

There's more than one way to become a 5-star hospital

What have we learned about Medicare's Hospital Star Rating System one year into the program?



Executive summary

The US Centers for Medicare and Medicaid Services (CMS) released the first ratings for the Medicare Overall Hospital Star Ratings Program on July 27, 2016. CMS developed the program to help consumers make more informed decisions by giving them a way to compare hospitals based on quality ratings.

After the initial ratings release, many hospitals sought to better understand how the Star Ratings Program works and determine how they could improve their scores. To shed light on these issues, the Deloitte Center for Health Solutions analyzed the 64 quality measures CMS used in July 2016 to compute the star ratings. Our analyses point to four main findings:

- **There are many ways to achieve a 5-star rating.** CMS designed the program to capture multiple aspects of quality and to offer a number of pathways for hospitals to achieve a 5-star rating. Based on service mix and patient caseloads, hospitals can have data on different combinations of quality measures and achieve a 5-star rating. Moreover, some hospitals might not have complete data for two or three of the heavily weighted quality categories, or could score below the national average in a category, but still receive a 5-star rating.
- **Hospitals that earn a 5-star rating generally have better scores in the heavily weighted categories (i.e., mortality, patient experience, safety, and readmission).** For example, among hospitals that met the threshold for reporting the safety of care category, 64 percent scored "above the national average." By contrast, just eight percent of 1-star hospitals received

the same score. However, 5-star hospitals did not always significantly outperform other hospitals in the lower-weighted quality categories (effectiveness of care, timeliness of care, and efficiency). For example, 12 percent of 5-star hospitals scored above the national average in the efficient use of medical imaging category, while 10 percent of 1-star hospitals received the same score.

- **Scores for individual outcomes measures vary widely.** Analysis of the individual measures that comprise the outcomes categories reveals that some measures see greater variation among hospitals than others. Greater variation in a measure could mean more opportunity for hospitals to receive a high score in that area. For example, hospital quality performance varies substantially between 1- and 5-star-rated hospitals for all of the measures in the readmission category but only for one of the 18 measures in the effectiveness of care category.
- **Variation in caseloads and the ability to report some measures appear to be tied to performance.** Hospitals with smaller caseloads are sometimes missing data for many individual measures, or even entire categories. This could be driving some of the differences in ratings. Regression analyses indicate that reporting on some quality measures is associated with star rating performance—even after controlling for hospital characteristics such as size, location, ownership, and case and payer mix. For example, 5-star hospitals are 16 to 25 percent less likely to report on five of the seven mortality measures and on five of the eight readmission measures compared with 1-star hospitals.

Hospital quality measurement is going to continue, as evidenced by CMS's continued commitment to improving the Star Ratings Program. The Hospital Star Ratings Program was designed to change over time. CMS already has made several updates to the program, dropping seven of the measures between the July and December 2016 reporting periods.

The Star Ratings Program is just one of CMS's initiatives to improve health care quality; hospitals also may be measured as accountable care organizations, through payment incentive programs, and by other payers using different sets of quality measures. Thus, hospitals may be best served by focusing on their own population needs and areas for improvement rather than having the Star Ratings Program drive their agenda. As hospitals look to improve quality over time and, in the process, improve their star ratings, they might consider adopting a broad quality improvement strategy, investing in technology and analytics tools to support quality improvement goals, and developing and promoting a culture of quality improvement among individual clinicians.

Our finding that 5-star hospitals report fewer measures than 1-star hospitals, even when we controlled for hospital characteristics, could be a consideration for CMS as it looks to help lower performing hospitals and considers revisions to the Star Ratings Program's risk adjustment methodology.

Background

The Medicare Overall Hospital Star Ratings Program began with the first ratings released on July 27, 2016.¹ The ratings supplement the Hospital Consumer Assessment of Healthcare Providers and Systems (HCAHPS) Survey, which gauges hospital performance in patient experience.² As with other quality ratings programs, CMS aims to use the Hospital Star Ratings Program to help consumers make informed decisions

about hospitals based on the quality of care they provide. The program uses quality data that has already been reported by hospitals through various performance programs (e.g., Hospital Inpatient Quality Reporting (IQR) Program and Hospital Outpatient Quality Reporting (OQR) Program). The ratings are published on Hospital Compare, a website that helps consumers compare quality and outcomes by assigning a star rating to each hospital.

For the July 2016 reporting period, CMS selected 64 of the 100 Hospital Compare measures to rate hospitals. It excluded measures that were specific to specialty hospitals (e.g., cancer or inpatient psychiatric hospitals), measures on which 100 or fewer hospitals reported data, duplicative measures, and other measures for certain reasons.³

After the initial ratings release, many hospitals sought to better understand how the Star Ratings Program works and determine how they might improve their rating and quality. To deepen our knowledge about the Star Ratings Program—and its implications for hospitals—the Deloitte Center for Health Solutions reviewed CMS data and the methodology it uses to calculate the star ratings and analyzed publicly available information on hospital quality measures paired with data on hospital characteristics from the American Hospital Association's Annual Survey and Medicare Cost Reports (provided by Truven).

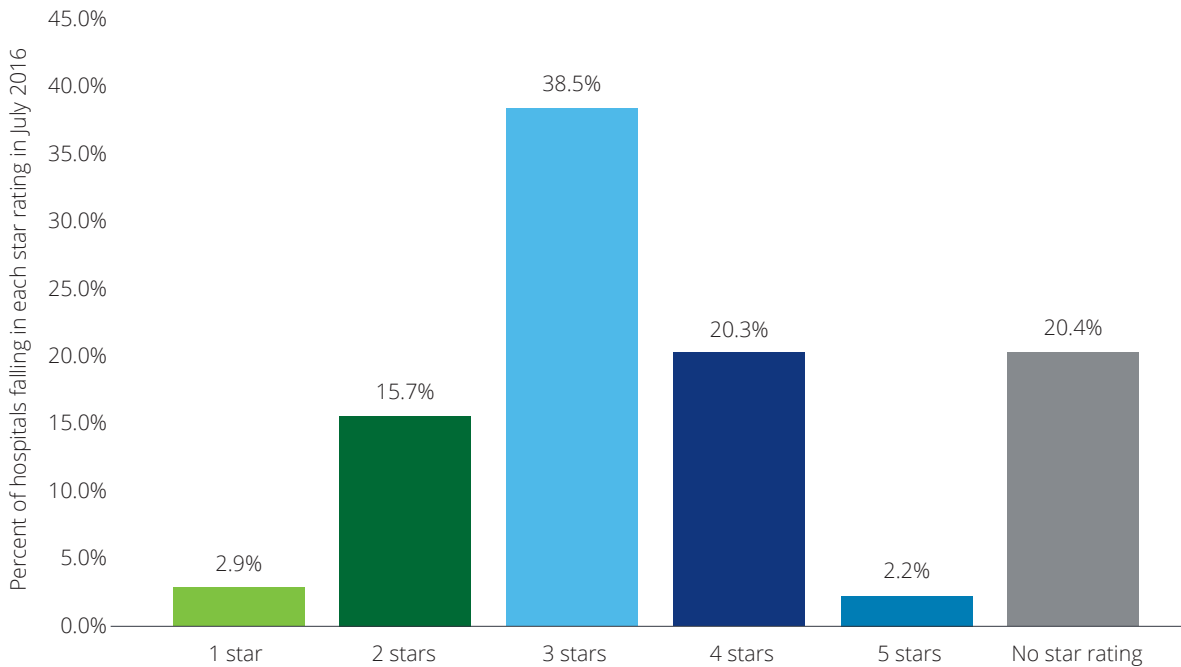
As hospitals look to improve quality over time—and in the process—improve their star ratings, they may be best served by focusing on their own population needs and areas for improvement.

CMS methodology for calculating hospital star ratings

To determine hospital ratings, CMS relies on a complex methodology, which it devised with the help of a technical expert panel. The score is calculated using a five-step process, which involves standardizing individual quality measures, grouping them into seven categories, calculating scores for each individual category, and then using a summary score to calculate the final star rating. (See sidebar and Table 1 on the following page.)

In July 2016, 1,770 hospitals (38.5 percent) earned three stars, 102 hospitals (2.2 percent) received five stars, and 133 hospitals (2.9 percent) received one star. About 20 percent of hospitals did not receive a star rating.⁴ (See Figure 1.)

Figure 1. CMS's methodology ensures that hospital ratings fall within a normal distribution range



Source: "Data Brief: Evaluation of National Distributions of Overall Hospital Quality Star Ratings," CMS, July 21, 2016. Available at [<https://www.cms.gov/Newsroom/MediaReleaseDatabase/Fact-sheets/2016-Fact-sheets-items/2016-07-21-2.html>].

CMS methodology for calculating star ratings

1 Step one: Select and standardize measures. For the July 2016 reporting period, CMS selected 64 measures from the Hospital Compare dataset, which includes measures collected through the Hospital IQR Program and the Hospital OQR Program, among others. CMS standardizes the measures to ensure they are comparable. For categories such as clinical protocols, for example, higher adherence reflects better results. But in areas such as mortality, decreases represent improvement.

2 Step two: Group measures into categories. After standardizing each measure, CMS groups them into seven categories, weighting outcomes and patient experience more than other measures. (See Table 1.)

Table 1. Star ratings are grouped into seven categories, each with different weights

Category type	Quality measure category (number of measures)	Weight in overall star-rating calculation (if reporting all seven categories)
Outcomes	Mortality (7): Includes Acute Myocardial Infarction 30-Day Mortality Rate and Pneumonia 30-Day Mortality Rate	22 percent
	Safety (8): Includes Central-Line Associated Bloodstream Infection (CLABSI) and Catheter-Associated Urinary Tract Infection (CAUTI)	22 percent
	Readmission (8): Includes Coronary Artery Bypass Graft 30-Day Readmission Rate and Hospital-Wide All-Cause Unplanned Readmission	22 percent
Patient experience	Patient experience (11): Includes Cleanliness of Hospital Environment (Q8 of the HCAHPS survey) and Nurse Communication (Q1, Q2, and Q3 of the HCAHPS survey)	22 percent
Process of care	Effectiveness of care (18)*: Includes Home Management Plan of Care Document Given to Patient/Caregiver and Emergency Department—Patient Left Without Being Seen	4 percent
	Timeliness of care (7): Includes Median Time to Transfer to Another Facility for Acute Coronary Intervention and Median Time to Electrocardiogram	4 percent
Efficiency of care	Imaging (5): Includes Abdomen CT Use of Contrast Material and Cardiac Imaging for Preoperative Risk Assessment for Non-Cardiac Low-Risk Surgery	4 percent

3 Step three: Calculate a group score for each category. CMS combines individual measures for each category into seven composite measures, one for each category, using a technique known as latent variable modeling. A latent variable model makes statistical adjustments that assume the measures we can see (those that are reported) are related to measures we cannot see (latent)—the “true” aspects of quality. This procedure essentially provides weights for each individual measure that are used to construct composite scores. (See Appendix I.)

CMS notes several advantages to using this method. Among them:

- Measures within categories that are highly correlated with each other are more heavily weighted
- The model can account for the fact that some hospitals might have missing information or might report different types of measures⁵

4 Step four: Generate a summary score. CMS combines the seven composite scores into a summary score. Some categories, such as outcomes, are considered more important and are weighted more heavily than others. For instance, CMS weights the outcome and patient experience categories higher (22 percent) than the process and efficiency categories (four percent). (See Table 1.)

5 Step five: Turn the summary score into a star rating. CMS uses a clustering procedure to turn each hospital’s summary score into a star rating of between one and five. Through this method, hospitals are grouped based on their individual performance relative to all other rated hospitals. The grouping is done to ensure that most hospitals fall in the middle range of the performance distribution.

*In the December 2017 update, CMS revised the effectiveness of care category to drop seven of the July measures. The following measures were dropped: CAC-3, Home Management Plan of Care Document Given to Patient/Caregiver; STK-1, Venous Thromboembolism Prophylaxis; STK-6, Discharged on Statin Medication; STK-8, Stroke Education; VTE-1, Venous Thromboembolism Prophylaxis; VTE-2, Intensive Care Unit Venous Thromboembolism Prophylaxis; VTE-3, Venous Thromboembolism Patients with Anticoagulation Overlap Therapy.

Important considerations in the star ratings methodology

Measures change over time. Our analysis relied on data from the July 2016 reporting period, which included 64 measures from the Hospital Compare site. The following December, CMS removed seven of the effectiveness-of-care measures. It may add or remove more measures in the future. (See sidebar on previous page.)

Hospitals are not required to have data on all 64 measures to receive a rating. Hospitals can be missing data from individual measures or categories and still receive a star rating. However, hospitals must have data on three measures in at least three categories, and at least one must be an outcome category (mortality, safety, or readmission). In July 2016, hospitals had complete data on an average of 39 measures and an average of five categories. Nearly 80 percent (3,662 hospitals) met the minimum reporting threshold to receive a star rating.⁶

If a hospital has complete data on fewer than seven categories, CMS re-weights the remaining categories. For example, if a hospital does not have sufficient data to report at least three measures in the efficient use of medical imaging category, that category's weight (four percent) is redistributed to the other categories according to their standard (non-redistributed) weights. In this scenario, the three outcome categories and patient experience would be weighted 22.9 percent, while the timeliness and effectiveness of care categories would be weighted 4.2 percent.⁷ (See Table 2.)

CMS updates the ratings twice per year. CMS expects to update its hospital star ratings each July and December. However, due to issues with three of the individual measures (CLABSI, Clostridium difficile infections [C. difficile], and PSI-90), CMS announced it would delay the July 2017 update until October 2017.⁸

Table 2. CMS reweights the seven star ratings categories if a hospital is missing a score in one (or more) of the categories

Below is an example of the weight redistribution when a hospital is missing a score for the medical imaging category

Category	Standard weights	Redistributed weights
Mortality	22%	22.9%
Safety of care	22%	22.9%
Readmission	22%	22.9%
Patient experience	22%	22.9%
Effectiveness of care	4%	4.2%
Timeliness of care	4%	4.2%
Efficient use of medical imaging	4%	--

Source: "Overall Hospital Quality Star Ratings on Hospital Compare Methodology Report (v2.0)," CMS, May 2016, available at [https://www.qualitynet.org/dcs/ContentServer?c=Page&pagename=QnetPublic%2FPage%2FQnetTier3&cid=1228775957165].

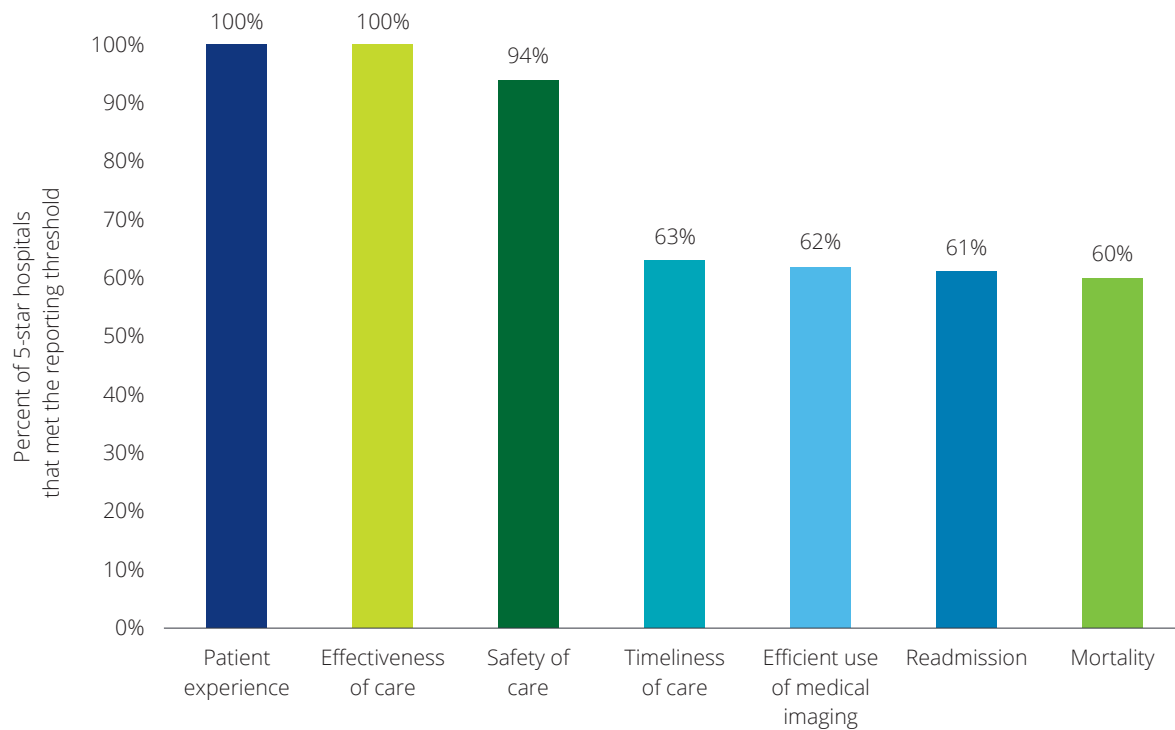
Key findings

There are many different ways to become a 5-star hospital

Approximately 100 hospitals (2.2 percent) received a 5-star rating in July 2016.⁹ CMS designed the program so that hospitals could achieve a 5-star rating in a variety of ways. As described above, hospitals must have sufficient data to report at least one outcome category (mortality, safety of care, or readmission) and must report at least three individual measures in at least three categories (a total of nine measures) to receive a star rating.

Hospitals that achieved a 5-star rating reported different numbers and combinations of measures and categories. For instance, 60 percent of 5-star hospitals had sufficient data to report the mortality category, but 96 percent of those hospitals met the threshold in the safety of care category. (See Figure 2.)

Figure 2. All 5-star hospitals met the reporting thresholds for patient experience and effectiveness of care



Source: Deloitte analysis of CMS Star Ratings data

Table 3 illustrates how hospitals can achieve a 5-star rating using combinations of measures and categories. For example, Hospital C had insufficient data in the safety of care and timeliness of care categories, and performed similarly to its peers in the mortality, effectiveness of care, and efficient use of medical imaging categories. The hospital, however, still achieved a 5-star rating by performing above the national average in the heavily weighted categories of patient experience and readmission. Hospitals could even score below the national average in a category, such as Hospital B did under timeliness of care, and still receive a 5-star rating.

Table 3. Hospitals can achieve a 5-star rating with different combinations of measures and categories

Hospital	Mortality (22%)	Safety of care (22%)	Readmission (22%)	Patient experience (22%)	Effectiveness of care (4%)	Timeliness of care (4%)	Efficient use of medical imaging (4%)
A	Not available	Above the national average	Above the national average	Above the national average	Same as the national average	Same as the national average	Not available
B	Above the national average	Above the national average	Above the national average	Same as the national average	Above the national average	Below the national average	Above the national average
C	Same as the national average	Not available	Above the national average	Above the national average	Same as the national average	Not available	Same as the national average

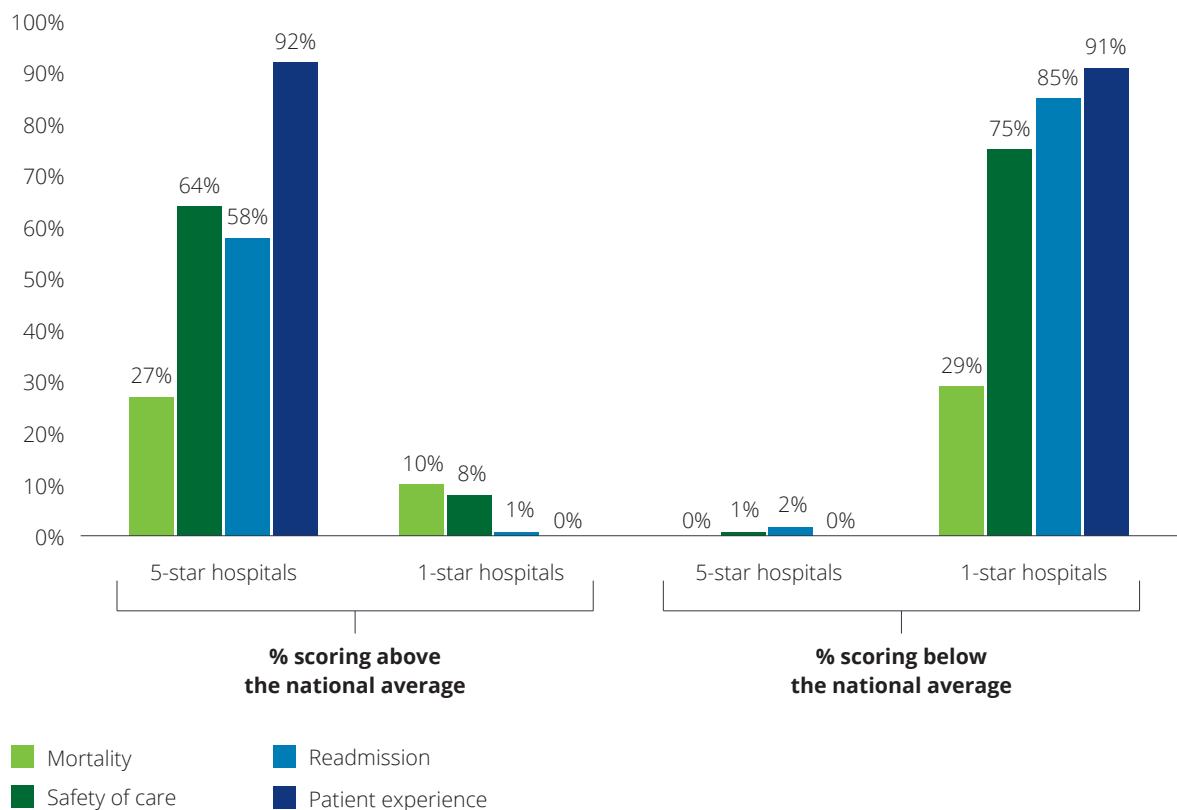
Source: Deloitte analysis of CMS Star Ratings data

As with other quality ratings programs, CMS aims to use the Hospital Star Ratings Program to help consumers make informed decisions about hospitals based on the quality of care they provide.

5-star rated hospitals generally had better scores in quality outcomes

5-star hospitals generally outperformed lower-rated hospitals on measures in the heavily weighted categories (particularly patient experience, safety, and readmission). Among 5-star hospitals that had sufficient data to report the safety of care category, for example, 64 percent received an “above the national average” score for that category. By contrast, only eight percent of 1-star hospitals were above average. Similarly, 58 percent of 5-star hospitals received an “above the national average” score in readmission, while only one percent of 1-star hospitals had that score. (See Figure 3.)

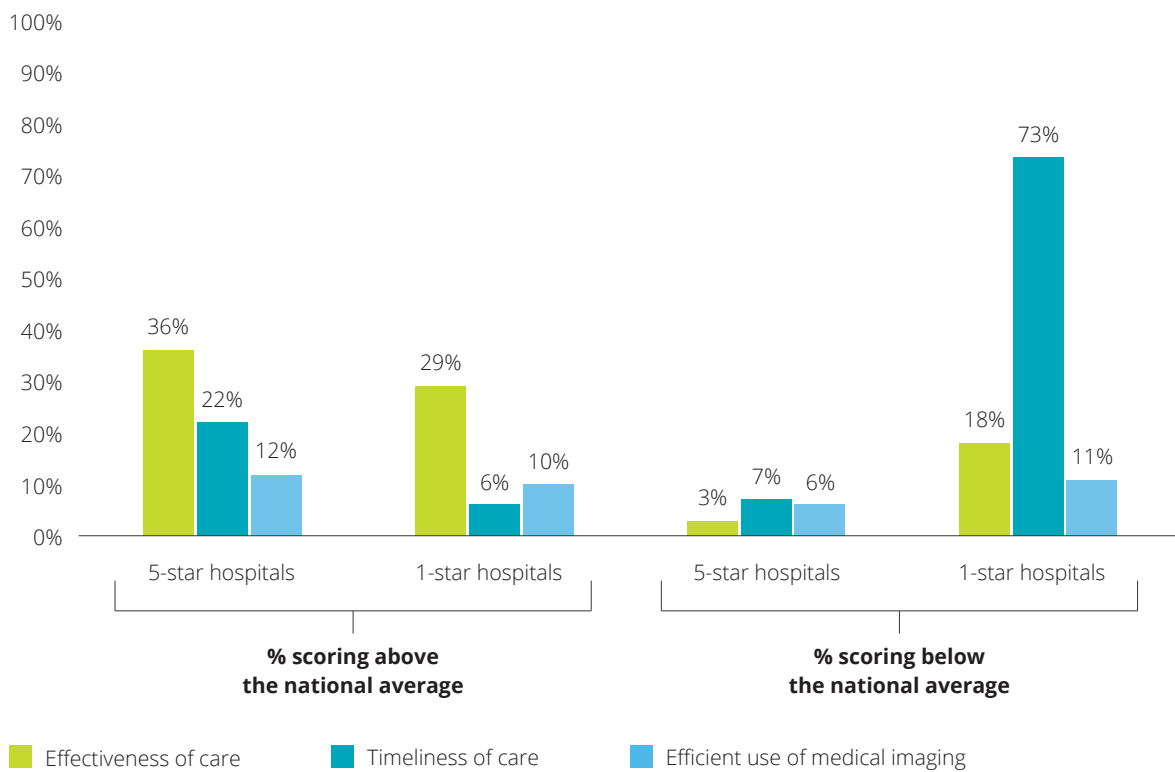
Figure 3. Many 5-star hospitals performed above the national average in the outcomes and patient experience categories



Source: Deloitte analysis of CMS Star Ratings data

5-star hospitals did not always significantly outperform other hospitals in the lower-weighted quality categories (effectiveness of care, timeliness of care, and efficiency). 5-star hospitals generally outperformed 1-star hospitals in these categories, but the difference in scores was much smaller when compared to scores in the heavily weighted categories. In the efficient use of medical imaging category, for example, 12 percent of 5-star hospitals, and 10 percent of 1-star hospitals scored above the national average. (See Figure 4.)

Figure 4. In some categories, 5-star hospitals did not significantly outperform 1-star hospitals



Source: Deloitte analysis of CMS Star Ratings data

5-star hospitals generally outperformed 1-star hospitals in lower-weighted categories (effectiveness of care, timeliness of care, and efficiency), but the difference in scores was much smaller when compared to scores in the heavily weighted categories.

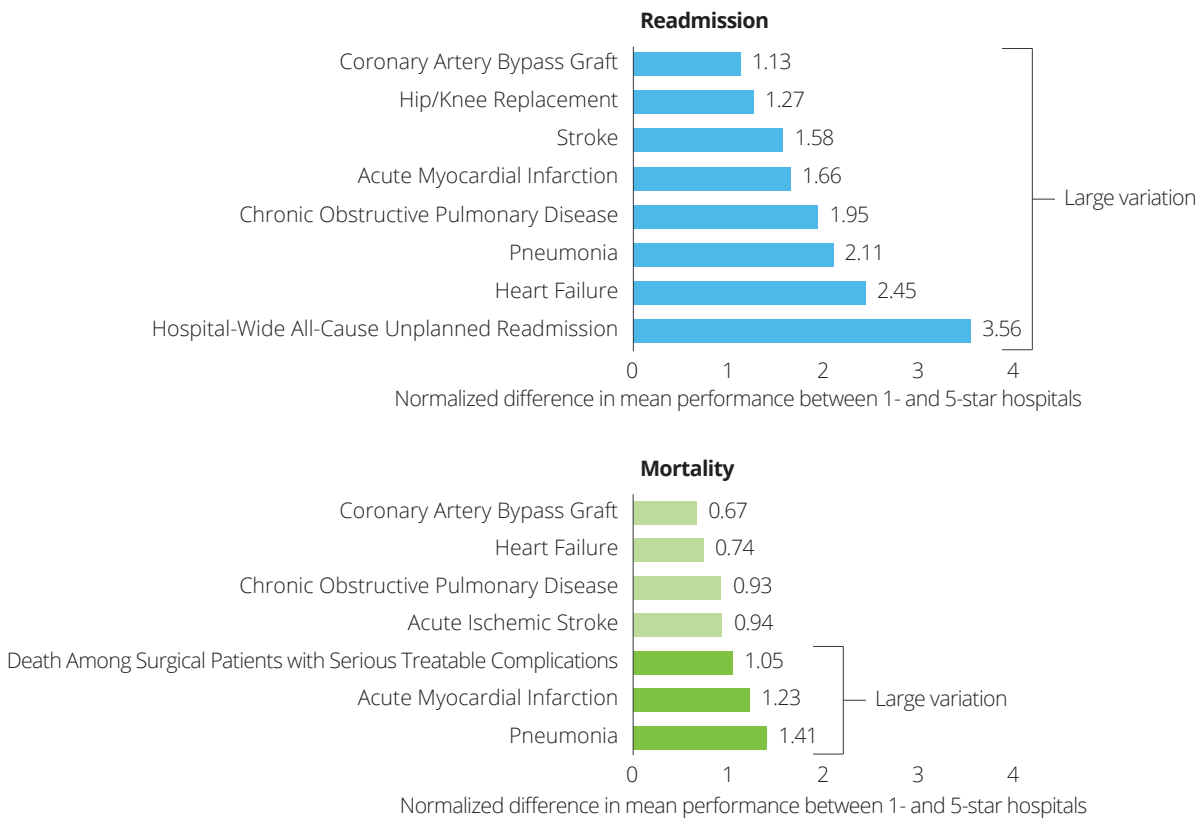
Scores for individual measures within categories varied widely

On average, 5-star hospitals outperformed lower-rated hospitals in the heavily weighted categories; however, within those categories, there was significant variation among the measures. Due to this disparity, hospitals that performed well on one measure could receive a high score in the category.

For each individual measure, we calculated the difference in mean performance between 1- and 5-star hospitals (and normalized this difference by dividing it by the standard deviation for each quality measure). The resulting ratio measures the variation in hospital performance—the higher the ratio, the higher the variation. We considered any ratio above 1 (whether positive or negative) to be noteworthy.

Wide variation is seen in some outcome measures. There could be an opportunity for hospitals to differentiate themselves in the readmission category, where many individual measures had high score variation. Hospital quality performance varied substantially between 1- and 5-star hospitals (the ratio is greater than 1) for all measures in the readmission category. In the mortality category, by contrast, the normalized difference in scores between 1- and 5-star hospitals was significant in only three of the seven individual measures (Death Among Surgical Patients with Serious Treatable Complications, Acute Myocardial Infarction, and Pneumonia). (See Figure 5.)

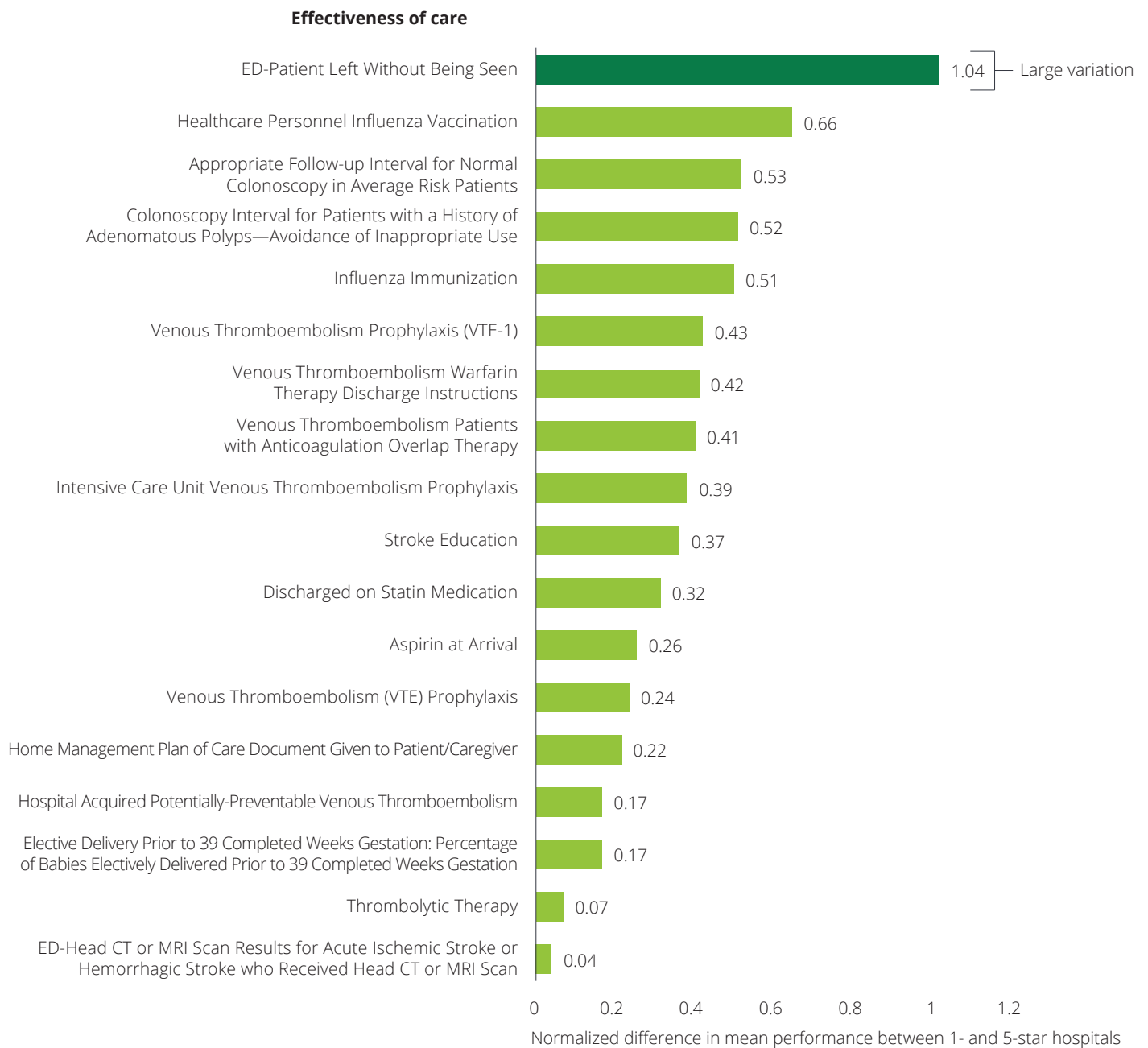
Figure 5. 1- and 5-star hospitals' individual scores for readmission measures varied significantly, while there was less variation between 1- and 5-star hospitals' scores for mortality measures



Source: Deloitte analysis of CMS Star Ratings data

Less variation was seen in lower-weighted categories. There may be less opportunity for hospitals to stand out among their peers in the lower-weighted categories where variation was not as significant. For example, in the effectiveness of care category, the normalized difference in scores between 1- and 5-star hospitals was more than 1 (in absolute value) for only one of the 18 individual measures. (See Figure 6.)

Figure 6. Performance variance was generally low in effectiveness of care measures



Source: Deloitte analysis of CMS Star Ratings data

Doing well under all of the categories can help a hospital achieve a high score in the Star Ratings Program. However, when limited resources make it difficult to prioritize everything, hospitals might consider focusing quality improvement efforts on outcomes over processes. Hospitals might also consider focusing on measures where greater quality differentiation might be possible. How well a hospital scores is partially dependent upon how other hospitals perform. As Appendix I shows, measures with larger variation tend to also have a relatively higher influence (i.e., higher loading factors) on star quality performance. This could change as CMS updates its methodologies.

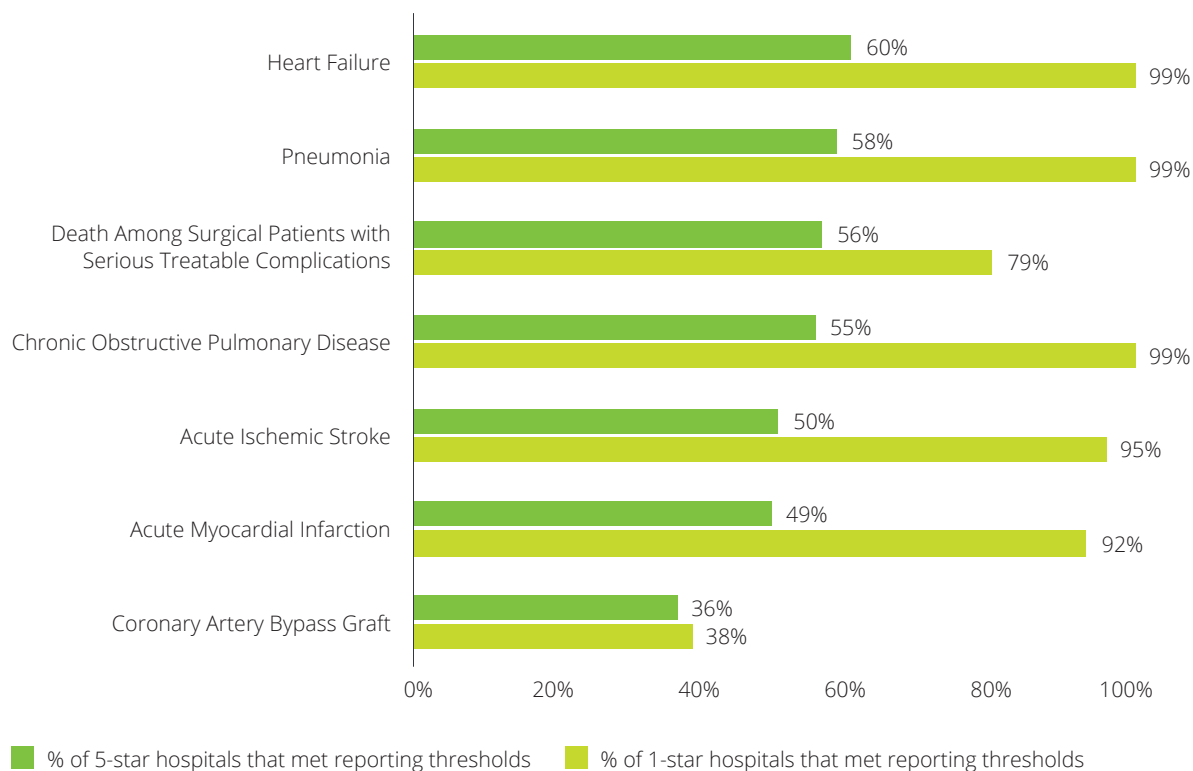
Variation in caseloads and, therefore, hospitals' ability to report some measures, appear to be related to star ratings performance

As noted earlier, hospitals may have sufficient data on different combinations of measures and categories. In our analyses of July 2016 data, we identified

many instances where hospitals were missing data for numerous individual measures or even entire categories. Most of the time, this occurred when a hospital had low caseloads for the conditions that the measures focus on.

5-star rated hospitals tended to be missing data for more measures than their lower-rated peers. While 99 percent of 1-star hospitals had sufficient data on the 30-day Mortality Rate for Heart Failure and Pneumonia measures, only about 60 percent of 5-star hospitals had sufficient data on these measures. (See Figure 7.) 5-star hospitals consistently had less data on measures across all groups, maintaining a gap of two measures less than the average number of measures reported by 1-star hospitals. This difference was highest for the effectiveness of care and efficient use of medical imaging categories, which are both non-outcome groups.

Figure 7. 5-star hospitals had sufficient data on fewer mortality measures than 1-star hospitals



Source: Deloitte analysis of CMS Star Ratings data

The Medicare Payment and Advisory Committee (MedPAC) has also noted that high-performing hospitals tend to have data on fewer measures. In a 2016 letter to Congress, MedPAC said that “a substantial share of the best-performing hospitals were not rated on a full set of outcome measures, [which] raises concerns that missing data is associated with higher ratings.”¹⁰

However, in most instances, the missing data is the result of a hospital having too few cases, according

to an analysis of the footnotes used by CMS on Hospital Compare. CMS offers 19 explanations for why a hospital might be missing data or why its performance on one measure may be based on a sample of data or a shorter time period. However, a lack of data doesn't necessarily prevent a hospital from receiving a score under a certain measure. Having too few cases/patients, or too few cases that meet the criteria for a measure, are the most commonly reported reasons for providing incomplete data. (See sidebar.)

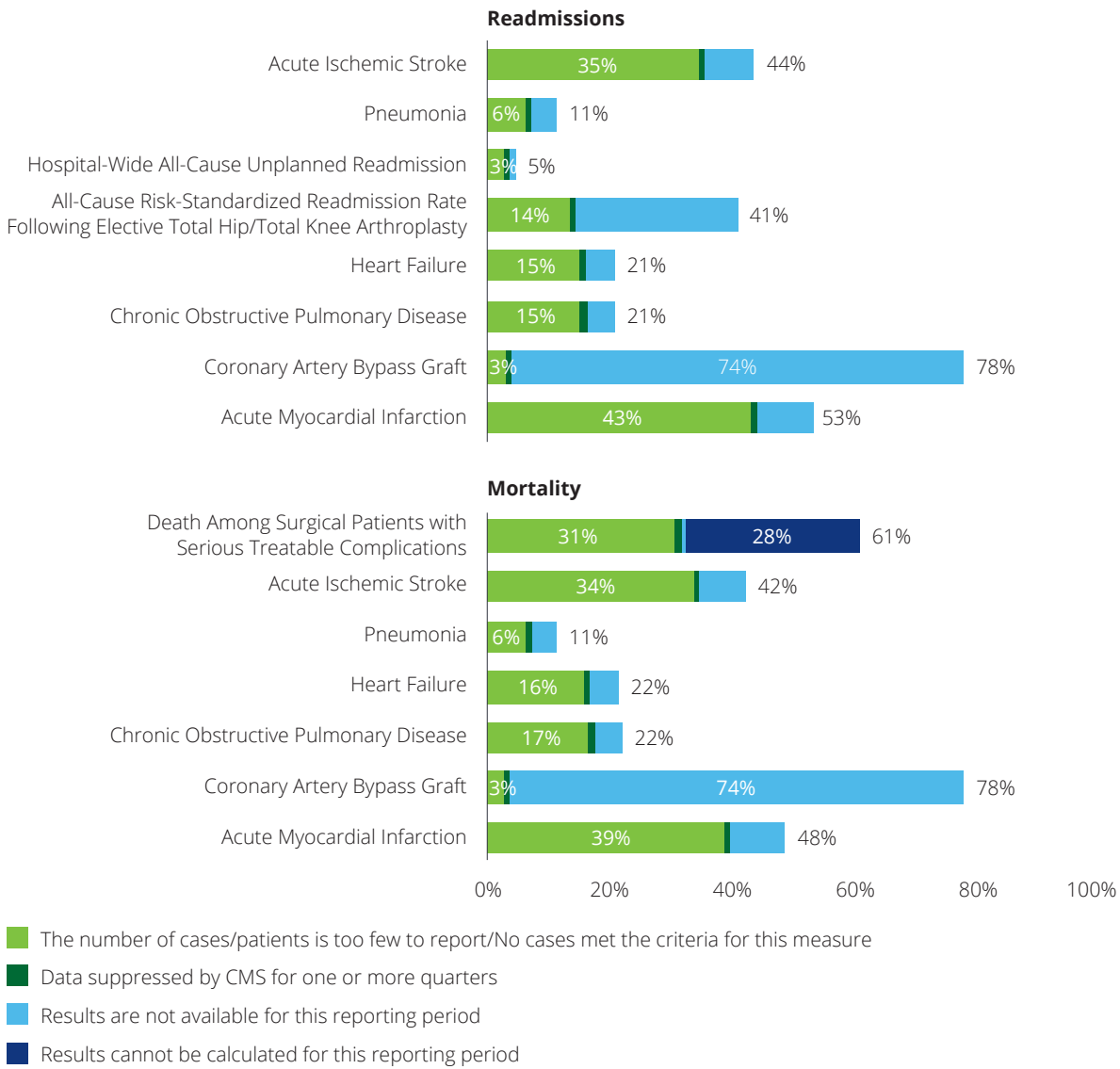
There are several reasons hospitals might be missing data; most have to do with having too few cases:

Footnote number	Footnote as displayed on Hospital Compare	Footnote details
1	The number of cases/patients is too few to report	This footnote is applied: <ul style="list-style-type: none"> • When the number of cases/patients doesn't meet the required minimum amount for public reporting • When the number of cases/patients is too small to reliably tell how well a hospital is performing • To protect personal health information
4	Data suppressed by CMS for one or more quarters	The results for these measures were excluded for various reasons, like data inaccuracies
5	Results are not available for this reporting period	This footnote is applied: <ul style="list-style-type: none"> • When a hospital elected not to submit data for the entire reporting period • When a hospital had no claims data for a particular measure • When a hospital elected to suppress a measure from being publicly reported
7	No cases met the criteria for this measure	This footnote is applied when a hospital didn't have any cases meet the inclusion criteria for a measure
12	This measure does not apply to this hospital for this reporting period	This footnote is applied when: <ul style="list-style-type: none"> • There were zero device days or procedures for the entire reporting period • The hospital does not have ICU locations • The hospital is a new member of the registry or reporting program and didn't have an opportunity to submit any cases • The hospital doesn't report this voluntary measure
13	Results cannot be calculated for this reporting period	This footnote is applied when: <ul style="list-style-type: none"> • The number of predicted infections is less than one • The number of observed MRSA or C. difficile infections present on admission (community-onset prevalence) was above a pre-determined cut-point
15	The number of cases/patients is too few to report a star rating	This footnote is applied when the number of completed surveys the hospital or its vendor provided to CMS is less than 100; to get HCAHPS Star Ratings, hospitals must have at least 100 completed HCAHPS Surveys over a 4 quarter period

Source: “Footnotes,” CMS, available at [<https://www.medicare.gov/hospitalcompare/Data/Footnotes.html>].

When we analyzed CMS footnotes for different quality categories, we found that, in many cases, hospitals have too few cases to be able to report on certain individual measures. This is most common for the mortality and readmission categories, which are primarily based on specific conditions. For example, nearly half (48 percent) of hospitals were missing data for Acute Myocardial Infarction 30-Day Mortality Rate and 30-Day Readmission Rate. (See Figure 8.)

Figure 8. Many hospitals are unable to report on individual mortality measures due to low caseloads



Note: The percentages at the far right of the bars (in black) indicate the percentage of hospitals with missing data for this measure.

Source: Deloitte analysis of CMS Star Ratings data

Hospitals with certain characteristics were less likely to have complete data on certain measures and also tended to receive higher star ratings.

Characteristics that can affect a hospital's star rating include being small, lacking an emergency department, and being a critical access hospital. Our analyses revealed that:

- Large hospitals were somewhat less likely to receive 5 stars than were smaller hospitals (13 versus 16 percent)
- A 5-star hospital was less likely to have an emergency department than a hospital with a lower rating (73 percent versus 98 percent)
- A 5-star hospital was less likely to be a critical access facility (one percent versus 15 percent) or have an intensive care unit (59 percent versus 74 percent)
- 49 percent of non-teaching hospitals received no star ratings
- Hospitals in the Midwest outperformed hospitals in other regions (22 percent received a 5-star rating), while the South had the smallest percentage of 5-star-rated hospitals by region (11 percent)

Regression results revealed that 5-star hospitals were less likely to have complete data on certain measures compared with 1-star hospitals, even after controlling for characteristics that could influence reporting.

For example, 5-star hospitals were less likely to have complete data for some categories—mortality and readmission, in particular—than others.

To better understand the association between star ratings and reporting, we ran regression models for individual quality measures in every category. In these models, we included controls for numerous hospital characteristics that could influence this association, such as hospital size, location, the presence of an emergency department, ownership type, teaching status, and case and payer mix.* (See Appendix II).

The regression analysis indicated that 5-star hospitals were 16 to 25 percent less likely than 1-star hospitals to have complete data on five of seven mortality measures, and five of eight readmission measures. (See Figure 9 and Appendix II.) By contrast, 4- and 3-star-rated hospitals were also less likely than 1-star hospitals to have complete data on certain quality measures for mortality and readmission, but the difference was not always statistically significant. (See Figure 9 and Appendix II.)

Figure 9. 5-star hospitals were less likely than 1-star hospitals to have complete data on most mortality measures, even after controlling for hospital characteristics

	2-star	3-star	4-star	5-star
Acute Myocardial Infarction		-	-	-
Coronary Artery Bypass Graft	+	+	+	+
Chronic Obstructive Pulmonary Disease				-
Heart Failure				-
Pneumonia				-
Stroke				-
Death Among Surgical Patients with Serious Treatable Complications		-		

■ ■ Negative/significant
 ■ ■ Positive/significant
 ■ Not significant

Note: Darker shade indicates higher strength of association

Source: Deloitte analysis of CMS Star Ratings data

*The regression analysis controlled for case mix index, critical access, ED, intensive care unit, size, teaching status, hospital affiliation, disproportionate share status, percent of Medicaid patients, percent of Medicare patients, and non-acute share.

For safety of care, 5-star hospitals were significantly more likely to have complete data on four of the eight measures (C. difficile, Patient Safety Indicator, Hip/Knee Complications, and Surgical Site Infection—Abdominal Hysterectomy) and less likely to have complete data on the other four (CAUTI, CLABSI, MRSA, and Surgical Site Infection—Colon). The same trend was found under the efficient use of medical imaging category. 5-star hospitals were also significantly less likely to have complete data on some measures (Abdomen CT Use of Contrast Material and Thorax CT Use of Contrast Material), but were more likely to have complete data on others (Cardiac Imaging for Preoperative Risk Assessment for Non-Cardiac Low-Risk Surgery and MRI Lumbar Spine for Low Back Pain). (See Appendix II.)

Implications for hospitals and health systems

Hospital quality measurement is going to continue, as evidenced by CMS's continued commitment to improving the Star Ratings Program. The Hospital Star Ratings Program was built to change over time. CMS already has made several updates to the program, dropping seven measures between the July and December 2016 reporting periods.

The Star Ratings Program is just one of CMS's initiatives to improve health care quality; hospitals also may be measured as accountable care organizations, through payment incentive programs, and by other payers using different sets of quality measures. Thus, hospitals may be best served by focusing on their own population needs and areas for improvement, rather than having the Star Ratings Program drive their agenda. As hospitals look to improve quality over time and, in the process, improve their star rating, they might consider the following:

- **Adopt a broad quality improvement strategy.**

Clear differences exist among hospitals and their ability to report on certain measures, but much of this is due to differences in caseloads—a factor over which hospitals have little control. As such, hospitals may do best to drive their quality strategy by optimizing patient outcomes and experiences, quality areas that CMS consistently weights more heavily and that show the highest variation among hospitals. The focus could be on broad quality performance improvement rather than one specific quality measure. A multi-pronged approach may be required, as the methodology is based on comparisons to the rest of the pack and a moving target.

- **Invest in technology and analytics tools to support quality improvement goals.**

Understanding the main drivers behind a hospital's performance in the areas of mortality, readmission, patient safety, and patient experience will likely be critical to improving quality broadly. Investing in tools that enable individual clinicians to understand their performance in these key areas may help hospitals improve quality overall.

- **Develop and promote a culture of quality improvement among individual clinicians.**

Individual clinicians drive the overall quality of services performed in a hospital. Thus, it is important to help them understand that they are a critical component of quality improvement. Leadership from the C-suite down to the clinicians at the bedside should communicate and promote a culture of quality. Hospital leadership should consider helping clinicians understand which areas need improvement and how they fit into the overall quality strategy.

Our finding that 5-star hospitals report fewer measures than 1-star hospitals, even when we controlled for hospital characteristics, could be a consideration for CMS as it looks to help lower-performing hospitals and considers revisions to the methodology of the Star Ratings Program and other quality programs. For example, the Government Accountability Office recently found that hospitals that were missing scores in the quality arena for the Hospital Value-Based Purchasing Program were more likely to receive bonuses than hospitals with complete scores.¹¹

As the Star Ratings Program and other quality performance initiatives mature, hospitals should consider developing flexible and adaptive quality improvement strategies.

The health care system is moving toward a model that bases payment upon outcomes and quality. As this happens, quality measurement will become even more important. CMS has championed the move toward value-based payment in developing its major quality performance programs (e.g., Hospital IQR Program and Hospital OQR Program). The Star Ratings Program is yet another way for CMS to measure quality and make quality performance transparent to consumers.

Appendix I. The quality measures included in the star ratings system are pulled from different sources, have wide score variation, and are weighted differently within the latent variable models

Variation: For each individual measure, we calculated the difference in mean performance between 1- and 5-star hospitals (and normalized this difference by

dividing it by the standard deviation for each quality measure to facilitate comparison across hospitals). The resulting ratio is a measure of the variation in hospital performance with respect to each measure; the higher the ratio, the higher the variation. We considered any ratio above 1 to be noteworthy and highlighted this in green in the table.

Loading coefficient: CMS weights individual measures based on how consistent or correlated they are to hospital performance. The higher the weight of the loading coefficient, the more influence that measure has on the group score.

Mortality

Measure	Data source	Difference in means between 1- and 5-stars	Loading coefficient
Pneumonia	Claims	1.41	0.66
Acute Myocardial Infarction		1.23	0.48
Death Among Surgical Patients with Serious Treatable Complications		1.05	0.29
Acute Ischemic Stroke		0.94	0.52
Chronic Obstructive Pulmonary Disease		0.93	0.62
Heart Failure		0.74	0.74
Coronary Artery Bypass Graft (CABG)		0.67	0.35

*Tables are sorted by variance between 1- and 5-star means for each measure

Safety of care

Measure	Data source	Difference in means between 1- and 5-stars	Loading coefficient
Complication/Patient Safety for Selected Indicators (PSI)	Claims	2.74	0.93
Complication Rate Following Elective Primary Total Hip Arthroplasty (THA) and Total Knee Arthroplasty (TKA)		1.02	0.17
Central-Line Associated Bloodstream Infection (CLABSI)	National Healthcare Safety Network	0.68	0.06
Catheter-Associated Urinary Tract Infection (CAUTI)		0.56	0.11
Clostridium Difficile (C.difficile)	Paper medical records; Claims; Electronic health record	0.55	0.001
MRSA Bacteremia	National Healthcare Safety Network	0.51	0.01
Surgical Site Infection from abdominal hysterectomy (SSI-abdominal hysterectomy)		0.41	0.06
Surgical Site Infection from colon surgery (SSI-colon)		0.31	0.09

Readmission

Measure	Data source	Difference in means between 1- and 5-stars	Loading coefficient
Hospital-Wide All-Cause Unplanned Readmission	Claims	3.56	0.94
Heart Failure		2.45	0.63
Pneumonia		2.11	0.61
Chronic Obstructive Pulmonary Disease		1.95	0.57
Acute Myocardial Infarction		1.66	0.54
Stroke		1.58	0.53
Hip/Knee Replacement		1.27	0.42
Coronary Artery Bypass Graft		1.13	0.27

Patient experience

Measure	Data source	Difference in means between 1- and 5-stars	Loading coefficient
Overall Rating of Hospital	HCAHPS	2.68	0.78
Willingness to Recommend Hospital		2.54	0.74
Nurse Communication		2.27	0.74
Item Care Transition Measure		2.26	0.77
Responsiveness of Hospital Staff		2.14	0.70
Pain Management		2.00	0.67
Cleanliness of Hospital Environment		1.91	0.65
Discharge Information		1.91	0.58
Communication About Medicines		1.86	0.69
Quietness of Hospital Environment		1.70	0.58
Doctor Communication		1.65	0.61

Effectiveness of care

Variable description	Data source	Difference in means between 1- and 5-stars	Loading coefficient
ED-Patient Left Without Being Seen	Claims	1.04	0.23
Health care Personnel Influenza Vaccination	National Healthcare Safety Network	0.66	0.17
Appropriate Follow-up Interval for Normal Colonoscopy in Average Risk Patients	Chart-abstracted data	0.53	0.32
Colonoscopy Interval for Patients with a History of Adenomatous Polyps—Avoidance of Inappropriate Use		0.52	0.4
Influenza Immunization	Medical record	0.51	0.41
Venous Thromboembolism Prophylaxis (VTE-1)*	EHR/eCQM	0.43	0.57
Venous Thromboembolism Warfarin Therapy Discharge Instructions		0.42	0.58
Venous Thromboembolism Patients with Anticoagulation Overlap Therapy*	eCQM	0.41	0.53
Intensive Care Unit Venous Thromboembolism Prophylaxis*	Electronic Clinical Data, EHR, Paper Medical Records, eCQM	0.39	0.67
Stroke Education*		0.37	0.48
Discharged on Statin Medication*	EHR/eCQM	0.32	0.41
Aspirin at Arrival	Chart-abstracted data	0.26	0.38
Venous Thromboembolism (VTE) Prophylaxis*	eCQM	0.24	0.54
Home Management Plan of Care Document Given to Patient/Caregiver*	EHR/eCQM	0.22	0.46
Elective Delivery Prior to 39 Completed Weeks Gestation: Percentage of Babies Electively Delivered Prior to 39 Completed Weeks Gestation	Medical record or EHR (eCQM)	0.17	0.26
Hospital Acquired Potentially-Preventable Venous Thromboembolism	Chart-abstracted data or eCQM	0.17	0.55
Thrombolytic Therapy		0.07	0.66
ED-Head CT or MRI Scan Results for Acute Ischemic Stroke or Hemorrhagic Stroke who Received Head CT or MRI Scan Interpretation Within 45 Minutes of Arrival	Chart-abstracted data	0.04	0.44

*Removed from December 2016 star ratings methodology

Timeliness of care

Measure	Data source	Difference in means between 1- and 5-stars	Loading coefficient
Median Time from ED Arrival to ED Departure for Admitted ED Patients	Medical record or EHR (eCQM)	1.65	0.84
Admit Decision Time to ED Departure Time for Admitted Patients		1.43	0.78
Door to Diagnostic Evaluation by a Qualified Medical Professional	Chart-abstracted data	1.08	0.53
Median Time to ECG		1.06	0.20
ED-Median Time to Pain Management for Long Bone Fracture		1.02	0.43
Median Time from ED Arrival to ED Departure for Discharged ED Patients		0.91	0.76
Median Time to Transfer to Another Facility for Acute Coronary Intervention	Medical record or EHR (eCQM)	0.76	0.18

Efficient use of medical imaging

Variable description	Data source	Difference in means between 1- and 5-stars	Loading coefficient
Simultaneous Use of Brain Computed Tomography (CT) and Sinus CT	Chart-abstracted data	1.04	-0.02
Cardiac Imaging for Preoperative Risk Assessment for Non-Cardiac Low-Risk Surgery	Claims	0.21	-0.01
MRI Lumbar Spine for Low Back Pain		0.18	0.08
Thorax CT Use of Contrast Material		0.16	0.30
Abdomen CT Use of Contrast Material		0.09	0.69

Appendix II. Regression analysis for each category

We performed regression analyses to analyze the association between the measures hospitals had sufficient data to report and the star rating they received. We used the July 2016 ratings data and included several hospital characteristics, such as the presence of an emergency department, presence of an intensive care facility, case mix index, presence of a teaching facility, hospital affiliation, share of Medicare, Medicaid and total acute admissions, and hospital size.

We ran one regression model per measure, comparing 5-, 4-, 3-, and 2-star hospitals with the 1-star-rated hospitals. We transformed the data into a binary format to represent whether or not a measure was reported.

Mortality

	2-star	3-star	4-star	5-star
Acute Myocardial Infarction		-	-	-
Coronary Artery Bypass Graft	+	+	+	+
Chronic Obstructive Pulmonary Disease				-
Heart Failure				-
Pneumonia				-
Stroke				-
Death Among Surgical Patients with Serious Treatable Complications		-		

■ ■ Negative/significant
 ■ ■ Positive/significant
 ■ Not significant

Note: Darker shade indicates higher strength of association

Safety of care

	2-star	3-star	4-star	5-star
Catheter-Associated Urinary Tract Infection (CAUTI)		-	-	-
Central-Line Associated Bloodstream Infection (CLABSI)	-	-	-	-
Clostridium Difficile (C.difficile)				+
Complication/Patient Safety for Selected Indicators (PSI)				+
Complication Rate Following Elective Primary Total Hip Arthroplasty (THA) and Total Knee Arthroplasty (TKA)	+	+	+	+
MRSA Bacteremia	-	-	-	-
Surgical Site Infection from abdominal hysterectomy (SSI-abdominal hysterectomy)		+	+	+
Surgical Site Infection from colon surgery (SSI-colon)				-

■ ■ Negative/significant
 ■ ■ Positive/significant
 ■ Not significant

Note: Darker shade indicates higher strength of association

Readmission

	2-star	3-star	4-star	5-star
Acute Myocardial Infarction	-	-	-	-
Chronic Obstructive Pulmonary Disease				-
Coronary Artery Bypass Graft	+	+	+	+
Heart Failure				-
Hip/Knee Replacement	+	+	+	+
Hospital-Wide All-Cause Unplanned Readmission				
Pneumonia				-
Stroke				-

■ ■ Negative/significant
 ■ ■ Positive/significant
 ■ Not significant

Note: Darker shade indicates higher strength of association

Patient experience

	2-star	3-star	4-star	5-star
Overall Rating of Hospital		+	+	+

■ Negative/significant
 ■ Positive/significant
 ■ Not significant

Note: Darker shade indicates higher strength of association measures. Patient experience includes 11 measures. However, hospitals that report one measure report them all as it is administered as a survey. All of the measures look the same as the Overall Rating of Hospital measure, so we have only included this one measure in the table.

Effectiveness of care**

	2-star	3-star	4-star	5-star
Discharged on Statin Medication			-	-
Elective Delivery Prior to 39 Completed Weeks Gestation	+	+	+	
Appropriate Follow-up Interval for Normal Colonoscopy in Average Risk Patients			+	-
Hospital Acquired Potentially-Preventable Venous Thromboembolism	-	-	-	-
Intensive Care Unit Venous Thromboembolism Prophylaxis			-	-
Stroke education			-	-
Thrombolytic therapy	-	-	-	-
Venous Thromboembolism (VTE) Prophylaxis			-	-
Venous Thromboembolism Patients with Anticoagulation Overlap Therapy				-
Venous Thromboembolism Warfarin Therapy Discharge Instructions		-	-	-

■ Negative/significant
 ■ Positive/significant
 ■ Not significant

**Only measures for which 5-star hospitals showed a significant difference to others are shown.

Note: Darker shade indicates higher strength of association

Timeliness of care

	2-star	3-star	4-star	5-star
Admit Decision Time to ED Departure Time for Admitted Patients				-
Door to Diagnostic Evaluation by a Qualified Medical Professional				-
ED-Median Time to Pain Management for Long Bone Fracture				-
Median Time from ED Arrival to ED Departure for Admitted ED Patients				-
Median Time from ED Arrival to ED Departure for Discharged ED Patients				-
Median Time to ECG			+	
Median Time to Transfer to Another Facility for Acute Coronary Intervention				

■ Negative/significant
 ■ Positive/significant
 ■ Not significant

Note: Darker shade indicates higher strength of association

Efficient use of medical imaging

	2-star	3-star	4-star	5-star
Abdomen CT Use of Contrast Material				-
Cardiac Imaging for Preoperative Risk Assessment for Non-Cardiac Low-Risk Surgery	+	+	+	+
MRI Lumbar Spine for Low Back Pain	+	+	+	+
Simultaneous Use of Brain Computed Tomography (CT) and Sinus CT				
Thorax CT Use of Contrast Material				-

■ Negative/significant
 ■ Positive/significant
 ■ Not significant

Note: Darker shade indicates higher strength of association

Endnotes

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Authors

David Betts

Principal
Deloitte Consulting LLP
dabetts@deloitte.com

Claire B. Cruse, MPH

Health Policy Manager
Deloitte Center for Health Solutions
Deloitte Services LP
cboozer@deloitte.com

Project team

Priyanshi Durbha led the data analysis for this project and wrote the section on the regression results. Andreea Balan-Cohen provided leadership and direction of the analysis throughout the project. Steve Davis provided editorial support in the writing of this research.

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Sarah Thomas, MS

Managing Director
Deloitte Services LP
sarthomas@deloitte.com

Email: healthsolutions@deloitte.com
Web: www.deloitte.com/centerforhealthsolutions

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