NQF-ENDORSED VOLUNTARY CONSENSUS STANDARDS FOR HOSPITAL CARE

Measure Information Form
Collected For: CMS Outcome Measures (Claims Based)

Measure Set: CMS Mortality Measures

Set Measure ID#: MORT-30-AMI

Performance Measure Name: Hospital 30-day, all-cause, risk-standardized mortality rate (RSMR) following acute myocardial infarction (AMI) hospitalization.

Description: The measure estimates a hospital-level, risk-standardized mortality rate (RSMR) for patients discharged from the hospital with a principal diagnosis of AMI.

Rationale: CMS developed the AMI 30-day mortality measure to complement the existing AMI process of care measures. Risk-standardized mortality rates (RSMRs) can provide important additional information about quality of care that is not currently captured by the process measures and is currently unavailable to hospitals. Variation in mortality, after adjusting for case-mix, may reflect differences in hospitals' general environments (such as coordination of care, patient safety policies, and staffing) or variation in care processes not measured in the current core measure set. Outcome measures can focus attention on a broader set of healthcare activities that affect patients' well-being. Moreover, improving outcomes is the ultimate goal of quality improvement, and so the inclusion of outcomes measures assists in attaining improvement goals.

AMI is a common condition with substantial mortality and morbidity and is part of the core measure set currently reported. The condition imposes a substantial burden on patients and the health care system, and there is marked variation in outcomes by institution.

Type of Measure: Outcome

Improvement Noted As: A decrease in the RSMR.

Numerator Statement:
This outcome measure does not have a traditional numerator and denominator like a core process measure (e.g., percentage of adult patients with diabetes aged 18-75 years receiving one or more hemoglobin A1c tests per year); thus, we are using this field to define our outcome. The calculation of the rate is defined below under Measure Calculation.

The outcome for this measure is 30-day all-cause mortality. We define mortality as death from any cause within 30 days after the index admission date.

Denominator Statement:
The target population for this measure includes admissions for Medicare Fee-for-Service (FFS) and Veteran Health Administration (VA) beneficiaries aged ≥65 years discharged from acute care non-federal hospitals or VA hospitals, having a principal discharge diagnosis of AMI.

Included Populations: Admissions for Medicare FFS and VA beneficiaries aged ≥65 years discharged from non-federal acute care hospitals or VA hospitals, having a principal discharge diagnosis of AMI.

CMS FFS beneficiaries with an index hospitalization within an acute care non-federal hospital are included if they have been enrolled in Part A and Part B Medicare for the 12 months prior to the date of admission to ensure a full year of administrative data for risk-adjustment. (This requirement is dropped for patients with an index admission within a VA hospital.)

For patients with more than one admission in a given year for a given condition, only one admission is randomly selected to include in the cohort (others are excluded). An index admission is the hospitalization considered for mortality outcome determination. The measure includes patients who are admitted to an acute care hospital with a diagnosis of AMI and then transferred to another acute facility if the primary discharge diagnosis is AMI at the second hospital. The measure considers admission to the first hospital as the start of an acute episode of care and assigns the patient‘s outcome to the hospital that initially admitted them.

ICD-9-CM codes that define the patient cohort:

410.00	AMI (anterolateral wall) – episode of care unspecified
410.01	AMI (anterolateral wall) – initial episode of care
410.10	AMI (other anterior wall) – episode of care unspecified
410.11	AMI (other anterior wall) – initial episode of care
410.20	AMI (inferolateral wall) – episode of care unspecified
410.21	AMI (inferolateral wall) – initial episode of care
410.30	AMI (inferoposterior wall) – episode of care unspecified
410.31	AMI (inferoposterior wall) – initial episode of care
410.40	AMI (other inferior wall) – episode of care unspecified
410.41	AMI (other inferior wall) – initial episode of care
410.50	AMI (other lateral wall) – episode of care unspecified
410.51	AMI (other lateral wall) – initial episode of care
410.60	AMI (true posterior wall) – episode of care unspecified
410.61	AMI (true posterior wall) – initial episode of care
410.70	AMI (subendocardial) – episode of care unspecified
410.71	AMI (subendocardial) – initial episode of care
410.80	AMI (other specified site) – episode of care unspecified
410.81	AMI (other specified site) – initial episode of care
410.90	AMI (unspecified site) – episode of care unspecified
410.91	AMI (unspecified site) – initial episode of care

Note: We do not include 410.x2 (AMI, subsequent episode of care)

Excluded Populations:
The measure excludes admissions for patients:

- who were discharged on the day of admission or the following day and did not die or get transferred (because it is less likely they had a diagnosis of AMI)
- with inconsistent or unknown mortality status or other unreliable data (e.g. date of death precedes admission date)
- who were transferred from another acute care hospital or VA hospital (because the death is attributed to the hospital where the patient was initially admitted)
- enrolled in the VA or Medicare Hospice programs any time in the 12 months prior to the index hospitalization including the first day of the index admission (since it is likely these patients are continuing to seek comfort measures only)
- who were discharged against medical advice (AMA) (because providers did not have the opportunity to deliver full care and prepare the patient for discharge)
- that were not the first hospitalization in the 30 days prior to a patient's death. This exclusion criterion is applied after one admission per patient per year is randomly selected. It only applies when two randomly selected admissions occur during the transition months (December and January for calendar-year data) and the patient subsequently dies. For example: a patient is admitted on December 18th, 2010 and readmitted on January 2nd, 2011; the patient dies on January 15th, 2011. If both of these admissions are randomly selected for inclusion (one for the 2010 calendar year time period and the other for the 2011 calendar year time period), the January 2, 2011 admission will be excluded to avoid assigning the death to two admissions (one in 2010 and one in 2011)

Risk Adjustment: For each patient, covariates are obtained from administrative data extending 12 months prior to, and including, the index admission. For all patients, information from Medicare inpatient claims, physician Part B claims and hospital outpatient claims are used for risk adjustment. For patients with an index admission in a VA hospital, VA administrative data is also obtained. Inpatient claim records have data on hospitalization for and include demographic information, principal and secondary diagnosis codes, and procedure codes. Diagnosis codes for comorbidities are also collected from physician and hospital outpatient files. These data are captured from the claim(s) for the index admission and from all inpatient and outpatient claims for the entire year before the patient's index AMI hospitalization to be utilized in the risk-adjustment model.

The VA administrative data includes 41 diagnosis and 46 procedure codes (as opposed to 25 and 25, respectively, in CMS administrative data). For the index hospitalization, all diagnosis and procedure codes were retained. For risk adjustment, all diagnosis and procedure codes were retained for visits prior to the index hospitalization.

Only variables that convey information about patients' clinical status at the time of admission are used for the risk-adjustment, while complications that arise during the course of patients' index hospitalization are not included in the model.

Full details of the development of the risk-standardization model for this measure are available at: http://www.qualitynet.org.

The final set of risk-adjustment variables included:

Demographics	Age-65 (years above 65, continuous) Male
Cardiovascular	History of PTCA History of CABG Congestive heart failure History of AMI Other acute/subacute forms of ischemic heart disease Anterior myocardial infarction Other location of myocardial infarction Chronic atherosclerosis Cardio-respiratory failure and shock Valvular and rheumatic heart disease
Comorbidity	Hypertension Stroke Cerebrovascular disease Renal failure Chronic Obstructive Pulmonary Disease Pneumonia Diabetes and DM complications Protein-calorie malnutrition Dementia and senility Hemiplegia, paraplegia, paralysis, functional disability Peripheral vascular disease Metastatic cancer, acute leukemia and other severe cancers Trauma in the last year Major psychiatric disorders Chronic liver disease

Model Validation: Hospital-specific risk-standardized mortality estimates derived from this claims-based model were compared to hospital-specific RSMRs based on a model developed using medical record data from the Cooperative Cardiovascular Project Initiative. The correlation coefficient of the RSMRs from the claims-based and medical record models was 0.90. Similarly, a medical record validation was conducted for use of the measures for VA hospitals.

Data Accuracy: The administrative claims data used to calculate the measure are maintained by CMS' Office of Information Services. These data undergo additional quality assurance checks during measure development and maintenance.

The data used to identify index admissions as well as inpatient and outpatient histories for the VA index hospitalizations come from administrative data extracted from the National Patient Care Database, originally constituted from the patient treatment files of each VA hospital.

Measure Analysis Suggestions: None

Sampling: No.

Data Reported As: Hospital 30-day, all-cause, risk-standardized mortality rate (RSMR) following acute myocardial infarction (AMI) hospitalization.

Measure Calculation:
The measure estimates hospital-level 30-day all-cause RSMR for AMI using hierarchical logistic regression modeling (a form of hierarchical generalized linear modeling [HGLM]). In brief, the approach simultaneously models two levels (patient and hospital) to account for the variance in patient outcomes within and between hospitals. At the patient level, the model adjusts the log-odds of mortality within 30 days of admission for age, sex, selected clinical covariates, and a hospital-specific intercept. At the hospital level, it models the hospital-specific intercepts as arising from a normal distribution. The hospital intercept represents the underlying risk of mortality at the hospital, after accounting for patient risk. The hospital-specific intercepts are given a distribution in order to account for the clustering (non-independence) of patients within the same hospital. If there were no differences among hospitals, then after adjusting for patient risk, the hospital intercepts should be identical across all hospitals.

The RSMR is calculated as the ratio of the number of “predicted” deaths to the number of “expected” deaths, multiplied by the national unadjusted mortality rate. For each hospital, the “numerator” of the ratio is the number of deaths within 30 days predicted on the basis of the hospital’s performance with its observed case-mix, and the “denominator” is the number of deaths expected on the basis of the nation’s performance with that hospital’s case-mix. This approach is analogous to a ratio of “observed” to “expected” used in other types of statistical analyses. It conceptually allows for a comparison of a particular hospital’s performance given its case-mix to an average hospital’s performance with the same case-mix. Thus, a lower ratio indicates lower-than-expected mortality or better quality, and a higher ratio indicates higher-than-expected mortality or worse quality.

The predicted number of deaths (the numerator) is calculated by regressing the risk factors and the hospital-specific intercept on the risk of mortality, multiplying the estimated regression coefficients by the patient characteristics in the hospital, transforming, and then summing over all patients attributed to the hospital to get a value. The expected number of deaths (the denominator) is obtained by regressing the risk factors and a common intercept on the mortality outcome using all hospitals in our sample, multiplying the subsequent estimated regression coefficients by the patient characteristics observed in the hospital, transforming, and then summing over all patients in the hospital to get a value. To assess hospital performance in any reporting period, we re-estimate the model coefficients using the years of data in that period.

The statistical modeling approach is described fully in the original methodology report.

Selected References:

- Krumholz HM, et al. *Risk-Adjustment Models for AMI* and *HF 30-Day Mortality Methodology*. Report prepared for Centers for Medicare & Medicaid Services. (report can be accessed in the Mortality Measures section of http://www.qualitynet.org).
- Krumholz HM, Wang Y, Mattera JA, Wang Y, Han LF, Ingber MJ, Roman S, Normand SLT. An administrative claims model suitable for profiling hospital performance based on 30-day mortality rates among patients with an acute myocardial infarction. *Circulation*.2006;113:1683-92.
- Krumholz HM, et al. 2008. Acute Myocardial Infarction, Heart Failure, and Pneumonia Mortality Measures Maintenance Technical Report. Report prepared for the Centers for Medicare & Medicaid Services (accessed in the Mortality Measures section of http://www.qualitynet.org).
- Krumholz HM, Brindis RG, Brush JE, et al. 2006. Standards for Statistical Models Used for Public Reporting of Health Outcomes: An American Heart Association Scientific Statement From the Quality of Care and Outcomes Research Interdisciplinary Writing Group: Cosponsored by the Council on Epidemiology and Prevention and the Stroke Council Endorsed by the American College of Cardiology Foundation. *Circulation* 113: 456-462.
- Normand S-LT, Shahian DM. 2007. Statistical and clinical aspects of hospital outcomes profiling. *Stat Sci* 22(2):206-226.