Editor's Perspective

Hospital Cardiovascular Outcome Measures in Federal Pay-for-Reporting and Pay-for-Performance Programs: A Brief Overview of Current Efforts

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In recent years, the Centers for Medicare & Medicaid Services (CMS) has expanded its array of hospital quality measures in cardiovascular disease. In doing so, CMS has shifted its focus from process measures to outcome measures, increasingly using the measures in pay-for-reporting and performance programs.[1] The emerging measures and their association with policy initiatives have changed over time and may be difficult to track for the casual observer, even as they increasingly influence payments to individuals and institutions.

This Perspective provides a primer on the CMS hospital cardiovascular outcome measures included in the Hospital Inpatient Quality Reporting Program (IQR), Hospital Readmissions Reduction Program (HRRP); and Hospital Value-Based Purchasing (HVBP) Program. We begin with a brief background on past and current CMS quality measurement efforts and then provide an overview of measure specifications for the current cardiovascular outcome measures used in these programs. We then summarize how the measures are currently used in the IQR, HRRP, and HVBP to assess hospital performance.

Background

CMS has a history of quality measurement dating back to its implementation of the Medicare Utilization and Quality Control Peer Review Program in the early 1980s. Initially, the Peer Review Program conducted implicit reviews of select cases, as suggested to them via beneficiaries, providers, or sampling

in order to determine if appropriate care was provided. Over time, CMS reorganized the Peer Review Program into Quality Improvement Organizations, which, in addition to their quality improvement objectives, were charged with systematically gathering and reviewing data for the purpose of quality measurement.[2,3] Concerns were raised surrounding the voluntary nature of participation in Quality Improvement Organization measurement activities and the potential for bias toward high-performing hospitals, which would be more likely to participate.[4]

Partially in response to these concerns, CMS shifted its quality measurement activities away from individual Quality Improvement Organizations and toward centralized national programs. Starting in 2004, CMS introduced the Reporting Hospital Quality Data for Annual Payment Update as instructed by the Medicare Prescription Drug, Improvement, and Modernization Act of 2003.[5] The program is a pay-for-reporting program that was enacted in order for hospitals participating in the Inpatient Prospective Payment System to publicly report their performance on the quality measures. More than 3,500 of the nation's hospitals are reimbursed under the Inpatient Prospective Payment System, which prospectively sets rates for hospital reimbursement under Medicare Part A based on the condition and severity of the admission.[6]

The first set of measures included in the Reporting Hospital Quality Data for Annual Payment Update were focused on process, such as providing aspirin on arrival for heart attack patients and angiotensin-converting enzyme inhibitors for heart failure patients.[7] The full list of measures originally included in the Reporting Hospital Quality Data for Annual Payment Update is listed in Table 1. In August 2007 (fiscal year 2008), CMS introduced measures that focused on outcomes, starting with 30-day acute myocardial infarction (AMI) and heart failure mortality.[8] While CMS attempted to monitor mortality rates for several conditions in the 1980s as part of the Peer Review Program, some experts criticized the measures and the effort was discontinued in the early 1990s.[9–12] The critiques were largely based around the risk-adjustment methodology, which excluded many variables directly related to mortality and did not adequately adjust for patient severity. In response to these concerns, the current claims-based measures were validated with models developed with medical records. Over the next several years, CMS would rename the Reporting Hospital Quality Data for Annual Payment Update as the Hospital Inpatient Quality Reporting Program (IQR) and add other conditions

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Table 1.   Original measures included in reporting hospital quality data for annual payment update

Measure	Condition
Was aspirin given to the patient upon arrival to the hospital	AMI
Was aspirin prescribed when the patient was discharged	
Was a β-blocker given to the patient upon arrival to the hospital	
Was a β-blocker prescribed when the patient was discharged	
Was an ACE inhibitor given for the patient with heart failure	
Did the patient get an assessment of his or her heart function	Heart failure
Was an ACE inhibitor given to the patient	
Was an antibiotic given to the patient in a timely way	Pneumonia
Had the patient received a pneumococcal vaccination	
Was the patient's oxygen level assessed	

AMI, acute myocardial infarction; ACE, angiotensin-converting enzyme

Table 2.   Complete list of measures included in the HVBP as of October 2014

Measure	Domain
Fibrinolytic therapy received within 30 min of hospital arrival for AMI	Process of care
Primary PCI received within 90 min of hospital arrival for AMI	
Discharge instructions for heart failure	
Blood cultures performed in the emergency department prior to initial antibiotic received in hospital for pneumonia	
Initial antibiotic selection for community acquired pneumonia in immunocompetent patient	
Prophylactic antibiotic received within 1 h prior to surgical incision	
Prophylactic antibiotic selection for surgical patients	
Prophylactic antibiotic discontinued within 24 h after surgery end time	
Cardiac surgery patients with controlled 6 AM postoperative serum glucose	
Urinary catheter removed on postoperative day 1 or postoperative day 2	
Surgery patients on β-blocker therapy prior to arrival who received β-blocker during the perioperative period	
Surgery patients who received appropriate venous thromboembolism prophylaxis within 24 h prior to surgery to 24 h after surgery	
Hospital consumer assessment of healthcare providers and systems survey	Patient experience
30-day AMI mortality	Outcome
30-day heart failure mortality	
30-day pneumonia mortality	
Composite score of patient safety for selected indicators	
Central line-associated bloodstream infections	
Medicare spending per beneficiary	Efficiency

AMI, acute myocardial infarction; HVBP, Hospital Value-Based Purchasing Program; PCI, percutaneous coronary intervention

and outcomes (readmission, complication, and payment). By October 2016, CMS will include a total of 63 measures in the IQR, 10 of which will be outcome measures for 4 cardiovascular conditions.[13]

With the passage of the Affordable Care Act, hospital quality measurement at CMS was linked to pay-for-performance. In particular, the Affordable Care Act introduced 3 programs that penalize or reward hospitals based on their performance on quality measures: 1) the Hospital Readmissions Reduction Program (HRRP); 2) the Hospital Value-Based Purchasing Program (HVBP); and 3) the Hospital Acquired Condition Reduction Program. We discuss only the HRRP and HVBP, because the Hospital Acquired Condition Reduction Program does not include cardiovascular outcome measures.

The HRRP took effect in October 2012 and originally included readmission measures for 3 conditions: AMI, heart failure, and pneumonia. As of October 2016, the expanded Program will include 6 conditions and procedures: AMI, heart failure, coronary artery bypass graft surgery, pneumonia, chronic obstructive pulmonary disease, and elective total hip or knee replacement.[14] The HRRP applies to hospitals reimbursed under the Inpatient Prospective Payment System, reducing a portion of total payments for hospitals that experience higher than expected readmission rates, given their case mix, on any of the measures included in the Program.

The HVBP began in fiscal year 2013, with the goal of improving the value of care provided to Medicare beneficiaries. Unlike the HRRP, the HVBP is a composite score that includes 4 domains: patient experience of care, outcome, efficiency, and clinical process of care. Each domain has its own weight, with the outcome and patient experience domains accounting for 30% each and the efficiency and process of care domains accounting for 20% each.[15] Over time, the weights of each domain are subject to change by CMS. The HVBP applies to hospitals in the Inpatient Prospective Payment System and provides payment incentives and payment penalties for high- and low-performing hospitals, respectively. By October 2014, the HVBP will include 12 process of care measures, 1 patient experience measure, 5 outcome measures, and 1 efficiency measure (Table 2).

The implementation of these programs is part of efforts at CMS to support the "Triple Aim" as described by then-CMS Administrator Dr. Donald Berwick.[16] The Triple Aim's goal is to improve healthcare quality and patient experience, while reducing healthcare costs. An integral aspect is the use of quality measurement to identify and learn from high-quality providers. The belief is that high performers set examples of achievable standards that others should be capable of replicating. For example, when discussing the HVBP, CMS mentions that, "when hospitals follow proven best practices, patients receive higher quality care and see better outcomes."[17] And recently, CMS has begun to see improvements in hospital performance in the areas in which these programs focus. For example, the current drop in readmission rates is cited as proof of high-quality care leading to reduced costs.[18]

Cardiovascular Outcome Measures

In Table 3, we list the cardiovascular outcome measures included in the IQR, HRRP, and HVPB and their implementation date. The sections below detail the major aspects of

Table 3. Cardiovascular outcome measures and CMS implementation date in pay-for-reporting/performance programs

Measure	IQR	HRRP	HVBP
Mortality			
AMI	October 2007	N/A	October 2013
Heart failure	October 2007	N/A	October 2013
Stroke	October 2015	N/A	N/A
CABG	October 2016	N/A	N/A
Readmission			
AMI	October 2009	October 2012	N/A
Heart failure	October 2009	October 2012	N/A
Stroke	October 2015	N/A	N/A
CABG	October 2016	October 2016	N/A
Payment			
AMI	October 2015	N/A	N/A
Heart failure	October 2016	N/A	N/A

AMI, acute myocardial infarction; CABG, coronary artery bypass graft surgery; CMS, Centers for Medicare & Medicaid Services; HRRP, Hospital Readmissions Reduction Program; HVBP, Hospital Value-Based Purchasing Program; IQR, Hospital Inpatient Quality Reporting Program

the measures; more comprehensive information is available in the technical reports.[8,19–26] In general, the methodology used to create these measures is similar across conditions and outcomes.

Data Sources Used to Calculate Measures

All of the measures use 3 years of CMS administrative claims data to assess hospital performance. Specifically, the measures use Standard Analytic Files, which are identifiable data files that include patient demographic characteristics (eg, age, race, zip code), diagnosis/procedure information, and limited hospital data (eg, provider number). There are 7 Standard Analytic Files, each for specific care settings: Inpatient, Outpatient, Home Health Agency, Hospice, Skilled Nursing Facility, Durable Medical Equipment, and Physician/Carrier.[27] The readmission and mortality measures only use the Inpatient and Outpatient Standard Analytic Files, while the payment measures use all seven.

Measure Cohorts

The measures used by CMS are limited to Medicare fee-for-service patients aged 65 years and older. Patients younger than 65 years who qualify for Medicare due to disability or end-stage renal disease are not included as they are deemed clinically distinct from the target population. Each measure uses primary International Classification of Diseases, Ninth Revision Clinical Modification discharge diagnosis codes to identify patients with a given condition or procedure to be included in the initial cohort. The measures then make additional minor exclusions in order to ensure that patients with missing data or atypical cases are not included (eg, patients discharged against medical advice or patients without continuous enrollment data during the outcome window).

Outcome

The outcome window for the readmission measures is 30 days post discharge while for the mortality and payment measures it is 30 days after admission. The readmission measures attribute the readmission to the hospital discharging the patient to a nonacute care setting. In order to be classified as a readmission, a patient must be formally admitted as an inpatient, meaning an observation stay does not count as a readmission. The mortality and payment measures attribute the outcome to the initial admitting hospital. The exceptions to this rule are the coronary artery bypass graft measures, in which the hospital that performed the initial procedure is held responsible for both the readmission and mortality outcomes. All of the conditions include outcomes both related and unrelated to the original reason for admission (eg, a readmission for a broken arm in a patient who was originally admitted for heart failure is counted as a readmission). However, the readmission measures only include unplanned readmissions.[28] While the outcome for the readmission and mortality measures is dichotomous (ie, yes/no), the payment measures implement a continuous outcome (total payment) and assign all inpatient and subsequent postacute payments back to the initial admitting hospital. Finally, the payment measures remove or average policy and geography adjustments in order to strictly profile providers on payments related to clinical care decisions.

Risk Adjusting for Patient Case Mix

The measures adjust for patient comorbidities that are present at the time of admission in order to fairly compare performance for providers with different case mix. This is accomplished by using administrative inpatient and outpatient claims data in the 12 months before admission, and inpatient claims data during the index admission, to identify comorbid conditions for risk adjustment. The measures do not adjust for potential complications of care nor do they adjust for race, income, education, or other socioeconomic variables. The original measures (AMI mortality/readmission; heart failure mortality/readmission; pneumonia mortality/readmission) were validated by comparing the output with the results achieved with a model that included detailed medical record data. In every case, the models produced very similar results.[8,23,24,29,30]

Calculating Hospital-Level Measures

The measures are calculated using hierarchical regression models in order to account for the clustering of patients within hospitals. The models generate a predicted over expected ratio for each hospital, including confidence intervals for each estimate. The expected rate for each hospital is estimated using that hospital's patient mix and the average hospital intercept. Specifically, for each patient in the data set, the estimated regression coefficients are multiplied by the observed characteristics and the average of the hospital-specific intercepts are added to this quantity. Then, the quantity is transformed to the probability scale. For each patient within a hospital, these probabilities are summed. The predicted rate in each hospital uses a similar calculation. The

predicted rate for each hospital is calculated by summing the predicted rates for all patients in the hospital. The predicted rate for each patient is calculated through the hierarchical model by applying the estimated regression coefficients to the patient characteristics observed and adding the hospital-specific intercept. The hospital-specific intercept is estimated by the model for each hospital based on the actual outcomes for its patients relative to hospitals with similar patients. A ratio of 1.0 is average performance, with anything below signifying better than expected performance and anything above signifying worse than expected performance. The exceptions to these performance categories are the payment measures that classify hospitals as lower, same as, or higher than the national average payment since lower or higher payment is not inherently good or bad. The reported measures multiply the ratio by the national rate of mortality, readmission, or average payment for that condition in order to produce a risk-standardized rate, making the ratios easier to interpret.

Implementation of Cardiovascular Outcome Measures in CMS Programs

IQR

The measures included in IQR are publicly reported on Hospital Compare for hospitals with at least 25 or more cases of a condition in the 3-year measurement period.[31] All hospitals are included in the calculation. In order for a hospital to be classified as better as or worse than average, the entire 95% interval estimate for its rate must be below or above the national average. In the example shown in Figure 1 for AMI readmission, the hospital is classified as no different than the national average, as a portion of the yellow interval estimate overlaps with the national average readmission rate of 18.3%. Hospitals are not penalized or rewarded for their performance but if they choose to suppress their results, they receive a reduced Annual Payment Update.[32] CMS also provides hospitals with an annual hospital-specific report (HSR), which includes all of a hospital's patients in the measures along with their characteristics (eg, age, admission and discharge dates, health insurance claim number). The goal of these reports is to share information that will stimulate performance improvement activities. The HSRs,

which include patient health information, are available to the hospital but not the general public. An example of the type of information included in an HSR is displayed in Figure 2. A full version of the HSR is located at the CMS Quality Net website.[33]

HRRP

As with IQR, the results of the measures included in HRRP are also publicly reported on Hospital Compare. However, they are reported on a separate portion of the website, with results for all hospitals included in a downloadable spreadsheet. They are also used by CMS to determine which hospitals will receive a payment penalty. Similar to IQR, rates and associated penalties are only calculated for hospitals with 25 or more cases of a condition in the 3-year measurement period.

However, a key difference between the use of the readmission measures in HRRP versus IQR is that the point estimate, and not the entire confidence interval, is used to determine if a hospital's rate is below or above the national average. Thus, the number of hospitals classified as having higher than expected readmissions in HRRP is far greater than the number in IQR. For example, in Figure 1, the hospital is classified as average in IQR but higher than average in HRRP since its point estimate (19.7%) is higher than the national average (18.3%). CMS has stated that the statutory language in the Affordable Care Act directs the use of the point estimate when calculating the excess readmission ratio.[34] Specifically, the language states that the excess readmission ratio is "the ratio (but not less than 1.0) of… the risk adjusted readmissions based on actual readmissions… to the risk adjusted expected readmissions."[35]

Once CMS calculates a hospital's penalty, it is then applied to the base operating Diagnosis-Related Group payments for all inpatient admissions, not just the measured conditions. Specifically, CMS reduces a hospital's base operating Diagnosis-Related Group payments as determined by the hospital's performance on the measures. As of the current fiscal year, this amount has reached its cap and cannot be higher than 3% of the total base operating Diagnosis-Related Group payment.[36] The steps used to calculate payment penalties for each condition included in the HRRP are displayed in Figure 3.
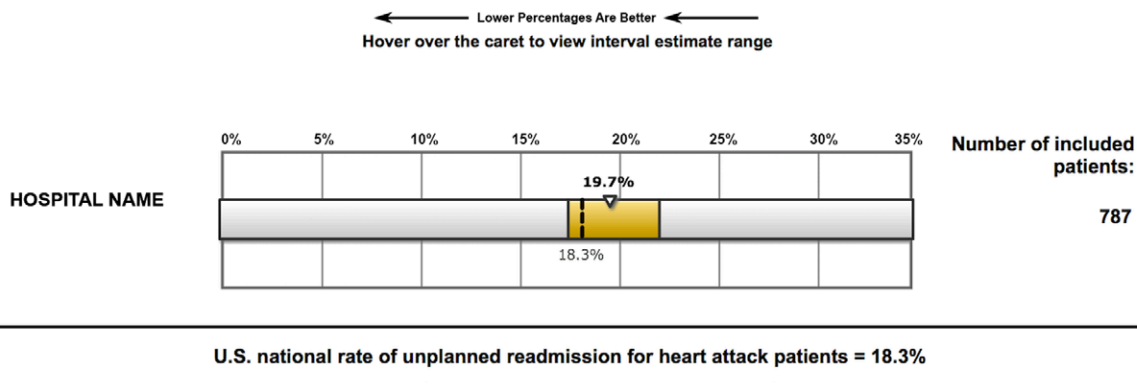

Figure 1. Hospital performance display for hospital inpatient quality reporting program.

ID Number	Provider ID	HICNO	Medical Record Number	Beneficiary DOB	Admission Date of Index Stay	Discharge Date of Index Stay
1	999999	499999999A	A001	07/27/1923	08/09/2009	08/14/2009
2	999999	499999999B	A002	2/29/1931	10/09/2009	10/10/2009
3	999999	499999999C	A003	11/22/1939	03/23/2010	03/27/2010
4	999999	499999999D	A004	10/11/1919	02/15/2009	02/16/2009
5	999999	499999999E	A005	12/16/1924	03/01/2009	03/06/2009
6	999999	499999999F	A006	02/09/1941	04/15/2009	04/24/2009
7	999999	499999999G	A007	08/27/1926	05/17/2009	05/22/2009
8	999999	499999999H	A008	12/20/1929	07/26/2009	08/02/2009
9	999999	499999999I	A009	07/16/1932	08/17/2009	08/18/2009
10	999999	499999999J	A010	05/15/1929	09/15/2009	09/18/2009
11	999999	499999999K	A011	04/05/1930	09/27/2009	10/02/2009
12	999999	499999999L	A012	07/13/1931	10/25/2009	10/31/2009

Figure 2. Example of information included in hospital-specific reports.
DOB, date of birth; HICNO, health insurance claim number; ID, identification

Performance on each measure is treated independently, instead of as a composite score. Thus, performing better than expected on one measure will not "cancel out" performing worse than expected on another measure. For example, if a hospital were to have lower than expected readmission rates for AMI and heart failure but a higher than expected rate for coronary artery bypass graft surgery, it would still be penalized. The implication of this policy is that adding conditions to the HRRP will increase the number of hospitals performing worse than expected on at least one of the measures, leading to a rise in the number of penalized hospitals. As in IQR, hospitals also receive HSRs for their patients in the HRRP measures.

HVBP

In keeping with IQR and HRRP, the results of each of the domains included in HVBP are publicly reported on Hospital Compare. As with the HRRP, hospitals' HVBP results are included in spreadsheets in a separate section of the Hospital Compare website. Of the 5 measures included in the outcome domain, 2 are for AMI and heart failure mortality. These mortality measures are the same as those included in IQR and are similarly limited to hospitals with 25 or more cases, but are distinct in their measurement period of 1 year rather than 3.[37] As with the HRRP measures, CMS uses the point estimates, not the interval estimates, to determine hospitals' performance on the AMI and heart failure mortality measures.

In order for hospitals to be included in the HVBP, they must meet the minimum number of cases for 2 of the 4 performance domains. The requirements for each domain are:

1. Calculate Excess Readmission Ratio = # of Predicted/Expected Readmissions

2. Calculate Aggregate Payments for Excess Readmissions = Base DRG Payment * # of Admissions for Measured Condition * (Excess Readmission Ratio − 1)

3. Payment Adjustment Factor = Aggregate Payments for Excess Readmissions/ Aggregate Payments for All Discharges for All Conditions

4. Hospital Payment = Base Operating DRG * Payment Adjustment Factor

Figure 3. Steps for calculating payment penalty for conditions included in the hospital readmissions reduction program.
DRG, diagnosis-related group

at least 10 cases for 4 of the 12 clinical process measures; at least 100 completed Hospital Consumer Assessment of Healthcare Providers and Systems surveys for the patient experience domain; 25 or more cases for the Medicare Spending Per Beneficiary measure in the efficiency domain; and the minimum number of cases for 2 of the 5 outcome measures in the outcome domain. CMS then uses historical data to calculate a baseline rate for each hospital and benchmarks to compare hospitals with each other, as well as determine how much they have improved over their baseline period. After arriving at a score for each domain, CMS calculates the composite score to determine if a hospital is eligible for an incentive or penalty payment. The maximum penalty a hospital can accrue will steadily increase until fiscal year 2017, when it will peak at 2% of all base operating Diagnosis-Related Group payments.[17] According to the statutory language, funding for incentive payments will be equal to the sum of all payment penalties, meaning that CMS will transfer payments withheld from "poor" performers to "high" performers.[38] As with the other programs, hospitals receive HSRs detailing their performance on each of the measures and domains.

Conclusion

As the nascent field of performance improvement continues to mature, the future of quality measurement remains dynamic. As medicine moves toward more accountability, measurement is a powerful tool for improving practice. There is a need to ensure that measurement provides a net benefit, creates incentives in the best interest of the patients, and is ultimately about improvement so that these efforts do not merely describe but also help to support ever better performance.

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