

NQF-ENDORSED VOLUNTARY CONSENSUS STANDARDS FOR HOSPITAL CARE

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

Measure Set: CMS CABG Mortality Measure

Set Measure ID #: MORT-30-CABG

Performance Measure Name: Hospital 30-Day, All-Cause, Risk-Standardized Mortality Rate (RSMR) Following Coronary Artery Bypass Graft (CABG) Surgery

Description:

The measure estimates a hospital-level, risk-standardized mortality rate (RSMR) for patients 18 years and older discharged from the hospital following a qualifying isolated CABG procedure. Mortality is defined as death from any cause within 30 days of the procedure date of an index CABG admission. The measure was developed using Medicare Fee-for-Service (FFS) patients 65 years and older and was tested in all-payer patients 18 years and older. An index admission is the hospitalization for a qualifying isolated CABG procedure considered for the mortality outcome.

Rationale:

A hospital-level, 30-day all-cause mortality measure will provide hospitals with an incentive to reduce mortality through improved coordination of perioperative care and strengthen incentives for quality improvement, particularly for peri- and post-operative care and care at the time of transitions (e.g., discharge to home or a skilled nursing facility). Improvements in inpatient surgical and perioperative care and care transitions for this common, costly procedure are likely to reduce mortality rates.

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. Mortality is defined as death for any reason within 30 days of the procedure date from the index admission for patients 18 and older discharged from the hospital after undergoing isolated CABG surgery.

Denominator Statement:

This claims-based measure can be used in either of two patient cohorts: (1) patients aged 65 years or older or (2) patients aged 18 years or older. We have tested the measure in both age groups.

The cohort includes admissions for patients who receive a qualifying isolated CABG procedure (see codes below) and with a complete claims history for the 12 months prior to admission. For simplicity of implementation and as testing demonstrated closely correlated patient-level and hospital-level results using models with or without age interaction terms, the only recommended modification to the measure for application to all-payer data sets is replacement of the “Age-65” variable with a fully continuous age variable.

If a patient has more than one qualifying isolated CABG admission in a year, one hospitalization is randomly selected for inclusion in the measure.

Included Populations:

Admissions for Medicare FFS greater than or equal to 65 years of age discharged from non-federal acute care hospitals, having a qualifying isolated CABG procedure (i.e., CABG surgeries that DO NOT occur concomitantly with excluded procedures or procedure groups such as aortic valve replacement). Please see the tables below for lists of codes that define relevant CABG procedures as well as the concurrent procedure groups that remove patients from being considered as having undergone an “isolated CABG” surgery.

ICD-9-CM codes that define the index CABG procedure:

- 36.1x - Aortocoronary bypass for heart revascularization, not otherwise specified
- 36.11 - (Aorto) coronary bypass of one coronary artery
- 36.12 - (Aorto) coronary bypass of two coronary arteries
- 36.13 - (Aorto) coronary bypass of three coronary arteries
- 36.14 - (Aorto) coronary bypass of four or more coronary arteries
- 36.15 - Single internal mammary- coronary artery bypass
- 36.16 - Double internal mammary- coronary artery bypass
- 36.17 - Abdominal- coronary artery bypass
- 36.19 - Other bypass anastomosis for heart revascularization

Concurrent procedure groups that remove patients from isolated CABG cohort:

Procedure groups <u>NOT</u> considered “isolated CABG” ¹	Rationale
<ul style="list-style-type: none"> • Valve procedures • Atrial and/or ventricular septal defects • Congenital anomalies • Other open cardiac procedures • Heart transplants • Aorta or other non-cardiac arterial bypass procedures • Head, neck, intracranial vascular procedures 	<ul style="list-style-type: none"> • Represent higher risk population of patients • Aligned with Society of Thoracic Surgery measures (to the extent possible given data limitations)

¹For full list of codes see Table 1.

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.

For patients with more than one qualifying admission in a given year, only one admission is randomly selected to include in the cohort (others are excluded). An index admission is the hospitalization considered for the mortality outcome determination.

The measure includes patients who are admitted to an acute care hospital for an isolated CABG procedure and then transferred to another acute facility. The measure considers admission to the first hospital, where the index CABG procedure was performed, as the start of an acute episode of care and assigns the patient's outcome to the hospital that initially admitted them.

Cohort exclusions (excluded admissions):

Hospitalizations are excluded if they meet any of the following criteria. Hospitalizations for:

- 1) Patients with inconsistent or unknown vital status or other unreliable data.

Rationale: We exclude these because the outcome cannot be adequately measured in these patients.

- 2) Patients who leave the hospital against medical advice (AMA)

Rationale: We exclude hospitalizations for patients who are discharged AMA because providers did not have the opportunity to deliver full care and prepare the patient for discharge.

- 3) Patients with qualifying CABG procedures subsequent to another qualifying CABG procedure during the measurement period

Rationale: CABG procedures are expected to last for several years without the need for revision or repeat revascularization. A repeat CABG procedure during the measurement period very likely represents a complication of the original CABG procedure and is a clinically more complex and higher risk surgery. We, therefore, select the first CABG admission for inclusion in the measure and exclude subsequent CABG admissions from the cohort.

Risk Adjustment:

The measures adjust for variables (i.e., age, comorbid diseases, and indicators of patient frailty) that are clinically relevant and have strong relationships with the outcome. For each patient, risk-adjustment variables are obtained from inpatient, outpatient, and provider Medicare administrative claims data extending 12 months prior to, and including, the index admission.

The measures adjust for case mix differences among hospitals based on the clinical status of the patient at the time of the index admission. Accordingly, only comorbidities that convey information about the patient at that time or in the 12 months prior, and not complications that arise during the course of the hospitalization, are included in the risk adjustment.

The measures do not adjust for patients' admission source or their discharge disposition (e.g., skilled nursing facility) because these factors are associated with the structure of the healthcare system, not solely patients' clinical comorbidities. Regional differences in the availability of post-acute care providers and practice patterns might exert undue influence on model results.

The final set of risk-adjustment variables included:

Demographics	Age (per year >65) Gender (Male)
Comorbidity	History of Prior CABG or Valve Surgery Cardiogenic Shock Cancer Protein-calorie Malnutrition Obesity/Disorders of Thyroid, Cholesterol, Lipids Liver and Biliary Disease Other Gastrointestinal Disorders Dementia or Other Specified Brain Disorders Hemiplegia, Paraplegia, Paralysis, Functional Disability Congestive Heart Failure Acute Myocardial Infarction Unstable Angina and Other Acute Ischemic Heart Disease Angina Pectoris/Old Myocardial Infarction Coronary Atherosclerosis/Other Chronic Ischemic Heart Disease Hypertension Stroke Vascular Disease and Complications or Circulatory Disease Chronic Obstructive Pulmonary Disease Pneumonia End-stage Renal Disease or Dialysis Renal Failure Decubitus Ulcer or Chronic Skin Ulcer

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

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 New York State Cardiac Surgery Reporting System (CSRS) from the New York Department of Health. The correlation coefficient of the RSMRs from the claims-based and medical record models was 0.90.

Data Collection Approach: Medicare claims data

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.

Measure Analysis Suggestions: None

Sampling: No

Data Reported As: Hospital 30-day, all-cause, risk-standardized mortality rate (RSMR) following coronary artery bypass graft (CABG) surgery

Measure Calculation:

The measure estimates hospital-level 30-day all-cause RSMR using hierarchical logistic regression models. In brief, the approach simultaneously models data at the patient and hospital levels to account for the variance in patient outcomes within and between hospitals. At the patient level, it models the log-odds of death within 30 days/ using age, selected clinical covariates, and a hospital-specific intercept. At the hospital level, the approach 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 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 at a given hospital, multiplied by the national observed mortality rate. For each hospital, the numerator of the ratio is the number of deaths within 30 days predicted based on the hospital’s performance with its observed case mix, and the denominator is the number of deaths expected based on 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 a particular hospital’s performance, given its case mix, to be compared to an average hospital’s performance with the same case mix. Thus, a lower ratio indicates lower-than-expected mortality rates or better quality, while a higher ratio indicates higher-than-expected mortality rates or worse quality.

The “predicted” number of deaths (the numerator) is calculated by using the coefficients estimated by regressing the risk factors and the hospital-specific intercept on the risk of mortality. The estimated hospital-specific intercept is added to the sum of the estimated regression coefficients multiplied by the patient characteristics. The results are transformed and summed over all patients attributed to a hospital to get a predicted value. The “expected” number of deaths (the denominator) is obtained in the same manner, but a common intercept using all hospitals in our sample is added in place of the hospital-specific intercept. The results are transformed and summed over all patients in the hospital to get an expected value. To assess hospital performance for each reporting period, we re-estimate the model coefficients using the years of data in that period.

This calculation transforms the ratio of predicted over expected into a rate that is compared to the national observed readmission rate. The hierarchical logistic regression models are described fully in the original methodology reports.

Selected References:

- Drye E, Krumholz H, Vellanky S, Wang Y. Probing New Conditions and Procedures for New Measure Development: Yale New Haven Health Systems Corporation; Center for Outcomes Research and Evaluation.; 2009:1-7.
- Massachusetts Data Analysis Center. Adult Coronary Artery Bypass Graft Surgery in the Commonwealth of Massachusetts: Hospital and Surgeons Risk-Standardized 30-Day Mortality Rates. In: Health MDoP, ed. Boston2009:77.
- Pennsylvania Health Care Cost Containment Council. Cardiac Surgery in Pennsylvania 2008-2009. Harrisburg2011:60.
- American New York State Department of Health. Adult Cardiac Surgery in New York State 2006-20082010:54.
- Normand S-LT, Shahian DM. 2007. Statistical and clinical aspects of hospital outcomes profiling. *Stat Sci* 22 (2): 206-226.
- Suter L.G., Wang, C., Vellanky S., Potteiger J., Curtis J., Lin Z., Geary L.L., Krumholz H.M., Drye E.D. Hospital-level 30-day All-Cause Mortality Following Coronary Artery Bypass Graft Surgery: Report prepared for the Centers for Medicare & Medicaid Services. 2012.

Table 1 - Codes used to Identify Non-Isolated CABG Procedures and Not Included in Final Cohort

EXCLUDE from CABG cohort if 36.1x occurs with any of the following:	Description	N*	Category
0.61	Percutaneous angioplasty or atherectomy of precerebral (extracranial) vessel(s)	105	Head, neck, intracranial vascular procedure
0.62	Percutaneous angioplasty or atherectomy of intracranial vessel(s)	11	Head, neck, intracranial vascular procedure
0.63	Percutaneous insertion of carotid artery stent(s)	102	Head, neck, intracranial vascular procedure
0.64	Percutaneous insertion of other precerebral (extracranial) artery stent(s)	6	Head, neck, intracranial vascular procedure
0.65	Percutaneous insertion of intracranial vascular stent(s)	2	Head, neck, intracranial vascular procedure
32.4x	Lobectomy with segmental resection of adjacent lobes of lung, excludes that with radical dissection [excision] of thoracic structures	23	Lobectomy
33.5x	Lung transplant	20	Lung Transplant

* N indicates the number of patients excluded from the CABG cohort

EXCLUDE from CABG cohort if 36.1x occurs with any of the following:	Description	N*	Category
33.6	Combined heart-lung transplantation	0	Lung Transplant
35.00	Closed heart valvotomy, unspecified valve	0	Valve procedures
35.01	Closed heart valvotomy, aortic valve	1	Valve procedures
35.02	Closed heart valvotomy, mitral valve	3	Valve procedures
35.03	Closed heart valvotomy, pulmonary valve	0	Valve procedures
35.04	Closed heart valvotomy, tricuspid valve	0	Valve procedures
35.10	Open heart valvuloplasty without replacement, unspecified valve	2	Valve procedures
35.11	Open heart valvuloplasty of aortic valve without replacement	232	Valve procedures
35.12	Open heart valvuloplasty of mitral valve without replacement	3,636	Valve procedures
35.13	Open heart valvuloplasty of pulmonary valve without replacement	9	Valve procedures
35.14	Open heart valvuloplasty of tricuspid valve without replacement	621	Valve procedures
35.20	Replacement of unspecified heart valve	2	Valve procedures
35.21	Replacement of aortic valve with tissue graft	15,503	Valve procedures
35.22	Other replacement of aortic valve	6,554	Valve procedures
35.23	Replacement of mitral valve with tissue graft	2,614	Valve procedures
35.24	Other replacement of mitral valve	1,680	Valve procedures
35.25	Replacement of pulmonary valve with tissue graft	9	Valve procedures
35.26	Other replacement of pulmonary valve	4	Valve procedures
35.27	Replacement of tricuspid valve with tissue graft	47	Valve procedures

EXCLUDE from CABG cohort if 36.1x occurs with any of the following:	Description	N*	Category
35.28	Other replacement of tricuspid valve	53	Valve procedures
35.31	Operations on papillary muscle	10	Valve procedures
35.32	Operations on chordae tendineae	75	Valve procedures
35.33	Annuloplasty	3,189	Valve procedures
35.34	Infundibulectomy	0	Valve procedures
35.35	Operations on trabeculae carneaе cordis	1	Valve procedures
35.39	Operations on other structures adjacent to valves of heart	53	Valve procedures
35.41	Enlargement of existing atrial septal defect	2	Atrial Septal Defect
35.42	Creation of septal defect in heart	1	Atrial Septal Defect
35.50	Repair of unspecified septal defect of heart with prosthesis	0	Atrial Septal Defect
35.51	Repair of atrial septal defect with prosthesis, open technique	36	Atrial Septal Defect
35.52	Repair of atrial septal defect with prosthesis, closed technique	32	Atrial Septal Defect
35.53	Repair of ventricular septal defect with prosthesis, open technique	33	Ventricular Septal Defect
35.54	Repair of endocardial cushion defect with prosthesis	2	Ventricular Septal Defect
35.55	Repair of ventricular septal defect with prosthesis, closed technique	0	Ventricular Septal Defect
35.60	Repair of unspecified septal defect of heart with tissue graft	1	Ventricular Septal Defect
35.61	Repair of atrial septal defect with tissue graft	62	Atrial Septal Defect
35.62	Repair of ventricular septal defect with tissue graft	41	Ventricular Septal Defect
35.63	Repair of endocardial cushion defect with tissue graft	5	Ventricular Septal Defect
35.70	Other and unspecified repair of unspecified septal defect of heart	41	Ventricular Septal Defect

EXCLUDE from CABG cohort if 36.1x occurs with any of the following:	Description	N*	Category
35.71	Other and unspecified repair of atrial septal defect	1,101	Atrial Septal Defect
35.72	Other and unspecified repair of ventricular septal defect	60	Ventricular Septal Defect
35.73	Other and unspecified repair of endocardial cushion defect	6	Ventricular Septal Defect
35.81	Total repair of tetralogy of Fallot	1	Correction of congenital anomalies
35.82	Total repair of total anomalous pulmonary venous connection	4	Correction of congenital anomalies
35.83	Total repair of truncus arteriosus	0	Correction of congenital anomalies
35.84	Total correction of transposition of great vessels, not elsewhere classified	1	Correction of congenital anomalies
35.91	Interatrial transposition of venous return	3	Correction of congenital anomalies
35.92	Creation of conduit between right ventricle and pulmonary artery	0	Correction of congenital anomalies
35.93	Creation of conduit between left ventricle and aorta	7	Correction of congenital anomalies
35.94	Creation of conduit between atrium and pulmonary artery	0	Correction of congenital anomalies
35.95	Revision of corrective procedure on heart	14	Correction of congenital anomalies
35.96	Percutaneous valvuloplasty	7	Valve procedures
35.98	Other operations on septa of heart	2	Ventricular Septal Defect
35.99	Other operations on valves of heart	23	Other valve procedures
37.31	Pericardiectomy	255	Repair/restoration of pericardium
37.32	Excision of aneurysm of heart	430	Other open cardiac procedures
37.33	Excision or destruction of other lesion or tissue of heart, open approach	4,784	Other open cardiac procedures
37.35	Partial ventriculectomy	6	Other open cardiac procedures
37.51	Heart transplantation	1	Heart transplant

EXCLUDE from CABG cohort if 36.1x occurs with any of the following:	Description	N*	Category
37.52	Implantation of total internal biventricular heart replacement system	0	Heart replacement procedures
37.53	Replacement or repair of thoracic unit of (total) replacement heart system	0	Heart replacement procedures
37.54	Replacement or repair of other implantable component of (total) replacement heart system	0	Heart replacement procedures
37.55	Removal of internal biventricular heart replacement system	1	Heart replacement procedures
37.63	Repair of heart assist system	12	Circulatory assist devices (includes VAD)
37.67	Implantation of cardiomyostimulation system	0	Circulatory assist devices (includes VAD)
38.11	Head and Neck Endarterectomy	3	Head, neck, intracranial vascular procedure
38.12	Endarterectomy, other vessels of head and neck	2,033	Head, neck, intracranial vascular procedure
38.14	Endarterectomy of Aorta	372	Aorta or other non-cardiac arterial bypass procedures
38.15	Thoracic Endarterectomy	12	Aorta or other non-cardiac arterial bypass procedures
38.16	Endarterectomy: Excision of tunica intima of artery to relieve arterial walls thickened by plaque or chronic inflammation. Location includes abdominal arteries excluding abdominal aorta: Celiac, Gastric, Hepatic, Iliac, Mesenteric, Renal, Splenic, Umbi	12	Aorta or other non-cardiac arterial bypass procedures
38.17	Endarterectomy - abdominal veins: Iliac, Portal, Renal, Splenic, Vena cava.	0	Aorta or other non-cardiac arterial bypass procedures

EXCLUDE from CABG cohort if 36.1x occurs with any of the following:	Description	N*	Category
38.34	Resection of vessel with replacement: Angiectomy, excision of aneurysm (arteriovenous), blood vessel (lesion) with anastomosis (4=aorta, abdominal)	0	Aorta or other non-cardiac arterial bypass procedures
38.42	Resection of vessel with replacement: Angiectomy, excision of aneurysm with replacement (2= other vessels of head and neck; carotid, jugular)	4	Head, neck, intracranial vascular procedure
38.44	Resection of vessel with replacement, aorta, abdominal	203	Aorta or other non-cardiac arterial bypass procedures
38.45	Resection of vessel with replacement, thoracic vessels	1,612	Aorta or other non-cardiac arterial bypass procedures
39.21	Caval-pulmonary artery anastomosis	2	Aorta or other non-cardiac arterial bypass procedures
39.22	Aorta-subclavian-carotid bypass	75	Aorta or other non-cardiac arterial bypass procedures
39.23	Other intrathoracic vascular shunt or bypass	4	Aorta or other non-cardiac arterial bypass procedures
39.24	Aorta-renal bypass	2	Aorta or other non-cardiac arterial bypass procedures
39.25	Aorta-iliac-femoral bypass	13	Aorta or other non-cardiac arterial bypass procedures
39.26	Other intra-abdominal vascular shunt or bypass	5	Aorta or other non-cardiac arterial bypass procedures
39.28	Extracranial-intracranial (EC-IC) vascular bypass	0	Head, neck, intracranial vascular procedure
39.29	Other (peripheral) vascular shunt or bypass	151	Aorta or other non-cardiac arterial bypass procedures

EXCLUDE from CABG cohort if 36.1x occurs with any of the following:	Description	N*	Category
39.71	Endovascular implantation of graft in abdominal aorta	69	Aorta or other non-cardiac arterial bypass procedures
39.72	Endovascular embolization or occlusion of head and neck vessels	4	Head, neck, intracranial vascular procedure
39.73	Endovascular implantation of graft in thoracic aorta	82	Aorta or other non-cardiac arterial bypass procedures
39.74	Endovascular removal of obstruction from head and neck vessel(s)	22	Head, neck, intracranial vascular procedure
39.75	Endovascular embolization or occlusion of vessel(s) of head or neck using bare coils	0	Head, neck, intracranial vascular procedure
39.76	Endovascular embolization or occlusion of vessel(s) of head or neck using bioactive coils	0	Head, neck, intracranial vascular procedure
39.79	Other endovascular procedures on other vessels	62	Aorta or other non-cardiac arterial bypass procedures
85.22	Resection of quadrant of breast	0	Mastectomy
85.23	Subtotal Mastectomy, which excludes quadrant resection (85.22)	0	Mastectomy
85.4x	Mastectomy - includes simple/extended simple, unilateral/bilateral, radical/extended radical	1	Mastectomy