TRUVEN HEALTH ANALYTICS

100 TOP HOSPITALS

100 Top Hospitals Study, 2016

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Truven Health 100 Top Hospitals,® Study Overview, 23rd Edition

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Introduction

100 Top Hospitals:

Seizing Opportunities. Delivering Value.

The annual Truven Health 100 Top Hospitals® study uses independent, quantitative research that identifies U.S. hospitals with the best overall performance across multiple organizational metrics. To maintain the study's high level of integrity and eliminate bias, only quantifiable public data sources are used for calculating outcome metrics. This ensures inclusion of all hospitals across the country, and facilitates consistency of definitions and data. Hospitals do not apply for consideration, and winners do not pay for use of the 100 Top Hospitals title.

The 100 Top Hospitals national balanced scorecard, based on Norton and Kaplan's concept, is the foundation of our research, and is comprised of key measures of organizational performance: quality inpatient and outpatient care, operational efficiency, financial health, and customer perception of care. The overall performance score derived from these measures reflects the highest levels of excellence in hospital leadership.

The healthcare industry is changing quickly, and winners of the 100 Top Hospitals designation demonstrate how effective leaders manage change and achieve excellence in a dynamic environment. Winners consistently set industry benchmarks for critical performance measures like 30-day readmissions, mortality rates, customer satisfaction, and profit margins.

Distinctive Leadership in a Time of Transformation

For 23 years, the 100 Top Hospitals program has collaborated with top academics to uncover the impact organizational leadership has on the performance and best practices within the nation's top healthcare organizations. Those studies have found that leadership excellence is essential for superior performance and delivery of high value to community stakeholders.

The 100 Top Hospitals methodology also creates an integrated program that identifies long-term rates of improvement, providing a clear picture of how innovative leaders can transform the performance of the entire organization over time by identifying and seizing improvement opportunities and adjusting organizational goals for key performance domains. Higher composite scores on the 100 Top Hospitals national balanced scorecard reflect more effective leadership and consistent delivery of high value to communities. This approach, coupled with our objective insights into the effectiveness of hospital leadership, is what makes the 100 Top Hospitals program unique — and the standard for measuring quality of hospital care in the United States.

New Ranked Metrics

This year, we have added new core measures for stroke care and blood clot prevention, in place of the retired acute myocardial infarction, heart failure, pneumonia, and surgical care core measures. These updated core measures provide a new challenge to hospitals to raise the bar on basic standards of care for two additional groups of patients. We also added emergency department (ED) throughput measures to expand our measurement of process efficiency in a department that is an important healthcare access point for every community. These enhancements, and our efforts to persistently develop the national balanced scorecard, ensure that our study continues to reflect healthcare executives' determination to transform the delivery system and manage the full continuum of care, including the prominent shift from inpatient to outpatient utilization.

Equal Consideration for Hospitals in Each Category

Health systems, accountable care organizations (ACOs), and insurance networks in today's healthcare environment continue to expect consistent outcomes and expanded transparency, regardless of hospital type — and this is only magnified by the Affordable Care Act (ACA).

However, because different types of hospitals perform at varying levels for each metric, the 100 Top Hospitals study divides the nation's hospitals into five categories (teaching, major teaching, small community, medium community, and large community). This makes certain that benchmarks are comparable and actionable across each organizational type. Each kind of hospital has its own inherent set of specific challenges and opportunities, and each category requires a different level of risk tolerance.

While hospital types differ, our studies demonstrate year after year that leaders at the nation's best-performing hospitals are the ones who work to transform and adapt to meet the challenges of their respective industry categories. They use evidence-based management, driven by objective data and analytics, to help prevent the acceptance of performance patterns that, while traditional, have proven to be unnecessary or detrimental to progress. They evaluate all resources to drive new practice patterns in their categories and set targets for performance improvement initiatives.

How This Year's Winners Compare to Their Industry Peers

Using the measures presented in our national balanced scorecard, this year's 100 Top Hospitals study revealed significant differences between award winners and their nonwinning peers.

The nation's best hospitals:

- Had a lower mortality index, considering patient severity
- Had fewer patient complications
- Followed accepted care protocols
- Had lower 30-day mortality and 30-day readmission rates
- Sent patients home sooner
- Provided more timely emergency care
- Kept expenses low, both in-hospital and through the aftercare process
- Score better on patient surveys of hospital experience

The Standard of Excellence

The industry is transforming, and the ability of winning hospital leadership to adjust accordingly demonstrates why 100 Top Hospitals winners set the standards their peers seek to achieve.

Since 1993, 100 Top Hospitals award winners have proven that better care and operational efficiency can be achieved simultaneously — even during tumultuous industry change. That tradition continues this year.

In fact, our study projections indicate that if the new national benchmarks of high performance were achieved by all hospitals in the U.S.:

- Nearly 104,000 additional lives could be saved in-hospital
- Nearly 48,400 additional patients could be complication-free
- Over $2 billion in inpatient costs could be saved
- The typical patient could be released from the hospital a half-day sooner and would have 2 percent fewer expenses related to their complete episode of care than the median patient in the U.S.
- Nearly 245,000 fewer discharged patients would be readmitted within 30 days
- Patients would spend 10 minutes less in hospital EDs per visit

This analysis, conducted by comparing study winners with a peer group of nonwinners, is based only on Medicare patients included in this study. If the same standards were applied to all inpatients, the impact would be even greater.

The Versatility of the 100 Top Hospitals Program

To increase understanding of trends in specific areas of the industry, the Truven Health 100 Top Hospitals program includes a range of studies and reports:

- **100 Top Hospitals and Everest Award studies**: Highly anticipated research that annually recognizes the best hospitals in the nation based on overall organizational performance, as well as long-term rates of improvement
- **50 Top Cardiovascular Hospitals study**: An annual study identifying hospitals that demonstrate the highest performance in hospital cardiovascular services
- **15 Top Health Systems study**: A groundbreaking study introduced in 2009 that provides an objective measure of health system performance as a sum of its parts
- **100 Top Hospitals Performance Matrix**: A two-dimensional analysis — available for nearly all U.S. hospitals — that provides a clear view of how long-term improvement and current performance overlap and compare with national peers
- **Custom benchmark reports**: A variety of reports designed to help executives understand how their performance compares with their peers within health systems, states, and markets

You can read more about all of these studies and reports, and view lists of all winners by visiting **100tophospitals.com**.

About Truven Health Analytics

At Truven Health Analytics,™ we deliver the answers that clients need to improve healthcare quality and access while reducing costs. We provide market-leading performance improvement solutions built on data integrity, advanced analytics, and domain expertise. For more than 30 years, our insights and solutions have been providing hospitals and clinicians, employers and health plans, state and federal government agencies, life sciences companies, and policymakers the facts they need to make confident decisions that directly affect the health and well-being of people and organizations in the U.S. and around the world.

Truven Health owns some of the most trusted brands in healthcare, such as MarketScan,® 100 Top Hospitals, Advantage Suite,® Micromedex,® Simpler,® ActionOI,® Heartbeat Experts, and JWA. Truven Health has its principal offices in Ann Arbor, Mich.; Chicago, Ill.; and Denver, Colo. For more information, please visit **truvenhealth.com**.

Award Winners

Truven Health Analytics™ is proud to present the 2016 Truven Health 100 Top Hospitals® award winners. We stratify winners by five separate peer comparison groups: major teaching, teaching, large community, medium community, and small community hospitals.

To see a full list of *Winners Through the Years,* please visit **100tophospitals.com/studies-winners/100-top-hospitals/year**.

Major Teaching Hospitals*			
Hospital	**Location**	**Medicare ID**	**Total Year(s) Won**
Advocate Lutheran General Hospital	Park Ridge, IL	140223	Seventeen
Cedars-Sinai Medical Center	Los Angeles, CA	050625	One
Christiana Care Health System	Newark, DE	080001	Four
Froedtert & the Medical College of Wisconsin	Milwaukee, WI	520177	Four
Houston Methodist Hospital	Houston, TX	450358	Four
NorthShore University HealthSystem	Evanston, IL	140010	Seventeen
NYU Langone Medical Center	New York, NY	330214	One
OhioHealth Doctors Hospital	Columbus, OH	360152	Six
Providence-Providence Park Hospital	Southfield, MI	230019	Eight
Rush University Medical Center	Chicago, IL	140119	Three
St. Joseph Mercy Hospital	Ann Arbor, MI	230156	Eight
St. Joseph's Hospital and Medical Center	Phoenix, AZ	030024	Six
St. Luke's University Hospital - Bethlehem	Bethlehem, PA	390049	Four
University of Colorado Hospital	Aurora, CO	060024	Three
University of Iowa Hospitals & Clinics	Iowa City, IA	160058	One

* Everest Award winners are in bold type above.

Teaching Hospitals*			
Hospital	**Location**	**Medicare ID**	**Total Year(s) Won**
Aspirus Wausau Hospital	Wausau, WI	520030	Four
Bethesda North Hospital	Cincinnati, OH	360179	Six
BSA Health System	Amarillo, TX	450231	Three
Carolinas Medical Center-Mercy	Charlotte, NC	340098	Three
Good Samaritan Hospital	Cincinnati, OH	360134	Four
Kendall Regional Medical Center	Miami, FL	100209	Nine
Kettering Medical Center	Kettering, OH	360079	Twelve
LDS Hospital	Salt Lake City, UT	460006	Three
McKay-Dee Hospital	Ogden, UT	460004	Six
Mercy Health Saint Mary's	Grand Rapids, MI	230059	One
Mercy Hospital St. Louis	St. Louis, MO	260020	Four
Mercy Medical Center	Cedar Rapids, IA	160079	Four
MidMichigan Medical Center-Midland	Midland, MI	230222	Four
Park Nicolett Methodist Hospital	St. Louis Park, MN	240053	Three
Parkview Regional Medical Center	Fort Wayne, IN	150021	Two
Poudre Valley Hospital	Fort Collins, CO	060010	Ten
Riverside Medical Center	Kankakee, IL	140186	Seven
Rose Medical Center	Denver, CO	060032	Nine
Spectrum Health Medical Center	Grand Rapids, MI	230038	Nine
St. Cloud Hospital	St. Cloud, MN	240036	Ten
St. Luke's Boise Medical Center	Boise, ID	130006	Eight
St. Mary's Hospital	Madison, WI	520083	Three
St. Vincent Healthcare	Billings, MT	270049	One
The Christ Hospital Health Network	Cincinnati, OH	360163	Six
UnityPoint - Meriter Hospital	Madison, WI	520089	Four

* Everest Award winners are in bold type above.

Large Community Hospitals*

Hospital	Location	Medicare ID	Total Year(s) Won
Advocate Good Samaritan Hospital	Downers Grove, IL	140288	Seven
Asante Rogue Regional Medical Center	Medford, OR	380018	Four
Billings Clinic Hospital	Billings, MT	270004	Four
Centinela Hospital Medical Center	Inglewood, CA	050739	Five
Edward Hospital	Naperville, IL	140231	Two
El Camino Hospital	Mountain View, CA	050308	Three
EvergreenHealth Kirkland	Kirkland, WA	500124	One
FirstHealth Moore Regional Hospital	Pinehurst, NC	340115	Four
Florida Hospital Memorial Medical Center	Daytona Beach, FL	100068	Two
Franciscan St. Francis Health - Indianapolis	Indianapolis, IN	150162	Three
Memorial Hermann Memorial City Medical Center	Houston, TX	450610	Five
Mercy Hospital	Coon Rapids, MN	240115	Five
Mosaic Life Care	St. Joseph, MO	260006	Two
Mother Frances Hospital Tyler	Tyler, TX	450102	Six
Roper Hospital	Charleston, SC	420087	Two
Sarasota Memorial Hospital	Sarasota, FL	100087	Three
Scripps Memorial Hospital La Jolla	La Jolla, CA	050324	One
St. David's Medical Center	Austin, TX	450431	Seven
West Florida Hospital	Pensacola, FL	100231	Three
West Georgia Medical Center	LaGrange, GA	110016	One

* Everest Award winners are in bold type above.

Medium Community Hospitals*

Hospital	Location	Medicare ID	Total Year(s) Won
Alhambra Hospital Medical Center	Alhambra, CA	050281	One
Aurora BayCare Medical Center	Green Bay, WI	520193	Three
Blanchard Valley Hospital	Findlay, OH	360095	Four
Bon Secours St. Francis Hospital	Charleston, SC	420065	Three
Chino Valley Medical Center	Chino, CA	050586	Five
Clermont Hospital	Batavia, OH	360236	Seven
Dupont Hospital	Fort Wayne, IN	150150	Three
French Hospital Medical Center	San Luis Obispo, CA	050232	Three
Holland Hospital	Holland, MI	230072	Eleven
Houston Methodist Sugar Land Hospital	Sugar Land, TX	450820	Two
Lawrence Memorial Hospital	Lawrence, KS	170137	Four
Logan Regional Hospital	Logan, UT	460015	Six
Mercy Iowa City	Iowa City, IA	160029	One
Ochsner Medical Center - Baton Rouge	Baton Rouge, LA	190202	One
Sentara Williamsburg Regional Medical Center	Williamsburg, VA	490066	One
Sherman Oaks Hospital	Sherman Oaks, CA	050755	One
Sycamore Medical Center	Miamisburg, OH	360239	Seven
Texas Health Harris Methodist Hospital Southwest Fort Worth	Fort Worth, TX	450779	One
Timpanogos Regional Hospital	Orem, UT	460052	Two
West Valley Medical Center	Caldwell, ID	130014	Three

* Everest Award winners are in bold type above.

Small Community Hospitals*			
Hospital	**Location**	**Medicare ID**	**Total Year(s) Won**
Aurora Medical Center	Two Rivers, WI	520034	One
Brigham City Community Hospital	Brigham City, UT	460017	Four
Fairview Northland Medical Center	Princeton, MN	240141	One
Franklin Woods Community Hospital	Johnson City, TN	440184	One
Hawkins County Memorial Hospital	Rogersville, TN	440032	One
Hill Country Memorial Hospital	Fredericksburg, TX	450604	Six
HSHS St. Joseph's Hospital Breese	Breese, IL	140145	Three
Kansas Medical Center	Andover, KS	170197	One
Lakeview Hospital	Bountiful, UT	460042	Six
Lakeview Medical Center	Rice Lake, WI	520011	One
Mercy Defiance Hospital	Defiance, OH	360270	Two
Morris Hospital & Healthcare Centers	Morris, IL	140101	Three
OhioHealth Dublin Methodist Hospital	Dublin, OH	360348	Five
Parkview Huntington Hospital	Huntington, IN	150091	Four
Pomerene Hospital	Millersburg, OH	360148	One
Renown South Meadows Medical Center	Reno, NV	290049	Two
Roper St. Francis Mount Pleasant Hospital	Mount Pleasant, SC	420104	One
St. Luke's Hospital - Quakertown	Quakertown, PA	390035	One
Waynesboro Hospital	Waynesboro, PA	390138	One
Zeeland Community Hospital	Zeeland, MI	230003	Two

* Everest Award winners are in bold type above.

The Everest Award

The Truven Health 100 Top Hospitals® Everest Award honors hospitals that have both the highest current performance and the fastest long-term improvement.

This award recognizes the boards, executives, and clinical leaders who developed and executed the transformative strategies that drove the highest rates of improvement, resulting in the highest performance in the U.S. at the end of five years.

The Everest Award winners are a special group of the 100 Top Hospitals award winners that, in addition to achieving benchmark status for one year, have simultaneously set national benchmarks for the fastest long-term improvement on our national balanced scorecard. In 2016, only 17 organizations achieved this exceptional level of performance.

The 2016 Everest Award Winners

Truven Health Analytics™ is proud to present the winners of the 100 Top Hospitals Everest Award.

2016 Everest Award Winners			
Hospital	**Location**	**Medicare ID**	**Total Year(s) Won**
Bon Secours St. Francis Hospital	Charleston, SC	420065	One
Christiana Care Health System	Newark, DE	080001	Two
El Camino Hospital	Mountain View, CA	050308	One
Florida Hospital Memorial Medical Center	Daytona Beach, FL	100068	One
Franklin Woods Community Hospital	Johnson City, TN	440184	One
Good Samaritan Hospital	Cincinnati, OH	360134	One
Hawkins County Memorial Hospital	Rogersville, TN	440032	One
HSHS St. Joseph's Hospital Breese	Breese, IL	140145	Three
Mercy Defiance Hospital	Defiance, OH	360270	One
MidMichigan Medical Center-Midland	Midland, MI	230222	One
Mosaic Life Care	St. Joseph, MO	260006	Two
Park Nicolett Methodist Hospital	St. Louis Park, MN	240053	One
Renown South Meadows Medical Center	Reno, NV	290049	Two
Scripps Memorial Hospital La Jolla	La Jolla, CA	050324	One
St. Joseph Mercy Hospital	Ann Arbor, MI	230156	One
Texas Health Harris Methodist Hospital Southwest Fort Worth	Fort Worth, TX	450779	One
University of Iowa Hospitals & Clinics	Iowa City, IA	160058	One

Value to the Healthcare Industry

Leaders making critical decisions in an increasingly transparent environment must have more sophisticated intelligence that provides objective insight into the complexity of changing organizational performance. Being good today is not good enough. Leaders must also balance short- and long-term goals to drive continuous gains in performance and value.

Transparency presents hospital boards and CEOs with a very public challenge to increase the value of core services to their communities. Providing real value is not a one-time event — it is a continuous process of increasing worth over time. We provide unique insights into making smarter decisions that help hospitals achieve these objectives, by comparing individual hospital performance with integrated national benchmarks for highest achievement and fastest improvement.

Integrating national benchmarks for highest achievement with those for fastest long-term improvement radically increases the value of objective business information available for strategy development and decision-making. Comparing hospital or health system performance to these integrated benchmarks allows leaders to review the effectiveness of the long-term strategies that led to current performance. This integrated information enables boards and CEOs to better answer multidimensional questions, such as:

- Did our long-term strategies result in a stronger hospital across all performance areas?
- Did our strategies drive improvement in some areas but inadvertently cause deteriorating performance in others?
- What strategies will help us increase the rate of improvement in the right areas to come closer to national performance levels?
- What incentives do we need to implement for management to achieve the desired improvement more quickly?
- Will the investments we are considering help us achieve improvement goals?
- Can we quantify the long- and short-term increases in value our hospital has provided to our community?

How We Select the Everest Award Winners

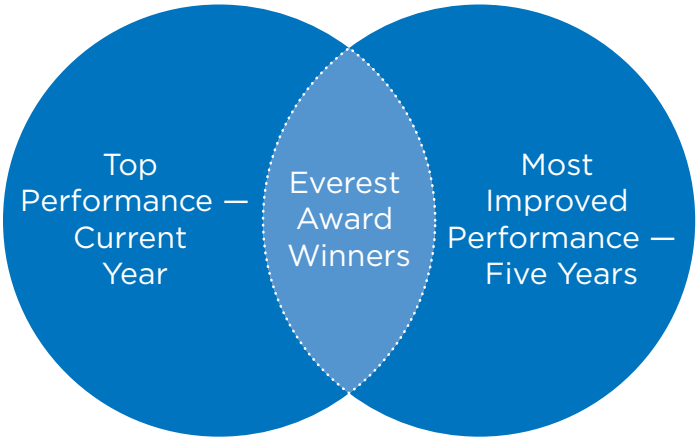
Winners of the 100 Top Hospitals Everest Award are setting national benchmarks for both long-term (five-year) improvement and highest current year performance on the study's balanced scorecard. Everest Award winners are selected from among the new 100 Top Hospitals award winners. The national award and the Everest Award are based on a set of measures that reflect highly effective performance across the whole organization.

Our methodology for selecting the Everest Award winners can be summarized in three main steps:

1. Selecting the annual 100 Top Hospitals award winners using our objective methodology,* based on publicly available data and a balanced scorecard of performance measures using the most current data available (2014 at the time of this study)
2. Using our five-year (2010–2014) trending methodology to select the 100 hospitals that have shown the fastest, most consistent improvement rates on the same balanced scorecard of performance measures
3. Identifying those hospitals that ranked in the top 100 on both lists; these hospitals are the Everest Award winners

* For full details on how the 100 Top Hospitals winners are selected, please see the Methodology section of this document.

Combining these two methodologies yields a very select group of Everest Award winners. The number of winners will vary every year, based solely on performance in the two dimensions.



Data Sources

As with all of the 100 Top Hospitals awards, our methodology is objective, and all data come from trusted public sources. We build a database of short-term, acute care, nonfederal U.S. hospitals that treat a broad spectrum of patients. The primary data sources are the Medicare Provider Analysis and Review (MEDPAR) patient claims dataset, the Centers for Medicare & Medicaid Services (CMS) Hospital Compare hospital performance dataset, and the Hospital Cost Report Information System (HCRIS) Medicare cost report file. We use the most recent five years of data available for trending and the most current year for selection of winners.*

Residency program information, used in classifying teaching hospitals, is from the American Medical Association (Accreditation Council for Graduate Medical Education [ACGME]-accredited programs) and the American Osteopathic Association (AOA).

For this year's study, after excluding hospitals with data that would skew study results (i.e., specialty hospitals), we had a database study group of nearly 2,800 hospitals.

Comparison Groups

Because bed size and teaching status have a profound effect on the types of patients a hospital treats and the scope of services it provides, we assigned each hospital in our study database to one of five comparison groups, or classes, according to its size and teaching status (for definitions of each group, see the Methodology section):

- Major Teaching Hospitals
- Teaching Hospitals
- Large Community Hospitals
- Medium Community Hospitals
- Small Community Hospitals

To judge hospitals fairly and compare them to like hospitals, we use these classes for all scoring and ranking to determine winners. For more information on how we build the database, please see the Methodology section of this document.

* Hospital inpatient mortality and complications are based on two years of data combined for each study year data point. See the Performance Measures section for details.

Performance Measures

Both the 100 Top Hospitals and Everest Award winners are based on a set of measures that assess balanced performance across the whole organization, reflecting the leadership effectiveness of board members, medical staff, management, and nursing. These measures fall into seven domains of performance: inpatient outcomes, process of care, extended outcomes, operational efficiency, cost efficiency, financial health, and patient experience.

The 11 measures used to select the 2016 winners are:

1. Risk-adjusted mortality index (inpatient)
2. Risk-adjusted complications index
3. Core measures mean percent
4. Mean 30-day risk-adjusted mortality rate (includes acute myocardial infarction [AMI], heart failure [HF], pneumonia, chronic obstructive pulmonary disease [COPD], and stroke)
5. 30-day risk-adjusted readmission rate (includes AMI, HF, pneumonia, hip/knee arthroplasty, COPD, and stroke)
6. Severity-adjusted average length of stay (ALOS)
7. Mean emergency department (ED) throughput (minutes)
8. Case mix- and wage-adjusted inpatient expense per discharge
9. Medicare spend per beneficiary index (MSPB)
10. Adjusted operating profit margin
11. Hospital Consumer Assessment of Healthcare Providers and Systems (HCAHPS) score (patient rating of overall hospital performance)

For full details, including calculation and scoring methods, please see the Methodology section. We use present-on-admission (POA) data in our proprietary risk models. POA coding became available in the 2009 MEDPAR dataset.

For inpatient mortality and complications — clinical measures with low frequency of occurrence — we combine two years of data for each study year to stabilize results. This year, we combined as follows:

- Study year 2014 = 2014 and 2013 MEDPAR datasets
- Study year 2013 = 2013 and 2012 MEDPAR datasets
- Study year 2012 = 2012 and 2011 MEDPAR datasets
- Study year 2011 = 2011 and 2010 MEDPAR datasets
- Study year 2010 = 2010 and 2009 MEDPAR datasets

For specific data years used for each measure, please see page 27 of the Methodology section.

Ranking and Five-Year Trending Summary

To select the 100 Top Hospitals award winners, we rank hospitals on the basis of current year performance on each of the study measures relative to other hospitals in their comparison group. We then sum each hospital's performance-measure rankings and re-rank them, overall, to arrive at a final rank for the hospital. The hospitals with the best final ranks in each comparison group are selected as the 100 Top Hospitals award winners. See the Methodology section for details on the ranking methodology, including measures, weighting, and selection of 100 Top Hospitals winners.

Separately, for every hospital in the study, we calculate a t-statistic that measures five-year performance improvement for each of the included performance measures. This statistic measures the direction and magnitude of change in performance, and the statistical significance of that change. We rank hospitals on the basis of their performance improvement t-statistic on each of the study measures relative to other hospitals in their comparison group. We then sum each hospital's performance-measure rankings and re-rank them overall, to arrive at a final rank for the hospital. The hospitals with the best final rank in each comparison group are selected as the performance improvement benchmark hospitals. See the Methodology section for details on trending, including measure weighting.

As our final step, we find those hospitals that are identified as benchmarks on both lists. These hospitals are the Everest Award winners.

Findings

The Truven Health 100 Top Hospitals® study sheds an important light on how the best hospitals in the country operate. These healthcare industry leaders have successfully balanced the fine line between running highly effective operations every day, and being innovative and forward-thinking in ways that grow their organizations over the short and long term.

The study is more than a list of accomplishments — it's a method for all U.S. hospital and health system leaders to guide their own performance improvement initiatives. By highlighting what the highest-performing leaders around the country are doing well, we are creating aspirational benchmarks for the rest of the industry.

Through the years, the body of published research proving the validity and stability of the 100 Top Hospitals program has continued to grow.[1–27] There's no better way to see how the nation's health and the industry's bottom lines could be improved than by aggregating the winner-versus-nonwinner data from this study.

Based on comparisons between the 100 Top Hospitals study winners and a peer group of similar high-volume hospitals that were not winners, we found that if all hospitals performed at the level of this year's winners:

- Nearly 104,000 additional lives could be saved in-hospital
- Nearly 48,400 additional patients could be complication-free
- Over $2 billion in inpatient costs could be saved
- The typical patient could be released from the hospital a half-day sooner and would have 2 percent fewer expenses related to the complete episode of care than the median patient in the U.S.
- Nearly 245,000 fewer discharged patients would be readmitted within 30 days
- Patients would spend 10 minutes less in hospital emergency departments (EDs) per visit

We based this analysis on the Medicare patients included in this study. If the same standards were applied to all inpatients, the impact would be even greater.

How Winning Hospitals Compared to Their Peers

In this section, we show how the 100 Top Hospitals performed within their comparison groups, or classes (major teaching and teaching hospitals; and large, medium, and small community hospitals), compared with nonwinning peers. For performance measure details and definitions of each comparison group, please see the Methodology section.

Please note: In Tables 1–6, data for the 100 Top Hospitals award winners are labeled Benchmark, and data for all hospitals, excluding award winners, are labeled Peer Group. In columns labeled Benchmark Compared With Peer Group, we calculate the actual and percentage difference between the benchmark hospital scores and the peer group scores.

100 Top Hospitals Had Better Survival Rates*

- Overall, the winners had 23 percent fewer deaths than expected (0.77 index), considering patient severity, while their nonwinning peers had 5 percent more deaths as would be expected (1.05 index) (Table 1).
- Small community hospitals had the most dramatic difference between winners and nonwinners. The winning small hospital median mortality rate was 44.1 percent lower than nonwinning peers (Table 6).
- Medium-sized community hospitals also had a significantly lower median mortality index than nonwinning peer hospitals, with a 25.3 percent lower index (Table 5).

100 Top Hospitals Had Fewer Patient Complications*

- Overall, patients at the winning hospitals had 21 percent fewer complications than expected (0.79 index), considering patient severity, while their nonwinning peers had only 6 percent fewer complications than expected (0.94 index) (Table 1).
- Small and medium community hospital winners had the best complications performance with index values of 0.65 and 0.69, respectively (Tables 5 and 6).
- Medium community hospitals also showed the most dramatic difference between winners and nonwinners. Winning hospitals had a median complications index that was 30.1 percent lower than nonwinning hospitals (Table 5).

100 Top Hospitals Followed Accepted Care Protocols

The core measure composite metric is made up of new individual core measures from the Centers for Medicare & Medicaid Services (CMS) Hospital Compare dataset. Stroke care and blood clot prevention process-of-care measures have replaced the retired acute myocardial infarction (AMI), heart failure (HF), pneumonia, and Surgical Care Improvement Project (SCIP) measures that historically made up the core measure mean composite measure. The introduction of these measures offers hospitals a new challenge to address basic standards of care with two new patient groups, which is evident by the lower median scores across all comparison groups (Tables 2–6).

* Risk-adjusted measures are normalized by comparison group, so results cannot be compared across comparison groups.

- Overall, winning hospitals' higher median value for the core measures composite (97.4 percent) tells us that they had better adherence to recommended standards of care than their peers, who had a median of 94.7 percent (Table 1).
- Medium and small community hospitals had the highest rates of compliance with core measures standards for both winners (98.4 percent and 98.2 percent, respectively) and nonwinners (95 percent for both comparison groups) (Tables 5 and 6).

100 Top Hospitals Had Lower 30-Day Mortality and Readmission Rates

This year, we added two new patient groups to the 30-day mortality and readmission extended care measures. The mean 30-day mortality rate now includes AMI, HF, pneumonia, chronic obstructive pulmonary disease (COPD), and stroke patient groups, and the mean 30-day readmission rate includes AMI, HF, pneumonia, hip/knee arthroplasty, COPD, and stroke patient groups.

- Mean 30-day mortality and readmission rates were lower at the winning hospitals than nonwinning hospitals, across all comparison groups (Table 1).
- Major teaching hospital winners demonstrated the best 30-day mortality performance among all hospital comparison groups (10.5 percent). In addition, the winning hospitals had a 1 percent lower 30-day mortality rate as compared to nonwinners, which was the greatest difference among all comparison groups (Table 2).
- Large community hospital winners had the best 30-day readmission performance among all comparison groups (14.7 percent) and along with teaching hospital winners, outperform nonwinners by the greatest margin at 0.9 percent (Tables 3 and 4).

Patients Treated at 100 Top Hospitals Returned Home Sooner*

- Overall, winning hospitals had a median severity-adjusted average length of stay (ALOS) that was a half-day shorter than peers (Table 1).
- The winning medium-sized and small community hospitals had the shortest ALOS, with both groups at 4.2 days. They also had the greatest difference in ALOS relative to nonwinning peers, of all the groups, with median ALOS 0.8 and 0.7 days shorter, respectively (Tables 5 and 6).

Patients Spent Less Time in the Emergency Departments of 100 Top Hospitals

- Overall, winning hospitals had shorter median throughput times for services** than their peers by 6.5 percent (Table 1).
- The most dramatic difference between winning hospitals and their peers in any of the five comparison groups was in the major teaching category, where there was an average of 47 minutes less time-to-service in the ED; although teaching hospitals had the longest throughput times of all comparison groups (181.3 median minutes) (Table 2).
- As might be expected, small community hospitals had the shortest throughput times of all comparison groups for both winning and nonwinning hospitals (125 and 135 median minutes, respectively) (Table 6).

* Risk-adjusted measures are normalized by comparison group, so results cannot be compared across comparison groups.

** Includes median minutes for discharge from the ED, admission to the hospital, and receipt of pain medications for broken bones.

100 Top Hospitals Had Lower Inpatient Expenses and Medicare Spend per Beneficiary (MSPB) Episode Costs

- Although the findings show that, overall, the winning hospital median for case mix- and wage-adjusted inpatient expense per discharge was lower than the median for nonwinner peers (3.4 percent), this favorable difference is small and does not appear in all comparison groups (Table 1).
- For MSPB, which is a measure of the expenses associated with an admission episode, including three days prior through 30 days post-admission, winning hospitals had a lower median index than nonwinning hospitals by 2 percent, overall (Table 1).
- Major teaching and large community hospital winners both had median inpatient expenses that were higher than the nonwinning hospitals (1.5 percent and 3.6 percent higher, respectively) (Tables 2 and 4).
- As noted above, inpatient expenses for large community hospital winners were 3.6 percent higher than for nonwinners, which is the largest unfavorable difference found. However, winners had a favorable difference in MSPB episode expenses, where the median index was 3.9 percent better than for nonwinners (Table 4).
- Medium and small community hospital winners had the lowest case mix- and wage-adjusted inpatient expenses per discharge, at $6,145 and $6,308, respectively (Tables 5 and 6).
- The best MSPB episode cost performance was in the small community hospital group, where both winners and nonwinners outperformed all other groups with MSPB indexes of 0.93 and 0.94, respectively (Table 6).

Further investigation of the interrelationship between inpatient care and episode care is needed. Given that some winners had higher inpatient expenses but lower Medicare spend, one possibility is that winning organizations are moving patients to lower-cost settings more quickly. Another possibility is that the inpatient expense factor in our overall scorecard now has less impact on the selection of winners.

In addition, the relationship between the use of acute and non-acute care in achieving best patient outcomes — and the cost-benefit tradeoffs of each — should be explored. It would be important to know whether or not hospitals that manage the inpatient stay and the selection of appropriate sites of care cost more on the acute side but achieve more economical care overall, with equal or better outcomes.

100 Top Hospitals Were More Profitable

- Overall, winning hospitals have a median operating profit margin that was nearly 9 percentage points higher than nonwinning hospitals (12.6 percent versus 3.9 percent) (Table 1).
- Profitability difference was the most dramatic in the medium and small community hospital groups, where winners had profitability that was 16.5 and 11.5 percentage points higher than nonwinners, respectively (Tables 5 and 6).
- Medium hospital winners also had the largest median operating profit margin of any winning group at 16.5 percent (Table 5).
- Major teaching hospital winners had the lowest median operating profit margin of any winning group at 5.5 percent (Table 2).

Patients Rated 100 Top Hospitals Higher Than Peer Hospitals

- The winners' 3.8 percent higher median Hospital Consumer Assessment of Healthcare Providers and Systems (HCAHPS) score tells us that patients treated at the 100 Top Hospitals reported a better overall hospital experience than those treated in peer hospitals (Table 1).
- The winning small community hospitals had the highest median HCAHPS score at 275.5 versus 263 for nonwinners (maximum score is 300). Both small and medium community hospital winners had the biggest performance difference over peers (4.8 percent) among the comparison groups (Tables 5 and 6).

Table 1: National Performance Comparisons (All Classes)

Performance Measure	Medians		Benchmark Compared With Peer Group		
	Winning Benchmark Hospital	Nonwinning Peer Group of U.S. Hospitals	Difference	Percent Difference	Comments
Mortality Index[1]	0.77	1.05	-0.28	-26.3%	Lower Mortality
Complications Index[1]	0.79	0.94	-0.15	-16.0%	Lower Complications
Core Measures Mean Percent (%)[2]	97.4	94.7	2.7	n/a[6]	Greater Care Compliance
30-Day Mortality Rate (%)[3]	11.4	12.0	-0.6	n/a[6]	Lower 30-Day Mortality
30-Day Readmission Rate (%)[3]	15.1	15.6	-0.6	n/a[6]	Fewer 30-Day Readmissions
Average Length of Stay (ALOS) (days)[1]	4.4	4.9	-0.5	-9.3%	Shorter Stays
Emergency Department (ED) Measure Mean Minutes[4]	146.8	157.0	-10.2	-6.5%	Less Time-to-Service
Inpatient Expense per Discharge ($)[5]	6,457	6,687	-230	-3.4%	Lower Inpatient Cost
Medicare Spend per Beneficiary (MSPB) Index[4]	0.97	0.99	-0.02	-2.0%	Lower Episode Cost
Operating Profit Margin (%)[5]	12.6	3.9	8.7	n/a[6]	Higher Profitability
HCAHPS Score[4]	272.0	262.0	10.0	3.8%	Better Patient Experience

1. Mortality, complications, and ALOS based on present-on-admission (POA)-enabled risk models applied to MEDPAR 2013 and 2014 data (ALOS 2014 only).
2. Core measures data from CMS Hospital Compare Oct. 1, 2013–Sept. 30, 2014, dataset.
3. 30-day rates from CMS Hospital Compare July 1, 2011–June 30, 2014, dataset.
4. ED measure, MSPB, and HCAHPS data from CMS Hospital Compare Jan. 1, 2014–Dec. 31, 2014, dataset.
5. Inpatient expense and operating profit margin data from CMS Hospital Cost Report Information System (HCRIS) data file, 2014.
6. We do not calculate percent difference for this measure because it is already a percent value.

Table 2: Major Teaching Hospital Performance Comparisons

Performance Measure	Medians		Benchmark Compared With Peer Group		
	Winning Benchmark Hospital	Nonwinning Peer Group of U.S. Hospitals	Difference	Percent Difference	Comments
Mortality Index[1]	0.80	1.03	-0.23	-22.3%	Lower Mortality
Complications Index[1]	0.95	1.01	-0.07	-6.6%	Lower Complications
Core Measures Mean Percent (%)[2]	97.0	93.6	3.4	n/a[6]	Greater Care Compliance
30-Day Mortality Rate (%)[3]	10.5	11.6	-1.0	n/a[6]	Lower 30-Day Mortality
30-Day Readmission Rate (%)[3]	15.6	16.2	-0.7	n/a[6]	Fewer 30-Day Readmissions
ALOS (days)[1]	4.5	5.0	-0.5	-10.9%	Shorter Stays
ED Measure Mean Minutes[4]	181.3	228.3	-47.0	-20.6%	Less Time-to-Service
Inpatient Expense per Discharge ($)[5]	7,673	7,560	113	1.5%	Higher Inpatient Cost
MSPB Index[4]	0.98	1.00	-0.02	-2.0%	Lower Episode Cost
Operating Profit Margin (%)[5]	5.5	3.8	1.8	n/a[6]	Higher Profitability
HCAHPS Score[4]	268.0	261.0	7.0	2.7%	Better Patient Experience

1. Mortality, complications, and ALOS based on present-on-admission (POA)-enabled risk models applied to MEDPAR 2013 and 2014 data (ALOS 2014 only).
2. Core measures data from CMS Hospital Compare Oct. 1, 2013–Sept. 30, 2014, dataset.
3. 30-day rates from CMS Hospital Compare July 1, 2011–June 30, 2014, dataset.
4. ED measure, MSPB, and HCAHPS data from CMS Hospital Compare Jan. 1, 2014–Dec. 31, 2014, dataset.
5. Inpatient expense and operating profit margin data from CMS Hospital Cost Report Information System (HCRIS) data file, 2014.
6. We do not calculate percent difference for this measure because it is already a percent value.

Table 3: Teaching Hospital Performance Comparisons

Performance Measure	Medians		Benchmark Compared With Peer Group		
	Winning Benchmark Hospital	Nonwinning Peer Group of U.S. Hospitals	Difference	Percent Difference	Comments
Mortality Index[1]	0.89	1.00	-0.11	-11.0%	Lower Mortality
Complications Index[1]	0.87	0.99	-0.12	-12.3%	Lower Complications
Core Measures Mean Percent (%)[2]	96.0	94.2	1.8	n/a[6]	Greater Care Compliance
30-Day Mortality Rate (%)[3]	11.4	11.9	-0.4	n/a[6]	Lower 30-Day Mortality
30-Day Readmission Rate (%)[3]	14.8	15.7	-0.9	n/a[6]	Fewer 30-Day Readmissions
ALOS (days)[1]	4.5	5.0	-0.5	-9.8%	Shorter Stays
ED Measure Mean Minutes[4]	146.7	179.2	-32.5	-18.1%	Less Time-to-Service
Inpatient Expense per Discharge ($)[5]	6,317	6,477	-160	-2.5%	Lower Inpatient Cost
MSPB Index[4]	0.95	1.01	-0.06	-5.9%	Lower Episode Cost
Operating Profit Margin (%)[5]	12.1	4.5	7.6	n/a[6]	Higher Profitability
HCAHPS Score[4]	272.0	262.0	10.0	3.8%	Better Patient Experience

1. Mortality, complications, and ALOS based on present-on-admission (POA)-enabled risk models applied to MEDPAR 2013 and 2014 data (ALOS 2014 only).
2. Core measures data from CMS Hospital Compare Oct. 1, 2013–Sept. 30, 2014, dataset.
3. 30-day rates from CMS Hospital Compare July 1, 2011–June 30, 2014, dataset.
4. ED measure, MSPB, and HCAHPS data from CMS Hospital Compare Jan. 1, 2014–Dec. 31, 2014, dataset.
5. Inpatient expense and operating profit margin data from CMS Hospital Cost Report Information System (HCRIS) data file, 2014.
6. We do not calculate percent difference for this measure because it is already a percent value.

Table 4: Large Community Hospital Performance Comparisons

Performance Measure	Medians		Benchmark Compared With Peer Group		
	Winning Benchmark Hospital	Nonwinning Peer Group of U.S. Hospitals	Difference	Percent Difference	Comments
Mortality Index[1]	0.81	1.04	-0.24	-22.6%	Lower Mortality
Complications Index[1]	0.83	0.99	-0.16	-16.4%	Lower Complications
Core Measures Mean Percent (%)[2]	97.3	94.7	2.6	n/a[6]	Greater Care Compliance
30-Day Mortality Rate (%)[3]	11.5	11.8	-0.3	n/a[6]	Lower 30-Day Mortality
30-Day Readmission Rate (%)[3]	14.7	15.6	-0.9	n/a[6]	Fewer 30-Day Readmissions
ALOS (days)[1]	4.6	5.0	-0.5	-9.3%	Shorter Stays
ED Measure Mean Minutes[4]	153.2	175.0	-21.8	-12.5%	Less Time-to-Service
Inpatient Expense per Discharge ($)[5]	6,567	6,338	228	3.6%	Higher Inpatient Cost
MSPB Index[4]	0.98	1.02	-0.04	-3.9%	Lower Episode Cost
Operating Profit Margin (%)[5]	11.8	6.7	5.0	n/a[6]	Higher Profitability
HCAHPS Score[4]	270.5	262.0	8.5	3.2%	Better Patient Experience

1. Mortality, complications, and ALOS based on present-on-admission (POA)-enabled risk models applied to MEDPAR 2013 and 2014 data (ALOS 2014 only).
2. Core measures data from CMS Hospital Compare Oct. 1, 2013–Sept. 30, 2014, dataset.
3. 30-day rates from CMS Hospital Compare July 1, 2011–June 30, 2014, dataset.
4. ED measure, MSPB, and HCAHPS data from CMS Hospital Compare Jan. 1, 2014–Dec. 31, 2014, dataset.
5. Inpatient expense and operating profit margin data from CMS Hospital Cost Report Information System (HCRIS) data file, 2014.
6. We do not calculate percent difference for this measure because it is already a percent value.

Table 5: Medium-Sized Community Hospital Performance Comparisons

Performance Measure	Medians		Benchmark Compared With Peer Group		
	Winning Benchmark Hospital	Nonwinning Peer Group of U.S. Hospitals	Difference	Percent Difference	Comments
Mortality Index[1]	0.74	0.99	-0.25	-25.3%	Lower Mortality
Complications Index[1]	0.69	0.99	-0.30	-30.1%	Lower Complications
Core Measures Mean Percent (%)[2]	98.4	95.0	3.4	n/a[6]	Greater Care Compliance
30-Day Mortality Rate (%)[3]	11.4	12.0	-0.6	n/a[6]	Lower 30-Day Mortality
30-Day Readmission Rate (%)[3]	15.1	15.7	-0.6	n/a[6]	Fewer 30-Day Readmissions
ALOS (days)[1]	4.2	5.0	-0.7	-14.9%	Shorter Stays
ED Measure Mean Minutes[4]	139.7	157.3	-17.7	-11.2%	Less Time-to-Service
Inpatient Expense per Discharge ($)[5]	6,145	6,475	-330	-5.1%	Lower Inpatient Cost
MSPB Index[4]	0.95	0.99	-0.04	-3.5%	Lower Episode Cost
Operating Profit Margin (%)[5]	21.0	4.5	16.5	n/a[6]	Higher Profitability
HCAHPS Score[4]	273.0	260.5	12.5	4.8%	Better Patient Experience

1. Mortality, complications, and ALOS based on present-on-admission (POA)-enabled risk models applied to MEDPAR 2013 and 2014 data (ALOS 2014 only).
2. Core measures data from CMS Hospital Compare Oct. 1, 2013–Sept. 30, 2014, dataset.
3. 30-day rates from CMS Hospital Compare July 1, 2011–June 30, 2014, dataset.
4. ED measure, MSPB, and HCAHPS data from CMS Hospital Compare Jan. 1, 2014–Dec. 31, 2014, dataset.
5. Inpatient expense and operating profit margin data from CMS Hospital Cost Report Information System (HCRIS) data file, 2014.
6. We do not calculate percent difference for this measure because it is already a percent value.

Table 6: Small Community Hospital Performance Comparisons

Performance Measure	Medians		Benchmark Compared With Peer Group		
	Winning Benchmark Hospital	Nonwinning Peer Group of U.S. Hospitals	Difference	Percent Difference	Comments
Mortality Index[1]	0.58	1.04	-0.46	-44.1%	Lower Mortality
Complications Index[1]	0.65	0.92	-0.27	-28.8%	Lower Complications
Core Measures Mean Percent (%)[2]	98.2	95.0	3.2	n/a[6]	Greater Care Compliance
30-Day Mortality Rate (%)[3]	11.7	12.1	-0.4	n/a[6]	Lower 30-Day Mortality
30-Day Readmission Rate (%)[3]	15.2	15.5	-0.4	n/a[6]	Fewer 30-Day Readmissions
ALOS (days)[1]	4.2	5.0	-0.8	-15.6%	Shorter Stays
ED Measure Mean Minutes[4]	125.0	135.0	-10.0	-7.4%	Less Time-to-Service
Inpatient Expense per Discharge ($)[5]	6,308	7,105	-796	-11.2%	Lower Inpatient Cost
MSPB Index[4]	0.93	0.94	-0.01	-1.6%	Lower Episode Cost
Operating Profit Margin (%)[5]	12.9	1.4	11.5	n/a[6]	Higher Profitability
HCAHPS Score[4]	275.5	263.0	12.5	4.8%	Better Patient Experience

1. Mortality, complications, and ALOS based on present-on-admission (POA)-enabled risk models applied to MEDPAR 2013 and 2014 data (ALOS 2014 only).
2. Core measures data from CMS Hospital Compare Oct. 1, 2013–Sept. 30, 2014, dataset.
3. 30-day rates from CMS Hospital Compare July 1, 2011–June 30, 2014, dataset.
4. ED measure, MSPB, and HCAHPS data from CMS Hospital Compare Jan. 1, 2014–Dec. 31, 2014, dataset.
5. Inpatient expense and operating profit margin data from CMS Hospital Cost Report Information System (HCRIS) data file, 2014.
6. We do not calculate percent difference for this measure because it is already a percent value.

U.S. Map and States by Region

The U.S. map below, based on the 2016 study (Figure 1), provides a visual representation of the variability in performance across the country. Additionally, Table 7 shows each state's rank quintile performance, grouped by geographic region. To produce these data, we calculated the 100 Top Hospitals measures at the state level,* ranked each measure, then weighted and summed the ranks to produce an overall state performance score. States are ranked from best to worst on the overall score, and the results are reported as rank quintiles.

We made a number of changes to our methodology and measures this year, in line with our commitment to continually improve the value of our study to healthcare leaders. We also continue to expand performance measurement beyond the inpatient setting. Due to these changes, we did not compare this year's state performance to last year's.

We made the following changes that could impact results:

- Retired the AMI, HF, pneumonia, and surgical core measures and replaced them with the new core measures for stroke care and blood clot prevention
- Added COPD and stroke to the 30-day mortality rate group (now two of five included measures, along with AMI, HF, and pneumonia)
- Added COPD and stroke to the 30-day readmission rate group (now two of six included measures, along with AMI, HF, pneumonia, and hip/knee arthroplasty)
- Added the mean ED throughput measure as a ranked measure for the first time
- Due to increased frequency of invalid POA code "0" in MEDPAR data, we changed our MEDPAR processing of POA coding** to reduce false positives for complications, and more accurately determine the risk of death and complications and expected LOS

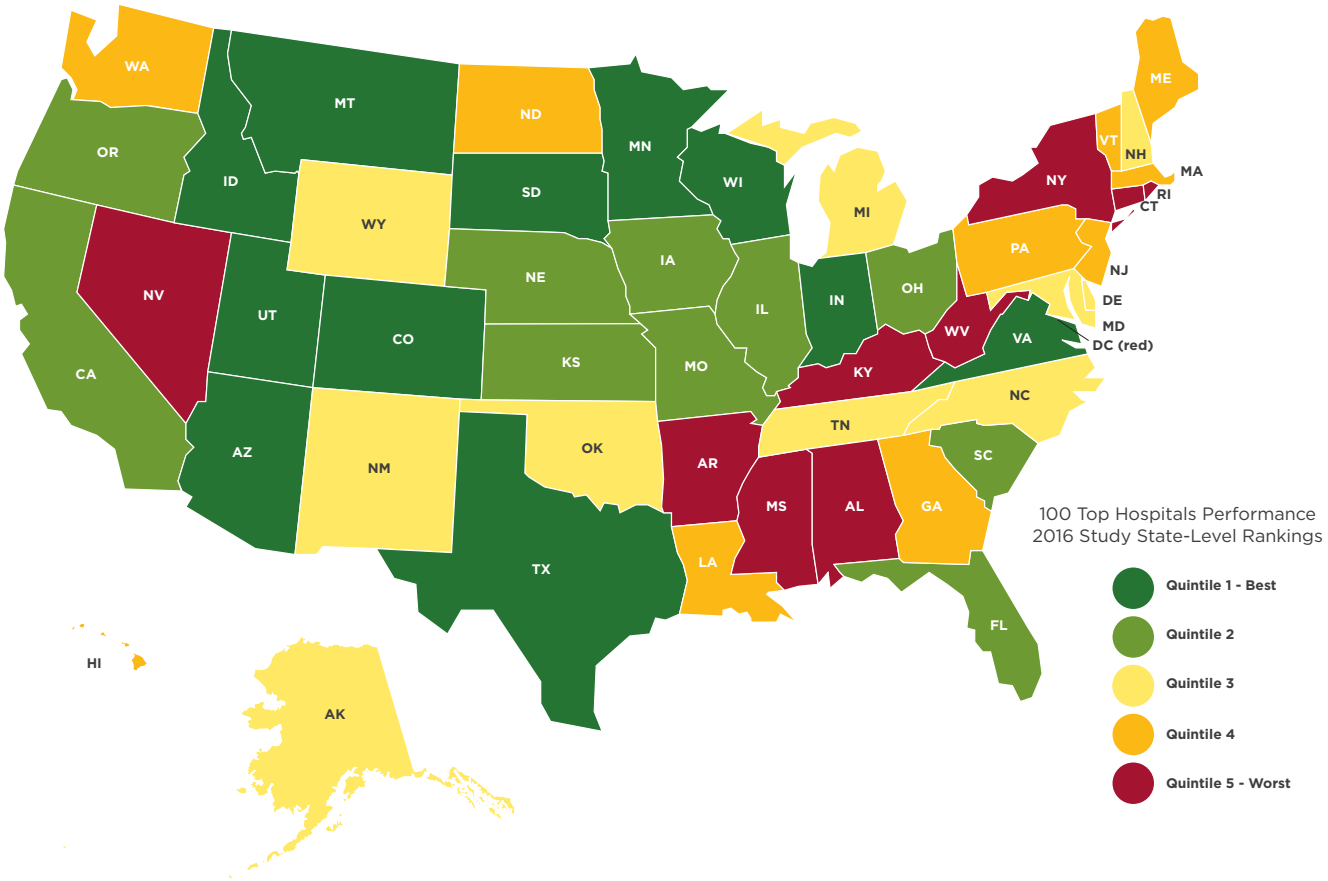
Our observations regarding state performance:

- The Midwest is the frontrunner in the percentage of hospitals in the top two performance quintiles (83.3 percent), with the West coming in second (53.8 percent)
- In addition, the Midwest is the only region with no hospitals in the bottom performance quintile
- The Northeast shows the poorest performance overall, by a large margin, with 88.9 percent of its states in the bottom two quintiles.
- In addition, the Northeast is the only region with no hospitals in the top two quintiles

* Each state measure was calculated from the acute care hospital data for that state. Mortality, complications, and ALOS were aggregated from MEDPAR patient record data. Core measures, 30-day mortality, and 30-day readmission rates were aggregated from the numerator and denominator data for each hospital. Inpatient expense per discharge, operating profit margin, MSPB index, and HCAHPS scores were hospital values weighted by the number of acute discharges at each hospital; mean ED throughput was weighted by the ED visits. A mean weighted value was calculated for each state. Individual measure ranks were weighted using the same measure weights as in the 100 Top Hospitals study.

** See Methodology section page 27 for details.

Figure 1: State-Level Performance Comparisons, 2016 Study



State Data Note: The 2016 state findings are based on the 100 Top Hospitals measure methodologies, using 2013 and 2014 MEDPAR data (combined) for clinical measures, July 1, 2011–June 30, 2014 for 30-day rates, and 2014 data for all other measures.

Table 7: 100 Top Hospitals State-Level Performance, 2016 Study

Northeast	Midwest	South	West
Connecticut	Illinois	Alabama	Alaska
Maine	Indiana	Arkansas	Arizona
Massachusetts	Iowa	Delaware	California
New Hampshire	Kansas	District of Columbia	Colorado
New Jersey	Michigan	Florida	Hawaii
New York	Minnesota	Georgia	Idaho
Pennsylvania	Missouri	Kentucky	Montana
Rhode Island	Nebraska	Louisiana	Nevada
Vermont	North Dakota	Maryland	New Mexico
	Ohio	Mississippi	Oregon
	South Dakota	North Carolina	Utah
	Wisconsin	Oklahoma	Washington
		South Carolina	Wyoming
		Tennessee	
		Texas	
		Virginia	
		West Virginia	

Quintile 1 - Best
Quintile 2
Quintile 3
Quintile 4
Quintile 5 - Worst

Performance Improvement Over Time: All Hospitals

By studying the direction of performance change of all hospitals in our study (winners and nonwinners), we can see that in recent years, U.S. hospitals have not been able to significantly improve performance across the entire balanced scorecard (Table 8). However, over the years we studied (2010 through 2014), there were a few noteworthy performance improvements for specific measures (see green column in Table 8):

- Almost 74 percent of hospitals significantly improved their 30-day readmission rates — likely a result of the attention these measures are getting in payment systems
- Nearly 30 percent of hospitals significantly improved their inpatient mortality rates and 21 percent of hospitals significantly improved their 30-day mortality rates
- Over 22 percent of hospitals also showed significant improvement in ALOS
- On the operating efficiency front the picture is different: Nearly 22 percent of the hospitals studied had a significant increase in expense per discharge (declining performance)

For the remainder of the measures, the majority of hospitals in the study had no statistically significant change in performance (yellow column in Table 8).

Table 8: Direction of Performance Change for All Hospitals in Study, 2010–2014

Performance Measure	Significantly Improving Performance		No Statistically Significant Change in Performance		Significantly Declining Performance	
	Count of Hospitals[1]	Percent of Hospitals[2]	Count of Hospitals[1]	Percent of Hospitals[2]	Count of Hospitals[1]	Percent of Hospitals[2]
Risk-Adjusted Mortality Index	804	29.5%	1,916	70.3%	4	0.1%
Risk-Adjusted Complication Index	217	8.0%	2,455	90.1%	52	1.9%
30-Day Mortality Rate	576	21.1%	2,024	74.3%	124	4.6%
30-Day Readmission Rate	2003	73.5%	720	26.4%	1	0.0%
Severity-Adjusted ALOS	620	22.8%	1,990	73.1%	114	4.2%
Adjusted Inpatient Expense per Discharge	49	1.8%	2,062	76.1%	598	22.1%
Operating Profit Margin	212	7.8%	2,333	86.0%	168	6.2%
HCAHPS Score	435	16.0%	2,202	80.8%	87	3.2%

1. Count refers to the number of in-study hospitals whose performance fell into the highlighted category on the measure.
Note: Total number of hospitals included in the analysis will vary by measure due to exclusion of interquartile range outlier data points. Inpatient expense and profit are affected. Some in-study hospitals had too few data points remaining to calculate trend.
2. Percent is of total in-study hospitals across all peer groups.

Potential New Metrics for 2017

Every year, we evaluate the 100 Top Hospitals study and explore whether new measures would enhance the value of the analysis we provide. For this 2016 study, we are testing new performance measures that update basic standards of inpatient care and expand the balanced scorecard across the continuum of care. If you would like to provide feedback on these proposed measures, please email **100tophospitals@truvenhealth.com**.

- **New Healthcare-Associated Infection (HAI) Measures** — The HAIs reported by CMS in the public Hospital Compare dataset capture important new information about the quality of inpatient care. Tracking and intervening to reduce infection rates for methicillin-resistant staphylococcus aureus (MRSA), CLABSI, catheter-associated urinary tract infection (CAUTI), Clostridium difficile colitis (C.diff), and other problem infections are becoming an important focus in hospitals. New public data will allow the development of national benchmarks for use by hospital leadership to affect change.

- **New 30-Day Mortality and Readmission Measures** — We also are publishing the following new 30-day measures that CMS is publicly reporting in the Hospital Compare dataset: coronary artery bypass graft (CABG) 30-day mortality and 30-day readmission measures, and the hospital-wide 30-day readmission measure. The data period for CABG is the same as for the other 30-day metrics: July 1, 2011, through June 30, 2014. The data period for the hospital-wide readmission measure is July 1, 2013, through June 30, 2014.
- **New 30-Day Episode-of-Care Payment Measures** — Risk-standardized payments associated with 30-day episode-of-care measures for three patient groups have recently been published by CMS in the Hospital Compare dataset. These new measures capture differences in services and supplies provided to patients who have been diagnosed with AMI, HF, or pneumonia. According to the CMS definition of these new measures, they are the sum of payments made for care and supplies beginning the day the patient enters the hospital and for the next 30 days. The data period for these measures is the same as for the other 30-day metrics for specific patient conditions — three years, combined (July 1, 2011, through June 30, 2014).

Please see Table 9 for the national performance of benchmark and peer hospitals on these test metrics.

Table 9: National Performance Comparisons (All Classes)

Performance Measure	Medians		Benchmark Compared With Peer Group		
	Winning Benchmark Hospital	Nonwinning Peer Group of U.S. Hospitals	Difference	Percent Difference	Comments
30-Day CABG Mortality Rate[1]	3.1	3.1	0.0	n/a[4]	No Difference
30-Day CABG Readmission Rate[1]	14.7	14.9	-0.2	n/a[4]	Fewer 30-Day Readmissions
30-Day Hospital-Wide Readmission Rate[3]	14.6	15.2	-0.6	n/a[4]	Fewer 30-Day Readmissions
Central Line-Associated Blood Stream Infections (CLABSI) Rate[2]	0.3	0.4	-0.1	n/a[4]	Fewer Infections
Catheter-Associated Urinary Tract Infections (CAUTI) Rate[2]	0.9	1.0	-0.1	n/a[4]	Fewer Infections
Surgical Site Infection From Colon Surgery Rate[2]	0.8	0.8	0.0	n/a[4]	No Difference
Surgical Site Infection From Abdominal Hysterectomy Rate[2]	0.7	0.8	-0.1	n/a[4]	Fewer Infections
Clostridium Difficile (C.Diff.-Intestinal) Rate[2]	0.7	0.8	-0.1	n/a[4]	Fewer Infections
Methicillin-Resistant Staphylococcus Aureus (MRSA-Bloodstream) Rate[2]	0.8	0.8	0.0	n/a[4]	No Difference
AMI 30-Day Episode Payment ($)[1]	22,299	22,017	282	1.3%	Higher Episode Payment
HF 30-Day Episode Payment ($)[1]	15,616	15,327	289	1.9%	Higher Episode Payment
Pneumonia 30-Day Episode Payment ($)[1]	14,236	14,360	-124	-0.9%	Lower Episode Payment

1. 30-day CABG mortality, 30-day CABG readmissions, and 30-day episode payment metrics from CMS Hospital Compare July 1, 2011–June 30, 2014, dataset.
2. Healthcare-Associated Infections (HAIs) from CMS Hospital Compare Oct. 1, 2013–Sept. 30, 2014, dataset.
3. Hospital-wide 30-day readmissions from CMS Hospital compare July 1, 2013–June 30, 2014, dataset.
4. We do not calculate percent difference for this measure because it is already a percent value.

Methodology

Truven Health 100 Top Hospitals® is a quantitative study that annually identifies 100 U.S. hospitals with the highest achievement on a balanced scorecard. The 100 Top Hospitals balanced scorecard, based on Norton and Kaplan's[28] concept, consists of 11 measures distributed across seven domains — inpatient outcomes, process of care, extended outcomes, process efficiency, cost efficiency, financial health, and patient experience — and uses only publicly available data. The hospitals with the highest ranking on a composite score of the 11 measures are the highest-achieving hospitals. This study includes only short-term, nonfederal, acute care U.S. hospitals that treat a broad spectrum of patients.

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

- Building the database of hospitals, including special selection and exclusion criteria
- Classifying hospitals into comparison groups by size and teaching status
- Scoring hospitals on a balanced scorecard of 11 performance measures across seven domains
- Determining 100 Top Hospitals by ranking hospitals relative to their comparison group

The following section is intended to be an overview of these steps. To request more detailed information on any of the study methodologies outlined here, please email **100tophospitals@truvenhealth.com** or call +1.800.366.7526.

Note: This section details the methods used to determine the 100 Top Hospitals award winners. For details on the methods used to select the Everest Award winners, please see the Everest Awards section of this document.

Building the Database of Hospitals

The publicly available data used for this study primarily come from:

- Medicare Provider Analysis and Review (MEDPAR) dataset
- Medicare Cost Reports
- Centers for Medicare & Medicaid Services (CMS) Hospital Compare dataset

We used MEDPAR patient-level demographic, diagnosis, and procedure information to calculate mortality, complications, and length of stay (LOS). The MEDPAR dataset contains information on the approximately 15 million Medicare patients discharged annually from U.S. acute care hospitals. In this study, we used the most recent two federal fiscal years of MEDPAR data available — 2013 and 2014 — which include Medicare Advantage (HMO) encounters.[29] Hospitals that file Medicare claims jointly with other hospitals under one provider number were analyzed as one organization.

We, like a multitude of highly respected academic researchers, have used the MEDPAR database for many years. We believe it to be an accurate and reliable source for the types of high-level analyses performed in this study. Performance based on Medicare data has been found to be highly representative of both the inpatient all-payer and the inpatient medical-surgical populations.

Note: To choose the Everest Award winners, we also reviewed the most recent five years of data, 2010 through 2014, to study the rate of change in performance through the years. To read more about the Everest Award methodology, see the special Everest Award section of this document. For specific data sources for each performance measure, see the table on page 39.

We used Medicare Cost Reports to create our 100 Top Hospitals database, which contains hospital-specific demographic information and hospital-specific, all-payer revenue and expense data. 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 to receive reimbursement from Medicare. It should be noted that the Medicare Cost Report includes all hospital costs, not just costs associated with Medicare beneficiaries.

The Medicare Cost Report promotes comparability of costs and efficiency among hospitals in reporting. We used hospital 2014 cost reports published in the federal Healthcare Cost Report Information System (HCRIS) third quarter 2015 dataset for this study. If we did not have a complete 2014 cost report for a hospital, we excluded the hospital from the study.

In this study, we used CMS Hospital Compare datasets published in the second and third quarters of 2015 for core measures, 30-day mortality rates, 30-day readmission rates, emergency department (ED) throughput medians, Medicare spend per beneficiary (MSPB) index, and Hospital Consumer Assessment of Healthcare Providers and Systems (HCAHPS) patient experience of care data. We also used residency program information to classify hospitals. This comes from the American Medical Association (Accreditation Council for Graduate Medical Education [ACGME]-accredited programs)[30] and the American Osteopathic Association (AOA).[31]

Severity-Adjustment Models and Present-on-Admission (POA) Data

The Truven Health proprietary risk- and severity-adjustment models for mortality, complications, and LOS were recalibrated this release using federal fiscal year (FFY) 2013 data available in the Truven Health all-payer Projected Inpatient Database (PIDB). The PIDB is one of the largest U.S. inpatient all-payer databases of its kind, containing approximately 23 million inpatient discharges annually, obtained from approximately 3,700 hospitals, which comprise more than 65 percent of the non-federal U.S. hospital market. Truven Health risk- and severity-adjustment models take advantage of available POA coding that is reported in all-payer data. Only patient conditions that are present on admission are used to determine the probability of death, complications, or expected LOS.

The recalibrated models were used in producing the risk-adjusted mortality and complications indexes, based on two years of MEDPAR data (2013 and 2014). The severity-adjusted LOS was produced based on MEDPAR 2014 data.

Hospital Exclusions

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

- Specialty hospitals (e.g., critical access, children's, women's, psychiatric, substance abuse, rehabilitation, cardiac, orthopedic, heart, cancer, and long-term acute care)
- Federally owned hospitals
- Non-U.S. hospitals (such as those in Puerto Rico, Guam, and the U.S. Virgin Islands)
- Hospitals with fewer than 25 acute care beds
- Hospitals with fewer than 100 Medicare patient discharges in FFY 2014
- Hospitals with Medicare average LOS (ALOS) longer than 25 days in FFY 2014
- Hospitals with no reported Medicare patient deaths in FFY 2014
- Hospitals for which a 2014 Medicare Cost Report was not available
- Hospitals with a 2014 Medicare Cost Report that was not for a 12-month reporting period
- Hospitals that had fewer than 60 percent of patient records with valid POA codes
- Hospitals missing data required to calculate performance measures

In addition, specific patient records were also excluded:

- Patients discharged to another short-term facility (this is done to avoid double-counting)
- Patients who were not at least 65 years old
- Rehabilitation, psychiatric, and substance-abuse patients
- Patients with stays shorter than one day

After all exclusions were applied, 2,769 hospitals were included in the study.

Measures and Methods Changes

POA Coding Adjustments

From 2009 through 2014, we have observed a significant rise in the number of principal diagnosis (PDX) and secondary diagnosis (SDX) codes that do not have a valid POA code in the MEDPAR data files. Since 2011, a code "0" is appearing — apparently in place of missing POA codes. The percentage of diagnosis codes with POA code 0 are displayed in Figure 2 below. This phenomenon has led to an artificial rise in the number of conditions that appear to be occurring during the hospital stay.

Figure 2: Trend in Diagnosis Codes With POA Code O

	2010	2011	2012	2013	2014
PDX	0.00%	4.26%	4.68%	4.37%	3.40%
SDX	0.00%	15.05%	19.74%	22.10%	21.58%

To correct for this bias, we adjusted MEDPAR record processing through our mortality, complications, and LOS risk models as follows:

- We treated all diagnosis codes on the CMS exempt list as "exempt," regardless of POA coding
- We treated all principal diagnoses as present on admission
- We treated secondary diagnoses, where POA code Y or W appeared more than 50 percent of the time in the Truven Health all-payer database, as present on admission

Patient Safety Indicator Removed From Study

This year, we have removed the Agency for Healthcare Research and Quality (AHRQ) patient safety metrics from the 100 Top Hospitals study for further evaluation due to concerns that many of the metrics reflect inaccurate coding and documentation rather than adverse patient safety incidents. The concerns were first raised by the Institute of Medicine and more recently amplified in peer-reviewed journals in regard to the Patient Safety Composite (Patient Safety Indicator, or PSI, 90) and some of the included PSIs. Because of the importance of patient safety, we will complete a thorough analysis of the patient safety metrics to ensure that national comparisons are accurate and actionable. The results will be published in our next 100 Top Hospitals program study.

DNR Exclusion Added

The Truven Health mortality risk model now excludes records with "do not resuscitate" (DNR) (v49.86) orders that are coded as present on admission. Excluding records that are DNR status at admission removes these high-probability-of-death patients from the analysis and allows hospitals to concentrate more fully on events that could lead to deaths during the hospitalization.

* Truven Health asked AHRQ to clarify how the PSI models treated POA coding. The response included the following statement: "A condition is considered to be POA only if the diagnosis is listed with a POA code of Y or W. A code of N,U,E,1,X or Missing is considered not POA."

Classifying Hospitals Into Comparison Groups

Bed size, teaching status, and extent of 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 important to evaluate it against other similar hospitals. To address this, we assigned each hospital in our study to one of five comparison groups, or classes, according to its size and teaching status.

Our classification methodology draws a significant distinction between major teaching hospitals and teaching hospitals by reviewing the number and type of teaching programs, and by accounting for level of involvement in physician education and research through evidence of program sponsorship versus simple participation. This methodology de-emphasizes the role of bed size and focuses more on teaching program involvement. Using this approach, we seek to measure both the depth and breadth of teaching involvement and recognize teaching hospitals' tendencies to reduce beds and concentrate on true tertiary care.

Our formula for defining the teaching comparison groups includes each hospital's bed size, residents*-to-acute-care beds ratio, and involvement in graduate medical education (GME) programs accredited by either the ACGME[30] or the AOA.[31] The definition includes both the number of programs and type (sponsorship or participation) of GME program involvement. In this study, AOA residency program involvement is treated as being equivalent to ACGME program sponsorship.

The five comparison groups and their parameters are as follows:

Major Teaching Hospitals

There are three ways to qualify:

1. 400 or more acute care beds in service, plus a resident†-per-bed ratio of at least 0.25, plus:
   - Sponsorship of at least 10 GME programs, or
   - Involvement in at least 20 programs overall
2. Involvement in at least 30 GME programs overall (regardless of bed size or resident*-per-bed ratio)
3. A resident*-per-bed ratio of at least 0.60 (regardless of bed size or GME program involvement)

Teaching Hospitals

- 200 or more acute care beds in service, and
- Either a resident*-per-bed ratio of at least 0.03 or involvement in at least three GME programs overall

Large Community Hospitals

- 250 or more acute care beds in service, and
- Not classified as a teaching hospital per definitions above

* We include interns, residents, and fellows reported in full-time equivalents (FTEs) on the hospital cost report.

Medium Community Hospitals

- 100 to 249 acute care beds in service, and
- Not classified as a teaching hospital per definitions above

Small Community Hospitals

- 25 to 99 acute care beds in service, and
- Not classified as a teaching hospital per definitions above

Scoring Hospitals on Weighted Performance Measures

Evolution of Performance Measures

We use a balanced scorecard approach, based on public data, to select the measures most useful for boards and CEOs in the current hospital operating environment. Throughout the life of the study, we have worked diligently to meet this vision. We gather feedback from industry leaders, hospital executives, academic leaders, and internal experts; review trends in the healthcare market; and survey hospitals in demanding marketplaces to learn what measures are valid and reflective of top performance.

As the market has changed, our methods have evolved. Our current measures are centered on seven main components of hospital performance: inpatient outcomes, process of care, extended outcomes, process efficiency, cost efficiency, financial health, and patient experience.

The measures for the 2016 study are:

Inpatient Outcomes

1. Risk-adjusted mortality index (inpatient)
2. Risk-adjusted complications index

Process of Care

3. Core measures mean percent (stroke care and blood clot prevention)

Extended Outcomes

4. Mean 30-day risk-adjusted mortality rate (acute myocardial infarction [AMI], heart failure [HF], pneumonia, chronic obstructive pulmonary disease [COPD], and stroke)
5. Mean 30-day risk-adjusted readmission rate (AMI, HF, pneumonia, hip/knee arthroplasty, COPD, and stroke)

Process Efficiency

6. Severity-adjusted ALOS
7. Mean ED throughput measure

Cost Efficiency

8. Case mix- and wage-adjusted inpatient expense per discharge
9. MSPB index

Financial Health

10. Adjusted operating profit margin

Patient Experience

11. HCAHPS score (patient rating of overall hospital performance)

Following is the rationale for the selection of our balanced scorecard domains and the measures used for each.

Inpatient Outcomes

Our measures of inpatient outcomes include two measures — risk-adjusted mortality index and risk-adjusted complications index. These measures show us how the hospital is performing on the most basic and essential care standards — survival and error-free care — while treating patients in the hospital.

Process of Care

We include two groups of core measures — stroke care and blood clot prevention. These measures were developed by The Joint Commission and CMS, and endorsed by the National Quality Forum (NQF), as minimum basic process-of-care standards. These measures have included specific guidelines for a wide variety of patient conditions, and as compliance has grown, CMS has retired many and replaced them with new ones. Our core measures score is based on the stroke care and blood clot prevention measures, using Hospital Compare data reported on the CMS website.[33] In this study, we include core measures that CMS mandated for reporting in 2014. See Appendix C for a list.

Extended Outcomes

The extended outcomes measures — 30-day mortality rates for AMI, HF, pneumonia, COPD, and stroke patients and 30-day readmission rates for AMI, HF, pneumonia, hip/knee arthroplasty, COPD, and stroke patients — help us understand how a hospital's patients are faring over a longer period. These measures are part of the CMS Value-Based Purchasing program and are watched closely in the industry. Hospitals with lower values appear to be providing or coordinating a continuum of care with better medium-term results for these conditions.

As hospitals become more interested in contracting for population health management, understanding outcomes beyond the walls of the acute care setting is imperative. We are committed to adding new metrics that assess performance along the continuum of care as they become publicly available.

Process Efficiency

The process efficiency domain includes severity-adjusted ALOS and ED throughput measures. ALOS serves as a proxy for clinical efficiency in an inpatient setting, while the ED throughput measures focus on process efficiency in one of the most important access points to hospital care. For ED throughput, we use the mean of the reported median minutes for three critical processes: time from door to admission, time from door to discharge for non-admitted patients, and time-to-receipt of pain medications for broken bones.

Average LOS requires adjustment to increase the validity of comparisons across the hospital industry. We use a Truven Health proprietary severity-adjustment model to determine expected LOS at the patient level. Patient-level observed and expected LOS values are used to calculate the hospital-level, severity-adjusted ALOS.

Cost Efficiency

The cost efficiency domain includes inpatient expense per discharge and the MSPB index. We adjust inpatient expense, as reported on the hospital cost report, for patient severity (Medicare case mix index) and area wage levels (CMS area wage index applied to labor cost). These adjustments allow us to more accurately compare hospitals with different levels of patient severity operating in varying cost-of-living environments. See Appendix C for details on the calculation of this measure.

The MSPB index is a new proxy for continuum-of-care performance, recently added to the study. This measure, as defined and calculated by CMS, is the ratio of Medicare spending per beneficiary treated in a specific hospital and the median Medicare spending per beneficiary, nationally. It includes Medicare Part A and Part B payments three days prior to the hospital stay, during the stay, and 30 days post-discharge. We believe this indicator can be a beginning point for understanding hospital and local area cost performance relative to hospital peer markets.

Financial Health

Currently, we have one measure of hospital financial health: adjusted operating profit margin. The operating profit margin is a measure of management's ability to operate within its current financial constraints and provides an indicator of the hospital's financial health. We adjust operating profit margin for net related organizational expense, as reported on the hospital cost report, to provide a more accurate measure of a hospital's profitability. See Appendix C for details on the calculation of this measure.

Previous studies included measures of hospital liquidity and asset management. We retired these measures as more and more hospitals became a part of health systems. Health system accounting practices often recognize hospitals as units of the system, with no cash or investment assets of their own; a typical practice is to transfer revenue up to the health system accounts daily. Moreover, hospitals in health systems are now often reported as also having no debt in their own name. Using public data, there is no effective way to accurately measure liquidity or other balance sheet-related measures of financial health.

Patient Experience

We believe that a measure of patient perception of care (the patient "experience") is crucial to the balanced scorecard concept. Understanding how patients perceive the care a hospital provides, and how that perception compares and contrasts with perceptions of patients in peer hospitals, is an important step a hospital must take in pursuing performance excellence. For this reason, we calculate an HCAHPS score, based on patient perception-of-care data from the HCAHPS patient survey. In this study, the HCAHPS score is based on the HCAHPS overall hospital rating question only.

A Comprehensive, Balanced View

Through the combined measures described above, we hope to provide a balanced picture of overall hospital performance, which is really a reflection of leadership's ability to consistently improve performance over time and sustain high performance, once achieved. Full details about each of these performance measures are included on the following pages.

Performance Measures

Risk-Adjusted Mortality Index (Inpatient)			
Why We Include This Element	**Calculation**	**Comment**	**Favorable Values Are**
Patient survival is a universally accepted measure of hospital quality. The lower the mortality index, the greater the survival of the patients in the hospital, considering what would be expected based on patient characteristics. While all hospitals have patient deaths, this measure can show where deaths did not occur but were expected, or the reverse, given the patient's condition.	We calculate an index value based on the number of actual in-hospital deaths in 2013 and 2014, divided by the number expected, given the risk of death for each patient. We use our proprietary risk-adjusted mortality index model to determine expected deaths. This model is designed to predict the likelihood of a patient's death based on patient-level characteristics (age, sex, presence of complicating diagnoses, and other characteristics). We normalize the expected value based on the observed and expected deaths for each comparison group. We calculate a normalized index based on the observed and normalized expected deaths and patient count. Palliative care patients (v66.7) are included in the risk model. POA coding is considered in the risk model. Post-discharge deaths are not included. 'DNR' patients (v49.86) are excluded. For more information, see Appendix C. The reference value for this index is 1.00; a value of 1.15 indicates 15 percent more deaths occurred than were predicted, and a value of 0.85 indicates 15 percent fewer deaths than predicted.	We rank hospitals on the difference between observed and expected deaths, expressed in normalized standard deviation units (z-score).[34, 35] Hospitals with the fewest deaths, relative to the number expected, after accounting for standard binomial variability, receive the most favorable scores. We use two years of MEDPAR data (2013 and 2014) to reduce the influence of chance fluctuation. The MEDPAR dataset includes both Medicare fee-for-service claims and Medicare Advantage (HMO) encounter records. Hospitals with observed values statistically worse than expected (99-percent confidence), and whose values are above the high trim point, are not eligible to be named benchmark hospitals. For more details, see Appendix C.	Lower

Risk-Adjusted Complications Index			
Why We Include This Element	**Calculation**	**Comment**	**Favorable Values Are**
Keeping patients free from potentially avoidable complications is an important goal for all healthcare providers. A lower complications index indicates fewer patients with complications, considering what would be expected based on patient characteristics. Like the mortality index, this measure can show where complications did not occur but were expected, or the reverse, given the patient's condition.	We calculate an index value based on the number of cases with complications in 2013 and 2014, divided by the number expected, given the risk of complications for each patient. We use our proprietary expected complications risk index models to determine expected complications. These models account for patient-level characteristics (age, sex, principal diagnosis, comorbid conditions, and other characteristics). Complications rates are calculated from normative data for two patient risk groups: medical and surgical. We normalize the expected value based on the observed and expected complications for each comparison group. POA coding is considered in the risk model. For more details, see Appendix C. The reference value for this index is 1.00; a value of 1.15 indicates 15 percent more complications occurred than were predicted, and a value of 0.85 indicates 15 percent fewer complications than predicted.	We rank hospitals on the difference between the observed and expected number of patients with complications, expressed in normalized standard deviation units (z-score).[34, 35] We use two years of MEDPAR data (2013 and 2014) to reduce the influence of chance fluctuation. The MEDPAR dataset includes both Medicare fee-for-service claims and Medicare Advantage (HMO) encounter records. Hospitals with observed values statistically worse than expected (99-percent confidence), and whose values are above the high trim point, are not eligible to be named benchmark hospitals.	Lower

Core Measures Mean Percent

Why We Include This Element	Calculation	Comment	Favorable Values Are
To be truly balanced, a scorecard must include various measures of quality. Core measures were developed by The Joint Commission and endorsed by the NQF as minimum basic standards. They are a widely accepted method for measuring patient care quality. The reported core measure percent values reflect the percentage of eligible patients who received the expected standard of patient care.	Core measure values are from CMS Hospital Compare. We include data for Oct. 1, 2013, through Sept. 30, 2014, for stroke care and for blood clot prevention measures. For each hospital, we calculate the arithmetic mean of the included core measure percent values. We consider reported core measure percents with patient counts less than or equal to 25, or with relative standard error values greater than or equal to 0.30, statistically unreliable. In these cases, we substitute the comparison group-specific median percent value for the affected core measure.	We rank hospitals by comparison group, based on the mean core measure percent value for included core measures (stroke care, blood clot prevention). Because of low reporting, we exclude a number of core measures for small community hospitals and medium community hospitals. For a list of the measures used and those excluded, please see Appendix C.	Higher

Mean 30-Day Risk-Adjusted Mortality Rate (AMI, HF, Pneumonia, COPD, and Stroke Patients)

Why We Include This Element	Calculation	Comment	Favorable Values Are
30-day mortality rates are a widely accepted measure of the effectiveness of hospital care. They allow us to look beyond immediate inpatient outcomes and understand how the care the hospital provided to inpatients with these particular conditions may have contributed to their longer-term survival. Because these measures are part of the CMS Value-Based Purchasing program, they are now being watched closely in the industry. In addition, tracking these measures may help hospitals identify patients at risk for post-discharge problems, and target improvements in discharge planning and aftercare processes. Hospitals that score well may be better prepared for a pay-for-performance structure.	Data are from the CMS Hospital Compare dataset. CMS calculates a 30-day mortality rate (all-cause deaths within 30 days of admission, per 100 patients) for each patient condition using three years of MEDPAR data, combined. We included data for the July 1, 2011, through June 30, 2014, dataset. CMS does not calculate rates for hospitals where the number of cases is too small (less than 25). In these cases, we substitute the comparison group-specific median rate for the affected 30-day mortality measure. For more information about this data, see Appendix C. We calculate the arithmetic mean of the included 30-day mortality rates (AMI, HF, pneumonia, COPD, and stroke).	We rank hospitals by comparison group, based on the mean rate for included 30-day mortality measures (AMI, HF, pneumonia, COPD, and stroke). The CMS Hospital Compare data for 30-day mortality is based on Medicare fee-for-service claims only. For more information, see Appendix C.	Lower

Mean 30-Day Risk-Adjusted Readmission Rate (AMI, HF, Pneumonia, Hip/Knee Arthroplasty, COPD, and Stroke Patients)

Why We Include This Element	Calculation	Comment	Favorable Values Are
30-day readmission rates are a widely accepted measure of the effectiveness of hospital care. They allow us to understand how the care the hospital provided to inpatients with these particular conditions may have contributed to issues with their post-discharge medical stability and recovery. These measures are now being watched closely in the industry. Tracking these measures may help hospitals identify patients at risk for post-discharge problems if discharged too soon, as well as target improvements in discharge planning and aftercare processes. Hospitals that score well may be better prepared for a pay-for-performance structure.	Data are from the CMS Hospital Compare dataset. CMS calculates a 30-day readmission rate (all-cause readmissions within 30 days of discharge, per 100 patients) for each patient condition using three years of MEDPAR data, combined. We included data for the July 1, 2011, through June 30, 2014, dataset. CMS does not calculate rates for hospitals where the number of cases is too small (less than 25). In these cases, we substitute the comparison group-specific median rate for the affected 30-day readmission measure. For more information about this data, see Appendix C. We calculate the arithmetic mean of the included 30-day readmission rates (AMI, HF, pneumonia, hip/knee arthroplasty, COPD, and stroke).	We rank hospitals by comparison group, based on the mean rate for included 30-day readmission measures (AMI, HF, pneumonia, hip/knee arthroplasty, COPD, and stroke). The CMS Hospital Compare data for 30-day readmissions is based on Medicare fee-for-service claims only. For more information, see Appendix C.	Lower

Severity-Adjusted ALOS

Why We Include This Element	Calculation	Comment	Favorable Values Are
A lower severity-adjusted ALOS generally indicates more efficient consumption of hospital resources and reduced risk to patients.	We used 2014 MEDPAR data for this measure. We calculate an LOS index value by dividing the actual LOS by the normalized expected LOS. Expected LOS adjusts for difference in severity of illness using a linear regression model. We normalize the expected values based on the observed and expected LOS of the hospitals in each comparison group. Each hospital LOS index is converted to an average LOS in days by multiplying by the in-study population grand mean LOS. See Appendix C for more information. POA coding is considered in the severity-adjustment model. For more details, see Appendix C.	We rank hospitals on their severity-adjusted ALOS. We severity-adjust ALOS to factor out differences attributable to the varying severity of illness of patients at each hospital.	Lower

Mean ED Throughput Measure

Why We Include This Element	Calculation	Comment	Favorable Values Are
The hospital emergency department is an important access point to healthcare for many people. A key factor in evaluating ED performance is process "throughput" — measures of the timeliness with which patients receive treatment, and either are admitted or discharged. Timely ED processes impact both care quality and the quality of the patient experience.	Data are from the CMS Hospital Compare dataset. CMS publishes the median minutes for each throughput measure, by calendar year (2014). We include three of the published measures in our calculation of the mean ED throughput measure.	We chose to include three measures that define three important ED processes: time from door to admission, time from door to discharge for non-admitted patients, and time-to-receipt of pain medications for broken bones. For more details, see appendix C.	Lower

Case Mix- and Wage-Adjusted Inpatient Expense per Discharge

Why We Include This Element	Calculation	Comment	Favorable Values Are
This measure helps to determine how efficiently a hospital cares for its patients. Low values indicate lower costs and thus better efficiency.	This measure used Medicare Cost Report data for hospital cost reports ending in calendar year 2014. We calculate the inpatient expense per discharge measure by aggregating the cost center-level inpatient expense from the hospital cost report and dividing by the total acute inpatient discharges, adjusted for case mix and area wage indexes. Inpatient expense for each department is calculated from fully allocated cost using the ratio of inpatient charges to total charges. For inpatient nursing units, this will always be 100 percent of the fully allocated cost. For departments with inpatient and outpatient services, the ratio will vary. Non-reimbursable and special-purpose cost centers are omitted as these have no charges for patient care. See Appendix C for detailed calculations and the Medicare Cost Report locations (worksheet, line, and column) for each calculation element.	Adjusted inpatient expense per discharge measures the hospital's average cost of delivering inpatient care on a per-unit basis. The hospital's CMS-assigned case mix index adjusts inpatient expense to account for differences in patient complexity. The CMS area wage index is applied to labor cost only and accounts for geographic differences in cost of living. We rank hospitals on their adjusted inpatient expense per discharge. Hospitals with extreme outlier values for this measure are not eligible to be named benchmark hospitals (see "Eliminating Outliers" on page 39).	Lower

Medicare Spend per Beneficiary (MSPB) Index Index

Why We Include This Element	Calculation	Comment	Favorable Values Are
Medicare spend per beneficiary helps to determine how efficiently a hospital coordinates the care for its patients across continuum-of-care sites. Lower values indicate lower costs relative to national medians and thus greater efficiency.	We reported the hospital index published in the CMS Hospital Compare public dataset for calendar year 2014. CMS aggregates costs associated with the index admission from three days preadmission, through inpatient stay, and 30 days post-discharge. This cost is divided by the median national cost. CMS applies both numerator and denominator adjustments. An index value above 1.0 means higher-than-national median cost per beneficiary. An index value below 1.0 means lower-than-national median cost per beneficiary.	We rank hospitals on the MSPB index. CMS calculates the cost of care for each admitted patient including both Medicare Part A and Part B costs.	Lower

Adjusted Operating Profit Margin

Why We Include This Element	Calculation	Comment	Favorable Values Are
Operating profit margin is one of the most straightforward measures of a hospital's financial health. It is a measure of the amount of income a hospital is taking in versus its expenses.	This measure used Medicare Cost Report data for hospital cost reports ending in calendar year 2014. We calculate the adjusted operating profit margin by determining the difference between a hospital's total operating revenue and total operating expense, expressed as a percentage of its total operating revenue, adjusted for net related organizational expense. Total operating revenue is the sum of net patient revenue plus other operating revenue. See Appendix C for detailed calculations and the Medicare Cost Report locations (worksheet, line, and column) for each calculation element.	We adjust hospital operating expense for net related organizational expense to obtain a true picture of the operating costs. Net related organizational expense includes the net of costs covered by the hospital on behalf of another organization and costs covered by another organization on behalf of the hospital. We rank hospitals on their adjusted operating profit margin. Hospitals with extreme outlier values for this measure were not eligible to be named benchmark hospitals (see "Eliminating Outliers" on page 39).	Higher

HCAHPS Score (Patient Rating of Overall Hospital Performance)

Why We Include This Element	Calculation	Comment	Favorable Values Are
We believe that including a measure of patient assessment/perception of care is crucial to the balanced scorecard concept. How patients perceive the care a hospital provides has a direct effect on its ability to remain competitive in the marketplace.	Data are from the CMS Hospital Compare dataset. We included the HCAHPS results for calendar year 2014. We use the HCAHPS survey instrument question, "How do patients rate the hospital, overall?" to score hospitals. Patient responses fall into three categories, and the number of patients in each category is reported as a percent: ▪ Patients who gave a rating of 6 or lower (low) ▪ Patients who gave a rating of 7 or 8 (medium) ▪ Patients who gave a rating of 9 or 10 (high) For each answer category, we assign a weight as follows: 3 equals high or good performance, 2 equals medium or average performance, and 1 equals low or poor performance. We then calculate a weighted score for each hospital by multiplying the HCAHPS answer percent by the category weight. For each hospital, we sum the weighted percent values for the three answer categories. The result is the HCAHPS score.	We rank hospitals based on the weighted percent sum or HCAHPS score. The highest possible HCAHPS score is 300 (100 percent of patients rate the hospital high). The lowest HCAHPS score is 100 (100 percent of patients rate the hospital low). See Appendix C for full details. HCAHPS data are survey data, based on either a sample of hospital inpatients or all inpatients. The dataset contains the question scoring of survey respondents.	Higher

Data Sources and Periods		
Performance Measure	**Current Performance (100 Top Hospitals Award Selection)**	**Five-Year Trend Performance (Everest Award Selection)**
Risk-Adjusted Mortality Index (Inpatient)	MEDPAR FFY 2013 and 2014*	MEDPAR FFY 2009 and 2014*
Risk-Adjusted Complications Index	MEDPAR FFY 2013 and 2014*	MEDPAR FFY 2009 and 2014*
Core Measures Mean Percent (Stroke Care, Blood Clot Prevention)	CMS Hospital Compare Oct. 1, 2013–Sept. 30, 2014	Trend Not Available
Mean 30-Day Mortality Rate** (AMI, HF, Pneumonia, COPD, Stroke)	CMS Hospital Compare July 1, 2011–June 30, 2014	CMS Hospital Compare: Three-Year Datasets Ending June 30 in 2010, 2011, 2012, 2013, 2014
Mean 30-Day Readmission Rate*** (AMI, HF, Pneumonia, Hip/Knee Arthroplasty, COPD, Stroke)	CMS Hospital Compare July 1, 2011–June 30, 2014	CMS Hospital Compare: Three-Year Datasets Ending June 30 in 2010, 2011, 2012, 2013, 2014
Severity-Adjusted ALOS	MEDPAR FFY 2014	MEDPAR FFY 2010–2014
Mean ED Throughput Measure	CMS Hospital Compare Calendar Year (CY) 2014	Trend Not Available
Inpatient Expense per Discharge (Case Mix- and Wage-Adjusted)	HCRIS Medicare Cost Reports Ending in 2014	HCRIS Medicare Cost Reports Ending in 2010–2014
MSPB Index	CMS Hospital Compare CY 2014	Trend Not Available
Adjusted Operating Profit Margin	HCRIS Medicare Cost Reports Ending in 2014	HCRIS Medicare Cost Reports Ending in 2010–2014
HCAHPS Score (Consumers' Overall Hospital Rating)	CMS Hospital Compare CY 2014	CMS Hospital Compare 2010–2014

*Two years of data are combined for each study year data point.
**Trend data for 30-day mortality does not include COPD or stroke.
***Trend data for 30-day readmission does not include hip/knee arthroplasty, COPD or stroke.

Determining the 100 Top Hospitals

Eliminating Outliers

Within each of the five hospital comparison groups, we ranked hospitals based on their performance on each of the measures relative to other hospitals in their group. Prior to ranking, we used three methods of identifying hospitals that were performance outliers. These hospitals were not eligible to be named winners.

Interquartile Range Methodology

We used the interquartile range methodology to identify hospitals with extreme outlier values for the following measures:

- Case mix- and wage-adjusted inpatient expense per discharge (high or low outliers)
- Adjusted operating profit margin (high or low outliers)

This was done to avoid the possibility of hospitals with poor patient safety performance or a high probability of having erroneous cost report data being declared winners.

For more information on the interquartile range methodology, please see Appendix C.

Mortality and Complications Outliers

For mortality and complications, which have observed and expected values, we identify hospitals with performance that is statistically worse than expected. Hospitals that are worse than expected are excluded from consideration when we select the study winners. This is done because we do not want hospitals that have poor clinical outcomes to be declared winners.

A hospital winner is excluded if both of the following conditions apply:

1. Observed value is higher than expected and the difference is statistically significant with 99-percent confidence. When a hospital's observed value is 30 or greater, we use the approximate binomial confidence interval methodology. When a hospital's observed value is less than 30, we use the exact mid-P binomial confidence interval methodology. If the hospital's low confidence interval index value is greater than or equal to 1.0, the hospital is statistically worse than expected with 99-percent confidence.
2. We calculate the 75th percentile index value for mortality and complications, including data only for hospitals that meet condition 1. These values are used as the high trim points for those hospitals. Hospitals with mortality or complications index values above the respective trim points are winner-excluded.

Operating Profit Margin Outliers

We identify hospitals with a negative adjusted operating profit margin as outliers. This is done because we do not want hospitals that fail to meet this very basic financial responsibility to be declared winners.

Ranking

Within the five hospital comparison groups, we rank hospitals on the basis of their performance on each of the performance measures independently, relative to other hospitals in their group. Each performance measure is assigned a weight for use in overall ranking (see table below). Each hospital's performance measure ranks are summed to arrive at a total score for the hospitals. The hospitals are then ranked based on their total scores, and the hospitals with the best overall rankings in each comparison group are selected as the winners.

Measure	Weight
Risk-Adjusted Mortality Index (Inpatient)	1
Risk-Adjusted Complications Index	1
Core Measures Mean Percent (Stroke Care, Blood Clot Prevention)	1
Mean 30-Day Mortality Rate (AMI, HF, Pneumonia, COPD, Stroke)	1
Mean 30-Day Readmission Rate (AMI, HF, Pneumonia, Hip/Knee Arthroplasty, COPD, Stroke)	1
Severity-Adjusted ALOS	1
Mean ED Throughput Measure	1
Inpatient Expense per Discharge (Case Mix- and Wage-Adjusted)	1/2
MSPB Index	1/2
Adjusted Operating Profit Margin	1
HCAHPS Score (Consumers' Overall Hospital Rating)	1

This study hospital population includes:

Comparison Group	Number of Winners	Number of Nonwinners	Total Hospitals in Study
Major Teaching Hospitals	15	187	202
Teaching Hospitals	25	404	429
Large Community Hospitals	20	307	327
Medium Community Hospitals	20	930	950
Small Community Hospitals	20	841	861
All Hospitals	**100**	**2,669**	**2,769**

Appendix A

Distribution of Winners by State and Region*

State	Number of Winners	
	Current Study	Previous Study
Alabama	0	0
Alaska	0	0
Arizona	1	2
Arkansas	0	0
California	8	14
Colorado	3	3
Connecticut	0	0
Delaware	1	1
District of Columbia	0	0
Florida	4	3
Georgia	1	3
Hawaii	0	0
Idaho	2	1
Illinois	8	10
Indiana	4	4
Iowa	3	3
Kansas	2	2
Kentucky	0	0
Louisiana	1	0
Maine	0	0
Maryland**	0	0
Massachusetts	0	2
Michigan	7	4
Minnesota	4	7
Mississippi	0	0
Missouri	2	3
Montana	2	1
Nebraska	0	0
Nevada	1	1
New Hampshire	0	0
New Jersey	0	0

State	Number of Winners	
	Current Study	Previous Study
New Mexico	0	0
New York	1	0
North Carolina	2	2
North Dakota	0	0
Ohio	11	10
Oklahoma	0	0
Oregon	1	1
Pennsylvania	3	1
Rhode Island	0	0
South Carolina	3	3
South Dakota	0	0
Tennessee	2	1
Texas	8	5
Utah	6	7
Vermont	0	0
Virginia	1	1
Washington	1	0
West Virginia	0	0
Wisconsin	7	5
Wyoming	0	0

U.S. Census Region	Number of Winners	
	Current Study	Previous Study
Northeast	4	3
Midwest	48	48
South	23	19
West	25	30

* For a listing of states within each U.S. Census region, see Appendix B.
** Maryland hospitals are winner-excluded for missing measures (no POA coding prior to FFY 2014; no MSPB index).

Appendix B States Included in Each U.S. Census Region

Northeast	Midwest	South	West
Connecticut	Illinois	Alabama	Alaska
Maine	Indiana	Arkansas	Arizona
Massachusetts	Iowa	Delaware	California
New Hampshire	Kansas	District of Columbia	Colorado
New Jersey	Michigan	Florida	Hawaii
New York	Minnesota	Georgia	Idaho
Pennsylvania	Missouri	Kentucky	Montana
Rhode Island	Nebraska	Louisiana	Nevada
Vermont	North Dakota	Maryland	New Mexico
	Ohio	Mississippi	Oregon
	South Dakota	North Carolina	Utah
	Wisconsin	Oklahoma	Washington
		South Carolina	Wyoming
		Tennessee	
		Texas	
		Virginia	
		West Virginia	

Appendix C: Methodology Details

Methods for Identifying Patient Severity

Without adjusting for differences in patient severity, comparing outcomes among hospitals does not present an accurate picture of performance. To make valid normative comparisons of hospital outcomes, we must adjust raw data to accommodate differences that result from the variety and severity of admitted cases.

Truven Health Analytics™ 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 to adjust for severity within clinical case-mix groupings. Conceptually, we group patients with similar characteristics (e.g., age, sex, principal diagnosis, procedures performed, admission type, and comorbid conditions) to produce expected, or normative, comparisons. 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.[36]

To support the transition from ICD-9-CM to ICD-10-CM, our risk- and severity-adjustment models have been modified to use the Agency for Healthcare Research and Quality (AHRQ) Clinical Classifications Software (CCS)[37] categories for risk assignment. CCS categories are defined in both coding languages with the intent of being able to accurately compare ICD-9 categories with ICD-10 categories. Calibrating our models using CCS categories provides the flexibility to accept and process patient record data in either ICD-9 or ICD-10 coding formats, and produces consistent results in risk and severity adjustment.

The CCS-based approach applies to all Truven Health proprietary models that use code-based rate tables, which include the Risk-Adjustment Mortality Model (RAMI), Expected Complication Risk Index (ECRI), and Patient Financial Data/Expected Resource Demand (PFD/ERD) Length-of-Stay (LOS) models used in this study.

Normative Database Development

Truven Health constructed a normative database of case-level data from its Projected Inpatient Database (PIDB), a national, all-payer database containing more than 23 million all-payer discharges annually. These data are obtained from approximately 3,700 hospitals, representing more than half of all discharges from short-term, general, nonfederal hospitals in the U.S. PIDB discharges are statistically weighted to represent the universe of that population. Demographic and clinical data are also included: age, sex, and LOS; clinical groupings (Medicare Severity Diagnosis-Related Groups, or MS-DRGs), ICD-9-CM principal and secondary diagnoses, and ICD-9-CM principal and secondary procedures; present-on-admission (POA) coding; admission source and type; and discharge status. For this study, risk models were recalibrated using FFY 2013 all-payer data.

Use of POA Data

Under the Deficit Reduction Act of 2005, as of FFY 2008, hospitals receive reduced payments for cases with certain conditions — such as falls, surgical site infections, and pressure ulcers — that were not present at the time of the patient's admission but occurred during hospitalization. As a result, the Centers for Medicare & Medicaid Services (CMS) now requires all Inpatient Prospective Payment System hospitals to document whether a patient has these and other conditions when admitted. The Truven Health proprietary risk-adjustment models for mortality, complications, and LOS take into account POA data reported in the all-payer data. Our risk models develop expected values based only on conditions that were present on admission.

In addition to considering the POA coding data in calibration of our risk- and severity-adjustment models, we also have adjusted for missing/invalid POA coding found in the Medicare Provider Analysis and Review (MEDPAR) data files. From 2009 through 2014, we have observed a significant rise in the number of principal diagnosis (PDX) and secondary diagnosis (SDX) codes that do not have valid POA codes in the MEDPAR data files. Since 2011, a code of "0" is appearing — apparently in place of missing POA codes. The percentage of diagnosis codes with POA code 0 are displayed in the table below. This phenomenon has led to an artificial rise in the number of conditions that appear to be occurring during the hospital stay.

	2010	2011	2012	2013	2014
PDX	0.00%	4.26%	4.68%	4.37%	3.40%
SDX	0.00%	15.05%	19.74%	22.10%	21.58%

To correct for this bias, we adjusted MEDPAR record processing through our mortality, complications, and LOS risk models as follows:

1. We treated all diagnosis codes on the CMS exempt list as "exempt," regardless of POA coding
2. We treated all principal diagnoses as present on admission
3. We treated secondary diagnoses, where POA code Y or W appeared more than 50 percent of the time in the Truven Health all-payer database, as present on admission

Risk-Adjusted Mortality Index Models

Truven Health has developed an overall mortality risk model. We exclude long-term care, psychiatric, substance abuse, rehabilitation, and federally owned or controlled facilities. In addition, we exclude certain patient records from the dataset: psychiatric, substance abuse, rehabilitation, and unclassified cases (MS-DRGs 945, 946, and 999); cases in which patient age was less than 65 years; and cases in which a patient transferred to another short-term, acute care hospital. Palliative care patients (v66.7) are included in the mortality risk model, which is calibrated to determine probability of death for these patients. The Truven Health mortality risk model now excludes records with "do not resuscitate" (DNR) (v49.86) orders that are coded as present on admission. Excluding records that are DNR status at admission removes these high-probability-of-death patients from the analysis and allow hospitals to concentrate more fully on events that could lead to deaths during the hospitalization.

A standard logistic regression model is used to estimate the risk of mortality for each patient. This is done by weighting the patient records of the 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, etc.)[38–42] This model takes into account only patient conditions that are present on admission when calculating risk. Additionally, in response to the upcoming transition to ICD-10-CM, diagnosis and procedure codes, and the interactions among them, have been mapped to AHRQ CCS groups for assignment of risk instead of using the individual diagnosis, procedure, and interaction effects. See the discussion under Methods for Identifying Patient Severity above.

Staff physicians at Truven Health have suggested important clinical patient characteristics that were also incorporated into the proprietary 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 health system, hospital, service line, or MS-DRG classification.

Expected Complications Rate Index Models

Risk-adjusted complications refer to outcomes that may be of concern when they occur at a greater-than-expected rate among groups of patients, possibly reflecting systemic quality-of-care issues. The Truven Health complications model uses clinical qualifiers to identify complications that have occurred in the inpatient setting. The complications used in the model are:

Complication	Patient Group
Postoperative complications relating to urinary tract	Surgical only
Postoperative complications relating to respiratory system, except pneumonia	Surgical only
Gastrointestinal complications following procedure	Surgical only
Infection following injection/infusion	All patients
Decubitus ulcer	All patients
Postoperative septicemia, abscess, and wound infection	Surgical, including cardiac
Aspiration pneumonia	Surgical only
Tracheostomy complications	All patients
Complications of cardiac devices	Surgical, including cardiac
Complications of vascular and hemodialysis devices	Surgical only
Nervous system complications from devices/complications of nervous system devices	Surgical only
Complications of genitourinary devices	Surgical only
Complications of orthopedic devices	Surgical only
Complications of other and unspecified devices, implants, and grafts	Surgical only
Other surgical complications	Surgical, including cardiac
Miscellaneous complications	All patients
Cardio-respiratory arrest, shock, or failure	Surgical only
Postoperative complications relating to nervous system	Surgical only
Postoperative AMI	Surgical only
Postoperative cardiac abnormalities, except AMI	Surgical only
Procedure-related perforation or laceration	All patients
Postoperative physiologic and metabolic derangements	Surgical, including cardiac

Complication	Patient Group
Postoperative coma or stupor	Surgical, including cardiac
Postoperative pneumonia	Surgical, including cardiac
Pulmonary embolism	All patients
Venous thrombosis	All patients
Hemorrhage, hematoma, or seroma complicating a procedure	All patients
Postprocedure complications of other body systems	All patients
Complications of transplanted organ (excludes skin and cornea)	Surgical only
Disruption of operative wound	Surgical only
Complications relating to anesthetic agents and central nervous system depressants	Surgical, including cardiac
Complications relating to antibiotics	All patients
Complications relating to other anti-infective drugs	All patients
Complications relating to antineoplastic and immunosuppressive drugs	All patients
Complications relating to anticoagulants and drugs affecting clotting factors	All patients
Complications relating to blood products	All patients
Complications relating to narcotics and related analgesics	All patients
Complications relating to non-narcotic analgesics	All patients
Complications relating to anticonvulsants and antiparkinsonism drugs	All patients
Complications relating to sedatives and hypnotics	All patients
Complications relating to psychotropic agents	All patients
Complications relating to CNS stimulants and drugs affecting the autonomic nervous system	All patients
Complications relating to drugs affecting cardiac rhythm regulation	All patients
Complications relating to cardiotonic glycosides (digoxin) and drugs of similar action	All patients
Complications relating to other drugs affecting the cardiovascular system	All patients
Complications relating to antiasthmatic drugs	All patients
Complications relating to other medications (includes hormones, insulin, iron, and oxytocic agents)	All patients

A standard regression model is used to estimate the risk of experiencing a complication for each patient. This is done by weighting the patient records of the hospital by the regression coefficients associated with the corresponding terms in the prediction models and intercept term. This method produces the expected probability of a complication for each patient based on the experience of the norm for patients with similar characteristics. After assigning the predicted probability of a complication for each patient in each risk group, it is then possible to aggregate the patient-level data across a variety of groupings,[43-46] including health system, hospital, service line, or MS-DRG classification. This model takes into account only patient conditions that are present on admission when calculating risk. Additionally, in response to the upcoming transition to ICD-10-CM, diagnosis and procedure codes, and the interactions among them, have been mapped to AHRQ CCS for assignment of risk instead of using the individual diagnosis, procedure, and interaction effects.

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 that 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 number based on the normative experience. An index value of 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 line).

Core Measures

Core measures were developed by The Joint Commission and endorsed by the National Quality Forum (NQF), the nonprofit public-private partnership organization that endorses national healthcare performance measures, as minimum basic care standards. They have been a widely accepted method for measuring quality of patient care that includes specific guidelines for a wide variety of patient conditions. CMS no longer requires reporting of the core measures formerly used in the study — acute myocardial infarction (AFI), pneumonia, and Surgical Care Improvement Project (SCIP) measures — so these have been dropped. In their place, we are now including the stroke care and blood clot prevention core measures in our composite core measures mean percent metric. The data in this study are for Oct. 1, 2013, through Sept. 30, 2014.

In calculating each hospital's core measures mean percent, the comparison group median core measure value was substituted for a missing core measure. In addition, the comparison group median core measure value was substituted when the hospital reported core measures with patient counts less than or equal to 25 or with relative standard error greater than or equal to 0.30. This was done because the original reported values were considered statistically unreliable.

Stroke Care Core Measures	
STK-1	Ischemic or hemorrhagic stroke patients who received treatment to keep blood clots from forming anywhere in the body within two days of arriving at the hospital
STK-4**	Ischemic stroke patients who received medicine to break up a blood clot within three hours after symptoms started
STK-6	Ischemic stroke patients needing medicine to lower cholesterol, who were given a prescription for this medicine before discharge
STK-8*	Ischemic or hemorrhagic stroke patients or caregivers who received written educational materials about stroke care and prevention during the hospital stay

Blood Clot Prevention and Treatment Core Measures	
VTE-1	Patients who received treatment to prevent blood clots on the day of or day after hospital admission or surgery
VTE-2	Patients who received treatment to prevent blood clots on the day of or day after being admitted to the intensive care unit
VTE-3	Patients with blood clots who received the recommended treatment, which includes using two different blood thinner medicines at the same time
VTE-5*	Patients with blood clots who were discharged on a blood thinner medicine and received written instructions about that medicine
VTE-6**	Patients who developed a blood clot while in the hospital who did not get treatment that could have prevented it

30-Day Risk-Adjusted Mortality Rates and 30-Day Risk-Adjusted Readmission Rates

This study currently includes two extended outcome measures — 30-day mortality and 30-day readmissions, as developed by the CMS and published in the Hospital Compare dataset. The longitudinal data period contained in this analysis is July 1, 2011, through June 30, 2014. The Hospital Compare website and database were created by CMS, the U.S. Department of Health and Human Services, and other members of the Hospital Quality Alliance. The data on the website come from hospitals that have agreed to submit quality information that will be made public. Both of the measures used in this study have been endorsed by the NQF.

CMS calculates the 30-day mortality and 30-day readmission rates from Medicare enrollment and claims records using sophisticated statistical modeling techniques that adjust for patient-level risk factors and account for the clustering of patients within hospitals. Only Medicare fee-for-service records are included. We are including 30-day mortality rates for AMI, HF, pneumonia, chronic obstructive pulmonary disease (COPD), and stroke patients, and 30-day readmission rates for AMI, HF, pneumonia, elective total hip or knee arthroplasty, COPD, and stroke patients.

The individual CMS mortality models estimate hospital-specific, risk-standardized, all-cause 30-day mortality rates for patients hospitalized with a principal diagnosis of AMI, HF, pneumonia, COPD, or stroke. All-cause mortality is defined as death from any cause within 30 days after the admission date, regardless of whether the patient dies while still in the hospital or after discharge.

* We did not include this measure for small community hospitals due to very low reporting.
** We did not include this measure for small and medium community hospitals due to very low reporting.

The individual CMS readmission models estimate hospital-specific, risk-standardized, all-cause 30-day readmission rates for patients discharged alive to a non-acute care setting with a principal diagnosis of AMI, HF, pneumonia, elective total hip or knee arthroplasty, COPD, or stroke. Patients may have been readmitted back to the same hospital, to a different hospital, or to an acute care facility. They may have been readmitted for the same condition as their recent hospital stay or for a different reason (this is to discourage hospitals from coding similar readmissions as different readmissions).[40] All readmissions that occur 30 days after discharge to a non-acute care setting are included, with a few exceptions. CMS does not count planned admissions (obstetrical delivery, transplant surgery, maintenance chemotherapy, rehabilitation, and non-acute admissions for a procedure) as readmissions.

Length-of-Stay Methodologies

We use the Truven Health proprietary severity-adjusted resource demand methodology for the length of stay (LOS) performance measure. The LOS severity-adjustment model is calibrated using our normative PIDB — a national, all-payer database containing more than 27 million all-payer discharges annually, described in more detail at the beginning of this appendix.

Our severity-adjusted resource demand model allows us to produce risk-adjusted performance comparisons on LOS between or across virtually any subgroup of inpatients. These patient groupings can be based on clinical groupings, hospitals, product lines, geographic regions, physicians, etc. This regression model adjusts for differences in diagnosis type and illness severity, based on ICD-9-CM coding. It also adjusts for patient age, gender, and admission status. Its associated LOS weights allow group comparisons on a national level and in a specific market area. In response to the upcoming transition to ICD-10-CM, diagnosis, procedure, and interaction codes have been mapped to AHRQ CCS for severity assignment instead of using the individual diagnosis, procedure, and interaction effects.

POA coding allows us to determine appropriate adjustments to LOS weights based on pre-existing conditions versus complications that occurred during hospital care. We calculate expected values from model coefficients that are normalized to the clinical group and transformed from log scale.

ED Throughput Measure

New to our study this year as a ranked metric, we have included three emergency department (ED) throughput measures from the CMS Hospital Compare dataset. The hospital ED is an important access point to healthcare for many people. A key factor in evaluating ED performance is process "throughput" — measures of timeliness with which patients are seen by a provider, receive treatment, and either are admitted or discharged. Timely ED processes impact both care quality and the quality of the patient experience. We chose to include measures that define three important ED processes: time from door to admission, time from door to discharge for non-admitted patients, and time-to-receipt of pain medications for broken bones.

The measure data from CMS Hospital Compare is published in median minutes and is based on calendar year (2014) data. Our ranked metric is the calculated mean of the three included measures. The hospital's comparison group median ED measure value was substituted for a missing measure for the purpose of calculating the composite measure. Hospitals missing all three included measures were excluded from the study.

ED Throughput Measures	
ED-1b	Average time patients spent in the ED before they were admitted to the hospital as an inpatient
OP-18b	Average time patients spent in the ED before being sent home
OP-21	Average time patients who came to the ED with broken bones had to wait before receiving pain medication

Inpatient Expense per Discharge and Operating Profit Margin Measure Calculations

A number of our calculations include data from the Medicare Cost Report. Below you will find our calculations and the cost report locations (worksheet, line, and column) for all of these items. The following apply to the 100 Top Hospitals study and the hospital Medicare Cost Report for the hospital fiscal year ending in 2014. The line and column references are the standard based on CMS Form 2552-10. Any deviations from this standard are checked by system and manual data analysis to ensure coding has been done properly.

MSPB Index

The Medicare spend per beneficiary (MSPB) index is included as a proxy for episode-of-care cost efficiency for hospitalized patients. CMS develops and publishes this risk-adjusted index in the public Hospital Compare datasets, and in FFY 2015, it began to be included in the Value-Based Purchasing program. The CMS-stated reason for including this measure is "...to reward hospitals that can provide efficient care at a lower cost to Medicare." In this study, we are using data for calendar year 2014.

The MSPB index evaluates hospitals' efficiency relative to the efficiency of the median hospital, nationally. Specifically, the MSPB index assesses the cost to Medicare of services performed by hospitals and other healthcare providers during an MSPB episode, which comprises the period three days prior to, during, and 30 days following a patient's hospital stay. Payments made by Medicare and the beneficiary (i.e., allowed charges) are counted in the MSPB episode as long as the start of the claim falls within the episode window. Inpatient Prospective Payment System (IPPS) outlier payments (and outlier payments in other provider settings) are also included in the calculation of the MSPB index. The index is available for Medicare beneficiaries enrolled in Medicare Parts A and B who were discharged from short-term acute care hospitals during the period of performance. Medicare Advantage enrollees are not included. This measure excludes patients who died during the episode.

The MSPB index is calculated by dividing the profiled hospital's risk-adjusted average episode cost by the national hospital median. The profiled hospital's MSPB amount is the sum of standardized, risk-adjusted spending across all of a hospital's eligible episodes divided by the number of episodes for that hospital. This is divided by the median MSPB amount across all episodes nationally. CMS adjusts spending amounts for area price variation and also for various risk factors including case mix, age, and hierarchical condition category indicators.

Case Mix- and Wage-Adjusted Inpatient Expense per Discharge

[(0.62 × Acute Inpatient Expense ÷ CMS Wage Index) + 0.38 × Acute Inpatient Expense) ÷ Acute Inpatient Discharges] ÷ Medicare Case Mix Index

Acute Inpatient Expense = Inpatient Expense − Subprovider Expense − Nursing Expense − Skilled Nursing Facility Expense − Intermediate-Care Facility Expense − Other Long-Term Care Facility Expense − Cost Centers Without Revenue (e.g., Organ Procurement, Outpatient Therapy, Other Capital-Related Costs, etc.)

Inpatient Expense = Sum Over All Departments
[(Inpatient Department Charges ÷ Department Charges) × Department Cost]

Individual Element Locations in the Medicare Cost Report:

- Acute Inpatient Discharges — Worksheet S-3, Line 14, Column 15
- Inpatient Department (Cost Center) elements
  - Fully Allocated Cost — Worksheet C, Part 1, Column 1; If Missing, Use Worksheet B, Part 1, Column 26
  - Total Charges — Worksheet C, Part 1, Column 8
  - Inpatient Charges — Worksheet C, Part 1, Column 6
- Medicare Case Mix Index — Federal Register:
  CMS IPPS FFY 2014 Final Rule Table 2 (Cost Report End Dates in 2014 Q1, Q2, Q3)
  or IPPS FFY 2015, Table 2 (Cost Report End Dates in 2014 Q4)
- CMS Wage Index — CMS Federal Register:
  CMS IPPS FFY 2014 (Cost Report End Dates in 2014 Q1, Q2, Q3)
  or IPPS FFY 2015, Table 2 (Cost Report End Dates in 2014 Q4

Adjusted Operating Profit Margin

[(Net Patient Revenue + Other Operating Revenue − (Total Operating Expense + Net Related Organization Expense)) ÷ (Net Patient Revenue + Other Operating Revenue)] × 100

Other Operating Revenue = [Total Other Income − Other Income: Contributions, Donations, etc. − Other Income From Investments]

Individual Element Locations in the Medicare Cost Report:

- Net Patient Revenue — Worksheet G-3, Line 3, Column 1
- Total Other Income — Worksheet G-3, Line 25, Column 1
- Other Income: Contributions, Donations, Etc. — Worksheet G-3, Line 6, Column 1
  Other Income From Investments — Worksheet G-3, Line 7, Column 1
- Total Operating Expense — Worksheet G-3, Line 4, Column 1
- Related Organization Expense — Worksheet A-8, Line 12, Column 2

HCAHPS Overall Hospital Rating

To measure patient perception of care, this study uses the Hospital Consumer Assessment of Healthcare Providers and Systems (HCAHPS) patient survey. HCAHPS is a standardized survey instrument and data collection methodology for measuring patients' perspectives on their hospital care. HCAHPS is a core set of questions that can be combined with customized, hospital-specific items to produce information that complements the data hospitals currently collect to support internal customer service and quality-related activities.

HCAHPS was developed through a partnership between CMS and AHRQ that had three broad goals:

- Produce comparable data on patients' perspectives of care that allow objective and meaningful comparisons among hospitals on topics that are important to consumers
- Encourage public reporting of the survey results to create incentives for hospitals to improve quality of care
- Enhance public accountability in healthcare by increasing the transparency of the quality of hospital care provided in return for the public investment

The HCAHPS survey has been endorsed by the NQF and the Hospital Quality Alliance. The federal government's Office of Management and Budget has approved the national implementation of HCAHPS for public reporting purposes.

Voluntary collection of HCAHPS data for public reporting began in October 2006. The first public reporting of HCAHPS results, which encompassed eligible discharges from October 2006 through June 2007, occurred in March 2008. HCAHPS results are posted on the Hospital Compare website, found at **hospitalcompare.hhs.gov** or through a link on **medicare.gov**. A downloadable version of HCAHPS results is available.

For this study, we used Hospital Compare data for calendar year 2014. Although we are reporting hospital performance on all HCAHPS questions, only performance on the overall hospital rating question, "How do patients rate the hospital, overall?" is used to rank hospital performance. Patient responses fall into three categories, and the number of patients in each category is reported as a percent:

- Patients who gave a rating of 6 or lower (low)
- Patients who gave a rating of 7 or 8 (medium)
- Patients who gave a rating of 9 or 10 (high)

For each answer category, we assign a weight as follows: 3 equals high or good performance, 2 equals medium or average performance, and 1 equals low or poor performance. We then calculate a weighted score for each hospital by multiplying the HCAHPS answer percent by the category weight. For each hospital, we sum the weighted percent values for the three answer categories. Hospitals are then ranked by this weighted percent sum. The highest possible HCAHPS score is 300 (100 percent of patients rate the hospital high). The lowest possible HCAHPS score is 100 (100 percent of patients rate the hospital low).

Performance Measure Normalization

The mortality, complications, and LOS measures are normalized based on the in-study population and by comparison group to provide a more easily interpreted comparison among hospitals. To address the impact of bed size and teaching status, including extent of residency program involvement, and compare hospitals to other like hospitals, we assign each hospital in the study to one of five comparison groups (major teaching, teaching, large community, medium community, and small community hospitals). Detailed descriptions of the patient and hospital comparison groups can be found in the Methodology section of the 100 Top Hospitals study.

For the mortality and complications measures, we base our ranking on the difference between observed and expected events, expressed in standard deviation units (z-scores) that have been normalized. We normalize the individual hospital expected values by multiplying them by the observed-to-expected ratio for their comparison group. We then calculate the normalized z-score based on the observed and normalized expected values and the patient count.

For the LOS measure, we base our ranking on the normalized, severity-adjusted LOS index expressed in days. This index is the ratio of the observed and the normalized expected values for each hospital. We normalize the individual hospital's 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. We convert this normalized index into days by multiplying by the average LOS of all in-study hospitals (grand mean LOS).

Interquartile Range Methodology

For each measure, we calculate an interquartile range (IQR) based on data for all in-study hospitals. Two outlier points (trim points) are set for each measure: one upper limit and one lower limit.

A value (X) is considered an outlier if either of the following is true:

X > = Upper-Limit Outlier Point

X < = Lower-Limit Outlier Point

The procedure for calculating the IQR and outlier points is as follows:

- Determine the first quartile (Q1). This is the 25th percentile value of all records in the population.
- Determine the third quartile (Q3). This is the 75th percentile value of all records in the population.
- Calculate the IQR by subtracting Q1 from Q3 (IQR = Q3 – Q1).
- Calculate the upper- and lower-limit trim points for inpatient expense per discharge:
  - Upper Limit = Q3 + (3.0 × IQR)
  - Lower Limit = Q1 – (3.0 × IQR)
- Calculate the upper- and lower-limit trim points for operating profit margin:
  - Upper Limit = Q3 + (2.0 × IQR)
  - Lower Limit = Q1 – (2.0 × IQR)

Data points outside the IQR limits are considered to be extreme outliers and are excluded.

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.[47]

We also do not report percent change when the metrics are already percentages. In these cases, we report the simple difference between the two percentage values.

Protecting Patient Privacy

In accordance with patient privacy laws, we do not report any individual hospital data that are based on 11 or fewer patients. This affects the following measures:

- Risk-adjusted mortality index
- Risk-adjusted complications index
- 30-day mortality rates for AMI, HF, pneumonia, COPD, and stroke (CMS does not report a rate when count is less than 25)
- 30-day readmission rates for AMI, HF, pneumonia, hip/knee arthroplasty, COPD, and stroke (CMS does not report a rate when count is less than 25)
- Average LOS

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