# 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

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| **TAP/Workgroup Reviewer Name:** | |
| **Steering Committee Reviewer Name:** | |
| **Staff Reviewer Name(s):** | |
| **NQF Review #:** 1573 **NQF Project:** Endorsing Resource Use Standards- Phase II | |

| **BRIEF MEASURE INFORMATION** |
|---|
| **Measure Title:** Episode of care for management of coronary artery disease post re-vascularization |
| **Measure Steward (IP Owner):** American Board of Medical Specialties Research and Education Foundation, 222 N. LaSalle St., Suite 1500, Chiacago, Illinois, 60601 |
| **Brief description of measure:** Resource use and costs associated with management of coronary artery disease (CAD) care over a one-year period post revascularization (coronary artery bypass graft [CABG] or percutaneous coronary intervention [PCI]) without an acute myocardial infarction (AMI). Patients are identified who had a revascularization and CAD-related resource use and costs during a 12-month period post revascularization are measured. |
| **Resource use service categories:** Inpatient services: Inpatient facility services<br>Inpatient services: Evaluation and management<br>Inpatient services: Procedures and surgeries<br>Inpatient services: Imaging and diagnostic<br>Inpatient services: Lab services<br>Inpatient services: Admissions/discharges<br>Ambulatory services: Outpatient facility services<br>Ambulatory services: Emergency Department<br>Ambulatory services: Pharmacy<br>Ambulatory services: Evaluation and management<br>Ambulatory services: Procedures and surgeries<br>Ambulatory services: Imaging and diagnostic<br>Ambulatory services: Lab services<br>Durable Medical Equipment (DME) |
| **Brief description of measure clinical logic:** Resource use and costs associated with management of coronary artery disease (CAD) care over a one-year period post revascularization (coronary artery bypass graft [CABG] or percutaneous coronary intervention [PCI]) without an acute myocardial infarction (AMI). Patients are identified who had a revascularization and CAD-related resource use and costs during a 12-month period post revascularization are measured. |
| ***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<br>Other |

| **CONDITIONS FOR CONSIDERATION BY NQF** | |
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| **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.**<br>***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.***<br><br>**A.1.Do you attest that the measure steward holds intellectual property rights to the measure? (If no, do not submit)** | **A**<br><br>**Y☐**<br>**N☐** |

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| Yes<br><br>**A.2. Please check if either of the following apply:**<br><br>**A.3. Measure Steward Agreement.**<br><br>Agreement signed and submitted<br><br>**A.4. Measure Steward Agreement attached:** | |
| **B. Maintenance.**<br>***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)***<br><br>Yes, information provided in contact section | **B**<br><br>**Y☐**<br>**N☐** |
| **C. Purpose/ Use *(All the purposes and/or uses for which the measure is specified and tested:***<br><br>Quality Improvement (Internal to the specific organization) | **C**<br><br>**Y☐**<br>**N☐** |
| **D. Testing.**<br>***The measure is fully specified and tested for reliability and validity (See guidance on measure testing).***<br><br>Yes, reliability and validity testing completed | **D**<br><br>**Y☐**<br>**N☐** |
| **E. Harmonization and Competing Measures.**<br>***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)***<br><br>Yes<br><br>***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)**<br><br>No related measures<br><br>*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**<br><br>**Y☐**<br>**N☐** |
| **F. Submission Complete.**<br>***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**<br><br>**Y☐**<br>**N☐** |
| **Have all conditions for consideration been met?**<br>**Staff Notes to Steward** (*if submission returned*)**:** | **Y ☐**<br>**N ☐** |
| **Staff Notes to Reviewers** (*issues or questions regarding any criteria*)**:** | |
| **File Attachments Related to Measure/Criteria:**<br>Attachment:<br>Attachment: S5_Data Dictionary-634343410558110628.pdf | |

Attachment:
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Attachment:
Attachment: 10.1_Risk adjustment method-634339204677575356.pdf
S12_sample score report CAD post revasc.pdf
Attachment: SA_ Reliability_Validity Testing CAD Post Revasc.pdf

| IMPORTANCE TO MEASURE AND REPORT | |
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| **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.**<br><br>**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**<br><br>**IM1. Demonstrated high impact aspect of healthcare:**<br><br>A leading cause of morbidity/mortality<br>High resource use<br><br>**IM1.1. Summary of evidence of high impact:**<br><br>The Institute of Medicine and AQA have identified angina/coronary artery disease (CAD) as one of 20 conditions that should be considered priority areas in need of quality improvement based on its relevance to a significant volume of patients, its impact on those patients, and the perception of opportunity to significantly improve the quality and efficiency of related care. Approximately 7 million people in the U.S. were living with angina during 2007, and there are 400,000 new angina cases annually (1). CAD had also been previously identified as a priority area in other national initiatives including AHRQ's Medical Expenditure Panel Survey and the VA's Quality Enhancement Research Initiative (2). In addition, the costs of treatment for CAD patients can be very high in some cases – one study noted, "U.S. healthcare expenditures in the treatment of patients with acute chest pain total $10 billion to $12 billion annually, despite the fact that most of these patients do not have acute coronary syndromes." (3)<br><br>For people over age 40, lifetime risk of developing CAD is 49 percent in men and 32 percent in women. Coronary events rise steeply with age, although women lag men by a period of almost a decade (4). Men are more likely to present with myocardial infarction rather than stable angina pectoris. Additional factors that influence the initial presentation of CAD is recent prior therapy with "statins" and beta blockers (5).<br><br>**IM1.2. Citations for evidence of high impact cited in IM1.1.:**<br><br>1. "What is Angina?" National Heart Lung and Blood Institute. November 2007. http://www.nhlbi.nih.gov. Accessed Jan. 21, 2009.<br>2. Priority Areas for National Action: Transforming Health Care Quality. Institute of Medicine. Karen Adams and Janet Corrigan Editors. March 10, 2003.<br>3. S. Wood. "Multislice CT Angiography Offers Effective Evaluation of Chest Pain in ED." Medscape. www.medscape.com/viewarticle/552469<br>4. Lloyd-Jones, DM, Larson, MG, Beiser, A, Levy, D. Lifetime risk of developing coronary heart disease. Lancet 1999; 353: 89.<br>5.Go, AS, Iribarren, C, Chandra, M, et al. Statin and beta-blocker therapy and the initial presentation of coronary heart disease. Ann Intern Med 2006; 144:229. | **1a**<br><br>**H☐**<br>**M☐**<br>**L☐**<br>**I☐** |

**IM2. Opportunity for Improvement**

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

To identify actionable information on the underlying causes of differences in patterns of care for CAD post-revascularization, it is useful to examine resource use and costs during an episode of care. If results from these analyses can provide clear and actionable information on which components of care can (or should) be reduced and which components of care can (or should) be increased, this information can help reduce spending while maintaining or even improving clinical quality and outcomes. This measure can be used to identify and, if necessary, address unwarranted variability in the resources used to treat CAD patients post-revascularization annually. In addition, where gaps in utilization occur leading to suboptimal quality, education and care coordination can implemented.

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

- Curtis et al examined readmissions and repeat revscularization after percutaneous coronary intervention in a cohort of Medicare fee for service beneficiaries and found that a substantial proportion of PCI patients are readmitted within 30 days of discharge. Readmissions were associated with significantly higher 30-day mortlity rates and repeat revascularization procedures.(1)
- A study by Mercuri et al found up to a 4-fold difference between cardiologists working within the same cardiac unit in the decision to treat CAD via revascularization vs. medical therapy alone. Variation was also seen among physicians in the decision to recommend CABG rather than PCI once revascularization therapy was selected. The odds ratios ranged from 1.5 to 4.2 (2)
- Ayanian et al, 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. (3)
- A study by Fiscella et al, found that physicians using risk assessment tools such as the Framingham Risk Scores may underestimate the contribution of socioeconomic status (SES) to health disparities. Underestimation of risk for persons with low SES may further exacerbate underuse of statins or aspirin, which in turn results in outcome disparities for this population. (4)
- Cook and colleagues examined electronic records from primary care facilities affiliated with two academic medical centers in a retrospective cohort study to determine if access to a cardiologist for the care of CAD and CHF varied by race/ethnicity, gender, or insurance status. They found that 79.6% of patients with CAD and 90.3% of patients with CHF had a cardiology consultation. In multivariate analyses, they found women were less likely than men to receive a consultation for both conditions. Women also had 15% fewer follow up consults than men. Patients receiving primary care at community centers were less likely to receive consultations for both conditions, and had 20% fewer follow-up consults relative to those at hospital-based practices. Black and Hispanic CHF patients had 13% fewer follow-up consults than white patients. In adjusted analyses, consultation was associated with better processes of care compared with no consultation, particularly for women. (5)

**IM2.3. Citations for data on variation:**

1. Curtis JP, Schreiner G, Wang Y, et al. All-cause readmission and repeat revascularization after percutaneous coronary intervention in a cohort of Medicare patients. J Am Col Cardiology 2009;54:903-907.
2. Mercuri M, Natarajan MK, Norman G, et al. An even smaller area variation: differing practice patterns among interventional cardiologists within a single high volume tertiary cardiac centre. Health Policy 2010, dec 4 Epub.
3. 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.
4. Fiscella, K. and D. Tancredi, Socioeconomic status and coronary heart disease risk prediction. JAMA, 2008. 300(22): p. 2666-8.
5. Cook, N.L., et al., Differences in specialist consultations for cardiovascular disease by race, ethnicity, gender, insurance status, and site of primary care. Circulation, 2009. 119(18): p. 2463-70.

**1b**

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

- Several studies have shown persistent disparities in cardiovascular care and outcomes, with women, racial/ethnic minorities, and people of low socioeconomic standing experiencing higher morbidity and mortality rates for CAD (1-4).
- Coronary artery disease affects black women disproportionately. The mortality rate from CAD is 69% higher in

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black females than in white females (5). While black females have less angiographic evidence of CAD, death rates from CAD are paradoxically higher in this group. Black women are referred for cardiac catheterization 40% less often than white men. Access to preventive care for CAD also is lacking for black women. (5).

- Poverty/low SES also is associated with higher incidence of ischemic heart disease and disparities in care provided. Rao and colleagues studied whether there were income-based disparities in the pattern of care and outcomes in patients with acute coronary syndromes. Using income data collected in a trial focusing on unstable angina, the authors found that low-income patients were sicker at presentation with more chronic medical problems.(6) "Among low-income patients, the use of some evidence-based medications and cardiac procedures was lower and the unadjusted rate of 30-day death and six-month death was higher. Income level is associated with a trend toward worse outcomes among patients with acute coronary syndromes," (6).
- The relationship between race and cardiovascular outcomes also was tested in a study by Sabatine, et al., that focused on comparing outcomes in patients receiving modern therapy in whom the use of invasive cardiac procedures followed a clinical trial protocol. They conducted a randomized trial of invasive versus conservative treatment strategy in patients with non-ST-elevation ACS. There were 1722 white and 461 nonwhite participants. The authors found that after adjustment for baseline factors, nonwhite participants had a significantly worse prognosis than white patients, regardless of treatment strategy (7).
- Cook and colleagues examined electronic records from primary care facilities affiliated with two academic medical centers in a retrospective cohort study to determine if access to a cardiologist for the care of CAD and CHF varied by race/ethnicity, gender, or insurance status. They found that 79.6% of patients with CAD and 90.3% of patients with CHF had a cardiology consultation. In multivariate analyses, they found women were less likely than men to receive a consultation for both conditions. Women also had 15% fewer follow up consults than men. Patients receiving primary care at community centers were less likely to receive consultations for both conditions, and had 20% fewer follow-up consults relative to those at hospital-based practices. Black and Hispanic CHF patients had 13% fewer follow-up consults than white patients. In adjusted analyses, consultation was associated with better processes of care compared with no consultation, particularly for women (8).

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

1.Institute of Medicine, Unequal Treatment: Confronting Racial and Ethnic Disparities in Health Care. Washington, DC: National Academy Press; 2002.

2.Gillum, R. F. (1982). Coronary heart disease in black populations: mortality and morbidity. American Heart Journal, 104:839-851.

3.Ayanian, J.Z., Udvarhelyi, I.S., Gastonis, C.A., et al., (1993). Racial differences in the use of revascularization procedures after coronary angiography. Journal of the American Medical Association, 269:2642-46.

4.Hadley, J. Sicker and Poorer: The Consequences of Being Uninsured. Washington, DC: Kaiser Commission on Medicaid and the Uninsured; 2002

5.Williams, R.A. (2009). Cardiovascular disease in African American women: A health care disparities issue. Journal of the National Medical Association, 101:536-540.

6.Rao, S.V., Kaul, P., Newby, L.K., et al., (2003). Poverty, process of care, and outcome in acute coronary syndromes. Journal of the American College of Cardiology, 41:1948-54

7.Sabatine, M.S., Blake, G.J., Drazner, M.H., et al., (2005). Influence of race on death and ischemic complications in patients with non-ST-elevated acute coronary syndromes despite modern, protocol-guided treatment. Circulation, 111:1217-1224.

8.Cook, N.L., Ayanian, J.Z., Orav, E.J., & Hicks L.S. (2009). Differences in specialist consultations for cardiovascular disease by race, ethnicity, gender, insurance status and site of primary care. Circulation, 119:2463-2470.

***IM3. Measure Intent***

**1c**

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

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While documentation of regional variability in the overall costs of care reveals that inefficiencies exist in the healthcare system, it does not provide actionable information on the underlying causes of these differences or how they can be

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| reduced. One potential solution is to focus on episode-based resource use and costs so that variations within a particular clinical area can be examined and areas of variability can be optimized. Moreover, episode-based resource measures can be combined with surrogate measures of quality care to identify highly efficient care where quality is high and costs are low. With this information, all parties involved (consumers, purchasers, and providers) can optimize treatment decisions that affect the balance of costs and quality of care. | |
| **IM4. Resource use service categories are consistent with measure construct**<br><br>*Refer to IM3.1. & all S9 items to evaluate this criteria.* | **1d**<br><br>**H☐**<br>**M☐**<br>**L☐**<br>**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?**<br>**Rationale:** | **Y☐**<br>**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

**Eval Rating 2a1/2b1**

**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

**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-634343410558110628.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 the guidelines 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 management of coronary artery disease (CAD) care over a one-year period post revascularization (coronary artery bypass graft [CABG] or percutaneous coronary intervention [PCI]) without an acute myocardial infarction (AMI). Patients are identified who had a revascularization and CAD-related resource use and costs during a 12-month period post revascularization are measured.

**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 following steps were used to create the clinical framework for the measure.
Step 1: Identify patients that had a revascularization during the identification period (see also Table CADPR-A in written measure specification). The following codes, present in any field, will be used to identify CAD revascularization patients during the measurement period, regardless of corresponding ICD-9 codes. One-day hospitalizations cannot trigger episodes. Coronary artery bypass graft: CPT: 33510, 33511, 33512, 33513, 33514, 33516, 33517, 33518, 33519, 33521, 33522, 33523, 33530, 33533, 33534, 33535, 33536; ICD9 procedure: 36.15, 36.16; percutaneous coronary intervention: CPT: 92980, 92981, 92982, 92984, 92995, 92996; HCPCs: G0290, G0291; ICD9 procedure: 00.66, 36.09, 36.06, 36.07, 36.03
Step 2: Identify patients that meet age, eligibility and continuous enrollment criteria
1. Age
a. Identify patients 18 years and older
2. 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
i. Medical benefit
ii. Pharmacy benefit
3.Continuous enrollment
a. Determine enrollment during both the identification and measurement years
b. To be eligible, persons must have medical and pharmacy coverage for the measurement period and prior period

Step 3: Identify patients with exclusion criteria
1. Identify patients that meet one or more of the following exclusion criteria during the prior 12 months before the triggering event (See also Tables CADPR-E1 and E2 in written measure specification): Acute myocardial infarction 14

to 365 days before the triggering event: ICD9: 410.xx; Revascularization: Coronary artery bypass graft: CPT: 33510, 33511, 33512, 33513, 33514, 33516, 33517, 33518, 33519, 33521, 33522, 33523, 33530, 33533, 33534, 33535, 33536; ICD9 Procedure: 36.15, 36.16; Percutaneous coronary intervention: CPT: 92980, 92981, 92982, 92984, 92995, 92996; HCPCs: G0290, G0291; ICD9 procedure: 00.66, 36.09, 36.06, 36.07, 36.03

2. Identify patients that meet one or more of the following exclusion criteria during the identification OR the measurement year (see also Tables CAD-F3 – CAD-F8): 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 Diagnosis: 042; normal pregnancy: ICD9 Diagnosis: v22.x; ectopic pregnancy: CPT: 59120, 59121, 59130, 59135, 59136, 59140, 59150, 59151; D&C after pregnancy: CPT: 59160; Insertion of cervical dilator: CPT: 59200; Episiotomy or vaginal repair :CPT: 59300; Revision of cervix :CPT:59320, 59325; Repair of uterus: CPT: 59350; Obstetrical care: CPT: 59400, 59409,59410; Antepartum manipulation: CPT:59412; Deliver placenta:CPT:59414: Antepartum care only:CPT: 59425, 59426; Care after delivery: CPT: 59510, 59514, 59515, 59525; Vbac delivery: CPT: 59610, 59612, 59614; Attempted vbac delivery: CPT: 59618, 59620, 59622; Treatment of miscarriage:CPT: 59812, 59820, 59821; Treat uterus infection: CPT: 59830; Abortion: CPT: 59840, 59841, 59850, 59851, 59852, 59855, 59856, 59857, 59866; Remove cerclage suture: CPT: 59871; Fetal invas px w/us: CPT: 59897; Lapro proc, ob care/deliver: CPT: 59898; Maternity care procedure: CPT: 59899; OB US < 14 wks: CPT: 76801, 76802; OB US >/= 14 wks: CPT: 76805, 76810; OB US: CPT: 76811, 76812, 76813, 76814, 76815, 76816; transvaginal us: CPT: 76817; fetal biophys profile: CPT: 76818, 76819; Umbilical artery echo: CPT: 76820; middle cerebral artery echo: CPT: 76821; echo exam of fetal heart: CPT: 76825; Anesth: CPT: 01958, 01960,01961; Complications of pregnancy: ICD9 diagnosis: 630-676; polyarteritis nodosa and allied conditions: ICD9: 446.xx; arteritis, unspecified: ICD9: 447.6

**Eval Rating 2a1**

**H☐ M☐ L☐ I☐**

Step 4: Combine prior steps to identify measure population

c. Identify CAD eligible population
d. Exclude those patients not meeting general inclusion criteria (e.g. age, continuous eligibility)
e. Exclude those patients meeting one or more measure exclusion criteria
f. The resulting collection of patients is the measure population

**Eval Rating 2b1**

**H☐ M☐ L☐ I☐**

Eligible event identification:
The following codes are used to identify clinically relevant services during a CAD episode.
Inpatient and outpatient events:
These codes will be used to identify CAD post revascularization -related services during the measurement period. The code can appear in any position on the claim. (see also Table CADPR-B1 in written measure specification): other and unspecified mitral valve disease: ICD9: 394.9; Hypertensive disease: ICD9: 401.xx, 402.xx, 403.x, 404.x, 405.x; Ischemic Heart disease: ICD9: 410.x, 411.xx, 412, 413.0, 413.9, 414.xx; Diseases of pulmonary circulation: ICD9: 415.1, 415.11, 415.19, 417.8; Other forms of heart disease: ICD9: 420.xx, 421.xx, 422.xx, 423.xx, 424.1, 424.9, 425.x, 426.0, 426.1x, 426.3, 426.4, 426.5x, 426.6, 426.7, 426.8, 426.82, 426.89, 426.9, 427.xx, 428.xx, 429.2, 429.3, 429.4, 429.5, 429.6, 429.7x, 429.8x Cerebrovascular disease: ICD9: 431, 432.0, 432.9, 433.xx, 434.x, 435.x, 436, 437.0, 437.1, 437.2, 437.3, 437.4, 437.6, 437.7, 437.8, 437.9, 438.xx, Diseases of arteries, arterioles, and capillaries: ICD9: 440.xx, 441.xx, 442.xx, 443.0, 443.2x, 443.81, 443.89, 443.9, 444.xx, 445.xx, 447.0, 447.1, 447.2, 447.5, 447.8, 447.9, 448.x, 449; Diseases of veins and lymphatics, and other diseases of circulatory system: ICD9: 458.xx, 459.0; Anomolies of aortic arch: ICD9: 747.21; unspecified anomaly of circulatory system: ICD9: 747.9; Symptoms involving cardiovascular system: ICD9: 785.xx; Nonspecific abnormal results of function studies, cardiovascular: ICD9: 794.3x; electrolyte/fluid disorders nec: ICD9: 276.9; hyperpotassemia: ICD9: 276.7; hypopotassemia: ICD9: 276.8; fluid overload: ICD9: 276.6; abnormal blood chemistry nec: ICD9: 790.6; Abnormal coagulation profile: ICD9: 790.92; Long term use anticoagulants: ICD9: V58.61; Mechanical complication of cardiac device, implant and graft: ICD9:996.0x; Mechanical complication of other vascular device, implant and graft: ICD9: 996.1; chest pain: ICD9: 786.50, 786.51, 786.52, 786.59; Other specified gastritis with hemorrhage: ICD9: 535.41; abnormal chest sounds: ICD9: 786.7; Tietze's disease: ICD9: 733.6; other postoperative infection: ICD9: 998.59; other respiratory complications: ICD9: 997.39; arteriovenous fistula, acquired: ICD9: 447.0; pseudoaneurysm: ICD9: 442.9.

The following codes will be used to help identify those services that should be categorized as "E&M" during the analyses. Such services, when present in the identification (pre-measurement) period, are used to identify patients for the measure's denominator. When present during the measurement period, these services are counted to determine the provider or providers to whom the episode will be attributed (see also Table CADPR- B2). General physician office visits: CPT: 99201-99205, 99211-99215; preventive medicine screening: CPT: 99394-99397, 99401-99404, 99411, 99412, 99420, 99429, 99384-99387; observation care: CPT: 99217-99220; emergency dept care: CPT: 99281-99285; home health: CPT: 99341-99345, 99347-99350; skilled nursing facility: CPT: 99304-99310, 99315, 99316, 99318, 99324-99328, 99334-99337; office consultation: CPT: 99241-99245; unlisted: CPT: 99455, 99456.

Procedures and laboratory
The following procedure codes will be used to identify CAD Post revascularization -related services during the measurement period, regardless of corresponding ICD-9 diagnosis codes. Codes may appear in any position on the claim (see also Table CADPR B3-C): Coronary artery bypass graft: CPT: 33510, 33511, 33512, 33513, 33514, 33516, 33517, 33518, 33519, 33521, 33522, 33523, 33530, 33533, 33534, 33535, 33536; ICD9 procedure: 36.15, 36.16; percutaneous coronary intervention: CPT: 92980, 92981, 92982, 92984, 92995, 92996; HCPCs: G0290, G0291; ICD9 procedure: 00.66, 36.09, 36.06, 36.07, 36.03; catheterizations: CPT: 93510, 93511, 93524, 93526, 93527, 93528, 93529, 93530, 93531, 93532, 93533, 93539, 93540, 93545, 93555, 93556; stress cardiac MR: CPT: 75563,75564; stress positron emission tomography: CPT: 78491, 78492; Single photon emission computed tomography (SPECT): CPT: 78460,78461, 78469, 78494, 78464, 78465, 78478, 78480; HCPCs: A9500, A9502, A9505, J0152, J1245, J1250; cardiac CT: HCPCs: 0144T, 0145T; angiography: CPT: 71275, 71555, 75635, 93508; HCPCs: 0146T, 0147T, 0148T, 0149T, 0150T, 0151T; ICD9 procedure: 88.5, 88.50, 88.51, 88.52, 88.53, 88.54, 88.55, 88.56, 88.57, 88.58, 88.59; Positron Emission tomography (PET): CPT: 78459; Cardiac monitors: CPT: 93290, 93297, 93299; echocardiogram: CPT: 93303, 93304, 93305, 93306, 93307, 93308, 93312, 93313, 93314, 93315, 93317, 93318, 93320, 93321, 93325, 93350; HCPCs: A9900; stress testing: CPT: 93015, 93016, 93017, 93018, 93024; injections: HCPCs: C9109, C9121, J0130, J0152, J0350, J0365, J0583, J1160, J1162, J1245, J1250, J1327, J1642, J1644, J1645, J1650, J1652, J1655, J2993, J2995, J2997, J3100, J3100, J3245, J3246, J3265, J3364, J3365

Prescription drugs
The episode includes the following medications by therapeutic class or generic brand: Ace inhibitors: benazepril, captopril, enalapril, fosinopril, lisinopril, moexipril, perindopril, quinapril, ramipril, trandolapril; beta-blockers: metoprolol, carvedilol, bisoprolol, ARBs: candesartan, eprosartan, irbesartan, losartan, olmesartan, telmisartan, valsartan; antihyperlipidemics/statins, anti-platelets, calcium channel blockers, nitrates, all CV combination products (e.g. ACE inhibitors + statins), anticoagulants: warfarin, heparin, ranolazine, ADP antagonists, anti-arrythmics, diuretics, zetia, welchol

Rationale for cluster, grouping and assignment framework:
Age: The measure includes individuals 18 years of age or older. Those younger than 18 were excluded because management of cardiovascular disease might differ in pediatric patients and therefore they were not considered a meaningful group to include in the measure.
Revascularization event: To be included in the measure, an individual must have had at an inpatient admission for CHF.
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 included in the analysis.
Exclusion of patients with acute myocardial infarction (AMI) and/or revascularization: Individuals with an AMI during the 14 to 365 day period before the triggering revascularization are excluded. The 14 day period is to ensure that the AMI is not associated with the triggering revascularization. Individuals with a revascularization during the 12 month period before the triggering revascularization are also excluded. Individuals with AMI or prior revascularizations in the identification period were excluded because they are likely to have substantially higher healthcare utilization than individuals without these.
Exclusion of patients with vasculitis: The vasculitidies are a heterogenous group of diseases characterized by presence of leukocytes and inflammation of the vessel wall with manifestations and treatment that are different than the management of coronary artery disease.

Rationale for assignment of specified codes

The scope of this measure was focused on a one year period of management for CAD post revascularization so that this measure can ultimately be paired with quality measures that examine CAD. Each of the codes included in the list that

identifies CAD-related care was considered to be related to CAD-care during the one-year measurement period post revascularization by the CAD clinical workgroup. The workgroup created a list of diagnoses, procedures and medications that would have a high likelihood of being related to the CAD 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 CAD 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 of CAD post revascularization. Importantly, this was not limited to appropriate care, but rather focused on resources that were likely to be associated with CAD post revascularization.

The diagnostic codes selected as related to the episode include those for any subsequent care related to the management of CAD post revascularization. Each of the diagnostic codes identifies resources grouped to the episode if the code is present in any diagnosis field.

The following provides the rationale for the codes included in the CAD post revascularization measure. CAD is generally used to refer to the pathologic process affecting the coronary arteries (usually atherosclerosis). CAD is a multifactorial disease. We have included the codes for ischemic heart disease and other forms of heart disease that affect the coronaries. Hypertension is a well-established risk factor for adverse cardiovascular outcomes, including mortality and stroke (1,2). Consequently, we have included the codes for hypertension. Different coagulation factor abnormalities may be related to cardiovascular risk such as plasma fibrinogen (3), elevated levels of fibrin D-dimer (4), high levels of factor XI and factor XII activities (5), and we have included codes for abnormal coagulation profile and use of anticoagulants.
The symptoms of gastritis can mimic the chest pain present in CAD. Tietze´s syndrome has been defined as a benign, painful, nonsuppurative localized swelling of the costosternal, sternoclavicular, or costochondral joints, most often involving the area of the second and third ribs (6) with symptoms similar to those present in CAD. Additional codes were included to account for abnormal blood chemistry, including hyperpotassemia and hypopotassemia, that could cause different forms of arrhythmia in CAD and in the postoperative period. CABG is an invasive procedure, involving sternotomy, and the risk for infection is present. Consequently, the postoperative infection code was included. Other postoperative complications could include fluid overload, respiratory insufficiency, and codes have been included in the measure.

Codes to identify diagnostic procedures relevant to care of patients with CAD and revascularization have been included in the measure. Stress electrocardiogram (ECG) testing is important in the evaluation of patients with known CAD. It assists in the initial assessment of CAD that may prompt further investigations with coronary angiography and catheterization that will assess the need for further coronary intervention. Codes to identify tests used in the prognosis of CAD have been included (e.g., single photon emission computed tomography [SPECT], stress cardiac MRI). Coronary angiography can be an important test in CAD, with 50% luminal narrowing of a coronary artery considered evidence of significant CAD (7). Coronary angiography can determine the number of vessels involved and determine the need for further percutaneous coronary intervention versus CABG. Stress echocardiography is considered a consolidated technique for risk stratification of patients with known CAD (8).

The medications selected for inclusion in the measure met at least one of the following criteria:
- Used in the chronic management of CAD
- Used to treat symptoms that may be associated with CAD
- Used to treat hyperlipidemia
- Used to treat hypertension
- Used to treat different forms of arrhythmia
- Anticoagulants and antiplatelet agents.

References:
1. Miura K, Daviglus ML, Dyer AR, et al. Relationship of blood pressure to 25-year mortality due to coronary heart disease, cardiovascular diseases, and all causes in young adult men: the Chicago Heart Association Detection Project in Industry. Arch Intern Med. 2001;161(12):1501-8.
2. Lewington S, Clarke R, Qizilbash N, et al. Age-specific relevance of usual blood pressure to vascular mortality: a meta-analysis of individual data for one million adults in 61 prospective studies. Lancet. 2002;360(9349):1903-13.
3. Fibrinogen Studies Collaboration, Danesh J, Lewington S, et al. Plasma fibrinogen level and the risk of major cardiovascular diseases and nonvascular mortality: an individual participant meta-analysis. JAMA. 2005;294(14):1799-809.
4. Danesh J, Whincup P, Walker M, et al. Fibrin D-dimer and coronary heart disease: prospective study and meta-

analysis. Circulation. 2001;103(19):2323-7.
5. Doggen CJ, Rosendaal FR, Meijers JC. Levels of intrinsic coagulation factors and the risk of myocardial infarction among men: Opposite and synergistic effects of factors XI and XII. Blood. 2006;108(13):4045-51.
6. Aeschlimann A, Kahn MF. Tietze´s syndrome: a critical review. Clin Exp Rheumatol 1990; 8:407.
7. Little WC. Angiographic assessment of the culprit coronary artery lesion before acute myocardial infarction. Am J Cardiol. 1990;66(16):44G-47G.
8. Jesus Peteiro, Alberto Bouzas-Mosquera. Exercise echocardiography. World J Cardiol. 2010 Aug 26;2(8):223-32.

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

See Risk Adjustment details in Section S10.1 below.

**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 S10.1 of the submission form 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 severity level is defined for patients included in the episode. We attempt to create a relatively homogenous population through our inclusion and exclusion criteria.

**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 <u>supplemental</u> 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. Creation of 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 following steps are used to complete the construction sequence (for specific codes, see Section S8.2 clinical framework and written measure specification/technical appendix).

This measure starts with the identification of a revascularization event (either PCI or CABG) and ends 365 days post trigger event.

Eligible population identification

Step 1. Identify patients that meet the following criteria during the identification year: One ambulatory visit for CAD-related care in the identification year (see Table CAD-A).

Step 2: Identify patients that meet age, eligibility and continuous enrollment criteria. Age: Identify patients 18 years and older. Eligibility : Identify benefits during both the identification year and the measurement year. To be included persons must have both of the following benefits in both years: Medical benefit, Pharmacy benefit. Continuous enrollment: Determine enrollment during both the identification and measurement years. To be eligible, persons must have medical and pharmacy coverage for the measurement period and prior period (do not include persons whose pharmacy benefits are dropped partway through the identification or measurement period).

Step 3: Identify patients with exclusion criteria. Identify patients that meet one or more exclusion criteria during the prior period 12 months before the triggering event: 1) Patients with acute myocardial infarction (AMI) (See Table CADPR-E1for codes) 14 to 365 days before the triggering event 2) Patients with revascularization (See Table CADPR-A for codes): Coronary artery bypass graft or Percutaneous coronary intervention (PCI)
Also identify patients that meet one or more of the following exclusion criteria during the identification OR the measurement year (Tables CADPR E3 – CADPR-E8): Active cancer treatment, ESRD, organ transplant, HIV/AIDs, pregnancy, polyarteritis nodosa and allied conditions, arteritis, unspecified.
Step 4: Combine prior steps to identify measure population: 1) Identify CAD post revascularization eligible population. 2) Exclude those patients not meeting general inclusion criteria (e.g. age, continuous eligibility 3) Exclude those patients meeting one or more measure exclusion criteria, 4) The resulting collection of patients is the measure population

Eligible event identification
For each individual in the measure population, identify the following paid claims for services rendered during the measurement year. Claims / encounters will be identified based on the presence of CAD post revascularization-related diagnosis codes or procedure codes. These events will be used to determine the related resource use.
Inpatient and Outpatient events: Identify all inpatient and outpatient claims / encounters with a CAD post revascularization-related diagnostic code appearing in any position (see Table CADPR-B1).
Procedures and laboratory: Identify all claims / encounters with one of the following CPT, HCPCs, or ICD-9 procedure codes (see Tables CADPR-C). These procedure codes will be used to identify CAD post revascularization-related services during the measurement period, regardless of corresponding ICD-9 diagnosis codes.

Prescription drugs: Identify the following medications by therapeutic class or generic/brand medication name during the measurement period (See Table CADPR-D)

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 CAD Post revascularization-related. For further details on standardized pricing methods, see section S10.3 below)

Create episode specific strata— Patients included in the post-revascularization measure will be stratified by whether patients did or did not have multiple revascularizations during the 12-month measurement period (see Table CADPR-A).

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

Because CAD patients with a revascularization may have more subsequent resource utilization than CAD patients without a revascularization, this episode of care measure assesses the resource use and costs for CAD patients following a revascularization. Consequently, the triggering event for this episode of care is a revascularization (either CABG or PCI). The expert panel of clinicians in the CAD workgroup recommended that healthcare resources and costs during a 1-year period following the trigger event be assessed in order to capture the subsequent health care that could be related to this initial revascularization. (see also Section 1 of the written measure specification technical appendix).

**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 coronary artery disease, we have elected to create two distinct measures. One measure for chronic coronary artery disase and a separate measure for coronary artery disease post revascularization. There is no overlap between the two measures.

Beyond CAD, 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
Durable Medical Equipment (DME)

**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 coronary artery disease post revascularization was: 11,398
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 CADPR-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., CAD for the CAD 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 CAD post revascularization episode.

Risk Adjustment Model
CAD Post Revascularization Episode Risk Adjusted Costs = $13,175+ (Male*-$871)+ (Specified Heart Arrhythmias*$3,375)+ (Vascular Disease*$3,934)+ (Renal Failure*$1,880)+ (Septicemia/Shock*$3,715)+ (Multiple Sclerosis*$11,084)+ (Parkinsons and Huntingtons Diseases*$17,716)+ (Respirator Dependence/Tracheostomy Status*$9,932)+ (Cardio-Respiratory Failure and Shock*$4,590)+ (Congestive Heart Failure*$3,739)+ (Cerebral Hemorrhage*$21,722)+ (Ischemic or Unspecified Stroke*$2,837)+ (Vascular Disease with Complications*$4,359)+ (Chronic Obstructive Pulmonary Disease*$2,007)+ (Major Head Injury*-$13,617)+ (Vertebral Fractures without Spinal Cord Injury*-$11,872)

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 CADPR-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 CAD post revascularization episode in the test episode: Average Cost: $12,641

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 =$15,169. Calculate the adjustment factor by dividing the costs from the current population by the average costs of $12,641. That would result in an adjustment factor = 1.20 (15,169/12,641). These adjustment factors are then applied to the estimated coefficients to provide an adjusted risk adjustment model.

Risk Adjusted Model
Risk and Mean Adjusted CAD Post Revascularization Episode Costs = 1.20* CAD Post Revascularization Episode Risk Adjusted Cost

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-634339204677575356.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 included in the post-revascularization measure will be stratified by whether patients did or did not have multiple revascularizations during the 12-month measurement period. Also see section 4 of the Measure Specification Technical Appendix.

Rationale
To examine variation in resource use among patients with CAD post-revascularization due to differences in practice patterns, it is useful to indentify a relatively homogeneous patient cohort for comparison. Because CAD patients with multiple revascularizations are likely to require more resource use than patients with a single revascularization, examining these patients separately will facilitate identification of variation in resource use due to differences in treatment patterns rather than differences in burden of illness.

**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:
Pereira BJG. Medicare Prescription Drug, Improvement and Modernization Act: Average Wholesale Price (AWP) Medscape Nephrology.2005;2(1)

Ritzwoller DP, Goodman MJ, Maciosek MV, Lafata JE, Meenan R, Hornbrook MC, Fishman PA. Creating Standard Cost Measures Across Integrated Health Care Delivery Systems. J Natl Cancer Inst Monogr 2005;35:80 – 87

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 CAD post revascularization episodes are attributed to one or more physicians on a hierarchical basis. The episode's total count of qualifying E&M codes by unique provider ID are used for provider attribution. For each episode identify all such E&M codes occurring during the measurement year. The E&M codes are used to assign attribution using the following hierarchy:
1. Costs and resource use are assigned to a single provider if that physician has at least 70% of the episode's E&M codes during the measurement year ("single attribution"); OR
2. If no provider has more than 70% of the E&M codes, costs and resource use are assigned to each of the providers that have at least 30% of the episode's E&M codes during the measurement year ("multiple attribution"); OR
3. If no provider has at least 30% of the episode's E&M codes during the measurement year, the costs and resource use for that patient are not attributed to any provider ("no attribution").

To identify the attributable provider, the following steps will be used:
Step 1: Identify qualifying E&M codes for the episode:
Evaluation and Management: CPT: Office or Other Outpatient Services 99201–99215; Hospital Observation Services 99217–99220; Hospital Inpatient Services99221–99239; Consultations99241–99275; Critical Care and Intensive Care Services 99289–99298; Nursing Facility, Domiciliary and Home Services 99301–99350; Case Management Services and Care Plan Oversight Services 99361–99380; Preventive Medicine Services 99381–99429; Other E&M Services99450–99456, 99354–99357

Step 2: For every episode, count the total number of qualifying E&M codes and count the number of qualifying E&M codes for each unique provider id.

Step 3: For every episode and unique provider id combination, calculate the percentage of qualifying E&M codes using the formula below:

Percentage of Care = 100*(Episode's count of a provider's qualifying E&M codes divided by the Episode's total count of all qualifying E&M codes).

Step 4: Assign attribution based on the hierarchical attribution model described above.

Rationale:
A minimum of 30% of physician visits or physician costs has often been used as a minimum before an episode has been

attributed to a physician (1,2). Similar to these previous efforts, our physician workgroup believed that this was a reasonable cutoff to define the minimum number of E&M codes before a physician received attribution. By the same token until a physician was responsible for 70% of E&M codes, it was believed by the physician workgroup that more than one physician shared responsibility for the costs of the episode and therefore multiple attribution was appropriate. Further, an advantage of multiple attribution is that it increases the number of cases attributed to physicians – a factor that is important given the generally acknowledged problem of many physicians having too limited number of cases to allow them to be included in a comparison with other physicians. As to the use of E&M codes rather than payments to define attribution cutoff levels, the use of codes appears to be more transparent to physicians, especially given the use of standardized rather than actual payments and the fact that many expensive aspects of care resulting from physician decisions are not billed by that physician. Further, when primary physicians are involved in the episode, their physician-related payments are likely to be lower due to lower visit fees, yet it is more likely that they were responsible for referrals to specialists.

1. Merotra A, Adams JL, Thomas W, McGlynn A. The effect of different attribution rules on individual physician cost profiles. Annals of Internal Medicine 2010; 152:649-654.
2. Adams JL, Mehrotra A, Thomas JW, McGlynn EA. Physician cost profiling – reliability and risk of misclassification. N England J Med; 362: 1014-21.

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

Guidelines : Peer group comparisons should be based on physician specialty (as user data sets allow) as providers should only be compared to those of the same specialty.

Focusing on comparing physicians of the same specialty is another mechanism to ensure the severity of patients is similar across providers. It is quite possible that patients predominantly seen by cardiologists or other specialists may be more complex or sicker patients than those seen by primary care physicians.

**S11.3. Level of Analysis:**

Clinician : Individual

**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 physician 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 CAD post revasc.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 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

**S12.3. 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%

| | |
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| 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 | Eval Rating |
|---|---|
| **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.** | |
| **TESTING ATTACHMENT (5MB or less) or URL:**<br>***If needed, attach supplemental 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.***<br><br>URL:<br>Please supply the username and password:<br>Attachment: SA_ Reliability_Validity Testing CAD Post Revasc.pdf | |
| **SA1. Reliability Testing**<br>***For each module tested or for the overall measure score:***<br><br>**SA1.1. Data/sample**<br>***(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)***<br><br>Thomson Reuter´s Marketscan Dataset was used in the testing of the ABMS REF episode-based resource use measures.<br><br>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.<br><br>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.<br><br>Features of the MarketScan Research Databases include:<br>• Fully paid and adjudicated claims including inpatient, outpatient, and prescription drug claims<br>• Complete payment/charge information, including amount of patient responsibility<br>• Validated diagnosis, procedure, and other standard codes on claims where applicable (CPT, ICD-9, DRG, NDC, etc)<br>• Demographic information on enrollees including age, gender, and geographic information (three-digit zip codes and MSA)<br>• 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<br>• Standardized data elements and definitions, ensuring accurate comparisons<br>• 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<br>• 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. | **2a2**<br><br>**H☐**<br>**M☐**<br>**L☐**<br>**I☐** |

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.

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

Reliability refers to the reproducibility of results (Bannigan and Watson, 2009). To investigate the reliability of the measure, we examined the means, medians, and distribution of costs across categories of care (inpatient facility charge, evaluation and management, procedures, etc.) for all individuals with CAD post revascularization in the Marketscan data who met inclusion/exclusion criteria and for a subsample of this cohort. After applying inclusion criteria to the Marketscan data, we identified 26,742 CAD index revascularizations (see attached data summary Slide 4). After applying the exclusion criteria, there were 11,398 episodes for the measure. The subsample of this cohort was obtained as part of our investigation of the attribution of episodes of care to providers. To examine the attribution of episodes of care to providers, we first had to determine which providers had provider identification codes in the Marketscan data. There were 45.5% of episodes for which we were able to assign attribution. Then, we examined the distribution of costs across categories of care for the entire cohort and the subsample. Rationale: Our investigation of reliability allowed us to leverage on analyses that were being done to examine overall resource use and attribution of care.

Reference: Bannigan K, Watson R. Reliability and validity in a nutshell Journal of Clinical Nursing. 2009;18: 3237–3243

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

For all episodes of CAD post revascularization in the Marketscan data that met the inclusion/exclusion criteria (i.e., 11,398 episodes), drugs, procedures, and inpatient facility charges comprised the largest portion of costs (see attached data summary Slide 6). Moreover, inpatient facility charges were most relevant for episodes whose costs were in the highest 95th percentile of costs. Among the subsample of episodes for which a provider could be attributed, drugs, procedures, and inpatient facility charges also comprised the largest portion of costs with inpatient facility charges being most relevant in for episodes in the highest 95th percentile of costs (see attached data summary Slide 23).

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

The results of our comparison would suggest that the measure could be deemed reliable. It should be noted that this investigation highlighted a limitation of the data regarding the portion of missing provider identifiers.

**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 dataset.

**2b2**

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

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 and 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.

**H☐ M☐ L☐ I☐**

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.

By presenting our results to the clinical workgroups and others to examine the distributions of resource use and costs to determine if these results meant their clinical expectations, we were able to access the face validity of our results.

**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)***

We have developed a measure specification to measure resource use associated with an episode of care for management of CAD post revascularization. The measure includes resource use related to management of CAD post revascularization over a 1-year period in order to capture all CAD-related annual costs of treating these patients. For the Level 1 analysis, we found that there were 26,742 individuals meeting our inclusion criteria and 11,398 individuals after applying our exclusion criteria (see attached data summary Slide 4). We found that the average total cost of a CAD post revascularization episode was $12,641, and the predominating costs of the episode were procedure (33% of the total costs), drug charges (24% of the total costs) and inpatient facility charges (16%). The next highest cost categories were for evaluation and management (14%) and imaging (7%). We were able to attribute 45.5% of the episodes to providers in our data due (54.2% could not be attributed due to missing provider identifiers) (see attached data summary Slide 21). We found that 67.1% of episodes could be attributed to a single provider and 31.5% of episodes could be attributed to multiple providers. As part of the Level 2 analyses, we examined variability in per episode resource use by specialties of the attributed providers. The highest volume specialty was cardiology (see attached data summary Slide 26). It would be expected that drugs and inpatient facility charges would be a large component of costs for patients with CAD because management of cardiovascular disease involves proper therapeutic selection from the pharmacologic, interventional, and mechanical options available (Almeda & Hollenberg, 2003). The large portion of costs for procedures is also consistent with the need for revascularization, particularly for patients who received percutaneous coronary intervention. It would also be expected that cardiology would account for a high volume of resource use. These results were presented to the clinical workgroup who concurred that these results met their clinical expectations and had face validity.

Reference: Almeda FQ, Hollenberg SM. Update on therapy for acute and chronic heart failure. Applying advances in outpatient management. Postgrad Med. 2003 Mar;113(3):36-8, 41-4, 47-8

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

Based on the results of our investigations and concurrence from the clinical workgroup, our measure should be deemed to have face validity.

**SA3.Testing for Measure Exclusions** — **2b3**

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

**criteria**

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 clinical workgroup: age < 18 years, acute myocardial infarction 14 to 365 days before the index revascularization, vasculitis, and revascularization in the prior year. We examined the impact of these and other exclusions on the resulting cohort size.

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

The exclusion of individuals without continuous enrollment in health insurance with medical and pharmacy benefits had the largest impact on the cohort size. Among the 26,742 revascularizations, 12,914 (or 48.3% of the total) remained after the continuous enrollment exclusion criteria were applied (see attached data summary Slide 4). Among the other exclusion criteria, 3.9% of individuals met the NCQA exclusion criteria, 6.3% had a prior revascularization, 3.9% had acute myocardial infarction 14 to 365 days before the index revascularization, 0.3% had vasculitis, and 0.2% were < 18 years of age. Additionally, the clinical workgroup suggested exploring the time period for excluding acute myocardial infarction (AMI). If AMI between 0 and 365 days prior to the index revascularization were used as the exclusion criteria, 19.2% of eligible episodes would be excluded. Because of concern that an AMI between 0 and 14 days before the index revascularization might be related to the revascularization, the workgroup recommended using an AMI between 14 and 365 days before the index revascularization as the exclusion criteria.

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

Based on the results of our analyses and feedback from the clinical workgroup, we would deem the measure to be reliable. Our investigation did find that a substantial portion of individuals were excluded due to the continuous enrollment criteria, which is related to the data itself rather than the clinical characteristics of the individuals.

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

Commercial

**H☐ M☐ L☐ I☐**

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| **SA5. Risk adjustment strategy**<br><br>***Refer to items S10.1 and S10.2 to rate this criterion.*** | **2b4**<br><br>**H☐ M☐ L☐ I☐** |
| **SA6. Data analysis and scoring methods** | **2b5** |

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| ***Refer to items S12-S12.3 to rate this criterion.*** | **H☐ M☐ L☐ I☐** |
| **SA7. Multiple data sources**<br><br>***Refer to S7 & all SA1 items to evaluate this criterion.*** | **2b6**<br>**H☐ M☐ L☐ I☐ NA☐** |
| **SA6. Stratification of Disparities (if applicable)**<br><br>***Refer to item S10.2 to rate this criterion.*** | **2c**<br><br>**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?**<br>**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**<br><br>**U1. Current Use:**<br><br>Public reporting (disclosure to performance results to the public at large)<br>Quality improvement with external benchmarking<br><br>**U1.1. Use in Public Reporting Initiative Use in Public Reporting.**<br>***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)***<br><br>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 (AF4Q) 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 AF4Q communities toward the goal of public reporting and quality improvement benchmarking.<br><br>**U1.2. Use in QI**<br>***(If used in improvement programs, provide name of program(s), locations, Web page URL(s)).***<br><br>See Section U1.1 above.<br><br>**U1.3. Use for other Accountability Functions (payment, certification, accreditation)**<br>***(If used in a public accountability program, provide name of program(s), locations, Web page URL(s).*** | **3a**<br><br>**H☐ M☐ L☐ I☐** |

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|---|---|
| See section U1.1 above. | |
| **U2. Testing of Interpretability**<br>***(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).***<br><br>**U2.1. If understanding or usefulness was demonstrated**<br>***(e.g., through systematic feedback from users, focus group, cognitive testing, analysis of quality improvement initiatives) describe the data, methods, and results.***<br><br>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**<br><br>**H☐**<br>**M☐**<br>**L☐**<br>**NA☐** |
| **U2.2. Resource use data and result can be decomposed for transparency and understanding.**<br><br>***Refer to items S11 -S12.3.*** | **3c**<br><br>**H☐**<br>**M☐**<br>**L☐**<br>**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.**<br><br>**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?**<br><br>**U3.2. If the measure specifications are not completely harmonized identify the differences, rationale, and impact on interpretability and data collection burden.**<br>***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**<br><br>**H☐**<br>**M☐**<br>**L☐**<br>**I☐**<br>**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?**<br>**Rationale:** | **H☐**<br>**M☐**<br>**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**<br>***How are the data elements needed to compute measure scores generated? Data used in the measure*** | **4a** |

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|---|---|
| ***are:***<br><br>Coded by someone other than person obtaining original information (e.g., DRG, ICD-9 codes on claims) | H☐<br>M☐<br>L☐<br>I☐ |
| **F2. Electronic Sources**<br>***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)***<br><br>ALL data elements in electronic claims<br><br>**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**<br><br>H☐<br>M☐<br>L☐<br>I☐ |
| **F3. Susceptibility to Inaccuracies, Errors, or Unintended Consequences**<br>***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.***<br><br>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.<br>• 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. If users are unable to achieve adequate sample size at the level of the individual provider, the measures specifications may still provide valuable information at the level of group, system or region.<br>• 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.<br>• 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 an important component of performance evaluation.<br>• 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.<br>• 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**<br><br>H☐<br>M☐<br>L☐<br>I☐ |
| **F4. Data Collection Strategy**<br>***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).***<br><br>Administrative claims lack the detail necessary to fully understand appropriateness of resource use in relation to | **4d**<br><br>H☐<br>M☐<br>L☐<br>I☐ |

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 REFepisode-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.

**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, Chiacago, 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, Chiacago, 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.**

Coronary Artery Disease/Angina Workgroup Members
Brian Bachelder, MD, American Academy of Family Physicians
Joseph Cacchione, MD, American College of Cardiology
Paul Dobesh, PharmD, American College of Clinical Pharmacy
Gordon Fung, MD, American Heart Association
Michael Phelan, MD, American College of Emergency Physicians
Arthur Stillman, MD, American College of Radiology
Susan Zieman, MD, American Geriatrics Society

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:**

The Episode-based Resource Use Measures (Measures) and related data specifications, developed by the American Board of Medical Specialties Research and Education Foundation (ABMS REF), are intended to facilitate quality improvement activities by physicians.
These Measures are intended to assist physicians in enhancing quality of care. Measures are designed for use by any physician who manages the care of a patient for a specific condition or for prevention. These Measures are not clinical guidelines and do not establish a standard of medical care. The ABMS REF has not tested its Measures for all potential applications. The ABMS REF encourages the testing and evaluation of its Measures. Measures are subject to review and may be revised or rescinded at any time by the ABMS REF. The Measures may not be altered without the prior written approval of the ABMS REF. The Measures developed by the ABMS REF, while copyrighted, can be reproduced and distributed, without modification, for noncommercial purposes, e.g., use by health care providers in connection with their practices. Commercial use is defined as the sale, license, or distribution of the Measures for commercial gain, or incorporation of the Measures into a product or service that is sold, licensed or distributed for commercial gain. Commercial uses of the Measures require a license agreement between the user and ABMS REF. Neither the ABMS REF nor its members shall be responsible for any use of these Measures.
Portions of the exclusion criteria in the ABMS REF episode-based resource use measures were adapted from HEDIS ® measure specifications.
Limited proprietary coding is contained in the Measure specifications for convenience. Users of the proprietary code sets should obtain all necessary licenses from the owners of these code sets. The ABMS REF disclaims all liability for use or accuracy of coding contained in the specifications.

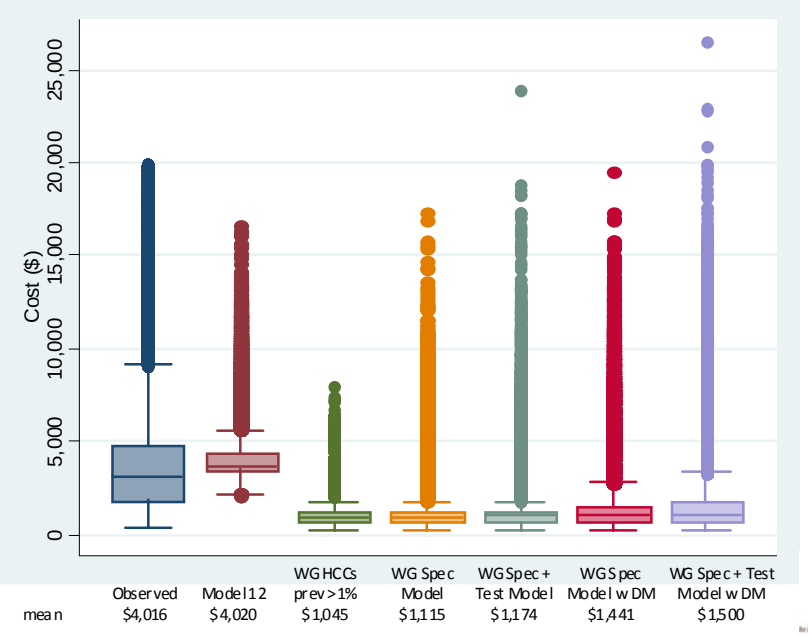

**Ad. 7 Date of Submission** (*MM/DD/YY*)**:**

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: Coronary Artery Disease Post-Revascularization Episode of Care

# Overview of Analyses Presented for CAD Episode*

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

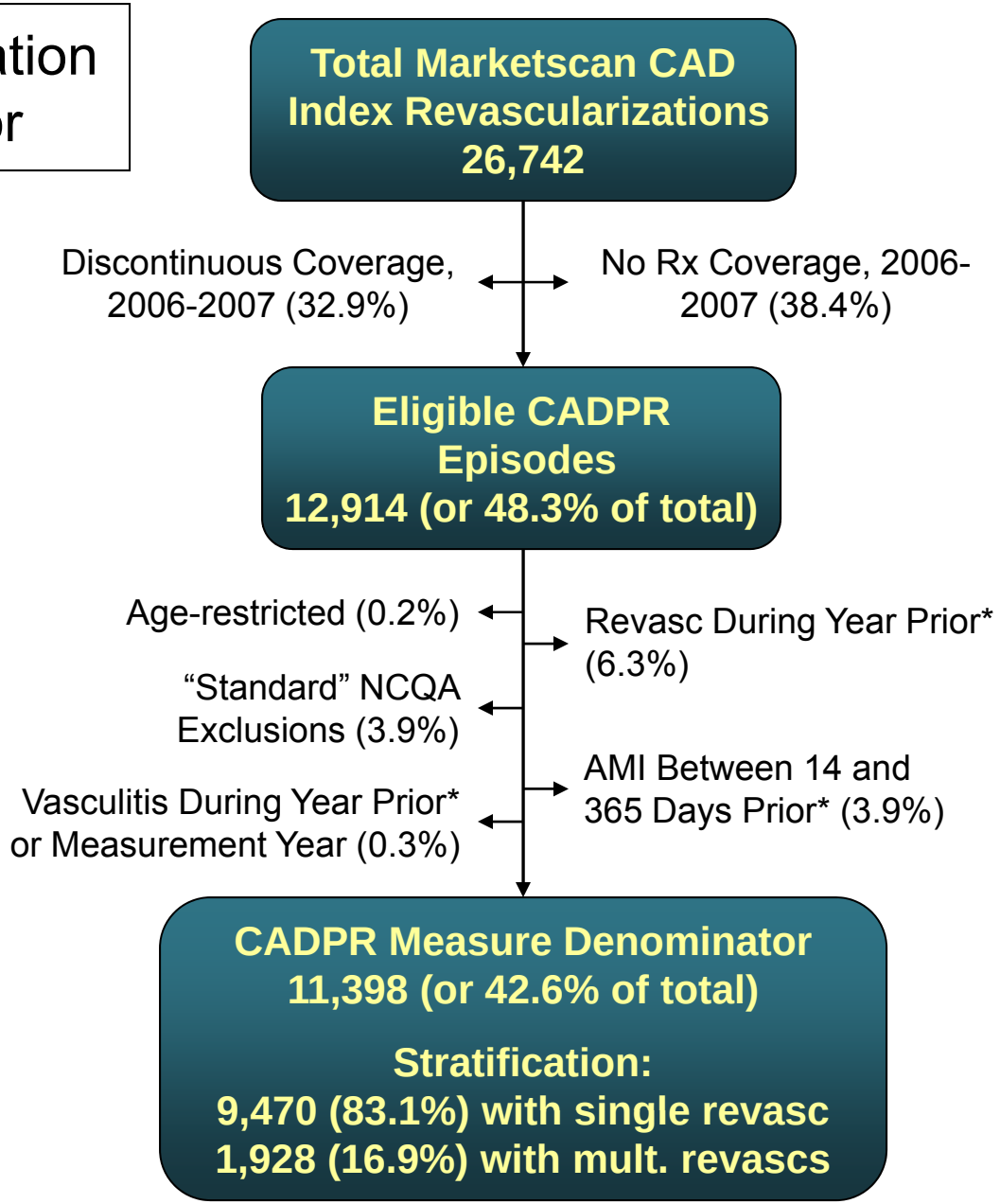
** The following results are based on the measure specification at different points in time, so the numbers are not always consistent, but they are not substantively different.*

# 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.

# CAD Post-Revascularization Measure Denominator

- 12 months of CAD management following revascularization (PCI or CABG)
- Index admissions during July 1, 2006 – December 31, 2006
- Test data: Marketscan 2006-2007
- Note: exclusions are not additive (double-counting occurs often)




* Exclusion applied to all available data for each episode – between 6 and 12 months look-back

# Related and Non-Related Services

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

# Resource use by Type of Service, Post-revascularization CAD

| Description | Mean | % of Total | 5th % | 25th % | 50th % | 75th % | 95th % |
|---|---|---|---|---|---|---|---|
| Inpatient Facility Charge | $2,010 | 16% | $0 | $0 | $0 | $0 | $10,919 |
| Evaluation and Management | $1,825 | 14% | $71 | $471 | $1,141 | $2,363 | $5,916 |
| Procedures | $4,160 | 33% | $99 | $1,692 | $2,172 | $5,629 | $11,980 |
| Imaging | $859 | 7% | $0 | $274 | $612 | $1,298 | $2,310 |
| Tests | $325 | 3% | $0 | $86 | $219 | $417 | $984 |
| Durable Medical Equipment | $51 | 0% | $0 | $0 | $0 | $0 | $174 |
| Other Services | $267 | 2% | $0 | $0 | $0 | $20 | $1,223 |
| Unclassified | $49 | 0% | $0 | $0 | $0 | $0 | $0 |
| Drug Charges | $3,095 | 24% | $154 | $1,933 | $2,967 | $4,065 | $6,285 |
| **Sum of charges** | **$12,641** | **100%** | **$3,570** | **$6,735** | **$9,613** | **$14,417** | **$30,363** |

# Top 20, CAD-related E&M, Post-revascularization Episode

- 14% of total episode costs

| CPT | Svcs. | Cost | % of Svcs | % of Cost | Description |
|---|---|---|---|---|---|
| 99213 | 20,917 | $8,979,695 | 18.2% | 43.2% | Office or other outpatient visit, established patient |
| 99214 | 17,748 | $1,928,453 | 15.4% | 9.3% | Office or other outpatient visit, established patient |
| 99232 | 18,615 | $1,390,065 | 16.2% | 6.7% | Subsequent hospital care |
| 99215 | 1,716 | $960,979 | 1.5% | 4.6% | Office or other outpatient visit, established patient |
| 99233 | 8,686 | $947,498 | 7.5% | 4.6% | Subsequent hospital care |
| 99291 | 2,355 | $735,532 | 2.0% | 3.5% | Critical care; first 30-74 minutes |
| 99285 | 2,345 | $726,154 | 2.0% | 3.5% | Emergency department visit for E&M care |
| 99223 | 3,304 | $632,477 | 2.9% | 3.0% | Initial hospital care |
| 99238 | 6,633 | $578,322 | 5.8% | 2.8% | Hospital discharge day management; 30 minutes or less |
| 99222 | 1,410 | $566,725 | 1.2% | 2.7% | Initial hospital care |
| 99254 | 2,423 | $413,451 | 2.1% | 2.0% | Inpatient consultation for a new or established patient |
| 99255 | 1,597 | $381,950 | 1.4% | 1.8% | Inpatient consultation for a new or established patient |
| 99231 | 6,367 | $319,154 | 5.5% | 1.5% | Subsequent hospital care |
| 99239 | 1,789 | $217,151 | 1.6% | 1.0% | Hospital discharge day management; more than 30 minutes |
| 99244 | 898 | $177,358 | 0.8% | 0.9% | Office consultation for a new or established patient |
| 99212 | 2,614 | $159,813 | 2.3% | 0.8% | Office or other outpatient visit, established patient |
| 99253 | 1,257 | $157,256 | 1.1% | 0.8% | Inpatient consultation for a new or established patient |
| 99284 | 626 | $132,590 | 0.5% | 0.6% | Emergency department visit for E&M care |
| 99243 | 542 | $124,857 | 0.5% | 0.6% | Office consultation for a new or established patient |
| 99217 | 1,094 | $113,055 | 1.0% | 0.5% | Observation care discharge day management |
| Total | 115,128 | $20,796,230 | 100.0% | 100.0% | |

# CAD Non-related E&M, Top 20 ICD-9 Codes, Post-revascularization Episode

| ICD-9 Code | Related | Not Related | Related Costs | Non-Related Costs |
|---|---|---|---|---|
| 25000-Dm II wo Cmp Nt St Uncntr | 2,203 | 3,215 | $527,192 | $367,968 |
| 25002-Dm II wo Cmp Uncntrld | 1,476 | 1,275 | $240,701 | $143,922 |
| 2724 -Hyperlipidemia NEC/NOS | 647 | 1,137 | $201,613 | $112,943 |
| 51881-Acute Respiratry Failure | 2,063 | 653 | $318,849 | $91,066 |
| 78605-Shortness of Breath | 458 | 437 | $100,392 | $76,190 |
| V700 -Routine Medical Exam | 115 | 577 | $27,520 | $70,566 |
| 7242 -Lumbago | 211 | 577 | $82,531 | $66,239 |
| 496 -Chr Airway Obstruct NEC | 405 | 456 | $71,123 | $65,096 |
| 78900-Abdmnal Pain Unspcf Site | 172 | 470 | $46,438 | $63,244 |
| 4660 -Acute Bronchitis | 187 | 550 | $85,804 | $55,951 |
| 2859 -Anemia NOS | 209 | 293 | $40,352 | $55,625 |
| 4619 -Acute Sinusitis NOS | 126 | 509 | $63,831 | $55,341 |
| 5789 -Gastrointest Hemorr NOS | 220 | 370 | $29,728 | $54,785 |
| 2720 -Pure Hypercholesterolem | 289 | 537 | $106,524 | $53,610 |
| 7802 -Syncope & Collapse | 294 | 322 | $51,701 | $52,783 |
| 486 -Pneumonia, Organism NOS | 279 | 377 | $40,758 | $51,745 |
| 78609-Respiratory Abnorm NEC | 353 | 342 | $65,914 | $46,209 |
| V4582-Status-Post Ptca | 641 | 789 | $69,526 | $46,137 |
| 7295 -Pain in Limb | 136 | 393 | $51,455 | $43,953 |
| V4581-Aortocoronary Bypass | 916 | 742 | $95,687 | $43,666 |

# Top 20, CAD-related Procedures, Post-revascularization Episode

- 33% of total episode costs

| CPT | Svcs. | Cost | % of Svcs | % of Cost | Description |
|---|---|---|---|---|---|
| 92980 | 10,028 | $12,560,148 | 16.6% | 26.5% | Transcatheter placement of an intracoronary stent |
| 33533 | 3,708 | $8,071,153 | 6.2% | 17.0% | Coronary artery bypass, single arterial graft |
| 00562 | 2,689 | $5,810,056 | 4.5% | 12.3% | Anesthesia for procedures on heart |
| 93510 | 9,232 | $3,740,076 | 15.3% | 7.9% | Left heart catheterization, retrograde |
| 33534 | 585 | $1,705,197 | 1.0% | 3.6% | Coronary artery bypass, two coronary arterial grafts |
| 00566 | 478 | $1,304,377 | 0.8% | 2.8% | Anesthesia for direct coronary artery bypass |
| 93503 | 2,418 | $806,393 | 4.0% | 1.7% | Insertion of flow directed catheter (eg, Swan-Ganz) |
| 92982 | 728 | $701,036 | 1.2% | 1.5% | Percutaneous transluminal coronary balloon angioplasty |
| 33519 | 1,198 | $620,660 | 2.0% | 1.3% | Coronary artery bypass, ; three venous grafts |
| 33405 | 203 | $574,931 | 0.3% | 1.2% | Replacement, aortic valve, with cardiopulmonary bypass |
| 33518 | 1,442 | $543,707 | 2.4% | 1.1% | Coronary artery bypass, two venous grafts |
| 92981 | 1,239 | $478,080 | 2.1% | 1.0% | Transcatheter placement of an intracoronary stent |
| 93508 | 1,037 | $420,638 | 1.7% | 0.9% | Catheter placement in coronary artery for angiography |
| 33535 | 171 | $410,506 | 0.3% | 0.9% | Coronary artery bypass, three coronary arterial grafts |
| 36620 | 2,724 | $339,589 | 4.5% | 0.7% | Arterial catheterization or cannulation for sampling |
| 33512 | 130 | $318,951 | 0.2% | 0.7% | Coronary artery bypass, three coronary venous grafts |
| 00563 | 111 | $317,054 | 0.2% | 0.7% | Anesthesia for procedures on heart |
| 36556 | 1,156 | $305,665 | 1.9% | 0.6% | Insertion of centrally inserted central venous catheter |
| 33521 | 432 | $278,553 | 0.7% | 0.6% | Coronary artery bypass, four venous grafts |
| 33249 | 192 | $257,411 | 0.3% | 0.5% | Insertion or repositioning of electrode lead(s) for pacemaker |
| Total | 60,282 | $47,418,661 | 100.0% | 100.0% | |

# Common CAD non-related Procedures, Post-revascularization Episode

| CPT | Label | Related | Not Related | Related Costs | Non-Related Costs |
|---|---|---|---|---|---|
| 97110 | Therapeutic procedure, one or more areas, each 15 minutes; therap | 1,180 | 3,564 | $71,083 | $204,527 |
| 66984 | Extracapsular cataract removal with insertion of intraocular lens pro | 30 | 142 | $26,759 | $167,573 |
| 00790 | Anesthesia for intraperitoneal procedures in upper abdomen includi | 36 | 143 | $28,235 | $142,753 |
| 45378 | Colonoscopy, flexible, proximal to splenic flexure; diagnostic, with o | 58 | 305 | $23,435 | $128,242 |
| 27447 | Arthroplasty, knee, condyle and plateau; medial AND lateral compar | 0 | 68 | $0 | $118,134 |
| 97140 | Manual therapy techniques (eg, mobilization/ manipulation, manual | 763 | 2,303 | $51,294 | $103,201 |
| 00810 | Anesthesia for lower intestinal endoscopic procedures, endoscope i | 43 | 230 | $16,822 | $95,908 |
| 43239 | Upper gastrointestinal endoscopy including esophagus, stomach, an | 129 | 312 | $39,625 | $94,355 |
| 45380 | Colonoscopy, flexible, proximal to splenic flexure; with biopsy, single | 36 | 179 | $15,229 | $81,271 |
| 90772 | Therapeutic, prophylactic or diagnostic injection (specify substance | 470 | 1,169 | $79,832 | $61,648 |
| 00740 | Anesthesia for upper gastrointestinal endoscopic procedures, endos | 77 | 135 | $38,617 | $58,458 |
| 00562 | Anesthesia for procedures on heart, pericardial sac, and great vessel | 2,690 | 24 | $5,810,056 | $48,035 |
| 33405 | Replacement, aortic valve, with cardiopulmonary bypass; with prost | 203 | 16 | $574,931 | $46,125 |
| 33430 | Replacement, mitral valve, with cardiopulmonary bypass | 85 | 10 | $195,859 | $26,704 |
| 36556 | Insertion of non-tunneled centrally inserted central venous catheter | 1,156 | 65 | $305,665 | $17,374 |
| 36620 | Arterial catheterization or cannulation for sampling, monitoring or tr | 2,725 | 97 | $339,589 | $12,118 |
| 33863 | Ascending aorta graft, with cardiopulmonary bypass, with or withou | 35 | 1 | $95,555 | $4,249 |
| 93503 | Insertion and placement of flow directed catheter (eg, Swan-Ganz) f | 2,418 | 13 | $806,393 | $3,963 |
| 33249 | Insertion or repositioning of electrode lead(s) for single or dual cham | 192 | 3 | $257,411 | $3,550 |
| 00560 | Anesthesia for procedures on heart, pericardial sac, and great vessel | 97 | 2 | $157,003 | $3,037 |

# Top 20, CAD-related Imaging, Post-revascularization Episode

- 7% of total episode costs

| CPT | Svcs. | Cost | % of Svcs | % of Cost | Description |
|---|---|---|---|---|---|
| 78465 | 4,200 | $1,685,587 | 3.8% | 17.2% | Myocardial perfusion imaging; tomographic (SPECT) |
| 93556 | 10,142 | $821,817 | 9.1% | 8.4% | Imaging supervision; pulmonary angiography, aortography |
| 93307 | 5,278 | $702,634 | 4.7% | 7.2% | Echocardiography, transthoracic |
| 93545 | 10,196 | $618,136 | 9.1% | 6.3% | Injection for coronary angiography |
| 93555 | 8,582 | $609,262 | 7.7% | 6.2% | Imaging supervision; ventricular and/or atrial angiography |
| A9500 | 2,004 | $394,563 | 1.8% | 4.0% | Technetium tc-99m sestamibi, diagnostic |
| 71010 | 16,383 | $381,907 | 14.7% | 3.9% | Radiologic examination, chest; single view |
| 93320 | 5,685 | $353,240 | 5.1% | 3.6% | Doppler echocardiography, pulsed wave |
| 93543 | 8,599 | $346,015 | 7.7% | 3.5% | Injection for selective left ventricular or left atrial angiography |
| 78478 | 4,107 | $339,362 | 3.7% | 3.5% | Myocardial perfusion study with wall motion |
| 78480 | 4,091 | $327,224 | 3.7% | 3.3% | Myocardial perfusion study with ejection fraction |
| 93325 | 5,736 | $309,858 | 5.1% | 3.2% | Doppler echocardiography color flow velocity mapping |
| A9502 | 1,176 | $265,500 | 1.1% | 2.7% | Technetium tc-99m tetrofosmin, diagnostic |
| 93312 | 897 | $215,052 | 0.8% | 2.2% | Echocardiography, transesophageal |
| 36245 | 394 | $163,402 | 0.4% | 1.7% | Selective catheter placement, arterial system |
| 93880 | 1,196 | $155,875 | 1.1% | 1.6% | Duplex scan of extracranial arteries |
| 71020 | 5,144 | $152,061 | 4.6% | 1.6% | Radiologic examination, chest, two views |
| A9505 | 700 | $118,462 | 0.6% | 1.2% | Thallium tl-201 thallous chloride, diagnostic |
| 92978 | 703 | $117,280 | 0.6% | 1.2% | Intravascular ultrasound (coronary vessel or graft) |
| 71275 | 358 | $68,781 | 0.3% | 0.7% | CT angiography, chest (noncoronary) |
| Total | 111,691 | $9,796,155 | 100.0% | 100.0% | |

# Common CAD non-related Imaging, Post-revascularization Episode

| CPT | Label | Related | Not Related | Related Costs | Non-Related Costs |
|---|---|---|---|---|---|
| 70553 | Magnetic resonance (eg, proton) imaging, brain (including brain sten | 140 | 130 | $47,448 | $93,113 |
| 72148 | Magnetic resonance (eg, proton) imaging, spinal canal and contents, | 50 | 186 | $10,524 | $78,410 |
| 73721 | Magnetic resonance (eg, proton) imaging, any joint of lower extremi | 37 | 196 | $6,907 | $77,218 |
| 71020 | Radiologic examination, chest, two views, frontal and lateral; | 5,147 | 2,142 | $152,061 | $68,025 |
| 72158 | Magnetic resonance (eg, proton) imaging, spinal canal and contents, | 12 | 76 | $3,897 | $63,729 |
| 74160 | Computed tomography, abdomen; with contrast material(s) | 188 | 348 | $26,782 | $56,447 |
| 72193 | Computed tomography, pelvis; with contrast material(s) | 186 | 365 | $26,704 | $55,731 |
| 72141 | Magnetic resonance (eg, proton) imaging, spinal canal and contents, | 47 | 130 | $9,316 | $44,572 |
| 73221 | Magnetic resonance (eg, proton) imaging, any joint of upper extremi | 35 | 117 | $5,699 | $44,348 |
| 74150 | Computed tomography, abdomen; without contrast material | 186 | 305 | $20,074 | $43,802 |
| 71260 | Computed tomography, thorax; with contrast material(s) | 428 | 252 | $62,602 | $43,603 |
| 74170 | Computed tomography, abdomen; without contrast material, follow | 103 | 180 | $19,715 | $42,509 |
| 70450 | Computed tomography, head or brain; without contrast material | 426 | 337 | $45,787 | $41,776 |
| 72192 | Computed tomography, pelvis; without contrast material | 177 | 291 | $18,431 | $41,698 |
| 71010 | Radiologic examination, chest; single view, frontal | 16,384 | 1,749 | $381,907 | $40,546 |
| 77057 | Screening mammography, bilateral (2-view film study of each breast | 31 | 409 | $1,403 | $28,469 |
| 70551 | Magnetic resonance (eg, proton) imaging, brain (including brain sten | 80 | 72 | $15,513 | $26,202 |
| 71250 | Computed tomography, thorax; without contrast material | 164 | 164 | $21,128 | $25,760 |
| 93880 | Duplex scan of extracranial arteries; complete bilateral study | 1,196 | 125 | $155,875 | $20,259 |
| 93971 | Duplex scan of extremity veins including responses to compression a | 239 | 239 | $12,626 | $20,100 |

# Top 20, CAD-related Tests, Post-revascularization Episode

- 3% of total episode costs

| CPT | Svcs. | Cost | % of Svcs | % of Cost | Description |
|---|---|---|---|---|---|
| 93015 | 4,040 | $611,320 | 2.7% | 16.5% | Cardiovascular stress test |
| 93010 | 23,389 | $436,149 | 15.6% | 11.8% | Electrocardiogram, routine ECG with at least 12 leads |
| 93000 | 8,107 | $380,466 | 5.4% | 10.3% | Electrocardiogram, routine ECG with at least 12 leads |
| 80061 | 6,402 | $108,218 | 4.3% | 2.9% | Lipid panel |
| 93350 | 620 | $102,312 | 0.4% | 2.8% | Echocardiography, transthoracic |
| 36415 | 7,961 | $100,775 | 5.3% | 2.7% | Collection of venous blood by venipuncture |
| 93641 | 184 | $90,880 | 0.1% | 2.5% | Electrophysiologic evaluation of cardioverter-defibrillator |
| 88305 | 650 | $83,783 | 0.4% | 2.3% | Level IV - Surgical pathology, gross and microscopic exam |
| 80048 | 6,920 | $77,740 | 4.6% | 2.1% | Basic metabolic panel |
| 80053 | 4,721 | $72,105 | 3.2% | 1.9% | Comprehensive metabolic panel |
| 85025 | 7,327 | $66,140 | 4.9% | 1.8% | Blood count; complete (CBC) |
| 93224 | 245 | $54,461 | 0.2% | 1.5% | Electrocardiographic monitoring by ECG waveform |
| 93922 | 527 | $49,161 | 0.4% | 1.3% | Studies of upper or lower extremity arteries |
| 85610 | 6,872 | $48,384 | 4.6% | 1.3% | Prothrombin time |
| 93016 | 1,230 | $45,746 | 0.8% | 1.2% | Cardiovascular stress test, maximal or submaximal exercise |
| 95810 | 117 | $45,315 | 0.1% | 1.2% | Polysomnograph, attended by a technologist |
| 93018 | 1,473 | $45,147 | 1.0% | 1.2% | Cardiovascular stress test |
| 93230 | 209 | $43,995 | 0.1% | 1.2% | Electrocardiographic monitoring by ECG waveform |
| 95811 | 123 | $38,670 | 0.1% | 1.0% | Polysomnography, with initiation of cpap |
| 84484 | 2,815 | $36,840 | 1.9% | 1.0% | Troponin, quantitative |
| Total | 149,654 | $3,702,656 | 100.0% | 100.0% | |

# Common CAD non-related Tests, Post-revascularization Episode

| CPT | Label | Related | Not Related | Related Costs | Non-Related Costs |
|---|---|---|---|---|---|
| 88305 | Level IV - Surgical pathology, gross and microscopic examination Abc | 650 | 1,522 | $83,783 | $224,129 |
| 95811 | Polysomnography; sleep staging with 4 or more additional paramete | 129 | 281 | $38,670 | $163,604 |
| 80061 | Lipid panel This panel must include the following: Cholesterol, serum | 6,467 | 6,666 | $108,218 | $128,960 |
| 95810 | Polysomnography; sleep staging with 4 or more additional paramete | 117 | 234 | $45,315 | $127,904 |
| 80053 | Comprehensive metabolic panel This panel must include the followir | 4,735 | 3,980 | $72,105 | $64,660 |
| 95904 | Nerve conduction, amplitude and latency/velocity study, each nerve | 74 | 259 | $13,310 | $55,761 |
| 36415 | Collection of venous blood by venipuncture | 8,006 | 7,937 | $100,775 | $55,419 |
| 83036 | Hemoglobin; glycosylated (A1C) | 2,090 | 3,579 | $24,190 | $53,538 |
| 85025 | Blood count; complete (CBC), automated (Hgb, Hct, RBC, WBC and p | 7,332 | 4,123 | $66,140 | $46,064 |
| 84153 | Prostate specific antigen (PSA); total | 767 | 1,585 | $16,971 | $43,569 |
| 95903 | Nerve conduction, amplitude and latency/velocity study, each nerve | 38 | 162 | $7,994 | $39,258 |
| 84443 | Thyroid stimulating hormone (TSH) | 1,254 | 1,470 | $22,322 | $37,215 |
| 80050 | General health panel This panel must include the following: Comprel | 609 | 738 | $22,835 | $28,909 |
| 95900 | Nerve conduction, amplitude and latency/velocity study, each nerve | 45 | 128 | $10,626 | $26,658 |
| 93000 | Electrocardiogram, routine ECG with at least 12 leads; with interpret | 8,109 | 611 | $380,466 | $23,381 |
| 80076 | Hepatic function panel This panel must include the following: Album | 1,412 | 1,826 | $18,113 | $23,224 |
| 80048 | Basic metabolic panel (Calcium, total) This panel must include the fo | 6,937 | 1,652 | $77,740 | $20,823 |
| 93010 | Electrocardiogram, routine ECG with at least 12 leads; interpretation | 23,389 | 1,106 | $436,149 | $19,571 |
| 88307 | Level V - Surgical pathology, gross and microscopic examination Adre | 48 | 101 | $8,052 | $19,134 |
| 88342 | Immunohistochemistry (including tissue immunoperoxidase), each a | 32 | 111 | $4,338 | $18,640 |

# CAD-related Inpatient Admissions, Post-revascularization Episode

- 16% of total episode costs

| ICD-9 Diagnosis | N | Amount |
|---|---|---|
| 41401-Crnry Athrscl Natve Vssl | 4,290 | $4,978,593 |
| 4280 -Chf NOS | 157 | $1,165,191 |
| 41071-Subendo Infarct, Initial | 635 | $980,056 |
| V5789-Rehabilitation Proc NEC | 39 | $821,479 |
| 78659-Chest Pain NEC | 271 | $677,574 |
| 51881-Acute Respiratry Failure | 25 | $524,983 |
| 42731-Atrial Fibrillation | 87 | $386,263 |
| 99672-Comp-Oth Cardiac Device | 122 | $323,695 |
| 78650-Chest Pain NOS | 133 | $308,047 |
| 99859-Other Postop Infection | 36 | $303,589 |
| 41400-Cor Ath Unsp Vsl Ntv/Gft | 105 | $278,897 |
| 486 -Pneumonia, Organism NOS | 40 | $273,679 |
| 0389 -Septicemia NOS | 13 | $263,667 |
| 3090 -Adjustmnt Dis w Depressn | 1 | $254,408 |
| 41402-Crn Ath Atlg Vn Bps Grft | 134 | $237,091 |
| Top 10 | 5,795 | $10,469,470 |
| Grand Total | 9,250 | $22,910,432 |

| DRG | DRGlabel | N | Amount |
|---|---|---|---|
| 249 | Perc cardiovasc proc w non-drug-eluting sten | 302 | $1,563,991 |
| 287 | Circulatory disorders except AMI, w card cath | 227 | $1,146,782 |
| 313 | Chest pain | 167 | $682,747 |
| 303 | Atherosclerosis w/o MCC | 91 | $571,946 |
| 247 | Perc cardiovasc proc w drug-eluting stent w/ | 128 | $541,593 |
| 3 | ECMO or trach w MV 96+ hrs or PDX exc face | 5 | $533,353 |
| 251 | Perc cardiovasc proc w/o coronary artery ste | 110 | $521,977 |
| 392 | Esophagitis, gastroent & misc digest disorder | 48 | $481,205 |
| 234 | Coronary bypass w cardiac cath w/o MCC | 21 | $447,096 |
| 470 | Major joint replacement or reattachment of l | 69 | $429,081 |
| 229 | Other cardiothoracic procedures w CC | 28 | $420,521 |
| 293 | Heart failure & shock w/o CC/MCC | 49 | $389,137 |
| 291 | Heart failure & shock w MCC | 18 | $379,538 |
| 945 | Rehabilitation w CC/MCC | 11 | $349,918 |
| 292 | Heart failure & shock w CC | 30 | $339,460 |
| Top 10 | | 1,168 | $6,919,771 |
| Grand Total | | 9,250 | $22,910,432 |

Note: 0.3% of admissions were discharged to a SNF. These admissions accounted for 3.1% of inpatient facility costs for the post-revascularization episode.

# CAD Non-related Inpatient Admissions, Post-revascularization Episode

| ICD-9 Diagnosis | N | Amount |
|---|---|---|
| 486 -Pneumonia, Organism NOS | 17 | $129,426 |
| 99667-React-Oth Int Ortho Dev | 2 | $118,006 |
| 6826 -Cellulitis of Leg | 13 | $81,726 |
| 49121-Obs Chr Bronc W(Ac) Exac | 9 | $81,715 |
| V5789-Rehabilitation Proc NEC | 7 | $61,543 |
| 71536-Loc Osteoarth NOS-L/Leg | 7 | $57,374 |
| 1977 -Second Malig Neo Liver | 2 | $56,562 |
| 0389 -Septicemia NOS | 8 | $52,162 |
| 5770 -Acute Pancreatitis | 5 | $47,831 |
| 99859-Other Postop Infection | 22 | $46,796 |
| 5550 -Reg Enteritis, Sm Intest | 1 | $38,016 |
| 49322-Ch Obst Asth w (Ac) Exac | 3 | $36,504 |
| 99851-Infected Postop Seroma | 3 | $34,778 |
| 5589 -Noninf Gastroenterit NEC | 6 | $34,204 |
| 8244 -Fx Bimalleolar-Closed | 1 | $33,996 |
| Top 10 | 92 | $733,141 |
| Grand Total | 410 | $2,242,586 |

| DRG | DRGlabel | N | Amount |
|---|---|---|---|
| 470 | Major joint replacement or reattachment of l | 11 | $109,607 |
| 513 | Hand or wrist proc, except major thumb or jo | 1 | $101,761 |
| 392 | Esophagitis, gastroent & misc digest disorder | 10 | $96,307 |
| 192 | Chronic obstructive pulmonary disease w/o C | 7 | $87,211 |
| 195 | Simple pneumonia & pleurisy w/o CC/MCC | 5 | $52,791 |
| 493 | Lower extrem & humer proc except hip,foot, | 3 | $50,994 |
| 330 | Major small & large bowel procedures w CC | 4 | $44,753 |
| 193 | Simple pneumonia & pleurisy w MCC | 3 | $44,058 |
| 603 | Cellulitis w/o MCC | 6 | $43,836 |
| 885 | Psychoses | 9 | $41,179 |
| 420 | Hepatobiliary diagnostic procedures w MCC | 1 | $38,136 |
| 326 | Stomach, esophageal & duodenal proc w MC | 1 | $38,016 |
| 203 | Bronchitis & asthma w/o CC/MCC | 6 | $35,317 |
| 394 | Other digestive system diagnoses w CC | 4 | $35,216 |
| 460 | Spinal fusion except cervical w/o MCC | 6 | $33,703 |
| Top 10 | | 59 | $672,497 |
| Grand Total | | 410 | $2,242,586 |

# CAD-Related Drug Costs, Post-revascularization Episode

- Notes: Drugs compose 24% of total episode costs

| Therapeutic Class | N | Amount | % of N | % of Amount |
|---|---|---|---|---|
| 053-Antihyperlipidemic Drugs, NEC | 113,393 | $15,102,089 | 27.3% | 40.5% |
| 045-Antiplatelet Agents, NEC | 74,206 | $11,700,796 | 17.8% | 31.4% |
| 051-Cardiac, Beta Blockers | 80,992 | $3,302,804 | 19.5% | 8.9% |
| 047-Cardiac, ACE Inhibitors | 50,838 | $2,143,752 | 12.2% | 5.8% |
| 046-Cardiac Drugs. NEC | 21,996 | $2,027,169 | 5.3% | 5.4% |
| 052-Cardiac, Calcium Channel | 20,070 | $1,510,433 | 4.8% | 4.1% |
| 055-Vasodilating Agents, NEC | 20,107 | $451,035 | 4.8% | 1.2% |
| 039-Coag/Anticoag, Anticoagulants | 6,298 | $399,374 | 1.5% | 1.1% |
| 049-Cardiac, Antiarrhythmic Agents | 2,538 | $251,899 | 0.6% | 0.7% |
| 120-Diuretics, Loop Diuretics | 11,937 | $147,899 | 2.9% | 0.4% |
| 123-Diuretics, Potassium-Sparing | 5,560 | $111,565 | 1.3% | 0.3% |
| 124-Diuretics, Thiazides & related | 7,096 | $73,832 | 1.7% | 0.2% |
| 050-Cardiac, Alpha-Beta Blockers | 482 | $29,098 | 0.1% | 0.1% |
| 058-Analg/Antipyr, Salicylates | 166 | $4,542 | 0.0% | 0.0% |
| 041-Coag, Anticoag, Hemostatics | 1 | $803 | 0.0% | 0.0% |
| 125-Diuretics, Carb Anhydrase Inhib | 38 | $741 | 0.0% | 0.0% |
| .-Missing | 2 | $29 | 0.0% | 0.0% |
| Grand Total | 415,720 | $37,257,860 | 100.0% | 100.0% |

# CAD Non-related Drug Costs, Post-revascularization Episode

| Therapeutic Class | N | Amount | % of N | % of Amount |
|---|---|---|---|---|
| 162-Gastrointestinal Drugs Misc, NEC | 27,430 | $5,420,840 | 7.6% | 16.8% |
| 174-Antidiabetic Agents, Misc | 29,479 | $3,786,670 | 8.2% | 11.8% |
| 069-Psychother, Antidepressants | 28,143 | $2,612,423 | 7.8% | 8.1% |
| 172-Antidiabetic Agents, Insulin | 12,681 | $1,969,756 | 3.5% | 6.1% |
| 234-Unclassified Agents, NEC | 12,022 | $1,868,317 | 3.3% | 5.8% |
| 060-Anal/Antipyr, Opiate Agonists | 32,755 | $1,483,385 | 9.1% | 4.6% |
| 068-Anticonvulsants, Misc | 5,324 | $1,038,830 | 1.5% | 3.2% |
| 085-Diabetes Mell/Diab Supply, NEC | 7,464 | $898,650 | 2.1% | 2.8% |
| 059-Analg/Antipyr, Nonsteroid/Antiinflan | 11,583 | $810,059 | 3.2% | 2.5% |
| 075-Anxiolytic/Sedative/Hypnotic NEC | 8,219 | $706,998 | 2.3% | 2.2% |
| 173-Antidiabetic Ag, Sulfonylureas | 13,539 | $653,933 | 3.8% | 2.0% |
| 166-Adrenals & Comb, NEC | 7,933 | $645,226 | 2.2% | 2.0% |
| 001-Antihistamines & Comb, NEC | 7,961 | $615,302 | 2.2% | 1.9% |
| 181-Immunosuppressants, NEC | 611 | $481,723 | 0.2% | 1.5% |
| 077-CNS Agents, Misc. | 2,849 | $473,956 | 0.8% | 1.5% |
| 999-Other/unavailable | 7,545 | $424,209 | 2.1% | 1.3% |
| Grand Total | 360,156 | $32,186,649 | 100.0% | 100.0% |

# CAD 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

- "Tiered" attribution model, depending on the number of each episode's CAD-related E&M visits during the measurement period and the distribution of those visits across providers
  - Requires that the episode has at least 1 E&M visit and that at least 70% of the E&M visits include valid provider ID numbers
- Tier 1 – Single Attribution: if one provider ID has at least 70% of an episode's E&M visits, that provider will be attributed the episode
- Tier 2 – "Multiple" Attribution: if no provider has at least 70% of the episode's E&M visits, any provider with at least 30% will be attributed the episode
- Tier 3 – No Attribution: if no provider has at least 30% of the episode's E&M visits, no provider will be attributed the episode

# CAD Post-Revascularization Episode: Attribution Testing

- Required: 1) ≥ 1 E&M visit for CAD care; 2) ≥ 70% of E&M visits with valid provider IDs
- 1 provider with ≥ 70% of E&M visits – single attribution only; else
- 1+ providers with ≥ 30% of E&M visits – up to 3 providers attributed episode; else
- No attribution

| **CAD Post-Revascularization Measure Denominator** | **11,078** | **100.0%** |
|---|---|---|
| No related E&M visits during measurement window | 35 | 0.3% |
| Episode's E&M visits have insufficient provider IDs | 6,006 | 54.2% |
| **Episodes to be attributed** | **5,037** | **45.5%** |
| **Single attribution** | **3,382** | **67.1%** |
| **Multiple attribution** | **1,589** | **31.5%** |
| *2 providers* | *1,500* | *29.8%* |
| *3 providers* | *89* | *1.8%* |
| **No attribution** | **66** | **1.3%** |

Note: Among episodes attributed to a single provider, 73% had one provider with at least 70% of the episode's CAD-related E&M visits. In the remaining episodes, the attributed provider had between 30% and 70% of related E&M visits.

# Identifying Variability in CAD-Specific Resource Use

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

# CAD Post-Revascularization: Mean Resource Use by Type of Service, All Episodes*

| Description | Mean | % of Total | 5th % | 25th % | 50th % | 75th % | 95th % |
|---|---|---|---|---|---|---|---|
| Inpatient Facility | $2,525 | 18% | $0 | $0 | $0 | $0 | $14,060 |
| Durable Medical Equipment | $23 | 0% | $0 | $0 | $0 | $0 | $0 |
| OP Facility | $1,535 | 11% | $0 | $0 | $0 | $133 | $9,575 |
| Imaging | $1,136 | 8% | $86 | $368 | $911 | $1,629 | $2,881 |
| Evaluation and Management | $1,119 | 8% | $182 | $426 | $800 | $1,361 | $3,129 |
| Other Services | $329 | 2% | $0 | $0 | $0 | $28 | $1,129 |
| Procedures | $4,408 | 32% | $1,319 | $1,698 | $2,183 | $5,903 | $12,469 |
| Tests | $352 | 3% | $18 | $115 | $245 | $440 | $1,003 |
| Unclassified | $18 | 0% | $0 | $0 | $0 | $0 | $0 |
| Drug Costs | $2,355 | 17% | $222 | $1,578 | $2,404 | $3,092 | $4,328 |
| **Total** | **$13,801** | **100%** | **$4,266** | **$6,565** | **$9,346** | **$15,518** | **$36,147** |

* Analysis limited to those episodes that could be attributed to one or more providers and had non-zero CAD-related costs (n=5,037)

# CAD Post-Revascularization: Resource Use by Type of Service vs. Overall Mean, by Region

| Description | Mean | Northeast | North Central | South | West |
|---|---|---|---|---|---|
| **N** | **5,037** | **280** | **946** | **3,183** | **618** |
| Inpatient Facility | $2,525 | 0.64 | 0.86 | 1.14 | 0.66 |
| DME | $23 | 0.25 | 0.83 | 0.94 | 1.91 |
| OP Facility | $1,535 | 0.76 | 1.09 | 0.95 | 1.22 |
| Imaging | $1,136 | 1.02 | 0.98 | 1.02 | 0.93 |
| E&M | $1,119 | 0.99 | 0.98 | 1.01 | 0.99 |
| Other Services | $329 | 1.07 | 1.04 | 0.96 | 1.12 |
| Procedures | $4,408 | 1.02 | 1.09 | 0.98 | 0.94 |
| Tests | $352 | 1.01 | 0.89 | 1.05 | 0.89 |
| Unclassified | $18 | 0.88 | 0.37 | 1.03 | 1.87 |
| Drug Costs | $2,355 | 1.04 | 1.02 | 0.98 | 1.04 |
| **Total** | **$13,801** | **0.92** | **1.01** | **1.01** | **0.95** |

* Analysis limited to those episodes that could be attributed to one or more providers and had non-zero CAD-related costs (n=5,037)

# CAD Post-Revascularization: Resource Use by Type of Service vs. Overall Mean, by State

| Description | Mean | TX | GA | TN | CA | SC |
|---|---|---|---|---|---|---|
| **N** | **5,037** | **737** | **533** | **429** | **294** | **272** |
| Inpatient Facility | $2,525 | 1.28 | 1.26 | 1.06 | 0.78 | 1.22 |
| DME | $23 | 2.10 | 1.03 | 0.51 | 1.88 | 0.74 |
| OP Facility | $1,535 | 2.24 | 0.20 | 0.57 | 0.28 | 0.46 |
| Imaging | $1,136 | 1.04 | 0.87 | 1.08 | 0.89 | 1.05 |
| E&M | $1,119 | 1.11 | 0.97 | 1.04 | 0.92 | 0.87 |
| Other Services | $329 | 0.77 | 1.37 | 1.19 | 1.01 | 0.85 |
| Procedures | $4,408 | 0.91 | 0.99 | 1.07 | 0.97 | 1.05 |
| Tests | $352 | 1.45 | 0.85 | 0.95 | 0.87 | 0.90 |
| Unclassified | $18 | 0.24 | 3.11 | 0.93 | 3.09 | 0.96 |
| Drug Costs | $2,355 | 0.96 | 0.98 | 0.97 | 1.04 | 0.93 |
| **Total** | **$13,801** | **1.17** | **0.95** | **0.99** | **0.86** | **0.97** |

* Analysis limited to those episodes that could be attributed to one or more providers and had non-zero CAD-related costs (n=5,037)

# CAD Post-Revascularization: Resource Use by Type of Service vs. Overall Mean, by Specialty*

- Results presented for high-volume specialties: Top 5

| Description | Mean | Cardiology | Internal Medicine | Family Practice | Medical Doctor NEC | Multi-specialty Group |
|---|---|---|---|---|---|---|
| **N** | **5,037** | **3,201** | **1,023** | **961** | **435** | **269** |
| Inpatient Facility | $2,525 | 0.91 | 0.96 | 0.95 | 0.88 | 0.67 |
| DME | $23 | 0.62 | 0.76 | 1.55 | 0.36 | 2.09 |
| OP Facility | $1,535 | 1.04 | 0.85 | 0.72 | 0.87 | 0.42 |
| Imaging | $1,136 | 1.04 | 1.02 | 0.90 | 0.86 | 0.82 |
| E&M | $1,119 | 0.97 | 1.04 | 0.99 | 0.92 | 0.96 |
| Other Services | $329 | 1.00 | 0.77 | 0.95 | 0.78 | 1.08 |
| Procedures | $4,408 | 0.97 | 1.01 | 1.07 | 0.97 | 0.93 |
| Tests | $352 | 1.02 | 1.02 | 0.95 | 0.85 | 0.94 |
| Unclassified | $18 | 1.04 | 1.00 | 0.72 | 0.53 | 1.68 |
| Drug Costs | $2,355 | 1.02 | 0.94 | 0.99 | 1.01 | 0.99 |
| **Total** | **$13,801** | **0.98** | **0.97** | **0.97** | **0.93** | **0.84** |

* Individual episodes may be attributed to as many as three providers, and so the resource use associated with any given episode may be reflected in the results for up to three provider specialties

# 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

# CAD Episode Risk Adjustment Matrix

| 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 |

# Example CAD Episode Report

**CAD Revascularization Episode**

**Report for Physician #170632708**

Provider type = Cardiology

| | MD | Peer Group | Non-Peer Group | National Avg |
|---|---|---|---|---|
| Episodes | 12 | 3,189 | 8,179 | 11,380 |
| Observed Costs* | | | | |
| Average | $ 16,740 | $ 13,142 | $ 13,372 | $ 13,311 |
| Min | $ 4,380 | $ 3,276 | $ 3,276 | $ 3,276 |
| Median | $ 16,724 | $ 9,513 | $ 9,444 | $ 9,465 |
| Max | $ 29,481 | $ 56,815 | $ 56,815 | $ 56,815 |
| Predicted Costs | | | | |
| Average | $ 12,944 | $ 13,312 | $ 13,322 | $ 13,319 |
| Min | $ 12,303 | $ 12,303 | $ (1,313) | $ (1,313) |
| Median | $ 12,303 | $ 12,303 | $ 12,303 | $ 12,303 |
| Max | $ 18,244 | $ 30,282 | $ 41,991 | $ 41,991 |
| Observed-to-Expected Ratio | | | | |
| Average | 1.31 | 0.99 | 1.00 | 1.00 |
| Min | 0.36 | 0.27 | (5.83) | (5.83) |
| Median | 1.23 | 0.72 | 0.72 | 0.72 |
| Max | 2.40 | 4.62 | 11.06 | 11.06 |
| % ≥ 2.0 | 16.7% | 8.7% | 10.0% | 10.3% |
| % ≥ 2.5 | 0% | 5.5% | 6.1% | 7.1% |
| % ≥ 75th percentile peers | 50.0% | (21.1%, 78.9%) | | |

* Observed costs adjusted for outliers (windsorized)

Notes:
- Use Model 12
- Includes all episodes

# Example CAD Episode Report

**CAD Revascularization Episode**

**Report for Physician #170632708**

Provider type = Cardiology

| | MD | Peer Group | Non-Peer Group | National Avg |
|---|---|---|---|---|
| Episodes | 12 | 3,189 | 8,179 | 11,380 |
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| Min | $ 4,380 | $ 3,276 | $ 3,276 | $ 3,276 |
| Median | $ 16,724 | $ 9,513 | $ 9,444 | $ 9,465 |
| Max | $ 29,481 | $ 56,815 | $ 56,815 | $ 56,815 |
| Predicted Costs | | | | |
| Average | $ 12,944 | $ 13,312 | $ 13,322 | $ 13,319 |
| Min | $ 12,303 | $ 12,303 | $ (1,313) | $ (1,313) |
| Median | $ 12,303 | $ 12,303 | $ 12,303 | $ 12,303 |
| Max | $ 18,244 | $ 30,282 | $ 41,991 | $ 41,991 |
| Observed-to-Expected Ratio | | | | |
| Average | 1.31 | 0.99 | 1.00 | 1.00 |
| Min | 0.36 | 0.27 | (5.83) | (5.83) |
| Median | 1.23 | 0.72 | 0.72 | 0.72 |
| Max | 2.40 | 4.62 | 11.06 | 11.06 |
| % ≥ 2.0 | 16.7% | 8.7% | 10.0% | 10.3% |
| % ≥ 2.5 | 0% | 5.5% | 6.1% | 7.1% |
| % ≥ 75th percentile peers | 50.0% | (21.1%, 78.9%) | | |

* Observed costs adjusted for outliers (windsorized)

Notes:
- Use Model 12
- Includes all episodes