NATIONAL QUALITY FORUM

Resource Use Measure Evaluation 1.0
January 2011

This form contains the measure information submitted by stewards. Blank fields indicate no information was provided. Attachments also may have been submitted and are provided to reviewers. The subcriteria and most of the footnotes from the evaluation criteria are provided in Word comments within the form and will appear if your cursor is over the highlighted area. Hyperlinks to the evaluation criteria and ratings are provided in each section.

Resource Use Definition:

- Resource use measures are broadly applicable and comparable measures of input counts—(in terms of units or dollars)-- applied to a population or population sample
- Resource use measures count the frequency of specific resources; these resource units may be monetized, as appropriate.
- The approach to monetizing resource use varies and often depends on the perspective of the measurer and those being measured. Monetizing resource use allows for the aggregation across resources.

NQF Staff: NQF staff will complete a preliminary review of the measure to ensure conditions are met and the form has been completed according to the developer's intent. Staff comments have been highlighted in green.

TAP/Workgroup (if utilized)**:** Complete all yellow highlighted areas of the form. Evaluate the extent to which each subcriterion is met. Based on your evaluation, summarize the strengths and weaknesses in each section.

Note: *If there is no TAP or workgroup, the SC also evaluates the subcriteria (yellow highlighted areas)*.

Steering Committee: Complete all pink highlighted areas of the form. Review the workgroup/TAP assessment of the subcriteria, noting any areas of disagreement; then evaluate the extent to which each major criterion is met; and finally, indicate your recommendation for the endorsement. Provide the rationale for your ratings.

Evaluation ratings of the extent to which the subcriteria are met (TAP or Steering Committee)
High (H) – based on the information submitted, there is high confidence (or certainty) that the criterion is met
Moderate (M) – based on the information submitted, there is moderate confidence (or certainty) that the criterion is met
Low (L) - based on the information submitted, there is low confidence (or certainty) that the criterion is met
Insufficient (I) – there is insufficient information submitted to evaluate whether the criterion is met, e.g., blank, incomplete, or information is not relevant, responsive, or specific to the particular question (unacceptable)
Not Applicable (NA) - Not applicable (only an option for a few subcriteria as indicated)

Evaluation ratings of whether the measure met the overall criterion (Steering Committee)
Yes (Y)- The overall criteria has been met
No (N)-The overall criterion has NOT been met
High (H) – There is high confidence (or certainty) that the criterion is met
Moderate (M) – There is moderate confidence (or certainty) that the criterion is met
Low (L) - There is low confidence (or certainty) that the criterion is met

Recommendations for endorsement (Steering Committee)
Yes (Y) – The measure should be recommended for endorsement
No (N)-The measure should NOT be recommended for endorsement
Abstain (A)- Abstain from voting to recommend the measure

TAP/Workgroup Reviewer Name:	
Steering Committee Reviewer Name:	
Staff Reviewer Name(s):	
NQF Review #: 1570	**NQF Project:** Endorsing Resource Use Standards- Phase II

BRIEF MEASURE INFORMATION
Measure Title: Acute myocardial infarction episode-of-care for 30 days following onset
Measure Steward (IP Owner): American Board of Medical Specialties Research and Education Foundation, 222 N. LaSalle St., Suite 1500, Chicago, Illinois, 60601
Brief description of measure: Resource use and costs associated with acute myocardial infarction (AMI) episode during the acute period. The acute period is defined as 30 days following initial hospitalization for an AMI event. An index AMI event is identified and all AMI-related services are identified in the 30 days following the onset of the acute event. Total AMI-related costs are calculated for each patient and summarized at the attributable hospital level. Observed costs are compared to risk-adjusted expected costs at the hospital level.
Resource use service categories: Inpatient services: Inpatient facility services Inpatient services: Evaluation and management Inpatient services: Procedures and surgeries Inpatient services: Imaging and diagnostic Inpatient services: Lab services Inpatient services: Admissions/discharges Ambulatory services: Outpatient facility services Ambulatory services: Emergency Department Ambulatory services: Pharmacy Ambulatory services: Evaluation and management Ambulatory services: Procedures and surgeries Ambulatory services: Imaging and diagnostic Ambulatory services: Lab services
Brief description of measure clinical logic: Resource use and costs associated with acute myocardial infarction (AMI) episode during the acute period. The acute period is defined as 30 days following initial hospitalization for an AMI event. An index AMI event is identified and all AMI-related services are identified in the 30 days following the onset of the acute event. Total AMI-related costs are calculated for each patient and summarized at the attributable hospital level. Observed costs are compared to risk-adjusted expected costs at the hospital level.
If included in a composite or paired with another measure, please identify composite or paired measure:
Subject/ Topic Areas: Cardiovascular
Type of resource use measure: Per episode
Data Type: Administrative claims Other

CONDITIONS FOR CONSIDERATION BY NQF	
Four conditions must be met before proposed measures may be considered and evaluated for suitability as voluntary consensus standards:	**NQF Staff**
A. Measure Steward Agreement. ***The measure is in the public domain or an intellectual property (measure steward agreement) is signed. Public domain only applies to governmental organizations. All non-government organizations must sign a measure steward agreement even if measures are made publicly and freely available.*** **A.1.Do you attest that the measure steward holds intellectual property rights to the measure? (If no, do not submit)**	**A** **Y☐** **N☐**

Yes **A.2. Please check if either of the following apply:** **A.3. Measure Steward Agreement.** Agreement signed and submitted **A.4. Measure Steward Agreement attached:**	
B. Maintenance. ***The measure owner/steward verifies there is an identified responsible entity and process to maintain and update the measure on a schedule that is commensurate with the rate of clinical innovation, but at least every 3 years. (If no, do not submit)*** Yes, information provided in contact section	**B** **Y☐** **N☐**
C. Purpose/ Use *(All the purposes and/or uses for which the measure is specified and tested:* Quality Improvement (Internal to the specific organization)	**C** **Y☐** **N☐**
D. Testing. ***The measure is fully specified and tested for reliability and validity (See guidance on measure testing).*** Yes, reliability and validity testing completed	**D** **Y☐** **N☐**
E. Harmonization and Competing Measures. ***Have NQF-endorsed measures been reviewed to identify if there are related or competing measures? (List the NQF # and title in the section on related and competing measures)*** Yes ***E.1.*Do you attest that measure harmonization issues with related measure (either the same measure focus or the same target population) have been considered and addresses as appropriate? (List the NQF # and title in the section on related and competing measures)** No related measures *E.2.Do you attest that competing measures (both the same measure focus and the same target population) have been considered and addressed where appropriate?* No competing measures	**E** **Y☐** **N☐**
F. Submission Complete. ***The requested measure submission information is complete and responsive to the questions so that all the information needed to evaluate all criteria is provided.***	**F** **Y☐** **N☐**
Have all conditions for consideration been met? **Staff Notes to Steward** (*if submission returned*)**:**	**Y ☐** **N ☐**
Staff Notes to Reviewers (*issues or questions regarding any criteria*)**:**	
File Attachments Related to Measure/Criteria: Attachment:	

Attachment: S5_Data Dictionary-634343572803699640.pdf
Attachment:
Attachment:
Attachment:
Attachment:
Attachment:
Attachment:
Attachment: 10.1_Risk adjustment method-634343583695504932.pdf
S12_sample score report-634345780927019254.pdf
Attachment: SA_Reliability_Validity Testing AMI Acute.pdf

IMPORTANCE TO MEASURE AND REPORT	
Extent to which the specific measure focus is important to making significant gains in health care quality (safety, timeliness, effectiveness, efficiency, equity, patient-centeredness) and improving health outcomes for a specific high impact aspect of healthcare where there is variation in performance. **Importance to Measure and Report is a threshold criterion that must be met in order to recommend a measure for endorsement. All subcriteria must be met to pass this criterion.**	**Eval Rating**
High Impact **IM1. Demonstrated high impact aspect of healthcare:** A leading cause of morbidity/mortality High resource use **IM1.1. Summary of evidence of high impact:** The Institute of Medicine and AQA have identified acute myocardial infarction (AMI) as one of twenty conditions that should be considered a priority area in need of quality improvement based on the prevalence of the condition, its impact on morbidity and mortality, and the opportunity to significantly improve the quality of related care. The prevalence of AMI in the United States is great. In 2009, an estimated 785,000 Americans will have a new acute myocardial infarction (AMI), and about 470,000 will have a recurrent attack (1). It is estimated that an additional 195,000 silent first myocardial infarctions occur every year(1). Put another way, about every 35 seconds an American will have an AMI, and about every minute someone will die from one (1). When adjusted for race, AMI prevalence varies slightly. In the Atherosclerosis Risk in Communities (ARIC) study, the annual age-adjusted rates per 1000 population of first MI (1987-2001) were 4.2 in black men, 3.9 in white men, 2.8 in black women and 1.7 in white women (2). Due to such a high prevalence, society pays a high price for AMI health care. The estimated direct and indirect cost of coronary heart disease for 2009 is $165.4 billion (1). In 2006, hospital discharges cost between $14,0091 and $17,500 per discharge for a total of nearly $12 billion nationwide (3). Aside from cost, the detrimental impact of AMI on Americans is substantial. The estimated average number of years of life lost because of an MI is 15 (4). People who have had an MI have a sudden death rate 4-6 times that of the general population (5). Depending on their sex and clinical outcome, people who survive the acute stage of an MI have a chance of illness and death 1.5 to 15 times higher than that of the general population (5). As the treatment of AMI evolves, trends in mortality appear to be decreasing. According to data from the National Health and Nutrition Examination Survey (NHANES), from 1980 to 2000, there was an estimated 47% decrease in deaths from coronary heart disease which was attributed to initial treatments of AMI (10%) and secondary preventive therapies after MI or revascularization (11%)(6). According to data from the National Registry of Myocardial Infarction(7): from 1990 to 1999 in-hospital AMI mortality declined from 11.2% to 9.4%. Among Medicare patients between 1994 and 2004, the overall inpatient mortality rate declined from 124.9 to 81.7 deaths per 1000 admissions with AMI(8). Part of the improvement in mortality is due to improved adherence to national treatment guidelines. For example, according to data from the 2007 National Healthcare Quality Report, all 6 of the component measures recommended for care for Medicare AMI patients showed improvement, including aspirin within 24 hours of admission (81.5% to 95.3%), aspirin at discharge (85.9% to 95.6%), counseling for smoking cessation (42.7% to 90.0%), Beta-blocker within 24 hours	**1a** **H☐** **M☐** **L☐** **I☐**

of admission (69.3% to 91.5%) and Beta-blocker at discharge (78.5% to 94.5%)(8). As patients leave the hospital improved medication adherence may further reduce AMI mortality. Yet, in a 19-center prospective registry of patients discharged on aspirin, Beta-blockers, and statins after AMI, ~12% of discontinued all 3 medications within 1 month of hospital discharge (9).

According to national guidelines, AMI is divided into two groups according to changes on electrocardiogram (10, 11). The two groups are comprised of "ST" segment elevation myocardial infarction (STEMI) and "non-ST" segment elevation myocardial infarction (NSTEMI). According to National Registry of Myocardial Infarction 4 (12), ~29% of MI patients are STEMI patients. While the evidence base and clinical practice guidelines differ for the two, quality improvement measures group STEMI and non-STEMI events together. This grouping occurs because many of the interventions between the two are similar and it is often not possible to differentiate the events in administrative datasets (13). Therefore, this measure groups STEMI and NSTEMI into a single metric while acknowledging the differences in resource use and quality of care makes it important separate the two in the future when possible (12).

While AMI is primarily an acute condition managed in the hospital setting, the successful management of patients that are post-AMI also involves need for longer-term treatment and secondary prevention (10).

IM1.2. Citations for evidence of high impact cited in IM1.1.:

1. Lloyd-Jones D, Adams R, Carnethon M, et al. Heart disease and stroke statistics--2009 update: a report from the American Heart Association Statistics Committee and Stroke Statistics Subcommittee. Circulation 2009;119:480-6.
2. National Heart L, and Blood Institute. Incidence and Prevalence: 2006 Chart Book on Cardiovascular and Lung Diseases. Bethesda: National Institutes of Health; 2006.
3. Health Care and Utilization Project. (Accessed March 2009, at http://hcupnet.ahrq.gov.)
4. Kung HC, Hoyert DL, Xu J, Murphy SL. Deaths: final data for 2005. Natl Vital Stat Rep 2008;56:1-120.
5. Thorn TJ KW, Silbershatz H, D´Agostino RB. Cardiovascular disease in the United States and preventive approaches. In: Fuster V AR, ed. Hurst´s The Heart, Arteries and Veins. 10th ed ed. New York, NY: McGraw-Hill; 2001.
6. Ford ES, Ajani UA, Croft JB, et al. Explaining the decrease in U.S. deaths from coronary disease, 1980-2000. N Engl J Med 2007;356:2388-98.
7. National Registry of Myocardial Infarction. (Accessed February 20, 2008, at http://www.nrmi.org/nrmi_data.html.)
8. 2007 National Healthcare Quality Report. Rockville: US Department of Helath and Human Services; 2008.
9. Ho PM, Spertus JA, Masoudi FA, et al. Impact of medication therapy discontinuation on mortality after myocardial infarction. Arch Intern Med 2006;166:1842-7.
10. Antman EM, Anbe DT, Armstrong PW, et al. ACC/AHA guidelines for the management of patients with ST-elevation myocardial infarction: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines (Committee to Revise the 1999 Guidelines for the Management of Patients with Acute Myocardial Infarction). Circulation 2004;110:e82-292.
11. Kushner FG, Hand M, Smith SC, Jr., et al. 2009 Focused Updates: ACC/AHA Guidelines for the Management of Patients With ST-Elevation Myocardial Infarction (updating the 2004 Guideline and 2007 Focused Update) and ACC/AHA/SCAI Guidelines on Percutaneous Coronary Intervention (updating the 2005 Guideline and 2007 Focused Update): a report of the American College of Cardiology Foundation/American Heart Association Task Force on Practice Guidelines. Circulation 2009;120:2271-306.
12. Roe MT, Parsons LS, Pollack CV, Jr., et al. Quality of care by classification of myocardial infarction: treatment patterns for ST-segment elevation vs non-ST-segment elevation myocardial infarction. Arch Intern Med 2005;165:1630-6.
13. Chen J, Rathore SS, Radford MJ, Krumholz HM. JCAHO accreditation and quality of care for acute myocardial infarction. Health Aff (Millwood) 2003;22:243-54.

IM2. Opportunity for Improvement

IM2.1. Briefly explain the benefits envisioned by use of this measure:

There are existing measures on the 30-day readmission rates following AMI. This measure complements those measures by focusing on the resource use during that period. It will ultimately be important to use the results from this measure in combination with 30-day readmission measures to evaluate the overall efficiency of care for AMI events. Those hospitals with high costs may perform better with respect to 30-day readmission rates and therefore it is important to couple these two measurements to get an assessment of the overall efficiency of healthcare provided.

IM2.2. Summary of data demonstrating variation across providers or entities:

- Bradley & colleagues (2004) studied racial/ethic differences in door-to-drug and door-to balloon times for patients receiving primary reperfusion for ST-segment elevation myocardial infarction, and found that there were significant differences in door-to-drug and door-to-balloon times for African Americans and Hispanics compared to white patients. They concluded that a "substantial portion of the racial/ethnic disparity in time to treatment was accounted for by the specific hospital to which patients were admitted, in contrast to differential treatment by race/ethnicity within the hospital." (1).
- Cohen et al found that evidence-based care for patients with AMI appeared to improve over time among hospitals engaged in a national quality monitoring and improvement program. (2)
- Ross and colleagues conducted an analysis of Medicare claims for beneficiaries who were hospitalized between 2004 and 2006 in acute care hospitals across the US. Admission to higher volume hospitals was associated with a reduction in mortality for acute myocardial infarction(3)
- Ayanian and colleagues examined the outcome of myocardial infarction according to provider type and found the two year mortality rate for patients who saw a cardiologist was lower than for patients who saw only an internist or a family practitioner. Patients who were under the care of both a cardiologist and an internist or family practitioner had a lower mortality rate than patients who received care from a cardiologist only. (4)
- Stukel, Lucas and Wennberg found that regions with more invasive treatment practice styles had more cardiac catheterization laboratory capacity. Patients in these regions were more likely to receive interventional treatment, regardless of age, clinical indication or risk profile." For both STEMI and NSTEMI patients, survival improved with regional intensity of both invasive and medical management. (5)
- In a national study of Medicare beneficiaries, Fisher and colleagues examined variations in spending, content, quality and accessibility of care for patients hospitalized for hip fracture, colorectal cancer or AMI. The authors conclude that neither quality of care nor access to care appear to be better for Medicare enrollees in higher-spending regions (6).
- Cleary and colleagues found significant inter-institutional variations in length of stay for patients hospitalized for AMI, CABG, and four other conditions. When controlled for other predictors, length of stay did not have a significant impact on mortality, functional status or probability of readmission (7)
- Gastonis and colleagues examined variations in the utilization of coronary angiography for elderly patients with an AMI finding large variations in the utilization of procedures despite uniform insurance coverage. Aggressive use of angiography was highly variable across states.(8)
- In a study of 4,450 non-federal hospitals in the U.S., Hasnain-Wynia and her colleagues found that for the care of AMI, heart failure and pneumonia, disparities existed in lower-performing hospitals where minorities were more likely to receive care, rather than differential treatment of minorities within hospitals (9).

IM2.3. Citations for data on variation:

1b

1. Bradley, E. H., Herrin, J., Wang, Y., et al., (2004). Racial and ethnic differences in time to acute reperfusion therapy for patients hospitalized with myocardial infarction. JAMA, 292(13):1563-1572.
2. Cohen, M.G., Fonarow, G.C., Peterson, E.D., et al., (2010). Racial and ethnic differences in the treatment of myocardial infarction: Findings from the Get With The Guidelines-Coronary Artery Disease Program. Circulation, 121:2294-2301.
3. Ross, J.S., et al., Hospital volume and 30-day mortality for three common medical conditions. N Engl J Med, 2010. 362(12): p. 1110-8.
4. Ayanian, J.Z., et al., Specialty of ambulatory care physicians and mortality among elderly patients after myocardial infarction. N Engl J Med, 2002. 347(21): p. 1678-86.
5. Stukel, T.A., F.L. Lucas, and D.E. Wennberg, Long-term outcomes of regional variations in intensity of invasive vs medical management of Medicare Patients with acute myocardial infarction. JAMA, 2005. 293(11): p. 1329-37.

H☐ M☐ L☐ I☐

6. Fisher, ES, Wennberg DE, Stukel TA, et al. The implications of regional variations in Medicare spending. Part 1: the content, quality and accessibility of care. Ann Intern Med, 2003;138:273-87.
7. Cleary PD, Greenfield S, Mulley AG, et al, Variations in length of stay and outcomes for six medical and surgical conditions in Massachusetts and California. JAMA 1991;266:73-79.
8. Gatsonis CA, Epstein AM, Newhouse JP, et al. Variations in the utilization of angiography for elderly patients with an acute myocardial infarction. Medical Care 1995;33:625-642.
9. Hasnain-Wynia, R., Kang, R., Landrum, M.B., et al., (2010). Racial and ethnic disparities within and between hospitals for inpatient quality of care: An examination of patient-level hospital quality alliance measures. Journal of Health Care for the Poor and Underserved, 21:629-648.

IM2.4. Summary of data on disparities by population group:

The recent AMI literature (2000-2010) documents gender, racial/ethnic, and socioeconomic disparities in the pattern of care AMI patients receive.
Gender disparities in the receipt of screening and treatment for heart disease have been demonstrated. Women are at greater risk for worse outcomes for acute coronary syndromes than are men because they may be treated less aggressively even when more aggressive treatment is warranted (1). In a study of the CRUSADE Quality Improvement Initiative registry data, Shoaibi and colleagues found that men received significantly higher rates of coronary intervention than women after controlling for age, cardiac catheterization findings and biochemical evidence of myocardial infarction (1). Hollenbeak and colleagues assessed whether there were gender disparities in the use of percutaneous coronary interventions (PCI) in treating AMI in Pennsylvania hospitals, and if so, whether outcomes were affected. The authors found that after controlling for age, race/ethnicity, severity at admission, location of infarct, and source of admission, women had 24% lower odds than men of receiving PCI. Women who received PCI were significantly less likely to die(2). A study by Roncalli, et al. found that elderly women have a disproportionately high in-hospital mortality rate during the first 48 hours after PCI for treatment of STEMI AMI. Post-AMI, men are more likely than women to receive reperfusion therapy and guideline based medical therapy. (3)

Racial/ethnic disparities in cardiovascular care are well documented. Administrative and registry data show that African American patients are less likely than their white counterparts to receive coronary angiography, percutaneous coronary interventions (PCI) and coronary artery bypass graft (CABG) after AMI. (4-7) Minorities are less likely than whites to receive evidence-based care and are more likely to be treated with lower adherence to composite measures. (4) African Americans are also less likely to receive thrombolytic therapy and other medications such as aspirin, B-blockers, and lipid lowering therapy after AMI (6).

Evidence of socioeconomic disparities in the receipt of care for AMI among the elderly also have been noted. Rao, et al., found that higher-income Medicare beneficiaries received higher rates of evidence-based therapies and had lower short and long term mortality rates, while the opposite was true on both dimensions for lower-income beneficiaries in the study. The authors conclude that despite Medicare entitlement, disparities in treatment and mortality among elderly patients following AMI remain problematic.(8)

Similarly, insurance status affects the quality and quantity of AMI care one receives. Hiestand and colleagues found that self pay patients were most likely to receive less expensive therapies for AMI, while patients with private insurance were more likely to receive invasive procedures.(9) Delays in seeking care for AMI have been documented among the insured patients. Smolderen and colleagues found that insured patients with financial concerns about accessing care were more likely to delay emergency care seeking for AMI, and had prehospital delays of greater than six hours. Delays in seeking emergency care for AMI can have adverse consequences on patient outcomes, and can lead to disparities in health based on socioeconomic status. (10)

Studies have documented gender and racial/ethnic disparities in outcomes after AMI, but the explanation of these disparities remains limited. In a setting that controls for access to medical care (16 Kaiser Permanente of Northern California hospitals), Iribarren and colleagues evaluated whether gender and racial/ethnic disparities in prognosis after AMI persist after consideration of socioeconomic characteristics, personal medical history and medical management. (5) They found that age-adjusted risk of AMI recurrence was significantly higher in black men, black women, and Asian women compared with white men. But when the set of covariables (sociodemographic characteristics, personal clinical/medical history and evidence-based medications) were accounted for, the gender and racial/ethnic disparities no longer existed. The authors interpreted this to mean that minority groups in their study experienced worse outcomes after AMI because of disadvantaged socioeconomic standing, and higher prevalence of comorbid conditions and cardiovascular disease risk factors.

Spertus and colleagues found that Black patients with myocardial infarction have worse outcomes that white patients, these differences did not persist after adjustment for patient factors and site of care--suggesting the need for

strategies that focus on improving baseline cardiac risk (11). Spertus suggests that neighborhoods of residence can be independently associated with the prevalence of cardiovascular risk factors and the development of disease. Understanding the contribution of personal and regional socioeconomic status to health outcomes is necessary if interventions are to be developed that address the underlying causes of disparities in health (12). In earlier work, Tonne, et al.,also found that AMI survival is lower in more deprived neighborhoods.(13)

An evaluation of a structured initiative, Guidelines Applied in Practice (GAP), for improving care of patients with AMI was conducted to determine if comparable care was given to whites and nonwhite patients admitted to GAP hospitals in Michigan. While the authors report that the GAP program led to significant increases in rates of evidence-based care in both white and nonwhite Medicare patients, nonwhite patients continued to receive less of a quality improvement discharge tool and smoking cessation counseling (6).

IM2.5. Citations for data on disparities cited in IM2.4:

1. Shoaibi, T.D., Chen, A.Y., Uchida, T., et al., (2010). Gender differences in the treatment of non-ST segment elevation myocardial infarction. Clinical Cardiology, 33(2):99-103.
2. Hollenbeak, C.S., Weisman, C.S., Rossi, M., et al., (2005). Gender disparities in percutaneous coronary interventions for acute myocardial infarction in Pennsylvania. Medical Care, 44(1): 24-30.
3. Cohen, M.G., Fonarow, G.C., Peterson, E.D., et al., (2010). Racial and ethnic differences in the treatment of myocardial infarction: Findings from the Get With The Guidelines-Coronary Artery Disease Program. Circulation, 121:2294-2301.
4. Roncalli, J., et al., Gender disparity in 48-hour mortality is limited to emergency percutaneous coronary intervention for ST-elevation myocardial infarction. Arch Cardiovasc Dis, 2010. 103(5): p. 293-301.
5. Iribarren, C., Tolstykh, I., Somkin, C.P., et al., (2005). Sex and racial/ethnic disparities in outcomes after acute myocardial infarction. Archives of Internal Medicine, 165:2105-2113.
6. Olomu, A.B., Grzybowski, M., Ramanath, V.S., et al., (2010). Evidence of disparity in the application of quality improvement efforts for the treatment of acute myocardial infarction: The American College of Cardiology's guidelines applied in practice initiative in Michigan. American Heart Journal, 159:377-84.
7. Mehta, J.L., et al., Racial disparities in prescriptions for cardioprotective drugs and cardiac outcomes in Veterans Affairs Hospitals. Am J Cardiol, 2010. 105(7): p. 1019-23.
8. Rao, S.V., Schulman, K.A., Curtis, L.H., et al., (2004). Socioeconomic status and outcome following acute myocardial infarction in elderly patients. Archives of Internal Medicine, 164:1128-1133.
9. Hiestand, B.C., Prall, D.M., Lindsell, C.J., et al., (2004). Insurance status and the treatment of myocardial infarction at academic centers. Academic Emergency Medicine, 11:343-348.
10. Smolderen, K.G., Spertus, J.A., Nallamothu, B.K., et al., (2010). Health care insurance, financial concerns in accessing care, and delays to hospital presentation in acute myocardial infarction. JAMA, 202(14): 1392-1400.
11. Spertus, J.A., Jones, P.G., Masoudi, F.A., et al., (2009). Factors associated with racial differences in myocardial infarction outcomes. Annals of Internal Medicine, 150:314-324.
12. Spertus, J. (2010). Broadening our understanding of survival after myocardial infarction: The association of neighborhood with outcomes. Circulation, 121:348-350.
13. Tonne, C., Schwartz, J., Mittleman, M., et al., (2005). Long-term survival after acute myocardial infarction is lower in more deprived neighborhoods. Circulation, 111:3063-3070.

IM3. Measure Intent

IM3.1. Describe intent of the measure and its components/ Rationale (including any citations) for analyzing variation in resource use in this way

The intent is that the measure will be used along with a measure of 30-day readmissions for to examine the overall efficiency of care being provided to patients with an AMI. This will help to identify hospitals that may be undertaking best care practices through identification of those facilities that provide 'efficient' care by examining both the resource use as well as the readmission rates. It will be necessary to put both of these measures together in order to fully realize the potential of resource use measures.

1c

H☐ M☐ L☐ I☐

IM4. Resource use service categories are consistent with measure construct

Refer to IM3.1. & all S9 items to evaluate this criteria.

1d

H☐ M☐ L☐

	I☐
TAP/Workgroup: What are the strengths and weaknesses in relation to the subcriteria for *Importance to Measure and Report*?	
Steering Committee: Was the threshold criterion, *Importance to Measure and Report*, met? **Rationale:**	**Y☐** **N☐**

SCIENTIFIC ACCEPTABILITY OF MEASURE PROPERTIES

Extent to which the measure, as specified, produces consistent (reliable) and credible (valid) results about the quality of care when implemented.

MEASURE SPECIFICATIONS

S1. Measure Web Page:
Do you have a web page where current detailed measure specifications can be obtained?

Yes
http://www.healthqualityalliance.org/hvhc-project/cost-care-measurement-development

S2. General Approach
If applicable, summarize the general approach or methodology to the measure specification. This is most relevant to measures that are part of or rely on the execution of a measure system or applies to multiple measures.

The ABMS REF episode-based resource use measures were created in an open and transparent manner with input from a wide range of clinical experts, methodologists, health care economists and other stakeholders. The measure development process involved a series of deliberate steps where participating clinicians took into account the natural progression of a condition and existing best practices before carefully considering how to best use administrative claims data to construct the episode. They aimed to identify clinically homogenous populations so that the measures would be sensitive to provider decisions and existing practice protocols for like patients. Workgroup members were then asked to conceptualize the measure specifications based on their combined knowledge of guidelines, evidence, and clinical experience. The workgroups helped to define the denominator, duration, clinically relevant services and attribution of each episode as related to the clinical progression and treatment of the condition. Project staff then worked to translate the concepts into detailed written measure specifications and test the measures on a commercial database. The workgroups subsequently re-convened via a series of conference calls to review data analyses, share expert opinions, consider additional evidence-based literature, revise and finalize the measure specifications. Each measure was developed independently and, as such, they are not summative.

Attachment:

S3. Type of resource use measure:

Per episode

S4. Target Population:

S4.1. Subject/Topic Areas:

Cardiovascular

S4.2. Cross Cutting Areas *(HHS or NPP National health goal/priority)*

Care Coordination

Eval Rating 2a1/2b1

S5. Data dictionary or code table
Please provide a web page URL or attachment if exceeds 2 pages. NQF strongly prefers URLs. Attach documents only if they are not available on a web page and keep attached file to 5MB or less.

Data Dictionary:

URL:
Please supply the username and password:
Attachment: S5_Data Dictionary-634343572803699640.pdf

Code Table:

URL:
Please supply the username and password:
Attachment:

S6.Data Protocol (Resource Use Measure Module 1)
The measure developer must determine which of the following data protocol steps: data preparation, data inclusion criteria, data exclusion criteria, and missing data, are submitted as measure specifications or as guidelines. Specifications limit user options and flexibility and must be strictly adhered to; whereas guidelines are well thought out guidance to users while allowing for user flexibility. If the measure developer determines that the requested specification approach is better suited as guidelines, please select and submit guidelines, otherwise specifications must be provided.

Data Protocol Supplemental Attachment or URL:
If needed, attach document that supplements information provided for data protocol for analysis, data inclusion criteria, data exclusion criteria, and missing data (Save file as: S6_Data Protocol). All fields of the submission form that are supplemented within the attachment must include a summary of important information included in the attachment and its intended purpose, including any references to page numbers, tables, text, etc.

URL: http://www.healthqualityalliance.org/hvhc-project/cost-care-measurement-development
Please supply the username and password:
Attachment:

S6.1. Data preparation for analysis
Detail (specify) the data preparation steps and provide rationale for this methodology.

Guidelines : Approach to Data Cleaning:
If a standardized cleaning methodology or logic for the claims data exists, users are encouraged to apply the existing methodology, or conversely, encouraged not to remove data cleaning steps already implemented. If however, organizations impute missing data, we recommend using only non-imputed data.
Rationale: Each organization will be more familiar with the nature of their data therefore any standard cleaning procedures are likely to be appropriate. Imputation can produce unpredictable biases in the results.

S6.2.Data inclusion criteria
Detail initial data inclusion criteria and rationale(related to claim-line or other data quality, data validation, e.g. truncation or removal of low or high dollar claim)

Guidelines : Paid claims with non-missing enrollee identification numbers, primary procedure and diagnosis codes should be included in the measure.
Note: The ABMS REF resource use measures are constructed based on date of service, not date of payment. Therefore, we recommend applying the measures to finalized or "closed" datasets so that complete claims histories during the measurement period are captured in the data.
Including enrollees with at least 24 months of continuous medical and pharmacy benefit enrollment during the identification year and the measurement year is recommended. However, the measure has been tested on enrollees with at least 320 total days of coverage during each year. If precise information regarding persons' total days of coverage is not available, it is recommended that measure implementers estimate this information to the best of their ability using

available data elements (e.g., monthly enrollment indicators). This approach is based on the similar eligibility requirements used by NCQA for HEDIS measure denominators.

S6.3. Data exclusion criteria
Detail initial data exclusion criteria and rationale (related to claim-line or other data quality, data validation, e.g. truncation or removal of low or high dollar claim)

Guidelines : Beyond the standard data cleaning steps, we recommend that claim lines with missing or zero quantity values be set to a quantity of one and claim lines missing enrollee identification variables, primary diagnosis and procedure codes, and service date be eliminated. We also recommend eliminating all rejected or unpaid claims. Because a single provider id could have multiple specialties, we also recommend generating a uniform specialty for all providers by assigning each provider the specialty which is most frequently observed from all their Evaluation and Management visits.
Rationale: Converting missing or zero quantities to a minimum value of 1 allows for the pricing of these services. Claim lines missing enrollee identifiers, or primary procedure and diagnosis codes cannot be attributed to an individual, and without procedure and diagnosis codes, services cannot be properly identified and categorized. The resource use measures are intended to track costs to the payer, not general or societal costs, so rejected or unpaid claims should be eliminated.
Standardizing the specialty of all providers eliminates the possibility that providers are classified as one specialty for one enrollee and another specialty for others.

S6.4. Missing Data
Detail steps associated with missing data and rationale(e.g., any statistical techniques used)

Guidelines : Users are encouraged to eliminate claim lines missing enrollee identification variables or primary procedure and diagnosis codes. We do not recommend using any imputation methods to replace missing data.
Rationale: Claim lines missing enrollee identifiers cannot be attributed to an individual, and without procedure and diagnosis codes, services cannot be properly identified and categorized. Imputation of missing information could introduce bias into the measure, so we do not recommend the use of imputed data.

S7. Data Type: Administrative claims
Other

S7.1. Data Source or Collection Instrument
Identify the specific data source/data collection instrument (e.g. name of database, clinical registry, collection instrument, etc.)

Sources for administrative claims: commercial databases, CMS databases
Standardized price tables: Users can download tables from the NCQA website (see url below) or use guidelines provided in the technical appendix of the written measure specification to create their own standardized prices.

S7.2. Data Source or Collection Instrument Reference
(Please provide a web page URL or attachment). NQF strongly prefers URLs. Attach documents only if they are not available on a web page and keep attached file to 5MB or less)

URL: http://www.ncqa.org/tabid/1092/Default.aspx
Please supply the username and password:
Attachment:

S8.Measure Clinical Logic (Resource Use Measure Module 2)
The measure's clinical logic includes the steps that identify the condition or event of interest and any clustering of diagnoses or procedures. For example, the diagnoses and procedures that qualifies for a cardiac heart failure episode, including any disease interaction, comorbid conditions, or hierarchical structure to the clinical logic of the model. (Some of the steps listed separately below may be embedded in the risk adjustment description, if so, please indicate NA and in the rationale space list 'see risk adjustment details.')

Clinical Logic Supplemental Attachment or URL:
If needed, provide a URL or document that supplements information provided for the clinical framework, co-morbid interactions, clinical hierarchies, clinical severity levels, and concurrency of clinical events

URL: http://www.healthqualityalliance.org/hvhc-project/cost-care-measurement-development
Please supply the username and password:
Attachment:

S8.1. Brief Description of Clinical Framework
Briefly describe your clinical logic approach including clinical topic area, whether or not you account for comorbid and interactions, clinical hierarchies, clinical severity levels and concurrency of clinical events.

Resource use and costs associated with acute myocardial infarction (AMI) episode during the acute period. The acute period is defined as 30 days following initial hospitalization for an AMI event. An index AMI event is identified and all AMI-related services are identified in the 30 days following the onset of the acute event. Total AMI-related costs are calculated for each patient and summarized at the attributable hospital level. Observed costs are compared to risk-adjusted expected costs at the hospital level.

S8.2. Clinical framework
Detail any clustering and the assignment of codes, including the grouping methodology, the assignment algorithm, and relevant codes and rationale for these methodologies.

The focus of the measure is individuals that experience an acute myocardial infarction during the measurement period. To be included, individuals must meet the following criteria:

Age: 18 to 85 years during the measurement year

Patient Inclusion Criteria: Continuous medical and pharmacy benefit enrollment for at least one year preceding the onset of the AMI episode and for one year following the episode onset, with no more than one gap in enrollment of more than 45 days during each year of continuous enrollment. Patients that die during the year following the event are included in the sample. To be included individuals must have an inpatient hospitalization with a primary diagnosis of 410.xx. The exception is 410.x2 which are excluded from being triggering events.

Event/diagnosis: Admitted to an inpatient setting for an AMI between January 1 and December 31 of the measurement year and no AMI admission in the preceding 30 days with a length of stay > 1 day and discharged alive. Codes to identify AMIs: ICD-9 410.xx

Exclusion Exclude hospitalizations with ICD-9 Code 410.x2; Exclude patients with DRG (v24) 123 (MS-DRG 283, 284, 285) at index hospitalization.
Persons with any of the following diagnoses in the measurement year or the year prior to measurement are excluded (see also table AMI-D in written specification): active cancer; ICD-9 Diagnosis: 140-171; 174-184; 187-203; 204.0; 204.2; 204.8; 205-208; 230-239 WITH CPT: 38230, 38240-38242, 77261-77799, 79000-79999, 96400-96549; ICD-9-CM Procedure: 41.0, 41.91, 92.2; UB Revenue 028x, 033x, 0342, 0344, 0973; end stage renal disease (ESRD) including renal dialysis: CPT36145, 36800-36821, 36831-36833, 90919-90921, 90923-90925, 90935, 90937, 90939, 90940, 90945, 90947, 90989, 90993, 90997, 90999, 99512; HCPCS: G0257, G0311-G0319, G0321-G0323, G0325-G0327, G0392, G0393, S9339;ICD-9-CM Diagnosis:585.5, 585.6, V42.0, V45.1, V56; ICD-9-CM Procedure: 38.95, 39.27, 39.42, 39.43, 39.53, 39.93, 39.94, 39.95, 54.98; UB Revenue: 080x, 082x-085x, 088x ; UB Type of Bill: 72x; POS: 65; organ transplant: CPT: 32850-32856, 33930-33945, 44132-44137, 44715-44721, 47133-47147, 48160, 48550-48556, 50300-50380; HCPCS: S2152, S2053-S2055, S2060, S2061, S2065; ICD-9-CM Procedure: 33.5, 33.6, 37.5, 41.94, 46.97, 50.5, 52.8, 55.6; UB Revenue: 0362, 0367, 0810-0813, 0819; HIV/AIDS: ICD-9-CM Diagnosis: 042
Also exclude patients discharged to a skilled nursing facility (SNF)

Eligible event identifcation
The following codes occurring within 30 days of the triggering event are identified as AMI-related codes and accumulated as part of the episode. The codes may be present in any diagnostic field during the 30-day measurement

period.(see also Table AMI-B in written measure specification): AMI: ICD-9 410.xx; DRG v24 121, 122, 535;DRG v25 (MS-DRG)280, 281, 282, 222, 223; Unstable angina: ICD-9 Code:411.xx, 413.x; DRG v24;140, 143; DRG v25 (MS-DRG)311, 313; Arrhythmia and ICD / Pacemaker: ICD-9 Code:427.xx, except 427.5; DRG v24: 138, 139, 117, 118, 515, 535, 536, 551, 552; DRG v25 (MS-DRG):308, 309, 310, 260, 261, 262, 258, 259, 226, 227, 222, 223, 224, 225, 242, 243, 244; Cardiac arrest: ICD-9 Code: 427.5; DRG v24: 129; DRG v25 (MS-DRG): 296, 297, 298; PCI: ICD-9 Code: 00.66, 36.01, 36.02, 36.05, 36.06, 36.07; DRG v24: 555, 556, 557, 558; DRG v25 (MS-DRG): 248, 249, 246, 247; CABG: ICD-9 Code:36.10-36.16; DRG v24: 547, 548, 549, 550; DRG v25 (MS-DRG): 233, 234, 235, 236; Coronary Atherosclerosis: ICD-9 Code: 414.0x, 414.8, 414.9; Heart failure: ICD-9 Code: 402.01, 402.11, 402.91, 404.01, 404.03, 404.11, 404.13, 404.91, 404.93, 428.0, 428.00, 428.1, 428.10, 428.90, 428.20, 428.21, 428.22, 428.23, 428.30, 428.31, 428.32, 428.33, 428.40, 428.41, 428.42, 428.43, 428.9

Other Codes to Identify AMI-related Services:
Inpatient Facility Codes: Nonacute inpatient: CPT: 99301-99313, 99315, 99316, 99318, 99321-99328, 99331-99337; Acute inpatient: CPT:99221-99223, 99231-99233, 99238, 99239, 99251-99255, 99261-99263, 99291

Eval Rating 2a1

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Codes present with another code (eg. ICD-9, CPT, HCPCs, DRG) for AMI-related service (see also Table AMI C in written measure specification): Evaluation and Management Codes: CPT: 99201–99215,99217–99220, 99358, 99360, 99221–99239, 99241–99255, 99261–99263, 99271–99275, 99289–99298, 99301–99350, 99361–99380, 99385–99390, 99395–99405, 99410–99429, 99450–99456, 99354–99357

Surgery and Procedure Codes (codes may be present in any field)(see also Table AMI-C in written measure specification):
PCI: ICD-9 Code: 00.66, 36.01, 36.02, 36.05, 36.06, 36.07; CPT: 92982-92984, 92995;DRG: 555, 556, 557, 558; MS-DRG (v25): 248, 249, 246, 247; CABG: ICD-9 Code: 36.10-36.16; CPT: 33503-33505, 33510-33516, 33517-33519, 33521-33523, 33533-33535; DRG: 547, 548, 549, 550; MS-DRG (v25): 233, 234, 235, 236; Coronary thrombolysis: ICD-9 Code: 36.04; Diagnostic cardiac catheterization; coronary arteriography: ICD-9 Code: 37.21-37.23, 88.52-88.57;CPT: 93526-93529, 93536, 93503, 93561-93562, 93555-93556, 93539-93545, 93510-93524; Insertion; revision; replacement; removal of cardiac pacemaker or cardioverter/defibrillated: ICD-9 Code: 00.50-00.57, 37.70-37.83, 37.85-37.87, 37.89, 37.94-37.98; CPT: 33200-33201, 33206-33208, 33210-33211, 33216-33217, 33212-33213; DRG: 117, 118, 515, 535, 536, 551, 552; MS-DRG (v25): 260, 261, 262, 258, 259, 226, 227, 222, 223, 224, 225, 242, 243, 244; Other vascular procedures: DRG: 553, 554; MS-DRG (v25): 253, 254; Radiology: CPT: 71010, 71015, 71020, 71021, 71022, 71030, 71035, 71090, 71250, 71260, 71270, 71275; EKG: CPT: 93000, 93005, 93010, 93012, 93014, 93015, 93016, 93017, 93018, 93040, 93041, 93042, 93224, 93225, 93226, 93227, 93230, 93231, 93232, 93233, 93235, 93237

Eval Rating 2b1

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Pharmacy: The following classes of medications are included as AMI-related medications:
1. Beta-blockers
2. ACE Inhibitors
3. ARBs
4. Clopidogrel, plavix
5. Lipid lowering medications (statins, niacin, etc.)
6. Nitrates

The following HCPCs codes identify additional AMI-related medications

HCPC	Short Description
C9109	Tirofiban hcl, 6.25 mg
C9121	Injection, argatroban
J0130	Abciximab injection
J0350	Injection anistreplase 30 u
J0365	Aprotonin, 10,000 kiu
J0583	Bivalirudin
J1160	Digoxin injection
J1162	Digoxin immune fab (ovine)
J1245	Dipyridamole injection
J1327	Eptifibatide injection
J1642	Inj heparin sodium per 10 u
J1644	Inj heparin sodium per 1000u
J1645	Dalteparin sodium

J1650 Inj enoxaparin sodium
J1652 Fondaparinux sodium
J1655 Tinzaparin sodium injection
J2993 Reteplase injection
J2995 Inj streptokinase /250000 IU
J2997 Alteplase recombinant
J3100 Tenecteplase injection
J3245 Tirofiban hydrochloride
J3246 Tirofiban HCl
J3265 Injection torsemide 10 mg/ml
J3364 Urokinase 5000 IU injection
J3365 Urokinase 250,000 IU inj

Rationale for cluster, grouping and assignment framework:
Age: The measure includes individuals age 18-85 years at the time of the qualifying event. Those younger than 18 were excluded because the event does not typically occur in that group and therefore they were not considered a meaningful group to include in the measure. The upper age limit of 85 years was put in place because care processes may differ in an older patient population than in those younger than 85 years when managing care following an AMI. The different in management choices could lead to large differences in healthcare resource use. Therefore, those older than 85 years were felt to represent a group of individuals that would not be homogeneous with the rest of the population included in the measure.

First event: The measure only includes the first event in any 30 day period as the triggering event for the episode. This was done such that repeat hospitalizations are not counted as new events but rather have the resources attributed to the initial event. Therefore, facilities with high rates of rehospitalization following AMI will be attributed the resources consumed during that rehospitalization.

Length of stay: For an event to qualify for initiating the episode the length of stay needs to be > 1 day. This was to avoid including events that may have received an eligible AMI code but that resulted in observation unit care but were not admitted to the hospital. The concern was that patients with suspected AMI may be included in the measure if we did not have the LOS requirement as these patients could receive an eligible code but were AMI rule outs rather than true events.

Discharged alive: The measure only includes individuals that were discharged alive because we measure resource use for the 30 days following the event. Hospitals are being compared in the episode and if patients that died during their inpatient stay were included in the event, hospitals with high AMI mortality rates could look like lower cost facilities because the costs to day 30 would be $0. Therefore, we require survival through the initial hospital discharge to be included in the episode.

Standard exclusions: We have several standard exclusions for each of our measures that are similar to the NCQA exclusions for their relative resource use measures. We exclude individuals with high resource use and high cost conditions that would likely be systematically different from the majority of individuals included in the analysis. These individuals are excluded to create a more homogeneous population for the analysis.

Exclusion of 410.x2: The five digit subclassification system for acute myocardial infarctions is used to classify the episode of care. Codes with a 2 in the fifth digit are classified as ‘subsequent episodes of care’ and therefore are excluded from being triggering events for the episode. As noted, the episode is triggered by an initial event in a 30 day period and not triggered by subsequent or secondary events.

Rationale for assignment of specified codes:
The scope of this measure was focused on the 30 days following identification of the index event so that this measure can ultimately be paired with quality measures that examine 30-day rehospitalization rates. Each of the codes included in the list that identifies AMI-related care was considered to be related to AMI care during the 30-day measurement period by the AMI clinical workgroup. The workgroup created a list of diagnoses, procedures and medications that would have a high likelihood of being related to the AMI during the measurement period. The group then reviewed healthcare claims for the identified cohort to determine if additional codes should be added to those classified as AMI related.

The overarching rationale for each of the codes included on the list is that the clinical workgroup considered the codes as potentially associated with the care following an acute myocardial infarction. Importantly, this was not limited to appropriate care, but rather focused on resources that were likely to be associated with the event.

The diagnostic codes selected as related to the episode include those for identifying the AMI event, any subsequent AMI

events and interventions related to the management of the AMI (e.g. PCI, CABG). Each of the diagnostic codes identifies resources grouped to the episode if the code is present as a primary diagnosis for an inpatient stay or as any diagnosis for an outpatient claim. Inpatient claims are required to have the primary diagnosis because we did not want to capture inpatient stays where a qualifying diagnosis code was included as a comorbidity, rather we focused on events that were more clearly attributable to the episode. For outpatient claims, the presence of the code in any field will qualify the claim as related to the episode. This strategy was selected because the order of diagnostic codes listed on claims for outpatient services is less relevant than on inpatient claims. Therefore, we wanted to include any claim that may have included care for the qualifying conditions for the episode.

The following provides the rationale for each of the codes included in the AMI measure. The code for angina was included because chest pain can be a symptom of coronary artery disease which likely led to the AMI event and can be managed in the period following the index date. If this code occurred in the 30 days following the initial event it was considered AMI-related. Both arrhythmia and heart failure codes were included as they may be a consequence of coronary artery disease and the acute myocardial infarction and associated resource use.(references 1-4). Therefore, it is important to capture the care for these two potential complications of acute myocardial infarction. Ventricular arrhythmias are one of the leading causes of death in the two years following AMI and can lead to cardiac arrest and sudden cardiac death (ref 5). Therefore, care related to cardiac arrest is included as part of the episode. Elevated LDL and coronary atherosclerosis are key risk factors for acute myocardial infarction (ref 6) and treatment following an initial myocardial infarction has shown reduction in recurrent events (ref 7-8) Therefore, diagnostic codes for coronary atherosclerosis are included in the measure.

The surgery and procedure codes that are included as AMI-related are used in the management of an acute myocardial infarction or the complications associated with an AMI. Both CABG and PCI can be used as interventions following the initial AMI. It is possible that these interventions could also be scheduled in the 30 day period following the initial event. In addition to the interventional coronary catheterization procedures, those that may be used as a diagnostic procedure are included in the measure. Procedures for coronary thrombolysis are included in the measure as this may be done upon presentation to the hospital to treat the index event. Placement of pace makers and implantable defibrillators can be used to treat the complications that can result from the AMI. Finally, radiology services that may be used in the initial presentation or in the follow-up period are included as related healthcare services. Similarly, EKGs are also included in the measure because of their use as a diagnostic in the management of an AMI event.

Medications selected for inclusion in the measure met at least one of the following criteria:

- Used in the management of patients post myocardial infarction
- Used to treat symptoms that may be associated with coronary artery disease (eg. nitrates)
- Used to treat hyperlipidemia
- Used to reduce risk of recurrent events following the initial AMI (eg. clopidogrel)
- Used in the treatment or management of the acute AMI event

References:

1. Newby KH, Thompson T, Stebbins A, Topol EJ, Califf RM, Natale A, for the GUSTO Investigators. Sustained ventricular arrhythmias in patients receiving thrombolytic therapy: incidence and outcomes. Circulation 1999;98:2257-2573.
2. Maggioni AP, Zuanetti G, Franzosi MG, Rovelli F, Santoro E, Staszewsky L, et al., on behalf of GISSI-2 Investigators: Prevalence and prognostic significance of ventricular arrhythmias after acute myocardial infarction in the fibrinolytic era: GISSI-2 results. Circulation 1993, 87:312–322.
3. Gheorghiade M, Bonow RO. Chronic heart failure in the United States: a manifestation of coronary artery disease. Circulation 1998;97:282–9.
4. Hellerman JP, Goraya TY, Jacobsen SJ, et al. Incidence of heart failure after myocardial infarction: is it changing over time? Am J Epidemiol 2003;157(12):1101-1107.
5. JT Bigger Jr, JL Flaiss and J Kleiger et al., The relationship among ventricular arrhythmias, left ventricular dysfunction, and mortality in two years after myocardial infarction, Circulation 69 (1984), pp. 250–258.
6. Rose G, Hamilton PJ, Keen H, Reid DD, McCartney P, Jarrett RJ. Myocardialischemia, risk factors and death from coronary heart-disease. Lancet 1977;1:105-9.
7. Scandinavian Simvastatin Survival Study Group. Randomized trial of cholesterol lowering in 4444 patients with coronary heart disease: the Scandinavian Simvastatin Survival Study (4S). Lancet 1994;344:1383-9.
8. Sacks FM, Pfeffer MA, Moye LA, et al for the Cholesterol and Recurrent Events Trial Investigators. The effect of pravastatin on coronary events after myocardial infarction in patients with average cholesterol levels. N Engl J Med

1996;335(14):1001-1009

S8.3. Comorbid and interactions
Detail the treatment of co-morbidities & disease interactions and provide rationale for this methodology.

For the most part, comorbidities are handled in the risk adjustment model. See section S10.1 below. The exception is heart failure which is used as stratification in the measure. Groups are divided based on the presence of heart failure in the period preceding the index event. Heart failure has been shown to be associated with longer length of stay than in patients that do not have heart failure(Saczynski 2010). This longer length of stay can result in differential resource use if groups being compared are unbalanced with respect to the presence of heart failure. In addition to the longer length of stay, heart failure patients may be treated differently than patients without heart failure leading to differences in resource use. For these reasons, the measure stratifies the population based on the presence of heart failure. See also risk adjusment section of this measure submission form and section 6 of the Measure Specification Technical Appendix for detailed description of risk adjustment model and rationale.
References:
1. Saczynski JS, Lessard D, Spencer FA, et al. Declining Length of Stay for Patients Hospitalized with AMI: Impact on Mortality and Readmissions, Am J Med 2010;123(11): 1007-1015.

S8.4. Clinical hierarchies
Detail the hierarchy for codes or condition groups used and provide rationale for this methodology.

The only clinical hierarchies used in the measure are associated with the identification of comorbid conditions that are used in risk adjustment. Details are provided in Section 10.1 below and in the risk adjustment section of the technical appendix of the written measure specification. In short, we use the CMS hierarchical condition categories (HCC) for assignment of comorbid conditions which utilizes a hierarchy of codes based on the ICD-9 codes present during the pre-index period. We rely on the HCC system for identifying comorbid conditions in our risk adjustment procedure. The hierarchies are important for our risk adjustment as they are intended to identify different levels of severity of conditions that may be differentially associated with resource use. We used the HCC system because it is a previously developed and validated system for use in resource use measures.

Within our episode measure there are no hierarchies assigned to any of the codes that use.

S8.5. Clinical severity levels
Detail the method used for assigning severity level and provide rationale for this methodology.

We do not provide specifications for clinical severity levels.
No clinical severity measure is used to differentiate patients that qualify for the measure. Importantly, guidelines for the management of AMI differentiate ST-segment elevation myocardial infarction (STEMI) from non-ST-segment elevation myocardial infarction (NSTEMI)(1-2). A factor contributing to the differentiation is the evidence available around effective treatments for STEMI and NSTEMI. While the evidence base and clinical practice guidelines differ for the two, quality improvement measures group STEMI and non-STEMI events together as many of the interventions are similar between the two and it is not possible to differentiate the events in administrative datasets.(3) Therefore, this measure includes STEMI and NSTEMI in a single measuring due to the inability to differentiate these in administrative datasets, while acknowledging it may be important to create separate measures when it becomes possible to accurately identify STEMI versus NSTEMI as resource use and quality of care differ between the two (4).

References:
1.Antman EM, Anbe DT, et al. ACC/AHA guidelines for the management of patients with ST-elevation myocardial infarction; a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines. J Am Coll Cardiol. 2004;44:e1-e211.
2. Anderson JL, Adams CD, et al. ACC/AHA 2007 Guidelines for the Management of Patients with Unstable Angina/Non-ST-Elevation Myocardial Infarction. J Am Coll Cardoil. 2007; 50:1-157.
3. Chen J, Rathore SS, et al. JCAHO accreditation and quality of care for acute myocardial infarction. Health Aff (Milwood). 2003; 22:243-254.
4. Roe MT, Parson LS, et al. Quality of care by classification of myocardial infarction: treatment patterns for ST-

segment elevation vs non-ST-segment elevation myocardial infarction. Arch Intern Med. 2005; 165(14):1630-1636.

S8.6. Concurrency of clinical events (that may lead to a distinct measure)
Detail the method used for identifying concurrent clinical events, how to manage them, and provide the rationale for this methodology.

We do not provide specifications for concurrency of clinical events.
Each of the measures developed as part of the ABMS measure set was intended as a standalone measure. The measures were not designed to be combined into a single composite measure of resource use for providers. Because the focus during the development of these measures was there eventual pairing with quality measures, each of the measures is considered as a unique measure. Therefore, the concurrency of events and the fact that events may be counted in more than one measure is not an issue. We were not trying to account for the overall resource use of a population but rather focused on resource use within specific cohorts of patients. The relative resource information produced is intended to result in actionable information which is not possible when all of the episodes are combined into a single composite measure.

S9. Measure Construction Logic (Resource Use Measure Module 3)
The measure's construction logic includes steps used to cluster, group or assign claims beyond those associated with the measure's clinical logic. For example, any temporal or spatial (i.e., setting of care) parameters used to determine if a particular diagnosis or event qualifies for the measure of interest.

Construction Logic Supplemental Attachment or URL:
If needed, attach supplemental documentation (Save file as: S9_Construction Logic). All fields of the submission form that are supplemented within the attachment must include a summary of important information included in the attachment and its intended purpose, including any references to page numbers, tables, text, etc.)

URL: http://www.healthqualityalliance.org/hvhc-project/cost-care-measurement-development
Please supply the username and password:
Attachment:

S9.1. Brief Description of Construction Logic
Briefly describe the measure's construction logic.

The following sequence is used to construct the measures:
1. Eligible population identification
2. Identification of related resources
3. Assignment of standardized prices
4. Create episode specific strata (if applicable)

S9.2. Construction Logic
Detail logic steps used to cluster, group or assign claims beyond those associated with the measure's clinical logic.

The measure starts with the identification of an index AMI event and ends 30 days post trigger.

The following steps are used to complete the construction sequence (for specific codes, see Section S8.2 on clinical framework above and the written measure specification/technical appendix).

Eligible population identification

Step 1: Identify patients that meet the episode definition inclusion criteria
1. Identify patients 18 to 85 years during the measurement year
2. Identify patients that meet the following inclusion criteria during the measurement year:
i. Admitted to inpatient facility for AMI ICD9 410.xx (excluding 410.x2) between January 1 and December 31 of measurement year;
ii. No AMI admission in the preceding 30 days;
iii. Length of stay > 1 day; AND
iv. Discharged alive

3. Identify patients that are transferred between two inpatient facilities. This information is used when reporting the results as findings are stratified by those that were and were not transferred.

Step 2: Identify patients that meet eligibility and continuous enrollment criteria
1. Eligibility
a. Identify benefits during both the identification year and the measurement year
b. To be included persons must have both of the following benefits in both years (do not include persons whose pharmacy benefits are dropped partway through the identification or measurement period).
i. Medical benefit
ii. Pharmacy benefit

2. Continuous enrollment
a. Determine enrollment during both the identification and measurement years
b. Identify (or estimate) total days of coverage in each year
c. To be eligible, persons must have at least 320 total days of coverage during each year

Step 3: Identify patients with exclusion criteria
1. Identify patients that meet any of the following exclusion criteria during either the identification year OR the measurement year:
a. Exclude hospitalizations with ICD-9 Code 410.x2;
b. Exclude patients with DRG (v24) 123 (MS-DRG 283, 284, 285) at index hospitalization;
c. Discharged to skilled nursing facility (SNF) at index hospitalization
d. Any of the following diagnoses during the identification or measurement year (see Table AMI-D in written measure specification or codes described in section S8.2 above):
i. Active cancer (excluding melanoma, skin, prostate, and CLL)
ii. End stage renal disease (ESRD)
iii. End stage liver disease (ESLD)
iv. HIV/AIDS
v. Organ transplant

Step 4: Combine prior steps to identify measure population
1. Identify acute AMI eligible population
2. Exclude those patients not meeting general inclusion criteria (e.g., continuous eligibility)
3. Exclude patients meeting one or more measure exclusion criteria
4. The resulting collection of patients is the measure population

Identification of related resources

For each individual in the measure population, identify the paid claims for services rendered during the measurement period (days 1-30 following index hospitalization). Claims / encounters will be identified based on the presence of AMI-related diagnosis codes or procedure codes. These events will be used to determine the AMI-related resource use.

Inpatient hospitalization events
Identify all inpatient hospitalization events with one of the diagnosis codes appearing in the primary diagnosis field (see Table AMI-B or section S8.2 above).

Outpatient events
Identify all outpatient claims / encounters with an AMI-related diagnostic code appearing in any position (see Table AMI-B or section S8.2 above for specific codes).

Procedures and laboratory
Identify all claims / encounters with one of the following CPT, HCPCs, or ICD-9 procedure codes associated with that claim(see Tables AMI-B, AMI-C and section S8.2 above).
Prescription drugs
Identify medications in the appropriate therapeutic classes or HCPCs codes during the measurement period (see Table AMI-D or section S8.2 above).

Assignment of standardized prices

Standardized prices are calculated for all of the components of care used to treat or manage the patient's condition to ensure that comparisons can be made solely on the basis of differential practice patterns and resource use. Three separate methodologies are used to derive these standardized prices: for inpatient facility charges, for ambulatory pharmacy charges (i.e., prescriptions dispensed outside the inpatient hospital setting), and for all other charges. These standardized prices are then applied to the claims identified as AMI-related. For more detailed informatin see section S10.3 below)

Create episode specific strata--see section S10.2 below

S9.3. Measure Trigger and End mechanisms
Detail the measure's trigger and end mechanisms and provide rationale for this methodology.

The measure starts with the identification of an index AMI event and ends 30 days post trigger.

While AMI is primarily an acute condition, the successful management of patients that are post-AMI also involves need for longer-term treatment and secondary prevention. Additionally, the initial event and resource use around that event will be associated with disproportionate costs than the medical management following the initial event. Therefore, this measure focuses around the resource intensive period of the initial 30 days following the index AMI. The measure is intended to to measure variation in resource use at the hospital following patient presentation and during the post-hospitalization period (so as to capture variability associated with readmissions and the use of post-acute care), this measure begins at admission and follows the patient for the next 30 days. The 30 day cycle corresponds with current measures around AMI quality and overall hospital quality that focus on 30 day readmission rates. Importantly, an AMI event that occurs in the 30 days following an index eligible event is not included in the measure as the resource use for that event is likely very different compared to initial AMI events and is captured in a separate AMI post acute measure.

S9.4.Measure redundancy or overlap
Detail how redundancy and overlap of measures can be addressed and provide rationale for this methodology.

We do not provide specifications for measure redundancy or overlap.
To avoid redundancy and overlap within episodes of Acute myocardial infarction, we have elected to create two distinct measures. One measure for the acute phase (admission through 30 days) and a separate measure for the post acute phase (days 31-365). The two measures follow the same cohort of patients at different time periods, so there is no redundancy or overlap within the AMI measures.

Beyond AMI, the measures developed by ABMS REF were developed as standalone measures to address all relevant services associated with a particular health care condition. Collectively, the measures do not sum-up to a single total and there is the potential for overlap and redundancy to occur when multiple measures are applied simultaneously.

S9.5.Complementary services
Detail how complementary services have been linked to the measure and provide rationale for this methodology.

We do not provide specifications for linking complementary services.
All services included in the measure are included based on the presence of diagnosis codes, procedure codes, or medications.
Services are identified based on presence of qualifying codes. There is no effort to link complementary services to the episode. The strategy for all of our measures was to rely on the presence of codes to qualify for inclusion in the episode rather than to make assumptions about temporal or other associations between events.

S9.6.Resource Use Service Categories

Inpatient services: Inpatient facility services
Inpatient services: Evaluation and management
Inpatient services: Procedures and surgeries
Inpatient services: Imaging and diagnostic
Inpatient services: Lab services
Inpatient services: Admissions/discharges

Ambulatory services: Outpatient facility services
Ambulatory services: Emergency Department
Ambulatory services: Pharmacy
Ambulatory services: Evaluation and management
Ambulatory services: Procedures and surgeries
Ambulatory services: Imaging and diagnostic
Ambulatory services: Lab services

S9.7.Identification of Resource Use Service Categories
For each of the resource use service categories selected above, provide the rationale for their selection and detail the method or algorithms to identify resource units, including codes, logic and definitions.

At the claim line level, the user should identify all relevant codes specified in the clinical framework Section 8.2 above (see also written measure specification). For inpatient services, these include all relevant ICD9, DRG v24, DRGv25, CPT codes; for ambulatory services, these in clued all relevant ICD9, and CPT codes; for procedures and laboratory these include all relevant ICD9 procedure codes, HCPCs, and CPT codes, and for prescription drugs, these include relevant HCPCs and NDCs.

The above categories were selected because they represent the vast majority of resource use for the episode and the measure developers examined the distribution of costs between categories to evaluate the face validity of the measure. Developers also reasoned that resource use variation between providers by category would be informative. Please refer to Section S8.2 Clinical Framework for the algorithms used to identify/assign some services.

Measure developers also applied the Berenson-Eggers Types of Service (BETOS) system which categorizes all HCPCS codes into resource use areas (e.g. Evaluation and Management, Procedures, Imaging, etc). In addition to the BETOS category there is an additional category included for medications related resource use that is determined using pharmacy data and HCPCs.

Rationale: The BETOS classification system is a widely used, publically available system for classifying healthcare services. These categories can be used to examine cost patterns across providers to identify differences across the different categories of service. This system provides a sufficient number of categories to make meaningful comparisons across patterns of resource use and yet is not too broad so as not to be able to draw conclusions based on differences. Furthermore, identification of important differences allows users to drill down within those categories to identify cost drivers within BETOS categories that may ultimately provide actionable information for providers.

If needed, provide specifications URL (preferred) or as an attachment:

URL:
Please supply the username and password:
Attachment:

S9.8. Care Setting; *provides information on which care settings the measure encompasses.*

Ambulatory Care : Ambulatory Surgery Center (ASC)
Ambulatory Care : Clinic/Urgent Care
Ambulatory Care : Clinician Office
Hospital/Acute Care Facility
Imaging Facility
Laboratory
Pharmacy

S10.Adjustments for Comparability (Resource Use Measure Module 4)
External factors can mingle and affect or confound a measure's result. Confounding occurs if an

extraneous factor causes or influences the outcome (e.g., higher resource use) and is associated with the exposure of interest (e.g., episode of diabetes with multiple co-morbidities). Measure developers often include steps to adjust the measure to increase comparability of results among providers, employers, and health plans.

S10.1. Risk adjustment method
Define risk adjustment variables and describe the conceptual, statistical, or other relevant aspects of the model and provide rationale for this methodology.

Calculation of risk adjusted costs (see also the risk adjustment section in the technical appendix of the written measure specification).
The risk adjustment models were developed and tested on the same population used for the measure testing—the Thomson Reuters Healthcare Marketscan database, with over 30 million covered lives in each year.
The sample size for the AMI Acute measure was: 11,054

The models were developed using a split sample approach with 75% of the cohort used in the development phase and 25% used to evaluate the model fit. In addition, model fit was also evaluated in the entire cohort.

The model developed for comorbidity adjustment uses Hierarchical Condition Categories (HCC) to identify comorbidities. This reflects the risk adjustment methodology used by CMS and recently evaluated by NCQA for their Relative Resource Use (RRU) measures. However, there is an important distinction between the use of HCCs by CMS and the model evaluated by NCQA and the risk adjustment model used to estimate expected costs. The CMS and NCQA model use HCCs to adjust TOTAL costs of care, whereas this model focuses on episode-specific costs of care. Because models developed to adjust total costs of care may not reflect the expected costs for episode-specific resource use, new models were developed from a sample of commercially insured patients for risk adjustment. The following process was completed to develop the models:

1. Utilized quasi-Modified Delphi approach with the condition-specific workgroup to categorize HCCs into three groups:
- Include in risk adjustment model;
- Exclude in risk adjustment model; and
- Test impact in risk adjustment model.

2. Identified HCCs in denominator population during the 12 months preceding the measurement year.

3. Tested 12 different model specifications (see Table AMI-RA1 in technical appendix of written measure specification), where the HCCs included in the model varied, and the distribution and link functions in the generalized linear models also varied. Models were developed in a stepwise manner as indicated. The first four models used a gamma distribution and a log link function. The first model included all HCCs identified by the condition-specific workgroup as "Include HCCs" with a prevalence in the population of >=1%. The second model was a reduction of the first model that only included HCCs where $p<0.1$. The third model extended the second model by including HCCs with prevalence >=1% identified as "Test HCCs" by the condition-specific workgroup. The fourth model was a reduction of the third model and included only those HCCs where $p<0.1$. The next set of four models (Models 5-8) repeated the process of the first four models but used a normal distribution and identity link function. Model 9 used all of the HCCs, with the exception of the HCC for the episode being evaluated (e.g., AMI for the AMI hospitalization episode), and a gamma distribution with log link function. Model 10 was a reduction of Model 9 where only the HCCs with $p<0.1$ were included. The final two models (Models 11-12) used the same process as Models 9 and 10 with a normal distribution and identity link function.

4. Models were developed in a split sample approach with 75% of the population randomly selected for model development and the remaining 25% used in model evaluation. Model performance was also evaluated in the full cohort.

5. The performance of each model was evaluated through comparisons of the observed and predicted distributions, comparisons of residuals, comparisons of absolute differences between observed and predicted, comparisons of observed-to-predicted ratios, and comparisons of mean squared errors across models. Summary information on model performance was presented to the condition-specific workgroup for selection of a risk adjustment model for the condition. Final model selection was based on the best performing model across metrics. Where model performance

was similar, models using the normal distribution were preferentially chosen over the gamma distribution models for ease of implementation. More parsimonious models were also preferentially chosen.

The following is the model selected for estimating adjusted costs in the AMI acute episode.

Risk Adjustment Model

Risk Adjusted AMI Acute Episode Costs = $13,878 + (Male x $920) + (Age x-y x $1829) + (Age x-y x $2644) + (Age x-y x $2451) + (Diabetes with Renal or Peripheral Circulatory Manifestations x $4117) + (Diabetes with Neurologic or other Specified Manifestations x $1904) + (Cardio-respiratory Failure and Shock x $3749) + (Diabetes with Ophthalmologic or Unspecified Manifestation x $4039) + (Diabetes without Complication x $1978) + (Congestive Heart Failure x $1614)

Measure implementers have two choices when calculating risk adjusted costs. The first is to follow the process specified above to create risk adjustment models that are specific to their population and their dataset. The second option is to follow the below steps and use the above estimates for calculating risk adjusted costs. While the latter is a straightforward calculation, caution is warranted as the risk adjusted equations were derived from a population that may be different from the population to which the measure is being applied.

To estimate risk adjusted costs using the above risk adjustment equations in the measurement population, use the following steps:

Step 1: Identify the presence of HCCs on any claim in the 12 months preceding the measurement year, utilizing both inpatient (primary diagnosis field only) and outpatient encounters (all diagnosis fields).

Step 2: Create a person level file that contains an indicator (yes/no) variable for each of the HCCs. These variables indicate whether or not the patient had evidence of each HCC during the previous 12 months.

Step 3: Calculate an adjustment factor of the average episode costs in the measure population and divide it by the average cost of the test episode (Table AMI-RA2). Apply the inflation factor to the risk adjustment coefficients to account for cost differences between datasets used in development of the risk adjustment models and those used in calculating episode costs.

Summary estimates of the average cost for the AMI acute episode in the test episode: Average Cost: $16,712

Example: To calculate the inflation factor, determine the average episode cost for the population to which the measure is being applied. As an example, the average cost might be $19,720. Calculate the adjustment factor by dividing the costs from the current population by the average cost of $16,712. That would result in an adjustment factor of 1.18. The adjustment factor is then applied to the estimated coefficients to provide an adjusted risk adjustment model.

Risk Adjusted Model

Risk and Mean Adjusted Acute AMI Episode Costs = 1.18 * Risk Adjusted Acute AMI Episode Costs
Step 4: Use the equation for the appropriate age group to generate risk adjusted expected costs for each individual in the dataset.

Comorbidity Adjustment Strategy Rationale:

We acknowledge that risk adjustment is an important part of the development of an episode of care measure. Risk adjustment is intended to account for variation in episode costs that are not due to differences in practice patterns but rather are due to differences in the case mix of patients. When reporting episode costs at the provider level, risk adjustment attempts to account for differences in the case mix of patients across providers and minimizes the assertion that one providers patients are sicker than the comparator patients. An additional advantage of episode-based measurement is that focusing on costs related to care only for that episode may be a form of risk adjustment because we are not looking at the overall healthcare costs of the patients. Our risk adjustment strategy was not to attempt to account for all of the variation within an episode; however we want to be able to control for resource use variation that is attributed to the episode that may result from differences in patient case mix.

We selected to use Hierarchical Condition Categories (HCC) as our primary strategy for identification of comoribid conditions and for risk adjustment. We selected HCCs because of their use in risk adjustment methodology used by CMS and recently evaluated by NCQA for their Relative Resource Use (RRU) measures. We felt that many users of our episodes would be familiar with HCCs and the use of these measures in administrative data. Moreover, the analytic programmers for generating HCCs are freely available on the CMS website and therefore we mitigate issues of access to code for creating the risk adjustment groups.

While we use HCC as the starting point for our risk adjustment models, there is an important distinction between the use of HCCs by CMS and the model evaluated by NCQA and our episode definitions. The CMS and NCQA model use HCCs to adjust for TOTAL costs of care whereas, we are focused on the episode-specific costs of care. Briefly, NCQA has created weights for each of the HCCs on total costs of care using data from a large population that has one of the conditions in their RRU measure. These weights can then be applied to different populations to adjust for the presence of comorbid conditions when estimating total costs. The primary concern with applying the adjustment factors available from either CMS or NCQA are the fact they are total costs and not related to the episode-specific costs of care. This would lead to very different risk adjustment models that would not account for as much of the variability within the episode as a risk adjustment model focused on episode-specific costs. We compared the use of the 'off the shelf' HCC values with a risk adjustment model developed specifically for our episode.

See attached supplemental document for illustrative example of comparison of "off the shelf" HCC values to the risk adjustment model developed specifically for our episode (note: diabetes is used for purposes of illustration).

Given the disparity in the means and distributions of the off the shelf HCC values, we felt this justified our approach to develop risk adjustment models for each of our episodes that were focused on episode specific costs.

If needed, provide supplemental information via a web URL (preferred) or attachment with the risk adjustment specifications.

URL:
Please supply the username and password:
Attachment: 10.1_Risk adjustment method-634343583695504932.pdf

S10.2. Stratification Method
Detail the stratification method including all variables, codes, logic or definitions required to stratify the measure and rationale for this methodology

Patients are stratified based on the presence of heart failure when making comparisons across resource use. In addition, separate strata are also created based on if a patient is transferred to another acute care facility during the hospitalization for the index event.

Stratification for heart failure is derived from HCCs(if HCC80=1 then they
are in the CHF group).
For transfers, we used Discharge status (if dstatus=´02´ "Transfer to short-term hospital").

Heart failure has been shown to be associated with longer length of stay than in patients that do not have heart failure. This longer length of stay can result in differential resource use if groups being compared are unbalanced with respect to the presence of heart failure. In addition to the longer length of stay, heart failure patients may be treated differently than patients without heart failure leading to differences in resource use. For these reasons, the measure stratifies the population based on the presence of heart failure.

The stratification around transfer status was included as a method to account for differences in acuity of patients that are transferred that may result in differential resource utilization. Because patients that are transferred to a facility that may specialize in cardiac care may be more complex or sicker patients, they will likely have differential resource utilization and this could result in systematic differences between hospitals. Therefore, those that are and are not transferred are maintained as separate strata in the measure.

S10.3. Costing Method
Detail the costing method including the source of cost information, steps to capture, apply or estimate cost information, and provide rationale for this methodology.

Standardized prices are calculated for all of the components of care used to treat or manage the patient's condition to ensure that comparisons can be made solely on the basis of differential practice patterns and resource use. Three separate methodologies are used to derive these standardized prices: for inpatient facility charges, for ambulatory pharmacy charges (i.e., prescriptions dispensed outside the inpatient hospital setting), and for all other charges. These standardized prices are then applied to the claims identified as related.

Standard Cost Calculation

Step 1 Identify all claims paid for services rendered during the measurement period and with positive non-zero paid amounts for all patients, regardless as to whether they have been included in the measure population (rejected or unadjudicated claims should be dropped). Categorize these claims as follows (in accordance with the BETOS classification process):

- Inpatient Facility (services provided by a facility during an acute inpatient hospital stay, standard price includes room and board and ancillary services)
- Ambulatory Pharmacy (ambulatory prescriptions included in a member's pharmacy benefit)
- All other (E&M, procedures, imaging, tests, DME, other, and exceptions/unclassified)

Step 2 For each category identified, compute standardized prices. Refer to each service category's instructions (i.e., Calculating Standard Units of Service and Total Standard Cost) below.
Step 3 Combine standardized prices with eligible events (e.g., through a file merge as specified in each service category's instructions).
Step 4 For each individual claim, multiply the standardized price by the number of service units identified on the claim to determine the full cost of the service, hospitalization, or prescription.

Calculating Standard Units of Service and Total Standard Cost: Inpatient Facility

For inpatient facility costs, standardized prices are developed at the diagnosis-related group (DRG) level and – for those hospitalizations where DRG-level information is unavailable – at the ADSC level. Each is adjusted for length-of-stay (LOS) so as to more closely mirror the payment systems typically applied among commercial health plans. Both approaches use RRU HEDIS standardized daily price tables developed by NCQA. All inpatient facility costs are considered "acute" for this analysis.

Step 1 Identify all inpatient stays that occurred during the measurement period. Include stays that may have started before the measurement period or ended after the close of the measurement period. Define a single, unique record describing the member's inpatient stay.
Step 2. Identify the primary discharge DRG. Also identify the DRG version (e.g., CMS-DRG vs. MS-DRG). Care must be taken in using the standardized price tables (specified below) to insure the data and the tables use the same DRG version.
Step 3 Compute the stay's total LOS in days, using paid or expected-to-be-paid days only. Include all paid days in the LOS calculation, whether or not they fall outside the measurement period. Also identify the stay's LOS group based on the stay's LOS and the information below.

LOS (Days)	LOS GRP
1	A
2	B
3-4	C
5-6	D
7-8	E
9-15	F
16 or more	G

Step 4 Compute the LOS per diem multiplier. If the inpatient stay falls completely within the measurement period, use the total number of paid days as the per diem multiplier. If the inpatient stay does not fall completely inside the

measurement period, count only the days within the measurement period (including the last day of the period) to compute the per diem multiplier.

Step 5 Download the HEDIS RRU standardized daily price tables from the NCQA website (http://www.ncqa.org/tabid/1092/Default.aspx) for the corresponding measurement periods. Note that there is a one period lag in the file and data periods (i.e. files designated 2007 are based on 2006 data). Some periods may have two sets of tables if there is a significant change in DRG versions. Note: The project staff worked in collaboration with NCQA in development of this methodology for purposes of testing the initial set of measures. Users of the measures may wish to implement their own methodology that does not rely on a price list from NCQA.

Step 6 Calculate the DRG-specific per-diem payment rate by adjusting the standard daily prices for inflation to a reference period using the medical care component of the Consumer Price Index (CPI).

Step 7 Combine DRG-specific per-diem payment rates with the dataset containing eligible inpatient hospital events for the measure. For each event, multiply the per-diem payment rate by the event's LOS per diem multiplier to determine the event's total standard cost.
Total standard costs will not be computed using this approach for stays that have not been assigned a DRG, and for DRGs that are not assigned a standard price by HEDIS. These stays will be assigned a standard price using the ADSC method described below. (Note: Figures presented in this example are arbitrary and do not reflect any particular dataset or patient. Additionally, the DRG XXX is intended to be used as an illustrative example for calculating inpatient costs. Only DRGs related to the episode should be included in this calculation).

Example:

Assume the calculated DRG-specific per-diem payment rate for DRG XXX for FY 2007 is $900.17. An eligible member had an inpatient stay with the following characteristics:
- A principal diagnosis with an eligible ICD-9 code
- A DRG of XXX (DRG associated with an eligible inpatient stay for the episode)
- Date of admission of February 2, 2007 and date of discharge of February 9, 2007 (fiscal period 2007)
- A LOS of 8 days, and therefore a LOS per diem multiplier of 8 days

This event has a calculated total standard cost of $900.17 x 8 = $7,201.36.

Example:

Again assume the calculated DRG-specific per-diem payment rate for DRG XXX for FY 2007 is $900.17. An eligible member had an inpatient stay with the following characteristics:
- A principal diagnosis with an eligible ICD-9 code
- A DRG of XXX (DRG associated with an eligible inpatient stay for the episode)
- Date of admission of December 28, 2006 and date of discharge of January 2, 2007 (fiscal period 2007)
- A LOS of 6 days, and a LOS per diem multiplier of 2 days (January 1-2).

This event has a calculated total standard cost of $900.17 x 2 = $1,800.34.

Step 8 If DRG information is not available for a given inpatient hospitalization a method must be used that assigns prices to those hospitalizations. The methodology used in testing the initial development of the measures was to assign an Aggregate Diagnostic Service Category (ADSC) for the stay using the principal discharge diagnosis. To assign ADSC, download the ADSC Table (Table SPT-INP-ADSC) from the NCQA Web site (http://www.ncqa.org/tabid/1092/Default.aspx) and match the principal ICD-9-CM Diagnosis code from the discharge claim to an ADSC. If the claim does not contain a DRG and the primary ICD-9-CM Diagnosis code is invalid or missing, map the inpatient stay to the ADSC Table's MISA category. An alternative would be to create average prices from the dataset the measures are being implemented for each of the ADSC categories and discharge ICD-9-CM codes and assign those prices to missing hospitalizations.

Step 9 Determine if the member underwent major surgery during the inpatient stay. If this information is not available within the dataset, this may be determined using the list of codes included in a table from the NCQA Web site (Maj-Surg Table). Flag eligible members if one procedure code in the Maj-Surg-Table is present from any provider during the time period defined by the admission and discharge dates.

Step 10 Match each ADSC, LOS per diem multiplier, and major surgery flag assignment for the stay to a value in the

Table SPT-INP-ADSC to obtain the assigned standard price. For each event, multiply the per-diem payment rate by the event's LOS per diem multiplier to determine the event's total standard cost. As with the DRG method, the ADSC standard prices must be adjusted for inflation to a reference period using the CPI. Between this ADSC methodology and the previously described DRG-based methodology, each inpatient hospital stay should now have an associated standardized price.

Example:

An eligible member had an inpatient stay with the following characteristics:
- A principal diagnosis for an eligible event assigned to ADSC category Respiratory-C (RESC)
- No available valid DRG information
- Date of admission of February 2, 2007 and date of discharge of February 9, 2007
- A LOS of 8 days, and therefore LOS group E
- A major surgery event during the stay

Using Sample Table SPT-INP-ADSC, we determine this event has a standard per-diem payment rate of $1,474.00. Therefore this event has a calculated total standard cost of $1,474 x 8 = $11,792.

Calculating Standard Units of Service and Total Standard Cost: Ambulatory Pharmacy

For ambulatory pharmacy-related costs, standardized prices are developed at the NDC level, adjusted for days supply.

Step 1 Identify all pharmacy services that occurred during the measurement period. The following pharmacy services should also be included:
- Prescriptions that may have been dispensed before the measurement period and had days supply that extended into the measurement period (e.g., a prescription with a dispensed date of December 15, 2007 and 30 days supply would extend 13 days into the measurement period beginning January 1, 2008)
- Prescriptions that may have been dispensed during the measurement period and had days supply that extended into the following period (e.g., a prescription with a dispensed date of December 20, 2008).

Define a single, unique record describing the pharmacy service.
Step 2 Identify the NDC code and the days supply for each prescription, whether or not some days fall outside the measurement period.
If the days supply is not available for a given pharmacy claim, set the claim's standard cost to be equal to its listed payment amount.
Step 3 Compute the days supply per diem multiplier. If the prescription's days supply fall completely within the measurement period, use the claim's listed days supply as the per diem multiplier. If the prescription's days supply do not fall completely inside the measurement period, count only the days within the measurement period (including the last day of the period) to compute the per diem multiplier.
Step 4 For each NDC, calculate the total NDC-specific payments and the total days supply across all pharmacy claims within that NDC during the measurement period. Using these totals, calculate NDC-specific per-day-supply payment rates by dividing total NDC-specific payments by total days supply for each NDC.
Step 5 Combine NDC-specific per-day-supply payment rates with the dataset containing eligible pharmacy events for the measure. For each event, multiply the per-day-supply payment rate by the event's days supply per diem multiplier to determine the event's total standard cost.

Calculating Standard Units of Service and Total Standard Cost: All Other

For all non-inpatient hospital, non-pharmacy costs, standardized prices are developed at the procedure code and modifier level.

Step 1 Identify all non-inpatient hospital, non-pharmacy services that occurred during the measurement period.
Step 2 Identify the primary procedure code (CPT, HCPCs, ICD-9, etc.) and the first modifier code for each service.
Step 3 For each procedure-modifier combination, calculate the total procedure/modifier-specific payments across all non-inpatient-hospital, non-pharmacy claims with that procedure-modifier combination as well as the frequency of the procedure-modifier combination during the measurement period. Calculate procedure/modifier-specific payment rates by dividing total procedure/modifier-specific payments by the frequency for each procedure-modifier combination.

Example:
Assume that there are 3 non-inpatient-hospital, non-pharmacy claims during the measurement period with the following characteristics:
Patient: 1111, Procedure (CPT-4): 71010, Modifier: Date: 2/1/2007, Payment: $21
Patient: 1111, Procedure (CPT-4): 72240, Modifier: TC, Date: 2/18/2007, Payment: $90
Patient: 2222, Procedure (CPT-4): 71010, Modifier: Date: 1/5/2007, Payment: $25

For the procedure/modifier combination: 71010
The total payment is $21 + $25 = $46
The total frequency is 2
Therefore the procedure/modifier-specific payment rate is $46/2 = $23
For the procedure/modifier combination: 72240/TC
The total payment is $90
The total frequency is 1
Therefore the procedure/modifier-specific payment rate is $90/1 = $90

Step 4 Combine procedure/modifier-specific payment rates with the dataset containing eligible non-inpatient-hospital, non-pharmacy events for the measure so that each procedure-modifier combination is paired with its corresponding payment rate. This payment rate is the event's total standard cost.

Calculation of total individual episode costs

The resource use identified as diabetes-related– and to which standardized prices have been applied (i.e., the collection of eligible events) – is used to calculate individual level episode costs. The following steps are used in the calculation of total individual level costs.

Step 1: For each individual included in the episode, sum all of the total standard costs linked to diabetes-related events occurring during the measurement period at the BETOS service category level. This will provide an estimate of the costs of each category of service over the measurement period.

Step 2: For each individual in the episode, sum ALL total standard costs linked to diabetes-related events to calculate TOTAL episode costs.

Step 3: Exclude individuals that do not have positive, non-zero costs (e.g. outpatient visit, hospitalization, medication use) during the measurement period.

Rationale for costing method

We used standardized prices to estimate the costs for all components of care in the claims data that a patient received data during the measurement period. Because costs in claims data reflect both the quantity and mix of services delivered as well as the prices paid for those services, some of the cost variation is due to price differences across providers (Thomas et al., 2005). Variations in cost data among organizations and over time can obscure real cost differences (Ritzwoller, et al., 2004) and impede comparisons across providers. To ensure that comparisons are made on the basis of differences in practice patterns and resource use, we developed standardized prices, such that a given service would have the same price across all providers (Thomas et al., 2005). We used separate methods to estimate standardized price that were used to calculate for inpatient facility costs, pharmacy costs, and cost for all other care.
For the inpatient facility use, we developed standardized prices using diagnosis-related group (DRG) information. For hospitalizations without DRG-level information, we used aggregate diagnostic service category (ADSC) level information. In each case, we adjusted for length-of-stay (LOS) during the measurement period so as to more closely mirror the payment systems typically applied among commercial health plans. Both approaches use relative resource use (RRU) HEDIS standardized daily price tables developed by NCQA. We worked in collaboration with NCQA in development of this methodology; however, users of the measure may need to implement their own methodology that does not rely on a price list from NCQA.
For pharmacy use, we determined the days supply for each medication that was dispensed during the measurement period identified by a unique national drug code (NDC). We calculated a standardized price per diem for each NDC in our data by dividing the total payments in the claims data by the total days supply in the claims data for that NDC. We then estimated patient's pharmacy costs by multiplying the standardized price per diem for each NDC by the patient's days supply during the measurement period for that NDC. Standardized prices for pharmacy was estimated using this

approach rather than an average whole price (AWP) because the AWP is not defined by law or regulation and does not reflect discounts obtained by most purchasers. As a result, the ultimate price paid by purchasers is often significantly lower than the AWP (Pereira, 2005).
For all other use, we identify the primary procedure code (CPT, HCPCs, ICD-9, etc.) and the first modifier code for each service. We calculated a standardized price for each procedure/modifier by dividing the total procedure/modifier-specific payments by the frequency for each procedure/modifier combination in the claims data. We then applied this standardized price to each patient's procedure/modifier combination that occurred during the measurement period. This approach allowed for a consistent methodology to be applied to each procedure/modifier combination in the claims data to achieve the same price for a service across all providers.

References:
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Thomas JW, Grazier KL, Ward K. Economic Profiling of Primary Care Physicians: Consistency among Risk-Adjusted Measures. Health Services Research. 2004;39(4):985- 1004

S11. Measure Reporting (Resource Use Measure Module 5)
The measure developer must determine which of the following Measure Reporting functions: attribution approach, peer group, outliers and thresholds, sample size, and benchmarking and comparative estimates, are submitted as measure specifications or as guidelines. Specifications limit user options and flexibility and must be strictly adhered to; whereas guidelines are well thought out guidance to users while allowing for user flexibility. If the measure developer determines that the requested specification approach is better suited as guidelines, please select and submit guidelines, otherwise specifications must be provided.

S11.1. Detail attribution approach
Detail the attribution rule(s) used for attributing costs to providers and rationale for this methodology (e.g., a proportion of total measure cost or frequency of visits during the measure's measurement period) and provide rationale for this methodology.

Resource use and costs for AMI episodes are attributed at the hospital level. The results are attributed to the hospital with the majority of the length of stay during the initial AMI event.

Rationale:

The process for managing a patient with an AMI is largely driven by the system in place at the hospital at which the patient presents. There is no individual clinician that is responsible for the care process and resources that are used during the acute event. This is largely a team process where all providers involved in the care of the patient can impact the resource use. Therefore, the care for each patient is attributed to the hospital that had the majority of the length of stay during the initial AMI event. We had considered attribution at the 'team' level where all providers involved in the care of a patient would be grouped and the care for all of the patients that this 'team' saw would be combined. However, it was not possible to reliably measure the providers that were involved in the care of the patient in existing data. Therefore, the 30-day AMI measure uses the hospital as the unit of attribution.

S11.2.Identify and define peer group
Identify the peer group and detail how peer group is identified and provide rationale for this methodology

We do not provide specifications or guidelines for identifying and defining the peer group : Because the measure focuses at the hospital level, it is reasonable to compare the results to all other hospitals. Therefore, there are no defined peer groups for making comparisons with this measure. For the measure, we do not think it is feasible for most users to link with databases that contain hospital information, such as number of beds, teaching status, or other criteria that could be used to differentiate hospitals. Therefore, we feel it is reasonable to compare results to all other hospitals that are included.

S11.3. Level of Analysis:

Facility

S11.4.Detail measure outliers or thresholds
Detail any threshold or outlier rules and decisions based on measure resource use and provide rationale for this methodology

Guidelines : For the provider reports,total observed episode costs are winsorized at the 2nd and 98th percentile, but claim line outliers are not removed and the use of risk adjusted results are intended to correct for any extreme outliers. The only exception is inpatient admissions. Extremely high admissions costs are winsorized at the 99th percentile (i.e. any value higher than the 99th percentile are set to the 99th percentile cost).
Rationale: Winsorizing and risk adjustment limits the influence of outliers. Episodes with extremely high admission costs skews mean costs for the entire episode. Winsorizing admissions at the 99th percentile reduces this effect without eliminating information on the distribution of total episode costs.

S11.5.Detail sample size requirements
Detail the sample size requirement including rules associated with the type of measure

We do not provide specifications or guidelines for sample size requirements : The ABMS REF episode-based resource use measures do not randomly sample enrollees nor do we recommend that implementers construct measures from a random sample. Regarding the issue of sample size determination. It is well known that the nature of resource use measurement at the level of individual providers will often lead to unstable estimations. There have been a number of efforts to derive a single number for which such measures might be stable enough for comparison of providers or individual providers over time. Yet to date there is no commonly accepted minimum. At this time we have not attempted to derive a minimal sample size for measure use.

S11.6.Define benchmarking or comparative estimates
Detail steps to produce benchmarking and comparative estimates and provide rationale for this methodology

Guidelines : Creation of provider summaries
The provider summaries are a report of the resource use for an attributable unit (hospital or provider) compared to their peer group, their non-peer group and all episodes in the dataset. Creation of the provider summaries uses the summary episode costs combined with the attributable provider data and the risk adjusted episode costs.

Step 1: Create a dataset that includes the following information: patient ID, total episode cost, attributable provider ID (or ID for the attributable unit if at the hospital level), attributable provider specialty type and episode expected costs from the risk adjustment model.

Step 2: Calculate the observed-to-expected ratio for each of the episodes by dividing observed costs for the episode by expected (predicted) costs for the episode.
O-to-E = Sum of Observed Costs / Expected Costs from Risk Adjustment Model
Step 3: If applicable, create indicators for the strata the episodes fall into so that separate summaries can be created for each of the strata.
Step 4: Summarize the observed, expected and observed-to-expected ratio for each attributable provider. Report minimum, maximum, median and mean values of the observed-to-expected ratio for all episodes attributed to the provider.

Step 5: Summarize the observed, expected and observed-to-expected ratio for each provider type, overall, and within each strata (if applicable). Report summary statistics for each of the provider types so the data are summarized for all providers of the same type. For example, report the summary statistics for the observed-to-expected ratio for all of the family practice physicians to facilitate peer group comparisons.

Step 6: Summarize the observed, expected, and observed-to-expected ratio for all of the episodes.
Step 7: For each of the individual attributable units (hospital or provider), determine the proportion of O-to-E ratios that are greater than or equal to the 75th percentile of the O-to-E ratio for the peer group. Calculate the 95%

confidence interval for the proportion. For example, if the provider for which summary statistics are being calculated is a general internist and it is Dr. Y, the 75th percentile of O-to-E ratios for all episodes attributable to general interests is determined. The proportion of Dr. Y´s O-to-E ratio that are above the 75th percentile for all general interest episodes is determined and a 95% confidence interval is calculated for that proportion.
Step 8: Create provider summary reports for each attributable provider in the dataset

S12.Type of Score:

Ratio

If available, please provide a sample report:

S12_sample score report-634345780927019254.pdf

S12.1. Interpretation of Score.
(Classifies interpretation of score (s) according to whether higher or lower resource use amounts is associated with a higher or lower score, a score falling within a defined interval, or a passing score, etc)

The summary score calculated for the measure is the ratio of the observed cost to the expected cost or the O-to-E ratio. The O-to-E ratio is calculated for each patient for the attributable provider and summary statistics are calculated for the O-to-E ratio. The O-to-E ratio provides an estimate of the observed cost for a patient to the expected cost based on the patient's mix of chronic conditions. Expected costs for each patient are the calculation of their risk adjusted costs. A value of 1 for the O-to-E ratio indicates that the observed costs are equal to the expected costs. A value greater than 1 indicates that observed costs are more than what would be expected based on the patient's mix of chronic conditions. A value less than 1 indictates that the observed costs are less than what would be expected based on the patient's mix of chronic conditions. Calculation of the O-to-E ratio incorporates our approach to risk adjustment by determining the expected costs from the risk adjustment model. A summary O-to-E ratio is calculated for each of the attributable providers which combines all the episodes for that provider. Summary statistics are calculated for each provider for the raw (unadjusted) costs for the episode, expected costs and the O-to-E ratio. Each summary measure includes minimum, maximum, median, and mean values.

S12.2. Detail Score Estimation
Detail steps to estimate measure score.

Creation of provider summaries

The provider summaries are a report of the resource use for an individual hospital compared to all episodes in the dataset. Creation of the provider summaries uses the summary episode costs combined with the attributable provider data and the risk adjusted episode costs.

Step 1: Create a dataset that includes the following information: patient ID, total episode cost, attributable provider ID, attributable provider specialty type and episode expected costs from the risk adjustment model.

Step 2: Calculate the observed-to-expected ratio for each of the episodes by dividing observed costs for the episode by expected (predicted) costs for the episode.

Step 3: Create each strata of reporting by determining which strata the events fall into. Strata include transfer vs. not transferred and heart failure (HCC80) vs. no heart failure in preceding 12 months. These factors are used to create summary reports stratified by transfer status and presence of heart failure.

Step 4: Summarize the observed, expected and observed-to-expected ratio for each attributable hospital, overall and within each of the strata.

Step 5: Summarize the observed, expected and observed-to-expected ratio for the all of the episodes.

Step 6: For each hospital, determine the proportion of observed-to-expected ratios above the 75% percentile of all

hospitals and calculate the 95% confidence interval

Step 7: Create provider summary reports for each attributable hospital

Attached is a sample report --provided for illustrative purposes only --figures do not reflect AMI hospitalization costs.

S12.3. Describe discriminating results approach
Detail methods for discriminating differences (reporting with descriptive statistics--e.g., distribution, confidence intervals)

Summary reports are generated at the attribution level that includes a summary estimate for the provider or hospital, the peer group, the non-peer group and the overall summary for the episode in the entire population. For each attributable provider / hospital the observed, expected and O-to-E ratio are summarized. The summaries are created to facilitate comparisons for the attributable provider or hospital with other providers in the same peer group and overall. The most meaningful comparisons are likely those between the provider or hospital and the peer group. Even though the results are risk adjusted, this may help to further balance the case mix or severity of the patients being compared. The summary statistics for the O-to-E ratios can be compared in order to provide a sense of the relative performance of the provider or hospital compared to peers. In addition, the proportion of O-to-E ratios about thresholds of 2.0 and 2.5 are provided for comparisons. Finally, for the attributable unit (hospital or provider) the proportion of O-to-E ratios that are greater than or equal to the 75th percentile of the O-to-E ratio for the peer group is determined and the 95% confidence interval calculated. The expectation would be that 25% of the estimates for the attributable provider would fall about this value if the distribution of O-to-E ratios is similar to the peer group. A statistically significant difference would be found between the groups if the 95% confidence interval did not include 25% in the range. For example, if the proportion at or above the 75th percentile of the peer group is 38% and the 95% confidence interval ranges from 28% to 48% than this provider would have significantly more O-to-E ratios at the upper end of the distribution than the peer providers. Alternatively, if the proportion at or above the 75th percentile was 8% and the 95% confidence interval ranged from 3% to 16% then the provider would have significantly fewer O-to-E ratios in the upper end of the distribution than the peer group. The 75th percentile in our testing was selected as an illustrative cut-point and it will be important to evaluate this threshold for comparing providers.

TESTING/ANALYSIS	
Measure testing must demonstrate adequate reliability and validity in order to be recommended for endorsement. Testing may be conducted for data elements and/or the computed measure score. See guidance on measure testing.	**Eval Rating**
TESTING ATTACHMENT (5MB or less) or URL: ***If needed, attach <u>supplemental</u> documentation (Save file as: SA_Reliability_Validity Testing) All fields of the submission form that are supplemented within the attachment must include a summary of important information included in the attachment and its intended purpose, including any references to page numbers, tables, text, etc.*** URL: Please supply the username and password: Attachment: SA_Reliability_Validity Testing AMI Acute.pdf	
SA1. Reliability Testing ***For each module tested or for the overall measure score:*** **SA1.1. Data/sample** ***(Description of the data or sample including number of measured entities; number of patients; dates of data; if a sample, characteristics of the entities included)*** ABMS Episode-based Resource Use Measures were tested on Thomson Reuters Marketscan Dataset. Additional testing was performed on a sample of CMS Medicare Data.	**2a2** **H☐** **M☐**

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The MarketScan Commercial Database provides a rich, comprehensive source of longitudinal administrative claims data, offering the largest convenience sample available in proprietary databases with over 30 million covered lives in each of the three most current years of data. The MarketScan Commercial Claims and Encounters (Commercial) Database is constructed from data contributed from over 100 medium and large size employers and health plans, representing over 130 unique carriers. The MarketScan Databases' large sample size constitutes a nationally representative data sample of the U.S. population under the age of 65 with employer-sponsored health insurance.

The stability of MarketScan data sources provides superior continuity of patients over multiple years, generally longer than other claims databases because the majority of the MarketScan data are sourced from large employers. As long as individuals remain with the same employer, they can be tracked across health plans.

Features of the MarketScan Research Databases include:
- Fully paid and adjudicated claims including inpatient, outpatient, and prescription drug claims
- Complete payment/charge information, including amount of patient responsibility
- Validated diagnosis, procedure, and other standard codes on claims where applicable (CPT, ICD-9, DRG, NDC, etc)
- Demographic information on enrollees including age, gender, and geographic information (three-digit zip codes and MSA)
- Plan-type identifiers in the database include major medical, comprehensive, PPO, EPO, HMO, consumer-driven health plan, capitated or part-capitated POS and non capitated POS
- Standardized data elements and definitions, ensuring accurate comparisons
- Clinical data enhancements, such as Therapeutic Class and Generic Product Identifiers on drug records, and Major Diagnostic Categories and Diagnosis Related Groups on inpatient and outpatient records
- Case records linking all of the hospital, physician, and ancillary services provided during an inpatient stay, allowing for comparisons based on such statistics as average length of stay, cost per admission, etc.

These data reflect the real world of treatment patterns and costs by tracking millions of patients as they travel through the healthcare system, offering detailed information about all aspects of care. Data from individual patients are integrated from all providers of care, maintaining all healthcare utilization and cost record connections at the patient level.

CMS testing in Medicare database
Through a CMS contract to Mathematica Policy Research, the AMI measures were also tested on a 100% sample of the Medicare population in 12 metropolitan sites (3.3 million beneficiaries) to assess feasibility and compare analytic results across the commercially insured and fee for service Medicare populations.

SA1.2. Analytic Methods
(Describe method of reliability testing and rationale)

Marketscan testing
The iterative development process that was employed in defining the episode of care resulted in episode measures being examined (means, medians, distributions)and modified several different times. As the workgroup would suggest changes to the specifications, modifications would be made in the programming language to reflect these changes. This would allow us to examine the reliability of our implementation of the episode measures as we would not anticipate large changes in the observed costs with only small changes in the logic of the episode measure. For example, if we added a new diagnosis code to our episode that only had a small number of associated claims in our Level 1 analysis we would not expect large changes in the overall cost of the episode. Conversely, if large changes were made in the logic of the episode we would expect similar changes in the overall resource use and cost.

CMS Medicare testing
For testing the measure in the Medicare database, we structured our analytic tests as similarly as possible to those we had completed previously using the Marketscan database to ensure comparability. However, it was necessary that we make some modifications to our analytic methodologies given the important differences in the two populations, the benefits available to the populations, and the differences in the incentives underlying the commercial and Medicare provider reimbursement systems. We conducted sensitivity analyses to assess the magnitude of the effects each modification would have when applied, and through those analyses we determined that meaningful comparisons could still be made between the two sets of results. The modifications included:

- Excluding outpatient drug costs from all analyses, given the unavailability of Part D claims data
- Developing a new set of prices to be applied to individual services and hospitalizations during the tabulation of total episode-related costs
- Deploying a modified BETOS classification system in breaking out the types of services provided during episodes
- Dropping analyses of resource use by individual provider or provider specialty, given the limited availability of physician and hospital identifiers
- Limiting analyses of Medicare claims to the calendar years 2006 and 2007 (versus 2006 through 2008 using Marketscan)

In general, patterns of resource use within and across both Acute and Post-Acute AMI episodes were very comparable between the Marketscan and Medicare population analyses.

SA1.3.Testing Results
(reliability statistics, assessment of adequacy in the context of norms for the test conducted)

Marketscan testing:
The iterative modification of measure specifications resulted in several runs of the episode programming. Comparisons between results showed expected changes in overall resource use. The addition of a new diagnosis code that was previously included as unrelated but only had a minimal number of claims associated with it did not change the overall results associated with the episode.

CMS Medicare testing:
Among the 3.3 million individuals in the FFS Medicare database, 24,763 (0.75%) had at least one AMI hospital admission (the episode-triggering event) between July 1, 2006 and November 1, 2007, the period during which all episodes to be studied would be identified. There were a total of 29,469 AMI events identified during this period, 25,757 (87%) of which met our technical criteria ensuring the validity of the events and thereby qualified as "potential AMI index admissions." Of those 25,757 events, 9,093 (35%) were included in the final analytic sample because they were not excluded on the basis of incomplete coverage or because of other clinical or categorical exclusions such as the patient's age (under 18 or over 85) or the presence of another AMI event within 30 days prior to the event.
These findings are comparable to those obtained through analysis of the Marketscan database, where we observed 11,054 events (36%) retained for the final analytic sample from the initial pool of 29,921 AMI events (experienced by about 26,000 [0.08%] of the for the approximately 33 million individuals in the Marketscan database). That the final proportions of AMI events retained after all exclusions were applied were similar between these two populations may be coincidental, however, as the proportions excluded on the basis of incomplete coverage from each pool and the proportions excluded on the basis of clinical exclusions from each pool, respectively, are quite different: significantly fewer AMI events were excluded from the initial pool of potential AMI index admissions in the Medicare FFS data because of incomplete coverage (due to the more consistent enrollment and coverage patterns among Medicare beneficiaries), while significantly more AMI events were excluded in the Medicare FFS data analysis because of various clinical exclusions (due to the increased morbidity among the elderly).
Analysis of the AMI Acute episodes observed in the Medicare FFS database also revealed significantly larger proportions of episodes for patients who were discharged to a skilled nursing facility (SNF) or had comorbid congestive heart failure (CHF) at the time of the AMI admission than there were in the Marketscan database. These findings, which were as expected given the increased morbidity among Medicare beneficiaries versus younger, commercially insured adults, emphasize the importance of stratifying measure results by SNF-transfer status and CHF comorbidity in a Medicare population, as recommended in the measure's specifications. We conducted episode-level analysis of resource use, broken out by types of service and percentiles, both overall and separately for each of four stratification subgroups (with CHF/no SNF transfer, without CHF/no SNF transfer, with CHF/transferred to SNF, without CHF/transferred to SNF). Total episode costs averaged $18,027, of which $14,464 (80.2%) was for inpatient facility charges, $926 (5.1%) was for evaluation and management (E&M) professional services, and $916 (5.1%) was for procedural professional services. Our resource-use analytic results for the Medicare population showed reasonable variability across stratification subgroups, with total costs considerably higher for patients who were transferred to a SNF following their hospitalization and not significantly different for those who were and were not identified as having comorbid CHF.
These results are very similar to those obtained using the Marketscan database, with 81% of total episode costs for inpatient facility charges, 4% for E&M professional services, and 9% for procedural professional services . The differences between the two populations in terms of the proportion of total costs accounted for by procedural professional services appear reasonable given the clinical expert workgroup's reasoning that physicians may be less likely to recommend invasive procedures such as coronary artery bypass graft (CABG) or percutaneous coronary

intervention catheterization (PCI-CATH) for less robust, elderly AMI patients. Each population's results also showed similar levels of right-skewness over their distributions.
The distribution of these primary diagnoses is similar to that identified in the Marketscan database.

SA1.4.Finding statement(s)—*(i.e., is the measure deemed reliable, limitations identified)*

We were able to produce consistent results within the episode.

SA2.Validity Testing
For each module tested or for the overall measure score:

SA2.1. Data/Sample
(Description of the data or sample including number of measured entities; number of patients; dates of data; if a sample, characteristics of the entities included)

See section SA1.1 for description of Thomson Reuters Marketscan and CMS sample datasets

SA2.2.Analytic Method
(Describe method of validity testing and rationale; if face validity, describe systematic assessment)

The iterative process of developing the specification with the clinical workgroup represented an assessment of the face validity of the results. Summary findings from the specifications would be presented to the workgroup to determine if results met their expectations or if there were modifications that were necessary. Specifically, the workgroup would assess whether the type of care being included in the measure would make sense in terms of the clinical condition. Moreover, the most frequently and highest cost services that were not related to the episode but were appearing in the data would also be examined. If there were services in this grouping that belonged in the related list modifications would be made. This was facilitated by the Level 1 and Level 2 testing that was done as part of the measure evaluation process.

Validity testing focused primarily on face validity. Initial testing included:
Level 1 analyses
- Examined impact of inclusion/exclusion criteria on episode denominator
- Examined total episode spending by type of service--means, medians, distributions
- Identified top 20 "condition-related" and "non-condition-related" E&M, procedures, imaging, tests, inpatient admissions (by ICD-9 and DRG) and drugs, by service counts and dollar volume
- Tested proposed attribution logic, examined variability in per-episode resource use at individual provider level (as relevant) and by provider specialty.

Level 2 analyses
- Incorporated risk adjustment
- Produced sample physician-level reports in which observed-to-expected ratios are computed and the distribution of each physician's episodes is compared to the peer group's distribution.
- Examined specific drivers of resource use variation
- Examined variability in per-episode resource use across regions, states and the specialties of attributed providers.

Throughout the process of empirically testing the measures, summary analyses were presented to the workgroups for review and discussion. The workgroups reviewed denominator attrition diagrams to assess how the measure's inclusion and exclusion criteria affected the episode's denominator. They also reviewed summaries of costs by type of service (inpatient hospital care, outpatient care, procedures, imaging, tests, and prescription drugs) and were asked to assess whether the distributions matched the clinical expectations for the condition's treatment. The clinicians were also presented with analyses of diagnosis and procedure level details in order to ensure that appropriate services were being captured and grouped to the episodes. At each step in the process, the measure specifications were revised based on workgroup feedback.
In addition to workgroup feedback results of the preliminary testing were also shared with a Technical Advisory Committee and the QASC Episodes Work Group and the measures revised according to feedback.

For the CMS testing of the AMI measure, a similar process was followed. The workgroup was presented summary results on the costs associated with an AMI episode in the Medicare population and cost drivers were examined.

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SA2.3.Testing Results
(statistical results, assessment of adequacy in the context of norms for the test conducted; if face validity, describe results of systematic assessment)

Results of our Level 1 analyses for the measure are shown in the data summary tables in attachment SA_reliability_validity_testing_AMI Acute.pdf
There were 11,054 events that qualified for inclusion in our measure in the Marketscan data. Of the AMI-related procedures, the top 20 accounted for 92% of the overall procedure costs (page 6). These were driven by the top four procedures which included placement of intracoronary stents, coronary artery bypass graft, left heart catheterization and anesthsia costs all of which have strong face validity for costs related to an AMI episode. Moreover, the costs of the procedures accounted for 16% of the total episode costs. Overall, the average cost for an episode was $30,971 (page 15). The majority of these costs were for inpatient facility costs which comprised 81% of the total episode costs. Again, this is what would be expected from the measure given that it is triggered by an inpatient event and only lasts for 30 days. Importantly, we did further analyses to identify additional cost drivers among the AMI acute episodes. Consistent with what would be expected, patients that had a coronary procedure during their episode had higher costs than those that did not have a procedure. Among those with a procedure, patients that had a coronary artery bypass graft cost significantly more than patients with a percutaneous coronary intervention. In addition, length of stay was categorized and compared across patients. Those in the highest length of stay category cost on average $30,000 more than patients in the lowest length of stay category. Overall, the costs monotonically increased as the length of stay increased which is what we would anticipate for the results. When comparing the 20% of the episodes with the highest costs to the 80% of episodes with lower costs, the high costs episodes had an average length of stay of 8 days and the lower cost episodes had an average length of stay of 3 days. Also, the proportion with a readmission was higher in the high cost episodes, with more than 25% of patients having a readmission during the 30 day measurement period.

Results of CMS testing on Medicare sample:
The overall results from the Medicare testing were similar to the Marketscan findings. The inpatient facility costs were the primary cost driver in the analysis. In the Medicare cohort, the inpatient facility costs were responsible for 80% of the overall episode costs.

SA2.4. Finding statement(s)—(*i.e., is the measure deemed reliable, limitations identified)*

The analyses conducted indicate that our measures have strong face validity for the measurement of AMI-related costs during the acute period.

SA3.Testing for Measure Exclusions

SA3.1. Describe how the impact of exclusions (if specified) is transparent as required in the criteria

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In the attached data summary, we have detailed how the exclusions impacted the resulting size of the cohort (see attached data summary Slide 4).

SA3.2. Data/sample for analysis of exclusions
(Description of the data or sample including number of measured entities; number of patients; dates of data; if a sample, characteristics of the entities included)

See section SA1.1 for description of Thomson Reuters Marketscan dataset.

SA3.3. Analytic Method
(Describe type of analysis and rationale for examining exclusions, including exclusion related to patient preference)

We examined the impact of several types of exclusions. In order to ensure that data are available for assessing the episode of care, we excluded individuals without continuous insurance coverage including medical and pharmacy benefits. We also excluded individuals who met standard NCQA exclusions for conditions that are resource intensive, which could potentially have a larger impact on resource use than the condition being studied (i.e., end stage renal disease, active cancer management, etc.) There were also exclusion criteria that were specified for this condition by the

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clinical workgroup: age 18 to 85 years, hospitalization for AMI 410.x2. We examined the impact of these exclusions on the resulting cohort size.

SA3.4. Results
(statistical results for analysis of exclusions, e.g., frequency, variability, sensitivity analyses)

During the July 1, 2006 – November 30, 2007 measurement window there were
29,921 potentially eligible AMI events in the Marketscan data. The eligibility criteria of continuous coverage and presence of a prescription drug benefit had a major impact on the number of eligible events. These criteria reduced the number of eligible events by 50% to 14,961 events.
The majority of these events were deemed eligible for inclusion in the measure, as the final cohort size was 11,054. From the 14,961 potentially eligible events, 8.3% had a length of stay <=1 day, and 3.9% had an AMI in the preceding 30 days, 2% had a standard NCQA exclusion (e.g. HIV/AIDS, ESRD, active cancer, organ transplant). The other exclusion criteria for the measure had very little impact on the overall cohort sample size.

SA3.5. Finding statement(s)-- ***(i.e., is the measure deemed reliable, limitations identified)***

Based on the findings from our cohort attrition analysis described above and feedback from the clinical workgroup, the measure is identifying the appropriate group for inclusion. The exclusions due to continuous enrollment are a function of the data that is available and necessary criteria to fully implement the measure. These criteria result in the largest loss of potentially eligible episodes for inclusion. Few potential episodes are excluded for measure-specific criteria. Overall, the workgroup felt this group represented the most homogenous population that could be reasonably compared across providers.

SA4. Testing Population
Which populations were included in the testing data? (Check all that apply)

Commercial
Medicare

SA5. Risk adjustment strategy ***Refer to items S10.1 and S10.2 to rate this criterion.***	**2b4** **H☐** **M☐** **L☐** **I☐**
SA6. Data analysis and scoring methods ***Refer to items S12-S12.3 to rate this criterion.***	**2b5** **H☐** **M☐** **L☐** **I☐**
SA7. Multiple data sources ***Refer to S7 & all SA1 items to evaluate this criterion.***	**2b6** **H☐** **M☐** **L☐** **I☐** **NA☐**
SA6. Stratification of Disparities (if applicable) ***Refer to item S10.2 to rate this criterion.***	**2c** **H☐** **M☐** **L☐** **I☐**

TAP/Workgroup: What are the strengths and weaknesses in relation to the subcriteria for *Scientific Acceptability of Measure Properties*?	
Steering Committee: Overall, was the criterion, *Scientific Acceptability of Measure Properties*, met? **Rationale:**	**Y☐** **N☐**
USABILITY	
Extent to which intended audiences (e.g., consumers, purchasers, providers, policy makers) can understand the results of the measure and are likely to find them useful for decision making.	**Eval Rating**
Meaningful, Understandable, and Useful Information **U1. Current Use:** Public reporting (disclosure to performance results to the public at large) Quality improvement with external benchmarking **U1.1. Use in Public Reporting Initiative Use in Public Reporting.** ***Disclosure of performance results to the public at large (If used in a public reporting program, provide name of program(s), locations, Web page URL(s). If not publicly reported in a national or community program, state the plans to achieve public reporting, potential reporting programs or commitments, and timeline, e.g., within 3 years of endorsement)*** The ABMS REF has only recently completed the development and testing of its Episode-based Resource Use Measures. The Robert Wood Johnson Foundation (RWJF) has provided follow-up funding in the form of technical assistance to Aligning Forces for Quality communities for continued testing of the measures—a 15-month award to Brookings Institute with a subcontract to ABMS REF for continued field testing of select measures in up to four Aligning Forces for Quality (AF4Q) communities toward the goal of public reporting and quality improvement benchmarking. **U1.2. Use in QI** ***(If used in improvement programs, provide name of program(s), locations, Web page URL(s)).*** See Section U1.1 above. **U1.3. Use for other Accountability Functions (payment, certification, accreditation)** ***(If used in a public accountability program, provide name of program(s), locations, Web page URL(s).*** See Section U1.1 above.	**3a** **H☐** **M☐** **L☐** **I☐**
U2. Testing of Interpretability ***(Provide a rationale for why the measure performance results are meaningful, understandable, and useful to the intended audience(s) for both public reporting and quality improvement).*** **U2.1. If understanding or usefulness was demonstrated** ***(e.g., through systematic feedback from users, focus group, cognitive testing, analysis of quality improvement initiatives) describe the data, methods, and results.*** The ABMS REF measures have not yet been tested for usefulness or interpretability. They are currently undergoing continued testing in up to four RWJF AF4Q communities.	**3b** **H☐** **M☐** **L☐** **NA☐**

U2.2. Resource use data and result can be decomposed for transparency and understanding. ***Refer to items S11 -S12.3.***	**3c** **H☐** **M☐** **L☐** **I☐**
U3. If there are similar or related measures (either same measure focus or target population) measures (both the same measure focus and same target population), list the NQF # and title of all related and/or similar measures. **U3.1. If this measure has EITHER the same measure focus OR the same target population as NQF-endorsed measure(s): Are the measure specifications completely harmonized?** **U3.2. If the measure specifications are not completely harmonized identify the differences, rationale, and impact on interpretability and data collection burden.** ***Describe why this measure is superior to competing measures (e.g., a more valid or efficient way to measure quality); OR provide a rationale for the additive value of endorsing an additional measure. (Provide analyses when possible.)***	**3d** **H☐** **M☐** **L☐** **I☐** **NA☐**
TAP/Workgroup: What are the strengths and weaknesses in relation to the subcriteria for *Usability*?	
Steering Committee: Overall, to what extent was the criterion, *Usability*, met? **Rationale:**	**H☐** **M☐** **L☐**
FEASIBILITY	
Extent to which the required data are readily available, retrievable without undue burden, and can be implemented for performance measurement.	Eval Rating
F1. Data Elements Generated as Byproduct of Care Processes ***How are the data elements needed to compute measure scores generated? Data used in the measure are:*** Coded by someone other than person obtaining original information (e.g., DRG, ICD-9 codes on claims)	**4a** **H☐** **M☐** **L☐** **I☐**
F2. Electronic Sources ***Are the data elements needed for the measure as specified available electronically? (Elements that are needed to compute measure scores are in defined, computer-readable fields)*** ALL data elements in electronic claims **F2.1. If ALL data elements are not from electronic sources, specify a credible, near-term path to electronic capture, OR provide a rationale for using other than electronic sources.**	**4b** **H☐** **M☐** **L☐** **I☐**

F3. Susceptibility to Inaccuracies, Errors, or Unintended Consequences
Identify susceptibility to inaccuracies, errors, or unintended consequences of the measurement identified during testing and/or operational use and strategies to minimize or prevent. If audited, provide results.

- The majority of measures developed for this project are of 12 months duration or less with identification of the population in one year and measurement in the following. This resulted in eligibility criteria requiring a minimum of 24 months of continuous data (full medical and pharmacy benefit enrollment). Often, clinical workgroup members expressed a desire to extend the duration of a measure to encompass more longitudinal clinical outcomes (e.g. cardiac complications for diabetes) however this was not practical due to the typical enrollment patterns in the commercial population.
- Sample size may be of concern for implementers seeking to measure resource use at the level of the individual provider. Many of the measures, when tested on commercial datasets, resulted in small sample sizes that may prohibit meaningful attribution. Discontinuous medical coverage and missing pharmacy coverage were responsible for significant (often greater than 50%) decreases in eligible populations, emphasizing the trade-offs between ensuring adequate sample size and achieving specificity/homogeneity in the measure denominator.
- Administrative claims lack the detail necessary to fully understand appropriateness of resource use in relation to severity of disease (e.g. bundled hospital payments, absence of cancer staging information, absence of cardiac severity indicators, Type 1 v. Type 2 diabetes). Future efforts should consider the integration of administrative claims with other sources of clinical information such as registries and electronic health records.
- Resource use is only one component of efficiency measurement. The measures created in this project are not intended to be used in isolation to evaluate physician performance; rather they are intended to complement quality measures as important parts of performance evaluation.
- The measures developed in this project represent a small subset of clinical conditions, and do not address the full range of patient and provider experience. Each measure was developed independently and, as such, they are not summative. Efforts to sum multiple measures will result in double counting of services.
- The standardized pricing algorithms used for testing the measures were developed for use in the Marketscan dataset. The technical appendices accompanying the measures provide a guide to assist users in developing their own set of standardized prices unique to their datasets. Until a national list of standardized prices is made available to the general public, the methods employed in the testing phase of this project do not allow for national benchmarking.

4c

H☐ M☐ L☐ I☐

F4. Data Collection Strategy
Describe what you have learned/modified as a result of testing regarding barriers to operational use of the measure (e.g., availability of data, missing data, timing and frequency of data collection, sampling, patient confidentiality, time and cost of data collection, cost of proprietary measures).

Administrative claims lack the detail necessary to fully understand appropriateness of resource use in relation to severity of disease (e.g. bundled hospital payments, absence of cancer staging information, absence of cardiac severity indicators, Type 1 v. Type 2 diabetes). Future efforts should consider the integration of administrative claims with other sources of clinical information such as registries and electronic health records.

There were several lessons learned throughout the development and testing of the ABMS REF episode-based resource use measures. First, was the importance of garnering a diverse range of clinical input in a transparent manner to foster face validity and acceptance in the clinical community. Second was the importance of adequate resources for data acquisition, preparation and analyses (time and personnel). Not all datasets are formatted the same which can lead to significant amounts of programmer time for re-formatting code or datasets. It is also important to allow 2-6 months lead time to negotiate data use agreements as use of health care data–even de-identified data--often involves complex contract negotiations.

4d

H☐ M☐ L☐ I☐

TAP/Workgroup: What are the strengths and weaknesses in relation to the subcriteria for *Feasibility*?

Steering Committee: Overall, to what extent was the criterion, *Feasibility*, met?
Rationale:

H☐ M☐ L☐

RECOMMENDATION

Steering Committee: Do you recommend for endorsement? **Comments:**	**Y☐** **N☐** **A☐**

CONTACT INFORMATION

Co.1 Measure Steward (Intellectual Property Owner)

Co.1 Organization

American Board of Medical Specialties Research and Education Foundation, 222 N. LaSalle St., Suite 1500, Chicago, Illinois, 60601

Co.2 Point of Contact

Kevin, Weiss, MD, kweiss@abms.org, 312-436-2600-

Measure Developer If different from Measure Steward

Co.3 Organization

American Board of Medical Specialties Research and Education Foundation, 222 N. LaSalle St., Suite 1500, Chicago, Illinois, 60601

Co.4 Point of Contact

Kevin, Weiss, MD, kweiss@abms.org, 312-436-2600-

Co.5 Submitter If different from Measure Steward POC

Robin, Wagner, rwagner@abms.org, 312-436-2605-, American Board of Medical Specialties Research and Education Foundation

Co.6 Additional organizations that sponsored/participated in measure development

Development of the ABMS REF Episode-based Resource Use Measures was supported by the Robert Wood Johnson Foundation under the High Value Healthcare Project: Characterizing Episodes and Costs of Care. Grant number 63609.

ADDITIONAL INFORMATION

Workgroup/Expert Panel involved in measure development

Ad.1 Provide a list of sponsoring organizations and workgroup/panel members' names and organizations. Describe the members' role in measure development.

AMI Workgroup Members
Dennis Beck, MD American College of Emergency Physicians
Robert Bonow, MD, American College of Cardiology
Donald Casey, Jr., MD, American College of Physicians
David Filipi, MD, American College of Family Physicians
John Golden, MD, Kaiser Permanente
Frederick Masoudi, MD, American College of Cardiology
Timothy Zeddies, PhD, Independence Health
Workgroups consisting of a panel of experts were assembled for each condition. In collaboration with the AMA PCPI, a formal call for nominations was issued to the PCPI membership. This process was supplemented with direct outreach to relevant organizations in an effort to achieve representation from a wide range of clinical expertise (medical, nursing, pharmacy, other allied health professionals). Workgroup members were selected based on their clinical knowledge and administrative experience—many also had significant experience in developing quality measures. Where possible, groups also included

technical expertise from the health plan perspective.
The measure development process involved a series of deliberate steps where participating clinicians took into account the natural progression of a condition and existing best practices before carefully considering how to best use administrative claims data to construct the episode.

Each clinical workgroup initially convened for a two-day in-person meeting that began with an introduction to the concepts of episodes of care and resource use measurement-- including a review of the NQF framework for evaluating efficiency across episodes of care. The groups were then asked to conceptualize one or more episodes based on the phases of the NQF model. They aimed to identify clinically homogenous populations so that the measures would be sensitive to provider decisions and existing practice protocols for like patients. Workgroup members were then asked to conceptualize the measure specifications based on their combined knowledge of guidelines, evidence, and clinical experience. The workgroups helped to define the denominator, duration, clinically relevant services and attribution of each episode as related to the clinical progression and treatment of the condition.

Throughout the months following the in-person meeting, project staff then worked to translate the concepts into detailed written measure specifications. The workgroups subsequently re-convened via a series of conference calls to review data analyses, share expert opinions, consider additional evidence-based literature, revise and finalize the measure specifications.

Measure Developer/Steward Updates and Ongoing Maintenance

Ad.2 Year the measure was first released:

2010

Ad.3 Month and Year of most recent revision:

12, 2010

Ad.4 What is your frequency for review/update of this measure?

every 3 years

Ad.5 When is the next scheduled review/update for this measure?

12, 2013

Ad.6 Copyright statement/disclaimers:

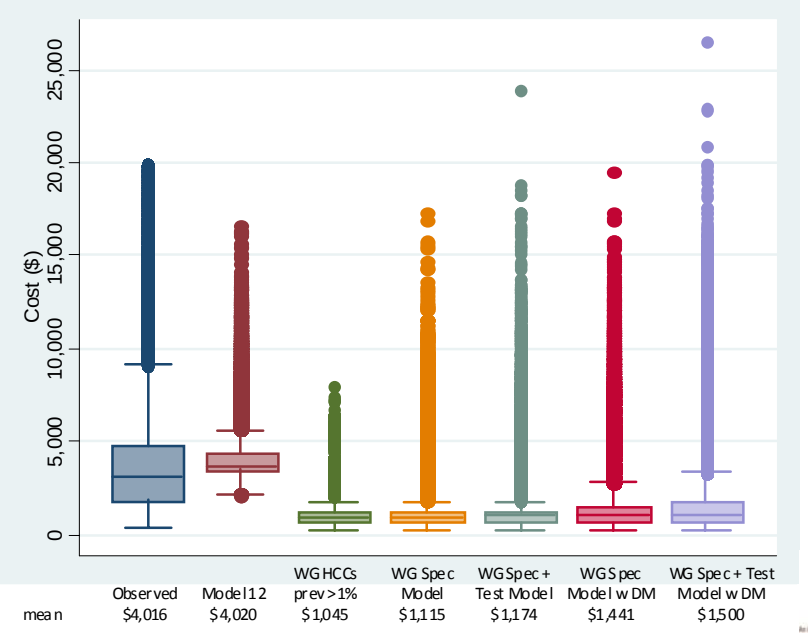
Ad. 7 Date of Submission (*MM/DD/YY*)**:**

03/18/2011

Comparison 'off the shelf' HCC Values with Episode-specific Risk Adjustment Model

Below we show the figure for the comparison of the diabetes risk adjustment model with diabetes risk adjustment models if we had used HCC values. The first box plot in the figure shows the observed costs in for the episode. The second box plot shows the risk adjustment model that we developed for our diabetes episode that is focused on diabetes-related costs. The final five box plots show the distribution of predicted costs including different HCCs for our diabetes episode if we had relied on the off the shelf HCC values. The mean predicted value for all of the off the shelf HCCs models is $1500 or less, while the observed episode costs were slightly more than $4,000. Given the disparity in the means and distributions of the off the shelf HCC values we felt this justified our approach to develop risk adjustment models for each of our episodes that were focused on episode specific costs

Observed and Predicted Values – Diabetes Episode with "off the shelf HCCs"



For this reason, we have developed separate risk adjustment models for each of our episodes that are based on episode-specific costs. We realize this increases the complexity of implementing our measures; however, we feel it is a more appropriate approach for risk adjustment within our episodes. Within our risk adjustment approach, we control for different comorbidities for each condition because patients with each of the measurement conditions often had very different risk profiles.

We used the following risk adjustment strategy in the development of our risk adjustment models:

1. Utilized quasi-Modified Delphi approach with the condition-specific workgroup to categorize HCCs into three groups:

- Include in risk adjustment model;
- Exclude in risk adjustment model; and
- Test impact in risk adjustment model.

2. Identified HCCs in denominator population during the 12 months before the measurement year.

3. Tested 12 different model specifications shown in Table 1 (below), where the HCCs included in the model varied, and the distribution and link functions in the generalized linear models also varied. Models were developed in a stepwise manner as indicated. The first four models used a gamma distribution and a log link function. This functional form of the model was selected as cost data are typically skewed and we wanted to account for that in the analysis. The first model included all HCCs identified by the condition-specific workgroup as "Include HCCs" with a prevalence in the population of >=1%. The second model was a reduction of the first model that only included HCCs where $p<0.1$. The third model extended the second model by including HCCs with prevalence >=1% identified as "Test HCCs" by the condition-specific workgroup. The fourth model was a reduction of the third model and included only those HCCs where $p<0.1$. The next set of four models (Models 5-8) repeated the process of the first four models but used a normal distribution and identity link function. We opted to include this functional form of the model so that the model output could be interpreted in dollars without requiring a transformation. We followed this strategy as we felt it would be easier for those implementing our measure to create their own risk adjustment models using this functional form of the model if they decided to create their own models. Finally, we opted to evaluate models that included all of the HCCs in case the work group may have failed to include HCCs that were influential on the overall episode costs. Model 9 used all of the HCCs, with the exception of the HCC for the episode being evaluated (e.g., diabetes for the diabetes episode; however HCCs for complications of diabetes were included), and a gamma distribution with log link function. Model 10 was a reduction of Model 9 where only the HCCs with $p<0.1$ were included. The final two models (Models 11-12) used the same process as Models 9 and 10 with a normal distribution and identity link function.

Table 1. Risk Adjustment Model Specifications

Model #	Independent Variables						Distri-bution	Link function
	WG Specified (> 1%)	WG specified (> 1%) p < 0.1	Test conditions (> 1%)	Test conditions (> 1%) p < 0.1	All HCCs	All HCCs p < 0.1		
1	X						Gamma	Log
2		X					Gamma	Log
3		X	X				Gamma	Log
4		X		X			Gamma	Log
5	X						Normal	Identity
6		X					Normal	Identity
7		X	X				Normal	Identity
8		X		X			Normal	Identity
9					X		Gamma	Log
10						X	Gamma	Log
11					X		Normal	Identity
12						X	Normal	Identity

4. Models were developed in a split sample approach with 75% of the population randomly selected for model development and the remaining 25% used in model evaluation. Model performance was also evaluated in the full cohort.

5. The performance of each model was evaluated through comparisons of the observed and predicted distributions, comparisons of residuals, comparisons of absolute differences between observed and predicted, comparisons of observed-to-predicted ratios, and comparisons of mean squared errors across models. Summary information on model performance was presented to the condition-specific workgroup for selection of a risk adjustment model for the condition. Final model selection was based on the best performing model across metrics. Where model performance was similar, models using the normal distribution were preferentially chosen over the gamma distribution models for ease of implementation. More parsimonious models were also preferentially chosen.

Variable Name	Variable Description	Required Data Sources*
admdate	Date of Admission	A
age	Age	E
billtyp	Facility Bill Type Code	C
days	Length of Stay	A
daysupp	Day's Supply	D
disdate	Date of Discharge	A
drg	Diagnosis related group	A,B
dstatus	Discharge status	A
egeoloc	Geographic Location	E
enrolid	Enrollee ID	All
fachdid	Facility Header Record ID	C
facprof	Professional/Facility Indicator	C
gennme	Generic Drug Name	D
mastfrm	Master Form Code	D
memdays	Member Days	E
ndcnum	National Drug Code (ndc_code in Redbook)	D
pay	Payment	A,B,C,D
pdx,dx1,dx2,…,dxn	Diagnosis Codes	A,B,C
physid	Physician ID	A,B
pproc, pproc1,…, pprocn	Procedure/Service Codes	A,B,C
procmod	Procedure Code Modifier	A,C
proctyp	Procedure Code Type	B,C
prodnme	Product Name	D
provid	Provider ID	A
qty	Quantity of Services	A,B,C,D
region	Region	E
revcode	Revenue Code	C
rx	Cohort Drug Indicator	D
sex	Gender	E
stdplac	Place of Service	C
stdprov	Provider Type	C
svcdate	Service Date	A,B,C,D
thercls	Therapeutic Class	D
tsvcdat	Date Service Ending	C

Data Sources*

A. Administrative claims data – inpatient (facility)
B. Administrative claims data – inpatient (professional)
C. Administrative claims data – outpatient/ambulatory (professional and facility)
D. Administrative claims data – pharmacy
E. Enrollment/coverage data (2 or more years)

Measure Component	**Required Variables**
Standardized Prices*	enrolid, ndcnum, pay, qty, drg, pproc,…,pprocn.
Exclusions and standard coverage definition	enrolid, pdx,dx1,…,dxn, age, svcdate, pproc, pproc1,…, pprocn, pay, qty, revcode, memdays, rx, stdplac, proctyp.
Cohort Definition	enrolid, svcdate, pdx, pdx1,…,pdxn, pproc1,…, pprocn, pay, qty, sex, age, thercls, dstatus, stdplac, billtyp, fachdid, revcode.
Related Resource Use	enrolid, facprof, pay, qty, pproc1,…, pprocn, svcdate, admdate, disdate, pdx, dx1,…, dxn, drg, ndcnum, thercls, gennme, prodnme, daysupp, procmod, mastfrm.
Output and Attribution	enrolid, svcdate, standardized price variables*, BETOS**, pproc1,…,pprocn, pdx, dx1,…,dxn, egeoloc, region, provid, stdprov, age, sex, physid.

* For internal testing and validation purposes, drug prices were calculated by taking the average of 2006 and 2007 Marketscan prices, inpatient facility prices were computed by calculating average daily price by DRG from 2007, and outpatient and service prices were constructed by calculating the mean price by procedure code within the Marketscan dataset.
** Berenson-Eggers Type of Service – Categorizes Health Care Procedure Coding System (HCPCS) procedure codes in order to analyze health care expenditures. See link for full description.
http://www.cms.hhs.gov/hcpcsreleasecodesets/20_betos.asp

Condition (Workgroup)	***Measure Name***	***Abbreviation***
Acute Myocardial Infarction (AMI)	Episode-of-Care for 30 days Following Onset	AMI1
Acute Myocardial Infarction (AMI)	Episode-of-Care for Post-Acute Period (Days 31-365 Days Post-Event)	AMI2
Asthma	Episode-of-Care for Patients with Asthma over a 1-year Period	ASTH
Breast Cancer	Episode-of-Care for 60-Day Period Preceding Breast Biopsy	BB
Breast Cancer	Episode-of-Care for Treatment in Newly Diagnosed Cases of Breast Cancer over a 15-month Period	BCT
Chronic Obstructive Pulmonary Disease (COPD)	Episode-of-Care for Patients with Stable COPD over a 1-year Period	COPD1
Chronic Obstructive Pulmonary Disease (COPD)	Episode-of-Care for Patients with Unstable COPD over a 1-year Period	COPD2
Colon Cancer	Episode-of-Care for 21-Day Period Around Colonoscopy	COL
Colon Cancer	Episode-of-Care for Treatment of Localized Colon Cancer	CCT
Congestive Heart Failure (CHF)	Episode-of-Care for Management of CHF Over 1-Year Period	CHF1
Congestive Heart Failure (CHF)	Episode-of-Care for Post Hospitalization Management of CHF over 4-Month Period	CHF2
Coronary Artery Disease (CAD)	Episode-of-Care for Management of Chronic CAD Over 1-Year Period	CAD1
Coronary Artery Disease (CAD)	Episode-of-Care for Management of CAD Post Revascularization Over 1-Year Period	CAD2
Diabetes	Episode-of-Care for Diabetes Over 1-Year Period	DIAB
Low Back Pain	Episode-of-Care for Simple Non-Specific Lower Back Pain (Acute and Sub-Acute)	LBP1
Low Back Pain	Episode-of-Care for Acute/Sub-Acute Lumbar Radiculopathy With or Without Lower Back Pain	LBP2
Pneumonia	Episode-of-Care for Community-Acquired Pneumonia Hospitalization	PN1
Pneumonia	Episode-of-Care for Ambulatory Pneumonia Episode	PN2

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Analytic Findings: AMI Acute Episode of Care

Overview of Analyses Presented for AMI Acute Episode*

- Denominator Attrition
- Related and Non-related Services
- Resource Use, Attribution and
- Risk Adjustment

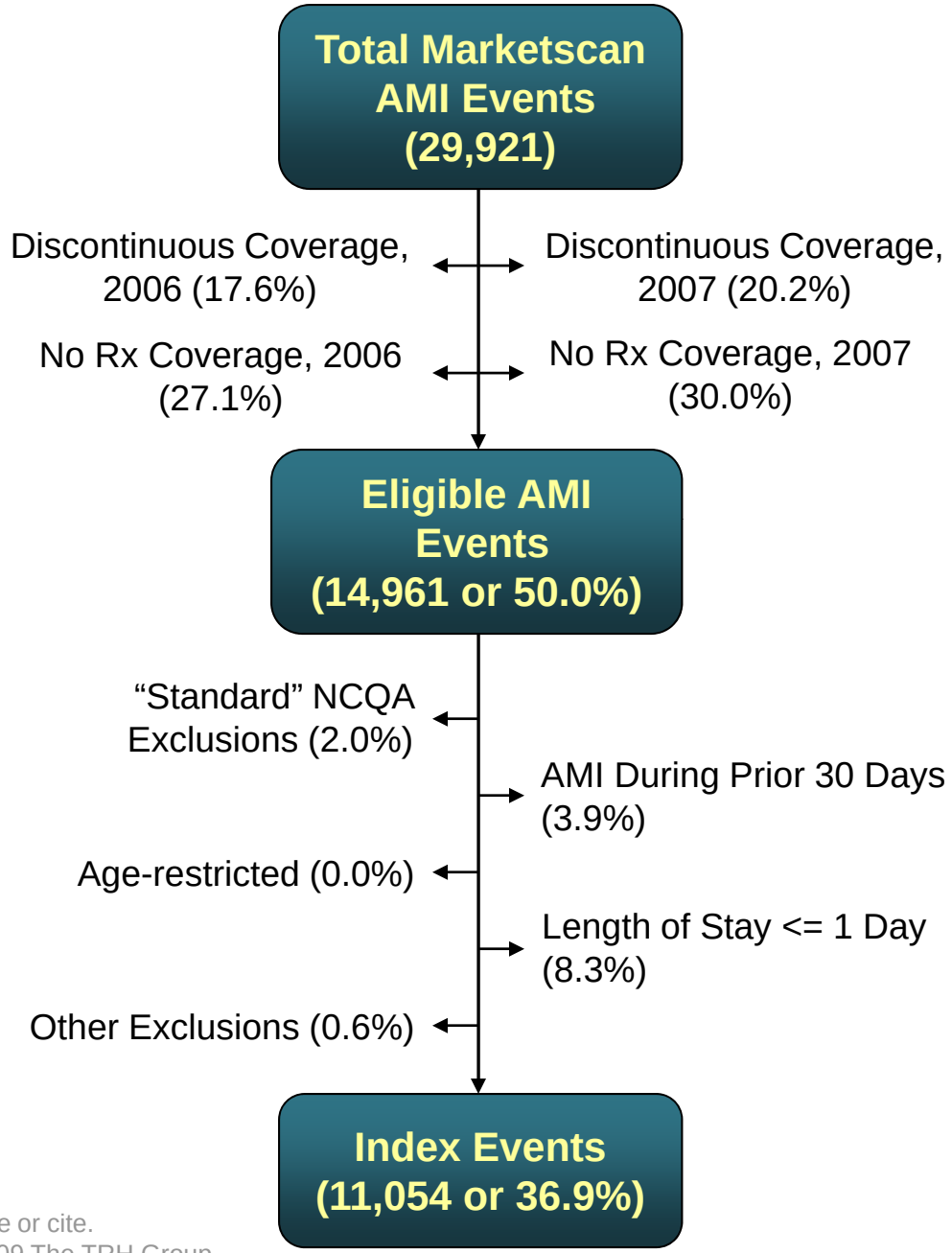
** The following results are based on the measure specification at different points in time, so the numbers are not always consistent, but they are not substantively different.*

Denominator Attrition

- Summarizes the initial denominator based on the workgroup's specifications
- Describes the percentage of enrollees removed from the analysis due to NCQA exclusions or other criteria.

AMI Acute Measure Denominator

- First 30 days following index AMI admission
- AMI admissions included in measure calculation (2006-2007 test data, Marketscan)
- Measurement window: July 1, 2006 – November 30, 2007
- Note: exclusions are not additive (double-counting occurs often)



Related and Non-Related Services

- Examines most frequent related and non-related resource use by BETOS category
  - Evaluation and Management Visits, Procedures, Imaging, Tests, Admissions and Medications.
- Results are presented to the workgroup to examine the face validity of episodes.

Top 20, AMI-related procedures, Acute Episode

- 16% of total episode costs

CPT	Svcs.	Costs	% of Svcs.	% of Costs	Description
92980	7,890	$9,933,087	22.2%	34.4%	Intracoronary stent(s), percutaneous; single
33533	2,068	$4,423,706	5.8%	15.3%	Coronary artery bypass; single CA graft
93510	9,045	$3,472,517	25.4%	12.0%	Left heart catheterization, retrograde, percutaneous
00562	1,473	$3,362,039	4.1%	11.6%	Anesthesia for procedures on heart
33534	315	$787,310	0.9%	2.7%	Coronary artery bypass; two CA grafts
00566	307	$776,425	0.9%	2.7%	Anesthesia for direct coronary artery bypass grafting
92982	588	$562,201	1.7%	1.9%	Percutaneous balloon angioplasty; single vessel
93503	1,324	$456,370	3.7%	1.6%	Flow directed catheter (eg, Swan-Ganz)
33519	714	$384,650	2.0%	1.3%	Coronary artery bypass; three venous grafts
93508	920	$375,595	2.6%	1.3%	Catheter placement for coronary angiography
33518	858	$324,144	2.4%	1.1%	Coronary artery bypass; two venous grafts
92981	710	$272,638	2.0%	0.9%	Intracoronary stent(s), percutaneous; each additional
33535	88	$249,167	0.2%	0.9%	Coronary artery bypass; three CA grafts
33967	574	$198,067	1.6%	0.7%	Insertion of intra-aortic balloon assist device, percutaneous
33521	304	$196,121	0.9%	0.7%	Coronary artery bypass; four venous grafts
33512	82	$179,197	0.2%	0.6%	Coronary artery bypass; three CV grafts
92973	667	$177,880	1.9%	0.6%	Percutaneous transluminal coronary thrombectomy
36620	1,414	$168,959	4.0%	0.6%	Arterial catheterization or cannulation; percutaneous
33249	115	$156,070	0.3%	0.5%	Insertion or repositioning of electrode lead(s) for pacemaker
Top 20	30,029	$26,609,094	84.4%	92.1%	
Total	35,600	$28,881,793	100.0%	100.0%	

Top 20, non-AMI related procedures, Acute Episode

CPT Code	ICD-9 Code	Costs	% of Svcs.	% of Costs	Description
93510	78650-Chest Pain NOS	$155,498	19.1%	11.3%	Left heart catheterization, retrograde
92980	78650-Chest Pain NOS	$151,115	6.2%	11.0%	Transcatheter placement of an intracoronary stent(s)
33533	4292 -Ascvd	$80,259	1.7%	5.8%	CABG; single arterial graft
00562	4241 -Aortic Valve Disorder	$55,057	0.4%	4.0%	Anesthesia for procedures on heart with pump oxygenator
92980	78651-Precordial Pain	$49,185	1.9%	3.6%	Transcatheter placement of an intracoronary stent(s)
00562	4240 -Mitral Valve Disorder	$44,332	1.1%	3.2%	Anesthesia for procedures on heart with pump oxygenator
92980	78659-Chest Pain NEC	$41,081	1.6%	3.0%	Transcatheter placement of an intracoronary stent(s)
93510	78651-Precordial Pain	$39,551	4.8%	2.9%	Left heart catheterization, retrograde
93510	78659-Chest Pain NEC	$23,791	3.1%	1.7%	Left heart catheterization, retrograde
00566	4292 -Ascvd	$21,211	0.5%	1.5%	Anesthesia for direct CABG without pump oxygenator
00562	4292 -Ascvd	$17,549	0.4%	1.3%	Anesthesia for procedures on heart with pump oxygenator
92982	78650-Chest Pain NOS	$15,058	0.8%	1.1%	Percutaneous transluminal coronary balloon angioplasty
92980	4280 -Chf NOS	$13,027	0.5%	0.9%	Transcatheter placement of an intracoronary stent(s)
93508	78650-Chest Pain NOS	$12,715	1.4%	0.9%	Catheter placement in coronary artery
92980	412 -Old Myocardial Infarct	$11,700	0.4%	0.8%	Transcatheter placement of an intracoronary stent(s)
33249	4280 -Chf NOS	$11,561	0.4%	0.8%	Insertion or repositioning of electrode leads for pacemaker
93510	79431-Abnorm Electrocardiogram	$11,499	1.5%	0.8%	Left heart catheterization, retrograde
92980	79431-Abnorm Electrocardiogram	$11,476	0.5%	0.8%	Transcatheter placement of an intracoronary stent(s)
33533	78650-Chest Pain NOS	$10,798	0.2%	0.8%	CABG; single arterial graft
Top 20		$786,775	46.7%	57.0%	
Total		$1,379,449	100.0%	100.0%	

Top 20, AMI-related Imaging, Acute Episode

- 2% of total episode costs

CPT	Svcs.	Costs	% of Svcs.	% of Costs	Description
93556	9,822	$716,086	16.1%	18.2%	Pulmonary angiography, aortography
93545	9,641	$583,070	15.8%	14.8%	Injection for coronary angiography
93555	8,350	$546,509	13.7%	13.9%	Ventricular and/or atrial angiography
93307	3,975	$397,324	6.5%	10.1%	Echocardiography, transthoracic
93543	8,405	$330,026	13.8%	8.4%	Injection for left ventricular or left atrial angiography
78465	522	$208,785	0.9%	5.3%	Myocardial perfusion imaging; tomographic (SPECT)
93320	3,956	$184,405	6.5%	4.7%	Doppler echocardiography, pulsed wave
93325	3,919	$118,189	6.4%	3.0%	Doppler echocardiography color flow velocity mapping
93312	392	$89,868	0.6%	2.3%	Echocardiography, transesophageal
71010	4,375	$72,241	7.2%	1.8%	Radiologic examination, chest, single
92978	401	$64,033	0.7%	1.6%	Intravascular ultrasound during diagnostic evaluation
78478	510	$41,085	0.8%	1.0%	Myocardial perfusion study with wall motion
78480	502	$39,309	0.8%	1.0%	Myocardial perfusion study with ejection fraction
93539	788	$38,918	1.3%	1.0%	Injection for selective opacification of arterial conduits
36245	95	$38,537	0.2%	1.0%	Selective catheter placement, arterial system
A9500	166	$35,237	0.3%	0.9%	Technetium tc-99m sestamibi, diagnostic
93540	645	$33,368	1.1%	0.8%	Injection for selective opacification of venous bypass grafts
93318	107	$31,710	0.2%	0.8%	Echocardiography, transesophageal (TEE) for monitoring
A9502	127	$30,055	0.2%	0.8%	Technetium tc-99m tetrofosmin, diagnostic
Top 20	57,670	$3,620,317	94.5%	91.8%	
Total	61,045	$3,944,433	100.0%	100.0%	

Top 20, non-AMI-related imaging, Acute Episode

CPT Code	ICD-9 Code	Costs	% of Svcs.	% of Costs	Description
71010	78650-Chest Pain NOS	$102,360	17.7%	6.6%	Radiologic examination, chest; single view, frontal
93307	78650-Chest Pain NOS	$64,839	2.1%	4.2%	Echocardiography, transthoracic
93307	4240 -Mitral Valve Disorder	$62,541	1.7%	4.0%	Echocardiography, transthoracic
78465	78650-Chest Pain NOS	$57,349	0.6%	3.7%	Myocardial perfusion imaging; tomographic (SPECT)
93556	78650-Chest Pain NOS	$30,219	1.2%	2.0%	Imaging supervision; pulmonary angiography, aortography
93320	4240 -Mitral Valve Disorder	$29,972	1.7%	1.9%	Doppler echocardiography, pulsed wave
93320	78650-Chest Pain NOS	$28,980	1.9%	1.9%	Doppler echocardiography, pulsed wave
93545	78650-Chest Pain NOS	$24,527	1.2%	1.6%	Injection for coronary angiography
93555	78650-Chest Pain NOS	$23,780	1.0%	1.5%	Imaging supervision; ventricular and/or atrial angiography
71020	78650-Chest Pain NOS	$22,547	2.9%	1.5%	Radiologic examination, chest, two views, frontal and lateral
93325	4240 -Mitral Valve Disorder	$22,084	1.8%	1.4%	Doppler echocardiography color flow velocity mapping
93307	4293 -Cardiomegaly	$20,738	0.6%	1.3%	Echocardiography, transthoracic
93880	43310-Ocl Crtd Art wo Infrct	$20,716	0.7%	1.3%	Duplex scan of extracranial arteries
71260	78650-Chest Pain NOS	$19,861	0.4%	1.3%	CT thorax; with contrast material(s)
71010	5180 -Pulmonary Collapse	$19,546	3.5%	1.3%	Radiologic examination, chest; single view, frontal
71275	78650-Chest Pain NOS	$19,024	0.4%	1.2%	CT angiography, chest (noncoronary)
93325	78650-Chest Pain NOS	$15,686	1.9%	1.0%	Doppler echocardiography color flow velocity mapping
93307	4242 -Nonrheum Tricusp Val Dis	$14,632	0.4%	0.9%	Echocardiography, transthoracic
93543	78650-Chest Pain NOS	$14,540	1.1%	0.9%	Injection for left ventricular or left atrial angiography
78478	78650-Chest Pain NOS	$12,897	0.6%	0.8%	Myocardial perfusion study with wall motion
Top 20		$626,839	43.3%	40.5%	
Total		$1,547,448	100.0%	100.0%	

Top 20, AMI-related E&M, Acute Episode

- 5% of total episode costs

CPT	Svcs.	Costs	% of Svcs.	% of Costs	Description
99291	4,067	$1,208,696	6.1%	14.6%	Critical care, first 30-74 minutes
99232	16,250	$1,207,867	24.4%	14.5%	Subsequent hospital care
99223	5,295	$1,014,259	8.0%	12.2%	Initial hospital care
99233	8,132	$869,797	12.2%	10.5%	Subsequent hospital care
99285	3,054	$858,352	4.6%	10.3%	Emergency department visit
99238	5,807	$494,844	8.7%	6.0%	Hospital discharge day management; 30 minutes or less
99255	1,889	$425,418	2.8%	5.1%	Inpatient consultation for a new or established patient
99214	3,714	$338,864	5.6%	4.1%	Office or other outpatient visit
99254	1,974	$332,743	3.0%	4.0%	Inpatient consultation for a new or established patient
99222	1,587	$239,149	2.4%	2.9%	Initial hospital care
99213	3,489	$221,152	5.2%	2.7%	Office or other outpatient visit
99231	4,273	$209,219	6.4%	2.5%	Subsequent hospital care
99239	1,672	$197,048	2.5%	2.4%	Hospital discharge day management; more than 30 minutes
99253	751	$93,856	1.1%	1.1%	Inpatient consultation for a new or established patient
99284	394	$73,894	0.6%	0.9%	Emergency department visit
99292	358	$66,795	0.5%	0.8%	Critical care, each additional 30 minutes
99215	489	$64,921	0.7%	0.8%	Office or other outpatient visit
99244	300	$59,359	0.5%	0.7%	Office consultation for a new or established patient
99245	173	$44,820	0.3%	0.5%	Office consultation for a new or established patient
99204	207	$30,097	0.3%	0.4%	Office or other outpatient visit
Top 20	63,875	$8,051,152	96.1%	97.0%	
Total	66,489	$8,302,755	100.0%	100.0%	

Top 20, non-AMI related E&M, Acute Episode

CPT Code	ICD-9 Code	Costs	% of Svcs.	% of Costs	Description
99285	78650-Chest Pain NOS	$395,478	3.9%	8.6%	Emergency department visit for E&M care
99291	78650-Chest Pain NOS	$158,955	1.5%	3.5%	Critical care; first 30-74 minutes
99291	51881-Acute Respiratry Failure	$136,820	1.2%	3.0%	Critical care; first 30-74 minutes
99223	78650-Chest Pain NOS	$132,284	1.9%	2.9%	Initial hospital care
99232	78650-Chest Pain NOS	$98,224	3.6%	2.1%	Subsequent hospital care
99233	51881-Acute Respiratry Failure	$87,326	2.1%	1.9%	Subsequent hospital care
99233	78650-Chest Pain NOS	$66,131	1.7%	1.4%	Subsequent hospital care
99285	78651-Precordial Pain	$60,788	0.6%	1.3%	Emergency department visit for E&M care
99285	78659-Chest Pain NEC	$58,468	0.6%	1.3%	Emergency department visit for E&M care
99232	51881-Acute Respiratry Failure	$46,642	1.7%	1.0%	Subsequent hospital care
99232	25000-Dm II wo Cmp Nt St Uncntr	$40,095	1.5%	0.9%	Subsequent hospital care
99238	78650-Chest Pain NOS	$40,037	1.3%	0.9%	Hospital discharge day management; 30 minutes or less
99222	78650-Chest Pain NOS	$39,976	0.7%	0.9%	Initial hospital care
99255	78650-Chest Pain NOS	$38,342	0.5%	0.8%	Inpatient consultation for a new or established patient
99284	78650-Chest Pain NOS	$34,257	0.5%	0.7%	Emergency department visit for E&M care
99254	78650-Chest Pain NOS	$33,689	0.5%	0.7%	Inpatient consultation for a new or established patient
99232	4280 -Chf NOS	$33,313	1.2%	0.7%	Subsequent hospital care
99232	25002-Dm II wo Cmp Uncntrld	$28,139	1.0%	0.6%	Subsequent hospital care
99255	51881-Acute Respiratry Failure	$26,306	0.3%	0.6%	Inpatient consultation for a new or established patient
99232	5849 -Acute Renal Failure NOS	$25,274	0.9%	0.6%	Subsequent hospital care
Top 20		$1,580,545	27.3%	34.4%	
Total		$4,595,178	100.0%	100.0%	

AMI Acute Provider Attribution

- Identify the provider or providers “responsible” for the patient’s care during the course of an episode
- Support a comparison across providers rather than simply across all episodes, which may be reflective of a normal distribution of costs population-wide

Proposed Attribution Model, Acute Episode

- Hospital/system-level attribution
- C3 project's capacity to test variability among hospitals somewhat limited by available data elements
  - Hospital ID numbers available for 50.2% of cohort's index admissions
- Note: available data also include PHYSID variable, which identifies the professional who charges the most during the admission (specialty not available)
  - Similarly limited in available data: ID numbers available for only 48.4% of cohort's index admissions

Identifying Variability in AMI-specific Resource Use

- Analyses intended to identify trends in the observed variability in resource use for episodes of Acute AMI management
- Variability measured at the following levels:
  - Region
  - State
  - Specialty

AMI Acute: Mean Resource Use by Type of Service, All Episodes

Description	Mean	% of Total	5th %	25th %	50th %	75th %	95th %
Inpatient Facility Costs	$25,080	81%	$9,195	$14,800	$19,548	$29,875	$54,035
OP Facility Costs	$302	1%	$0	$0	$0	$0	$1,395
Evaluation and Management	$1,131	4%	$233	$622	$893	$1,322	$2,729
Procedures	$2,862	9%	$0	$1,423	$1,726	$2,899	$9,799
Imaging	$503	2%	$43	$262	$389	$616	$1,312
Tests	$169	1%	$0	$37	$92	$203	$560
Durable Medical Equipment	$8	0%	$0	$0	$0	$0	$0
Other Services	$688	2%	$0	$0	$0	$0	$2,529
Unclassified	$14	0%	$0	$0	$0	$0	$0
Drug Costs	$213	1%	$0	$117	$218	$289	$457
Sum of Costs	**$30,971**	**100%**	**$12,251**	**$17,828**	**$25,523**	**$37,471**	**$68,618**

AMI Acute: Resource Use by Type of Service vs. Overall Mean, by Region

Description	Mean	Northeast	North Central	South	West
N	**10,795**	**932**	**3,179**	**5,178**	**1,450**
IP Facility	$25,080	1.00	1.00	1.02	0.95
OP Facility	$302	1.14	1.00	0.99	0.93
E&M	$1,131	0.98	1.03	0.99	0.97
Procedures	$2,862	0.91	1.07	1.01	0.88
Imaging	$503	1.05	1.02	1.03	0.83
Tests	$169	0.95	0.96	1.12	0.68
DME	$8	0.91	0.96	1.19	0.50
Other Services	$688	0.82	0.90	1.08	1.08
Unclassified	$14	0.97	0.65	0.52	3.51
Drug Costs	$213	1.10	1.07	0.93	1.02
Total	**$30,971**	**0.99**	**1.00**	**1.02**	**0.94**

AMI Acute: Resource Use by Type of Service vs. Overall Mean, by State

Description	Mean	TX	MI	CA	GA	OH	TN	SC	FL	IL	IN
N	**10,795**	**1,215**	**828**	**709**	**667**	**641**	**581**	**442**	**425**	**399**	**392**
IP Facility	$25,080	1.00	1.00	0.97	1.03	1.04	1.03	1.03	1.04	1.01	1.00
OP Facility	$302	1.64	0.60	0.28	0.59	0.92	0.94	0.42	0.63	1.10	1.77
E&M	$1,131	1.07	1.03	0.91	0.90	1.11	1.05	0.80	1.47	1.13	0.90
Procedures	$2,862	0.98	0.93	0.69	1.03	1.15	1.12	1.12	1.05	1.24	1.04
Imaging	$503	1.04	1.10	0.67	0.93	1.06	1.14	0.91	1.25	1.00	0.88
Tests	$169	1.86	0.83	0.54	0.65	0.71	0.88	0.65	1.61	1.94	0.75
DME	$8	1.85	1.86	0.17	1.36	0.15	0.81	0.03	4.30	0.55	0.94
Other Services	$688	1.10	0.59	0.83	1.55	1.21	1.17	1.08	0.83	0.74	0.68
Unclassified	$14	0.24	0.31	2.67	0.46	1.19	0.35	0.64	2.22	0.22	0.12
Drug Costs	$213	0.97	1.09	1.01	0.82	1.04	0.90	0.86	1.05	1.07	1.05
Total	**$30,971**	**1.01**	**0.98**	**0.93**	**1.03**	**1.06**	**1.04**	**1.02**	**1.06**	**1.03**	**1.00**

AMI Acute: Resource Use by Type of Service, Bottom 80% of All Episodes

Description	Mean	% of Total	5th %	25th %	50th %	75th %	95th %
Inpatient Facility Costs	$19,148	82%	$8,140	$12,663	$18,159	$23,900	$32,730
OP Facility Costs	$270	1%	$0	$0	$0	$0	$1,294
Evaluation and Management	$917	4%	$200	$574	$826	$1,145	$1,890
Procedures	$1,687	7%	$0	$758	$1,698	$2,004	$3,696
Imaging	$440	2%	$16	$250	$372	$523	$1,140
Tests	$139	1%	$0	$37	$89	$184	$441
Durable Medical Equipment	$4	0%	$0	$0	$0	$0	$0
Other Services	$538	2%	$0	$0	$0	$0	$1,456
Unclassified	$6	0%	$0	$0	$0	$0	$0
Drug Costs	$231	1%	$0	$148	$233	$302	$473
Sum of Costs	**$23,379**	**100%**	**$11,936**	**$16,363**	**$21,897**	**$28,293**	**$39,191**
Length of Stay	3	n/a	2	2	3	4	6
Readmission count	0	n/a	0	0	0	0	1

N = 8,744 episodes

AMI Acute: Resource Use by Type of Service, Top 20% of All Episodes

Description	Mean	% of Total	5th %	25th %	50th %	75th %	95th %
Inpatient Facility Costs	$50,368	80%	$32,730	$40,553	$45,598	$55,575	$82,794
OP Facility Costs	$442	1%	$0	$0	$0	$0	$1,911
Evaluation and Management	$2,042	3%	$462	$1,005	$1,525	$2,422	$5,403
Procedures	$7,875	12%	$1,517	$3,471	$7,322	$9,821	$16,556
Imaging	$769	1%	$239	$454	$659	$948	$1,706
Tests	$296	0%	$0	$67	$145	$351	$1,104
Durable Medical Equipment	$27	0%	$0	$0	$0	$0	$6
Other Services	$1,329	2%	$0	$0	$0	$675	$10,467
Unclassified	$50	0%	$0	$0	$0	$0	$77
Drug Costs	$138	0%	$0	$56	$118	$207	$341
Sum of Costs	**$63,336**	**100%**	**$45,554**	**$50,658**	**$57,477**	**$69,598**	**$100,483**
Length of Stay	8	n/a	2	5	7	10	18
Readmission count	0	n/a	0	0	0	1	1

N = 2,051 episodes

Risk Adjustment

- Testing of risk adjustment models

- Apply risk adjusted results to produce a provider specific summary report.

Risk Adjustment Model Specification

- Test 12 different model specifications
  - Logged GLM model using gamma distribution
    - Full list of recommended comorbidities (> 1% prevalence)
    - Only recommended comorbidities that are statistically significant
    - Only recommended comorbidities that are statistically significant + additional comorbidities flagged for “empirical analysis” (all, significant only)
    - All HCCs & all statistically significant HCCs (regardless of prevalence)
  - Normal GLM model (estimates in dollars)
    - Same tweaks as above
- Fit models for the entire cohort, then for each of the age strata separately (total of 48 risk adjustment models)

AMI Acute Episode Risk Adjustment Matrix – Overall Cohort Model

Model #	Independent Variables						Distribution	Link function
	WG Specified (> 1%)	WG specified (> 1%) p < 0.1	Test conditions (> 1%)	Test conditions (> 1%) p < 0.1	All HCCs	All HCCs p < 0.1		
1	X						Gamma	Log
2		X					Gamma	Log
3		X	X				Gamma	Log
4		X		X			Gamma	Log
5	X						Normal	Identity
6		X					Normal	Identity
7		X	X				Normal	Identity
8		X		X			Normal	Identity
9					X		Gamma	Log
10						X	Gamma	Log
11					X		Normal	Identity
12						X	Normal	Identity

Sample Provider Summary Report

Report for Physician #xxxxx

Provider type = insert specialty

	MD	Peer Group	Non-Peer Group	National Avg
Episodes	21	9,512	68,434	77,967
Observed Costs*				
Average	$ 897	$ 992	$ 1,481	$ 1,421
Min	$ 45	$ 12	$ 12	$ 12
Median	$ 747	$ 538	$ 853	$ 807
Max	$ 2,797	$ 11,140	$ 11,140	$ 11,140
Predicted Costs				
Average	$ 1,400	$ 1,083	$ 1,523	$ 1,470
Min	$ 966	$ 831	$ 831	$ 831
Median	$ 1,126	$ 1,039	$ 1,502	$ 1,392
Max	$ 2,345	$ 8,286	$ 6,883	$ 8,286
Observed-to-Expected Ratio				
Average	0.64	0.91	0.98	0.97
Min	0.03	0.01	0.01	0.01
Median	0.54	0.51	0.58	0.57
Max	1.54	13.40	13.40	13.40
% ≥ 2.0	0%	10.9%	11.6%	11.5%
% ≥ 2.5	0%	7.0%	7.7%	7.6%
% ≥ 75th percentile peers	50.0%	(0%, 20.9%)		

* Observed costs adjusted for outliers (windsorized)

Notes:
- Use Model 12
- Includes all episodes