merATIVE

15 Top Health Systems 2022

Study Overview

June 30, 2022

Contents

Introduction 3

2022 15 Top Health Systems Award Winners 7

Findings 8

Methodology 20

Appendix A: Health System Winners And Their Member Hospitals 40

Appendix B: The Top Quintile: Highest Performing Health Systems 43

Appendix C: Methodology Details 46

Appendix D: All Health Systems In Study 60

References And Footnotes 60

Introduction

Welcome to the 14th edition of the 15 Top Health Systems study.

This year's study marks another milestone in the 100 Top Hospitals® program's rich history: 14 years of publishing an annual quantitative study designed to shine a light on the nation's highest-performing health systems.

Our research of US health system performance began with the same goal that has driven each study since the beginning of the 100 Top Hospitals program: To identify top performers and also deliver insights that may help healthcare systems better focus their improvement initiatives on achieving consistent, balanced, and sustainable high performance.

Health systems do not apply for our 15 Top Health Systems selection process, and winners do not pay to market their honor.

Illuminating achievement for a value-based world

Our research is based on clinical, operational, financial, and patient perception-of-care measures that form a balanced scorecard. For over a decade, the health systems achieving excellence on our scorecard inherently set attainable benchmarks for others in the industry to aspire to over time.

Providing these measures of success may be especially important today as we see the healthcare landscape continuing to evolve from fee-for-service toward value-based care models, with many health systems paying closer attention to population health management and system-wide alignment of performance.

By finding ways to take balanced performance to the next level, the winners of our 100 Top Hospitals award are identifying opportunities to deliver healthcare value to patients, communities, and payers. The performance levels achieved by these systems may motivate their peers to use data, analytics, and benchmarks to close performance gaps.

Delivering a robust and transparent assessment

The 15 Top Health Systems scorecard results are divided into two separate sections that graphically illustrate:

- *A health system's performance and improvement versus peer health systems*
- *Cross-system performance alignment of member hospitals*

We have designed this study to provide a view of health system performance across multiple dimensions: how they stand compared to peers and high performers (whole-system performance), where they stand in the evolution of their own cultures of performance improvement (relative long-term improvement and rate of improvement), and the achievement of cross-system performance alignment (member hospital performance).

These collective insights may be used by health system leaders to adjust continuous improvement targets, enrich the collaboration of member hospitals, and track system-wide alignment toward common performance goals.

To maintain the 15 Top Health Systems study's integrity and avoid bias, we use public data sources and explain the methodologies we use to calculate outcome metrics. This approach supports inclusion of systems across the country and facilitates consistency of definitions and data.

Our national balanced scorecard, based on Norton and Kaplan's concept,[1] is the foundation of our research. It is comprised of key measures of hospital performance: inpatient and extended care quality, operational efficiency, and patient experience. The composite score derived from these measures reflects excellence in hospital care, management, and leadership.

In addition, to support consideration of the differences in scale among systems, the study categorizes the nation's systems into three groups: large, medium, and small health systems. This produces benchmarks that are comparable and action-driving across similar systems.

Yielding a measure of leadership excellence

Since 1993, the 100 Top Hospitals program has sought to shed light on the efficacy of innovative leaders. The methodology is aimed at identifying leaders who can transform an organization by pinpointing improvement opportunities and adjusting goals for key performance domains. We believe that higher composite scores on the balanced scorecard typically indicate more effective leadership and a consistent delivery of value.

The leadership of today's health systems, including the board, executive team, and medical staff leadership, is responsible for ensuring all facets of a hospital are performing at similarly high levels in both the short and long term. The 15 Top Health Systems study and analytics provide a view of that enterprise performance alignment.

Comparing the performance of our 2022 winners to nonwinners

Understanding the similarities and differences between high and low performers can help provide benchmarks for the industry. The findings we assemble for this study provide examples of excellence, as evidenced in several additional published studies.[2-24]

Using the measures presented in our national balanced scorecard, this year's 15 Top Health Systems study revealed significant differences between award winners and their nonwinning peers.

Our study's highest-performing health systems:

- Had lower inpatient mortality and fewer patient complications, considering patient severity
- Delivered care that resulted in fewer HAIs
- Had lower 30-day readmission rates
- Sent patients home sooner

– Kept episode-of-care expenses low, both in-hospital and through the aftercare process
– Scored higher on patient ratings of their overall hospital experience

Our study projections also indicate that if the benchmarks of performance established by this year's winners were achieved by all hospitals in the US, the following would be true:

– More than 61,000 additional lives could be saved in-hospital
– Over 17,000 additional patients could be complication-free
– Over 5% fewer infections would be acquired by hospital patients
– The typical patient could be released from the hospital a half-day sooner and would have 4% fewer expenses related to the complete episode of care than the median patient in the US

This analysis is based on applying the difference between study winners and nonwinners to Medicare patient counts. If the same standards were applied to all inpatients, the impact would be even greater.

For more details about this study's findings and the achievements of the 15 Top Health Systems, please see the Findings section of this document.

Welcoming your input

The 100 Top Hospitals program works to ensure that the measures and methodologies used in our studies are fair, consistent, and meaningful. We continually test the validity of our performance measures and data sources. In addition, as part of our internal performance improvement process, we welcome comments about our study from health system, hospital, and physician executives.

Showcasing the versatility of the 100 Top Hospitals program

The 100 Top Hospitals research is one of three major annual studies of the 100 Top Hospitals program. To increase understanding of trends in specific areas of the healthcare industry, the program includes:

- 100 Top Hospitals and Everest Award studies
  Research that annually recognizes the 100 top-rated hospitals in the nation based on a proprietary, balanced scorecard of overall organizational performance, and identifies those hospitals that also excel at long-term rates of improvement in addition to performance
- 50 Top Cardiovascular Hospitals study
  An annual study introduced in 1999 that identifies hospitals demonstrating the highest performance in hospital cardiovascular services for four important patient groups: heart attack, heart failure, coronary artery bypass graft and percutaneous coronary intervention
- 15 Top Health Systems study
  An annual study introduced in 2009 that provides an objective measure of health system performance overall and offers insight into the ability of a system's member hospitals to deliver consistent top performance across the communities they serve, all based on our national health system scorecard

In addition to the major studies, customized analyses are also available from the 100 Top Hospitals program, including custom benchmark reports. Our reports are designed to help healthcare executives understand how their organizational performance compares to peers within health systems, states, and markets.

100 Top Hospitals program reports offer a two-dimensional view of both performance improvement over time, applying the most current methodologies across all years of data to produce trends, as well as the most current year performance.

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

2022 15 Top Health Systems Award Winners

The 100 Top Hospitals® program is pleased to present the 2022 15 Top Health Systems.

Note that the order of health systems in the following tables does not reflect performance rating. Systems are ordered alphabetically. For full details on these peer groups and the process we used to select the winning benchmark systems, see the Methodology section of this document.

Large Health Systems	Location
Allina Health	Minneapolis, MN
Baylor Scott & White Health	Dallas, TX
Mayo Clinic	Rochester, MN
Penn Medicine	Philadelphia, PA
Rush Health	Chicago, IL

Medium Health Systems	Location
Cone Health	Greensboro, NC
Edward-Elmhurst Health	Naperville, IL
PIH Health	Whittier, CA
Scripps Health	San Diego, CA
St. Luke's Health System	Boise, ID

Small Health Systems	Location
Asante	Medford, OR
CHI Memorial	Chattanooga, TN
CHI St. Vincent	Little Rock, AR
Franciscan Sisters of Christian Charity Sponsored Ministries	Manitowoc, WI
North Memorial Health	Robbinsdale, MN

Findings

The 15 Top Health Systems study profiles the top-performing health systems in the country. According to publicly available data and our transparent methodologies, these industry leaders appear to have successfully negotiated the fine line between running highly effective operations and being innovative and forward-thinking in ways that grow their organizations over the short and long term.*

For 14 years, the 15 Top Health Systems study has followed the results achieved by leading health systems and published numerous examples of the benchmark systems' clinical and operational excellence. The study is more than a list of accomplishments; it is a tool that US health system leaders can use to help guide their own performance improvement initiatives. By highlighting what the highest-performing leaders around the country are doing well, we create aspirational benchmarks for the rest of the industry.

How the winning systems compared to their peers

In this section, we show how the 15 Top Health Systems performed within their comparison groups (large, medium, and small systems), compared to nonwinning peers. In addition, we identify some key findings among comparison groups. For performance measure details and definitions of each comparison group, see the Methodology section of this document.

Note: In Tables 1 through 4, data for the 15 Top Health Systems award winners is labeled "Benchmark," and data for all health systems, excluding award winners, is labeled "Peer group." In columns labeled "Benchmark compared with peer group," we calculated the actual and percentage difference between the benchmark system scores and the peer group scores.

15 Top Health Systems had better survival rates**

- The winners had 14% fewer in-hospital deaths than their nonwinning peers, considering patient severity (Table 1)
- Mortality results for large health systems showed the greatest difference between winners and nonwinners, with 23% fewer deaths among benchmark health systems (Table 2)

15 Top Health Systems had fewer patient complications**

- Patients treated at the winning systems' member hospitals had significantly fewer complications, with rates 9% lower than at nonwinning system hospitals, considering patient severity (Table 1)
- Medium health systems had the greatest difference between winners and nonwinners, with 14% fewer complications (Table 3)

*To be defined as a health system in this study, an organization must have at least two short-term, general, acute care hospitals with separate Medicare provider identification numbers. Systems with multiple hospital facilities reporting under one provider ID are profiled as a single hospital in the 100 Top Hospitals® study.

** Mortality, complications and HAI index values cannot be compared among the three different comparison groups because they are normalized by comparison group.

15 Top Health Systems had fewer healthcare-associated infections*

Based on nationwide data availability, we built a composite measure of healthcare-associated infections (HAI) performance at the system level, considering up to six HAIs, depending on assigned comparison group. The six reported HAIs are: methicillin-resistant staphylococcus aureus (MRSA-bloodstream), central line-associated blood stream infections, catheter-associated urinary tract infections, clostridium difficile (C. diff), surgical site infections (SSIs) following colon surgery, and SSIs following an abdominal hysterectomy.**

- Among all types of systems, winners overall had a more favorable composite median HAI index value than nonwinner peers, at 0.78 versus 0.82, respectively; this reflects 4.7% fewer infections occurring at the 15 Top Health Systems compared to other peer systems (Table 1)
- Large health system winners and nonwinners showed the most dramatic difference on HAI performance: winners had a median HAI composite index value of 0.71, which was 11.5% lower than the median HAI index score at nonwinning systems (0.80) (Table 2)

15 Top Health Systems had better results on longer-term outcomes

Several patient groups are included in the 30-day mortality extended care composite metric. We calculate a mean 30-day mortality rate, which includes heart attack (AMI), heart failure (HF), pneumonia, chronic obstructive pulmonary disease (COPD), and stroke patient groups. We use CMS's 30-day hospital-wide readmission measure as another extended care metric. This measure tracks the percent of unplanned and all-cause readmissions to an acute care facility after 30-days from discharge at an acute care hospital.

30-day mortality results

- In this year's study, the winning systems had a better 30-day mortality rate than the nonwinning peers with rates of 11.3 % versus 12.2 % (Table 1)
- Medium health systems displayed the largest gap between winners and nonwinning peers on 30-day mortality (11.1 % versus 12.2%), while small health system winners showed the least difference in their performance from their peers (0.8 percentage points) in this year's study (Tables 3 and 4)

30-day hospital-wide readmission results

- Winning health systems had lower 30-day hospital-wide readmission rates than their nonwinning peers nationally (0.4 percentage points lower) (Table 1)
- Medium winning systems had the best median 30-day readmission rate (14.8%) among all comparison groups and outperformed their nonwinning peers by the greatest margin, 0.7 percentage points (Tables 2 - 4)

* HAI index values cannot be compared among the three different comparison groups because they are normalized by comparison group.
** As developed by a unit of the Centers for Disease Control and Prevention, the National Healthcare Safety Network, and reported by the Centers for Medicare & Medicaid Services (CMS) in the public Hospital Compare data set.

Patients treated in 15 Top Health Systems hospitals returned home sooner*

- Winning systems had a median average length of stay (ALOS) of 4.5 days, a half day shorter than the nonwinner median of 5.0 days (Table 1)
- The ALOS difference between winners and nonwinners was the greatest in the large health system comparison group, with benchmark systems discharging patients 0.6 days sooner (Table 2)

15 Top Health Systems hospitals had lower Medicare spending per beneficiary episode costs

- Overall, winning systems had a 4% lower Medicare spending per beneficiary (MSPB) index than nonwinners (Table 1)
- Small health systems showed the greatest difference between winners and nonwinners with a 5.9% lower MSPB index (Table 4)

Patients rated 15 Top Health Systems hospitals higher than peer system hospitals

- Winning systems had a higher top box percent than the nonwinning systems (77.6% versus 71.2%) on the Hospital Consumer Assessment of Healthcare Providers and Systems (HCAHPS), which tells us that patients treated by members of the top health systems reported a better overall hospital experience than those treated in nonwinning peer hospitals (Table 1)
- Large health system winners had the best HCAHPS top box value (77.6%) among the comparison groups (Tables 2 - 4)
- Large winning systems also had the biggest lead over nonwinning peers, with an HCAHPS score that was 6.4 percentage points higher (Table 2)

* ALOS cannot be compared among the three different comparison groups because values are normalized by comparison group.

Table 1: National Health System Performance Comparisons (All Systems)

Performance Measure	Medians		Benchmark Compared with Peer Group		
	Winning Benchmark Health Systems	Nonwinning Peer Group of U.S. Health Systems	Difference	Percent Difference	Comments
Inpatient Mortality Index[1]	0.91	1.06	-0.15	-13.9%	Lower mortality
Complications Index[1]	0.94	1.03	-0.09	-8.7%	Fewer complications
HAI Index[2]	0.78	0.82	-0.04	-4.7%	Fewer infections
30-Day Mortality Rate (%)[5]	11.3	12.2	-0.9	n/a[7]	Lower 30-day mortality
30-day Hospital-wide Readmission Rate (%)[6]	15.1	15.5	-0.4	n/a[7]	Fewer 30-day readmissions
Average Length of Stay (days)[1]	4.5	5.0	-0.5	-9.6%	Shorter stays
MSPB Index[3]	0.96	1.00	-0.04	-3.8%	Less episode cost
HCAHPS Top Box (%)[4]	76.6	70.9	5.7	n/a[7]	Better patient experience

1. Inpt mortality, complications and average length of stay based on Present on Admission (POA)-enabled risk models applied to MEDPAR 2019 and 2020 data (ALOS 2020 only)
2. HAI data from CMS Hospital Compare Oct 1, 2019 - March 31, 2021 data set
3. MSPB data from CMS Hospital Compare July 1, 2020-Dec 31, 2020 data set
4. HCAHPS data from CMS Hospital Compare July 1, 2020 - Dec 31, 2020 data set
5. 30-day mortality rates from CMS Hospital Compare July 1, 2017 - Dec 1, 2019 data set
6. 30-day hospital-wide readmission rates from CMS Hospital Compare July 1, 2019 - Dec 1, 2019
7. We do not calculate percent difference for these measures because they are already a percent value

Note: Measure values are rounded for reporting, which may cause calculated differences to appear off.

Table 2: Large Health Systems Performance Comparisons

Performance Measure	Medians		Benchmark Compared with Peer Group		
	Benchmark Health Systems	Peer Group of U.S. Health Systems	Difference	Percent Difference	Comments
Inpatient Mortality Index[1]	0.80	1.03	-0.23	-22.7%	Lower mortality
Complications Index[1]	1.01	1.04	-0.03	-2.9%	Fewer complications
HAI Index[2]	0.71	0.80	-0.09	-11.5%	Fewer infections
30-Day Mortality Rate (%)[5]	11.1	12.1	-1.0	n/a[7]	Lower 30-day mortality
30-day Hospital-wide Readmission Rate (%)[6]	15.2	15.4	-0.2	n/a[7]	Fewer 30-day readmissions
Average Length of Stay (days)[1]	4.5	5.0	-0.6	-11.5%	Shorter stays
MSPB Index[3]	0.96	1.00	-0.04	-3.6%	Less episode cost
HCAHPS Top Box (%)[4]	77.6	71.2	6.4	n/a[7]	Better patient experience

1. Inpt mortality, complications and average length of stay based on Present on Admission (POA)-enabled risk models applied to MEDPAR 2019 and 2020 data (ALOS 2020 only)
2. HAI data from CMS Hospital Compare Oct 1, 2019 - March 31, 2021 data set
3. MSPB data from CMS Hospital Compare July 1, 2020-Dec 31, 2020 data set
4. HCAHPS data from CMS Hospital Compare July 1, 2020 - Dec 31, 2020 data set
5. 30-day mortality rates from CMS Hospital Compare July 1, 2017 - Dec 1, 2019 data set
6. 30-day hospital-wide readmission rates from CMS Hospital Compare July 1, 2019 - Dec 1, 2019
7. We do not calculate percent difference for these measures because they are already a percent value

Note: Measure values are rounded for reporting, which may cause calculated differences to appear off.

Table 3: Medium Health Systems Performance Comparisons

Performance Measure	Medians		Benchmark Compared with Peer Group		
	Benchmark Health Systems	Peer Group of U.S. Health Systems	Difference	Percent Difference	Comments
Inpatient Mortality Index[1]	0.92	1.02	-0.09	-9.1%	Lower mortality
Complications Index[1]	0.90	1.04	-0.14	-13.8%	Fewer complications
HAI Index[2]	0.83	0.80	0.03	3.4%	More infections
30-Day Mortality Rate (%)[5]	11.1	12.2	-1.1	n/a[7]	Lower 30-day mortality
30-day Hospital-wide Readmission Rate (%)[6]	14.8	15.5	-0.7	n/a[7]	Fewer 30-day readmissions
Average Length of Stay (days)[1]	4.6	5.0	-0.5	-9.4%	Shorter stays
MSPB Index[3]	0.96	0.99	-0.03	-3.1%	Less episode cost
HCAHPS Top Box (%)[4]	76.6	72.3	4.4	n/a[7]	Better patient experience

1. Inpt mortality, complications and average length of stay based on Present on Admission (POA)-enabled risk models applied to MEDPAR 2019 and 2020 data (ALOS 2020 only)
2. HAI data from CMS Hospital Compare Oct 1, 2019 - March 31, 2021 data set
3. MSPB data from CMS Hospital Compare July 1, 2020-Dec 31, 2020 data set
4. HCAHPS data from CMS Hospital Compare July 1, 2020 - Dec 31, 2020 data set
5. 30-day mortality rates from CMS Hospital Compare July 1, 2017 - Dec 1, 2019 data set
6. 30-day hospital-wide readmission rates from CMS Hospital Compare July 1, 2019 - Dec 1, 2019
7. We do not calculate percent difference for these measures because they are already a percent value

Note: Measure values are rounded for reporting, which may cause calculated differences to appear off.

Table 4: Small Health Systems Performance Comparisons

Performance Measure	Medians		Benchmark Compared with Peer Group		
	Benchmark Health Systems	Peer Group of U.S. Health Systems	Difference	Percent Difference	Comments
Inpatient Mortality Index[1]	0.97	1.00	-0.04	-3.7%	Lower mortality
Complications Index[1]	0.84	0.97	-0.13	-13.4%	Fewer complications
HAI Index[2]	0.78	0.85	-0.07	-8.4%	Fewer infections
30-Day Mortality Rate (%)[5]	11.6	12.4	-0.8	n/a[7]	Lower 30-day mortality
30-day Hospital-wide Readmission Rate (%)[6]	15.1	15.5	-0.4	n/a[7]	Fewer 30-day readmissions
Average Length of Stay (days)[1]	4.5	4.9	-0.4	-7.9%	Shorter stays
MSPB Index[3]	0.95	1.01	-0.06	-5.9%	Less episode cost
HCAHPS Top Box (%)[4]	74.1	68.9	5.2	n/a[7]	Better patient experience

1. Inpt mortality, complications and average length of stay based on Present on Admission (POA)-enabled risk models applied to MEDPAR 2019 and 2020 data (ALOS 2020 only)
2. HAI data from CMS Hospital Compare Oct 1, 2019 - March 31, 2021 data set
3. MSPB data from CMS Hospital Compare July 1, 2020-Dec 31, 2020 data set
4. HCAHPS data from CMS Hospital Compare July 1, 2020 - Dec 31, 2020 data set
5. 30-day mortality rates from CMS Hospital Compare July 1, 2017 - Dec 1, 2019 data set
6. 30-day hospital-wide readmission rates from CMS Hospital Compare July 1, 2019 - Dec 1, 2019
7. We do not calculate percent difference for these measures because they are already a percent value

Note: Measure values are rounded for reporting, which may cause calculated differences to appear off.

Winning health system results

In Table 5, we provide the 15 Top Health Systems' values for each of the study's performance measures. For a list of all hospitals included in each winning health system, see Appendix A.

Table 5: Winning Health Systems Performance Measures Results

Winning System Name		IP Mortality Index[1]	Comp Index[1]	HAI Index[2]	30 Day Mortality Rate[3]	30 Day HW Readm Rate[4]	Average Length of Stay[1]	MSPB Index[5]	HCAHPS Top Box Percent[6]
Large Health Systems	Allina Health	0.99	1.01	0.97	4.4	15.2	11.4	0.94	74.3
	Baylor Scott & White Health	0.90	0.95	0.78	4.4	15.2	11.8	1.00	76.5
	Mayo Clinic	0.69	1.01	0.67	4.6	15.1	11.1	0.96	82.1
	Penn Medicine	0.72	0.89	0.71	5.0	14.8	10.9	0.97	77.6
	Rush Health	0.80	1.24	0.62	4.5	15.4	11.1	0.96	77.8
Medium Health Systems	Cone Health	1.00	0.90	0.76	4.6	14.5	12.5	0.92	71.0
	Edward-Elmhurst Health	0.80	0.96	0.76	4.8	14.8	10.7	1.01	77.6
	PIH Health	0.85	0.81	0.83	4.3	15.7	10.6	0.96	72.9
	Scripps Health	0.92	0.91	0.83	4.6	15.1	11.1	0.99	76.6
	St. Luke's Health System	0.95	0.87	0.91	4.2	14.7	12.0	0.96	77.6
Small Health Systems	Asante	1.14	0.50	0.48	5.1	14.5	11.0	0.95	74.1
	CHI Memorial	0.97	1.10	0.85	4.8	13.9	11.3	0.93	80.7
	CHI St. Vincent	0.73	0.77	0.78	4.5	15.3	12.1	1.05	67.5
	Franciscan Sisters of Christian Charity Sponsored Ministries	0.77	0.84	0.91	4.3	15.2	12.0	0.93	69.8
	North Memorial Health	1.02	1.20	0.65	4.4	15.1	11.6	0.97	78.3

1. Inpt mortality, complications and average length of stay based on Present on Admission (POA)-enabled risk models applied to MEDPAR 2019 and 2020 data (ALOS 2020 only)
2. HAI data from CMS Hospital Compare Oct 1, 2019 - March 31, 2021 data set
3. 30-day mortality rates from CMS Hospital Compare July 1, 2017 - Dec 1, 2019 data set
4. 30-day hospital-wide readmission rates from CMS Hospital Compare July 1, 2019 - Dec 1, 2019
5. MSPB data from CMS Hospital Compare July 1, 2020-Dec 31, 2020 data set
6. HCAHPS data from CMS Hospital Compare July 1, 2020 - Dec 31, 2020 data set

Note: Mortality, complications, HAI and ALOS measures cannot be compared across comparison groups because they are normalized by comparison group.

Top and bottom quintile results

We divided all the health systems in this study into performance quintiles, by comparison group, based on their performance on the study's measures.

In Table 6, we have highlighted differences between the highest- and lowest-performing quintiles by providing their median scores on the study performance measures. (See Appendix B for a list of the health systems included in the top-performance quintile and Appendix D for all systems included in the study.)

The top quintile systems outperformed their lowest quintile peers in the following ways:

- They had much better patient outcomes: 19.4% lower mortality and 12.7% lower complications
- They had fewer occurrences of HAIs in their facilities: a 22.7% lower median HAI index value (0.73) in the top performance quintile
- They had lower mean 30-day mortality rates (0.73 percentage points lower; includes AMI, HF, pneumonia, COPD, and stroke patients)
- They had somewhat lower 30-day hospital-wide readmission rates (15.2% versus 15.8%)
- They were more efficient, releasing patients almost one full day (0.81) sooner than the lowest performers and at a 2.4 % lower MSPB index
- They scored 7.26 percentage points higher on the HCAHPS overall patient rating of care with a median top box percent of 73.6

Table 6. Comparison of Health Systems in the Top and Bottom Quintiles of Performance

Performance Measure	Top Quintile Median	Bottom Quintile Median	Difference	Percent Difference	Top versus Bottom Quintile
Inpatient Mortality Index[2]	0.93	1.15	-0.22	19.4%	Lower Mortality
Complications Index[2]	0.96	1.10	-0.14	12.7%	Lower Complications
HAI Index[3]	0.73	0.94	-0.21	22.7%	Fewer Infections
30 Day Mortality Rate (%)[4]	11.8	12.5	-0.73	n/a[8]	Lower 30-day Mortality
30 Day Hosp-Wide Readmission Rate (%)[5]	15.2	15.8	-0.64	n/a[8]	Fewer 30-day Readmissions
Average Length of Stay (days)[2]	4.6	5.5	-0.81	14.8%	Shorter Stays
MSPB Index[6]	0.99	1.01	-0.02	2.4%	Less Episode Cost
HCAHPS Score[7]	73.6	66.4	7.26	n/a[8]	Better Patient Experience

1. Top and bottom performance quintiles were determined by comparison group and aggregated to calculate medians
2. Inpt mortality, complications and average length of stay based on Present on Admission (POA)-enabled risk models applied to MEDPAR 2019 and 2020 data (ALOS 2020 only)
3. HAI data from CMS Hospital Compare Oct 1, 2019 - March 31, 2021 data set
4. 30-day mortality rates from CMS Hospital Compare July 1, 2017 - Dec 1, 2019 data set
5. 30-day hospital-wide readmission rates from CMS Hospital Compare July 1, 2019 - Dec 1, 2019
6. MSPB data from CMS Hospital Compare July 1, 2020-Dec 31, 2020 data set
7. HCAHPS data from CMS Hospital Compare July 1, 2020 - Dec 31, 2020 data set
8. We do not calculate percent difference for these measures because they are already a percent value

Note: Measure values are rounded for reporting, which may cause calculated differences to appear off.

Test metrics: Reported for information only

Every year, we evaluate the 15 Top Health Systems study and explore whether new measures would enhance the value of the analysis we provide.

We continue to test the following performance measures that we believe reflect updated standards of care and expand the balanced scorecard across the continuum of care. These metrics are:

Patient safety indicators

Patient safety has become an increasingly important measure of hospital quality. Patient safety measures are reflective of both clinical quality and the effectiveness of systems within the hospital setting. CMS publishes in the Hospital Compare data set 10 individual PSI measures and one overall score that represents serious complications that were potentially avoidable.

Unplanned hospital revisits

This metric measures unplanned visits to the hospital after outpatient surgery. It is an outcome measure that CMS defines as 'unplanned hospital visits within 7 days of a same-day surgery at a hospital outpatient department '. Unplanned visits can include inpatient admission directly after surgery, or emergency department, observation stay or inpatient admission within 7 days of the surgical procedure. The population included in this measure is Medicare-fee-for-service patients aged 65 years and older.

30-day episode-of-care payment measures

We are continuing to publish risk-standardized payments associated with 30-day episode-of-care measures for three patient groups that are now being published by CMS in the Hospital Compare data set. These 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 measures, they are the sum of payments made for care and supplies starting the day the patient enters the hospital and for the next 30 days.

Excess days in acute care measures

Another set of measures available from CMS in the Hospital Compare data set are the excess days in acute care (EDAC) measures for AMI, HF, and pneumonia. CMS defines "excess days" as the difference between a hospital's average days in acute care and expected days, based on an average hospital nationally.

Days in acute care include days spent in an ED, a hospital observation unit, or a hospital inpatient unit for 30 days following a hospitalization.

90-day episode-of-care payment measure

Another measure from the Hospital Compare data set is the 90-day episode-of-care payment metric for primary, elective total hip arthroplasty and total knee arthroplasty (THA/TKA). Like the other 30-day episode-of-care payment measures, CMS calculates risk-standardized

payments associated with a 90-day episode of care, compared to an average hospital nationally. The measure summarizes payments for patients across multiple care settings, services, and supplies during the 90-day period, which starts on the day of admission.

90-day complication measure

We continue to publish the THA/TKA 90-day complication measure from CMS. This measure calculates a risk-standardized complication rate for THA/TKA procedures using the occurrence of one or more of the subsequent complications within the specified timeframes.

- AMI, pneumonia, or sepsis/septicemia/shock during or within seven days of index admission
- Surgical site bleeding, pulmonary embolism, or death during or within 30 days of index admission
- Mechanical complication or periprosthetic joint infection/wound infection during or within 90 days of index admission

See the CMS website for measure methodology. [25]

Tables 7 and 8 shows the national performance of benchmark and peer health systems on the test metrics.

This year, the 15 Top Health Systems winners outperformed nonwinning peers on the vast majority of test measures, with the exception of one 30-day episode of payment and two PSI measures.

- On three of the four reported CMS episode measures of cost, winning systems outperformed their nonwinner peers, with the exception of the 30-day heart failure episode of cost, with difference being only $200; the greatest difference was for total hip arthroplasty/total knee arthroplasty (THA/TKA) 90-day episode payment (3.8%)
- Winning health systems performed better on the AMI, HF and pneumonia 30-day EDAC measures, showing that patients spent fewer days than expected in the ED, in observation, or back in the hospital after an initial index acute care stay (7.4 days under the expected amount for AMI EDAC, 8.3 under for HF EDAC and 2.8 more for pneumonia); whereas nonwinning peers averaged 6.4, 7.5 and 11.8 days more than expected, respectively (EDAC values are reported as excess days per 100 discharges)
- On the 90-day THA/TKA complications rate, another CMS measure of outcomes extended outside the hospital stay, winning systems outperformed the nonwinning systems with 2.1 complication rate, compared to nonwinners with a 2.3 rate
- Ratio of unplanned hospital visits after outpatient surgery (OP-36), showed the nonwinning systems outperforming the winner group by a very small margin (3.9%)

Table 7: Information Only Measures - Health System Performance Comparisons (All Classes)

Performance Measure	Medians		Benchmark Compared with Peer Group		
	Benchmark Health Systems	Peer Group of U.S. Health Systems	Difference	Percent Difference	Comments
AMI 30-Day Episode Payment[1]	$25,645	$26,391	-$746	-2.8%	Lower episode cost
Heart Failure 30-Day Episode Payment[1]	$18,387	$18,187	$200	1.1%	Higher episode cost
Pneumonia 30-Day Episode Payment[1]	$18,495	$18,941	-$446	-2.4%	Lower episode cost
AMI 30-Day Excess Days in Acute Care[1]	-7.4	6.4	-13.8	-214.8%	Fewer excess days
Heart Failure 30-Day Excess Days in Acute Care[1]	-8.3	7.5	-15.8	-210.0%	Fewer excess days
Pneumonia 30-Day Excess Days in Acute Care[2]	2.8	11.8	-9.0	-76.1%	Fewer excess days
THA/TKA 90-Day Episode Payment[2]	$19,236	$19,945	-$709	-3.6%	Lower episode cost
THA/TKA 90-Day Complications Rate[2]	2.1	2.3	-0.2	n/a[4]	Fewer complications
Ratio of Unplanned Hospital Visits after Outpatient Surgery[3]	1.0	1.0	0.0	-3.9%	Fewer visits

1. 30-day measures from CMS Hospital Compare July 1, 2016 - June 30, 2019 data set.
2. 90-day measures from CMS Hospital Compare April 1, 2016 - March 31, 2019 data set.
3. OP-36 measure from CMS Hospital Compare Jan 1, 2019 - Dec 31, 2019.
4. We do not calculate percent difference for this measure because it is already a percent value.

Note: Measure values are rounded for reporting, which may cause calculated differences to appear off.

Table 8 shows the national performance of benchmark and peer health systems on the patient safety indictors

- The winning systems outperformed the nonwinning group on most PSI measures, with exceptions being PSI-9 (perioperative hemorrhage or hematoma) and PSI-14 (a wound that splits open after surgery on the abdomen or pelvis)
- Two PSIs had the same rates for both winning and nonwinning systems, PSI 6 (collapsed lung due to medical treatment) and PSI-8 (broken hip from after surgery), with rates of 0.2 and 0.1, respectively
- The greatest difference in performance between winners and nonwinners was with PSI-11 (postoperative respiratory failure rate) with a difference of 0.7 percentage points
- PSI-90, serious complications, showed a 2.5% difference between winning systems and nonwinning systems, with the winners having a 0.97 index value, compared to nonwinners with an index of 0.99

Table 8: Information Only Measures - Health System Performance Comparisons. (All Classes)

Performance Measure	Medians		Benchmark Compared With Peer Group		
	Winning Benchmark Hospitals	Nonwinning Peer Group of U.S. Hospitals	Difference	Percent Difference	Comments
PSI-3 Pressure Sores[1,2]	0.4	0.5	-0.1	n/a[4]	Fewer safety incidents
PSI-6 Collapsed Lung due to Medical Treatment[1,2]	0.2	0.2	0.0	n/a[4]	Same safety incidents
PSI-8 Broken Hip from a Fall after Surgery[1,2]	0.1	0.1	0.0	n/a[4]	Same safety incidents
PSI-9 Perioperative Hemorrhage or Hematoma Rate[1,2]	2.6	2.5	0.0	n/a[4]	More safety incidents
PSI-10 Postoperative Acute Kidney Injury Requiring Dialysis Rate[1,2]	1.4	1.4	0.0	n/a[4]	Fewer safety incidents
PSI-11 Postoperative Respiratory Failure Rate[1,2]	4.5	5.2	-0.7	n/a[4]	Fewer safety incidents
PSI-12 Serious Blood Clots after Surgery[1,2]	3.3	3.6	-0.3	n/a[4]	Fewer safety incidents
PSI-13 Blood Stream Infection after Surgery	4.8	4.9	-0.1	n/a[4]	Fewer safety incidents
PSI-14 A Wound that Splits Open after Surgery on the Abdomen or Pelvis[1,2]	0.9	0.8	0.0	n/a[4]	More safety incidents
PSI-15 Accidental Cuts and Tears from Medical Treatment[1,2]	1.1	1.2	0.0	n/a[4]	Fewer safety incidents
PSI-90 Serious Complications[1,3]	0.97	0.99	0.0	-2.5%	Fewer safety incidents

1. PSI measures from CMS Hospital Compare July 1, 2018 - Dec 31, 2019 data set
2. PSI measures are rate values per 1000 discharges
3. PSI measure is an index value
4. We do not calculate percent difference for this measure because it is already a percent value

Methodology

15 Top Health Systems is a quantitative study that annually identifies 15 US health systems with the highest overall achievement on a balanced scorecard.

The health system scorecard is based on the 100 Top Hospitals® national balanced scorecard methodologies and focuses on four performance domains: inpatient outcomes, extended outcomes, operational efficiency, and patient experience.

This 2022 health systems study includes eight measures that provide an objective comparison of health system performance using publicly available data. The health systems with the highest achievement are those with the highest ranking on a composite score based on these eight measures.

To analyze health system performance, we include data for short-term, acute care, nonfederal US hospitals, as well as cardiac, orthopedic, women's, and critical access hospitals (CAHs) that are members of the health systems.

The main steps we take in selecting the top 15 health systems are:

- Building the database of health systems, including special selection and exclusion criteria
- Identifying which hospitals are members of health systems
- Aggregating the patient-level and hospital-level data from member hospitals and calculating a set of performance measures at the system level
- Classifying health systems into comparison groups based on total operating expense
- Ranking systems on each of the performance measures by comparison group
- Determining the 15 top performers (five in each comparison group) from the health systems' overall rankings, based on their aggregate performance (sum of individual weighted measure ranks)

The following section is intended to be an overview of these steps.

Building the database of hospitals

Like all the 100 Top Hospitals studies, the 15 Top Health Systems study uses only publicly available data. The data for this study primarily came from:

- Medicare Provider Analysis and Review (MEDPAR) data set
- Medicare Hospital Cost Reports (all-payer)
- Centers for Medicare & Medicaid Services (CMS) Hospital Compare data sets

We use MEDPAR patient-level demographic, diagnosis, and procedure information to calculate inpatient mortality, complications, and length of stay (LOS). The MEDPAR data set contains information on the approximately 15 million Medicare patients discharged annually from US acute care hospitals.

In this year's study, for the current profile, we used the most recent federal fiscal year (FFY) of MEDPAR data available (2020), which included Medicare Advantage health maintenance organization encounters. For the inpatient mortality and complications (clinical measures with low frequency of occurrence), we combine two years of MEDPAR data for each study year to stabilize results. The combined data sets as follows:

For study year:	MEDPAR data sets used:
2020	2019 and 2020
2019	2018 and 2019
2018	2018 and 2017
2017	2017 and 2016
2016	2016 and 2016

For the trend profile, five years of MEDPAR data were used, instead of the typical six years of data (two combined years of MEDPAR data for every study year). This occurred due to the unavailability of ICD-10-CM coding data in MEDPAR 2015, therefore the trend profile contains MEDPAR 2016-2019 for inpatient mortality, complications and average length of stay measures, with the 2016 data containing two years of 2016 data for the inpatient mortality and complications measures. The 100 Top Hospitals program has 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.

We used the CMS Hospital Compare data set published in the January 2022 release for healthcare-associated infection (HAI) measures, 30-day mortality rates, 30-day hospital-wide readmission rates, Medicare spending per beneficiary (MSPB), and Hospital Consumer Assessment of Healthcare Providers and Systems (HCAHPS) patient perception-of-care data.[26]

We also used the most current year of Medicare cost reports, published in the federal Hospital Cost Report Information System (HCRIS) fourth-quarter 2021 data set, to create our proprietary database for determining system membership based on "home office" or "related organization" relationships reported by hospitals. The cost reports were also used to aggregate member hospital total operating expense to the system level. This data was used to classify health systems into three comparison groups.

Below are the specific time periods of data used in this study and their references throughout this document:

References in text	Time Periods
Federal fiscal years (FFY)	Oct - Sept
Study Year	2022
Current data year (MEDPAR)	FFY 2020
Current data year (Medicare Cost Reports)	Year ending in 2020
Two most current/recent years of data (MEDPAR/ Medicare Cost Reports)	2019 and 2020
Trend data years (MEDPAR)	FFY 2016 - 2020
Trend data years (Medicare Cost Reports)	Years ending in 2016 - 2020
PIDB data used in risk model development	FFY 2016, 2017, 2018

Risk- and severity-adjustment models

The risk-and severity-adjustment models for inpatient mortality, complications, and LOS have been recalibrated for this study release using FFYs 2016-2018 data available in the all-payer Projected Inpatient Database (PIDB). The PIDB is one of the largest US inpatient, all-payer databases of its kind, its kind, containing approximately 22 million inpatient discharges annually, obtained from approximately 5,300 hospitals, which comprise more than 60% of the nonfederal US market. The risk-and severity-adjustment models take advantage of available present-on-admission (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 the expected LOS.

The recalibrated models were used in producing the risk-adjusted inpatient mortality and complications indexes, based on the two most recent years of MEDPAR data. The severity-adjusted LOS was produced based on the current year of MEDPAR data.

Present-on-admission coding adjustments

From 2010, we have observed a significant rise in the number of principal diagnosis and secondary diagnosis codes that do not have a valid POA indicator code in the MEDPAR data files. Since 2011, an invalid code of "0" has been appearing. This phenomenon has led to an artificial rise in the number of complications that appear to be occurring during the hospital stay. See Appendix C for details.

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

1. Original, valid (Y, N, U, W, or 1) POA codes assigned to diagnoses were retained

2. Where a POA code of "0" appeared, we took the next four steps:
    - 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 the POA code "Y" or "W" appeared more than 50% of the time in the all-payer database, as "present on admission"
    - All others were treated as "not present"

Hospital exclusions

After building the database, we exclude hospitals that would have skewed study results. Excluded from the study were:

- Certain specialty hospitals (children's, psychiatric, substance abuse, rehabilitation, cancer, and long-term acute care)
- Federally owned hospitals
- Hospitals not located within the 50 states (such as those in Puerto Rico, Guam, and the US Virgin Islands)

– Hospitals with Medicare average LOS longer than 30 days in the current data year
– Hospitals with no reported Medicare patient deaths in the current data year
– Hospitals that had fewer than 60% of patient records with valid POA codes

Cardiac, orthopedic, women's hospitals, and CAHs are included in the study, if they are not excluded for any other criteria listed above .

In addition, specific patient records were also excluded:

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

After all exclusions were applied, 2,604 individual hospitals were included in the 2022 study.

Health system exclusions

Health systems are excluded if:

– One or more required measures are missing*
– Fewer than 50% of member hospitals have valid POA coding
– Fewer than 50% of member hospitals have valid data for any one or more required measures

After all system exclusions were applied, 349 individual health systems were included in the 2022 study.

NOTE: CMS does not publish MSPB measures for Maryland hospitals due to a separate payment agreement. For this reason, we substituted the comparison group median, and winner-excluded Maryland health systems that had no reported MSPB measure to allow Maryland health systems to remain in the study. If a Maryland health system included hospitals in other states, we winner-excluded them when more than 50% of their member hospitals had no reported MSPB measure.

*For composite measures (HAI, 30-day mortality), the exclusion is applied ONLY if all individual measures comprising the composite are missing.

- For HAI, different numbers of individual measures were required depending on the comparison group (5 for large and medium systems; 3 for small systems). A system not meeting the minimum was excluded. See Appendix C for details.
- In systems where one or more individual 30-day mortality rates were missing, BUT NOT ALL, we calculated a median value for each, by comparison group, and substituted the median for the missing value.

Identifying health systems

To be included in the study, a health system must have at least two short-term, general, acute care hospitals with separate Medicare provider identification numbers. The minimum of two hospitals must be met after hospital exclusions have been applied. In addition, we also include any cardiac, orthopedic, women's hospitals, and CAHs that passed the hospital exclusion rules cited on the previous page. We use multiple data sources to identify health systems and their member hospitals. The Medicare cost report is the primary data source. Other validation sources include: Agency for Healthcare Research and Quality (AHRQ), Definitive Healthcare, American Hospital Association, and American Hospital Directory. We also refer to the systems' websites and member hospitals' websites to verify and validate inclusion in the 15 Top health system study.

We identify health systems that have subsystems with their own reported home offices or related organization relationships or are clearly identified as a subsystem on their websites. Both the parent system and any identified subsystems are treated as "health systems" for purposes of this study and are independently profiled. Hospitals that belong to a parent health system and a subsystem are included in both for analysis of system performance.

To analyze health system performance, we aggregate data from all of a system's included hospitals. In the methodology summary tables in this section, we provide specific details about the calculations used for each performance measure and how these measures are aggregated to determine system performance.

After all exclusions were applied and parent systems identified, the final study group included 349 health systems with the profiles outlined in Table 10.

Table 10. 2022 Health Systems Study Group

System Category	Systems	Member Hospitals	Medicare Patient Discharges, FFY 2019	Average Hospitals per System	Average Discharges per System
Winning Systems	15	94	343,297	6.3	22,886
Nonwinning Systems	334	3,112	9,509,762	9.3	28,472
Total Systems	349	3,206	9,853,059	9.2	28,232

Classifying health systems into comparison groups

Health system comparison groups

We refine the analysis of health systems by dividing them into three comparison groups based on a number of elements: total operating expense of member hospitals, number of states member hospitals reside and number of short-term, general, acute care hospitals that make up the system. This is done to develop more action-driving benchmarks for like systems. For this study, the three comparison groups we used are listed in Table 11.

Table 11. Health System Comparison Groups, Defined

Health System Comparison Group	Criteria	Number of Systems in Study	Number of Winners
Large	>= $2.5 billion total operating expense **OR** >= $1.5 billion & >= 3 states **OR** $1.5B & >= 5 STGAC	147	5
Medium	>= $800 million tot exp & >= 5 STGAC **OR** >= $1 billion total operating expense	84	5
Small	Does not meet large or medium system criteria	103	5
Total Systems		334	15

Scoring health systems on weighted performance measures

Evolution of performance measures

We use a balanced scorecard approach, based on public data, to select the measures we believe to be most useful for boards, CEOs, and other leaders in the current health system operating environment.

In addition, we continually review trends in the healthcare market, to identify the need for, and availability of, new performance measurement approaches. We welcome feedback from hospital and system executives on the usefulness of our measures and our approach.

As the healthcare industry has changed, our methods have evolved. Our current measures are centered on five main components of system performance: inpatient outcomes, extended outcomes, operational efficiency, and patient experience.

The nine measures included in this study, by performance domain, are:

Inpatient outcomes

1. Risk-adjusted inpatient mortality index
2. Risk-adjusted complications index
3. Mean HAI index

Extended outcomes

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 all-cause hospital-wide readmission rate

Operational efficiency

6. Severity-adjusted average LOS
7. MSPB index

Patient experience

8. HCAHPS top box percent (overall hospital performance)

The data sources for these measures are listed in Table 12.

Table 12. Measure Data Sources and Time Periods

Performance Measure	Current performance (15 Top Health Systems award selection)	Five-year trend performance
Risk-Adjusted Inpatient Mortality Index	MEDPAR Federal Fiscal Year (FFY) 2019 and 2020[a]	MEDPAR Federal Fiscal Year (FFY) 2016-2020[a]
Risk-Adjusted Complications Index	MEDPAR FFY 2019 and 2020[a]	MEDPAR FFY 2016-2020[a]
Mean Healthcare-Associated Infection Index[b]	CMS Hospital Compare Oct 1, 2019-March 31, 2021	CMS Hospital Compare Calendar Year (CY) 2016-2019; Oct 1, 2019-March 31, 2021
Mean 30-Day Mortality Rate (AMI, Heart Failure, Pneumonia COPD, Stroke)	CMS Hospital Compare Jul 1, 2017-Dec 1, 2019[c]	CMS Hospital Compare: Three-year datasets ending Jun 30 in 2016, 2017, 2018, 2019[d]
30-Day Hospital-Wide Readmission Rate	CMS Hospital Compare Jul 1, 2019-Dec 1, 2019[e]	CMS Hospital Compare: One-year data sets ending Jun 30 in 2016, 2017, 2018, 2019[d,e]
Severity-Adjusted Average Length of Stay	MEDPAR FFY 2020	MEDPAR FFY 2016-2020
Medicare Spend per Beneficiary Index	CMS Hospital Compare July 1, 2020-Dec 31, 2020[e]	CMS Hospital Compare CY 2016-2019; July 1, 2020-Dec 31, 2020[e]
HCAHPS Top Box Percent (Overall Hospital Rating)	CMS Hospital Compare July 1, 2020-Dec 31, 2020[e]	CMS Hospital Compare CY 2016-2019; July 1, 2020-Dec 31, 2020[e]

a. Two years of data are combined for each study year data point

b. The HAI measure is not included in the small community hospital group ranked metrics

c. Measures have only 2 ½ years of data instead of 3 due to CMS removal of Q1 and Q2 2020 data from measure data sets

d. Two data points end in 2019 due to CMS removal of Q1 and Q2 2020 data from measure datasets in current year

e. Measure has only 6 months of data instead of 1 year due to CMS removal of Q1 and Q2 2020 data from measure data sets

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 three measures: risk-adjusted mortality index, risk-adjusted complications index, and mean HAI index. These measures show us how the system is performing on what we consider to be the most basic and essential care standards (survival, error-free care, and infection prevention) while treating patients in their hospitals.

Extended outcomes

The extended outcomes measures (30-day mortality rates for AMI, HF, pneumonia, COPD, and stroke patients; and 30-day all-cause hospital-wide readmission rates) help us understand how the system's patients are faring over a longer period.[27] These measures are part of the CMS Hospital Value-Based Purchasing Program and are widely reported on in the industry. Hospitals with lower values appear to be providing or coordinating the care continuum with better medium-term results for these conditions.

As systems become more interested in contracting for population health management, we believe that 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.

Efficiency

The efficiency domain includes severity-adjusted average LOS and the MSPB index. Average LOS serves as a proxy for clinical efficiency in an inpatient setting and the MSPB index is used as a proxy for continuum-of-care cost performance.

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

The Medicare Spend per Beneficiary (MSPB) 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.

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 with perceptions of patients in peer hospitals, is an important step a hospital can take in pursuing performance excellence. For this reason, we use the top box answer in CMS Hospital Compare data set as the measure's value. The top-box is defined as the percent of patients who gave their hospital a rating of 9 or 10 on a scale of 0 to 10, where 10 is the highest rating. We use the overall rating question only, as the ranked metric.

A comprehensive, balanced view

Through the combined measures described in this section, we hope to provide a balanced picture of overall health system performance, which can reflect leadership's ability to consistently improve their organizations over time and sustain high performance, once achieved. Full details about each of these measures are included on the following pages.

Performance measures

Risk-adjusted inpatient mortality index			
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 system's hospitals, 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 a mortality index value based on the aggregate number of actual in-hospital deaths for all member hospitals in each system, divided by the number of normalized expected deaths, given the risk of death for each patient. Expected deaths are derived by processing MEDPAR patient record data through our proprietary mortality risk model, which 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 values using the observed-to- expected ratio for in-study health systems, by comparison group. The mortality risk model takes into account Present on Admission coding (POA) in determining expected deaths. Palliative care patients (Z515) are included in the risk model. Do not resuscitate (DNR) patients (Z66) coded as 'present on admission' are excluded. Post-discharge deaths 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 systems, by comparison group, on the difference between observed and expected deaths, expressed in normalized standard deviation units (z-score).[28,29] Health systems 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 to reduce the influence of chance fluctuation. We report the system-level ratio of observed to normalized expected (Inpatient Mortality Index). Systems with observed values statistically worse than expected (99-percent confidence), and whose values are above the high trim point (75th percentile of statistical outliers), are not eligible to be named benchmark health systems.	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 a complications index value based on the aggregate number of cases with observed complications for all member hospitals in each system, divided by the number of normalized expected complications, given the risk of complications for each patient. Expected complications are derived by processing MEDPAR patient record data through our proprietary complications risk model, which is designed to predict the likelihood of complications during hospitalization. This model accounts for patient-level characteristics (age, sex, principal diagnosis, comorbid conditions, and other characteristics). We normalize the expected values using the observed-to-expected ratio for in-study health systems, by comparison group. Complications rates are calculated from normative data for two patient risk groups: medical and surgical. POA coding is used in the risk model to identify pre-existing conditions for accurate assessment of patient severity and to distinguish from complications occurring during hospitalization. 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 systems on the difference between the observed and expected number of patients with complications, expressed in normalized standard deviation units (z-score). We use two years of MEDPAR data to reduce the influence of chance fluctuation. We report the system-level ratio of observed to normalized expected (Complications Index) The MEDPAR data set includes both Medicare Fee-for-Service claims and Medicare Advantage (HMO) encounter records. Systems with observed values statistically worse than expected (99-percent confidence), and whose values are above the high trim point (75th percentile of statistical outliers), are not eligible to be named benchmark health systems.	Lower

Mean healthcare-associated infection index			
Why We Include This Element	Calculation	Comment	Favorable Values are
Because there is a public interest in tracking and preventing healthcare-associated infections (HAIs), we now use the HAI data reported by CMS to analyze hospital performance and provide national benchmarks in this area.	Measure data was obtained from the CMS Hospital Compare data set. Hospitals complete the required surveillance and report HAI occurrences, and the count of patient days or procedures associated with each HAI metric, through the US Centers for Disease Control and Prevention's National Healthcare Safety Network (NHSN), which in turn reports data to CMS. To calculate a standardized infection ratio (SIR) for reporting HAI incidence, expected values are developed by the NHSN using probability models constructed from NHSN baseline data, which represents a standard population. We sum member hospitals' observed and expected values to calculate the system level index for each HAI. The reported measure value is a composite HAI SIR. We calculate an unweighted mean of the aggregated observed and expected values for the included HAIs.	We rank systems using the normalized composite HAI z-score, by comparison group. The mean composite HAI index is used in reporting. See Appendix C for details on HAIs included in each comparison group. The CMS Hospital Compare HAI data set includes hospital-reported HAIs for all inpatients.	Lower

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. In addition, tracking these measures may help hospitals identify patients at risk for post-discharge problems and target improvements in discharge planning and after-care processes. Hospitals that score well may be better prepared for a pay-for-performance structure.	Data is from the CMS Hospital Compare data set. CMS calculates a 30-day mortality rate for each patient condition using three years of MEDPAR data, combined. We aggregate these data to produce a rate for each 30-day measure for each system. This is done by multiplying the hospital- level reported patient count (eligible patients) by the reported hospital rate to determine the number of patients who died within 30 days of admission. We sum the calculated deaths and divide by the sum of eligible patients for member hospitals of each system. This value is multiplied by 100 to produce the system-level 30-day mortality rate for each measure, expressed as a percent. 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. We calculate the arithmetic mean of the system-level included 30-day mortality rates (AMI, heart failure, pneumonia, COPD, stroke) to produce the ranked composite measure.	We rank systems by comparison group, based on the mean rate for included 30-day mortality measures. (AMI, heart failure, pneumonia, COPD, and stroke). The CMS Hospital Compare data for 30-day mortality is based on Medicare Fee-for-Service claims only.	Lower

30-Day risk-adjusted hospital-wide readmission rate			
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. Because these measures are part of the CMS value-based purchasing program, they 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 after-care processes. Hospitals that score well may be better prepared for a pay-for-performance structure.	Data is from the CMS Hospital Compare data set. CMS calculates a 30-day hospital-wide readmission rate using one year of MEDPAR data. We aggregate member hospital data to produce a rate for each system. This is done by multiplying the hospital-level reported patient count (eligible patients) by the reported hospital rate to determine the number of patients who were readmitted within 30 days of discharge. We sum the calculated readmissions and divide by the sum of eligible patients for member hospitals of each system. This value is multiplied by 100 to produce the system-level 30- day hospital-wide readmission rate, expressed as a percent. CMS does not calculate rates for hospitals where the number of cases is too small (less than 25).	We rank systems by comparison group, based on their rate. The CMS Hospital Compare data for 30-day readmissions is based on Medicare Fee-for-Service claims only.	Lower

Severity-adjusted average length of stay			
Why We Include This Element	Calculation	Comment	Favorable Values are
A lower severity-adjusted average LOS generally indicates more efficient consumption of hospital resources and reduced risk to patients.	We calculate a length of stay (LOS) index value for each health system by dividing the sum of the actual LOS of member hospitals by the sum of the normalized expected LOS for the hospitals in the system. Expected LOS adjusts for difference in severity of illness using a linear regression model. We normalize the expected values using the observed- to-expected ratio for in-study health systems, by comparison group. The LOS risk model takes into account POA coding in determining expected length of stay. We convert the LOS index into days by multiplying each system's LOS index by the grand mean LOS for all in-study health systems. We calculate grand mean LOS by summing in-study health systems' LOS and dividing that by the number of health systems.	We rank systems on their severity- adjusted average LOS. The MEDPAR data set includes both Medicare Fee-for-Service claims and Medicare Advantage (HMO) encounter records.	Lower

Medicare spend per beneficiary 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 a continuum of care sites. Lower values indicate lower costs relative to national medians and thus greater efficiency.	Data is from the CMS Hospital Compare data set. CMS calculates the cost of care for each admitted patient, including Medicare Part A and Part B costs. CMS aggregates costs associated with the index admission from 3 days preadmission, through inpatient stay, and 30 days post admission. This cost is divided by the median national cost. CMS applies both numerator and denominator adjustments. We calculate the system-level measure by weighting each member hospital index by the hospital's MEDPAR discharges for the most current year in the study. We sum the weighted values and divide by the sum of the MEDPAR discharges of all member hospitals. This produces a weighted average MSPB index for each system. 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 health systems on the weighted average Medicare spend per beneficiary index. CMS calculates the cost of care for each admitted patient including both Medicare Part A and Part B costs.	Lower

HCAHPS top-box percent (overall hospital rating)			
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 is from CMS Hospital Compare data set. We use the data published by CMS for 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 by CMS. § Patients who gave a rating of 6 or lower § Patients who gave a rating of 7 or 8 § Patients who gave a rating of 9 or 10 We use the "top box" HCAHPS answer to measure hospital performance; the percent of patients choosing a rating of 9 or 10. To calculate the HCAHPS rate for each system, member hospitals' percent value from each HCAHPS measure top box answer is aggregated to the system level. This is done by calculating the number of eligible patients who answered in the top box and dividing by the sum of the survey count for each system. Multiplying this value by 100 gives us the percent of patients who answered in the top box at the system level.	We rank systems based on the top-box answer for the overall hospital rating question, by comparison group. Rates for all other questions are calculated and reported for information only. HCAHPS data are survey data, based on either a sample of hospital inpatients or all inpatients. The data set contains the question scoring of survey respondents.	Higher

Determining the 15 Top Health Systems Ranking

We rank health systems based on their performance on each of the included measures relative to the other in-study systems, by comparison group. We sum the ranks, giving all measures equal weight, and re-rank overall to arrive at a final rank for the system. The top five health systems with the best final rank in each of the three comparison groups are selected as the winners (15 total winners). The ranked performance measures are listed in Table 13.

Table 13. Ranked Performance Measures and Weights

Ranked Measure	Weight in Overall Ranking
Risk-Adjusted Inpatient Mortality	1
Risk-Adjusted Complications	1
Mean Healthcare-Associated Infections	1
Mean 30-Day Mortality Rate	1
30-Day Hosp-Wide Readmission Rate	1
Severity-Adjusted Average Length of Stay	1
Medicare Spend per Beneficiary Index	1
HCAHPS Top Box (Overall Rating Question)	1

Winner exclusions

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

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

1. Observed value is higher than expected and the difference is statistically significant, with 99% confidence.
2. We calculate the 75th percentile index value for mortality and complications, including data only for systems that meet condition number 1 above. These values are used as the high trim points for those health systems. Systems with mortality or complications index values above the respective trim points are winner-excluded.
3. If MSPB is missing, the system is winner excluded.

Measure of “systemness”

The performance-weighted alignment score

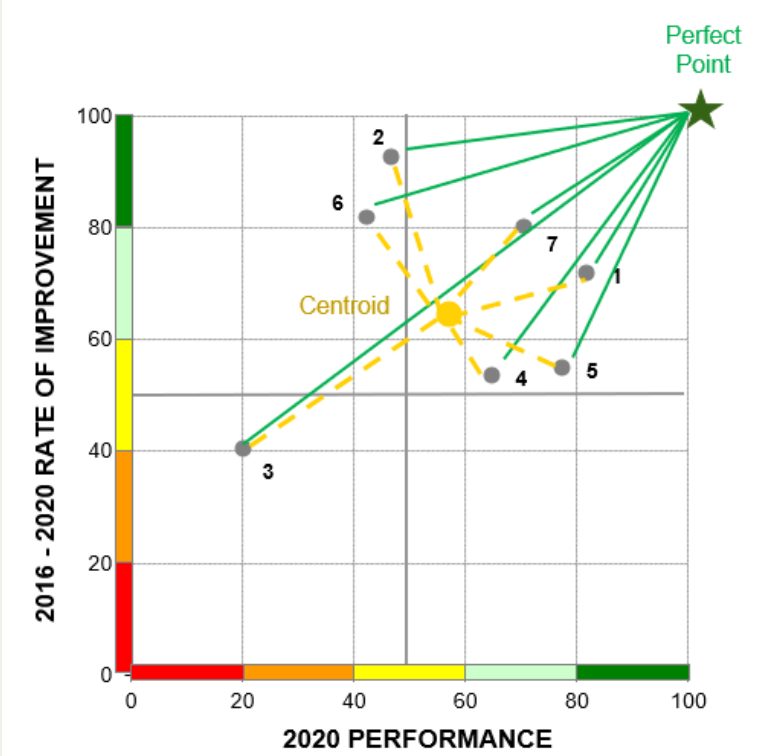
For several years, we have reported a performance-weighted alignment score that measures whether a system is consistently delivering top performance in each community served. It can bring focus to leadership goal-setting and contribute to the development of a system brand that represents reliable delivery of high value across all system sites.

Methodology

Each system performance-weighted alignment score is the average of the distance of each member hospital from their central point (centroid [measure of alignment]) and the distance of each of those hospitals from the 100th percentile point (perfect point [measure of performance]), weighted by the distance from the perfect point. A score is calculated for overall performance and for each individual measure.

The system performance-weighted alignment scores are ranked by comparison group and reported as rank percentiles. Higher percentiles mean better performance.

The profiled system performance is compared to the median alignment scores for the systems that were in the top quintile on both performance and improvement (top performance and improvement group). This group is selected using the study ranked metrics, not member hospital alignment. We find that high alignment has not yet been achieved uniformly across all measures, even in this high-performing group.



Policy on revocation of a 15 Top Health Systems award

To preserve the integrity of the study, it is the policy of the 100 Top Hospitals program to revoke a 15 Top Health Systems award if a system is found to have submitted inaccurate or misleading data to any data source used in the study.

At the discretion of the 100 Top Hospitals program, the circumstances under which a 15 Top Health Systems award could be revoked include, but are not limited to, the following:

- Discovery by 100 Top program staff, through statistical analysis or other means, that a health system has submitted inaccurate data
- Discovery of media or internet reports of governmental or accrediting agency investigations, or sanctions for actions by a health system that could have an adverse impact on the integrity of the 15 Top Health Systems studies or award winner selection

Appendix A: Health System Winners and Their Member Hospitals

Health System / Hospital Name	Location	Hospital Medicare ID
Allina Health	**Minneapolis, MN**	
Abbott Northwestern Hospital	Minneapolis, MN	240057
Buffalo Hospital	Buffalo, MN	240076
Cambridge Medical Center	Cambridge, MN	240020
District One Hospital	Faribault, MN	240071
Mercy Hospital	Coon Rapids, MN	240115
New Ulm Medical Center	New Ulm, MN	241378
Owatonna Hospital	Owatonna, MN	240069
Regina Hospital	Hastings, MN	240059
St. Francis Regional Medical Center	Shakopee, MN	240104
United Hospital	Saint Paul, MN	240038
River Falls Area Hospital	River Falls, WI	521349
Asante	**Medford, OR**	
Asante Ashland Community Hospital	Ashland, OR	380005
Asante Rogue Regional Medical Center	Medford, OR	380018
Asante Three Rivers Medical Center	Grants Pass, OR	380002
Baylor Scott & White Health	**Dallas, TX**	
Baylor Scott & White All Saints Medical Center - Fort Worth	Fort Worth, TX	450137
Baylor Scott & White Emergency Hospitals-Aubrey	Aubrey, TX	670062
Baylor Scott & White Heart & Vascular Hospital-Dallas	Dallas, TX	450851
Baylor Scott & White Hospital Medical Center - College Station	College Station, TX	670088
Baylor Scott & White Medical Center - Brenham	Brenham, TX	450187
Baylor Scott & White Medical Center - Centennial	Frisco, TX	450885
Baylor Scott & White Medical Center - Grapevine	Grapevine, TX	450563
Baylor Scott & White Medical Center - Hillcrest	Waco, TX	450101
Baylor Scott & White Medical Center - Lake Pointe	Rowlett, TX	450742
Baylor Scott & White Medical Center - Llano	Llano, TX	450219
Baylor Scott & White Medical Center - Marble Falls	Marble Falls, TX	670108
Baylor Scott & White Medical Center - Plano	Plano, TX	450890
Baylor Scott & White Medical Center - Round Rock	Round Rock, TX	670034
Baylor Scott & White Medical Center - Sunnyvale	Sunnyvale, TX	670060
Baylor Scott & White Medical Center - Taylor	Taylor, TX	451374
Baylor Scott & White Medical Center - Temple	Temple, TX	450054
Baylor Scott & White Medical Center at - McKinney	McKinney, TX	670082
Baylor Scott & White Medical Center-Irving	Irving, TX	450079
Baylor Scott & White Medical Center-Waxahachie	Waxahachie, TX	450372
Baylor Scott & White The Heart Hospital Denton	Denton, TX	450893
Baylor Scott & White The Heart Hospital Plano	Plano, TX	670025
Baylor University Medical Center	Dallas, TX	450021
CHI Memorial	**Chattanooga, TN**	
CHI Memorial Hospital - Georgia	Fort Oglethorpe, GA	110236
CHI Memorial	Chattanooga, TN	440091

Health System / Hospital Name	Location	Hospital Medicare ID
CHI St. Vincent	**Little Rock, AR**	
CHI St. Vincent Hot Springs	Hot Springs, AR	040026
CHI St. Vincent Infirmary Medical Center	Little Rock, AR	040007
CHI St. Vincent Medical Center-North	Sherwood, AR	040137
CHI St. Vincent Morrilton	Morrilton, AR	041324
Cone Health	**Greensboro, NC**	
Alamance Regional Medical Center	Burlington, NC	340070
Moses H. Cone Memorial Hospital	Greensboro, NC	340091
Edward-Elmhurst Health	**Naperville, IL**	
Edward Hospital	Naperville, IL	140231
Elmhurst Hospital	Elmhurst, IL	140200
Franciscan Sisters of Christian Charity Sponsored Ministries	**Manitowoc, WI**	
Genesis Hospital	Zanesville, OH	360039
St. Francis Memorial Hospital	West Point, NE	281322
Holy Family Memorial	Manitowoc, WI	520107
Mayo Clinic	**Rochester, MN**	
Mayo Clinic Hospital	Phoenix, AZ	030103
Mayo Clinic Hospital in Florida	Jacksonville, FL	100151
Mayo Clinic Health System - Albert Lea and Austin	Albert Lea, MN	240043
Mayo Clinic Health System in Cannon Falls	Cannon Falls, MN	241346
Mayo Clinic Health System in Fairmont	Fairmont, MN	240166
Mayo Clinic Health System in Lake City	Lake City, MN	241338
Mayo Clinic Health System in Mankato	Mankato, MN	240093
Mayo Clinic Health System in New Prague	New Prague, MN	241361
Mayo Clinic Health System in Red Wing	Red Wing, MN	240018
Mayo Clinic Health System in Saint James	Saint James, MN	241333
Mayo Clinic Health System in Waseca	Waseca, MN	241345
Mayo Clinic Health System Springfield	Springfield, MN	241352
Mayo Clinic Rochester	Rochester, MN	240010
Mayo Clinic Health System - Chippewa Valley in Bloomer	Bloomer, WI	521314
Mayo Clinic Health System - Franciscan Healthcare in La Crosse	La Crosse, WI	520004
Mayo Clinic Health System - Franciscan Healthcare in Sparta	Sparta, WI	521305
Mayo Clinic Health System - Northland in Barron	Barron, WI	521315
Mayo Clinic Health System - Oakridge in Osseo	Osseo, WI	521302
Mayo Clinic Health System - Red Cedar	Menomonie, WI	521340
Mayo Clinic Health System in Eau Claire	Eau Claire, WI	520070
North Memorial Health	**Robbinsdale, MN**	
Maple Grove Hospital	Maple Grove, MN	240214
North Memorial Health Hospital	Robbinsdale, MN	240001
Penn Medicine	**Philadelphia, PA**	
Penn Medicine Princeton Medical Center	Plainsboro, NJ	310010
Chester County Hospital	West Chester, PA	390179
Hospital of the University of Pennsylvania	Philadelphia, PA	390111
Penn Medicine Lancaster General Hospital	Lancaster, PA	390100

Health System / Hospital Name	Location	Hospital Medicare ID
Penn Presbyterian Medical Center	Philadelphia, PA	390223
Pennsylvania Hospital	Philadelphia, PA	390226
PIH Health	**Whittier, CA**	
Good Samaritan Hospital	Los Angeles, CA	050471
PIH Health Hospital - Downey	Downey, CA	050393
PIH Health Hospital - Whittier	Whittier, CA	050169
Rush Health	**Chicago, IL**	
Rush-Copley Medical Center	Aurora, IL	140029
Rush Oak Park Hospital	Oak Park, IL	140063
Rush University Medical Center	Chicago, IL	140119
Scripps Health	**San Diego, CA**	
Scripps Green Hospital	La Jolla, CA	050424
Scripps Memorial Hospital-Encinitas	Encinitas, CA	050503
Scripps Memorial Hospital-La Jolla	La Jolla, CA	050324
Scripps Mercy Hospital	San Diego, CA	050077
St. Luke's Health System	**Boise, ID**	
St. Luke's Elmore	Mountain Home, ID	131311
St. Luke's Jerome	Jerome, ID	131310
St. Luke's Magic Valley Medical Center	Twin Falls, ID	130002
St. Luke's McCall	McCall, ID	131312
St. Luke's Nampa	Nampa, ID	130071
St. Luke's Regional Medical Center	Boise, ID	130006
St. Luke's Wood River Medical Center	Ketchum, ID	131323

Appendix B: The Top Quintile: Highest Performing Health Systems

Large Health Systems

System Name	Location
AdventHealth	Altamonte Springs, FL
Adventist Health	Roseville, CA
Allina Health	**Minneapolis, MN**
Atlantic Health System	Morristown, NJ
Avera Health	Sioux Falls, SD
BayCare Health System	Clearwater, FL
Baylor Scott & White Health	**Dallas, TX**
Centura Health	Englewood, CO
CHI Health	Omaha, NE
CHI St Luke's Health	Houston, TX
CommonSpirit Health	Englewood, CO
HCA Continental Division	Denver, CO
HCA Tristar Division	Nashville, TN
Houston Methodist	Houston, TX
Inova Health System	Falls Church, VA
Intermountain Health Care	Salt Lake City, UT
Kettering Health Network	Dayton, OH
Mayo Clinic	**Rochester, MN**
Penn Medicine	**Philadelphia, PA**
Rush Health	**Chicago, IL**
Saint Joseph Mercy Health System	Ann Arbor, MI
SCL Health	Denver, CO
Sentara Healthcare	Norfolk, VA
Sharp HealthCare	San Diego, CA
St. Luke's University Health Network	Bethlehem, PA
Stanford Health Care	Stanford, CA
Sutter Health	Sacramento, CA
Sutter Health Bay Area	Sacramento, CA
Sutter Health Valley Area	Sacramento, CA
UCHealth	Aurora, CO
University Hospitals	Cleveland, OH

Medium Health Systems

System Name	Location
Adventist Health Central Valley Network	Hanford, CA
Bronson Healthcare Group	Kalamazoo, MI
Centracare Health System	Saint Cloud, MN
Cone Health	**Greensboro, NC**
Edward-Elmhurst Health	**Naperville, IL**
HCA Mountain Division	Cottonwood Heights, UT
HCA San Antonio Division	San Antonio, TX
HealthPartners	Bloomington, MN
Lee Memorial Health System	Fort Myers, FL
Main Line Health	Bryn Mawr, PA
Mount Carmel Health System	Columbus, OH
Munson Healthcare	Traverse City, MI
North Mississippi Health Services	Tupelo, MS
NorthShore University HealthSystem	Evanston, IL
PIH Health	**Whittier, CA**
Scripps Health	**San Diego, CA**
St. Luke's Health System	**Boise, ID**
TriHealth	Cincinnati, OH

Small Health Systems

System Name	Location
Asante	Medford, OR
AMITA AdventHealth	Chicago, IL
Asante	**Medford, OR**
Aspirus	Wausau, WI
Baptist Health Care (FL)	Pensacola, FL
CHI Memorial	**Chattanooga, TN**
CHI St. Vincent	**Little Rock, AR**
Emanate Health	Covina, CA
EvergreenHealth	Kirkland, WA
Franciscan Sisters of Christian Charity Sponsored Ministries	**Manitowoc, WI**
Hawaii Health Systems Corporation	Honolulu, HI
Hawaii Pacific Health	Honolulu, HI
Health First	Rockledge, FL
Lovelace Health System	Albuquerque, NM
Maury Regional Health	Columbia, TN
Mosaic Life Care	Saint Joseph, MO
North Memorial Health	**Robbinsdale, MN**
Palomar Health	Escondido, CA
Penn Highlands Healthcare	DuBois, PA
Saint Joseph Health System	Mishawaka, IN
St. Charles Health System	Bend, OR
St. Vincent's Healthcare	Jacksonville, FL
UM Upper Chesapeake Health	Bel Air, MD
Valley Health	Winchester, VA

Note: Winners are in Bold

Appendix C: Methodology Details

Normative database development

A normative database of case-level data has been constructed from the Projected Inpatient Database (PIDB), a national all-payer database containing more than 22 million all-payer discharges annually. This data is obtained from approximately 5,300 hospitals, representing over 60% of all discharges from short-term, general, nonfederal hospitals in the US. PIDB discharges are statistically weighted to represent the universe of short-term, general, nonfederal hospitals in the US. Demographic and clinical data are also included: age, sex, and LOS; clinical groupings (Medicare Severity Diagnosis Related Groups, or MS-DRGs), ICD-9-CM and ICD-10-CM principal and secondary diagnoses and procedures; present-on-admission (POA) coding; admission source and type; and discharge status. For this study, risk models were recalibrated using federal fiscal years (FFY) 2016-2018 all-payer data.

The risk models used by 100 Top Hospitals® makes normative comparisons of mortality and complications rates by using patient-level data to control for case mix and severity differences. We do this by evaluating ICD-10-CM diagnosis and procedure codes to adjust for severity within clinical case mix groupings. Conceptually, we group patients with similar characteristics (that is, age, sex, principal diagnosis, procedures performed, admission type, and comorbid conditions) to produce expected, or normative, comparisons. Through testing, we have found that this methodology produces normative comparisons using readily available administrative data, eliminating the need for additional data collection.[30–34]

The proprietary risk-adjustment models for inpatient mortality, complications, and the severity-adjustment models for LOS and cost per case, are recalibrated for each annual release using the latest federal fiscal years of data available in the PIDB. Changes this year to those models include the following:

- Risk adjustment rate tables are at the diagnosis and procedure code level – a finer level of granularity than the AHRQ Clinical Classification Software (CCS) categories that had been used in previous risk-adjustment models to accommodate the transition from ICD-9-CM to ICD-10-CM coding.
- Age categories are extended to a maximum of 90+ years of age, from 65+, to better capture risk for the oldest patients.
- Added Complexity of Diagnoses Score (CDS) coefficient to better describe the patient condition (Risk Adjusted Mortality Index model only).

Coronavirus disease 2019 (COVID-19) data adjustments

Due to the COVID-19 pandemic, patients identified as COVID-19 cases were removed from the claims driven measures. The ICD-10-CM codes below were used to identify COVID-19 records from MEDPAR 2020 data and those records were removed from the dataset:

- *B97.29 Other coronavirus* (for discharge dates prior to April 1, 2020)
- *U07.1 COVDI-19, virus identified (lab confirmed)* (for discharges from April 1, 2020 and forward)

CMS Hospital Compare dataset has been adjusted as well to account for disruption in data collection and data results due to the COVID-19 pandemic. CMS made the following changes to their publicly reported data that effected the time periods used in this study:[35]

- Deadlines for October 1, 2019 – December 31, 2019 (Q4) data submission optional.
- If Q4 is submitted, it will be used to calculate the 2019 performance and payment (where appropriate). If data for Q4 is unable to be submitted, the 2019 performance will be calculated based on data from January 1, 2019 – September 30, 2019 (Q1-Q3) and available data.
- CMS will not count data from January 1, 2020 through June 30, 2020 (Q1-Q2) for performance or payment programs. Data does not need to be submitted to CMS for this time period.
- CMS will not report q1-q2 2020 data in any of their measures in the Hospital Compare dataset.

Use of present-on-admission 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, which were not present at the time of the patient's admission but occurred during hospitalization. The Centers for Medicare & Medicaid Services (CMS) now requires all Inpatient Prospective Payment System (IPPS) hospitals to document whether a patient has these and other conditions when admitted. The proprietary risk- and severity-adjustment models for inpatient mortality, complications, and LOS use POA data reported in the all-payer data to identify conditions that were present on admission and distinguish them from complications that occurred while the patient was in the hospital. Our models develop expected values based only on conditions that were present on admission.

In addition to considering the POA indicator codes in calibration of our risk- and severity-adjustment models, we have adjusted for missing/invalid POA coding found in the Medicare Provider Analysis and Review (MEDPAR) data files. After 2010, we have observed a significantly higher percentage of principal diagnosis and secondary diagnosis codes that do not have a valid POA indicator code in the MEDPAR data files. Since 2011, an invalid code of "0" has been appearing. This phenomenon has led to an artificial rise in the number of conditions that appear to be occurring during the hospital stay, as invalid POA codes are treated as "not present" by POA-enabled risk models.

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

- Original, valid (Y, N, U, W, or 1) POA codes assigned to diagnoses were retained
- Where a POA code of "0" appeared, we took the next four steps:
    - 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 the POA code "Y" or "W" appeared more than 50% of the time in the all-payer database, as "present on admission"
    - All others were treated as "not present"

Percentage of diagnosis codes with POA indicator code of "0" by MEDPAR year						
	2015	2016	2017	2018	2019	2020
Principal diagnosis	4.99%	2.45%	3.96%	3.94%	3.90%	3.93%
Secondary diagnosis	23.36%	21.64%	24.11%	24.53%	24.87%	24.73%

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 normative comparisons of hospital outcomes, we must adjust raw data to accommodate differences that result from the variety and severity of admitted cases.

Risk-adjusted inpatient mortality index models

The inpatient mortality risk model can be applied to coded patient claims data to estimate the expected probability of death occurring, given various patient-related factors. The mortality risk model used in this study is calibrated for patients aged 90 and older.

We exclude long-term care, psychiatric, substance abuse, rehabilitation, and federally owned or controlled facilities. In addition, we exclude certain patient records from the data set: psychiatric; substance abuse; 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 (Z515) are included in the mortality risk model, which is calibrated to estimate probability of death for these patients. The mortality risk model excludes records with "do not resuscitate" (DNR) (Z66) orders that are coded as present on admission.

Hospice versus palliative care patients

Separately licensed hospice unit patient records are not included in MEDPAR data. They have a separate billing type and separate provider numbers. In addition, patients receiving hospice treatment in acute care beds are billed under hospice, not the hospital, and would not be in the MEDPAR data file.

Inpatients coded as palliative care (Z515) are included in the study. Over the past few years, the number of patients coded as palliative care has increased significantly, and our risk models have been calibrated in order to produce expected values for these patients.

Excluding records that are DNR status at admission is supported by the literature. A recent peer-reviewed publication stated: "Inclusion of DNR patients within mortality studies likely skews those analyses, falsely indicating failed resuscitative efforts rather than humane decisions to limit care after injury".[36] Our rationale is straightforward: If a patient is admitted DNR (POA), then typically no heroic efforts would be made to save that patient if they began to fail.

Without the POA DNR exclusion, if a given hospital has a higher proportion of POA DNR patients that it is not attempting to save from death compared to an otherwise similar hospital that is not admitting as high a proportion of such patients, the first hospital would look lower-performing compared to the second through no fault of its own. The difference would be driven by the proportion of POA DNR patients.

We are no longer able to exclude all rehabilitation patients as we have done in the past. This is because the ICD-10-CM coding system does not identify rehabilitation patients. We can only exclude those patients coded as being in a Prospective Payment System (PPS)-exempt hospital rehabilitation unit (provtype = R or T).

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 (for example, age, clinical grouping, and severity of illness).[30-34]

This model accounts for only patient conditions that are present on admission when calculating risk.

Staff physicians suggested clinical patient characteristics that were 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

A complications risk model has been developed that can be applied to coded patient claims data to estimate the expected probability of a complication occurring, given various patient-related factors. We exclude long-term care, psychiatric, substance abuse, rehabilitation, and federally owned or controlled facilities. In addition, we exclude certain patient records from the data set: psychiatric; substance abuse; 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 (Z515) are included in the complications risk model, which is calibrated to estimate probability of complications for these patients.

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 complications model uses clinical qualifiers to identify complications that have occurred in the inpatient setting. The complications used in the model are listed on the following page.

Complication	Patient Group
Intraoperative or Postprocedural Complications Relating to Urinary Tract	Surgical only
Intraoperative or Postprocedural complications relating to urinary tract	Surgical only
Intraoperative or Postprocedural 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
Post-operative septicemia, abscess, and wound infection	Surgical, including cardiac
Aspiration pneumonia	Surgical only
Tracheostomy complications	All patients
Complications of cardiac, vascular, and hemodialysis devices	Surgical, including cardiac
Nervous system complications from devices/complications of nervous system devices	Surgical only
Complications of genitourinary devices	Surgical only
Complications or 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
Intraoperative or Postprocedure complications relating to nervous system	Surgical only
Intraoperative or Postprocedure acute myocardial infarction (AMI)	Surgical only
Post-operative cardiac abnormalities except AMI	Surgical only
Procedure-related perforation or laceration	All patients
Post-operative physiologic and metabolic derangements	Surgical, including cardiac
Post-operative coma or stupor	Surgical, including cardiac
Post-operative pneumonia	Surgical, including cardiac
Pulmonary embolism	All patients
Venous thrombosis	All patients
Hemorrhage, hematoma or seroma complicating a procedure	All patients
Post-procedure 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 (CNS) 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 narcotics and related analgesics	All patients
Complications relating to non-narcotic analgesics	All patients
Complications relating to antiepileptic, sedatives-hypnotics and anti-parkinsonism drugs	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 anti-asthmatic drugs	All patients
Complications relating to other medications (includes hormones, insulin, iron, oxytocic agents)	All patients

Complication rates are calculated from normative data for two patient risk groups: medical and surgical. 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,[37–40] including health system, hospital, service line, or MS-DRG classification. This model accounts for only patient conditions that are present on admission when calculating risk.

Index interpretation

An outcome index is a ratio of an observed number of outcomes to an expected number of outcomes in a 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 the number of observed events divided by the number of expected events and can be calculated for outcomes that involve counts of occurrences (for example, 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% lower than the expected number of events based on the normative experience

Therefore, an index value of 1.0 indicates no difference between observed and expected outcome occurrence. An index value greater than 1.0 indicates an excess in the observed number of events relative to the expected based on the normative experience. An index value 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% more outcomes, and an index of 0.90 indicates 10% fewer outcomes than expected based on the experience of the norm. The index can be calculated across a variety of groupings (for example, hospital or service line).

Healthcare-associated infections

Healthcare-associated infections (HAIs), as developed by the National Healthcare Safety Network* (NHSN) and reported by CMS in the public Hospital Compare data set, capture new

information about the quality of inpatient care. Tracking and intervening to reduce infection rates for methicillin-resistant staphylococcus aureus (MRSA), central line-associated blood stream infections (CLABSI), catheter-associated urinary tract infection (CAUTI), clostridium difficile colitis (C.diff), and other problematic infections must be reported to CMS. New public data will allow the development of national benchmarks for use by hospital leadership to affect change.

Healthcare-Associated Infection Measures	
HAI-1	Central line-associated bloodstream infections (CLABSI) in ICUs and select wards
HAI-2	Catheter-associated urinary tract infections (CAUTI) in ICUs and select wards
HAI-3	Surgical Site Infection from colon surgery (SSI: Colon)
HAI-4	Surgical Site Infection from abdominal hysterectomy (SSI: Hysterectomy)
HAI-5	Methicillin-resistant Staphylococcus Aureus (MRSA) Blood Laboratory-identified Events (Bloodstream infections)
HAI-6	Clostridium difficile (C.diff.) Laboratory-identified Events (Intestinal infections)

The HAI measures are reported as risk-adjusted standardized infection ratios (SIRs) using probability models and normative data sets maintained by a branch of the Centers for Disease Control and Prevention (CDC), the NHSN. Along with reporting SIR data to CMS, NHSN is responsible for administering HAI surveillance procedures and reporting specifications, along with producing software and training programs for all participating hospitals. Its underlying methodology details for building the SIR are documented and updated annually in a reference guide posted at the CDC website.[41]

To calculate a Standardized Infection Ratio (SIR) for reporting HAI incidence, expected values are developed by the NHSN using probability models constructed from NHSN baseline data which represents a standard population. We sum member hospitals' observed and expected values (as reported in CMS Hospital Compare data set) to calculate the system level index for each HAI. We then create a composite HAI SIR, which is the unweighted mean of the available individual HAI SIRs.

Included HAIs vary by comparison group, due to data availability. A system must have data for the study minimum required number of HAIs to be in-study.

Compare Group	Required HAIs	Minimum Required
Large Health Systems	HAI-1, HAI-2, HAI-3, HAI-5, HAI-6	5
Medium Health System	HAI-1, HAI-2, HAI-3, HAI-5, HAI-6	5
Small Health System	HAI-1, HAI-3, HAI-6	3

* See blog.eoscu.com/blog/what-is-the-national-healthcare-safety-network for more information.

In addition to the SIR values for each HAI, CMS publishes the observed and expected values, as well as a population count (days or procedures), which varies by measure.

- CLABSI – device days
- CAUTI – urinary catheter days
- SSI: colon – procedures
- SSI: hysterectomy – procedures
- MRSA – patient days
- C.diff – patient days

System member hospitals' observed, expected and counts, for each HAI, are summed to produce system level values. The system's expected values are normalized by their comparison group and a normalized z-score is calculated. To develop a composite HAI measure, we believe it is not appropriate to simply "roll up" observed and expected values across the different HAIs because the overall observed to expected ratio would be weighted by the rates for each HAI, which could be quite different, and the HAIs are also likely to be distributed differently from hospital to hospital. For these reasons, we calculate an unweighted mean of the normalized z-scores as the composite HAI measure used for ranking systems.

For reporting, an unweighted mean of the composite HAI SIR is calculated. Using the member hospitals' summed observed and expected values for each HAI, a system-level SIR is calculated. The individual SIRs are then converted to a percent difference value which are summed and divided to produce a mean percent difference value. This value is then converted back to an index, which is the reported measure: system-level composite HAI SIR.

30-day risk-adjusted mortality rates and 30-day risk-adjusted hospital-wide readmission rates

This study currently includes two extended outcome measures (30-day mortality and 30-day hospital-wide readmissions), as developed by CMS and published in the Hospital Compare data set.

The Hospital Compare website and database were created by CMS, the US Department of Health and Human Services, and other members of the Hospital Quality Alliance. The data on the website comes from hospitals that have agreed to submit quality information that will be made public. Both measures used in this study have been endorsed by the National Quality Forum (NQF).

CMS calculates the 30-day mortality and 30-day readmission rates from Medicare enrollment and claims records using 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 acute myocardial infarction (AMI), heart failure (HF), pneumonia, chronic obstructive pulmonary disease (COPD), and stroke patients. 30-day hospital-wide readmission rates are based on unplanned, all-cause readmission after admission for any eligible condition within 30 days of acute care hospital discharge.

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.

Data note relating to the July 2016 Hospital Compare performance period (July 1, 2012 - June 30, 2015): The pneumonia measure cohort was expanded to include principal discharge codes for sepsis and aspiration pneumonia. This resulted in a significant increase in pneumonia 30-day mortality rates nationally, beginning with the 2015 data year.

Using the CMS 30-day mortality rate for each patient condition, we aggregate these data to produce a rate for each 30-day measure for each system. This is done by multiplying the hospital- level reported patient count (eligible patients) by the reported hospital rate to determine the number of patients who died within 30 days of admission. We sum the calculated deaths and divide by the sum of eligible patients for member hospitals of each system. This value is multiplied by 100 to produce the system-level 30-day mortality rate for each measure, expressed as a percent. 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.

We calculate the arithmetic mean of the system-level included 30-day mortality rates (AMI, heart failure, pneumonia, COPD, stroke) to produce the ranked and reported composite measure.

The CMS hospital-wide readmission model estimates hospital-specific, risk-standardized, unplanned, all-cause 30-day readmission rates for patients discharged alive to a non-acute care setting. Patients may have been readmitted back to the same hospital, to a different hospital, or to another acute care facility. They may have been readmitted for the same condition as their recent hospital stay or for a different reason (CMS has indicated this is to discourage hospitals from coding similar readmissions as different readmissions). 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.

The system-level ranked and reported 30-day hospital-wide readmission measure is calculated similar to that of the 30-day mortality measure.

Using the CMS 30-day hospital-wide readmission rates, we aggregate member hospital data to produce a rate for each system. This is done by multiplying the hospital-level reported patient count (eligible patients) by the reported hospital rate to determine the number of patients who were readmitted within 30 days of discharge. We sum the calculated readmissions and divide by the sum of eligible patients for member hospitals of each system. This value is multiplied by 100 to produce the system-level 30- day hospital-wide readmission rate, expressed as a percent, which is the ranked and reported measure value.

Length-of-stay methodologies

The severity-adjusted resource demand model can be applied to coded patient claims data to estimate the expected LOS, given various patient-related factors.[42] We exclude long-term care, psychiatric, substance abuse, rehabilitation, and federally owned or controlled facilities. In addition, we exclude certain patient records from the data set: psychiatric; substance abuse; unclassified cases (MS-DRGs 945, 946, and 999); cases in which patient age was less than 65 years; and cases in which a patient was transferred to another short-term, acute care hospital.

Palliative care patients (Z515) are included in the LOS model, which is calibrated to predict expected LOS for these patients.

Note: We are no longer able to exclude all rehabilitation patients, as we have done in the past, because the ICD-10-CM coding system does not identify rehabilitation patients. We can only exclude those patients coded as being in a PPS-exempt hospital rehabilitation unit (provtype = R or T).

Our severity-adjusted resource demand model allows us to produce risk-adjusted performance comparisons on LOS between or across subgroups of inpatients. These patient groupings can be based on factors such as clinical groupings, hospitals, product lines, geographic regions, and physicians. This regression model adjusts for differences in diagnosis type and illness severity, based on ICD-10-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.

POA coding allows us to estimate appropriate adjustments to LOS weights based on pre-existing conditions. Complications that occurred during the hospital stay are not considered in the model. We calculate expected values from model coefficients that are normalized to the clinical group and transformed from log scale.

We calculate a length of stay (LOS) index value for each health system by dividing the sum of the actual LOS of member hospitals by the sum of the normalized expected LOS for the hospitals in the system. Expected LOS adjusts for difference in severity of illness using a linear regression model. We normalize the expected values using the observed- to-expected ratio for in-study health systems, by comparison group.

We convert the LOS index into days by multiplying each system's LOS index by the grand mean LOS for all in-study health systems. We calculate grand mean LOS by summing in-study health systems' LOS and dividing that by the number of health systems. The result is the severity-adjusted average length of stay for each system, which is the ranked and reported measure value.

Medicare spend per beneficiary 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 data sets, and in FFY 2015, began to include it in the Hospital 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".[43]

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 (that is, allowed charges) are counted in the MSPB episode as long as the start of the claim falls within the episode window. 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 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 various risk factors including case mix, age, and hierarchical condition category (HCC) indicators.

To calculate the system-level MSPB index, we multiply each member hospital MSPB by the hospital's MEDPAR discharges for the most current year included in the study. This produces each hospital's weighted MSPB index.

To calculate the MSPB index for each health system, we sum the member hospital weighted MSPBs, sum the member hospital MEDPAR discharges, then divide the sum of the weighted MSPBs by the sum of the discharges. This produces the health system mean weighted MSPB index, which is the ranked measure in the study.

Hospital Consumer Assessment of Healthcare Providers and Systems 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 may be 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 medicare.gov/hospitalcompare. A downloadable version of HCAHPS results is available.

The HCAHPS data is adjusted by CMS for both survey mode (phone, web, or mail survey) and the patient mix at the discharging facility, since respondents randomized to the phone mode tend to provide more positive evaluations about their care experience than those randomized to the mail survey mode. Details on this adjustment's parameters are available for all facilities with each quarterly update, at hcahpsonline.org.

Although we report health system performance on all HCAHPS questions, only performance on the overall hospital rating question, "How do patients rate the hospital, overall?" is used to rank system performance.

At the hospital level, 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)

We use the "top box" HCAHPS answer to measure hospital and health system performance; the percent of patients choosing the top box answer (rate of 9 or 10) for the overall hospital rating question. CMS Hospital Compare provides the percent of patients that rated the hospital in all three categories, our performance metric is based solely on the top box percent for the overall hospital rating question. This is a change in our methodology. Previous studies used a weighted score based on the sum of all three categories. For the purpose of clarity and simplicity, we have moved to using the 'top box' percent.

To calculate the HCAHPS rate for each system, member hospitals' percent value from each HCAHPS measure top box answer is aggregated to the system level. This is done by calculating the number of eligible patients who answered in the top box and dividing by the sum of the survey count for each system. Multiplying this value by 100 gives us the percent of patients who answered the overall rating question in the top box at the system level, which is the ranked measure in this study.

Performance measure normalization

The inpatient mortality, complications, and LOS measures are normalized based on the in-study population, by comparison group, to provide a more easily interpreted comparison among health systems. We assign each health system in the study to one of three comparison groups based on the sum of member hospitals' total operating expense.

(Detailed descriptions of the comparison groups can be found in the Methodology section of this document.)

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 system's expected values by multiplying them by the ratio of the observed to expected values 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 health system. We normalize the individual system's expected values by multiplying them by the ratio of the observed to expected values for its comparison group. The system's normalized index is then calculated by dividing the system'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 systems (grand mean LOS).

Differences between current and trend profiles

Normalization

The current year values on the current and trend graphs will not match for inpatient mortality, complications, or average LOS. This is because we use different norm factors to normalize the expected values.

- Current profile: We combine in-study systems' data for only the most current study year to calculate each comparison group norm factor (observed/expected). Note: The current study year was comprised of the two most current years MEDPAR data for inpatient mortality and complications, and the current year data only for average LOS.
- Trend profile: We combine in-study systems' data for all five study years to calculate each comparison group norm factor.

In-study system counts

There are fewer in-study systems in the trend profile than the current profile because some systems do not have enough data points for one or more measures to calculate trend, so they are excluded. Three data points are required to calculate the t-statistic of the regression line, which is the ranked metric.

- Additional impact on average LOS calculation: The observed/normalized expected LOS index for each system is converted into an average LOS in days by multiplying it by the mean average LOS for all in- study systems (sum observed LOS/in-study system count). The grand mean average LOS will be different in current and trend profiles when there are different numbers of in-study systems.

Both the current and trend profiles are internally consistent. They each provide relevant comparisons of a profiled health system's performance versus peers and national benchmarks.

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. s Dividing such a value by a number that may be zero or negative does not convey any meaningful information because the amount of change is not proportional to its previous value.

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.

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. Dividing such a value by a number that may be zero or negative does not convey any meaningful information because the amount of change is not proportional to its previous value.

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

We do not report any individual hospital data that is based on 11 or fewer patients, as required by CMS. This affects the following measures:

- Risk-adjusted inpatient 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 hospital-wide readmission rates (CMS does not report a rate when count is less than 25)
- Average LOS

Appendix D: All Health Systems in Study

Health System Name	Location
Abrazo Community Health Network	Phoenix, AZ
AdventHealth	Altamonte Springs, FL
Adventist Health	Roseville, CA
Adventist Health Central Valley Network	Hanford, CA
Adventist Healthcare	Gaithersburg, MD
Advocate Aurora Health	Downers Grove, IL
Advocate Health Care	Downers Grove, IL
AHMC Healthcare Inc	Alhambra, CA
Alameda Health System	Alameda, CA
Allegheny Health Network	Pittsburgh, PA
Allegiance Health Management	Shreveport, LA
AllianceHealth	Clinton, OK
Allina Health	**Minneapolis, MN**
Alta Hospitals System	Los Angeles, CA
AMITA AdventHealth	Chicago, IL
AMITA Ascension	Chicago, IL
Appalachian Regional Healthcare (ARH)	Lexington, KY
Ardent Health Services	Nashville, TN
Asante	**Medford, OR**
Ascension Health	Saint Louis, MO
Ascension Michigan	Warren, MI
Ascension Wisconsin	Glendale, WI
Aspirus	Wausau, WI
Atlantic Health System	Morristown, NJ
Atrium Health	Charlotte, NC
Atrium Health Navicent	Macon, GA
Aultman Health Foundation	Canton, OH
Aurora Health Care	Milwaukee, WI
Avera Health	Sioux Falls, SD
Ballad Health	Johnson City, TN
Banner Health	Phoenix, AZ
Baptist Health	Montgomery, AL
Baptist Health (AR)	Little Rock, AR
Baptist Health Care (FL)	Pensacola, FL
Baptist Health of Northeast Florida	Jacksonville, FL
Baptist Health South Florida	Coral Gables, FL
Baptist Healthcare System (KY)	Louisville, KY
Baptist Memorial Health Care Corp	Memphis, TN
Bassett Healthcare	Cooperstown, NY
BayCare Health System	Clearwater, FL
Bayhealth	Dover, DE
Baylor Scott & White Health	**Dallas, TX**
Baystate Health	Springfield, MA

Health System Name	Location
Beacon Health System	South Bend, IN
Beaumont Health	Royal Oak, MI
Beth Israel Deaconess Lahey Health	Cambridge, MA
BJC HealthCare	Saint Louis, MO
Bon Secours	Marriottsville, MD
Bon Secours Mercy Health	Cincinnati, OH
Bronson Healthcare Group	Kalamazoo, MI
Brookwood Baptist Health	Birmingham, AL
Broward Health	Fort Lauderdale, FL
Butler Health System	Butler, PA
Cape Cod Healthcare	Hyannis, MA
Capital Health System	Trenton, NJ
CarePoint Health	Bayonne, NJ
Carilion Clinic	Roanoke, VA
Carle Health System	Urbana, IL
Carondelet Health Network	Tucson, AZ
Catholic Health	Buffalo, NY
Catholic Health Services of Long Island	Rockville Centre, NY
Centra Health	Lynchburg, VA
Centracare Health System	Saint Cloud, MN
Centura Health	Englewood, CO
CHI Franciscan Health	Tacoma, WA
CHI Health	Omaha, NE
CHI Memorial	**Chattanooga, TN**
CHI Saint Joseph Health	Lexington, KY
CHI St Luke's Health	Houston, TX
CHI St. Vincent	**Little Rock, AR**
ChristianaCare	Wilmington, DE
Christus Health	Irving, TX
Cleveland Clinic	Cleveland, OH
CommonSpirit Health	Englewood, CO
Commonwealth Health	Wilkes Barre, PA
Community Foundation of Northwest Indiana	Munster, IN
Community Health Network	Indianapolis, IN
Community Health Systems	Franklin, TN
Community Hospital Corp	Plano, TX
Community Medical Centers	Fresno, CA
Cone Health	**Greensboro, NC**
Conemaugh Health System	Johnstown, PA
Covenant Health	Knoxville, TN
Covenant Health (MA)	Tewksbury, MA
CoxHealth	Springfield, MO
Crozer-Keystone Health System	Springfield, PA
Dartmouth Hitchcock Health	Lebanon, NH
DCH Health System	Tuscaloosa, AL

Health System Name	Location
Deaconess Health System	Evansville, IN
Detroit Medical Center	Detroit, MI
Dignity Health	San Francisco, CA
Duke Health	Durham, NC
Duke LifePoint	Brentwood, TN
Edward-Elmhurst Health	**Naperville, IL**
Einstein Healthcare Network	Philadelphia, PA
Emanate Health	Covina, CA
Emory Healthcare	Atlanta, GA
Essentia Health	Duluth, MN
EvergreenHealth	Kirkland, WA
Excela Health	Greensburg, PA
Forrest Health	Hattiesburg, MS
Franciscan Health	Mishawaka, IN
Franciscan Missionaries of Our Lady Health System	Baton Rouge, LA
Franciscan Sisters of Christian Charity Sponsored Ministries	**Manitowoc, WI**
Froedtert & the Medical College of Wisconsin	Milwaukee, WI
Garnet Health	Middletown, NY
Geisinger Health System	Danville, PA
Genesis Health System	Davenport, IA
Guthrie Healthcare System	Sayre, PA
Hackensack Meridian Health	Neptune, NJ
Hartford HealthCare	Hartford, CT
Hawaii Health Systems Corporation	Honolulu, HI
Hawaii Pacific Health	Honolulu, HI
HCA Capital Division	Richmond, VA
HCA Central and West Texas Division	Austin, TX
HCA Continental Division	Denver, CO
HCA East Florida Division	Ft. Lauderdale, FL
HCA Far West Division	Las Vegas, NV
HCA Gulf Coast Division	Houston, TX
HCA Healthcare	Nashville, TN
HCA Medical City Healthcare	Dallas, TX
HCA MidAmerica	Kansas City, MO
HCA Mountain Division	Cottonwood Heights, UT
HCA North Florida Division	Tallahassee, FL
HCA San Antonio Division	San Antonio, TX
HCA South Atlantic Division	Charleston, SC
HCA Tristar Division	Nashville, TN
HCA West Florida Division	Tampa, FL
Health First	Rockledge, FL
Health Group of Alabama	Huntsville, AL
HealthPartners	Bloomington, MN
Hendrick Health	Abilene, TX

Health System Name	Location
Henry Ford Health System	Detroit, MI
Heritage Valley Health System	Beaver, PA
HighPoint Health System	Gallatin, TN
Hillcrest HealthCare System	Tulsa, OK
Holy Cross Health	Silver Spring, MD
HonorHealth	Scottsdale, AZ
Hospital Sisters Health System	Springfield, IL
Houston Healthcare	Warner Robins, GA
Houston Methodist	Houston, TX
Indiana University Health	Indianapolis, IN
Infirmary Health Systems	Mobile, AL
Inova Health System	Falls Church, VA
Inspira Health Network	Vineland, NJ
Integris Health	Oklahoma City, OK
Intermountain Health Care	Salt Lake City, UT
Jefferson Health	Philadelphia, PA
John D Archbold Memorial Hospital	Thomasville, GA
John Muir Health	Walnut Creek, CA
Johns Hopkins Health System	Baltimore, MD
Kaleida Health	Buffalo, NY
Keck Medicine of USC	Los Angeles, CA
Kettering Health Network	Dayton, OH
KPC Healthcare, Inc.	Santa Ana, CA
LCMC Health	New Orleans, LA
Lee Memorial Health System	Fort Myers, FL
Legacy Health	Portland, OR
Lehigh Valley Health Network	Allentown, PA
LifeBridge Health	Baltimore, MD
LifePoint Health	Brentwood, TN
Lifespan Corporation	Providence, RI
Loma Linda University Health	Loma Linda, CA
Los Angeles County-Department of Health Services	Los Angeles, CA
Lovelace Health System	Albuquerque, NM
Loyola Medicine	Maywood, IL
M Health Fairview	Minneapolis, MN
Main Line Health	Bryn Mawr, PA
MaineHealth	Portland, ME
Manatee Healthcare Services	Bradenton, FL
Marshfield Clinic Health System	Marshfield, WI
Mary Washington Healthcare	Fredericksburg, VA
Mass General Brigham	Boston, MA
Maury Regional Health	Columbia, TN
Mayo Clinic	**Rochester, MN**
McLaren Health Care Corp	Grand Blanc, MI
McLeod Health	Florence, SC

Health System Name	Location
Med Center Health	Bowling Green, KY
MediSys Health Network	Jamaica, NY
MedStar Health	Columbia, MD
Memorial Health System	Springfield, IL
Memorial Healthcare System	Hollywood, FL
Memorial Hermann Health System	Houston, TX
MemorialCare Health System	Fountain Valley, CA
Mercy	Chesterfield, MO
Mercy Health	Muskegon, MI
Mercy Health	Youngstown, OH
Mercyhealth	Janesville, WI
MercyOne	Clive, IA
Merit Health	Franklin, TN
Methodist Health System (TX)	Dallas, TX
Methodist Healthcare	Memphis, TN
MidMichigan Health	Midland, MI
Mohawk Valley Health System	Utica, NY
Mon Health	Morgantown, WV
Montefiore Health System	Bronx, NY
Monument Health	Rapid City, SD
Mosaic Life Care	Saint Joseph, MO
Mount Carmel Health System	Columbus, OH
Mount Sinai Health System	New York, NY
Mountain Health Network	Huntington, WV
MultiCare Health System	Tacoma, WA
Munson Healthcare	Traverse City, MI
MUSC Health	Charleston, SC
Nebraska Medicine	Omaha, NE
Nebraska Methodist Health System	Omaha, NE
New York City Health and Hospitals Corporation (HHC)	New York, NY
New York-Presbyterian Healthcare System	New York, NY
North Memorial Health	**Robbinsdale, MN**
North Mississippi Health Services	Tupelo, MS
Northeast Georgia Health System	Gainesville, GA
Northern Arizona Healthcare	Flagstaff, AZ
Northern Light Health	Brewer, ME
NorthShore University HealthSystem	Evanston, IL
Northside Hospital System	Atlanta, GA
Northwell Health	Great Neck, NY
Northwest Health Porter	Valparaiso, IN
Northwestern Medicine	Chicago, IL
Novant Health	Winston Salem, NC
Nuvance Health	Danbury, CT
Ochsner Health System	New Orleans, LA
Ochsner LSU Health	Shreveport, LA

Health System Name	Location
OhioHealth	Columbus, OH
Olathe Health System	Olathe, KS
Orlando Health	Orlando, FL
OSF Healthcare	Peoria, IL
Owensboro Health	Owensboro, KY
Palomar Health	Escondido, CA
Parkview Health	Fort Wayne, IN
PeaceHealth	Vancouver, WA
Penn Highlands Healthcare	DuBois, PA
Penn Medicine	**Philadelphia, PA**
Penn State Health	Hershey, PA
Phoebe Putney Health System	Albany, GA
Physicians for Healthy Hospitals	Hemet, CA
Piedmont Healthcare Inc	Atlanta, GA
PIH Health	**Whittier, CA**
Pipeline Health	El Segundo, CA
Premier Health	Dayton, OH
Presbyterian Healthcare Services	Albuquerque, NM
Prime Healthcare Services	Ontario, CA
Prisma Health	Greenville, SC
ProHealth Care	Waukesha, WI
ProMedica Health System	Toledo, OH
Providence St. Joseph Health	Renton, WA
Quorum Health Corporation	Brentwood, TN
Renown Health	Reno, NV
Riverside Heath System	Newport News, VA
RMC Health System	Anniston, AL
Rochester Regional Health	Rochester, NY
Roper St. Francis Healthcare	Charleston, SC
Rush Health	**Chicago, IL**
RWJBarnabas Health	West Orange, NJ
Sacred Heart Health System	Pensacola, FL
Saint Alphonsus Health System	Boise, ID
Saint Francis Health System	Tulsa, OK
Saint Joseph Health System	Mishawaka, IN
Saint Joseph Mercy Health System	Ann Arbor, MI
Saint Luke's Health System	Kansas City, MO
Saint Thomas Health	Nashville, TN
Samaritan Health Services	Corvallis, OR
Sanford Health	Sioux Falls, SD
SCL Health	Denver, CO
Scripps Health	**San Diego, CA**
Sentara Healthcare	Norfolk, VA
Seton Healthcare Family	Austin, TX
Sharp HealthCare	San Diego, CA

Health System Name	Location
Sinai Health System	Chicago, IL
Sisters of Charity Health System	Cleveland, OH
Skagit Regional Health	Mount Vernon, WA
SolutionHealth	Bedford, NH
Southeast Georgia Health System	Brunswick, GA
SoutheastHEALTH	Cape Girardeau, MO
Southern Illinois Healthcare	Carbondale, IL
Sparrow Health System	Lansing, MI
Spartanburg Regional Healthcare System	Spartanburg, SC
Spectrum Health	Grand Rapids, MI
SSM Health	Saint Louis, MO
St Bernards Healthcare	Jonesboro, AR
St Lawrence Health System	Potsdam, NY
St. Charles Health System	Bend, OR
St. Elizabeth Healthcare	Edgewood, KY
St. John Health System	Tulsa, OK
St. Joseph/Candler Health System	Savannah, GA
St. Luke's Health System	**Boise, ID**
St. Luke's University Health Network	Bethlehem, PA
St. Mary's Health Care System	Athens, GA
St. Peters Health Partners	Albany, NY
St. Vincent's Health System (AL)	Birmingham, AL
St. Vincent's Healthcare	Jacksonville, FL
Stanford Health Care	Stanford, CA
Steward Health Care System	Boston, MA
Sutter Health	Sacramento, CA
Sutter Health Bay Area	Sacramento, CA
Sutter Health Valley Area	Sacramento, CA
Swedish	Seattle, WA
Tanner Health System	Carrollton, GA
Tenet Healthcare Corporation	Dallas, TX
Texas Health Resources	Arlington, TX
The Queen's Health Systems	Honolulu, HI
The University of Vermont Health Network	Burlington, VT
The Valley Health System	Las Vegas, NV
ThedaCare	Appleton, WI
Tidelands Health	Murrells Inlet, SC
Tower Health	Reading, PA
TriHealth	Cincinnati, OH
Trinity Health	Livonia, MI
Trinity Health Mid-Atlantic	Philadelphia, PA
Trinity Health Of New England	Hartford, CT
Truman Medical Center Inc	Kansas City, MO
UAB Health System	Birmingham, AL
UC Health	Cincinnati, OH

Health System Name	Location
UCHealth	Aurora, CO
UChicago Medicine	Chicago, IL
UM Upper Chesapeake Health	Bel Air, MD
UMass Memorial Health Care	Worcester, MA
UNC Health Care System	Chapel Hill, NC
United Health Services	Binghamton, NY
UnityPoint Health	Des Moines, IA
Universal Health Services Inc	King of Prussia, PA
University Hospitals	Cleveland, OH
University of California Health System	Oakland, CA
University of Florida Health	Gainesville, FL
University of Maryland Medical System	Baltimore, MD
University of Mississippi Medical Center	Jackson, MS
University of Missouri Health Care	Columbia, MO
University of New Mexico Hospitals	Albuquerque, NM
University of Rochester Medical Center	Rochester, NY
University of Texas System	Austin, TX
UofL Health	Louisville, KY
UPMC Health System	Pittsburgh, PA
UPMC Pinnacle	Harrisburg, PA
UPMC Susquehanna	Williamsport, PA
UT Health East Texas	Tyler, TX
UW Medicine	Seattle, WA
Valley Baptist Health System	Harlingen, TX
Valley Health	Winchester, VA
VCU Health	Richmond, VA
Via Christi Health	Wichita, KS
Vidant Health	Greenville, NC
Virtua Health	Marlton, NJ
WakeMed	Raleigh, NC
Wellforce	Burlington, MA
WellSpan Health	York, PA
WellStar Health System	Marietta, GA
West Tennessee Healthcare	Jackson, TN
Westchester Medical Center Health Network	Valhalla, NY
WVU Medicine	Morgantown, WV
Yale New Haven Health Services	New Haven, CT

Note: Winners are in Bold

References and Footnotes

1. Kaplan RS, Norton DP. The Balanced Scorecard: Measures That Drive Performance. Harvard Bus Rev, Jan–Feb 1992.
2. Shook J, Chenoweth J. 100 Top Hospitals CEO Insights: Adoption Rates of Select Baldrige Award Practices and Processes. Ann Arbor, MI: Truven Health Analytics Center for Healthcare Improvement. October 2012.
3. Foster DA. Hospital System Membership and Performance. Ann Arbor, MI: Truven Health Analytics Center for Healthcare Improvement. May 2012.
4. HIMSS Analytics, Truven Health Analytics. 2012 HIMSS Analytics Report: Quality and Safety Linked to Advanced Information Technology Enabled Processes. Chicago, IL: HIMSS Analytics. April 2012.
5. Foster DA, Chenoweth J. Comparison of Baldrige Award Applicants and Recipients With Peer Hospitals on a National Balanced Scorecard. Ann Arbor, MI: Truven Health Analytics Center for Healthcare Improvement. October 2011.
6. Young J. Outpatient Care Standards Followed More Closely at Top-Performing Hospitals. Ann Arbor, MI: Truven Health Analytics Center for Healthcare Improvement. March 2011.
7. Young J. Hospitals Increase Cardiovascular Core Measure Compliance. Ann Arbor, MI: Truven Health Analytics Center for Healthcare Improvement. November 2010.
8. Foster DA. Top Cardiovascular Care Means Greater Clinical and Financial Value. Ann Arbor, MI: Truven Health Analytics Center for Healthcare Improvement. November 2009.
9. Lee DW, Foster DA. The association between hospital outcomes and diagnostic imaging: early findings. J Am Coll Radiol. 2009 Nov; 6(11):780 - 785.
10. Bonis PA, Pickens GT, Rind DM, Foster DA. Association of a clinical knowledge support system with improved patient safety, reduced complications and shorter length of stay among Medicare beneficiaries in acute care hospitals in the United States. Int J Med Inform. 2008 Nov;77(11):745 - 753. Epub June 2008.
11. Foster DA. HCAHPS 2008: Comparison Results for 100 Top Hospitals Winners Versus Non-Winners. Ann Arbor, MI: Truven Health Analytics Center for Healthcare Improvement. August 2008.
12. Foster DA. Risk-Adjusted Mortality Index Methodology. Ann Arbor, MI: Truven Health Analytics Center for Healthcare Improvement. July 2008.
13. Foster DA. Trends in Patient Safety Adverse Outcomes and 100 Top Hospitals Performance, 2000 - 2005. Ann Arbor, MI: Truven Health Analytics Center for Healthcare Improvement. March 2008.
14. Shook J, Young J. Inpatient and Outpatient Growth by Service Line: 2006 Truven Health 100 Top Hospitals: Performance Improvement Leaders Versus Peer Hospitals. Ann Arbor, MI: Truven Health Analytics Center for Healthcare Improvement. August 2007.
15. Chenoweth J, Safavi K. Leadership Strategies for Reaching Top Performance Faster. J Healthc Tech. January 2007. HCT Project Volume 4.
16. Griffith JR, Alexander JA, Foster DA. Is Anybody Managing the Store? National Trends in Hospital Performance. Healthc Manag. 2006 Nov–Dec; 51(6):392 - 405; discussion 405 - 406.
17. McDonagh KJ. Hospital Governing Boards: A Study of Their Effectiveness in Relation to Organizational Performance. Healthc Manag. 2006 Nov - Dec; 51(6).
18. Bass K, Foster DA, Chenoweth J. Study Results — Proving Measurable Leadership and Engagement Impact on Quality, CMS Invitational Conference on Leadership and Quality. Sept 28, 2006.
19. Chenoweth J, Foster DA, Waibel BC. Best Practices in Board Oversight of Quality. The Governance Institute. June 2006.
20. Kroch E, Vaughn T, Koepke M, Roman S, Foster DA, Sinha S, Levey S. Hospital Boards and Quality Dashboards. J Patient Safety. 2(1):10 - 19, March 2006.
21. Cejka Search and Solucient, LLC. 2005 Hospital CEO Leadership Survey.
22. Health Research and Educational Trust and Prybil, L. Governance in High- Performing Organizations: A Comparative Study of Governing Boards in Not-For- Profit Hospitals. Chicago: HRET in Partnership with AHA. 2005.
23. Griffith JR, Alexander JA, Jelinek RC. Measuring Comparative Hospital Performance. Healthc Manag. 2002 Jan - Feb; 47(1).
24. Griffith JR, Knutzen SR, Alexander JA. Structural Versus Outcomes Measures in Hospitals: A Comparison of Joint Commission and Medicare Outcomes Scores in Hospitals. Qual Manag Health Care. 2002; 10(2): 29 – 38
25. See the CMS website at cms.gov/Medicare/Quality-Initiatives-Patient-Assessment-Instruments/Value-Based-Programs/MACRA-MIPS-and-APMs/Final-MDP.pdf.
26. See the CMS Hospital Compare website at hospitalcompare.hhs.gov.
27. See the CMS website at cms.gov/Medicare/Quality- Initiatives- Patient-Assessment- Instruments/HospitalQualityInits/OutcomeMeasures
28. Iezzoni L, Ash A, Shwartz M, Daley J, Hughes J, Mackiernan Y. Judging Hospitals by Severity- Adjusted Mortality Rates: The Influence of the Severity- Adjusted Method. Am J Public Health. 1996; 86(10):1379 - 1387.

29. Iezzoni L, Shwartz M, Ash A, Hughes J, Daley J, Mackiernan Y. Using Severity- Adjusted Stroke Mortality Rates to Judge Hospitals. Int J Qual Health C. 1995;7(2) 81 - 94.
30. DesHarnais SI, et al. Measuring Hospital Performance: The Development and Validation of Risk-Adjusted Indexes of Mortality, Readmissions, and Complications. Med Car. 28, no. 12 (December 1990): 1127 - 1141.
31. Iezzoni LI, et al. Chronic Conditions and Risk of In-Hospital Death. Health Serv Res. 29, no. 4 (October 1994): 435 - 460.
32. Iezzoni LI, et al. Using Administrative Data to Screen Hospitals for High Complication Rates. Inquiry. 31, no. 1 (Spring 1994): 40 - 55.
33. Adams S, Cotton B, Wade C, Kozar R, Dipasupil E, Podbielski J, Gill B, Duke J, Adams P, Holcomb J. Do Not Resuscitate (DNR) Status, Not Age, Affects Outcomes After Injury: An Evaluation of 15,227 Consecutive Trauma Patients. J Trauma Acute Care Surg. 2013 May; 74(5):1327 - 1330.
34. Iezzoni LI, et al: Identifying Complications of Care Using Administrative Data. Med Care. 32, no.7 (Jul 1994): 700 - 715.
35. https://www.cms.gov/newsroom/press-releases/cms-announces-relief-clinicians-providers-hospitals-and-facilities-participating-quality-reporting
36. Adams S, Cotton B, Wade C, Kozar R, Dipasupil E, Podbielski J, Gill B, Duke J, Adams P, Holcomb J. Do Not Resuscitate (DNR) Status, Not Age, Affects Outcomes After Injury: An Evaluation of 15,227 Consecutive Trauma Patients. J Trauma Acute Care Surg. 2013 May; 74(5): 1327–1330.
37. Iezzoni LI, et al: Identifying Complications of Care Using Administrative Data. Med Care. 32, no.7 (Jul 1994): 700-715.
38. Iezzoni LI, et al. Using Administrative Data to Screen Hospitals for High Complication Rates. Inquiry. 31, no. 1 (Spring 1994): 40-55.
39. Iezzoni LI. Assessing Quality Using Administrative Data. Ann Intern Med. 127, no. 8 (Oct 1997): 666-674.
40. Weingart SN, et al. Use of Administrative Data to Find Substandard Care: Validation of the Complications Screening Program. Med Care. 38, no. 8 (Aug 2000): 796-806.
41. NHSN Standardized Infection Ratio (SIR): A Guide to the SIR, National Healthcare Safety Network. Centers for Disease Control and Prevention, National Center for Emerging and Zoonotic Infectious Diseases, Division of Healthcare Quality Promotion. July 2017. Available at cdc.gov/nhsn/ pdfs/ ps-analysis-resources/nhsn- sir-guide. pdf. Last accessed Jan. 23, 2018.
42. Foster, D. Model-Based Resource Demand Adjustment Methodology. Watson Health (Truven Health Analytics). July 2012.
43. AHRQ Medicare spending per beneficiary (MSPB) measure summary: Cost to Medicare of services performed by hospitals and other healthcare providers during a MSPB episode. October 2015. Available via qualitymeasures.ahrq.gov/ summaries.

For more information, visit 100tophospitals.com