on the difference between the observed and expected number of patients with post-operative infections, expressed in normalized standard deviation units (z-score). Normalization was done by comparison group and patient group. Hospitals with the fewest observed infections, relative to the number of infections expected, received the highest scores. Hospitals with values that were high statistical outliers, based on a normalized z-score greater than or equal to 1.64 (90 percent confidence), were not eligible to be benchmark hospitals. The Post-Operative Infection measure received ½ weight in the final overall ranking process.	Lower

MEASURE: CORE MEASURES SCORE

WHY WE INCLUDE THIS ELEMENT	CALCULATION	SCORING METHODOLOGY/ NOTES	FAVORABLE VALUES ARE
To be truly balanced, a scorecard must include various measures of quality. Core Measures, developed by The Joint Commission and CMS and endorsed by the National Quality Forum, are a widely accepted method for measuring patient care quality that includes specific guidelines for AMI and HF care.	Core measures values are from the CMS Hospital Compare Web site. We included six of the seven reported AMI measures and all of the reported HF measures, for a total of 10. We excluded the AMI core measure "Heart Attack Patients Given Fibrinolytic Medication within 30 Minutes of Arrival" because it was not reported by most in-study hospitals. For a list of the measures used, see the Appendix. For each hospital, we calculate the mean of the reported core measures percent values for all available core measures. We consider reported core measures percents with patient counts that are less than or equal to 25, or that have relative standard error values greater than or equal to 0.30 to be statistically unreliable. In these cases, we substitute the class median percent value for the affected core measure.	If the hospital did not report a specific core measure, or if the core measure was based on too few patients to be sufficiently precise, we substituted the median percent for the comparison group. Core measures values are from the CMS Hospital Compare Web site, third and fourth quarters of 2007, and first and second quarters of 2008.[5] The Core Measures Score received a weight of 1 in the final overall ranking process (½ for the score on AMI measures and ½ for the score on HF measures).	Higher

MEASURE: PERCENTAGE OF CABG PATIENTS WITH INTERNAL MAMMARY ARTERY USE

WHY WE INCLUDE THIS ELEMENT	CALCULATION	SCORING METHODOLOGY/ NOTES	FAVORABLE VALUES ARE
The clinical advantages of using an internal mammary graft are many. Studies over the last two decades have confirmed the benefits of internal mammary coronary artery bypass grafts over saphenous (leg) vein grafts, with a higher patency rate being the most significant clinical benefit.[6-10] On a patient-specific basis, certain factors may promote or prohibit the use of an internal mammary graft. However, it is reasonable to use the overall rate at which these grafts are performed as a measure of hospital quality.	Number of CABG surgeries using internal mammary arteries, divided by the total number of CABG surgeries. Patients with prior CABG surgeries are excluded from the calculation.	We used two years of MedPAR data (2007 and 2008) to reduce the influence of chance fluctuation. This measure received a weight of 1 in the final overall ranking process.	Higher

MEASURE: PROCEDURE VOLUME THRESHOLD

WHY WE INCLUDE THIS ELEMENT	CALCULATION	SCORING METHODOLOGY/ NOTES	FAVORABLE VALUES ARE
There is a large volume of published research showing a positive relationship between procedure volume and good outcomes.[11-33]	The number of PCI procedures and CABG surgeries performed in MedPAR data year 2008, compared with a recommended threshold.	We compared hospital procedure counts to established thresholds for each procedure. The designated threshold we used was based on published research that found the number of cases at which patient outcomes tended to improve. We adjusted the threshold values for application to our study's Medicare patient population and to account for the shift to outpatient treatment, to arrive at 149 procedures for PCI and 35 for CABG. For each hospital in the study, we calculated two separate scores — one for each procedure (CABG and PCI). We based the scoring on a binomial distribution, i.e., each hospital was assigned a 1 or 0, depending on whether the minimum threshold was met. If a facility met the threshold, the facility was assigned a 1. Hospitals were then ranked based on the sum of their scores for CABG and PCI. The composite Procedure Volume Threshold Measure received a weight of 1 in the final overall ranking process.	Higher

MEASURE: SEVERITY-ADJUSTED AVERAGE LENGTH OF STAY

WHY WE INCLUDE THIS ELEMENT	CALCULATION	SCORING METHODOLOGY/ NOTES	FAVORABLE VALUES ARE
A lower severity-adjusted average length of stay (average number of days spent by a patient in a hospital) generally indicates a more efficient consumption of hospital resources and, possibly, reduced risk to patients.	An unweighted mean of lengths of stay for AMI, HF, PCI, and CABG, considered separately. All average lengths of stay are adjusted for differences in severity of illness using Refined Diagnosis Related Groups (RDRGs). In the 2009 study, we normalized length of stay for each comparison group and for each patient group (AMI, HF, PCI, and CABG).	Data for this measure are from 2008 MedPAR only. This measure eliminates differences due to the varying severity of illness of patients at each hospital, allowing for a more valid comparison. Each length of stay measure (AMI, HF, PCI, CABG) received a weight of ¼ in the final overall ranking process. For more information on our length of stay methodology, see the Appendix.	Lower

MEASURE: SEVERITY- AND WAGE-ADJUSTED COST PER CASE

WHY WE INCLUDE THIS ELEMENT	CALCULATION	SCORING METHODOLOGY/ NOTES	FAVORABLE VALUES ARE
This measure helps to determine how cost effectively a hospital is caring for its patients.	An unweighted mean of costs for AMI, HF, PCI, and CABG, considered separately. All costs are adjusted for differences in severity of illness using RDRGs, and for differences in local wages, using the CMS wage-scale adjustment. In the 2009 study, we normalized cost for each comparison group and for each patient group (AMI, HF, PCI, and CABG). Cost-to-charge ratios are from the hospital's most recent Medicare Cost Report. In the 2009 study, we used the total cost-to-charge ratio reported by the hospital. For more information on our methodology, see the Appendix.	Charge data for this measure are from 2008 MedPAR only. Costs are severity adjusted to factor out differences attributable to the varying severity of illness of patients at each hospital within a market, and are wage-adjusted to allow for regional wage variations. Each cost per case measure (AMI, HF, PCI, CABG) received a weight of ¼ in the final overall ranking process. For more information on our length of stay and charge weight methodologies, see the Appendix.	Lower

DETERMINING THE 100 TOP HOSPITALS®: CARDIOVASCULAR BENCHMARKS

Scoring and Ranking

Within each of the three hospital comparison groups, we scored hospitals based on their performance on each of the measures relative to other hospitals in their group. First, each hospital was given a single score for each of the individual performance measures that make up the eight performance categories. Each performance *measure* is assigned a weight so that each *category* is equally weighted (e.g., the two medical mortality measures (AMI and HF mortality) each have a weight of ½, for a total medical mortality weight of 1). The weights for each measure are indicated in the table below. Each hospital's score was summed to arrive at a total score for the hospital within each of the three groups. The hospitals were then ranked based on their total scores, and the hospitals with the best overall rankings in each comparison group were selected as the benchmarks.

	RANKED PERFORMANCE METRIC	WEIGHT
	Risk-Adjusted Mortality for Acute Myocardial Infarction (AMI) Patients	1/2
	Risk-Adjusted Mortality for Heart Failure (HF) Patients	1/2
	Risk-Adjusted Mortality for Coronary Artery Bypass Graft (CABG) Patients	1/2
	Risk-Adjusted Mortality for Percutaneous Coronary Intervention (PCI) Patients	1/2
	Risk-Adjusted Post-Operative Infection	1/2
	Risk-Adjusted Post-Operative Hemorrhage	1/2
	AMI Core Measures Mean Percent	1/2
	HF Core Measures Mean Percent	1/2
	Percentage of CABG Patients with Internal Mammary Artery Use	1
Procedure Volume Threshold Score (0, 1)	Total CABG Cases 2008 Greater than 35	1/2
	Total PCI Cases 2008 Greater than 149	1/2
	Severity-Adjusted Average Length of Stay	1
	Wage- and Severity-Adjusted Average Cost per Case	1

Note: Mortality, post-op infection, and post-op hemorrhage are ranked on normalized z-scores, which are converted to indexes for reporting. See Methodology detail for each measure.

Screening for Outliers

To reduce the impact of unsustainable performance anomalies and reporting anomalies or errors, hospitals with one or more mortality or complications index scores that were high statistical outliers (90 percent confidence) were not eligible to be winners. In addition, hospitals with costs per case for any patient group that were high or low statistical outliers (using interquartile range trimming methodology) were not eligible to be winners.

The number of hospitals selected to receive the Thomson Reuters 100 Top Hospitals®: Cardiovascular Benchmarks award in each hospital category was:

- 30 hospitals in the Teaching Hospitals With Cardiovascular Residency Programs group
- 40 hospitals in the Teaching Hospitals Without Cardiovascular Residency Programs group
- 30 hospitals in the Community Hospitals group

We chose this stratification to maintain consistency with the representation of hospitals throughout the country, as identified in the original study research.

2009 THOMSON REUTERS 100 TOP HOSPITALS®: CARDIOVASCULAR AWARD WINNERS

Thomson Reuters is proud to present the 2009 100 Top Hospitals: Cardiovascular Benchmarks, listed on the following pages. We stratify winners by three separate peer groups: Teaching Hospitals With Cardiovascular Residency Programs, Teaching Hospitals Without Cardiovascular Residency Programs, and Community Hospitals.
For full details on these peer groups and the process we use to select the benchmark hospitals, please see the Methodology section of this document.

TEACHING HOSPITALS WITH CARDIOVASCULAR RESIDENCY PROGRAMS*

MEDICARE ID	HOSPITAL	LOCATION
030024	St. Joseph's Hospital and Medical Center	Phoenix, AZ
100289	Cleveland Clinic Florida	Weston, FL
140208	Advocate Christ Medical Center	Oak Lawn, IL
140223	Advocate Lutheran General Hospital	Park Ridge, IL
140276	Loyola University Medical Center	Maywood, IL
150084	St. Vincent Indianapolis Hospital	Indianapolis, IN
160064	Mercy Medical Center-North Iowa	Mason City, IA
200009	Maine Medical Center	Portland, ME
220036	Caritas St. Elizabeth's Medical Center	Boston, MA
220077	Baystate Medical Center	Springfield, MA
220086	Beth Israel Deaconess Medical Center	Boston, MA
220163	UMass Memorial Medical Center	Worcester, MA
220171	Lahey Clinic Medical Center	Burlington, MA
230019	Providence Hospital and Medical Center	Southfield, MI
300003	Dartmouth-Hitchcock Medical Center	Lebanon, NH
310001	Hackensack University Medical Center	Hackensack, NJ
330013	Albany Medical Center	Albany, NY
330160	Staten Island University Hospital	Staten Island, NY
360079	Kettering Medical Center	Kettering, OH
360085	The Ohio State University Medical Center	Columbus, OH
360133	Grandview Medical Center	Dayton, OH
360134	Good Samaritan Hospital	Cincinnati, OH
390006	Geisinger Medical Center	Danville, PA
390107	UPMC Passavant	Pittsburgh, PA
440039	Vanderbilt University Medical Center	Nashville, TN
450054	Scott and White Memorial Hospital	Temple, TX
470003	Fletcher Allen Health Care	Burlington, VT
490009	University of Virginia Medical Center	Charlottesville, VA
520098	University of Wisconsin Hospital and Clinics	Madison, WI
520138	Aurora St. Luke's Medical Center	Milwaukee, WI

*Order of hospitals does not reflect performance ranking. Hospitals are ordered by Medicare ID.

TEACHING HOSPITALS WITHOUT CARDIOVASCULAR RESIDENCY PROGRAMS*

MEDICARE ID	HOSPITAL	LOCATION
050280	Mercy Medical Center Redding	Redding, CA
060023	St. Mary's Hospital and Regional Medical Center	Grand Junction, CO
100127	Morton Plant Hospital	Clearwater, FL
130006	St. Luke's Boise Medical Center	Boise, ID
140053	St. John's Hospital	Springfield, IL
140164	Memorial Hospital of Carbondale	Carbondale, IL
150089	Ball Memorial Hospital	Muncie, IN
160083	Mercy Medical Center-Des Moines	Des Moines, IA
190026	Rapides Regional Medical Center	Alexandria, LA
220035	North Shore Medical Center	Salem, MA
230029	St. Joseph Mercy Oakland	Pontiac, MI
230038	Spectrum Health Hospitals	Grand Rapids, MI
230047	Henry Ford Macomb Hospitals	Clinton Township, MI
230054	Marquette General Hospital	Marquette, MI
230097	Munson Medical Center	Traverse City, MI
230156	St. Joseph Mercy Hospital	Ann Arbor, MI
230195	St. John Macomb-Oakland Hospital	Warren, MI
230269	William Beaumont Hospital-Troy	Troy, MI
240053	Park Nicollet Methodist Hospital	St. Louis Park, MN
270004	Billings Clinic	Billings, MT
330057	St. Peter's Hospital	Albany, NY
330125	Rochester General Hospital	Rochester, NY
340001	Carolinas Medical Center-NorthEast	Concord, NC
350011	MeritCare Hospital	Fargo, ND
350019	Altru Hospital	Grand Forks, ND
360006	Riverside Methodist Hospital	Columbus, OH
360025	Firelands Regional Medical Center	Sandusky, OH
360035	Mount Carmel	Columbus, OH
360070	Mercy Medical Center	Canton, OH
360123	St. John West Shore Hospital	Westlake, OH
360179	Bethesda North Hospital	Cincinnati, OH
380004	Providence St. Vincent Medical Center	Portland, OR
390063	Hamot Medical Center	Erie, PA
390067	PinnacleHealth	Harrisburg, PA
390079	Robert Packer Hospital	Sayre, PA
490021	Centra Health	Lynchburg, VA
490059	St. Mary's Hospital	Richmond, VA
520030	Aspirus Wausau Hospital	Wausau, WI
520037	Saint Joseph's Hospital	Marshfield, WI
520087	Gundersen Lutheran Health System	La Crosse, WI

*Order of hospitals does not reflect performance ranking. Hospitals are ordered by Medicare ID.

COMMUNITY HOSPITALS*

MEDICARE ID	HOSPITAL	LOCATION
010100	Thomas Hospital	Fairhope, AL
030094	Arrowhead Hospital	Glendale, AZ
030100	Tucson Heart Hospital	Tucson, AZ
030102	Arizona Heart Hospital	Phoenix, AZ
050224	Hoag Memorial Hospital Presbyterian	Newport Beach, CA
050232	French Hospital Medical Center	San Luis Obispo, CA
100062	Munroe Regional Medical Center	Ocala, FL
100070	Venice Regional Medical Center	Venice, FL
100080	JFK Medical Center	Atlantis, FL
140252	Northwest Community Hospital	Arlington Heights, IL
150153	St. Vincent Heart Center of Indiana	Indianapolis, IN
150154	The Indiana Heart Hospital	Indianapolis, IN
160016	Trinity Regional Medical Center	Fort Dodge, IA
180011	Saint Joseph-London	London, KY
180104	Western Baptist Hospital	Paducah, KY
210007	St. Joseph Medical Center	Towson, MD
240078	Fairview Southdale Hospital	Edina, MN
240115	Mercy Hospital	Coon Rapids, MN
350015	Medcenter One	Bismarck, ND
360041	Parma Community General Hospital	Parma, OH
360145	EMH Regional Medical Center	Elyria, OH
360155	Southwest General Health Center	Middleburg Heights, OH
370215	Oklahoma Heart Hospital	Oklahoma City, OK
390086	DuBois Regional Medical Center	DuBois, PA
430095	Avera Heart Hospital of South Dakota	Sioux Falls, SD
450824	Heart Hospital of Austin	Austin, TX
450855	Harlingen Medical Center	Harlingen, TX
460021	Dixie Regional Medical Center	St. George, UT
500014	Providence Regional Medical Center Everett	Everett, WA
520193	Aurora BayCare Medical Center	Green Bay, WI

*Order of hospitals does not reflect performance ranking. Hospitals are ordered by Medicare ID.

FINDINGS

With each 100 Top Hospitals® study release, we renew our commitment to more completely measure and describe the performance of hospitals treating cardiovascular disease. To that end, we study ways to show how the 100 Top Hospitals differ from their peers and how they are providing value to their communities. This year, new analysis revealed the cardiovascular 100 Top Hospitals have lower 30-day mortality rates for heart attack patients, and that heart attack and heart failure patients discharged from these hospitals are less likely to be re-admitted within 30 days of discharge. This finding is important for two reasons: it suggests that the study's winning hospitals are providing better overall care for heart attack and heart failure patients, and, because these measures are part of CMS' value-based purchasing program, it hints that the winning hospitals are more prepared to fare well in the pay-for-performance environment.

PATIENTS AT CARDIOVASCULAR 100 TOP HOSPITALS HAVE BETTER LONGER-TERM SURVIVAL, OUTCOMES

Our analysis of longer-term outcomes shows a clear difference in how heart patients at cardiovascular 100 Top Hospitals — compared with peer hospitals — fare after they are discharged:*

- Heart attack (AMI) patients treated at our award-winning hospitals have lower 30-day mortality rates than patients treated at non-winning hospitals.
- Heart attack (AMI) patients discharged from winning hospitals were less likely to be readmitted within 30 days than patients discharged from non-winning hospitals.
- Heart failure patients discharged from winning hospitals were less likely to be readmitted within 30 days than patients discharged from non-winning hospitals.

The 30-day mortality and readmission rates are part of the Centers for Medicare and Medicaid Services' (CMS) value-based purchasing (VBP)

*All differences are statistically significant.

program. The VBP initiative ties Medicare payments to performance on quality and efficiency and is part of CMS' effort to transform Medicare from a passive payer to an active purchaser of higher quality, more efficient healthcare. This pay-for-performance program gives hospitals a chance to earn financial incentives on Medicare reimbursement by performing well on quality of care measures. Conversely, organizations that do not meet specified performance standards could lose reimbursement.

Measures that are part of this program are watched closely in the industry. The measures used in this analysis, in particular, are important because they can reveal when deaths or complications are related to the care patients received at the hospital.

The bar chart and data table below show how the 100 Top Hospitals® Cardiovascular study winners outperformed the non-winners on these important measures.

FIGURE 1: HEART ATTACK AND HEART FAILURE OUTCOMES, 100 TOP HOSPITALS: CARDIOVASCULAR BENCHMARK WINNERS VERSUS NON-WINNERS

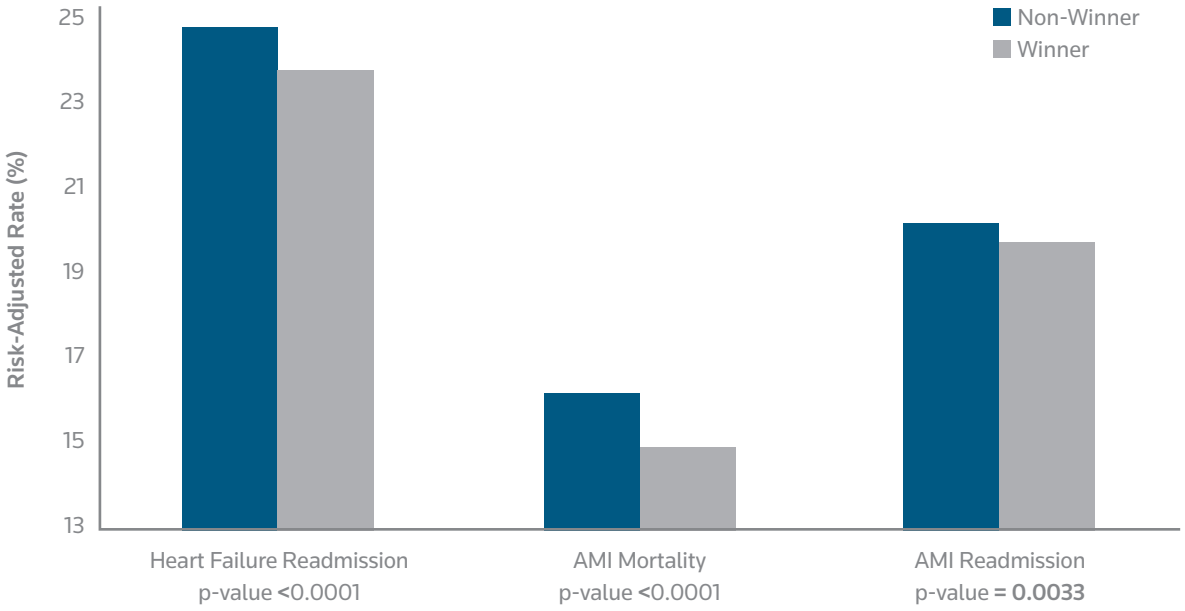

TABLE 1: HEART ATTACK AND HEART FAILURE OUTCOMES, 100 TOP HOSPITALS: CARDIOVASCULAR BENCHMARK WINNERS VERSUS NON-WINNERS

MEASURE	WINNER	NON-WINNER	WINNER VERSUS NON-WINNER	
			Difference	p-value
HEART FAILURE READMISSION (%)	23.73	24.72	-4.04%	<0.0001
AMI MORTALITY (%)	14.92	16.23	-8.04%	<0.0001
AMI READMISSION (%)	19.73	20.13	-2.01%	0.0033

Lower mortality and readmission rates generally reflect better patient care. Although a certain number of deaths and readmissions cannot be prevented — some cases are just too severe — a number of deaths and readmissions are certainly preventable. Following published care protocols; assembling highly qualified, well-managed critical care teams; and providing appropriate patient education, well-prepared, easy-to-understand discharge instructions, and follow-up care are all ways top hospitals can improve outcomes for heart patients. This analysis reinforces our belief that the 100 Top Hospitals® Cardiovascular study winners are providing higher quality of care. Using the Hospital Compare data suggests these hospitals will fare well in public reporting comparisons and in the VBP program.

Our statistics are from CMS Hospital Compare data for the 2008 federal fiscal year. The 30-day mortality rates include all deaths within 30 days of original admission, whether a patient dies in the hospital or after leaving, and whether a patient dies from heart attack, heart failure, or another condition. The 30-day post-discharge readmission rate measures how many patients were readmitted back into any hospital, for any reason, within 30 days of discharge. CMS adjusts all data for patient severity. To allow for fair comparisons between 100 Top Hospitals winners and non-winners, we added an adjustment for our study comparison groups. With these comparison groups, we assign hospitals to one of three groups based on teaching status, level of involvement in cardiovascular residency/fellowship programs, and bed size. For more information on hospital comparison groups, please see the Methodology section.

CARDIOVASCULAR 100 TOP HOSPITALS ARE SETTING THE STANDARDS FOR CARE

Cardiovascular hospitals are providing real value to their communities. Over the last several years, U.S. hospitals have improved outcomes for cardiovascular patients. Survival rates are increasing and serious complications are less frequent. In fact, this study shows that *97 percent of cardiovascular patients who receive inpatient care are surviving, and more than 99 percent are complication-free*! In addition to providing superior care, the winning hospitals are also more efficient. Compared with their peers, this year's typical cardiovascular study winner released patients two-thirds of a day earlier, on average, than their peers. What's more, the typical winner's average cost per case was 12 percent lower than their typical peer's.

In this section, we provide performance measure data for both the benchmark hospitals and the comparison groups of hospitals we studied. Tables 2–5 show the median results for each performance measure for benchmark hospitals (the winners) compared with all other hospitals in the study, and the percentages by which the benchmark facilities outperformed their peers. Table 2 shows data for all of the hospitals in the study; tables 3–5 show data for each of the three comparison groups: Teaching Hospitals *With* Cardiovascular Residency Programs, Teaching Hospitals *Without* Cardiovascular Residency Programs, and Community Hospitals. The text accompanying each table provides a discussion of some of the more compelling trends.

PERFORMANCE MEASURE NOTES

For each of the risk-adjusted mortality and complications indices, the reference value is 1.00, and numbers above or below 1.00 indicate more or fewer events (deaths or complications) than would be expected, given the patients' risk. For example, a value of 1.15 indicates 15 percent more events than predicted, and a value of 0.85 indicates 15 percent fewer.

For each set (acute myocardial infarction (AMI) and heart failure (HF)) of core measures, the tables below show the overall average percentage of times the measures were provided by the typical (median) benchmark hospital versus the median peer hospital in the comparison group. For a list of all core measures used in this calculation, please see the Appendix. A score of 100 percent would mean that, on average, every patient eligible for a particular core measure received it. With a median HF core measures score of 96 percent, we know that this year's Cardiovascular 100 Top Hospitals are using the recommended core measures protocol for 96 percent of their HF patients, while the peer (non-winner) hospitals are using the measures on only 93 percent (Table 2). Differences are just slightly less for AMI patients. For more information about these and all of the performance measures, please see the Methodology section and the Appendix of this document.

FINDINGS FOR ALL HOSPITALS

Again this year, a striking finding in the study is the large difference in volume of procedures between the Cardiovascular 100 Top Hospitals® (benchmarks) versus their peers. In the study, we compared the number of Percutaneous Coronary Interventions (PCIs) and Coronary Artery Bypass Grafts (CABGs) performed with recommended volume thresholds from published literature.[11-33] For each hospital in the study, we calculated two separate scores — one for CABG and one for PCI. Hospitals were then ranked based on their scores. (For more details, please see the Methodology section.) These data show that the benchmark hospitals performed 44 percent more CABGs and 40 percent more PCIs than did their peers. Our findings agree with previously published findings that volume is an important correlate with outcomes for cardiovascular patients.[11-33]

Survival rates are markedly better at benchmark hospitals, particularly for patients receiving bypass surgery and angioplasties (CABGs and PCIs). The median benchmark hospital had a risk-adjusted CABG mortality index of 0.70, meaning they experienced 30 percent fewer deaths than would be expected. Peer hospitals, on the other hand, had only 4 percent fewer CABG mortalities than expected. The risk that patients being treated at the benchmark hospitals would experience a post-operative hemorrhage, versus what would be expected given their illness severity and a variety of other factors, was markedly lower than for patients being treated at peer hospitals.

Winning hospitals appear to follow core measures protocols more closely. With a median HF core measures score of 96 percent, we know that this year's Cardiovascular 100 Top Hospitals are using the recommended core measures protocol for 96 percent of their HF patients, while the peer (non-winner) hospitals are using the measures on only 93 percent. Differences are just slightly lower for AMI patients (Table 2).

TABLE 2: NATIONAL PERFORMANCE COMPARISONS (ALL HOSPITALS IN STUDY)[1]

	PERFORMANCE MEASURE	BENCHMARK MEDIAN	PEER MEDIAN	DIFFERENCE	PERCENT DIFFERENCE	BENCHMARK HOSPITALS OUTPERFORM PEER HOSPITALS
Risk-Adjusted Medical Mortality[2]	AMI Mortality	0.85	1.02	-0.17	-16.7	lower mortality
	HF Mortality	0.90	1.00	-0.10	-10.0	lower mortality
Risk-Adjusted Surgical Mortality[2]	CABG Mortality	0.70	0.96	-0.26	-27.1	lower mortality
	PCI Mortality	0.75	0.96	-0.21	-21.9	lower mortality
Risk-Adjusted Complications[2]	Post-Operative Infection Index	0.73	0.85	-0.12	-14.1	fewer complications
	Post-Operative Hemorrhage Index	0.71	0.86	-0.15	-17.4	fewer complications
Core Measures Mean Percent	AMI Core Measures Mean Percent	96.67	94.67	2.00	n/a[3]	better performance
	HF Core Measures Mean Percent	95.88	92.50	3.38	n/a[3]	better performance
	Percentage of CABG Patients with Internal Mammary Artery Use (%)	95.68	91.46	4.22	n/a[3]	higher IMA use
Procedure Volumes (Thresholds: 35 CABG Cases; 149 PCI Cases)	Total 2008 CABG Cases	84	58	26	44.0	more CABG cases
	Total 2008 PCI Cases	247	177	70	39.6	more PCI cases
	Severity-Adjusted Average Length of Stay (days)	5.13	5.80	-0.67	-11.6	shorter ALOS
	Wage- and Severity-Adjusted Average Cost per Case ($)	14,485	16,448	-1,963	-11.9	lower cost per case

[1]Data are for federal fiscal year 2008. Performance measure definitions can be found in the Methodology section.
[2]Ratings greater than 1.0 exceed national norms; ratings less than 1.0 fall below national norms. See the Appendix for more details.
[3]We do not calculate percentage difference for this measure.

Not only are winning hospitals providing superior cardiovascular care, but they are also more efficient. By achieving the clinical outcomes highlighted above while discharging patients two-thirds of a day sooner and at a 12 percent lower cost than their peers, the typical benchmark hospital is demonstrating a greater level of efficiency while successfully treating cardiovascular patients.

TEACHING HOSPITALS *WITH* CARDIOVASCULAR RESIDENCY PROGRAMS IMPROVING SURVIVAL

Benchmark Teaching Hospitals With Cardiovascular Residency Programs had risk-adjusted mortality indices that were significantly lower than their peers. A 0.73 CABG mortality index for the median benchmark hospital in this group means they had 27 percent fewer deaths than would be expected. This is a markedly better outcome than that experienced by the peer hospitals in this group, who, with an index of 1.03, had 3 percent *more* mortalities than expected, given their patients' risk. Differences in benchmark and peer PCI mortality rates were similar. Benchmark hospitals in this group were also much more successful than their peers at avoiding post-operative hemorrhages in cardiology patients. Their risk-adjusted rate for this measure showed they had 27 percent fewer post-operative hemorrhages than expected, whereas their peers had only 13 percent fewer than expected (Table 3).

Teaching Hospitals With Residency Programs generally treat more complex patients and have more sophisticated personnel mixes and higher input costs than Community Hospitals and those without cardiovascular residency programs. As such, they must work hard to keep costs in check. The typical benchmark hospital in this group managed to keep costs 12 percent lower than the typical peer hospital and was able to release the average patient a half day sooner.

TABLE 3: PERFORMANCE COMPARISONS FOR TEACHING HOSPITALS WITH CARDIOVASCULAR RESIDENCY PROGRAMS[1]

	PERFORMANCE MEASURE	BENCHMARK MEDIAN	PEER MEDIAN	DIFFERENCE	PERCENT DIFFERENCE	BENCHMARK HOSPITALS OUTPERFORM PEER HOSPITALS
Risk-Adjusted Medical Mortality[2]	AMI Mortality	0.83	1.04	-0.21	-20.2	lower mortality
	HF Mortality	0.89	1.02	-0.13	-12.8	lower mortality
Risk-Adjusted Surgical Mortality[2]	CABG Mortality	0.73	1.03	-0.30	-29.1	lower mortality
	PCI Mortality	0.75	1.00	-0.25	-25.0	lower mortality
Risk-Adjusted Complications[2]	Post-Operative Infection Index	0.80	0.86	-0.06	-7.0	fewer complications
	Post-Operative Hemorrhage Index	0.73	0.87	-0.14	-16.1	fewer complications
Core Measures Mean Percent	AMI Core Measures Mean Percent	96.50	95.33	1.17	n/a[3]	better performance
	HF Core Measures Mean Percent	95.75	92.75	3.00	n/a[3]	better performance
	Percentage of CABG Patients with Internal Mammary Artery Use (%)	95.18	91.61	3.57	n/a[3]	higher IMA use
Procedure Volumes (Thresholds: 35 CABG Cases; 149 PCI Cases)	Total 2008 CABG Cases	92	66	26	38.6	more CABG cases
	Total 2008 PCI Cases	268	227	41	18.1	more PCI cases
	Severity-Adjusted Average Length of Stay (days)	5.24	5.77	-0.53	-9.2	shorter ALOS
	Wage- and Severity-Adjusted Average Cost per Case ($)	14,635	16,633	-1,998	-12.0	lower cost per case

[1]Data are for federal fiscal year 2008. Performance measure definitions can be found in the Methodology section.
[2]Ratings greater than 1.0 exceed national norms; ratings less than 1.0 fall below national norms. See the Appendix for more details.
[3]We do not calculate percentage difference for this measure.

100 TOP TEACHING HOSPITALS *WITHOUT* CARDIOVASCULAR RESIDENCY PROGRAMS KEEPING SURGICAL MORTALITIES AND COMPLICATIONS IN CHECK

Benchmark Teaching Hospitals Without Cardiovascular Residency Programs had risk-adjusted mortalities for PCI and CABG that were about 24 percent lower than their peers. A 0.73 CABG mortality index for the median benchmark hospital in this group means they had 27 percent fewer deaths than would be expected. This is a markedly better outcome than that experienced by the peer hospitals in this group, who, with an index of 0.96, had only 4 percent fewer PCI mortalities than expected. These hospitals also had relatively low post-operative infection and hemorrhage rates, especially compared with their peers. Their post-operative infection and post-operative hemorrhage indices were 18 and 19 percent, respectively, lower than their peers (Table 4).

TABLE 4: PERFORMANCE COMPARISONS FOR TEACHING HOSPITALS WITHOUT CARDIOVASCULAR RESIDENCY PROGRAMS[1]

	PERFORMANCE MEASURE	BENCHMARK MEDIAN	PEER MEDIAN	DIFFERENCE	PERCENT DIFFERENCE	BENCHMARK HOSPITALS OUTPERFORM PEER HOSPITALS
Risk-Adjusted Medical Mortality[2]	AMI Mortality	0.92	1.03	-0.11	-10.7	lower mortality
	HF Mortality	0.93	1.00	-0.07	-7.0	lower mortality
Risk-Adjusted Surgical Mortality[2]	CABG Mortality	0.73	0.96	-0.23	-24.0	lower mortality
	PCI Mortality	0.75	0.98	-0.23	-23.5	lower mortality
Risk-Adjusted Complications[2]	Post-Operative Infection Index	0.70	0.85	-0.15	-17.7	fewer complications
	Post-Operative Hemorrhage Index	0.71	0.88	-0.17	-19.3	fewer complications
Core Measures Mean Percent	AMI Core Measures Mean Percent	96.83	94.33	2.50	n/a[3]	better performance
	HF Core Measures Mean Percent	95.00	92.50	2.50	n/a[3]	better performance
	Percentage of CABG Patients with Internal Mammary Artery Use (%)	96.05	91.38	4.67	n/a[3]	higher IMA use
Procedure Volumes (Thresholds: 35 CABG Cases; 149 PCI Cases)	Total 2008 CABG Cases	84	66	18	27.3	more CABG cases
	Total 2008 PCI Cases	232	197	35	17.5	more PCI cases
	Severity-Adjusted Average Length of Stay (days)	5.32	5.78	-0.46	-8.0	shorter ALOS
	Wage- and Severity-Adjusted Average Cost per Case ($)	14,929	16,405	-1,476	-9.0	lower cost per case

[1]Data are for federal fiscal year 2008. Performance measure definitions can be found in the Methodology section.
[2]Ratings greater than 1.0 exceed national norms; ratings less than 1.0 fall below national norms. See the Appendix for more details.
[3]We do not calculate percentage difference for this measure.

BENCHMARK COMMUNITY HOSPITALS PERFORM NEARLY TWO-THIRDS AS MANY ANGIOPLASTIES AND BYPASSES AS PEERS

Nowhere is the case for higher volumes leading to better outcomes stronger than in our Community Hospitals. In 2008, these hospitals performed nearly two-thirds more PCIs as their peers (Table 5). Community Hospital winners also had comparatively high volumes of CABGs, performing one-third more of these surgeries in 2008 than their non-winning peers.

The benchmark Community Hospitals had the lowest surgical and medical mortality rates of all the comparison groups we studied, with 37 percent fewer CABG mortalities than expected, and approximately 27 percent fewer PCI deaths than expected.

The benchmark Community Hospitals also performed particularly well in avoiding post-operative hemorrhages and infections. For both indices, these hospitals avoided more complications, when compared with what would be expected given patient risk, than any of the hospital comparison groups.

Lastly, the benchmark Community Hospitals demonstrated a strong ability to hold down costs and lengths of stay. On average, their adjusted costs per case were 16 percent lower than their peers and were the lowest of the three hospital comparison groups we studied. These hospitals released patients nearly a day sooner, on average, than their peers.

TABLE 5: PERFORMANCE COMPARISONS FOR COMMUNITY HOSPITALS[1]

	PERFORMANCE MEASURE	BENCHMARK MEDIAN	PEER MEDIAN	DIFFERENCE	PERCENT DIFFERENCE	BENCHMARK HOSPITALS OUTPERFORM PEER HOSPITALS
Risk-Adjusted Medical Mortality[2]	AMI Mortality	0.78	1.01	-0.23	-22.8	lower mortality
	HF Mortality	0.83	0.99	-0.16	-16.2	lower mortality
Risk-Adjusted Surgical Mortality[2]	CABG Mortality	0.63	0.95	-0.32	-33.7	lower mortality
	PCI Mortality	0.73	0.95	-0.22	-23.2	lower mortality
Risk-Adjusted Complications[2]	Post-Operative Infection Index	0.64	0.83	-0.19	-22.9	fewer complications
	Post-Operative Hemorrhage Index	0.73	0.86	-0.13	-15.1	fewer complications
Core Measures Mean Percent	AMI Core Measures Mean Percent	96.33	94.67	1.66	n/a[3]	better performance
	HF Core Measures Mean Percent	96.88	92.50	4.38	n/a[3]	better performance
	Percentage of CABG Patients with Internal Mammary Artery Use (%)	95.62	91.49	4.13	n/a[3]	higher IMA use
Procedure Volumes (Thresholds: 35 CABG Cases; 149 PCI Cases)	Total 2008 CABG Cases	71	52	19	35.6	more CABG cases
	Total 2008 PCI Cases	265	167	98	58.4	more PCI cases
	Severity-Adjusted Average Length of Stay (days)	4.98	5.82	-0.84	-14.4	shorter ALOS
	Wage- and Severity-Adjusted Average Cost per Case ($)	13,965	16,550	-2,585	-15.6	lower cost per case

[1]Data for are federal fiscal year 2008. Performance measure definitions can be found in the Methodology section.
[2]Ratings greater than 1.0 exceed national norms; ratings less than 1.0 fall below national norms. See the Appendix for more details.
[3]We do not calculate percentage difference for this measure.

100 TOP HOSPITALS®: CARDIOVASCULAR BENCHMARKS, 1999-2009

HOSPITAL	LOCATION	YEAR(S) WON	TOTAL YEAR(S) WON
Morton Plant Hospital	Clearwater, FL	1999-2009	11
Scott and White Memorial Hospital	Temple, TX	2000-2009	10
St. Peter's Hospital	Albany, NY	1999-2005, 2007-2009	10
MeritCare Hospital	Fargo, ND	1999-2000, 2002-2009	10
Munroe Regional Medical Center	Ocala, FL	1999-2007, 2009	10
Mercy Medical Center-North Iowa	Mason City, IA	2000-2001, 2003-2009	9
Providence Hospital and Medical Center	Southfield, MI	2001-2009	9
St. Joseph Medical Center	Towson, MD	1999-2000, 2002-2005, 2007-2009	9
Rochester General Hospital	Rochester, NY	1999-2000, 2002-2006, 2008-2009	9
Spectrum Health Hospitals	Grand Rapids, MI	1999, 2001-2007, 2009	9
Providence Regional Medical Center Everett	Everett, WA	2000, 2002-2003, 2005-2009	8
Beth Israel Deaconess Medical Center	Boston, MA	1999, 2002-2007, 2009	8
Lahey Clinic Medical Center	Burlington, MA	2000-2003, 2005-2006, 2008-2009	8
St. Cloud Hospital	St. Cloud, MN	1999-2005, 2008	8
St. Mark's Hospital	Salt Lake City, UT	1999-2004, 2007-2008	8
Abbott Northwestern Hospital	Minneapolis, MN	1999, 2001, 2003-2008	8
The Christ Hospital	Cincinnati, OH	1999-2006	8
St. Mary's Medical Center	Duluth, MN	1999-2006	8
Oakwood Hospital and Medical Center-Dearborn	Dearborn, MI	1999-2001, 2003-2007	8
Parkwest Medical Center	Knoxville, TN	1999-2001. 2003-2007	8
Riverside Methodist Hospital	Columbus, OH	1999-2000, 2003, 2006-2009	7
St. Joseph Mercy Oakland	Pontiac, MI	2002-2005, 2007-2009	7
Mercy Hospital	Coon Rapids, MN	2003-2009	7
Aspirus Wausau Hospital	Wausau, WI	2001-2003, 2006-2009	7
Hackensack University Medical Center	Hackensack, NJ	1999, 2003-2004, 2006-2009	7
Saint Joseph's Hospital	Marshfield, WI	2002-2006, 2008-2009	7
Saint Thomas Hospital	Nashville, TN	1999, 2001-2002, 2005-2008	7
Cleveland Clinic Foundation	Cleveland, OH	1999, 2001-2005, 2007	7
Mission Hospitals	Asheville, NC	2000, 2002-2007	7
Munson Medical Center	Traverse City, MI	1999-2001, 2006, 2008-2009	6
Hamot Medical Center	Erie, PA	1999, 2004-2006, 2008-2009	6
Gundersen Lutheran Health System	La Crosse, WI	1999, 2003, 2005, 2007-2009	6
Robert Packer Hospital	Sayre, PA	2001, 2004-2007, 2009	6
University of Virginia Medical Center	Charlottesville, VA	1999, 2003-2005, 2007, 2009	6
University of Wisconsin Hospital and Clinics	Madison, WI	2001, 2005-2009	6
Park Nicollet Methodist Hospital	St. Louis Park, MN	2001, 2005-2009	6

HOSPITAL	LOCATION	YEAR(S) WON	TOTAL YEAR(S) WON
Billings Clinic	Billings, MT	2004-2009	6
Dartmouth-Hitchcock Medical Center	Lebanon, NH	2001, 2003, 2006-2009	6
Arizona Heart Hospital	Phoenix, AZ	2002, 2004-2005, 2007-2009	6
William Beaumont Hospital-Royal Oak	Royal Oak, MI	1999, 2003-2005, 2007-2008	6
St. John Hospital & Medical Center	Detroit, MI	1999, 2001-2002, 2004, 2007-2008	6
Penn Presbyterian Medical Center	Philadelphia, PA	2002-2006, 2008	6
Saint Joseph's Hospital of Atlanta	Atlanta, GA	1999-2001, 2003-2005	6
MetroSouth Medical Center	Blue Island, IL	1999, 2001-2005	6
Massachusetts General Hospital	Boston, MA	1999-2003, 2006	6
LDS Hospital	Salt Lake City, UT	1999-2000, 2002-2005	6
The Miriam Hospital	Providence, RI	1999, 2002-2004, 2006-2007	6
Baylor University Medical Center	Dallas, TX	1999-2003, 2005	6
Southwest General Health Center	Middleburg Heights, OH	2005-2009	5
Geisinger Medical Center	Danville, PA	1999, 2006-2009	5
Northwest Community Hospital	Arlington Heights, IL	2000, 2002, 2004, 2008-2009	5
St. Joseph Mercy Hospital	Ann Arbor, MI	2005-2009	5
Maine Medical Center	Portland, ME	1999, 2001, 2004, 2008-2009	5
Mount Carmel	Columbus, OH	2000-2001, 2003, 2008-2009	5
Aurora St. Luke's Medical Center	Milwaukee, WI	1999, 2004, 2007-2009	5
Loyola University Medical Center	Maywood, IL	2002-2003, 2006, 2008-2009	5
Heart Hospital of Austin	Austin, TX	2004-2005, 2007-2009	5
Centra Health	Lynchburg, VA	2000, 2003, 2005-2006, 2009	5
Union Memorial Hospital	Baltimore, MD	2001, 2004-2006, 2008	5
Yale-New Haven Hospital	New Haven, CT	2003-2005, 2007-2008	5
Saint Alphonsus Regional Medical Center	Boise, ID	2000-2001, 2003, 2007-2008	5
Regional Medical Center Bayonet Point	Hudson, FL	1999-2003	5
York Hospital	York, PA	1999-2001, 2003-2004	5
St. Luke's Hospital	Chesterfield, MO	1999, 2001-2004	5
Lee Memorial Health System	Fort Myers, FL	1999, 2001-2002, 2004-2005	5
University Hospital	Cincinnati, OH	1999-2000, 2002-2003, 2005	5
Baptist Hospital of East Tennessee	Knoxville, TN	1999-2003	5
Good Samaritan Hospital	Dayton, OH	1999, 2002-2003, 2005-2006	5
Sun Health Boswell Hospital	Sun City, AZ	2001-2005	5
Sarasota Memorial Hospital	Sarasota, FL	2002-2006	5
Ocala Regional Medical Center	Ocala, FL	1999-2002, 2004	5
BryanLGH Medical Center	Lincoln, NE	1999-2003	5
Rogue Valley Medical Center	Medford, OR	2000-2002, 2004-2005	5
UPMC Presbyterian	Pittsburgh, PA	1999, 2004-2007	5
Deaconess Medical Center	Spokane, WA	1999, 2002, 2004-2006	5
Charlotte Regional Medical Center	Punta Gorda, FL	1999-2000, 2002-2004	5
St. Patrick Hospital and Health Sciences Center	Missoula, MT	1999, 2001, 2005-2007	5
St. Vincent Healthcare	Billings, MT	1999, 2001-2003, 2005	5

HOSPITAL	LOCATION	YEAR(S) WON	TOTAL YEAR(S) WON
Sentara Norfolk General Hospital	Norfolk, VA	1999-2003	5
St. Luke's Boise Medical Center	Boise, ID	2002-2003, 2008-2009	4
St. Vincent Indianapolis Hospital	Indianapolis, IN	1999, 2007-2009	4
Advocate Lutheran General Hospital	Park Ridge, IL	2000-2001, 2005, 2009	4
St. Joseph's Hospital and Medical Center	Phoenix, AZ	2003-2005, 2009	4
Altru Hospital	Grand Forks, ND	2006-2009	4
Fairview Southdale Hospital	Edina, MN	2001, 2005, 2008-2009	4
Parma Community General Hospital	Parma, OH	2003, 2007-2009	4
Thomas Hospital	Fairhope, AL	2006-2009	4
Venice Regional Medical Center	Venice, FL	2006-2009	4
The Indiana Heart Hospital	Indianapolis, IN	2006-2009	4
Marquette General Hospital	Marquette, MI	2006-2009	4
Avera Heart Hospital of South Dakota	Sioux Falls, SD	2006-2009	4
Bethesda North Hospital	Cincinnati, OH	2002, 2004-2005, 2009	4
Mercy Medical Center	Canton, OH	1999, 2002-2003, 2009	4
Mercy Medical Center-Des Moines	Des Moines, IA	1999, 2004, 2007, 2009	4
The Western Pennsylvania Hospital	Pittsburgh, PA	1999, 2003, 2007-2008	4
Memorial Health Care System	Chattanooga, TN	1999, 2001, 2005-2006	4
University Hospitals Case Medical Center	Cleveland, OH	2003-2006	4
Henry Ford Hospital	Detroit, MI	2005-2008	4
Memorial Hermann Hospital System	Houston, TX	2003-2004, 2007-2008	4
Mayo Clinic Hospital	Phoenix, AZ	2005-2008	4
North Shore University Hospital	Manhasset, NY	1999, 2001-2002, 2008	4
Lankenau Hospital	Wynnewood, PA	2005-2008	4
Bellin Hospital	Green Bay, WI	1999, 2003, 2006-2007	4
Hospital of St. Raphael	New Haven, CT	1999, 2003-2005	4
St. Luke's Hospital and Health Network	Bethlehem, PA	1999, 2001-2003	4
CJW Medical Center	Richmond, VA	1999, 2002-2004	4
Loma Linda University Medical Center	Loma Linda, CA	1999, 2001-2003	4
Memorial Health System	Colorado Springs, CO	2003-2004, 2006-2007	4
Holy Cross Hospital	Fort Lauderdale, FL	2000-2003	4
Borgess Medical Center	Kalamazoo, MI	1999, 2003, 2006-2007	4
Memorial Medical Center	Johnstown, PA	1999, 2002-2004	4
Mercy Hospital Scranton	Scranton, PA	2004-2007	4
Cleveland Clinic Florida	Weston, FL	2007-2009	3
Good Samaritan Hospital	Cincinnati, OH	1999, 2008-2009	3
Providence St. Vincent Medical Center	Portland, OR	1999-2000, 2009	3
PinnacleHealth	Harrisburg, PA	1999, 2008-2009	3
UMass Memorial Medical Center	Worcester, MA	2003, 2008-2009	3
Henry Ford Macomb Hospitals	Clinton Township, MI	2007-2009	3
Baystate Medical Center	Springfield, MA	2005-2006, 2009	3
EMH Regional Medical Center	Elyria, OH	1999, 2001, 2009	3

HOSPITAL	LOCATION	YEAR(S) WON	TOTAL YEAR(S) WON
JFK Medical Center	Atlantis, FL	1999, 2007, 2009	3
St. John's Hospital	Springfield, IL	1999, 2004, 2009	3
St. Vincent Heart Center of Indiana	Indianapolis, IN	2006-2007, 2009	3
King's Daughters Medical Center	Ashland, KY	2006-2008	3
University Medical Center	Tucson, AZ	2000, 2006-2007	3
Centennial Medical Center	Nashville, TN	1999-2000, 2003	3
St. Luke's Hospital	Cedar Rapids, IA	2004, 2007-2008	3
St. Joseph's Hospital	St. Paul, MN	2005-2006, 2008	3
Banner Heart Hospital	Mesa, AZ	2006-2008	3
Nebraska Heart Institute Heart Hospital	Lincoln, NE	2006-2008	3
Morristown Memorial Hospital	Morristown, NJ	2000-2001, 2008	3
St. Alexius Medical Center	Bismarck, ND	2001, 2007-2008	3
St. Elizabeth Health Center	Youngstown, OH	1999, 2007-2008	3
Riverside Regional Medical Center	Newport News, VA	2000, 2006, 2008	3
Memorial Hermann-Texas Medical Center	Houston, TX	2005-2007	3
Brigham and Women's Hospital	Boston, MA	2002-2004	3
Inova Fairfax Hospital	Falls Church, VA	1999, 2001-2002	3
Saint Francis Hospital and Medical Center	Hartford, CT	1999, 2002, 2004	3
Summa Health System	Akron, OH	2000, 2005-2006	3
Orlando Regional Medical Center	Orlando, FL	1999, 2002-2003	3
Akron General Medical Center	Akron, OH	1999, 2003, 2005	3
Scripps Green Hospital	La Jolla, CA	1999, 2002, 2004	3
United Hospital	St. Paul, MN	2004-2006	3
Halifax Health Medical Center	Daytona Beach, FL	2001-2002, 2004	3
Legacy Good Samaritan Hospital and Medical Center	Portland, OR	2000, 2002, 2005	3
Rhode Island Hospital	Providence, RI	2005-2007	3
Providence Health Center	Waco, TX	2003-2005	3
Sacred Heart Medical Center	Spokane, WA	1999, 2006-2007	3
East Alabama Medical Center	Opelika, AL	1999-2001	3
Bridgeport Hospital	Bridgeport, CT	2005-2007	3
Holmes Regional Medical Center	Melbourne, FL	1999-2000, 2004	3
Lakeland Regional Medical Center	Lakeland, FL	1999, 2002-2003	3
Memorial Health University Medical Center	Savannah, GA	2002, 2004, 2006	3
Jewish Hospital	Louisville, KY	1999-2000, 2004	3
Lafayette General Medical Center	Lafayette, LA	2000-2001, 2003	3
North Memorial Health Care	Robbinsdale, MN	2002-2003, 2005	3
The Toledo Hospital	Toledo, OH	1999-2000, 2005	3
St. John Medical Center	Tulsa, OK	1999-2000, 2004	3
UPMC Presbyterian Shadyside	Pittsburgh, PA	1999-2000, 2002	3
Lehigh Valley Hospital	Allentown, PA	1999, 2002, 2004	3
Providence St. Peter Hospital	Olympia, WA	1999, 2002-2003	3
Overlake Hospital Medical Center	Bellevue, WA	2000, 2003, 2006	3

HOSPITAL	LOCATION	YEAR(S) WON	TOTAL YEAR(S) WON
Vanderbilt University Medical Center	Nashville, TN	2008-2009	2
Saint Joseph-London	London, KY	2008-2009	2
Memorial Hospital of Carbondale	Carbondale, IL	2008-2009	2
French Hospital Medical Center	San Luis Obispo, CA	2008-2009	2
Trinity Regional Medical Center	Fort Dodge, IA	2008-2009	2
Harlingen Medical Center	Harlingen, TX	2008-2009	2
Caritas St. Elizabeth's Medical Center	Boston, MA	2001, 2009	2
Medcenter One	Bismarck, ND	2006, 2009	2
William Beaumont Hospital-Troy	Troy, MI	2007, 2009	2
The Ohio State University Medical Center	Columbus, OH	2003, 2009	2
Albany Medical Center	Albany, NY	1999, 2009	2
Advocate Christ Medical Center	Oak Lawn, IL	1999, 2009	2
Tucson Heart Hospital	Tucson, AZ	2007, 2009	2
Firelands Regional Medical Center	Sandusky, OH	2007, 2009	2
Dixie Regional Medical Center	St. George, UT	2007, 2009	2
NorthShore University HealthSystem	Evanston, IL	2000-2001	2
University of Michigan Hospitals & Health Centers	Ann Arbor, MI	2005-2006	2
Mayo Clinic - Saint Marys Hospital	Rochester, MN	1999, 2001	2
St. Elizabeth Medical Center	Edgewood, KY	2000-2001	2
St. John's Regional Medical Center	Joplin, MO	1999, 2006	2
Allegheny General Hospital	Pittsburgh, PA	1999, 2008	2
Delray Medical Center	Delray Beach, FL	2007-2008	2
St. Vincent's Medical Center	Jacksonville, FL	1999, 2008	2
Butler Memorial Hospital	Butler, PA	2007-2008	2
Mercy Health Partners	Muskegon, MI	2006, 2008	2
Decatur Memorial Hospital	Decatur, IL	2007-2008	2
Edward Hospital	Naperville, IL	2006, 2008	2
University of Maryland Medical Center	Baltimore, MD	2007-2008	2
Regions Hospital	St. Paul, MN	2007-2008	2
Shands at the University of Florida	Gainesville, FL	2003-2004	2
Sanford USD Medical Center	Sioux Falls, SD	2000-2001	2
Southwest Florida Regional Medical Center	Fort Myers, FL	1999-2000	2
Torrance Memorial Medical Center	Torrance, CA	1999, 2002	2
Hartford Hospital	Hartford, CT	1999, 2004	2
St. John's Mercy Medical Center	St. Louis, MO	2001-2002	2
FirstHealth Moore Regional Hospital	Pinehurst, NC	2000-2001	2
Grant Medical Center	Columbus, OH	2001, 2003	2
Fairview Hospital	Cleveland, OH	1999-2000	2
Winchester Medical Center	Winchester, VA	1999, 2004	2
Mercy General Hospital	Sacramento, CA	1999, 2006	2
El Camino Hospital	Mountain View, CA	1999, 2006	2
Penrose-St. Francis Health Services	Colorado Springs, CO	2004-2005	2

HOSPITAL	LOCATION	YEAR(S) WON	TOTAL YEAR(S) WON
Lake Hospital System	Painesville, OH	2003, 2007	2
Sacred Heart Medical Center	Eugene, OR	1999, 2002	2
Medical University of South Carolina	Charleston, SC	2002-2003	2
UAB Hospital	Birmingham, AL	1999-2000	2
Saint Agnes Medical Center	Fresno, CA	1999, 2001	2
Washington Hospital Center	Washington, DC	1999, 2004	2
St. Joseph's Hospital	Tampa, FL	2002, 2007	2
Medical Center of Central Georgia	Macon, GA	1999, 2001	2
Memorial Hospital of South Bend	South Bend, IN	2000-2001	2
Allen Hospital	Waterloo, IA	2000, 2004	2
Willis-Knighton Medical Center	Shreveport, LA	2005-2006	2
Sparrow Health System	Lansing, MI	2000-2001	2
Boone Hospital Center	Columbia, MO	2001-2002	2
Catholic Medical Center	Manchester, NH	1999-2000	2
Robert Wood Johnson University Hospital	New Brunswick, NJ	2001, 2004	2
Pitt County Memorial Hospital	Greenville, NC	2002-2003	2
Wellmont Holston Valley Medical Center	Kingsport, TN	2005, 2007	2
St. David's South Austin Hospital	Austin, TX	2004-2005	2
DCH Regional Medical Center	Tuscaloosa, AL	2004-2005	2
Bakersfield Memorial Hospital	Bakersfield, CA	1999, 2001	2
Glendale Memorial Hospital & Health Center	Glendale, CA	2000, 2002	2
St. Vincent's Medical Center	Bridgeport, CT	1999, 2001	2
Shands Jacksonville Medical Center	Jacksonville, FL	2002, 2004	2
Mount Sinai Medical Center & Miami Heart Institute	Miami Beach, FL	2002-2003	2
Florida Hospital Ormond Memorial	Ormond Beach, FL	1999-2000	2
Athens Regional Medical Center	Athens, GA	1999-2000	2
Carle Foundation Hospital	Urbana, IL	2003, 2005	2
Provena Covenant Medical Center	Urbana, IL	2006-2007	2
Rush University Medical Center	Chicago, IL	2006-2007	2
St. James Hospital and Health Centers	Olympia Fields, IL	2004-2005	2
Methodist Medical Center of Illinois	Peoria, IL	1999, 2005	2
Iowa Methodist Medical Center	Des Moines, IA	1999, 2004	2
Wesley Medical Center	Wichita, KS	2000-2001	2
Central Baptist Hospital	Lexington, KY	2002-2003	2
CHRISTUS St Patrick Hospital	Lake Charles, LA	1999-2000	2
Our Lady of the Lake Regional Medical Center	Baton Rouge, LA	2001, 2003	2
Our Lady of Lourdes Regional Medical Center	Lafayette, LA	1999, 2002	2
East Jefferson General Hospital	Metairie, LA	2000-2001	2
Sinai Hospital of Baltimore	Baltimore, MD	1999, 2002	2
Covenant Medical Center Harrison	Saginaw, MI	1999, 2001	2
Mount Clemens Regional Medical Center	Mount Clemens, MI	2003, 2005	2
Heartland Regional Medical Center	Saint Joseph, MO	2000, 2004	2

HOSPITAL	LOCATION	YEAR(S) WON	TOTAL YEAR(S) WON
St. Luke's Hospital of Kansas City	Kansas City, MO	2004-2005	2
Vassar Brothers Medical Center	Poughkeepsie, NY	2005-2006	2
Lenox Hill Hospital	New York, NY	1999, 2002	2
St. Francis Hospital	Roslyn, NY	1999, 2001	2
United Health Services Hospitals	Binghamton, NY	2006-2007	2
Penn State Milton S. Hershey Medical Center	Hershey, PA	2002, 2005	2
Jackson-Madison County General Hospital	Jackson, TN	2005, 2007	2
Plaza Medical Center of Fort Worth	Fort Worth, TX	1999-2000	2
St. Mary's Medical Center	Huntington, WV	2000-2001	2
Western Baptist Hospital	Paducah, KY	2009	1
Aurora BayCare Medical Center	Green Bay, WI	2009	1
Kettering Medical Center	Kettering, OH	2009	1
DuBois Regional Medical Center	DuBois, PA	2009	1
Carolinas Medical Center-NorthEast	Concord, NC	2009	1
Staten Island University Hospital	Staten Island, NY	2009	1
Grandview Medical Center	Dayton, OH	2009	1
Hoag Memorial Hospital Presbyterian	Newport Beach, CA	2009	1
UPMC Passavant	Pittsburgh, PA	2009	1
Arrowhead Hospital	Glendale, AZ	2009	1
Ball Memorial Hospital	Muncie, IN	2009	1
Rapides Regional Medical Center	Alexandria, LA	2009	1
North Shore Medical Center	Salem, MA	2009	1
St. John West Shore Hospital	Westlake, OH	2009	1
Fletcher Allen Health Care	Burlington, VT	2009	1
Mercy Medical Center Redding	Redding, CA	2009	1
St. Mary's Hospital and Regional Medical Center	Grand Junction, CO	2009	1
St. John Macomb-Oakland Hospital	Warren, MI	2009	1
St. Mary's Hospital	Richmond, VA	2009	1
Oklahoma Heart Hospital	Oklahoma City, OK	2009	1
Doctors Hospital at Renaissance	Edinburg, TX	2008	1
Duke University Hospital	Durham, NC	2001	1
Hillcrest Hospital	Mayfield Heights, OH	2006	1
Lancaster General Hospital	Lancaster, PA	2002	1
Northwestern Memorial Hospital	Chicago, IL	2004	1
Central DuPage Hospital	Winfield, IL	2005	1
Avera McKennan Hospital & University Health Center	Sioux Falls, SD	2001	1
Riverside Medical Center	Kankakee, IL	2007	1
Waukesha Memorial Hospital	Waukesha, WI	2007	1
Advocate Good Samaritan Hospital	Downers Grove, IL	2006	1
North Mississippi Medical Center	Tupelo, MS	2001	1
Bronson Methodist Hospital	Kalamazoo, MI	2008	1
Corpus Christi Medical Center	Corpus Christi, TX	2008	1

HOSPITAL	LOCATION	YEAR(S) WON	TOTAL YEAR(S) WON
VCU Medical Center	Richmond, VA	2008	1
Mercy Hospital Fairfield	Fairfield, OH	2008	1
Memorial Regional Hospital	Hollywood, FL	2008	1
Ochsner Medical Center-New Orleans	New Orleans, LA	2008	1
Louisiana Medical Center & Heart Hospital	Lacombe, LA	2008	1
Heart Hospital of Lafayette	Lafayette, LA	2008	1
Forum Health Northside Medical Center	Youngstown, OH	2008	1
Erlanger Health System	Chattanooga, TN	2008	1
Memorial Hermann Memorial City Medical Center	Houston, TX	2008	1
St. Anthony Central Hospital	Denver, CO	2006	1
Rex Healthcare	Raleigh, NC	2000	1
Florida Hospital	Orlando, FL	2002	1
NCH Downtown Naples Hospital	Naples, FL	2005	1
Tallahassee Memorial HealthCare	Tallahassee, FL	1999	1
OSF Saint Francis Medical Center	Peoria, IL	2006	1
The Mount Sinai Medical Center	New York, NY	1999	1
Saint Vincent Health Center	Erie, PA	2007	1
Medical Center Hospital	Odessa, TX	2001	1
Meriter Hospital	Madison, WI	2006	1
Blake Medical Center	Bradenton, FL	2006	1
Leesburg Regional Medical Center	Leesburg, FL	2004	1
Southwest Washington Medical Center	Vancouver, WA	2000	1
Appleton Medical Center	Appleton, WI	2003	1
Exempla Saint Joseph Hospital	Denver, CO	2002	1
Largo Medical Center	Largo, FL	2002	1
Northwest Medical Center	Tucson, AZ	2006	1
Providence Portland Medical Center	Portland, OR	2002	1
Aultman Hospital	Canton, OH	1999	1
Thomas Jefferson University Hospital	Philadelphia, PA	2001	1
Tucson Medical Center	Tucson, AZ	2006	1
Mills-Peninsula Health Services	Burlingame, CA	2000	1
Scripps Mercy Hospital	San Diego, CA	2004	1
Piedmont Hospital	Atlanta, GA	2000	1
Deaconess Hospital & Health System	Evansville, IN	2000	1
Mercy Health Center	Oklahoma City, OK	1999	1
Excela Health Westmoreland	Greensburg, PA	2005	1
Seton Medical Center Austin	Austin, TX	2004	1
St. Elizabeth Hospital	Appleton, WI	2002	1
Providence Saint Joseph Medical Center	Burbank, CA	1999	1
Methodist Hospital of Southern California	Arcadia, CA	2002	1
Stanford Hospital & Clinics	Stanford, CA	1999	1
Eisenhower Medical Center	Rancho Mirage, CA	1999	1

HOSPITAL	LOCATION	YEAR(S) WON	TOTAL YEAR(S) WON
North Colorado Medical Center	Greeley, CO	2007	1
Florida Hospital-Ormond Memorial	Ormond Beach, FL	2004	1
Florida Medical Center	Fort Lauderdale, FL	2001	1
Emory University Hospital	Atlanta, GA	1999	1
Community Hospital East/North	Indianapolis, IN	2003	1
Regional Medical Center	Madisonville, KY	2007	1
Boston Medical Center	Boston, MA	2002	1
SSM St. Mary's Health Center	St. Louis, MO	2004	1
Freeman Health System	Joplin, MO	2003	1
Presbyterian Hospital	Albuquerque, NM	1999	1
St. Joseph's Hospital Health Center	Syracuse, NY	1999	1
Jewish Hospital	Cincinnati, OH	1999	1
Miami Valley Hospital	Dayton, OH	2006	1
OU Medical Center	Oklahoma City, OK	1999	1
Good Samaritan Regional Medical Center	Corvallis, OR	2002	1
The University of Tennessee Medical Center	Knoxville, TN	2004	1
St. Mary's Medical Center	Knoxville, TN	2002	1
Good Shepherd Medical Center	Longview, TX	2003	1
Mother Frances Hospital - Tyler	Tyler, TX	1999	1
The Methodist Hospital	Houston, TX	1999	1
Henrico Doctors' Hospital	Richmond, VA	2001	1
Virginia Mason Medical Center	Seattle, WA	2000	1
St. Joseph Hospital	Bellingham, WA	2000	1
Southeast Alabama Medical Center	Dothan, AL	2005	1
Baptist Medical Center South	Montgomery, AL	2001	1
St. Vincent's Hospital	Birmingham, AL	2000	1
Physicians Medical Center Carraway	Birmingham, AL	1999	1
Trinity Medical Center	Birmingham, AL	2000	1
Mobile Infirmary Medical Center	Mobile, AL	1999	1
Banner Good Samaritan Medical Center	Phoenix, AZ	2005	1
Phoenix Regional Medical Center	Phoenix, AZ	1999	1
Phoenix Memorial Hospital	Phoenix, AZ	2002	1
St. Edward Mercy Medical Center	Fort Smith, AR	1999	1
St. Helena Hospital	St. Helena, CA	2002	1
California Pacific Medical Center	San Francisco, CA	2000	1
Kaweah Delta Hospital	Visalia, CA	2000	1
Kaiser Permanente San Francisco Medical Center	San Francisco, CA	1999	1
St. Joseph's Medical Center	Stockton, CA	1999	1
Kaiser Permanente Los Angeles Medical Center	Los Angeles, CA	2001	1
Washington Hospital Healthcare System	Fremont, CA	1999	1
Sequoia Hospital	Redwood City, CA	1999	1
Seton Medical Center	Daly City, CA	2000	1

HOSPITAL	LOCATION	YEAR(S) WON	TOTAL YEAR(S) WON
Salinas Valley Memorial Healthcare System	Salinas, CA	1999	1
San Joaquin Community Hospital	Bakersfield, CA	1999	1
St. Mary's Medical Center	San Francisco, CA	2000	1
Long Beach Memorial Medical Center	Long Beach, CA	2000	1
John Muir Medical Center, Concord Campus	Concord, CA	1999	1
Shasta Regional Medical Center	Redding, CA	1999	1
Broward General Medical Center	Fort Lauderdale, FL	2000	1
Miami Heart Institute South	Miami Beach, FL	2001	1
Baptist Hospital	Pensacola, FL	2005	1
Central Florida Regional Hospital	Sanford, FL	2003	1
Palm Beach Gardens Medical Center	Palm Beach Gardens, FL	1999	1
North Ridge Medical Center	Fort Lauderdale, FL	1999	1
Emory Crawford Long Hospital	Atlanta, GA	1999	1
Redmond Regional Medical Center	Rome, GA	1999	1
Straub Clinic & Hospital	Honolulu, HI	2000	1
Sherman Hospital	Elgin, IL	2005	1
Rush North Shore Medical Center	Skokie, IL	2005	1
Saint Francis Hospital	Evanston, IL	2001	1
Mercy Hospital & Medical Center	Chicago, IL	2007	1
OSF St. Joseph Medical Center	Bloomington, IL	1999	1
Ingalls Memorial Hospital	Harvey, IL	2000	1
St. Elizabeth Medical Center	Lafayette, IN	2004	1
Saint Margaret Mercy Healthcare Centers	Hammond, IN	2001	1
Union Hospital	Terre Haute, IN	1999	1
Bloomington Hospital	Bloomington, IN	2000	1
Community Hospital	Munster, IN	1999	1
Mercy Medical Center - Sioux City	Sioux City, IA	2001	1
Stormont-Vail HealthCare	Topeka, KS	2003	1
St. Joseph Hospital	Lexington, KY	2001	1
St. Francis Medical Center	Monroe, LA	2001	1
Washington Adventist Hospital	Takoma Park, MD	1999	1
Peninsula Regional Medical Center	Salisbury, MD	1999	1
Mount Auburn Hospital	Cambridge, MA	2000	1
Tufts-New England Medical Center	Boston, MA	2002	1
St. Mary's of Michigan	Saginaw, MI	1999	1
Northern Michigan Regional Hospital	Petoskey, MI	2002	1
Memorial Hospital	Gulfport, MS	2001	1
Barnes-Jewish Hospital	Saint Louis, MO	2006	1
Sunrise Hospital & Medical Center	Las Vegas, NV	1999	1
Desert Springs Hospital	Las Vegas, NV	1999	1
Newark Beth Israel Medical Center	Newark, NJ	2006	1
Passaic Beth Israel Regional Medical Center	Passaic, NJ	2001	1

HOSPITAL	LOCATION	YEAR(S) WON	TOTAL YEAR(S) WON
Lovelace Medical Center	Albuquerque, NM	2000	1
Kaleida Health	Buffalo, NY	2000	1
Millard Fillmore Gates Circle Hospital	Buffalo, NY	1999	1
St. Luke's-Roosevelt Hospital Center	New York, NY	2000	1
Ellis Hospital	Schenectady, NY	2001	1
Maimonides Medical Center	Brooklyn, NY	2002	1
Long Island Jewish Medical Center	New Hyde Park, NY	2000	1
Erie County Medical Center	Buffalo, NY	2000	1
St. Vincent's Manhattan	New York, NY	2000	1
Presbyterian Hospital	Charlotte, NC	1999	1
WakeMed Releigh Campus	Raleigh, NC	2000	1
Deaconess Hospital	Cincinnati, OH	2002	1
INTEGRIS Baptist Medical Center	Oklahoma City, OK	1999	1
UPMC Mercy	Pittsburgh, PA	1999	1
St. Francis Medical Center	Pittsburgh, PA	1999	1
Spartanburg Regional Healthcare System	Spartanburg, SC	2001	1
Grand Strand Regional Medical Center	Myrtle Beach, SC	2001	1
Rapid City Regional Hospital	Rapid City, SD	1999	1
Johnson City Medical Center	Johnson City, TN	2004	1
Fort Sanders Regional Medical Center	Knoxville, TN	2000	1
Valley Baptist Medical Center	Harlingen, TX	2007	1
Christus Spohn Hospital Corpus Christi- Shoreline	Corpus Christi, TX	1999	1
CHRISTUS Santa Rosa Health Care	San Antonio, TX	2000	1
Covenant Health System	Lubbock, TX	1999	1
Woodland Heights Medical Center	Lufkin, TX	2000	1
The Medical Center of Southeast Texas	Port Arthur, TX	2004	1
Denton Regional Medical Center	Denton, TX	1999	1
Utah Valley Regional Medical Center	Provo, UT	1999	1
McKay-Dee Hospital Center	Ogden, UT	2006	1
Carilion Clinic	Roanoke, VA	1999	1
Yakima Regional Medical and Cardiac Center	Yakima, WA	2004	1
Central Washington Hospital	Wenatchee, WA	2006	1
Froedtert & the Medical College of Wisconsin	Milwaukee, WI	2007	1

APPENDIX: METHODOLOGY DETAILS

METHODS FOR IDENTIFYING COMPLICATIONS OF CARE

Risk-Adjusted Mortality Index Models

Without adjusting for differences, comparing outcomes among hospitals is like comparing the proverbial apples to oranges: hard, if not impossible, to do. In order to make valid normative comparisons of hospital outcomes, it is necessary to adjust raw data to accommodate for differences that result from the variety and severity of admitted cases. It is also necessary to account for individual facility characteristics that affect quality of care measures, such as the hospital's geographic location, size, teaching status, and community setting (urban versus rural).

Thomson Reuters is able to make valid normative comparisons of mortality and complications rates by using patient-level data to control effectively for case mix and severity differences. We do this by evaluating ICD-9-CM diagnosis and procedure codes in order to adjust for severity within clinical case mix groupings. Conceptually, we group patients with similar characteristics (i.e., age, sex, principal diagnosis, procedures performed, admission type, and comorbid conditions) to produce expected, or normative, comparisons. In the same way, we group facilities with similar characteristics. Through extensive testing, we have found that this methodology produces valid normative comparisons using readily available administrative data, eliminating the need for additional data collection.

Thomson Reuters constructs a normative database of case-level data from its Projected Inpatient Data Base (PIDB), a national all-payer database containing 20 million all-payer discharges annually, obtained from approximately 2,000 hospitals, representing 50 percent of all discharges from short-term, general, nonfederal hospitals in the United States. The data include age, sex, length of stay, clinical groupings: Diagnosis Related Groups (DRG) or Refined Diagnosis Related Groups (RDRG), ICD-9-CM principal and secondary diagnoses, ICD-9-CM principal and secondary procedures, hospital identification, admission source and type, and discharge status. Hospital characteristics are obtained by linking each hospital's identification number with American Hospital Association and Medicare Cost Report data.

From the model, we exclude long-term care facilities; psychiatric, rehabilitation, or other specialty facilities; and federally owned or controlled facilities. Excluded patient groups are newborns, cases transferred to other short-term hospitals, and cases with stays shorter than one day.

A standard logistic regression model is used to estimate the risk of mortality or complications for each patient. This is done by weighting the patient records of the client hospital by the logistic regression coefficients associated with the corresponding terms in the model and the intercept term. This produces the expected probability of an outcome for each eligible patient (numerator) based on the experience of the norm for patients with similar characteristics (age, clinical grouping, severity of illness, and so forth) at similar institutions (hospital bed size, census division, teaching status, urban or rural community setting).[34-38] This methodology also ensures that facilities are compared to other facilities with similar characteristics.

Staff physicians at Thomson Reuters have suggested important clinical patient characteristics that were also incorporated into the models. After assigning the predicted probability of the outcome for each patient, the patient-level data can then be aggregated across a variety of groupings including hospital, service, or the DRG and RDRG classification systems, which were developed at Yale University in the 1980s.

Risk-Adjusted Post-Operative Infection Index

This measure is based on the Agency for Healthcare Research and Quality (AHRQ) model for post-operative sepsis.[39] This is a risk-adjusted methodology for predicting the likelihood of a patient experiencing a post-operative infection, based on the patient's age, sex, diagnosis, and other complicating conditions.

The model defines an infection for post-operative patients as an occurrence of any one or more of the following ICD-9-CM codes as a secondary diagnosis:

Sepsis:

- 038.0 Streptococcal septicemia
- 038.1 Staphylococcal septicemia
- 038.10 Staphylococcal septicemia, unspecified
- 038.11 Staphylococcus aureus septicemia
- 038.19 Other staphylococcal septicemia
- 038.2 Pneumococcal septicemia (streptococcus pneumoniae septicemia)
- 038.3 Septicemia due to anaerobes
- 785.52 Septic shock
- 785.59 Other shock w/o mention of trauma
- 998.0 Post-operative shock

Septicemia due to:

- 038.40 Gram-negative organism, unspecified
- 038.41 Hemophilus influenzae
- 038.42 Escherichia coli
- 038.43 Pseudomonas
- 038.44 Serratia
- 038.49 Septicemia due to other gram-negative organisms
- 038.8 Other specified septicemias
- 038.9 Unspecified septicemia
- 995.91 Systemic inflammatory response syndrome due to infectious process without organ dysfunction
- 995.92 Systemic inflammatory response syndrome due to infectious process with organ dysfunction

This indicator limits the code for sepsis to secondary diagnosis codes to eliminate sepsis that was present on admission. It also excludes patients who have a principal diagnosis of infection, patients with a length of stay of fewer than three days, and patients with potential immuno-compromised states (e.g., AIDS, cancer, transplant).

Risk-Adjusted Post-Operative Hemorrhage Index

This measure is based on the AHRQ model for post-operative hemorrhage or hematoma.[39] This is a risk-adjusted methodology for predicting the likelihood of a patient experiencing a post-operative hemorrhage, based on the patient's age, sex, diagnosis, and other complicating conditions. The model defines a hemorrhagic complication as a discharge with ICD-9-CM codes for post-operative hemorrhage or post-operative hematoma in any secondary diagnosis field and codes for post-operative control of hemorrhage or drainage of hematoma in any procedure code field, as follows:

Post-operative hematoma diagnosis code:

- 998.12 Hematoma complicating a procedure

Post-operative hemorrhage diagnosis code:

- 998.11 Hemorrhage complicating a procedure

Control of post-operative hemorrhage procedure codes:

- 28.7 Control of hemorrhage after tonsillectomy and adenoidectomy
- 38.80 Other surgical occlusion of unspecified site
- 38.81 Other surgical occlusion of intracranial vessels
- 38.82 Other surgical occlusion of other vessels of head and neck
- 38.83 Other surgical occlusion of upper limb vessels
- 38.84 Other surgical occlusion of aorta, abdominal
- 38.85 Other surgical occlusion of thoracic vessel
- 38.86 Other surgical occlusion of abdominal arteries
- 38.87 Other surgical occlusion of abdominal veins
- 38.88 Other surgical occlusion of lower limb arteries
- 38.89 Other surgical occlusion of lower limb veins
- 39.41 Control of hemorrhage following vascular surgery
- 39.98 Control of hemorrhage NOS
- 49.95 Control of (post-operative) hemorrhage of anus
- 57.93 Control of (post-operative) hemorrhage of bladder
- 60.94 Control of (post-operative) hemorrhage of prostate

Drainage of hematoma procedure codes:

- 18.09 Other incision of external ear
- 54.0 Incision of abdominal wall
- 54.12 Reopening of recent laparotomy site
- 59.19 Other incision of perivesical tissue

- 61.0 Incision and drainage of scrotum and tunica vaginalis
- 69.98 Other operations on supporting structures of uterus
- 70.14 Other vaginotomy
- 71.09 Other incision of vulva and perineum
- 75.91 Evacuation of obstetrical incisional hematoma of perineum
- 75.92 Evacuation of other hematoma of vulva or vagina
- 86.04 Other incision with drainage of skin and subcutaneous tissue

Index Interpretation

An outcome index is a ratio of an observed number of outcomes to an expected number of outcomes in a particular population. This index is used to make normative comparisons and is standardized in that the expected number of events is based on the occurrence of the event in a normative population. The normative population used to calculate expected numbers of events is selected to be similar to the comparison population with respect to relevant characteristics including age, sex, region, and case mix.

The index is simply the number of observed events divided by the number of expected events and can be calculated for outcomes which involve counts of occurrences (e.g., deaths or complications). Interpretation of the index relates the experience of the comparison population relative to a specified event to the expected experience based on the normative population.

Examples:

10 events observed ÷ 10 events expected = 1.0: The observed number of events is equal to the expected number of events based on the normative experience.

10 events observed ÷ 5 events expected = 2.0: The observed number of events is twice the expected number of events based on the normative experience.

10 events observed ÷ 25 events expected = 0.4: The observed number of events is 60 percent lower than the expected number of events based on the normative experience.

Therefore, an index value of 1.0 indicates no difference between observed and expected outcome occurrence. An index value greater than 1.0 indicates an excess in the observed number of events relative to the expected based on the normative experience. An index value less than 1.0 indicates fewer events observed than would be expected based on the normative experience. An additional interpretation is that the difference between 1.0 and the index is the percentage difference in the number of events relative to the norm. In other words, an index of 1.05 indicates 5 percent more outcomes, and an index of 0.90 indicates 10 percent fewer outcomes than expected based on the experience of the norm. The index can be calculated across a variety of groupings (e.g., hospital, service, and DRG).

CORE MEASURES

Core measures were developed by The Joint Commission and CMS and endorsed by the National Quality Forum, as minimum basic care standards. They are a widely accepted method for measuring patient care quality that includes specific guidelines for heart attack (acute myocardial infarction), heart failure (HF), pneumonia, pregnancy and related conditions, and surgical infection prevention. Our Core Measures Score for this study is based on the AMI and HF areas of this program, using Hospital Compare data reported by the Centers for Medicare and Medicaid Services (CMS). We included six of the seven reported AMI measures and all of the reported HF measures. We excluded the AMI core measure "Heart Attack Patients Given Fibrinolytic Medication within 30 Minutes of Arrival" because it was not reported by most in-study hospitals.[5]

For each hospital, we calculate the mean of the reported core measures percent values for all available core measures. We consider reported core measures percents with patient counts that are less than or equal to 25, or that have relative standard error values greater than or equal to 0.30 to be statistically unreliable. In these cases, we substitute the class median percent value for the affected core measure.

The AMI and HF core measures included are:

Acute Myocardial Infarction Core Measures

1. Patients given ACE inhibitor or angiotensin II receptor blocker (ARB) for left ventricular systolic dysfunction
2. Patients given aspirin at arrival
3. Patients given aspirin at discharge
4. Patients given beta blocker at discharge
5. Patients given PCI within 90 minutes of arrival
6. Patients given smoking cessation counseling

Heart Failure Core Measures

1. Patients given ACE inhibitor or ARB for left ventricular systolic dysfunction
2. Patients given evaluation of left ventricular systolic (LVS) function
3. Patients given smoking cessation counseling
4. Patients given discharge instructions

LENGTH OF STAY AND CHARGE WEIGHT METHODOLOGIES

RDRG grouper-based methodologies allow us to produce risk-adjusted performance comparisons on length of stay (LOS) and hospital charges between or across virtually any arbitrary subgroup of inpatients. These patient groupings can be based on DRGs, hospitals, product lines, geographic regions, physicians, etc. The RDRG methodology adjusts for differences in diagnosis type and illness severity. Its associated LOS and charge weights allow group comparisons on a national level, and in a specific market area. These grouper-based weights are calculated separately for LOS and charges from the PIDB.

Normalized Charge and LOS Weights

Charge and LOS weights are calculated for RDRGs using the PIDB. These discharges are statistically weighted to represent the universe of all short-term, general, nonfederal hospitals in the U.S. To account for geographic cost of living differences, charges are adjusted for each hospital using the Centers for Medicare & Medicaid Services wage index. Cost is estimated using the cost-to-charge ratio reported by the hospital in its Medicare Cost Report. When comparing the actual charges to expected charges, the expected charges are reverse wage-adjusted. RDRG weights are calculated by dividing the average charge (or LOS) for each RDRG by the average charge (or LOS) of all patients in the universe of short-term, general, nonfederal hospitals in the U.S.

Estimated Costs

We estimate costs using the total cost-to-charge ratio (reported in the hospital's most current cost report), applied to the specific charges reported for the study's cardiovascular patients (AMI, HF, PCI, CABG) in the MedPAR file.

PERFORMANCE MEASURE NORMALIZATION

The mortality, complications, length of stay, and cost measures are normalized, based on the in-study population, to provide a more easily interpreted comparison among hospitals. To address the impact of bed size, teaching status, and residency program involvement and compare hospitals to other like hospitals, we assign each hospital in the study to one of three comparison groups (Teaching Hospitals With Cardiovascular Residency Programs, Teaching Hospitals Without Cardiovascular Residency Programs, and Community Hospitals).* All normalizations are done by comparison group.

For mortality and complications measures, we base our scoring on the difference between observed and expected events, expressed in standard deviation units (z-scores) that have been normalized. We normalize the individual hospital z-scores by finding the difference between the hospital z-score and the mean z-score for their comparison group. The difference is then divided by the standard deviation of the comparison group's z-scores to produce the normalized z-score for the hospital.

For length of stay and cost measures, we base our scoring on the severity-adjusted LOS index and the wage- and severity-adjusted cost per case index. These indices are the ratio of the observed and the normalized expected values for each hospital, where the expected values are the RDRG weights for the hospital cases included in the measure. We normalize the individual hospital expected values by multiplying them by the ratio of the observed to expected values for the comparison group. The hospital's normalized index is then calculated by dividing the hospital's observed value by its normalized expected value to produce the normalized index for the hospital.

WHY WE HAVE NOT CALCULATED PERCENT CHANGE IN SPECIFIC INSTANCES

Percent change is a meaningless statistic when the underlying quantity can be positive, negative, or zero. The actual change may mean something, but dividing it by a number that may be zero or of the opposite sign does not convey any meaningful information because the amount of change is not proportional to its previous value.[40]

*Detailed descriptions of the patient and hospital comparison groups can be found in the Methodology section of this document.

REFERENCES

1. American Heart Association. Heart Disease and Stroke Statistics-2007 Update. Dallas, Tex.: American Heart Association; 2006. Available online at http://www.americanheart.org/downloadable/heart/1166711577754HS_StatsInsideText.pdf.

2. The Centers for Medicare and Medicaid Services (CMS) has ruled that no data points based on fewer than 11 discharges may be displayed. To comply with this rule, we excluded any values based on fewer than 11 discharges.

3. We obtain GME program involvement data annually from the Accreditation Council for Graduate Medical Education (ACGME). This year's study is based on ACGME files from September 2009.

4. AOA residency information was collected from the AOA Web site (http://opportunities.osteopathic.org/) in September 2009.

5. CMS Hospital Compare can be viewed at http://www.hospitalcompare.hhs.gov/.

6. Tatoulis, J, Buxton, BF, Fuller, JA. Patencies of 2127 arterial to coronary conduits over 15 years. Ann Thorac Surg 2004; 77:93.

7. Sabik JF, 3rd, Lytle, BW, Blackstone, EH, et al. Comparison of saphenous vein and internal thoracic artery graft patency by coronary system. Ann Thorac Surg 2005; 79:544.

8. Goldman, S, Zadina, K, Moritz, T, et al. Long-term patency of saphenous vein and left internal mammary artery grafts after coronary artery bypass surgery: results from a Department of Veterans Affairs Cooperative Study. J Am Coll Cardiol 2004; 44:2149.

9. Cohn LH. Use of the Internal Mammary Artery Graft and In-Hospital Mortality and Other Adverse Outcomes Associated with Coronary Artery Bypass Surgery. Circulation. 2001; 103:483.

10. Loop F, Lytle B, et al. Influence of the Internal-Mammary-Artery Graft on 10-Year Survival and Other Cardiac Events. NEJM. 1986; 314:1-6.

11. Kimmel SE, Berlin JA, Laskey WK. The relationship between coronary angioplasty procedure volume and major complications. JAMA (1995 Oct 11) 274(14):1137-42.

12. Jollis JG, Peterson ED, Nelson CL, Stafford JA, DeLong ER, Muhlbaier LH, Mark DB. Relationship between physician hospital coronary angioplasty volume and outcome in elderly patients. Circulation (1997 Jun 3) 95(11):2485-91.

13. Smith SC Jr, Feldman TE, Hirshfeld JW Jr, Jacobs AK, Kern MJ, King SB 3rd, Morrison DA, O'Neill WW, Schaff HV, Whitlow PL, Williams DO. ACC/AHA/SCAI 2005 Guideline Update for Percutaneous Coronary Intervention: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines (ACC/AHA/SCAI Writing Committee to Update the 2001 Guidelines for Percutaneous Coronary Intervention). American Heart Association Web site. Available at: http://www.acc.org/qualityandscience/clinical/guidelines/percutaneous/update/index.pdf. Accessed 9/30/09.

14. Every NR, Maynard C, Schulman K, Ritchie JL. The association between institutional primary angioplasty procedure volume and outcome in elderly Americans. J Invasive Cardiol (2000 Jun) 12(6):303-8.

15. Canto JG, Every NR, Magid DJ, Rogers WJ, Malmgren JA, Frederick PD, French WJ, Tiefenbrunn AJ, Misra VK, Kiefe CI, Barron HV. The volume of primary angioplasty procedures and survival after acute myocardial infarction. National Registry of Myocardial Infarction 2 Investigators. N Engl J Med (2000 May 25) 342(21):1573-80.

16. Magid DJ, Calonge BN, Rumsfeld JS, Canto JG, Frederick PD, Every NR, Barron HV. Relation between hospital primary angioplasty volume and mortality for patients with acute MI treated with primary angioplasty vs. thrombolytic therapy. JAMA (2000 Dec 27) 284(24):3131-8.

17. Jollis JG, Romano PS. Volume-outcome relationship in acute myocardial infarction: the balloon and the needle. JAMA (2000 Dec 27) 284(24):3169-71.

18. Hannan EL, O'Donnell JF, Kilburn H, Bernard HR, Yazici A, Kilburn H Jr. Investigation of the relationship between volume and mortality for surgical procedures performed in New York State hospitals. JAMA (1989 Jul 28) 262(4):503-10.

19. Hannan EL, Kilburn H, Bernard H, O'Donnell JF, Lukacik G, Shields EP, Kilburn H Jr. Coronary artery bypass surgery: the relationship between in-hospital mortality rate and surgical volume after controlling for clinical risk factors. Med Care (1991 Nov) 29(11):1094-107.

20. Shroyer AL, Marshall G, Warner BA, Johnson RR, Guo W, Grover FL, Hammermeister KE. No continuous relationship between Veterans Affairs hospital coronary artery bypass grafting surgical volume and operative mortality. Ann Thorac Surg (1996 Jan) 61(1):17-20.

21. Veterans Health Administration. VISN 12 Service Delivery Options Report, Appendix N (Procedure Volume and Clinical Outcomes). Available at http://www1.va.gov/caresdecision/docs/napp.pdf. Accessed 9/30/09.

22. Eagle KA, Guyton RA, Davidoff R, Edwards FH, Ewy GA, Gardner TJ, Hart JC, Herrmann HC, Hillis LD, Hutter AM Jr, Lytle BW, Marlow RA, Nugent WC, Orszulak TA. ACC/AHA 2004 guideline update for coronary artery bypass graft surgery: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines (Committee to Update the 1999 Guidelines for Coronary Artery Bypass Graft Surgery). Available at: http://www.acc.org/qualityandscience/clinical/guidelines/cabg/index.pdf. Accessed 9/30/09.

23. King SB, Aversano T, Ballard WL, Beekman RH, Cowley MJ, Ellis SG, Faxon DP, Hannan EL, Hirshfeld JW Jr, Jacobs AK, Kellett MA Jr, Kimmel SE, Landzberg JS, McKeever LS, Moscucci M, Pomerantz RM, Smith KM, Vetrovec GW. ACCF/AHA/SCAI 2007 Update of the Clinical Competence Statement on Cardiac Interventional Procedures: a report of the American College of Cardiology Foundation/American Heart Association/American College of Physicians Task Force on Clinical Competence and Training (Writing Committee to Update the 1998 Clinical Competence Statement on Recommendations for the Assessment and Maintenance of Proficiency in Coronary Interventional Procedures). American Heart Association Web site. Available at: http://www.acc.org/qualityandscience/clinical/CIP.pdf. Accessed 9/30/09.

24. Sowden AJ, Deeks JJ, Sheldon TA. Volume and outcome in coronary artery bypass graft surgery: true association or artifact? BMJ (1995 Jul 15) 311(6998):151-5.

25. Nallamothu BK, Saint S, Ramsey SD, Hofer TP, Vijan S, Eagle KA. The role of hospital volume in coronary artery bypass grafting: is more always better? J Am Coll Cardiol (2001 Dec) 38(7):1923-30.

26. Nash IS, Corrato RR, Dlutowski MK, O'Connor JP, Nash DB. Generalist versus specialist care for acute myocardial infarction. Am J Cardiol (1999 Mar 1) 83(5):650-4.

27. Tu JV, Austin PC, Chan BT. Relationship between annual volume of patients treated by admitting physician and mortality after acute myocardial infarction. JAMA (2001 Jun 27) 285(24):3116-22.

28. Thiemann DR, Coresh J, Oetgen WJ. The association between hospital volume and survival after acute myocardial infarction in elderly patients. N Engl J Med (1999 May 27) 340(21):1640-8.

29. Antman EM, Anbe DT, Armstrong PW, Bates ER, Green LA, Hand M, Hochman JS, Krumholz HM, Kushner FG, Lamas GA, Mullany CJ, Ornato JP, Pearle DL, Sloan MA, Smith SC Jr. ACC/AHA guidelines for the management of patients with ST-elevation myocardial infarction: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines (Committee to Revise the 1999 Guidelines for the Management of Patients with Acute Myocardial Infarction). 2004. Available at www.acc.org/clinical/guidelines/stemi/index.pdf.

30. Birkmeyer JD, Stukel TA, Siewers AE, Goodney PP, Wennberg DE, Lucas FL. Surgeon volume and operative mortality in the United States. N Engl J Med (2003 Nov 27) 349(22):2117-2127.

31. Kizer KW. The volume-outcome conundrum. N Engl J Med (2003 Nov 27) 349(22):2159-2161.

32. Shahian DM. Improving cardiac surgery quality — volume, outcome, process? JAMA (2004 Jan 14) 291(2):246-248.

33. Peterson ED, Coombs LP, DeLong ER, Haan CK, Ferguson TB. Procedural volume as a marker of quality for CABG surgery. JAMA (2004 Jan 14) 291(2):195-201.

34. DesHarnais SI, McMahon LF Jr, Wroblewski RT. Measuring Outcomes of Hospital Care Using Multiple Risk-Adjusted Indexes. Health Serv Res. 26, no. 4 (Oct 1991): 425-445.

35. DesHarnais SI, et al. The Risk Adjusted Mortality Index: A New Measure of Hospital Performance. Medical Care. 26, no. 12 (Dec 1988): 1129-1148.

36. DesHarnais SI, et al. Risk-Adjusted Quality Outcome Measures: Indexes for Benchmarking Rates of Mortality, Complications, and Readmissions. Qual Manag Health Care. 5 (Winter 1997): 80-87.

37. DesHarnais SI, et al. Measuring Hospital Performance: the Development and Validation of Risk-Adjusted Indexes of Mortality, Readmissions, and Complications. Medical Care. 28, no. 12 (Dec 1990): 1127-1141.

38. Iezzoni LI, et al. Chronic Conditions and Risk of In-Hospital Death. Health Serv Res. 29, no. 4 (Oct 1994): 435-460.

39. AHRQ Quality Indicators — Guide to Patient Safety Indicators. Rockville, MD: Agency for Healthcare Research and Quality, 2003. Version 3.0a, (May 1, 2006). AHRQ Pub.03-R203.

40. Wall Street Journal, New York, NY, Help: Digest of Earnings (http://online.wsj.com/public/resources/documents/doe-help.htm).

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