Watson Health®

50 Top Cardiovascular Hospitals 2022

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Introduction

Each year, IBM Watson Health® conducts objective, quantitative research to shine a light on the nation's highest-performing hospitals, health systems, and cardiovascular service lines, through the Watson Health 100 Top Hospitals® program. The goal of the program is to deliver unbiased, guiding insights that can help all healthcare organizations focus their improvement initiatives and move toward consistent, sustainable top performance. Organizations do not apply to participate in the study, and award winners do not pay to market their honor.

Since 1998, we have analyzed public data with our proprietary methodologies to provide the industry with this year's Watson Health 50 Top Cardiovascular Hospitals study.

Similar to our other 100 Top Hospitals program research, this study creates a balanced scorecard of metrics to identify top-performing cardiovascular providers in the United States.

This study is far more than a list of high performing organizations, it is a benchmarking study focused on outcomes. Since our cardiovascular winners have achieved an outstanding balance of clinical and operational excellence in a complex and changing landscape, we believe their success can help provide a clear and bright path for others to follow.

The information contained in our 50 Top Cardiovascular Hospitals study is designed to put impartial, action-driving, attainable benchmarks in the spotlight for hospital and clinical leaders across the country to leverage as they work to raise their own organizations' standards of performance.

The Watson Health 50 Top Cardiovascular Hospitals study focuses on one of healthcare's most important service lines that affects hundreds of thousands of patients' lives annually and adds billions of dollars to our nation's overall healthcare costs.

That's why publishing new and achievable benchmarks for cardiovascular service line performance is important and has the potential to make a large and lasting impact on the quality and cost of care for heart patients across the US.

Illuminating achievement for a value-based world

By finding ways to take clinical and operational performance to the next level, the winners of our 50 Top Cardiovascular Hospitals study are identifying opportunities to deliver increasing healthcare value to patients, communities, and payers.

Repeatedly, we see that these hospitals lead the cardiovascular healthcare industry, often inspiring the clinicians and staff within their own walls and systems as well as their peers and competitors, to better understand data and benchmarks, and close performance gaps.

It is a kind of leadership that is becoming even more important as the industry continues to transition to a value-based payment environment.

Why cardiovascular hospitals?

A 2021 report from the American Heart Association states that between 2015 and 2018, 126.9 million American adults had some form of cardiovascular disease (CVD).[1] Cardiovascular diseases have a significant impact on mortality and healthcare costs, about 659,000 people in the United States die from heart disease each year—that's 1 in every 4 deaths. And heart disease costs the United States about $363 billion each year from 2016 to 2017. This includes the cost of health care services, medicines, and lost productivity due to death.[2] In addition, the number of people diagnosed with heart failure is increasing and projected to rise by 46 percent by 2030, resulting in more than 8 million people with heart failure.[3]

It is no wonder, then, that cardiovascular services are among the highest-profile service lines in healthcare. With the stakes so high, it is important that hospitals provide high-quality, highly efficient cardiac care and that they look for ways to improve. The 50 Top Cardiovascular Hospitals study attempts to answer that need each year.

The 50 Top Cardiovascular Hospitals study is also unique for the 100 Top Hospitals program. The program's research series publishes only this one clinical service line study. Only the cardiovascular service line has consistently had both the inpatient volume and supplemental clinical process metrics from the Centers for Medicare & Medicaid Services (CMS) Hospital Compare initiative to support the publication of scorecard-based benchmarks for a service line. And with each annual 50 Top Cardiovascular Hospitals study, more is learned, as the transparency and depth of inpatient and continuum-of-care data grow and evolve.

Objective, real-world assessment

To maintain the study's level of integrity, only public data sources are used for calculating study metrics. This helps eliminate bias while including as many hospitals as possible and facilitates consistency of definitions and data. In turn, this allows us to produce national norms and benchmarks that are useful for assessing clinical outcomes and operational efficiency in an objective, independent, and meaningful way. In addition, we report rate of improvement compared to peers, which enables clinical leadership and service line management to determine their real-world progress toward consistent top performance within and across the cardiovascular patient groups profiled.

A measure of leadership excellence and its effect on service line performance

For more than 20 years, the 100 Top Hospitals program has collaborated with academics on a wide range of topics to dig deeper into the leadership practices of the nation's top healthcare organizations.

As such, the 100 Top Hospitals studies not only provide a distinctive approach to measuring the performance of hospitals, health systems, and cardiovascular service lines, but also deliver insights into the effectiveness of hospital leadership. Higher composite scores on our national balanced scorecard reflect the effectiveness of the leadership team in executing both short-term and long-term strategies across the organization.

The leadership of today's hospitals, including the board, executive team, and medical staff leadership, is responsible for ensuring all facets of a hospital and its cardiovascular service line are performing at the same high level. The 50 Top Cardiovascular Hospitals study and analytics provide a view of that enterprise performance alignment. And that information can be helpful in assessing the strategic intersection among cost, quality, efficiency, and community value.

The performance of this year's 50 Top Cardiovascular Hospitals

The 50 Top Cardiovascular Hospitals study identifies US hospitals that have achieved the highest performance on a balanced scorecard of performance measures.

This year, based on comparisons between the study winners and a peer group of similar hospitals that were not winners, we found that our study winners delivered better outcomes while operating more efficiently and at a lower cost.

Compared to nonwinning cardiovascular hospitals, this year's winners had:

- Significantly higher inpatient survival (14.7% to 48.0% higher)
- Fewer patients with complications (10.9% to 11.1% fewer)
- Higher 30-day survival rates for acute myocardial infarction (AMI)[i], heart failure (HF)[ii] and coronary artery bypass grafting (CABG)[iii] patients (0.3 to 0.6 percentage points higher)
- Lower readmission rates for AMI, HF, and CABG patients (0.7 to 0.9 percentage points lower)
- Average lengths of stay (ALOS) varied between patient groups from 0.3 (PCI) to 0.8 (CABG) shorter length of stay
- $1,411 to $6,408 less in total costs per patient case (the smallest dollar-amount difference was for HF, and the largest was for CABG)
- Lower average 30-day episode of care payments for AMI and HF ($1,369 and $790 less per episode, respectively)
- Patients had a better experience at benchmark hospitals, with a top-box HCAHPS score of 78% versus 72%

Further, our study indicated that if all cardiovascular hospitals performed at the same level of this year's winners:

- More than 6,400 additional lives could be saved
- More than 5,000 heart patients could be complication-free
- Over $1.4 billion could be saved

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

[i] An AMI is a heart attack, which happens when the arteries leading to the heart become blocked and blood supply is slowed or stopped.
[ii] HF Heart failure is a weakening of the heart's pumping power, leading to the body not receiving enough oxygen and nutrients to work properly.
[iii] A CABG is a type of surgery that improves blood flow to the heart by moving or redirecting a blood vessel to bypass blockages.

Trends in cardiovascular care

An analysis of trends in cardiovascular care over the five years ending in this study's data year revealed:

- 30-day mortality rates for AMI patients showed statistically significant improvement in a large percentage of patients (33.2%)
- Readmission rates for CABG patients showed statistically significant improvement in a large percentage of hospitals (30.8%)
- A majority of hospitals continue to hold the cost of delivering care to AMI, HF, CABG, and PCI[i] patients stable from 2016 to 2020 (from 80% to 88%), with no statistically significant change, at 95% confidence

Additional findings

For more details about the 50 Top Cardiovascular Hospitals study findings, including complete hospital reporting data on this year's winning cardiovascular hospitals, please see the Findings section of this document.

The value of 50 Top Cardiovascular Hospitals benchmarks

- To improve performance, cardiovascular hospital leaders need objective information about what is achievable. They need relevant benchmarks that allow them to compare their performance to peers and top-performing organizations.
- By naming the 50 Top Cardiovascular Hospitals in the nation, the 100 Top Hospitals program provides hospital executives, physicians, and cardiovascular service line managers with practical targets for raising performance.
- Information in this study, and in separate hospital-specific reports, provides performance levels to reach for, with detailed analysis of how the winners and their nonwinning peers performed on the study's balanced scorecard of measures.

Study integrity

Organizations are included in the 100 Top Hospitals® program studies based solely on availability of data from Medicare and meeting criteria listed in the methodology section, without regard to whether they are a client. They do not apply to be included in the studies, nor do winners pay to promote their award.

To uphold the integrity of the study, it is the policy of IBM Watson Health to revoke a 100 Top Hospitals award if hospital data is found to be inaccurate or misleading for any 100 Top Hospitals data source.

[i] A PCI is a procedure that uses a small stent to open up blood vessels in the heart that have narrowed from a buildup of plaque.

At the sole discretion of IBM Watson Health, the circumstances under which a 100 Top Hospitals award could be revoked include, but are not limited to:

- Inaccurate data
- Agency investigations or sanctions

More about the 100 Top Hospitals program

The 50 Top Cardiovascular Hospitals research is one of several studies of the Watson Health 100 Top Hospitals program. To increase understanding of trends in specific areas of the healthcare industry, the program includes a range of studies and reports:

- 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 also identifies those hospitals that excel at long-term rates of improvement in addition to performance.
- 50 Top Cardiovascular Hospitals study: An annual study identifying hospitals that demonstrate the highest performance in hospital cardiovascular services.
- 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.
- 100 Top Hospitals Performance Matrix: A two-dimensional analysis, available for nearly all US hospitals, that provides a view of how long- term improvement and resultant current performance compare with national peers.
- Custom benchmark reports: A variety of reports designed to help healthcare executives understand how their organizational performance compares to peers within health systems, states, and markets.

You can read more about these studies and see lists of all winners by visiting 100tophospitals.com.

We welcome your input

Since 1993, the 100 Top Hospitals program has worked to ensure that the measures and methodologies used 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 systems, hospitals, and physicians. To submit comments, visit the Contact Us section of 100tophospitals.com.

About IBM Watson Health

Watson Health aspires to improve lives and give hope by delivering innovation to address the world's most pressing health challenges through data and cognitive insights.

Each day, professionals make powerful progress toward a healthier future. In an industry that is fragmented and complex, there are many opportunities to support professionals as they work toward their goals to simplify, solve, care or cure, so they can transform health for the people they serve.

At Watson Health, we see and work across the health landscape, from payers and providers to government and life sciences. With an unrivaled vantage point across the industry, deep health expertise, and the power of cognitive computing, we create intelligent connections that shape new ways of working, drive value, and accelerate breakthroughs.

With Watson Health at work in their organizations, our clients can uncover, connect, and act on the insights that advance their work, and change the world.

For more information about IBM Watson Health, visit ibm.com/watson-health.

The Watson Health 50 Top Cardiovascular Hospitals 2022

The Watson Health® 100 Top Hospitals® program is pleased to present the Watson Health 50 Top Cardiovascular Hospitals 2022.

We stratified winners by three separate peer groups: teaching hospitals with cardiovascular residency[i] programs, teaching hospitals without cardiovascular residency programs, and community hospitals

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

i Throughout this document where we refer to 'cardiovascular residency programs,' we are including cardiovascular fellowship programs as well. Please refer to the Methodology section of this document for a complete list of cardiovascular residency and fellowship programs that are used to classify hospitals.

Teaching hospitals with cardiovascular residency programs[i]

Hospital	Location	Medicare ID
Ascension Borgess Hospital	Kalamazoo, MI	230117
Atrium Health Carolinas Medical Center	Charlotte, NC	340113
Baylor Scott & White Medical Center - Temple	Temple, TX	450054
Baylor Scott & White The Heart Hospital - Plano	Plano, TX	670025
Baylor University Medical Center	Dallas, TX	450021
Froedert Hospital	Milwaukee, WI	520177
Intermountain Medical Center	Murray, UT	460010
Kettering Medical Center	Kettering, OH	360079
Mayo Clinic Florida	Jacksonville, FL	100151
Mayo Clinic Rochester	Rochester, MN	240010
Mercy Medical Center	Cedar Rapids, IA	160079
Northwestern Medicine Central DuPage Hospital	Winfield, IL	140242
Northwestern Memorial Hospital	Chicago, IL	140281
Penn Presbyterian Medical Center	Philadelphia, PA	390223
Piedmont Atlanta Hospital	Atlanta, GA	110083
Riverside Methodist Hospital	Columbus, OH	360006
St. Luke's University Hospital - Bethlehem	Bethlehem, PA	390049
Summa Health System - Akron Campus	Akron, OH	360020
UNC REX Hospital	Raleigh, NC	340114
University Hospital	Madison, WI	520098

[i] Order of hospitals does not reflect performance rating. Hospitals are ordered alphabetically.

Teaching hospitals without cardiovascular residency programs[i]

Hospital	Location	Medicare ID
Ascension Sacred Heart Hospital Pensacola	Pensacola, FL	100025
Aspirus Wausau Hospital	Wausau, WI	520030
Atrium Health Pineville	Charlotte, NC	340098
Baton Rouge General - Bluebonnet	Baton Rouge, LA	190065
Baylor Scott & White Medical Center - Hillcrest	Waco, TX	450101
Beaumont Hospital, Troy	Troy, MI	230269
Bronson Methodist Hospital	Kalamazoo, MI	230017
Chester County Hospital	West Chester, PA	390179
Chippenham Hospital	Richmond, VA	490112
Eisenhower Medical Center	Rancho Mirage,	050573
Missouri Baptist Medical Center	Saint Louis, MO	260108
Overland Park Regional Medical Center	Overland Park, KS	170176
Providence St. Patrick Hospital	Missoula, MT	270014
Redmond Regional Medical Center	Rome, GA	110168
Sarasota Memorial Hospital	Sarasota, FL	100087
St. Joseph Mercy Ann Arbor Hospital	Ypsilanti, MI	230156
St. Joseph's Hospital	Tampa, FL	100075
The Medical Center of Aurora	Aurora, CO	060100
The Moses H. Cone Memorial Hospital	Greensboro, NC	340091
TriStar Centennial Medical Center	Nashville, TN	440161

[i] Order of hospitals does not reflect performance rating. Hospitals are ordered alphabetically.

Community hospitals[i]

Hospital	Location	Medicare ID
Asante Rogue Regional Medical Center	Medford, OR	380018
Ascension St. Vincent Heart Center	Indianapolis, IN	150153
Bellin Hospital	Green Bay, WI	520049
Harlingen Medical Center	Harlingen, TX	450855
McLaren Northern Michigan	Petoskey, MI	230105
Oklahoma Heart Hospital North	Oklahoma City,	370215
Oklahoma Heart Hospital South	Oklahoma City,	370234
Parkwest Medical Center	Knoxville, TN	440173
Saint Mary's Regional Medical Center	Reno, NV	290009
UnityPoint Health - Allen Hospital	Waterloo, IA	160110

[i] Order of hospitals does not reflect performance rating. Hospitals are ordered alphabetically.

Findings

This year's Watson Health® 50 Top Cardiovascular Hospitals provided better clinical care and were more efficient than their peers. If all United States hospitals' cardiovascular service lines performed at the level of these study winners, more than 6,400 additional lives and over $1.4 billion could be saved, and over 5,000 additional bypass and angioplasty patients could be complication-free.

These findings are based on the Medicare patient data included in this study and analysis of study winners versus nonwinners. If the same standards were applied broadly to all inpatients, the impact would be even greater.

One of the goals of the Watson Health 100 Top Hospitals® program is to provide action-driving benchmarks that can help all hospitals improve their performance. This section highlights winner (benchmark) versus nonwinner differences in all study hospitals as a group and by hospital type (residency program and teaching status).

Benchmark hospitals outperformed peers

Comparisons between this year's 50 Top Cardiovascular Hospitals and their peers showed that room for improvement still exists (See Table 1).

- Survival rates were markedly better at benchmark (winning) hospitals, particularly for patients receiving coronary artery bypass graft surgeries (CABGs). The median benchmark hospital had a risk-adjusted CABG inpatient mortality index of 0.52, meaning there were 48% fewer deaths than would be expected, given patient severity. With an index of 1.00, peer (nonwinning) hospitals had just as many CABG deaths as would be expected.
- Notably, in the 2022 CABG patient group we also saw the most pronounced difference in severity- and wage-adjusted cost per case, with winners having an average cost of $38,218, versus peers at $44,627 – a difference of over $6,400.
- The 2022 cardiovascular study winners had 11.1% and 10.9% lower complications observed- to-expected index values for CABG and PCI, respectively, when compared to their peers.
- Long-term outcomes were better at winning hospitals; 30-day heart attack (AMI), heart failure (HF) and CABG mortality rates were all lower among winning hospitals than peers, meaning a smaller percentage of patients died, of any cause, within 30 days after inpatient admission. The difference was greatest among AMI patients, with a 30-day mortality rate of 11.6% for winners versus 12.2% for nonwinners.

- The winning hospitals also had lower readmission rates, with a smaller percentage of patients returning to the hospital, for any cause, within 30 days of discharge. CABG patient readmissions showed the largest difference, with rates of 11.7% versus 12.6%, which was a full percentage point better than nonwinning peers.
- Winning hospitals were more efficient, releasing patients sooner than their peers. In this year's study results, AMI, HF, CABG, and PCI patients were released 0.3 – 0.8 days sooner than patients getting care at nonwinning peers.
- The 50 Top Cardiovascular Hospitals maintained high clinical performance while keeping inpatient costs lower. The typical winning hospital spent over $6,400 less per CABG patient and $3,100 less per PCI case.
- Benchmark hospitals also showed stronger performance on measures of total Medicare claims payment across 30-day episodes of care for AMI and HF patients ($1,369 less per AMI episode and $790 less per HF episode) compared to nonwinning peers.
- Patients treated at the 50 Top Hospitals reported a better overall hospital experience than those treated in peer hospitals, with a Hospital Consumer Assessment of Healthcare Providers and Systems (HCAHPS) overall top-box percent median value that was 6.0 percentage points higher.

Table 1: National performance comparisons (all hospitals in study)							
	Performance measure		Benchmark median	Peer median	Benchmark compared with peer group		
					Difference	Percent difference	Comments
Clinical outcome measures[a]	Risk-adjusted inpatient mortality index	AMI mortality	0.78	1.00	-0.22	-22.0	Lower mortality
		HF mortality	0.81	0.95	-0.14	-14.7	Lower mortality
		CABG mortality	0.52	1.00	-0.48	-48.0	Lower mortality
		PCI mortality	0.78	0.98	-0.20	-20.4	Lower mortality
	Risk-adjusted complications index	CABG complications	0.72	0.81	-0.09	-11.1	Fewer complications
		PCI complications	0.82	0.92	-0.10	-10.9	Fewer complications
Extended outcome measures[b,d]	AMI 30-day mortality (%)		11.6	12.2	-0.6	n/a	Lower 30-day mortality
	HF 30-day mortality (%)		10.6	11.0	-0.4	n/a	Higher 30-day mortality
	CABG 30-day mortality (%)		2.6	2.9	-0.3	n/a	Lower 30-day mortality
	AMI 30-day readmission (%)		15.2	15.8	-0.7	n/a	Fewer 30-day readmissions
	HF 30-day readmission (%)		21.2	21.8	-0.7	n/a	Fewer 30-day readmissions
	CABG 30-day readmission (%)		11.7	12.6	-0.9	n/a	Fewer 30-day readmissions
Process efficiency	AMI severity-adjusted average length of stay (ALOS)		3.5	4.0	-0.4	-11.1	Shorter ALOS
	HF severity-adjusted ALOS		4.6	5.0	-0.4	-7.5	Shorter ALOS
	CABG severity-adjusted ALOS		8.3	9.1	-0.8	-8.6	Shorter ALOS
	PCI severity-adjusted ALOS		3.2	3.5	-0.3	-8.5	Shorter ALOS
Cost efficiency	AMI wage- and severity-adjusted average cost per case		$8,521	$10,237	-$1,716.43	-16.8	Lower cost per case
	HF wage- and severity-adjusted average cost per case		$8,713	$10,124	-$1,411.32	-13.9	Lower cost per case
	CABG wage- and severity-adjusted average cost per case		$38,218	$44,627	-$6,408.50	-14.4	Lower cost per case
	PCI wage- and severity-adjusted average cost per case		$15,603	$18,732	-$3,129.11	-16.7	Lower cost per case
Extended efficiency measures[b]	AMI 30-day episode payment		$25,224	$26,593	-$1,369.00	-5.1	Lower 30-day payment
	HF 30-day episode payment		$17,691	$18,481	-$790.00	-4.3	Lower 30-day payment
Patient experience[c,d]	HCAHPS score		78	72	6.0	n/a	Better patient experience

a. Medicare Provider Analysis and Review (MEDPAR) 2019 and 2020, combined
b. CMS Hospital Compare July 1, 2017 – Dec 1, 2019
c. CMS Hospital Compare CY 2019
d. We do not calculate percentage difference for measures already expressed as a percent

Better performance at benchmark teaching hospitals with cardiovascular residency programs

Teaching hospitals with specialized cardiovascular residency and fellowship programs are generally believed to treat more complex patients, have a more complex staffing mix, and incur higher costs than community hospitals and those without specific cardiovascular teaching programs. Evaluating performance among teaching hospitals with cardiovascular programs as a unique group helps to produce valid quantitative comparisons. (See Table 2.)

- Continuing to set the standard bar at a very high mark, cardiovascular teaching winners' inpatient mortality rates were 31% and 59% lower than peers for PCI and CABG patients, respectively.
- These benchmark hospitals were also leaders for treating PCI patients with 17% fewer complications, than at nonwinner peer hospitals. However, these same hospitals showed a 7% higher incidence of complications in treating CABG patients.
- Cardiovascular teaching benchmark hospitals were also much more efficient than their peers, with severity-adjusted costs among all patient groups being on average of 14% lower than costs calculated for peer facilities. The greatest absolute difference in cost was found for CABG patients at $5,231 less per bypass surgery case. In addition, winners had 9% lower cost per case for PCI patients, 16% lower cost per case for HF patients and 19% lower cost for AMI patients.
- Winners performed better than the nonwinning group on AMI and CABG 30-day mortality but their performance was no different on HF 30-day mortality rate with a rate of 10.2% for both winning and nonwinning hospitals. However, benchmark hospitals outperformed the nonwinning peers on all 30-day readmission measures with the greatest difference in AMI and HF 30-day readmission rates, 14.8% versus 15.9% and 20.9% versus 22.0%, respectively, (1.1 percentage points lower).
- Medicare 30-day episode payment measures showed AMI and HF patients at winning cardiovascular teaching hospitals performing better than their nonwinner peers. At winning cardiovascular teaching hospitals, 30-day AMI payments were 5% less than those at nonwinner peer hospitals ($25,275 versus $26,633) and 30-day HF payments were 6% less ($17,406 versus $18,533).
- Cardiovascular teaching benchmark hospitals had the highest median HCAHPS top-box percent among all comparison groups, at 79% versus 72% for nonwinners

Table 2: Performance comparisons for teaching hospitals with cardiovascular residency programs

	Performance measure		Benchmark median	Peer median	Benchmark compared with peer group		
					Difference	Percent difference	Comments
Clinical outcome measures[a]	Risk-adjusted inpatient mortality index	AMI mortality	0.86	0.98	-0.12	-12.2	Lower mortality
		HF mortality	0.88	0.93	-0.05	-5.4	Lower mortality
		CABG mortality	0.41	0.99	-0.58	-58.6	Lower mortality
		PCI mortality	0.69	1.00	-0.31	-31.0	Lower mortality
	Risk-adjusted complications index	CABG complications	0.82	0.77	0.05	6.5	More complications
		PCI complications	0.76	0.92	-0.16	-17.4	Fewer complications
Extended outcome measures[b,d]	AMI 30-day mortality (%)		11.7	12.1	-0.4	n/a	Lower 30-day mortality
	HF 30-day mortality (%)		10.2	10.2	0.0	n/a	Same 30-day mortality
	CABG 30-day mortality (%)		2.6	2.7	-0.2	n/a	Lower 30-day mortality
	AMI 30-day readmission (%)		14.8	15.9	-1.1	n/a	Fewer 30-day readmissions
	HF 30-day readmission (%)		20.9	22.0	-1.1	n/a	Fewer 30-day readmissions
	CABG 30-day readmission (%)		11.9	12.5	-0.6	n/a	Fewer 30-day readmissions
Process efficiency	AMI severity-adjusted average length of stay (ALOS)		3.3	4.0	-0.7	-16.3	Shorter ALOS
	HF severity-adjusted ALOS		4.6	5.0	-0.4	-8.4	Shorter ALOS
	CABG severity-adjusted ALOS		8.2	9.1	-0.9	-10.3	Shorter ALOS
	PCI severity-adjusted ALOS		3.1	3.5	-0.5	-12.7	Shorter ALOS
Cost efficiency	AMI wage- and severity-adjusted average cost per case		$8,211	$10,143	-$1,932.17	-19.0	Lower cost per case
	HF wage- and severity-adjusted average cost per case		$8,616	$10,224	-$1,607.94	-15.7	Lower cost per case
	CABG wage- and severity-adjusted average cost per case		$38,828	$44,060	-$5,231.78	-11.9	Lower cost per case
	PCI wage- and severity-adjusted average cost per case		$17,131	$18,881	-$1,750.32	-9.3	Lower cost per case
Extended efficiency measures[b]	AMI 30-day episode payment		$25,275	$26,633	-$1,358.00	-5.1	Lower 30-day payment
	HF 30-day episode payment		$17,406	$18,533	-$1,127.00	-6.1	Lower 30-day payment
Patient experience[c,d]	HCAHPS score		78.5	72	6.5	n/a	Better patient experience

a. Medicare Provider Analysis and Review (MEDPAR) 2019 and 2020, combined
b. CMS Hospital Compare July 1, 2017 – Dec 1, 2019
c. CMS Hospital Compare CY 2019
d. We do not calculate percentage difference for measures already expressed as a percent

Better performance at benchmark teaching hospitals without cardiovascular teaching programs

Winning teaching hospitals without cardiovascular teaching programs were much more efficient than their peers, with large differences found in a number of measures. (See Table 3.)

- This difference was most notable in the inpatient mortality measure across all patient groups, with PCI and CABG showing the greatest difference~~s~~ between winning and nonwinning hospitals: PCI with 23.7% fewer deaths and CABG with 49.5% fewer.
- These benchmark hospitals also treated AMI, HF, CABG, and PCI cases at a lower cost, 14%, 13%, 14.5% and 11.5% less, respectively, saving $6,474 per CABG case and $1,465 per AMI case.
- All 30-day extended outcome measures were also better at winning teaching hospitals without cardiovascular programs, with winners having median AMI, HF and CABG 30-day mortality rates 0.8, 0.8 and 0.4 percentage points lower, respectively, than those of peers (AMI – 11.4% v. 12.2%, HF – 10.6% v. 11.4%, CABG – 2.7% v. 3.0%).
- The greatest difference between winning and nonwinning hospitals in the extended outcome measures was found in the 30-day readmission measure for CABG patients where there was a full percentage point difference (1.1) with rates of 11.7% versus 12.7%.
- On the Medicare 30-day episode payment measures, winning teaching hospitals without cardiovascular residency programs outperformed their peers, with lower median AMI and HF 30-day payment values (5% and 2% lower, respectively).
- Teaching benchmark hospitals without CV residency programs outperformed nonwinning hospitals in HCAHPS with a top-box median percentage point difference of 6.5 (77.5 versus 71).

Table 3: Performance comparisons, teaching hospitals without cardiovascular residency programs

	Performance measure		Benchmark median	Peer median	Benchmark compared with peer group		
					Difference	Percent difference	Comments
Clinical outcome measures[a]	Risk-adjusted inpatient mortality index	AMI mortality	0.79	0.99	-0.20	-20.2	Lower mortality
		HF mortality	0.78	0.98	-0.20	-20.4	Lower mortality
		CABG mortality	0.51	1.01	-0.50	-49.5	Lower mortality
		PCI mortality	0.74	0.97	-0.23	-23.7	Lower mortality
	Risk-adjusted complications index	CABG complications	0.78	0.88	-0.10	-11.4	Fewer complications
		PCI complications	0.77	0.98	-0.21	-21.4	Fewer complications
Extended outcome measures[b,d]	AMI 30-day mortality (%)		11.4	12.2	-0.8	n/a	Lower 30-day mortality
	HF 30-day mortality (%)		10.6	11.4	-0.8	n/a	Lower 30-day mortality
	CABG 30-day mortality (%)		2.7	3.0	-0.4	n/a	Lower 30-day mortality
	AMI 30-day readmission (%)		15.5	15.7	-0.3	n/a	Fewer 30-day readmissions
	HF 30-day readmission (%)		21.2	21.5	-0.3	n/a	Fewer 30-day readmissions
	CABG 30-day readmission (%)		11.7	12.7	-1.1	n/a	Fewer 30-day readmissions
Process efficiency	AMI severity-adjusted average length of stay (ALOS)		3.7	4.0	-0.3	-6.8	Shorter ALOS
	HF severity-adjusted ALOS		4.7	5.0	-0.4	-7.3	Shorter ALOS
	CABG severity-adjusted ALOS		8.3	9.2	-0.9	-9.5	Shorter ALOS
	PCI severity-adjusted ALOS		3.4	3.6	-0.1	-3.9	Shorter ALOS
Cost efficiency	AMI wage- and severity-adjusted average cost per case		$9,017	$10,482	-$1,465.77	-14.0	Lower cost per case
	HF wage- and severity-adjusted average cost per case		$9,182	$10,559	-$1,376.59	-13.0	Lower cost per case
	CABG wage- and severity-adjusted average cost per case		$38,273	$44,748	-$6,474.75	-14.5	Lower cost per case
	PCI wage- and severity-adjusted average cost per case		$16,332	$18,446	-$2,114.31	-11.5	Lower cost per case
Extended efficiency measures[b]	AMI 30-day episode payment		$25,351	$26,535	-$1,184.00	-4.5	Lower 30-day payment
	HF 30-day episode payment		$18,065	$18,503	-$438.50	-2.4	Lower 30-day payment
Patient experience[c,d]	HCAHPS score		77.5	71	6.5	n/a	Better patient experience

a. Medicare Provider Analysis and Review (MEDPAR) 2019 and 2020, combined
b. CMS Hospital Compare July 1, 2017 – Dec 1, 2019
c. CMS Hospital Compare CY 2019
d. We do not calculate percentage difference for measures already expressed as a percent

Better performance at benchmark community hospitals

Benchmark community hospitals outperformed their peers on the inpatient risk-adjusted mortality measure in three of the four patient groups. The most observable performance difference being in the HF patient group, where winning community hospitals had a median risk-adjusted mortality index value of 0.56, compared to the median index value of 0.93 at peer hospitals (a 39.8% gap, with fewer patients dying at hospitals named winners). (See Table 4.)

- The nonwinning community hospitals in the PCI patient group had a better inpatient mortality rate this year, than the winning hospitals. Although only 3.2% higher, the peer group had an index value of 0.95, versus 0.98 for the benchmark group.
- The winning community hospitals were much more efficient than their peers, however. They discharged CABG patients almost a day sooner (0.7), followed by HF and PCI patients with almost a half-day sooner (0.4).
- Cost-per-case medians in all patient groups were also much lower for benchmark community hospitals, with the largest difference being observed for CABG patients, at $9,915 less per case than peer hospitals.
- Notably, benchmark community hospitals had the most marked contrast in performance between winning and nonwinning hospitals on the risk- adjusted complications measure for both CABG and PCI patients, with a median observed-to-expected ratio for winners at 0.48, versus 0.95 for nonwinning peers in the CABG patient group (a difference of 49.5%), and a median observed-to-expected ratio for winners at 0.58 versus 0.94 for nonwinners in the PCI patient group (a difference of 38.3%).
- Patients at community winning hospitals had a better overall experience than at nonwinning hospitals, with a median top-box percent of 77% versus 72%.

<table>
<tr><th colspan="9">Table 4: Performance comparisons for community hospitals</th></tr>
<tr><th rowspan="2"></th><th colspan="2" rowspan="2">Performance measure</th><th rowspan="2">Benchmark median</th><th rowspan="2">Peer median</th><th colspan="3">Benchmark compared with peer group</th></tr>
<tr><th>Difference</th><th>Percent difference</th><th>Comments</th></tr>
<tr><td rowspan="6">Clinical outcome measures[a]</td><td rowspan="4">Risk-adjusted inpatient mortality index</td><td>AMI mortality</td><td>0.73</td><td>0.98</td><td>-0.25</td><td>-25.5</td><td>Lower mortality</td></tr>
<tr><td>HF mortality</td><td>0.56</td><td>0.93</td><td>-0.37</td><td>-39.8</td><td>Lower mortality</td></tr>
<tr><td>CABG mortality</td><td>0.74</td><td>0.93</td><td>-0.19</td><td>-20.4</td><td>Lower mortality</td></tr>
<tr><td>PCI mortality</td><td>0.98</td><td>0.95</td><td>0.03</td><td>3.2</td><td>Higher mortality</td></tr>
<tr><td rowspan="2">Risk-adjusted complications index</td><td>CABG complications</td><td>0.48</td><td>0.95</td><td>-0.47</td><td>-49.5</td><td>Fewer complications</td></tr>
<tr><td>PCI complications</td><td>0.58</td><td>0.94</td><td>-0.36</td><td>-38.3</td><td>Fewer complications</td></tr>
<tr><td rowspan="6">Extended outcome measures[b,d]</td><td colspan="2">AMI 30-day mortality (%)</td><td>11.6</td><td>12.2</td><td>-0.6</td><td>n/a</td><td>Lower 30-day mortality</td></tr>
<tr><td colspan="2">HF 30-day mortality (%)</td><td>11.2</td><td>11.4</td><td>-0.2</td><td>n/a</td><td>Lower 30-day mortality</td></tr>
<tr><td colspan="2">CABG 30-day mortality (%)</td><td>2.4</td><td>2.9</td><td>-0.5</td><td>n/a</td><td>Lower 30-day mortality</td></tr>
<tr><td colspan="2">AMI 30-day readmission (%)</td><td>15.0</td><td>15.8</td><td>-0.9</td><td>n/a</td><td>Fewer 30-day readmissions</td></tr>
<tr><td colspan="2">HF 30-day readmission (%)</td><td>19.3</td><td>21.8</td><td>-2.6</td><td>n/a</td><td>Fewer 30-day readmissions</td></tr>
<tr><td colspan="2">CABG 30-day readmission (%)</td><td>10.6</td><td>12.7</td><td>-2.1</td><td>n/a</td><td>Fewer 30-day readmissions</td></tr>
<tr><td rowspan="4">Process efficiency</td><td colspan="2">AMI severity-adjusted average length of stay (ALOS)</td><td>3.6</td><td>3.8</td><td>-0.3</td><td>-7.0</td><td>Shorter ALOS</td></tr>
<tr><td colspan="2">HF severity-adjusted ALOS</td><td>4.5</td><td>5.0</td><td>-0.4</td><td>-8.9</td><td>Shorter ALOS</td></tr>
<tr><td colspan="2">CABG severity-adjusted ALOS</td><td>8.4</td><td>9.1</td><td>-0.7</td><td>-7.7</td><td>Shorter ALOS</td></tr>
<tr><td colspan="2">PCI severity-adjusted ALOS</td><td>3.1</td><td>3.5</td><td>-0.4</td><td>-11.1</td><td>Shorter ALOS</td></tr>
<tr><td rowspan="4">Cost efficiency</td><td colspan="2">AMI wage- and severity-adjusted average cost per case</td><td>$7,584</td><td>$10,070</td><td>-$2,485.55</td><td>-24.7</td><td>Lower cost per case</td></tr>
<tr><td colspan="2">HF wage- and severity-adjusted average cost per case</td><td>$8,382</td><td>$10,037</td><td>-$1,655.06</td><td>-16.5</td><td>Lower cost per case</td></tr>
<tr><td colspan="2">CABG wage- and severity-adjusted average cost per case</td><td>$35,019</td><td>$44,934</td><td>-$9,914.95</td><td>-22.1</td><td>Lower cost per case</td></tr>
<tr><td colspan="2">PCI wage- and severity-adjusted average cost per case</td><td>$14,596</td><td>$18,781</td><td>-$4,185.31</td><td>-22.3</td><td>Lower cost per case</td></tr>
<tr><td rowspan="2">Extended efficiency measures[b]</td><td colspan="2">AMI 30-day episode payment</td><td>$24,590</td><td>$26,629</td><td>-$2,039.00</td><td>-7.7</td><td>Lower 30-day payment</td></tr>
<tr><td colspan="2">HF 30-day episode payment</td><td>$17,169</td><td>$18,439</td><td>-$1,270.00</td><td>-6.9</td><td>Lower 30-day payment</td></tr>
<tr><td>Patient experience[c,d]</td><td colspan="2">HCAHPS score</td><td>77</td><td>72</td><td>5.0</td><td>n/a</td><td>Better patient experience</td></tr>
</table>

a. Medicare Provider Analysis and Review (MEDPAR) 2019 and 2020, combined
b. CMS Hospital Compare July 1, 2017 – Dec 1, 2019
c. CMS Hospital Compare CY 2019
d. We do not calculate percentage difference for measures already expressed as a percent

Additional measures for informational purposes

Every year, we publish measures that may be of interest to the leaders of hospitals and health systems. For this study edition, we continue to publish 30-day excess days in acute care (EDAC) measures for AMI and HF patients. These performance measures, along with the existing ranked extended care measures, 30-day mortality, readmission and episode of payment, offer health care leaders an additional insight into the performance of hospitals across the continuum of care. If you would like to provide feedback on these informational measures, please email 100tophospitals@us.ibm.com.

30-day day excess days in acute care (heart attack [AMI] and heart failure [HF])

In this study, we have profiled performance, for information only, on the relatively new Centers for Medicare & Medicaid Services (CMS) excess days in acute care (EDAC) measures:

1. 30-day EDAC for AMI patients
2. 30-day EDAC for HF patients

As defined by CMS,[4] the EDAC measures capture excess days that a hospital's patients spent in acute care within 30 days after discharge. These measures summarize the number of risk-adjusted days a hospital's patients spend in an emergency department (ED), a hospital observation unit, or a hospital inpatient unit during 30 days following a hospitalization for AMI or HF.

The measures report the difference ("excess") between each hospital's average days in acute care ("predicted days") and the number of days in acute care that each hospital's patients would have been expected to spend if discharged from an average- performing hospital ("expected days").

The measure is reported as excess days per 100 discharges.

Comparing benchmark hospitals and peers on this measure yields interesting results, as shown in Table 5 on the following page.

- The benchmark median EDAC score for AMI patients was 14.3 days less than the peer EDAC score, at -8.2 versus 6.1 for nonwinning hospitals.
- The benchmark median EDAC score for HF patients was 15.7 days less than the peer EDAC score, at -7.2 versus 8.5 for nonwinning hospitals

Table 5: National performance comparisons for excess days in acute care (all hospitals in study)						
	Performance measure	Benchmark median	Peer median	Benchmark compared with peer group		
				Difference	Percent difference	Comments
Extended efficiency measures[a,b]	AMI 30-day excess days in acute care[c]	-8.2	6.1	-14.3	n/a	Fewer days in acute care
	HF 30-day excess days in acute care[c]	-7.2	8.5	-15.7	n/a	Fewer days in acute care

a. CMS Hospital Compare July 1, 2017 – Dec 1, 2019

b. We do not calculate percentage difference for measures already expressed as a percent

c. Reported as excess days per 100 discharges

Trends in cardiovascular care

Again, in this edition of the 50 Top Cardiovascular Hospitals study, we are presenting new findings on trends in cardiovascular care delivered in the nation's teaching and community hospitals. Our intent is to provide healthcare leaders with new insights by showing the direction and magnitude of change in key cardiovascular care performance indicators, between 2016 and 2020.

Performance improvement over time: All hospitals

By studying the direction of performance change of all hospitals eligible for our study (winners and nonwinners), we can see that US hospitals have not been able to significantly improve performance across the entire 50 Top Cardiovascular Hospitals balanced scorecard: In the majority of measures (18 of 22), 70% or more of all in-study hospitals saw no statistically significant change on any of the scorecard measures. (See Table 6.) However, over the years we studied there were a few notable performance improvements for specific measures, especially those extending beyond the acute inpatient stay. (See the green left column in Table 6.)

- A healthy proportion of hospitals significantly improved their CABG 30-day readmission rates with 30.8% of the hospitals showing significantly improved performance.
- 33.2% of all hospitals significantly improved on the AMI 30-day mortality measure, between 2016-2020.
- However, there were two notable declines in performance over time that should also be pointed out. (See the right gray column in Table 6):
- AMI and HF 30-day episode of payment statistically worsened, or increased, in 79.5% and 69.1%, respectively, of all in-study hospitals.

Table 6: Direction of performance change for all cardiovascular hospitals in study, 2016 - 2020

Performance measure		Significantly improving performance		No statistically significant change in performance		Significantly declining performance	
		Count of hospitals[1]	Percent of hospitals[2]	Count of hospitals[1]	Percent of hospitals[2]	Count of hospitals[1]	Percent of hospitals[2]
Risk-adjusted inpatient mortality index	AMI mortality	36	3.9%	867	22	22	2.4%
	HF mortality	39	4.2%	854	32	32	3.5%
	CABG mortality	39	4.2%	867	19	19	2.1%
	PCI mortality	34	3.7%	871	20	20	2.2%
Risk-adjusted complications index	CABG complications	34	3.7%	847	44	44	4.8%
	PCI complications	51	5.5%	855	19	19	2.1%
AMI 30-day mortality		307	33.2%	597	64.5%	21	2.3%
HF 30-day mortality		181	19.6%	673	72.8%	71	7.7%
CABG 30-day mortality		171	18.5%	686	74.2%	68	7.4%
AMI 30-day readmission		128	13.8%	769	83.1%	28	3.0%
HF 30-day readmission		89	9.6%	671	72.5%	165	17.8%
CABG 30-day readmission		285	30.8%	610	65.9%	30	3.2%
AMI severity-adjusted average length of stay (ALOS)		57	6.2%	835	90.3%	33	3.6%
HF severity-adjusted ALOS		30	3.2%	754	81.5%	141	15.2%
CABG severity-adjusted ALOS		40	4.3%	822	88.9%	63	6.8%
PCI severity-adjusted ALOS		36	3.9%	838	90.6%	51	5.5%
AMI wage- and severity-adjusted average cost per case		80	8.7%	816	88.4%	27	2.9%
HF wage- and severity-adjusted average cost per case		55	6.0%	736	79.9%	130	14.1%
CABG wage- and severity adjusted average cost per case		64	6.9%	783	84.7%	77	8.3%
PCI wage- and severity-adjusted average cost per case		136	14.8%	749	81.3%	36	3.9%
AMI 30-day episode of payment		2	0.2%	188	20.3%	735	79.5%
HF 30-day episode of payment		6	0.6%	280	30.3%	639	69.1%

1. Count refers to the number of in-study hospitals whose performance fell into the highlighted category for the measure.
2. Percent is calculated by dividing the count by the total in-study hospitals across all comparison groups

Note: Total number of hospitals included in the analysis can vary by measure due to exclusion of IQR outlier data points, causing some in-study hospitals to have too few remaining data points to calculate trend. This affects the Cost per Case measures.

Methodology

The Watson Health® 50 Top Cardiovascular Hospitals study is based on quantitative research that uses a balanced scorecard approach, based on publicly available data, to identify the top cardiovascular hospitals in the US. This study focuses on short-term, acute care, nonfederal US hospitals that treat a broad spectrum of cardiology patients. It includes patients requiring medical management, as well as those who receive invasive or surgical procedures. Because multiple measures are used, a hospital must provide all forms of cardiovascular care, including open heart surgery, to be included in the study.

Overview

The main steps used in the selection of the 50 Top Cardiovascular Hospitals study winners are:

- Building the database of hospitals, including special selection and exclusion criteria
- Classifying hospitals into comparison groups
- Scoring hospitals on a set of weighted performance measures
- Determining the 50 hospitals with the best overall performance by ranking relative to like comparison groups

The following section is intended to be an overview of these steps. To request more detailed information on any of the study concepts outlined here, please email us at 100tophospitals@us.ibm.com or call 800-525-9083.

Building the database of hospitals

Like all Watson Health 100 Top Hospitals® studies, the 50 Top Cardiovascular Hospitals study uses only publicly available data. The data come from:

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

We use MEDPAR patient-level record information to calculate inpatient mortality, complications, and length of stay (LOS). MEDPAR is also used for patient- level charge data in estimating average cost per case. This data set contains information on approximately 14 million Medicare patients who are discharged from the nation's acute care hospitals annually.

In this year's study, five years of MEDPAR data (2016-2020) were used (instead of the typical six years) to develop the study trend database, due to lack of available ICD-10-CM codes in MEDPAR 2015 data. The 2016 data point in the trend profile uses two years of 2016 MEDPAR data for the clinical measures. The two most recent years of MEDPAR data available (2019 and 2020) are used to identify current performance and to select the winning hospitals. To be included in the study, a hospital must have both years of data available, with valid present-on-admission (POA) coding.

We use Medicare Cost Reports to create our proprietary database, which contains hospital-specific demographic information and hospital-specific, all-payer cost and charge data. The hospital cost-to-charge ratios are applied to MEDPAR patient-level claims data to estimate cost for the study's cost measures. This is done at the cost center and charge code levels for each patient record.

The Medicare Cost Report is filed annually by every US hospital that participates in the Medicare program. Hospitals are required to submit cost reports to receive reimbursement from Medicare. It should be noted, however, that cost report data includes services for all patients, not just Medicare beneficiaries.

The 100 Top Hospitals program and many others in the healthcare industry have used the MEDPAR and Medicare Cost Report databases for years. We believe they are accurate and reliable sources for the types of analyses performed in this study. Medicare data is highly representative of the cardiovascular patients included in this study. In fact, Medicare inpatients usually represent about two-thirds of all patients undergoing medical treatment for acute myocardial infarction (AMI) or experiencing heart failure (HF), and about half of all patients undergoing percutaneous coronary intervention (PCI) or coronary artery bypass grafting (CABG), as found in the Watson Health Projected Inpatient Database (PIDB).[i]

We use the CMS Hospital Compare data set for 30-day mortality and 30-day readmission rate performance measures, as well as the 30-day episode-of-care payment measures for AMI and HF patients. CMS publishes these rates as three-year combined data values. Five data points are used to develop the study trend database for these extended care measures. We label these data points based on the end year of each data set. For example, July 1, 2016-June 30, 2019 is named "2019." We used the current year (most recent data set available) to identify current performance and to select the winning hospitals.

We reference residency and fellowship program information from the Accreditation Council for Graduate Medical Education (ACGME) and the American Osteopathic Association (AOA) to classify teaching hospitals. Participation in a cardiovascular fellowship program is identified and confirmed using the sources listed below.

- AMA and AOA participation from ACGME files
- FREIDA database

[i] The Watson Health Projected Inpatient Database (PIDB) is one of the largest US inpatient, all-payer databases of its kind, 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.

Time periods of data

The following table identifies the years used in this study for both the current and trend profiles.

References made to 'current' year, 'most current' year and 'trend' years throughout this overview are defined below.

Table 7. Time Periods

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 – FFY 2018

The effect of present-on-admission data on risk and severity adjustment

- *Since 2008, CMS regulations have required all Inpatient Prospective Payment System hospitals to document whether a patient has certain conditions when admitted; these are coded as POA.*
- *Our complication rate methodology uses this POA data. Consequently, the complication rates exclude "false-positive" complications and are more accurate. In addition, our mortality, complications, LOS, and cost-per-case risk- and severity-adjustment models develop expected values based only on conditions that were present on admission.*

Present-on-admission data

Our risk-adjustment models for inpatient mortality and complications, and severity-adjustment models for LOS and cost per case included POA data reported in the MEDPAR data sets. Under the Deficit Reduction Act of 2005, as of federal fiscal year (FFY) 2008, hospitals receive a reduced payment for cases with certain conditions (such as falls, surgical-site infections, and pressure ulcers) that were not present on the patient's admission but occurred during hospitalization. As a result, CMS now requires all Inpatient Prospective Payment System hospitals to document whether a patient has these conditions when admitted.[5]

Present-on-admission coding adjustments

Since 2010 we have observed a significant rise in the number of principal diagnosis (PDX) and secondary diagnosis (SDX) codes that do not have a valid POA 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 the Appendix for details.

To correct for this bias, we adjust MEDPAR record processing through our inpatient mortality and complications risk models, and LOS and cost- per- case severity-adjustment models, as follows:

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

Hospitals and patient groups included

The focus of the study is on hospitals that offer both medical and surgical treatment options for patients with two of the most common cardiovascular conditions: AMI and HF. To build such a database, we included all hospitals that had, in the two most recent data years combined, at least 30 unique cases.

in each of the four patient groups described below.

- AMI patients – restricted to nonsurgical patients
- HF patients – restricted to nonsurgical patients
- CABG patients – includes all ICD- 10-CM procedure codes, principal or secondary in MS-DRGs 231 - 236
- PCI patients – excludes patients with open chest coronary artery angioplasty

Each patient group is mutually exclusive, by design. To define patient diagnoses, ICD-10-CM codes are used in both the current and trend profiles. See the Appendix for patient group definitions and the code-level detail.

Patient records excluded

The AMI and HF groups explicitly exclude patients who also had a PCI and/or CABG procedure. This helps ensure we have exclusively medical patients in these groups.

Also excluded:

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

Hospitals excluded

After building the database of cardiovascular hospitals, we exclude hospitals that reasonably might be expected to include a different patient population or population distribution, or whose data is not sufficient for analysis.

Excluded from the study were:

- Hospitals with fewer than 30 unique patient records in each patient group (AMI, HF, CABG, and PCI) for the two most current MEDPAR years combined
- Specialty hospitals, other than cardiac hospitals (critical access hospitals, children's, women's, psychiatric, substance abuse, rehabilitation, and long-term acute care hospitals)
- Federally owned hospitals
- Non-continental US hospitals (such as those in Puerto Rico, Guam, and the Virgin Islands)
- Hospitals with Medicare average LOS (ALOS) longer than 30 days
- Hospitals with no reported deaths
- Hospitals that did not have Medicare claims for the two most current years of data
- Hospitals missing data for calculation of one or more performance measures
- Hospitals for which a Medicare Cost Report was not available for the two most current years of data
- Hospitals that did not code POA indicators on the two most current years of MEDPAR data

Classifying hospitals into comparison groups

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

Our formula for defining the cardiovascular hospital comparison groups includes each hospital's bed size, residents-to-beds ratio, and involvement in graduate medical education (GME) programs accredited by the ACGME.[8] We define the groups as follows.

Teaching hospitals with cardiovascular residency programs

Hospitals in this category must meet the definition of teaching (see teaching hospitals without cardiovascular residency programs definition) and be involved in a cardiovascular residency program accredited by the ACGME[6] (for AMA or AOA programs). Cardiovascular residency programs include any of the following:

- Adult congenital heart disease
- Advanced heart failure and transplant cardiology
- Cardiology
- Cardiothoracic surgery
- Cardiovascular disease
- Cardiovascular medicine
- Clinical cardiac electrophysiology
- Interventional cardiology
- Thoracic surgery
- Thoracic surgery – integrated

Note: Cardiovascular radiology residency programs are not included.

Participation in a fellowship program was identified and confirmed using the following sources:

- AMA and AOA participation from ACGME files
- FREIDA database

Teaching hospitals without cardiovascular residency programs

Hospitals in this category have no involvement in a cardiovascular residency program. There are two ways to qualify as a teaching hospital:

- Meet two of the following three criteria:
  - 200 or more acute care beds in service
  - An intern/resident-per-bed ratio of at least 0.03
  - Involvement in at least 3 accredited GME programs overall
- Or: have an intern/ resident-per-bed ratio of 0.25 or greater, regardless of bed size

Community hospitals

Hospital must meet both of the following criteria:

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

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

Cardiovascular study groups

The final study group counts, after exclusions, are listed in Table 8.

Table 8. Cardiovascular hospital comparison groups

Comparison group	Total
Teaching hospitals with cardiovascular residency programs	277
Teaching hospitals without cardiovascular residency programs	341
Community hospitals	333
Total in-study hospitals	951

Scoring hospitals on weighted performance measures

Evolution of performance measures

We use a balanced scorecard approach, based on public data, to select the measures most useful for hospital boards and chief executive officers in the current operating environment.

We gather feedback from industry leaders, hospital executives, academic leaders, and internal experts; review trends in the healthcare market; and survey hospitals in demanding marketplaces to learn what measures are valid and reflective of top performance. As the market has changed, our methods have evolved.

The measures used in this year's study, along with their data sources, are outlined in Table 9, "Summary of measure data sources and data periods."

Below, we provide rationale for the selection of our balanced scorecard domains and the measures used for each.

Table 9. Summary of measure data sources and data periods			
	Ranked performance metric	Current profile data sources	Trend profile data sources
Clinical outcomes	1. Risk-adjusted inpatient mortality (AMI, HF, CABG, PCI)	MEDPAR Federal Fiscal Year (FFY) 2019 and 2020	MEDPAR Federal Fiscal Year (FFY) 2016 – 2020[a]
	2. Risk-adjusted complications (CABG, PCI)	MEDPAR FFY 2019 and 2020	Same data periods as inpatient mortality
Extended outcomes	3. 30-day mortality rates (AMI, HF, CABG)	CMS Hospital Compare July 1, 2017 – Dec 1, 2019[b]	CMS Hospital Compare 3-yr datasets ending Jun 30 of the following years: 2016, 2017, 2018, 2019[c]
	4. 30-day readmission rates (AMI, HF, CABG)	CMS Hospital Compare July 1, 2017 – Dec 1, 2019[b]	Same data periods as 30-day mortality
Efficiency	5. Severity-adjusted average LOS (AMI, HF, CABG, PCI)	MEDPAR FFY 2020	MEDPAR FFY 2016 - 2020
	6. Wage- and severity-adjusted average cost per case (AMI, HF, CABG, PCI)	MEDPAR FFY 2020	MEDPAR FFY 2016 - 2020
Extended efficiency	7. 30-day episode payment (AMI, HF)	CMS Hospital Compare July 1, 2017 – Dec 1, 2019[b]	CMS Hospital Compare 3-yr datasets ending Jun 30 of the following years: 2016, 2017, 2018, 2019[c]
Patient Experience	8. HCAHPS	CMS Hospital Compare Calendar year 2019	N/A[d]

a. Two years of MEDPAR data are combined for each study year, as follows: 2016-2016, 2016-2017, 2017-2018, 2018-2019, 2019-2020
b. 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
c. Two data points end in 2019 due to CMS removal of Q1 and Q2 2020 data from measure datasets in current year, 2 ½ years of data in 2020 data
d. HCAHPS measure not in trend profile this study year

Clinical excellence

Clinical excellence can be measured by looking at several key domains: outcomes, process, and extended outcomes.

Our clinical outcome measures are the risk-adjusted inpatient mortality indexes for all included cardiovascular patient groups (AMI, HF, CABG, and PCI) and risk-adjusted complications indexes for CABG and PCI patient groups. These mortality and complications measures show how the provider is performing on the most basic and essential care standards (patient survival and error-free care) while treating patients in the facility. Our study incorporates a comprehensive, risk-adjusted complications model that includes 44 possible patient complications with expected probabilities calculated from our national inpatient database.

For more information, see the measures details in the tables on the following pages and read about our mortality and complications models in the Appendix.

The study's extended outcomes domain includes 30-day mortality rates and 30-day readmission rates for AMI, HF, and CABG patients, and 30-day episode-of-care payment measures for AMI and HF patients. The 30-day mortality and readmission measures help us understand how the hospital's patients are faring over a longer period and help flag issues with discharge appropriateness, effectiveness of follow-up care coordination, and availability of appropriate post-acute care. The episode-of-care payment measures allow us to better understand differences in the patterns of post- discharge and associated payments made for Medicare patients across the continuum of care.

Hospitals with lower values appear to be providing care with better medium-term results along with lower costs for these conditions.

Service delivery efficiency

We use severity-adjusted ALOS and wage- and severity-adjusted cost per case as our measures of service delivery efficiency. For the life of the study, severity-adjusted ALOS has served as a proxy for clinical efficiency, and cost per case has served as a measure of both clinical and operating efficiency.

Cost per case provides insight into how cost- effectively a hospital is caring for its patients. Wage and severity adjustments consider patient acuity and labor market cost differences and help ensure fair comparisons among hospitals.

Patient Experience

New to the 50 Top Cardiovascular study this year is the inclusion of the Hospital Consumer Assessment of Healthcare Providers and Systems (HCAHPS) measure from the CMS Hospital Compare data set. 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.

Performance measures

For more information on methodologies, see the Appendix.

Risk-adjusted inpatient mortality index			
Why we include this element	**Calculation**	**Comments**	**Favorable values are**
Patient survival is a universally accepted measure of hospital quality. The lower the mortality index, the greater the survival of the patients in the hospital, considering what would be expected based on patient characteristics. While all hospitals have patient deaths, this measure can show where deaths occurred but were not expected, or the reverse, given the patient's condition.	The Risk-Adjusted Inpatient Mortality Index is the number of actual deaths occurring in the hospital divided by the number of normalized expected deaths, given the risk of death for each patient. Expected deaths are based on our statistical model for predicting the likelihood of a patient's death based on age, sex, presence of complicating diagnoses (POA only), and other characteristics. Palliative care patients (Z515) are included in the risk model. 'DNR' patients (Z66) are excluded at this time. Separate index values are calculated for each patient group: AMI, HF, CABG, PCI. We normalize each index based on the ratio of observed to normalized expected deaths for each patient group, by comparison group (cardio teaching, teaching, community hospital). The reference value for this index is 1.00; a value of 1.15 indicates 15 percent more events than predicted, and a value of 0.85 indicates 15 percent fewer.	We base the scoring for each patient group (AMI, HF, CABG, and PCI) on the difference between observed and expected deaths, expressed in normalized standard deviation units (z-score). Hospitals with the fewest deaths, relative to the number expected, after accounting for standard binomial variability, receive the most favorable scores. We use the two most recent years of MEDPAR data to reduce the influence of chance variation. The MEDPAR data set includes both Medicare Fee-for-Service claims and Medicare Advantage (HMO) encounter records. Hospitals with observed values statistically worse than expected (99-percent confidence), and whose values are above the high trim point, are not eligible to be named benchmark hospitals.	Lower

Risk-adjusted complications index			
Why we include this element	**Calculation**	**Comments**	**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 occurred but were not expected, or the reverse, given the patient's condition. Due to the infrequency of complications in the medical patient groups, this measure is restricted to the surgical groups, CABG and PCI.	The Risk-Adjusted Complications Index is the number of actual complications occurring in the hospital divided by the number of normalized expected complications, given the risk of complications for each patient. Observed complications are those that are coded as not present on admission. Expected complications are based on our statistical model for predicting the likelihood of a patient experiencing a complication while in the hospital, based on age, sex, presence of complicating diagnoses (POA only), and other characteristics. Separate index values are calculated for both patient groups, CABG and PCI. We normalize each index based on the ratio of observed to normalized expected complications for each patient group, by comparison group (Cardio Teaching, Teaching, Community Hospital). The reference value for this index is 1.00; a value of 1.15 indicates 15 percent more events than predicted, and a value of 0.85 indicates 15 percent fewer.	We base the scoring for each patient group (CABG and PCI) on the difference between observed and expected complications, expressed in normalized standard deviation units (z-score). Hospitals with the fewest complications, relative to the number expected, after accounting for standard binomial variability, receive the most favorable scores. We use the two most recent years of MEDPAR data to reduce the influence of chance variation. The MEDPAR data set includes both Medicare Fee-for-Service claims and Medicare Advantage (HMO) encounter records. Hospitals with observed values statistically worse than expected (99-percent confidence), and whose values are above the high trim point, are not eligible to be named benchmark hospitals.	Lower

30-day mortality rates for AMI, HF, and CABG patients			
Why we include this element	**Calculation**	**Comments**	**Favorable values are**
30-day mortality rates are an accepted measure of the effectiveness of overall hospital care. They allow us to look beyond immediate patient outcomes and understand how the care the hospital provided to inpatients with these particular conditions may have contributed to their longer-term survival. Because these measures are part of CMS value-based purchasing program, they are being watched closely in the industry. In addition, tracking these measures may help hospitals identify patients at risk for post-discharge problems and target improvements in discharge planning and aftercare processes. Hospitals that score well may be better prepared for risk-based population health payment systems.	CMS calculates a 30-day mortality rate for each patient condition using three years of MEDPAR data combined. CMS does not calculate rates for hospitals where the number of cases is too small (less than 25). The rates are presented as percentages. We use the rates as reported by CMS, without alteration. A 10-percent 30-day mortality rate indicates that 10 percent of patients died, of any cause, within 30 days of the original admission date.	Hospitals are ranked on each 30-day rate independently within their comparison group. The CMS Hospital Compare data for 30-day mortality is based on Medicare Fee-for-Service claims only from the second quarter release.[9]	Lower

30-day readmission rates for AMI, HF, and CABG patients			
Why we include this element	**Calculation**	**Comments**	**Favorable values are**
30-day readmissions are an accepted measure of the effectiveness of overall hospital care. They allow us to understand how the care the hospital provided to inpatients with these particular conditions may have contributed to issues with their post-discharge medical stability and recovery. These measures are now being watched closely in the industry. Tracking these measures may help hospitals identify patients at risk for post-discharge problems if discharged too soon, as well as target improvements in discharge planning and after-care processes. These measures are now being watched closely in the industry. Tracking these measures may help hospitals identify patients at risk for post-discharge problems if discharged too soon, as well as target improvements in discharge planning and after-care processes. Hospitals that score well may be better prepared for a pay-for-performance structure.	CMS calculates a 30-day readmission rate for each patient condition using three years of MEDPAR data combined. CMS does not calculate rates for hospitals where the number of cases is too small (less than 25). The rates are presented as percentages. We use the rates as reported by CMS, without alteration. A 20-percent 30-day readmission rate would indicate that 20 percent of patients were readmitted to an acute care hospital within 30 days of discharge.	Hospitals are ranked on each 30-day rate independently within their comparison group. The CMS Hospital Compare data for 30-day readmissions is based on Medicare Fee-for-Service claims only from the second quarter release. [9]	Lower

Severity-Adjusted Average Length of Stay (ALOS)			
Why we include this element	**Calculation**	**Comments**	**Favorable values are**
A lower severity-adjusted ALOS (average number of days spent by a patient in a hospital) generally indicates a more efficient consumption of hospital resources and reduced risk to patients.	We calculate a LOS index value for each patient group (AMI, HF, CABG, PCI) based on the sum of the observed patient LOS divided by the sum of the normalized expected LOS. Expected LOS adjusts for differences in severity of illness among patients using a linear regression model. Conditions that are present on admission (POA) are taken into account when determining expected LOS. We normalize the expected values based on the ratio of observed to expected LOS for each patient group (AMI, HF, CABG and PCI) by hospital comparison group. Each patient group LOS index is converted into an average LOS in days by multiplying it by the grand mean LOS of the group's in-study patient population without regard to hospital comparison group.	Data for this measure are from the most current MEDPAR year. The MEDPAR data set includes both Medicare Fee-for-Service claims and Medicare Advantage (HMO) encounter records.	Lower

Wage- and Severity-Adjusted Cost per Case

Why we include this element	Calculation	Comments	Favorable values are
The Cost per Case measure helps to determine how cost-effectively a hospital is caring for its patients. Ideally, best value is achieved when patients receive high-quality care, with good outcomes, at the lowest cost. Hospitals that score well may be better prepared for risk-based population health payment systems.	We calculate a cost index value for each patient group (AMI, HF, CABG, PCI) based on the sum of the patient- level observed cost divided by the sum of the normalized expected cost. We estimate the observed cost by applying the hospital cost-to-charge ratios for each cost center, as reported in the hospital cost report (most current available), to the MEDPAR patient-level charges by revenue code. Expected cost adjusts for differences in severity of illness using a linear regression model. Conditions that are present on admission (POA) are taken into account when determining expected cost. Expected cost is Area Wage Index-adjusted. We normalize the expected values based on the ratio of observed to expected cost per case for each patient group, by hospital comparison group. Each patient group cost index is converted into an average cost per case expressed in dollars by multiplying it by the grand mean cost per case of the group's in-study patient population, without regard to hospital comparison group.	Charge data for this measure is from the most current MEDPAR year. Cost-to-charge ratios are from the most current year of the hospital's Medicare Cost report available (if current year not available, previous year cost report is used). The MEDPAR data set includes both Medicare Fee-for-Service claims and Medicare Advantage (HMO) encounter records.	Lower

30-day episode-of-care payment for AMI and HF patients			
Why we include this element	**Calculation**	**Comments**	**Favorable values are**
Recently, CMS began publicly reporting hospital risk-standardized payments associated with a 30-day episode of care for AMI and HF. The values represent the payments made for the care and supplies for AMI and HF patients, beginning with the hospital admission through the next 30 days. They are meant to reflect differences in services and supplies provided to similar patients. CMS's intent in creating these measures is to better understand differences in the patterns of post-discharge care and associated payments made for Medicare patients across the entire continuum of care. The measures are meant to be use along with the other 30-day measures (mortality and readmission), in order to fully assess a hospital's financial and quality of care performance.	CMS calculates the 30-day payment by using the ratio of predicted 30- day payment to expected 30-day payment which is then multiplied by the national mean payment to get the risk-standardized payment for each hospital for AMI and HF patients. The payment measures include Medicare claims data for each patient condition using three years of MEDPAR data combined. CMS does not calculate rates for hospitals where the number of cases is too small (less than 25). The rates are presented as payment in dollars. We use the payments as reported by CMS, without alteration.	Hospitals are ranked on each 30-day payment measure independently within their comparison group. [9]	Lower

Hospital Consumer Assessment of Healthcare Providers and Systems (HCAHPS) score (overall hospital rating)			
Why we include this element	Calculation	Comments	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 the CMS Hospital Compare data set. For this study, we included the Hospital Consumer Assessment of Healthcare Providers and Systems (HCAHPS) results for the current calendar year. We use the HCAHPS survey instrument question, "How do patients rate the hospital, overall?" as the ranked metric, using the 'top box' response percent as the measured value	We rank hospitals based on the "top-box" answer percent value in the CMS Hospital Compare data set in the current CY. See Appendix C for full details. [9] HCAHPS data is survey data, based on either a sample of hospital inpatients or all inpatients.	Higher

Determining the 50 Top Cardiovascular Hospitals

Ranking

Within each of the three hospital comparison groups, we ranked hospitals based on their performance on each of the measures independently, relative to other hospitals in their group. Each performance measure was assigned a weight for use in overall ranking. The weights for each measure are indicated in the table below.

Each hospital's measure ranks were summed to arrive at a total score for the hospital. The hospitals were then ranked based on their total scores, and the hospitals with the best overall ranks in each comparison group were selected as the benchmark hospitals (winning hospitals).

Only current profile rank performance was used for the selection of benchmark award-winning hospitals. Trend performance was ranked for information only.

Table 10. Ranked performance measures and weights

Ranked performance measure	Patient group	Current profile weight	Trend profile weight
Risk-adjusted inpatient mortality (normalized z-score)	AMI	½	½
	HF	½	½
	CABG	½	½
	PCI	½	½
Risk-adjusted complications (normalized z-score)	CABG	¼	¼
	PCI	¼	¼
30-day mortality rates (%)	AMI	⅙	⅙
	HF	⅙	⅙
	CABG	⅙	⅙
30-day readmission rates (%)	AMI	⅙	⅙
	HF	⅙	⅙
	CABG	⅙	⅙
Severity-adjusted average length of stay (days)	AMI	¼	¼
	HF	¼	¼
	CABG	¼	¼
	PCI	¼	¼
Wage- and severity-adjusted cost per case ($)	AMI	¼	¼
	HF	¼	¼
	CABG	¼	¼
	PCI	¼	¼
30-day episode payment ($)	AMI	½	½
	HF	½	½
HCAHPS top-box score (%)		½	n/a

Note: Inpatient mortality and complications normalized z-scores are converted to indexes for reporting. We convert LOS and cost-per-case indexes to ALOS and average cost per case, respectively, for reporting. For more details, see the performance measures table on the preceding pages.

Screening for outliers

To reduce the impact of unsustainable performance anomalies, and reporting anomalies or errors, hospitals with one or more inpatient mortality or complications index values that were high statistical outliers (99% confidence) were not eligible to be winners.

Also, hospitals with costs per case for any patient group that were high or low statistical outliers (using interquartile range [IQR]-trimming methodology) were not eligible to be winners. In addition, any hospital that had fewer than 11 cases in any one of the four patient groups (AMI, HF, PCI, and CABG) in the most current data year is not eligible to be a winner.[7]

The number of hospitals selected to receive the 50 Top Cardiovascular Hospitals award in each hospital comparison group is as follows:

Table 11. Number of cardiovascular winning hospitals by comparison group

Comparison group	Total
Teaching hospitals with cardiovascular residency program	20
Teaching hospitals without cardiovascular residency program	20
Community hospitals	10
Total	50

Appendix: Methodology details

Normative database development

For the 50 Top Cardiovascular Hospitals study, Watson Health® constructed a normative database of case-level data from its Projected Inpatient Database (PIDB). The PIDB is one of the largest US inpatient, all-payer databases of its kind, 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 all short-term, general, nonfederal hospitals in the US). Demographic and clinical data are also included: age, sex, and length of stay (LOS); clinical groupings (MS-DRGs), ICD-10-CM principal and secondary diagnoses and procedures; present- on-admission (POA) coding; admission source and type; and discharge status.

The Watson Health 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 year of data available in the Watson Health 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:[8]

- 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.

Patient Group Definitions

Acute myocardial infarction (AMI) patient group

AMI patients in MS-DRGs 280-285 with the following ICD-10-CM codes as primary diagnosis only:	I2101	ST elevation (STEMI) myocardial infarction involving left main coronary artery
	I2102	ST elevation (STEMI) myocardial infarction involving left anterior descending coronary artery
	I2109	ST elevation (STEMI) myocardial infarction involving other coronary artery of anterior wall
	I2111	ST elevation (STEMI) myocardial infarction involving right coronary artery
	I2119	ST elevation (STEMI) myocardial infarction involving other coronary artery of inferior wall
	I2121	ST elevation (STEMI) myocardial infarction involving left circumflex coronary artery
	I2129	ST elevation (STEMI) myocardial infarction involving other sites
	I213	ST elevation (STEMI) myocardial infarction of unspecified site
	I214	Non-ST elevation (NSTEMI) myocardial infarction
	I219	Acute myocardial infarction, unspecified
	I21A1	Myocardial infarction type 2
	I21A9	Other myocardial infarction type
	I220	Subsequent ST elevation (STEMI) myocardial infarction of anterior wall
	I221	Subsequent ST elevation (STEMI) myocardial infarction of inferior wall
	I222	Subsequent non-ST elevation (NSTEMI) myocardial infarction
	I228	Subsequent ST elevation (STEMI) myocardial infarction of other sites
	I229	Subsequent ST elevation (STEMI) myocardial infarction of unspecified site

Heart failure (HF) patient group - restricted to nonsurgical patients

HF patients in MS-DRGs 291-293 with the following ICD-10-CM code as primary diagnosis only:	I501	Left ventricular failure, unspecified
	I5020	Unspecified systolic (congestive) heart failure
	I5021	Acute systolic (congestive) heart failure
	I5022	Chronic systolic (congestive) heart failure
	I5023	Acute on chronic systolic (congestive) heart failure
	I5030	Unspecified diastolic (congestive) heart failure
	I5031	Acute diastolic (congestive) heart failure
	I5032	Chronic diastolic (congestive) heart failure
	I5033	Acute on chronic diastolic (congestive) heart failure
	I5040	Unspecified combined systolic (congestive) and diastolic (congestive) heart failure
	I5041	Acute combined systolic (congestive) and diastolic (congestive) heart failure
	I5042	Chronic combined systolic (congestive) and diastolic (congestive) heart failure
	I5043	Acute on chronic combined systolic (congestive) and diastolic (congestive) heart failure
	I509	Heart failure, unspecified
	I0981	Rheumatic heart failure
	I110	Hypertensive heart disease with heart failure
	I130	Hypertensive heart and chronic kidney disease with heart failure and stage 1 through stage 4 chronic kidney disease, or unspecified chronic kidney disease
	I132	Hypertensive heart and chronic kidney disease with heart failure and with stage 5 chronic kidney disease, or end stage renal disease
	I50810	Right heart failure, unspecified
	I50811	Acute right heart failure
	I50812	Chronic right heart failure
	I50813	Acute on chronic right heart failure
	I50814	Right heart failure due to left heart failure
	I5082	Biventricular heart failure
	I5083	High output heart failure
	I5084	End stage heart failure
	I5089	Other heart failure

Coronary artery bypass graft (CABG) patient group

CABG patients in MS-DRGs 231 – 236 (includes all ICD-10-CM procedure codes, principal or secondary in these MS-DRGs)

Percutaneous coronary intervention (PCI) patient group

PCI patients in MS-DRGs 246-251 with any of the following ICD-10-CM procedure codes:	0270346	Dilation of Coronary Artery, One Artery, Bifurcation, with Drug-eluting Intraluminal Device, Percutaneous Approach
	027034Z	Dilation of Coronary Artery, One Artery with Drug-eluting Intraluminal Device, Percutaneous Approach
	0270356	Dilation of Coronary Artery, One Artery, Bifurcation, with Two Drug-eluting Intraluminal Devices, Percutaneous Approach
	027035Z	Dilation of Coronary Artery, One Artery with Two Drug-eluting Intraluminal Devices, Percutaneous Approach
	0270366	Dilation of Coronary Artery, One Artery, Bifurcation, with Three Drug-eluting Intraluminal Devices, Percutaneous Approach
	027036Z	Dilation of Coronary Artery, One Artery with Three Drug-eluting Intraluminal Devices, Percutaneous Approach
	0270376	Dilation of Coronary Artery, One Artery, Bifurcation, with Four or More Drug-eluting Intraluminal Devices, Percutaneous Approach
	027037Z	Dilation of Coronary Artery, One Artery with Four or More Drug-eluting Intraluminal Devices, Percutaneous Approach
	02703D6	Dilation of Coronary Artery, One Artery, Bifurcation, with Intraluminal Device, Percutaneous Approach
	02703DZ	Dilation of Coronary Artery, One Artery with Intraluminal Device, Percutaneous Approach
	02703E6	Dilation of Coronary Artery, One Artery, Bifurcation, with Two Intraluminal Devices, Percutaneous Approach
	02703EZ	Dilation of Coronary Artery, One Artery with Two Intraluminal Devices, Percutaneous Approach
	02703F6	Dilation of Coronary Artery, One Artery, Bifurcation, with Three Intraluminal Devices, Percutaneous Approach
	02703FZ	Dilation of Coronary Artery, One Artery with Three Intraluminal Devices, Percutaneous Approach
	02703G6	Dilation of Coronary Artery, One Artery, Bifurcation, with Four or More Intraluminal Devices, Percutaneous Approach
	02703GZ	Dilation of Coronary Artery, One Artery with Four or More Intraluminal Devices, Percutaneous Approach
	02703T6	Dilation of Coronary Artery, One Artery, Bifurcation, with Radioactive Intraluminal Device, Percutaneous Approach
	02703TZ	Dilation of Coronary Artery, One Artery with Radioactive Intraluminal Device, Percutaneous Approach
	02703Z6	Dilation of Coronary Artery, One Artery, Bifurcation, Percutaneous Approach
	02703ZZ	Dilation of Coronary Artery, One Artery, Percutaneous Approach
	0270446	Dilation of Coronary Artery, One Artery, Bifurcation, with Drug-eluting Intraluminal Device, Percutaneous Endoscopic Approach
	027044Z	Dilation of Coronary Artery, One Artery with Drug-eluting Intraluminal Device, Percutaneous Endoscopic Approach
	0270456	Dilation of Coronary Artery, One Artery, Bifurcation, with Two Drug-eluting Intraluminal Devices, Percutaneous Endoscopic Approach
	027045Z	Dilation of Coronary Artery, One Artery with Two Drug-eluting Intraluminal Devices, Percutaneous Endoscopic Approach

0270466	Dilation of Coronary Artery, One Artery, Bifurcation, with Three Drug-eluting Intraluminal Devices, Percutaneous Endoscopic Approach
027046Z	Dilation of Coronary Artery, One Artery with Three Drug-eluting Intraluminal Devices, Percutaneous Endoscopic Approach
0270476	Dilation of Coronary Artery, One Artery, Bifurcation, with Four or More Drug-eluting Intraluminal Devices, Percutaneous Endoscopic Approach
027047Z	Dilation of Coronary Artery, One Artery with Four or More Drug-eluting Intraluminal Devices, Percutaneous Endoscopic Approach
02704D6	Dilation of Coronary Artery, One Artery, Bifurcation, with Intraluminal Device, Percutaneous Endoscopic Approach
02704DZ	Dilation of Coronary Artery, One Artery with Intraluminal Device, Percutaneous Endoscopic Approach
02704E6	Dilation of Coronary Artery, One Artery, Bifurcation, with Two Intraluminal Devices, Percutaneous Endoscopic Approach
02704EZ	Dilation of Coronary Artery, One Artery with Two Intraluminal Devices, Percutaneous Endoscopic Approach
02704F6	Dilation of Coronary Artery, One Artery, Bifurcation, with Three Intraluminal Devices, Percutaneous Endoscopic Approach
02704FZ	Dilation of Coronary Artery, One Artery with Three Intraluminal Devices, Percutaneous Endoscopic Approach
02704G6	Dilation of Coronary Artery, One Artery, Bifurcation, with Four or More Intraluminal Devices, Percutaneous Endoscopic Approach
02704GZ	Dilation of Coronary Artery, One Artery with Four or More Intraluminal Devices, Percutaneous Endoscopic Approach
02704T6	Dilation of Coronary Artery, One Artery, Bifurcation, with Radioactive Intraluminal Device, Percutaneous Endoscopic Approach
02704TZ	Dilation of Coronary Artery, One Artery with Radioactive Intraluminal Device, Percutaneous Endoscopic Approach
02704Z6	Dilation of Coronary Artery, One Artery, Bifurcation, Percutaneous Endoscopic Approach
02704ZZ	Dilation of Coronary Artery, One Artery, Percutaneous Endoscopic Approach
0271346	Dilation of Coronary Artery, Two Arteries, Bifurcation, with Drug-eluting Intraluminal Device, Percutaneous Approach
027134Z	Dilation of Coronary Artery, Two Arteries with Drug-eluting Intraluminal Device, Percutaneous Approach
0271356	Dilation of Coronary Artery, Two Arteries, Bifurcation, with Two Drug-eluting Intraluminal Devices, Percutaneous Approach
027135Z	Dilation of Coronary Artery, Two Arteries with Two Drug-eluting Intraluminal Devices, Percutaneous Approach
0271366	Dilation of Coronary Artery, Two Arteries, Bifurcation, with Three Drug-eluting Intraluminal Devices, Percutaneous Approach
027136Z	Dilation of Coronary Artery, Two Arteries with Three Drug-eluting Intraluminal Devices, Percutaneous Approach
0271376	Dilation of Coronary Artery, Two Arteries, Bifurcation, with Four or More Drug-eluting Intraluminal Devices, Percutaneous Approach
027137Z	Dilation of Coronary Artery, Two Arteries with Four or More Drug-eluting Intraluminal Devices, Percutaneous Approach
02713D6	Dilation of Coronary Artery, Two Arteries, Bifurcation, with Intraluminal Device, Percutaneous Approach
02713DZ	Dilation of Coronary Artery, Two Arteries with Intraluminal Device, Percutaneous Approach

02713E6	Dilation of Coronary Artery, Two Arteries, Bifurcation, with Two Intraluminal Devices, Percutaneous Approach
02713EZ	Dilation of Coronary Artery, Two Arteries with Two Intraluminal Devices, Percutaneous Approach
02713F6	Dilation of Coronary Artery, Two Arteries, Bifurcation, with Three Intraluminal Devices, Percutaneous Approach
02713FZ	Dilation of Coronary Artery, Two Arteries with Three Intraluminal Devices, Percutaneous Approach
02713G6	Dilation of Coronary Artery, Two Arteries, Bifurcation, with Four or More Intraluminal Devices, Percutaneous Approach
02713GZ	Dilation of Coronary Artery, Two Arteries with Four or More Intraluminal Devices, Percutaneous Approach
02713T6	Dilation of Coronary Artery, Two Arteries, Bifurcation, with Radioactive Intraluminal Device, Percutaneous Approach
02713TZ	Dilation of Coronary Artery, Two Arteries with Radioactive Intraluminal Device, Percutaneous Approach
02713Z6	Dilation of Coronary Artery, Two Arteries, Bifurcation, Percutaneous Approach
02713ZZ	Dilation of Coronary Artery, Two Arteries, Percutaneous Approach
0271446	Dilation of Coronary Artery, Two Arteries, Bifurcation, with Drug-eluting Intraluminal Device, Percutaneous Endoscopic Approach
027144Z	Dilation of Coronary Artery, Two Arteries with Drug-eluting Intraluminal Device, Percutaneous Endoscopic Approach
0271456	Dilation of Coronary Artery, Two Arteries, Bifurcation, with Two Drug-eluting Intraluminal Devices, Percutaneous Endoscopic Approach
027145Z	Dilation of Coronary Artery, Two Arteries with Two Drug-eluting Intraluminal Devices, Percutaneous Endoscopic Approach
0271466	Dilation of Coronary Artery, Two Arteries, Bifurcation, with Three Drug-eluting Intraluminal Devices, Percutaneous Endoscopic Approach
027146Z	Dilation of Coronary Artery, Two Arteries with Three Drug-eluting Intraluminal Devices, Percutaneous Endoscopic Approach
0271476	Dilation of Coronary Artery, Two Arteries, Bifurcation, with Four or More Drug-eluting Intraluminal Devices, Percutaneous Endoscopic Approach
027147Z	Dilation of Coronary Artery, Two Arteries with Four or More Drug-eluting Intraluminal Devices, Percutaneous Endoscopic Approach
02714D6	Dilation of Coronary Artery, Two Arteries, Bifurcation, with Intraluminal Device, Percutaneous Endoscopic Approach
02714DZ	Dilation of Coronary Artery, Two Arteries with Intraluminal Device, Percutaneous Endoscopic Approach
02714E6	Dilation of Coronary Artery, Two Arteries, Bifurcation, with Two Intraluminal Devices, Percutaneous Endoscopic Approach
02714EZ	Dilation of Coronary Artery, Two Arteries with Two Intraluminal Devices, Percutaneous Endoscopic Approach
02714F6	Dilation of Coronary Artery, Two Arteries, Bifurcation, with Three Intraluminal Devices, Percutaneous Endoscopic Approach
02714FZ	Dilation of Coronary Artery, Two Arteries with Three Intraluminal Devices, Percutaneous Endoscopic Approach
02714G6	Dilation of Coronary Artery, Two Arteries, Bifurcation, with Four or More Intraluminal Devices, Percutaneous Endoscopic Approach
02714GZ	Dilation of Coronary Artery, Two Arteries with Four or More Intraluminal Devices, Percutaneous Endoscopic Approach

02714T6	Dilation of Coronary Artery, Two Arteries, Bifurcation, with Radioactive Intraluminal Device, Percutaneous Endoscopic Approach
02714TZ	Dilation of Coronary Artery, Two Arteries with Radioactive Intraluminal Device, Percutaneous Endoscopic Approach
02714Z6	Dilation of Coronary Artery, Two Arteries, Bifurcation, Percutaneous Endoscopic Approach
02714ZZ	Dilation of Coronary Artery, Two Arteries, Percutaneous Endoscopic Approach
0272346	Dilation of Coronary Artery, Three Arteries, Bifurcation, with Drug-eluting Intraluminal Device, Percutaneous Approach
027234Z	Dilation of Coronary Artery, Three Arteries with Drug-eluting Intraluminal Device, Percutaneous Approach
0272356	Dilation of Coronary Artery, Three Arteries, Bifurcation, with Two Drug-eluting Intraluminal Devices, Percutaneous Approach
027235Z	Dilation of Coronary Artery, Three Arteries with Two Drug-eluting Intraluminal Devices, Percutaneous Approach
0272366	Dilation of Coronary Artery, Three Arteries, Bifurcation, with Three Drug-eluting Intraluminal Devices, Percutaneous Approach
027236Z	Dilation of Coronary Artery, Three Arteries with Three Drug-eluting Intraluminal Devices, Percutaneous Approach
0272376	Dilation of Coronary Artery, Three Arteries, Bifurcation, with Four or More Drug-eluting Intraluminal Devices, Percutaneous Approach
027237Z	Dilation of Coronary Artery, Three Arteries with Four or More Drug-eluting Intraluminal Devices, Percutaneous Approach
02723D6	Dilation of Coronary Artery, Three Arteries, Bifurcation, with Intraluminal Device, Percutaneous Approach
02723DZ	Dilation of Coronary Artery, Three Arteries with Intraluminal Device, Percutaneous Approach
02723E6	Dilation of Coronary Artery, Three Arteries, Bifurcation, with Two Intraluminal Devices, Percutaneous Approach
02723EZ	Dilation of Coronary Artery, Three Arteries with Two Intraluminal Devices, Percutaneous Approach
02723F6	Dilation of Coronary Artery, Three Arteries, Bifurcation, with Three Intraluminal Devices, Percutaneous Approach
02723FZ	Dilation of Coronary Artery, Three Arteries with Three Intraluminal Devices, Percutaneous Approach
02723G6	Dilation of Coronary Artery, Three Arteries, Bifurcation, with Four or More Intraluminal Devices, Percutaneous Approach
02723GZ	Dilation of Coronary Artery, Three Arteries with Four or More Intraluminal Devices, Percutaneous Approach
02723T6	Dilation of Coronary Artery, Three Arteries, Bifurcation, with Radioactive Intraluminal Device, Percutaneous Approach
02723TZ	Dilation of Coronary Artery, Three Arteries with Radioactive Intraluminal Device, Percutaneous Approach
02723Z6	Dilation of Coronary Artery, Three Arteries, Bifurcation, Percutaneous Approach
02723ZZ	Dilation of Coronary Artery, Three Arteries, Percutaneous Approach
0272446	Dilation of Coronary Artery, Three Arteries, Bifurcation, with Drug-eluting Intraluminal Device, Percutaneous Endoscopic Approach
027244Z	Dilation of Coronary Artery, Three Arteries with Drug-eluting Intraluminal Device, Percutaneous Endoscopic Approach
0272456	Dilation of Coronary Artery, Three Arteries, Bifurcation, with Two Drug-eluting Intraluminal Devices, Percutaneous Endoscopic Approach

027245Z	Dilation of Coronary Artery, Three Arteries with Two Drug-eluting Intraluminal Devices, Percutaneous Endoscopic Approach
0272466	Dilation of Coronary Artery, Three Arteries, Bifurcation, with Three Drug-eluting Intraluminal Devices, Percutaneous Endoscopic Approach
027246Z	Dilation of Coronary Artery, Three Arteries with Three Drug-eluting Intraluminal Devices, Percutaneous Endoscopic Approach
0272476	Dilation of Coronary Artery, Three Arteries, Bifurcation, with Four or More Drug-eluting Intraluminal Devices, Percutaneous Endoscopic Approach
027247Z	Dilation of Coronary Artery, Three Arteries with Four or More Drug-eluting Intraluminal Devices, Percutaneous Endoscopic Approach
02724D6	Dilation of Coronary Artery, Three Arteries, Bifurcation, with Intraluminal Device, Percutaneous Endoscopic Approach
02724DZ	Dilation of Coronary Artery, Three Arteries with Intraluminal Device, Percutaneous Endoscopic Approach
02724E6	Dilation of Coronary Artery, Three Arteries, Bifurcation, with Two Intraluminal Devices, Percutaneous Endoscopic Approach
02724EZ	Dilation of Coronary Artery, Three Arteries with Two Intraluminal Devices, Percutaneous Endoscopic Approach
02724F6	Dilation of Coronary Artery, Three Arteries, Bifurcation, with Three Intraluminal Devices, Percutaneous Endoscopic Approach
02724FZ	Dilation of Coronary Artery, Three Arteries with Three Intraluminal Devices, Percutaneous Endoscopic Approach
02724G6	Dilation of Coronary Artery, Three Arteries, Bifurcation, with Four or More Intraluminal Devices, Percutaneous Endoscopic Approach
02724GZ	Dilation of Coronary Artery, Three Arteries with Four or More Intraluminal Devices, Percutaneous Endoscopic Approach
02724T6	Dilation of Coronary Artery, Three Arteries, Bifurcation, with Radioactive Intraluminal Device, Percutaneous Endoscopic Approach
02724TZ	Dilation of Coronary Artery, Three Arteries with Radioactive Intraluminal Device, Percutaneous Endoscopic Approach
02724Z6	Dilation of Coronary Artery, Three Arteries, Bifurcation, Percutaneous Endoscopic Approach
02724ZZ	Dilation of Coronary Artery, Three Arteries, Percutaneous Endoscopic Approach
0273346	Dilation of Coronary Artery, Four or More Arteries, Bifurcation, with Drug-eluting Intraluminal Device, Percutaneous Approach
027334Z	Dilation of Coronary Artery, Four or More Arteries with Drug-eluting Intraluminal Device, Percutaneous Approach
0273356	Dilation of Coronary Artery, Four or More Arteries, Bifurcation, with Two Drug-eluting Intraluminal Devices, Percutaneous Approach
027335Z	Dilation of Coronary Artery, Four or More Arteries with Two Drug-eluting Intraluminal Devices, Percutaneous Approach
0273366	Dilation of Coronary Artery, Four or More Arteries, Bifurcation, with Three Drug-eluting Intraluminal Devices, Percutaneous Approach
027336Z	Dilation of Coronary Artery, Four or More Arteries with Three Drug-eluting Intraluminal Devices, Percutaneous Approach
0273376	Dilation of Coronary Artery, Four or More Arteries, Bifurcation, with Four or More Drug-eluting Intraluminal Devices, Percutaneous Approach
027337Z	Dilation of Coronary Artery, Four or More Arteries with Four or More Drug-eluting Intraluminal Devices, Percutaneous Approach
02733D6	Dilation of Coronary Artery, Four or More Arteries, Bifurcation, with Intraluminal Device, Percutaneous Approach
02733DZ	Dilation of Coronary Artery, Four or More Arteries with Intraluminal Device, Percutaneous Approach

02733E6	Dilation of Coronary Artery, Four or More Arteries, Bifurcation, with Two Intraluminal Devices, Percutaneous Approach
02733EZ	Dilation of Coronary Artery, Four or More Arteries with Two Intraluminal Devices, Percutaneous Approach
02733F6	Dilation of Coronary Artery, Four or More Arteries, Bifurcation, with Three Intraluminal Devices, Percutaneous Approach
02733FZ	Dilation of Coronary Artery, Four or More Arteries with Three Intraluminal Devices, Percutaneous Approach
02733G6	Dilation of Coronary Artery, Four or More Arteries, Bifurcation, with Four or More Intraluminal Devices, Percutaneous Approach
02733GZ	Dilation of Coronary Artery, Four or More Arteries with Four or More Intraluminal Devices, Percutaneous Approach
02733T6	Dilation of Coronary Artery, Four or More Arteries, Bifurcation, with Radioactive Intraluminal Device, Percutaneous Approach
02733TZ	Dilation of Coronary Artery, Four or More Arteries with Radioactive Intraluminal Device, Percutaneous Approach
02733Z6	Dilation of Coronary Artery, Four or More Arteries, Bifurcation, Percutaneous Approach
02733ZZ	Dilation of Coronary Artery, Four or More Arteries, Percutaneous Approach
0273446	Dilation of Coronary Artery, Four or More Arteries, Bifurcation, with Drug-eluting Intraluminal Device, Percutaneous Endoscopic Approach
027344Z	Dilation of Coronary Artery, Four or More Arteries with Drug-eluting Intraluminal Device, Percutaneous Endoscopic Approach
0273456	Dilation of Coronary Artery, Four or More Arteries, Bifurcation, with Two Drug-eluting Intraluminal Devices, Percutaneous Endoscopic Approach
027345Z	Dilation of Coronary Artery, Four or More Arteries with Two Drug-eluting Intraluminal Devices, Percutaneous Endoscopic Approach
0273466	Dilation of Coronary Artery, Four or More Arteries, Bifurcation, with Three Drug-eluting Intraluminal Devices, Percutaneous Endoscopic Approach
027346Z	Dilation of Coronary Artery, Four or More Arteries with Three Drug-eluting Intraluminal Devices, Percutaneous Endoscopic Approach
0273476	Dilation of Coronary Artery, Four or More Arteries, Bifurcation, with Four or More Drug-eluting Intraluminal Devices, Percutaneous Endoscopic Approach
027347Z	Dilation of Coronary Artery, Four or More Arteries with Four or More Drug-eluting Intraluminal Devices, Percutaneous Endoscopic Approach
02734D6	Dilation of Coronary Artery, Four or More Arteries, Bifurcation, with Intraluminal Device, Percutaneous Endoscopic Approach
02734DZ	Dilation of Coronary Artery, Four or More Arteries with Intraluminal Device, Percutaneous Endoscopic Approach
02734E6	Dilation of Coronary Artery, Four or More Arteries, Bifurcation, with Two Intraluminal Devices, Percutaneous Endoscopic Approach
02734EZ	Dilation of Coronary Artery, Four or More Arteries with Two Intraluminal Devices, Percutaneous Endoscopic Approach
02734F6	Dilation of Coronary Artery, Four or More Arteries, Bifurcation, with Three Intraluminal Devices, Percutaneous Endoscopic Approach
02734FZ	Dilation of Coronary Artery, Four or More Arteries with Three Intraluminal Devices, Percutaneous Endoscopic Approach
02734G6	Dilation of Coronary Artery, Four or More Arteries, Bifurcation, with Four or More Intraluminal Devices, Percutaneous Endoscopic Approach
02734GZ	Dilation of Coronary Artery, Four or More Arteries with Four or More Intraluminal Devices, Percutaneous Endoscopic Approach

02734T6	Dilation of Coronary Artery, Four or More Arteries, Bifurcation, with Radioactive Intraluminal Device, Percutaneous Endoscopic Approach
02734TZ	Dilation of Coronary Artery, Four or More Arteries with Radioactive Intraluminal Device, Percutaneous Endoscopic Approach
02734Z6	Dilation of Coronary Artery, Four or More Arteries, Bifurcation, Percutaneous Endoscopic Approach
02734ZZ	Dilation of Coronary Artery, Four or More Arteries, Percutaneous Endoscopic Approach
02C03ZZ	Extirpation of Matter from Coronary Artery, One Artery, Percutaneous Approach
02C04ZZ	Extirpation of Matter from Coronary Artery, One Artery, Percutaneous Endoscopic Approach
02C13ZZ	Extirpation of Matter from Coronary Artery, Two Arteries, Percutaneous Approach
02C14ZZ	Extirpation of Matter from Coronary Artery, Two Arteries, Percutaneous Endoscopic Approach
02C23ZZ	Extirpation of Matter from Coronary Artery, Three Arteries, Percutaneous Approach
02C24ZZ	Extirpation of Matter from Coronary Artery, Three Arteries, Percutaneous Endoscopic Approach
02C33ZZ	Extirpation of Matter from Coronary Artery, Four or More Arteries, Percutaneous Approach
02C34ZZ	Extirpation of Matter from Coronary Artery, Four or More Arteries, Percutaneous Endoscopic Approach
X2C0361	Extirpation of Matter from Coronary Artery, One Artery using Orbital Atherectomy Technology, Percutaneous Approach, New Technology Group 1
X2C1361	Extirpation of Matter from Coronary Artery, Two Arteries using Orbital Atherectomy Technology, Percutaneous Approach, New Technology Group 1
X2C2361	Extirpation of Matter from Coronary Artery, Three Arteries using Orbital Atherectomy Technology, Percutaneous Approach, New Technology Group 1
X2C3361	Extirpation of Matter from Coronary Artery, Four or More Arteries using Orbital Atherectomy Technology, Percutaneous Approach, New Technology Group 1
02H03DZ	Insertion of Intraluminal Device into Coronary Artery, One Artery, Percutaneous Approach
02H03YZ	Insertion of Other Device into Coronary Artery, One Artery, Percutaneous Approach
02H13DZ	Insertion of Intraluminal Device into Coronary Artery, Two Arteries, Percutaneous Approach
02H13YZ	Insertion of Other Device into Coronary Artery, Two Arteries, Percutaneous Approach
02H23DZ	Insertion of Intraluminal Device into Coronary Artery, Three Arteries, Percutaneous Approach
02H23YZ	Insertion of Other Device into Coronary Artery, Three Arteries, Percutaneous Approach
02H33DZ	Insertion of Intraluminal Device into Coronary Artery, Four or More Arteries, Percutaneous Approach
02H33YZ	Insertion of Other Device into Coronary Artery, Four or More Arteries, Percutaneous Approach

PCI group definition

While most patients undergoing an inpatient PCI are grouped into one of the PCI-related MS-DRGs, a few are grouped into other MS-DRGs. Patients may be grouped into another MS-DRG if they have a cardiac procedure considered to be higher in the DRG surgical hierarchy than PCI, or if they have a principal diagnosis that is not cardiac in nature.

The approximately 15% of Medicare PCI patients grouped to other MS-DRGs in the most current year of data tend to have longer LOS, higher costs, and more complications than those in PCI MS-DRGs, likely because many of them have more complex surgeries during the same hospitalization. We have confined PCI patients to those patients in a PCI-related MS-DRG for this study.

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) that were not present on the patient's admission but occurred during hospitalization. As a result, the Centers for Medicare & Medicaid Services (CMS) now requires all Inpatient Prospective Payment System hospitals to document whether a patient has these conditions when they are admitted.[5] The Watson Health proprietary risk-adjustment models and severity-adjustment models take into account POA data reported in the Medicare Provider Analysis and Review (MEDPAR) data sets. Our inpatient mortality, complications, LOS, and cost-per-case models develop expected values based only on conditions that are present on admission.

From 2010, there have been a growing number of records with an invalid POA indicator code of "0" in the MEDPAR data files. (See "Percentage of diagnosis codes with POA indicator code" table for the last six years of findings.) In addition, coding of exempt diagnoses with the POA code of "1" has apparently been dropped by hospitals. For this reason, we used the CMS exempt code tables to identify and flag all exempt diagnoses. We also developed a methodology to determine whether a diagnosis was usually coded as present ("Y", "W") for all records with valid POA coding in the PIDB. Based on this analysis, we treat codes that were found to be present greater than 50% of the time as "present" in the MEDPAR file where "0" was coded. In addition, we treat all principal diagnoses as "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 valid normative comparisons of hospital outcomes, we must adjust raw data to accommodate differences that result from the variety and severity of admitted cases.

Watson Health makes valid normative comparisons of inpatient mortality and complications rates by using patient-level data to control effectively 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 (age, sex, principal diagnosis, procedures performed, admission type, and comorbid conditions that are present on admission) to produce expected, or normative, comparisons. Through extensive testing, we have found that this methodology produces valid normative comparisons using readily available administrative data, eliminating the need for additional data collection.[10]

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 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 to produce valid expected values for these patients.*

Risk-adjusted mortality index models

Watson Health has developed an overall inpatient mortality risk model, which is used for patients in the cardiovascular study. The mortality risk model used in this study is calibrated for patients age 65 and older.

We exclude patients who were transferred to another short-term, acute care facility. We also exclude all records that have Do Not Resuscitate (DNR), ICD-10-CM code Z66, coded as POA from the mortality risk models.

Excluding records that are DNR status at admission removes these high- probability-of-death patients from the analysis and allows hospitals to concentrate more fully on events that could lead to deaths during the hospitalization. Palliative care patients, ICD-10-CM code Z515, are included in the mortality risk models, which are calibrated to determine probability of death for these patients.

A standard logistic regression model is used to estimate the risk of mortality for each eligible discharge. This is done by weighting the patient records of the profiled hospital by the logistic regression coefficients associated with the corresponding terms in the model and the intercept term. This produces the expected probability of an outcome for each eligible patient (numerator) based on the experience of the norm for patients with similar characteristics (age, clinical grouping, severity of illness, and so forth. [11-15]

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 system, hospital, clinical service line, or the MS-DRG classification systems, which were originally developed at Yale University in the 1980s.

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

Expected complications rate index models

Risk-adjusted complications refer to outcomes that may be of concern when they occur at a greater- than-expected rate among groups of patients, possibly reflecting systemic quality-of-care issues. The Watson Health complications model uses clinical qualifiers to identify complications that have probably occurred in the inpatient setting. Only conditions that are not coded as POA are counted as observed complications.

The complications used in the model are listed in the "Complication" table.

Complication	Patient group
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 eligible discharge. This is done by weighting the patient records of the client 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.[16-19] This model considers 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 simply the number of observed events divided by the number of expected events and can be calculated for outcomes that involve counts of occurrences (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 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 than expected, 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 (system, hospital, clinical service line, and MS-DRG).

Length-of-stay and cost-per-case methodologies

The study's LOS and cost-per-case performance measures use Watson Health severity-adjusted resource demand methodologies.

Our severity-adjusted resource-demand model allows us to produce risk-adjusted performance comparisons on hospital LOS and costs between or across virtually any subgroup of inpatients. These patient groupings can be based on factors such as MS-DRGs, systems, hospitals, clinical service lines, geographic regions, and physicians. The methodology 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. These models consider only patient conditions that are present on admission when calculating risk.

The associated LOS and cost weights allow group comparisons on a national level and within a specific market area. These weights are calculated separately for LOS and cost from the PIDB. PIDB discharges are statistically weighted to represent the universe of all short-term, general, nonfederal hospitals in the US.

This regression-based model has been demonstrated to provide accuracy in predicting results. The POA component allows us to determine appropriate adjustments based on pre-existing conditions versus complications of hospitalization. We calculate expected values from model coefficients that are normalized to the clinical group and transformed from log scale.

We estimate costs using the cost center cost-to-charge ratios applied to the specific charges reported for the study's cardiovascular patients (AMI, HF, CABG, and PCI) in the most recent MEDPAR file. To account for geographic cost-of-living differences, expected values are adjusted for each hospital using the CMS area-wage index for the FFY that matches the MEDPAR file year.

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.

Although we report hospital performance on all HCAHPS questions, only performance on the overall hospital rating question, "How do patients rate the hospital, overall?" is used to rank hospital performance. Patient responses fall into three categories, and the number of patients in each category is reported as a percent:

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

Hospitals' performance is measured by using the highest rating, or top box, value. 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. Additionally, this measure represents all patients admitted to the hospital and is not restricted to the four cardiovascular patient groups (AMI, HF, CABG, PCI evaluated in this study.

Excess days in acute care after hospitalization for acute myocardial infarction and heart failure

In 2016, CMS first provided hospitals with their results on the 30-day AMI and HF excess days in acute care (EDAC) measures, and they appeared on the CMS Hospital Compare website publicly for the first time in July 2017. We continue to include them in reporting for information only.

These values represent the result of a risk- standardized algorithm applied to longitudinal Medicare beneficiary data combined across a three- year rolling data period. CMS defines days in acute care as days spent in an emergency department, admitted to observation status, or admitted as an unplanned readmission for any cause within 30 days from the date of discharge from the index AMI or HF hospitalization. From a patient perspective, days in acute care from any cause may represent an adverse event; hence, our decision to begin tracking and analyzing this measure for possible inclusion as a ranked measure in a future study.

Results are expressed as an integer that combines each of the three types of excess days, with a negative value indicating fewer excess days observed than expected, and a positive value indicating more excess days than expected.

Performance measure normalization

The inpatient mortality, complications, LOS, and cost measures are normalized, based on the in- study population, by hospital comparison group, to provide a more easily interpreted comparison among hospitals. To address the impact of bed size, teaching status, and residency program involvement, and compare hospitals to other like hospitals, we assign each hospital in the study to one of three comparison groups (teaching hospitals with cardiovascular residency programs, teaching hospitals without cardiovascular residency programs, and community hospitals). Detailed descriptions of the patient and hospital comparison groups can be found in the Methodology section of this document.

For the inpatient mortality and complications measures, we base our scoring on the difference between observed and expected events, expressed in standard deviation units (z-scores). We normalize the individual hospital expected values for each patient group by multiplying them by the ratio of the observed-to-expected values for the comparison group, prior to calculating the z-score.

For LOS and cost measures, we base our scoring on the severity-adjusted LOS index and the wage- and severity-adjusted cost-per-case index. These indexes are the ratio of the observed and the normalized expected values for each hospital, where the expected values are the sum of the expected values for the hospital cases included in the measure. We normalize the individual hospital expected values for each patient group by multiplying them by the ratio of the observed-to- expected values for the comparison group.

The hospital's normalized index is then calculated by dividing the hospital's observed value by its normalized expected value to produce the normalized index for the hospital, for each patient group.

Each patient group LOS index is converted into an average LOS (ALOS) in days by multiplying it by the grand mean LOS of the group's in-study patient population, without regard to hospital comparison group. Each patient group cost index is converted into an average cost per case expressed in dollars by multiplying it by the grand mean cost per case of the group's in-study patient population, without regard to hospital comparison group. The ALOS and average cost-per-case values are the reported values.

Interquartile range methodology

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

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

X > = upper-limit outlier point X < = lower-limit outlier point

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

- Determine the first quartile (Q1): this is the 25th percentile value of all records in the population
- Determine the third quartile (Q3): this is the 75th percentile value of all records in the population
- Calculate the IQR by subtracting Q1 from Q3 (IQR = Q3 – Q1)
- Calculate the upper- and lower-limit trim points:
  - Upper-limit = Q3 + (3.0 × IQR)
  - Lower-limit = Q1 – (3.0 × IQR)

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

Winner exclusion methodology: Binomial measures

We do not include hospitals with statistically poor inpatient mortality or complications during the winner selection process. We use a two-step process to identify excluded hospitals.

By measure, we calculate the approximate binomial confidence interval (or exact mid-p binomial confidence interval for less than 30 observations). We divide the upper and lower limits by the expected value. The confidence interval upper and lower index values are used to determine whether a measure is statistically better than, worse than, or as expected, with 99% confidence.

By measure, we calculate the 75th percentile index value from the range measure values that are worse than expected. This becomes the measure high trim point.

A hospital is excluded if both of the following conditions apply for one or more inpatient mortality or complications measures:

- The measure is statistically worse than expected with 99% confidence
- The measure value is above the high trim point

Why we have not calculated percent change in specific instances

We do not calculate winner (benchmark) versus peer percent differences when the performance measure value is already in units of percent. In this case, we report linear difference only. Percent change is a meaningless statistic when the underlying quantity can be positive, negative, or zero. In addition, we do not report percent change when the measure value can be positive, negative, or zero.

Endnotes

1. https://www.heart.org/-/media/PHD-Files-2/Science-News/2/2021-Heart-and-Stroke-Stat-Update/2021_heart_disease_and_stroke_statistics_update_fact_sheet_at_a_glance.pdf

2. https://www.cdc.gov/heartdisease/facts.htm

3. https://www.heart.org/en/news/2018/05/01/heart-failure-projected-to-increase-dramatically-according-to-new-statistics

4. Excess Days in Acute Care after Hospitalization Final Measure Methodology reports, Centers for Medicare & Medicaid Services, accessed via cms.gov/Medicare/ Quality- Initiatives-Patient-Assessment- Instruments/HospitalQualityInits/ Measure-Methodology.html

5. For more information on the CMS Hospital-Acquired Conditions (POA Indicator) program, see cms.gov/ HospitalAcqCond

6. We obtain GME program involvement data annually from the Accreditation Council for Graduate Medical Education (ACGME). This year's study is based on ACGME files from 2019 and 2020.

7. CMS has ruled that no data points based on fewer than 11 discharges may be displayed. To comply with this rule, we excluded any values based on fewer than 11 discharges

8. https://www.cms.gov/newsroom/press-releases/cms-announces-relief-clinicians-providers-hospitals-and-facilities-participating-quality-reporting

9. CMS Hospital Compare can be viewed at https://data.cms.gov/provider-data/topics/hospitals

10. Foster DA. Model-Based Resource Demand Adjustment Methodology. Ann Arbor, MI: Truven Health Analytics Center for Healthcare Improvement. August 2008.

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

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

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

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

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

16. Iezzoni LI, et al. Identifying Complications of Care Using Administrative Data. *Med Care*. 32, no. 7 (Jul 1994): 700-715.

17. Iezzoni LI, et al. Using Administrative Data to Screen Hospitals for High Complication Rates. *Inquiry*. 31, no. 1 (Spring 1994): 40-55.

18. Iezzoni LI. Assessing Quality Using Administrative Data. *Ann Intern Med*. 127, no. 8 (Oct 1997): 666-674.

19. 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.

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