Quality Indicator User Guide: Inpatient Quality Indicators (IQI) Composite Measures Version 4.3

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Chapter 1. Overview

The goal in developing composite measures was to provide a measure that could be used to monitor performance over time or across regions and populations using a method that applied at the national, regional, State or provider/area level. Potential benefits of composite measures are to: summarize quality across multiple indicators, improve the ability to detect differences, identify important domains and drivers of quality, prioritize action for quality improvement, make current decisions about future (unknown) health care needs and avoid cognitive "shortcuts." Despite these potential advantages there are concerns with composite measures, such as: masking important differences and relations among components, not being actionable, not being representative of parts of the health care system that contribute most to quality or detracting from the impact and credibility of reports. In weighing the benefits and concerns of composite measures there are also a number of potential uses to consider, such as: consumer use for selecting a hospital or health plan, provider use for identifying domains and drivers of quality, purchasers use for selection of hospitals or health plans to improve employee health and policymakers use for setting policy priorities to improve the health of a population. This document provides a technical overview for AHRQ QI users.

What Are the Composites?

Provider-Level Composites

Mortality for Selected Procedures. This composite is a weighted average of the reliability-adjusted ratios for the mortality indicators for patients undergoing selected procedures. The reliability-adjusted ratio is a weighted average of the risk-adjusted ratio and the reference population ratio, where the weight is determined empirically.

Mortality for Selected Conditions. This composite is a weighted average of the reliability-adjusted ratios for the mortality indicators for patients admitted for selected conditions. The reliability-adjusted ratio is a weighted average of the risk-adjusted ratio and the reference population ratio, where the weight is determined empirically.

Table 1. AHRQ IQI Composite Measure Components

Mortality for Selected Procedures (IQI #90)	Mortality for Selected Conditions (IQI #91)[1]
IQI #08 Esophageal Resection Mortality Rate	IQI #15 Acute Myocardial Infarction (AMI) Mortality Rate
IQI #09 Pancreatic Resection Mortality Rate	IQI #16 Congestive Heart Failure (CHF) Mortality Rate
IQI #11 Abdominal Aortic Aneurism (AAA) Repair Mortality Rate	IQI #17 Acute Stroke Mortality Rate
IQI #12 Coronary Artery Bypass Graft (CABG) Mortality Rate	IQI #18 Gastrointestinal Hemorrhage Mortality Rate
IQI #13 Craniotomy Mortality Rate	IQI #19 Hip Fracture Mortality Rate
IQI #14 Hip Replacement Mortality Rate	IQI #20 Pneumonia Mortality Rate
IQI #30 Percutaneous Transluminal Coronary Angioplasty (PTCA) Mortality Rate	
IQI #31 Carotid Endarterectomy Mortality Rate	

[1] This composite measure (i.e., IQI #91) is endorsed by the National Quality Forum (NQF: #530).

Chapter 2. Calculation

How are the Composites Created?

The composite measures are evaluated using three criteria: discrimination, forecasting and construct validity.

Discrimination is the ability of the composite measure to differentiate performance as measured by statistically significant deviations from the average performance.

Forecasting is the ability of the composite measure to predict performance for each of the component indicators. Ideally, the forecasting performance would reflect the weighting of the components, in the sense that forecasting would maximize the differences for the most highly weighted components.

Construct validity is the degree of association between the composite and other aggregate measures of quality. In this report we look primarily at the consistency in the composites with one another. A broader analysis of construct validity would examine the relationship between the composites and external measures of quality or other factors that might influence quality.

Steps for creating the composite

Step 1. Compute the risk-adjusted rate and confidence interval
The AHRQ QI risk-adjusted rate is computed based on a hierarchical logistic regression model for calculating a predicted value for each case. Then the predicted values among all the cases in the hospital are summed to compute the expected rate. The risk-adjusted rate is computed using indirect standardization as the observed rate (OR) divided by the expected rate (ER), with the result multiplied by the reference population rate: (RR) = (OR/ER × PR).

Step 2. Scale the risk-adjusted rate using the reference population

The relative magnitudes of the rates vary from indicator to indicator. To combine the component indicators using a common scale, each indicator's risk-adjusted rate is divided by the reference population rate to yield a ratio. The components of the composite are therefore defined in terms of a ratio to the reference population rate for each indicator. The component indicators are scaled by the reference population rate, so each indicator reflects the degree of deviation from the overall average performance.

Step 3. Compute the reliability-adjusted ratio
The reliability-adjusted ratio (RAR) is computed as the weighted average of the risk-adjusted ratio and the reference population ratio, where the weights vary from 0 to 1, depending on the degree of reliability for the indicator and provider (or other unit of analysis).
RAR = [risk-adjusted ratio × weight] + [reference population ratio × (1 – weight)]

For small providers, the weight is closer to 0. For large providers, the weight is closer to 1. For a given provider, if the denominator is 0, then the weight assigned is 0 (i.e., the reliability-adjusted ratio is the reference population ratio).

Step 4. Select the component weights
The composite measure is the weighted average of the scaled and reliability-adjusted ratios for the component indicators. Some examples of possible weights follow, though others are possible:

Single indicator weight. In this case, the composite is simply the reliability-adjusted ratio for a single indicator. For the procedure indicators, the single indicator weight composite is a "volume-outcome" composite since the reference population rate varies with the volume of the provider. For the condition indicators, the reference population rate is the same among all providers.

Equal weight. In this case, each component indicator is assigned an identical weight based on the number of indicators. That is, the weight equals 1 divided by the number of indicators in the composite (e.g., 1/8 = 0.1250).

Numerator weight. A numerator weight is based on the relative frequency of the numerator for each component indicator in the reference population. In general, a numerator weight reflects the amount of harm in the outcome of interest, in this case mortality. For other types of outcomes the harm might reflect the amount of excess mortality or complications associated with the adverse event.

Denominator weight. A denominator weight is based on the relative frequency of the denominator for each component indicator in the reference population. In general, a denominator weight reflects the amount of risk of experiencing the outcome of interest in a given population. For example, the denominator weight might be based on the demographic composition of a health plan, the employees of a purchaser, a State, an individual hospital, or a single patient.

Factor weight. A factor weight is based on some sort of analysis that assigns each component indicator a weight that reflects the contribution of that indicator to the common variation

among the indicators. The component indicator that is most predictive of that common variation is assigned the highest weight.

Step 5. Construct the composite measure
The composite measure is the weighted average of the component indicators using the selected weights and the scaled and reliability-adjusted indicators.

Composite = [indicator1 RAR × weight1] + [indicator2 RAR × weight2] + . . . + [indicatorN RAR × weightN]

The confidence interval of the composite is based on the standard error of the composite, which is the square root of the variance. The variance is computed based on the signal variance covariance matrix and the reliability weights.

Chapter 3. Use

How Have the Composites Changed?

With each new release of the AHRQ QI, the reference population is updated to the most current HCUP data available. The numerator and denominator weights are updated to reflect the indicator technical specifications as applied to the reference population.

What Are the Current Uses of the Composites?

Under the Hospital Inpatient Quality Reporting (IQR) Program (formerly known as the Reporting of Hospital Quality Data for Annual Payment Update (RHQDAPU) program) [1] the Centers for Medicare & Medicaid Services (CMS) adopted Inpatient Quality Indicators developed by the AHRQ for use in "Hospital Compare"; a comparative public report of hospital performance. Two of these indicators are composite measures: Mortality for Selected Conditions and Mortality for Selected Procedures.

One of these composite measures - Mortality for Selected Conditions – was ultimately endorsed by NQF in 2009[2] and will therefore appear in the 2011 Hospital Compare report. The other composite measure – Mortality for Selected Procedures – was not endorsed because of the relatively small number of hospitals that perform most of these procedures, the heterogeneity in the relative frequency of procedures performed at these hospitals, and the elective nature of the procedures. In turn, the Mortality for Selected Procedures has since been retired from IQR.

Users must use these "NQF Weights" when using the AHRQ QI software to compute the composite measures using their own data and when comparing the results of the software with the results reported under IQR. The following three tables provide these NQF weights for each

[1] Agency for Healthcare Research and Quality, "AHRQ Quality Indicators Computing Composites of the AHRQ QI Rates Under the RHQDAPU Program," (February 2010). The report is available at http://www.qualityindicators.ahrq.gov/modules/iqi_resources.aspx.
[2] Another AHRQ QI composite – Pediatric Patient Safety for Selected Indicators – was also endorsed by NQF but is not included in the RHQDAPU program because it applies only to the pediatric population.

composite measure. The sum of the weights for the indicators included in the same composite always equals one.

Table 2. NQF Weights for the Mortality for Selected Conditions Composite

Indicator	Label	Weight
IQI 15	Acute Myocardial Infarction (AMI) Mortality Rate	0.1468
IQI 16	Congestive Heart Failure (CHF) Mortality Rate	0.2704
IQI 17	Acute Stroke Mortality Rate	0.1356
IQI 18	Gastrointestinal Hemorrhage Mortality Rate	0.1312
IQI 19	Hip Fracture Mortality Rate	0.0679
IQI 20	Pneumonia Mortality Rate	0.248
SUM		0.9999

Source: 2008 State Inpatient Databases, Healthcare Cost and Utilization Program, Agency for Healthcare Research and Quality

Additional Resources

See the AHRQ QI website for additional resources and downloads: http://www.qualityindicators.ahrq.gov/modules/iqi_resources.aspx.

Agency for Healthcare Research and Quality, "Inpatient Quality Indicators (IQI) Composite Measure Workgroup Final Report," (March 2008). The report is available at http://www.qualityindicators.ahrq.gov/modules/iqi_resources.aspx.