Overview

In July 2003, Premier, Inc. and the Centers for Medicare and Medicaid Services (CMS) launched the Hospital Quality Incentive Demonstration Project (HQI), a three-year program designed to determine if financial incentives are effective at improving the quality of inpatient care. In the demonstration, CMS will measure performance and pay incentives to participating hospitals that achieve superior levels of performance in five clinical areas.

Hospital incentive payments will be based on quality measures associated with the following clinical conditions:

- acute myocardial infarction (AMI)
- coronary artery bypass graft (CABG)
- heart failure (HF)
- community-acquired pneumonia (CAP)
- hip and knee replacement (HNK)

Individual facility performance measures for each disease category will be aggregated into a composite score that will be used to establish baseline performance and relative distribution of hospital participants.

Development of HQI Composite Quality Score

Rewarding high overall performance requires a valid and reliable method by which measurement data may be aggregated and used to provide a comparison of hospitals based on a single quality score. While composite scoring has not been widely used in evaluating health care services, research indicates aggregated measures may improve consumer understanding of often complex performance indicators by combining measures of many dimensions of care into a single score[1].

The HQI Composite Quality Score is a modification of the opportunity model developed by the Hospital Core Performance Measurement Project (HCPM) for the Rhode Island Public Reporting Program for Health Care Services in 1998. After reviewing previous work by Landrum and others who had developed a latent variable model for inpatient AMI care, the HCPM developed its opportunity model to overcome challenges involving individual weighting, missing data, and sensitivity to case volumes. For example, unrealistically low rates occur in situations where a hospital has little or no case volume for a particular dimension of care, yet that measure is equally weighted with others in the composite.[2] To understand the HQI Composite Quality Score, it is useful to review the opportunity model on which it is based.

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[1] Landrum MB, Bronskill SE, Normand ST Analytic Methods for Constructing Cross-Sectional Profiles of Health Care Providers. *Health Services & Outcomes Research Methodology 1:1 (2000): 23-47*

[2] Scinto, J, Courtney, J, et al, Final Report: Hospital Core Performance Measurement Project, April 2002, p. 51

HCPM Opportunity Model

The HCPM developed its model on the assumption that an opportunity exists whenever a patient meets the criteria to be included in the target patient population for a particular measure. Given that, one patient represents numerous opportunities for evidence-based interventions that may be measured by performance indicators. A composite may be developed for a disease category by dividing the total number of achieved interventions by the total number of opportunities for the same targeted interventions.[3] The HCPM model produces a composite measure with the following attributes:

- Individual measures are weighted by the volume of opportunities for the associated intervention for a particular hospital (e.g., a hospital that frequently has patients with indications for aspirin post-AMI but rarely performs PTCA should be scored in a manner that weights aspirin measures more heavily).
- Missing values for a particular aspect of care provided by an individual hospital do not preclude that hospital from being represented in a public report, nor does the model require imputing missing values.
- The composite measure may be used within a single condition or across multiple conditions.
- The composite measure may be calculated and understood by quality assurance professionals using their own data.
- The composite measure may easily accommodate additional individual measures.[4]

Opportunity Model Composite Calculation

Once individual measurement data are collected, a composite facility measure for each disease category may be calculated. While the model may also be used for scoring at the care location or care stage-level to aid internal hospital quality improvement initiatives, provider-level scores are most useful for public reporting of performance and are therefore illustrated here.

Attributes of individual measures used to compute a composite score include:

- Substantiation through rigorous clinical research that indicates a significant relationship between the intervention being measured and quality patient outcomes.
- Individual measure validity and reliability so that the validity of the composite score is not compromised.
- Common directionality within the composite score, i.e. each measure changes in the same numeric direction as more desirable values are realized.
- A single measure for each aspect of care to avoid excessive weighting in the composite score.

Continuous variable measures, such as time to antibiotics for pneumonia patients, are converted to rate-based measures by establishing a threshold (e.g., eight hours) and then calculating the number of patients that received care within the established limits.[5]

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[3] Scinto et al, p. 53.
[4] Scinto et al, p. 53.

The numerators of all individual performance measures are summed to determine a composite numerator. The denominators of all individual performance measures are also summed to determine a composite denominator. The final composite score is produced by dividing the composite numerator by the composite denominator.

Table I illustrates a sample calculation of a condition-level composite for AMI care using six individual measures:

Table I - AMI Composite Measure from HCPM Opportunity Model

Measure	Numerator	Denominator
Aspirin at Arrival	15	17
Aspirin at Discharge	10	12
Beta Blocker at Discharge	7	8
Beta Blocker at Arrival	8	8
ACEI for LVSD	3	3
Time to Thrombolytics	1	2
AMI Care Composite	**44**	**50**

Thus, the calculated AMI care composite rate equals 44/50, or 88 percent. The methodology lends itself most easily to process measures; however, the HQI Composite Quality Score extends the HCPM opportunity model by introducing outcome measures for specific disease categories evaluated in the HQI project.

HQI Composite Quality Score Calculation

The HCPM Opportunity Model was modified by incorporating clinical outcome measures as a second component in the composite score. The opportunity model methodology is extended to produce a composite process score that is aggregated with an outcome score to compute a final quality score. For example, higher rates for process measures are desirable, but lower rates for mortality or readmissions indicate better outcomes. Therefore, to compute an outcome measure with consistent directionality to use in calculating a composite score, we have calculated a survival rate from the mortality rate.

The resulting HQI Composite Quality Score will be used to identify top performing hospitals participating in the CMS Hospital Quality Incentive Demonstration project. Year One baseline thresholds for each facility will also be determined using this composite calculation for any payment adjustments in Year Three of the HQI project as outlined in the project's terms and conditions.

Data for computing composite scores are extracted from internal hospital information systems and patient medical records and submitted by participating hospitals at least quarterly to Premier's clinical data repository. Hospitals with more than 75 cases per month per condition have the option of sampling patients using sample size and methodological requirements established by the JCAHO in its *Specification Manual for National Implementation of Hospital Core Measures, version 2.0*. Using either a simple

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[5] Scinto et al, p.55.

or systematic sampling method, hospitals must submit 75 cases or 20 percent of the defined patient population per month per condition, whichever is greater.

The following illustration of the composite calculation uses AMI measures to illustrate the steps in the composite calculation for the HQI project. For this example, sample data for the AMI focus area were compiled from JCAHO ORYX® Core Measure data submitted through Premier for two quarterly reporting periods. Consistent with HQI project methodology, the sample was filtered to include only those facilities with 30 or more condition-specific cases.

HQI Composite Quality Score Components

The HQI Composite Quality Score is comprised of two separate components: a *composite process score* and a *composite outcome score*. To account for the relative contribution of each component, proportional weighting values must be applied. In the AMI example, the composite process rate accounts for eight of the nine indicators, therefore a weight factor of .89 (8/9) is applied. Likewise, the single AMI outcome indicator is weighted with a factor of .11 (1/9). After the weights are applied to both components; a composite score is calculated using the formula below:

HQI Composite Quality Score = composite process score + composite quality score

Composite Process Score Component

Continuing the AMI example, a composite process rate is derived by summing the numerator and denominator values for each of the process-based indicators (see *Table 2*) to create a composite numerator and denominator for each hospital.

Table 2 - AMI Process Indicators for HQI Project

Measure	Numerator	Denominator
Aspirin at Arrival	60	60
Aspirin at Discharge	55	58
ACEI for LVSD	53	56
Smoking Cessation Counseling	55	61
Beta Blocker at Discharge	63	63
Beta Blocker at Arrival	59	61
Thrombolytic Received Within 30 Minutes of Arrival	35	48
PCI Within 120 Minutes of Hospital Arrival	27	31
Total	**407**	**438**

Each hospital's individual measure numerator and denominator values are aggregated as in the HCPM Opportunity Model to arrive at a composite process rate. Thus the hospital illustrated in *Table 2* achieved a composite process rate of 407/438 or 92.92%. The composite process rate is multiplied by the component weight factor times 100 to compute the *composite process score*, e.g. (0.9292 X 0.89) X 100 = 82.69.

Composite Outcome Score Component

The calculation of a *composite outcome score* used in the HQI composite quality score starts with each hospital's actual mortality rate and expected mortality rate derived from adjusting the actual rate for the presence of various risk factors. Risk of mortality is assigned to each eligible patient using probability-of-death coefficients for each risk factor a patient exhibits using the Joint Commission on Accreditation of Healthcare Organization's logistic regression adjustment model[6]. These coefficients are then summed for each patient. The resulting coefficients are averaged to create a risk-adjusted mortality rate for each hospital.

The next step in the process is to create an *actual survival rate* and an *expected survival rate* by using the formulas below:

Actual survival rate = (1 – actual mortality rate)

e.g. Actual survival rate = (1 – 0.0476) = 0.9524

Expected survival rate = (1 – expected mortality rate)

e.g. Expected survival rate = (1 – 0.1161) = 0.8839

Then, the *survival index* is calculated by dividing the *actual survival rate* by the *expected survival rate:*

Survival index = (actual survival rate / expected survival rate)

e.g. Survival index = (0.9524 / 0.8839) = 1.0775

The Composite Outcome Score equals the survival index times the outcome component weight factor times 100.

e.g. Composite Outcome Score = (1.0775 X .011) X 100 = 11.85

Combining the process and outcome components produces the HQI Composite Quality Score

HQI Composite Quality Score = composite process score + composite quality score

e.g. HQI Composite Quality Score = 82.69 + 11.85 = 94.54

Performance Distribution and Baseline Percentile Thresholds

The HQI Composite Quality Score is used to identify hospitals that perform in the top two deciles and to set the baseline thresholds to calculate any adjustment of Year Three payments as outlined in the HQI project terms and conditions. *Table 3* shows the results

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[6] JCAHO Specification Manual for National Implementation of Hospital Core Measures, version 2.0, section 6 – Risk Adjustment

of the percentile calculations from an AMI sample data set. Based on this example, the threshold scores for the first and second deciles are 96.58 and 94.26 respectively for the two percent and one percent incentive payment levels. If we were to use this example to set the Year One threshold for payment adjustment, all hospital participants that achieved an HQI Composite Quality Score greater than 81.73 in Year Three would be exempt from payment adjustment.[7]

Table 3 - Sample AMI Composite Score Thresholds

Deciles	HQI Composite Quality Score Threshold
90th	96.58
80th	94.26
70th	92.05
60th	90.31
50th	88.63
40th	87.04
30th	83.63
20th	81.73
10th	77.99

Disease-specific Calculations:

See *Attachment 1*

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[7] For additional information regarding HQI Project incentive payment structure, please visit:
http://www.qualitydemo.com

Sample HQI Composite Quality Score calculation for Premier Memorial Hospital

CABG Composite Quality Score:

Patient Level					Hospital Level				Composite Quality Score				

Patient Level

CABG	Process Component			
Patient 1:	**Process measures**	**Eligible**	**Actual**	
	Aspirin prescribed at discharge	Yes	Yes	
	CABG using IMA	Yes	Yes	
	Prophylactic antibiotic received < 1 our prior to surgical incision	Yes	Yes	
	Prophylactic antibiotic selection for isolated CABG patients	Yes	Yes	
	Prophylactic antibiotics discontinued < 24 hours after surgery end time	Yes	No	
	Total for patient 1	**5**	**4**	

Opportunities for intervention and actual interventions for all

individual measures are aggregated to the patient level.

Hospital Level

Process Component

	Eligible	Actual
CABG Patient 1	5	4
CABG Patient 2	5	5
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CABG Patient n	4	3
Total	**167**	**141**

Patient level values are aggregated to

the facility level.

Actual and expected mortality rates calculated

Actual and expected post operative hemmorrhage/hematoma rates calculated
(Act.post-op H/H rate) and
(Exp. post-op H/H rate)

Actual and expected post-operative physiologic and metabolic derangement rates calculated
(Actual post-op PMD rate) and
(Expected post-op PMD rate)

Composite Quality Score

Composite Process component:

Eligible	Actual	Facility rate	Component Weight	Composite Process Score
				(Facility rate X Weight X 100)
167	141	0.84	0.625	**52.77**

Composite Outcome component:

	Facility rate	Component Weight	Composite Outcome Score
Actual post-op H/H avoidance rate (1 - Actual post-op H/H rate)	0.9898		
Expected post-op H/H avoidance rate (1 - expected post-op H/H rate)	0.9700		
Post-op H/H avoidance index	**1.0204**	**0.125**	**12.76**
Actual post-op PMD avoidance rate (1 - Actual post-op PMD rate)	0.9760		
Expected post-op PMD avoidance rate (1 - expected post-op PMD rate)	0.9830		
Post-op PMD avoidance index	**0.9929**	**0.125**	**12.41**
Actual survival rate (1 - Actual mortality rate)	0.9564		
Expected survival rate (1 - expected mortality rate)	0.8869		
Survival index	**1.0784**	**0.125**	**13.48**

HQI Composite CABG Quality Score	**91.42**

Sample HQI Composite Quality Score calculation for Premier Memorial Hospital

AMI Composite Quality Score:

Patient Level			
Patient Level			
AMI	**Process Component**		
		Eligible	**Actual**
Patient 1:	**Process measures**	**Eligible**	**Actual**
	Aspirin at Arrival	Yes	Yes
	Aspirin at Discharge	Yes	No
	ACEI for LVSD	Yes	Yes
	Smoking Cessation Counseling	No	No
	Beta Blocker at Discharge	Yes	Yes
	Beta Blocker at arrival	Yes	Yes
	Thrombolytics Received Within 30 Minutes of Arrival	No	No
	PCI within 120 minutes of Hospital Arrival	No	No
	Total for patient 1	**5**	**4**

Hospital Level		
Hospital Level		
Process Component		
	Eligible	**Actual**
AMI Patient 1	5	4
AMI Patient 2	6	4
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.		
AMI Patient n	7	6
Total	**131**	**120**

Composite Quality Score

Composite Process component:

Eligible	Actual	Facility rate	Component Weight	Composite Process Score
				(Facility rate X Weight X 100)
131	120	0.9160	0.89	**81.53**

Composite Outcome component:

	Facility rate	Component Weight	Composite Outcome Score
Actual survival rate (1 - actual mortality rate)	0.9524		
Expected survival rate (1- expected mortality rate)	0.8839		
Survival index	**1.0775**	**0.11**	**11.85**

HQI Composite AMI Quality Score	**93.38**

Opportunities for intervention and actual interventions for all individual measures are aggregated to the patient level.

Patient level values are then aggregated to the facility level.

Actual mortality rate is calculated

Expected mortality rate is calculated

Sample HQI Composite Quality Score calculation for Premier Memorial Hospital

Hip and Knee Replacement Composite Quality Score:

Patient Level			
Hip/Knee	**Process Component**		
Patient 1:	**Process measures**	**Eligible**	**Actual**
	Prophylactic antibiotic received < 1 our prior to surgical incision	Yes	Yes
	Prophylactic antibiotic selection for isolated CABG patients	Yes	Yes
	discontinued < 24 hours after surgery end time	Yes	Yes
	Total for patient 1	**3**	**3**

Opportunities for intervention and actual interventions for all

individual measures are aggregated to the patient level.

Hospital Level		
Process Component		
	Eligible	**Actual**
HNK Patient 1	3	3
HNK Patient 2	3	2
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HNK Patient n	3	3
Total	**312**	**291**

Patient level values are aggregated to the facility level.

Actual and expected 30-day readmission rates calculated

Actual and expected post operative hemmorrhage/hematoma rates calculated (Act.post-op H/H rate) and (Exp. post-op H/H rate)

Actual and expected post-operative physiologic and metabolic derangement rates calculated (Actual post-op PMD rate) and (Expected post-op PMD rate)

Composite Quality Score

Composite Process component:

	Eligible	Actual	Facility rate	Component Weight	Composite Process Score
					(Facility rate X Weight X 100)
	312	291	0.9327	0.50	**46.63**

Composite Outcome component:

	Facility rate	Component Weight	Composite Outcome Score
Actual post-op H/H avoidance rate (1 - Actual post-op H/H rate)	0.9700		
Expected post-op H/H avoidance rate (1 - expected post-op H/H rate)	0.9600		
Post-op H/H avoidance index	**1.0104**	**0.167**	**16.87**
Actual post-op PMD avoidance rate (1 - Actual post-op PMD rate)	0.9890		
Expected post-op PMD avoidance rate (1 - expected post-op PMD rate)	0.9800		
Post-op PMD avoidance index	**1.0092**	**0.167**	**16.85**
Actual 30-day readmission avoidance rate (1 - actual 30-day readmit rate)	0.9400		
Expected 30-day readmission avoidance rate (1 - expected 30-day readmit rate)	0.9570		
30-day readmission avoidance index	**0.9822**	**0.167**	**16.37**

HQI Composite HNK Quality Score	**96.73**

Sample HQI Composite Quality Score calculation for Premier Memorial Hospital

HF Composite Quality Score:

Patient Level				Hospital Level				Composite Quality Score				

Patient Level

HF	**Process Component**		
Patient 1:	**Process measures**	**Eligible**	**Actual**
	LVF assessment	Yes	Yes
	Detailed discharge instructions	Yes	No
	ACEI for LVSD	Yes	Yes
	Smoking cessation Counseling	Yes	No
	Total for patient 1	**4**	**2**

Hospital Level

Process Component		
	Eligible	**Actual**
HF Patient 1	4	2
HF Patient 2	4	3
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.		
.		
.		
HF Patient n	4	4
Total	**185**	**169**

Composite Quality Score

Composite Process component:

Eligible	Actual	Facility rate	Component Weight	Composite Process Score (Facility rate X Weight X 100)
185	169	0.9135	1.0	**91.35**

Composite Outcome component:

				Composite Outcome Score
				N/A

HQI Composite HF Quality Score	**91.35**

Opportunities for intervention and actual interventions for all individual measures are aggregated to the patient level.

Patient level values are then aggregated to the facility level.

Sample HQI Composite Quality Score calculation for Premier Memorial Hospital

CAP Composite Quality Score:

Patient Level

CAP	Process Component		
Patient 1:	Process measures	Eligible	Actual
	Oxygenation assessment within 24 hours prior to or after arrival	Yes	Yes
	Initial antibiotic consistent with current recommendations	Yes	No
	Blood Culture collected prior to first antibiotic administration	Yes	Yes
	Influenza screening/vaccination	Yes	No
	Pneumococcal screening/vaccination	Yes	Yes
	Antibiotic timing: within 4 hours of hospital arrival	Yes	Yes
	Smoking cessation Counseling	No	No
	Total for patient 1	6	4

Hospital Level

Process Component	Eligible	Actual
CAP Patient 1	6	4
CAP Patient 2	7	6
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.		
CAP Patient n	7	5
Total	247	219

Composite Quality Score

Composite Process component:

Eligible	Actual	Facility rate	Component Weight	Composite Process Score
				(Facility rate X Weight X 100)
247	219	0.8866	1.0	**88.66**

Composite Outcome component:

Composite Outcome Score

N/A

HQI Composite CAP Quality Score	**88.66**

Opportunities for intervention and actual interventions for all individual measures are aggregated to the patient level.

Patient level values are then aggregated to the facility level.