

2015 Procedure-Specific Readmission Measures Updates and Specifications Report

Elective Primary Total Hip Arthroplasty (THA) and/or Total Knee Arthroplasty (TKA) – Version 4.0

Isolated Coronary Artery Bypass Graft (CABG) Surgery – Version 2.0

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1. HOW TO USE THIS REPORT

This report describes the Centers for Medicare & Medicaid Services' (CMS) procedure-specific readmission measures publicly reported on [*Hospital Compare*](#), the hospital-level 30-day risk-standardized readmission rates (RSRRs) following elective primary total hip arthroplasty (THA) and/or total knee arthroplasty (TKA) procedures, and following isolated coronary artery bypass graft (CABG) surgery. This report serves as a single source of information about these measures for a wide range of readers. Reports describing condition-specific readmission and mortality measures (acute myocardial infarction [AMI], heart failure [HF], pneumonia, chronic obstructive pulmonary disease [COPD], and stroke), hospital-wide readmissions, other procedure-specific outcome measures (hip/knee arthroplasty complications, as well as coronary artery bypass graft [CABG] surgery mortality), and 30-day episode-of-care payment measures for AMI, HF, and pneumonia can all be found on [*QualityNet*](#).

This report provides an overview of the measure methodology, methodology updates for 2015 public reporting, and the national results for 2015 public reporting. The appendices provide detailed specifications for each measure, including concise tables of the condition codes used for cohort derivation, risk adjustment, and a history of annual updates.

Specifically, the report includes:

- **Section 2 - An overview of the THA/TKA and CABG readmission measures:**
 - Background
 - Cohort inclusions and exclusions
 - included and excluded hospitalizations
 - how transferred patients are handled
 - differences in how the THA/TKA measure scores are calculated for the Hospital Inpatient Quality Reporting program and the Hospital Readmissions Reduction Program (HRRP) (Section 3025 of the Affordable Care Act)
 - Unplanned readmission outcome
 - Risk-adjustment variables
 - Data sources
 - Readmission rate calculation
 - Categorization of hospitals' performance score
- **Section 3 - 2015 measure updates:**
 - No updates were made to the specifications of the THA/TKA and CABG readmission measures for 2015.
- **Section 4 - 2015 measure results:**
 - Results from the THA/TKA model used for the Hospital Inpatient Quality Reporting program and the CABG model used for public reporting in 2015.

- **Section 5 - Glossary**

The Appendices contain detailed measure information, including:

- [Appendix A](#): Statistical approach to calculating RSRRs;
- [Appendix B](#): Data quality assurance;
- [Appendix C](#): Annual updates to measures since measure development;
- [Appendix D](#): Measure specifications; and
- [Appendix E](#): Detailed overview of the planned readmission algorithm.

For additional references, the original measure methodology reports, as well as prior updates and specifications reports, are available in the Measure Methodology and Archived Resources sections under the procedure-based readmission measures page of [QualityNet](#):

- Hospital-Level 30-Day All Cause Risk-Standardized Readmission Rate Following Elective Primary Total Hip Arthroplasty (THA) and/or Total Knee Arthroplasty (TKA): Measure Methodology Report (2012)¹
- 2013 Measure Updates and Specifications: Elective Primary Total Hip Arthroplasty (THA) and/or Total Knee Arthroplasty All-Cause Unplanned 30-Day Risk-Standardized Readmission Measure²
- 2014 Procedure-Specific Readmission Measure Updates and Specifications Report: Elective Primary Total Hip Arthroplasty (THA) and/or Total Knee Arthroplasty (TKA) – Version 3.0³
- Hospital-Level 30-Day All-Cause Unplanned Readmission Following Coronary Artery Bypass Graft Surgery Measure Technical Report (2014)⁴

2. BACKGROUND AND OVERVIEW OF MEASURE METHODOLOGY

2.1 Background on Readmission Measures

In December 2013, CMS began publicly reporting hospital 30-day RSRRs for THA/TKA for the nation's non-federal short-term acute care hospitals (including Indian Health Services hospitals) and critical access hospitals.

In 2015, CMS plans to report an additional readmission measure: Hospital 30-Day Coronary Artery Bypass Graft (CABG) Surgery Readmission Measure. This measure includes admissions to non-federal short-term acute care and critical access hospitals.

The readmission measures complement the elective primary THA/TKA complication and the CABG mortality measures. Results for these two readmission measures are posted on [Hospital Compare](#), which CMS updates annually.

CMS contracted with the Yale-New Haven Health Services Corporation/Center for Outcomes Research & Evaluation (CORE) to update the 30-day THA/TKA and CABG readmission measures for 2015 public reporting through a process of measure reevaluation. Measures are reevaluated annually to improve them by responding to stakeholder input and incorporating advances in science or changes in coding.

2.2 Overview of Measure Methodology

The 2015 risk-adjusted readmission measures use specifications from the initial measure methodology reports with slight refinements to the measures, as listed in [Appendix C](#) and described in the prior measure updates and specifications reports.¹⁻⁴ The National Quality Forum (NQF) endorsed the THA/TKA and CABG readmission measures in 2012 and 2014, respectively. An overview of the methodology is presented in this section.

The methodology for the Hospital Inpatient Quality Reporting THA/TKA readmission measure described in this report is the same that will be used to calculate excess readmissions for HRRP, Section 3025 of the Affordable Care Act, with certain differences in the measure cohorts application, as noted in [Section 2.2.1](#). These differences may make individual hospitals' results for the two programs slightly different.

2.2.1 Cohort

Index Admissions Included in the Measure

An index admission is the hospitalization to which the readmission outcome is attributed and includes admissions for patients:

- Having a qualifying elective primary THA/TKA procedure or isolated CABG surgery during the index admission;
- Enrolled in Medicare fee-for-service (FFS);
- Aged 65 or over;
- Discharged alive from a non-federal acute care hospital;
- Enrolled in Part A and Part B Medicare for the 12 months prior to the date of admission; and enrolled in Part A during the index admission.

Elective primary THA/TKA procedures are defined as those procedures *without* any of the following:

- Femur, hip, or pelvic fractures coded in principal or secondary discharge diagnosis fields of the index admission;
- Partial hip arthroplasty (PHA) procedures with a concurrent THA/TKA;
- Revision procedures with a concurrent THA/TKA;
- Resurfacing procedures with a concurrent THA/TKA;
- Mechanical complication coded in the principal discharge diagnosis field;
- Malignant neoplasm of the pelvis, sacrum, coccyx, lower limbs, or bone/bone marrow or a disseminated malignant neoplasm coded in the principal discharge diagnosis field;
- Removal of implanted devices/prostheses; or
- Transfer from another acute care facility for the THA/TKA

Isolated CABG surgeries are defined as those procedures performed *without* the following concomitant valve or other major cardiac, vascular, or thoracic procedures:

- Valve procedures;
- Atrial and/or ventricular septal defects;
- Congenital anomalies;
- Other open cardiac procedures;
- Heart transplants;
- Aorta or other non-cardiac arterial bypass procedures; or
- Head, neck, intracranial vascular procedures

International Classification of Diseases, 9th Revision, Clinical Modification (ICD-9-CM) codes used to define the cohort for each measure are listed in Appendix D.

Index Admissions Excluded from the Measures

The readmission measures exclude index admissions for patients:

- Without at least 30 days post-discharge enrollment in FFS Medicare; or,
- Discharged against medical advice (AMA).

Additional exclusion criteria for the THA/TKA cohort are that patients admitted for the index procedure and subsequently transferred to another acute care facility are not included in the cohort; patients with more than two THA/TKA procedure codes during the index hospitalization are also not included in the cohort.

An additional exclusion criterion for the CABG cohort is that patients with subsequent qualifying CABG procedures during the measurement period are not included as an index admission.

As a part of data processing prior to the measure calculation, records are removed for non-short-term acute care facilities such as psychiatric facilities, rehabilitation facilities, or long-term care hospitals. Additional data cleaning steps include removing claims with stays longer than one year, claims with overlapping dates, and records for providers with invalid provider IDs.

Finally, admissions within 30 days of discharge from an index admission are not considered index admissions. Thus, no hospitalization will be counted as both a readmission and an index admission within the same measure. However, because the cohorts for the readmission measures are determined independently of each other, a readmission in one measure may qualify as an index admission in the other CMS measures.

The number of admissions excluded based on each criterion is shown in [Section 4](#) in [Figure 4.2.1](#) and [Figure 4.3.1](#) for THA/TKA and CABG, respectively.

Patients Transferred Between Hospitals

The measures consider multiple contiguous hospitalizations as a single acute episode of care. Admissions to a hospital within one day of discharge from another hospital are considered transfers, whether or not the first institution indicates intent to transfer the patient in the discharge disposition code.

The THA/TKA readmission measure excludes admissions with transfers between acute care hospitals where the index procedure is performed at the receiving hospital. THA/TKA procedures that follow transfers between acute care hospitals are not likely to be elective. The measure also excludes admissions with transfers between acute care hospitals where the index procedure is performed at the transferring hospital. In these cases, attribution of the outcome to the appropriate hospital is difficult.

In contrast, admissions associated with transfers between acute care hospitals are not excluded from the CABG readmission measure. Transfer to another acute care facility after CABG surgery is most likely due to a complication of the CABG procedure or the peri-operative care the patient received, and as such, the care provided by the hospital performing the CABG procedure likely dominates readmission risk, even among transferred patients. However, the readmission outcome is always attributed to the hospital (in a series of one or more transfers) that performed the first (index) CABG procedure.

Hospital Readmissions Reduction Program (HRRP)

CMS uses the THA/TKA readmission measure in HRRP. The CABG readmission measure will be added to HRRP for FY 2017. HRRP includes only Subsection (d) hospitals and hospitals located in Maryland. Critical access hospitals, cancer hospitals, and hospitals in U.S. territories will not be included. Admissions to such hospitals will not be included as index admissions nor counted as readmissions. Because the set of hospitals among which these measures are calculated for HRRP differs from those used in calculations for the Hospital Inpatient Quality Reporting Program, hospital scores may differ.

Note: Subsection (d) hospitals encompass any acute care hospital located in one of the fifty states or the District of Columbia which does not meet any of the following exclusion criteria as defined by the Social Security Act: psychiatric, rehabilitation, children's, or long-term care hospitals, and cancer specialty centers. By definition, all other hospitals are considered Subsection (d) hospitals.

More information about HRRP can be found on *QualityNet's Hospital Readmissions Reduction Program* webpage and in the FY 2013, FY 2014, and FY 2015 IPPS *Final Rules* on the CMS website.

2.2.2 Outcome

All-Cause Unplanned Readmissions

The measures count all unplanned readmissions and are designed to capture readmissions that arise from acute clinical events requiring urgent rehospitalization within 30 days of discharge. Only an unplanned inpatient admission to a short-term acute care hospital can qualify as a readmission. Planned readmissions, which are generally not a signal of quality of care, are not counted. For more detail about how planned readmissions are defined, refer to Section 2.2.3 and Appendix E.

There are a number of reasons for counting unplanned readmissions for all causes in the CMS readmission measures. First, from a patient perspective, an unplanned readmission for any cause is an adverse event. In addition, making inferences about quality issues and accountability based solely on the documented cause of readmission is difficult. For example, a patient might experience a procedure-related complication following his/her THA/TKA, which may go untreated and result in renal failure following discharge. The resulting readmission for renal failure could have been prevented with high quality of care during the admission for the THA/TKA.

30-Day Time Frame

The readmission measures assess unplanned readmissions within a 30-day period from the date of discharge from an index admission. This standard time period is necessary so that the outcome for each patient is measured uniformly. The measures use a 30-day time frame because outcomes occurring within 30 days of discharge can be influenced by hospital care and the early transition to the outpatient setting. The use of the 30-day time frame is a clinically meaningful period for hospitals to collaborate with their communities in an effort to reduce readmissions.⁵

Multiple Readmissions

If a patient has more than one unplanned admission within 30 days of discharge from the index admission, only the first is counted as a readmission. The measures look for a dichotomous yes or no outcome of whether each admitted patient has an unplanned readmission within 30 days. However, if the first readmission after discharge is planned, any subsequent unplanned readmission is not counted as an outcome for that index admission because the unplanned readmission could be related to care provided during the intervening planned readmission rather than during the index admission.

2.2.3 Planned Readmission Algorithm (Version 3.0)

The planned readmission algorithm is a set of criteria for classifying readmissions as planned among the general Medicare population using Medicare administrative claims data. The algorithm identifies admissions that are typically planned and may occur within 30 days of discharge from the hospital.

The planned readmission algorithm has three fundamental principles:

1. A few specific, limited types of care are always considered planned (e.g., transplant surgery, maintenance chemotherapy/immunotherapy, rehabilitation);
2. Otherwise, a planned readmission is defined as a non-acute readmission for a scheduled procedure; and
3. Admissions for acute illness or for complications of care are never planned.

The algorithm was developed in 2011 as part of the Hospital-Wide Readmission measure. In 2013, CMS applied the algorithm to its other readmission measures. The planned readmission algorithm replaced the definition of planned readmissions in the original THA/TKA measure because the algorithm uses a more comprehensive definition. In applying the algorithm to condition- and procedure-specific measures, teams of clinical experts reviewed the algorithm in the context of each measure-specific patient cohort and, where clinically indicated, adapted the content of the algorithm to better reflect the likely clinical experience of each measure's patient cohort. The THA/TKA and CABG readmission measures make a few modifications to the planned readmission algorithm, which are listed in [Appendix E](#).

The planned readmission algorithm uses a flowchart and four tables of specific [procedure categories](#) and discharge diagnosis categories to classify readmissions as

planned ([Appendix E](#)). As [Figure PR.1](#) illustrates, readmissions are considered planned if any of the following occurs during the readmission:

1. A procedure is performed that is in one of the procedure categories that are always planned regardless of diagnosis;
2. The principal diagnosis is in one of the diagnosis categories that are always planned; or
3. A procedure is performed that is in one of the potentially planned procedure categories and the principal diagnosis is not in the list of acute discharge diagnoses.

2.2.4 Risk-Adjustment Variables

In order to perform comparisons of performance between hospitals, the measures adjust for variables (e.g., age, comorbid diseases, and indicators of patient frailty) that are clinically relevant and have strong relationships with the outcome. For each patient, [risk-adjustment variables](#) are obtained from inpatient, outpatient, and provider Medicare administrative claims data extending 12 months prior to, and including, the index admission.

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

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

The measures also do not adjust for socioeconomic status (SES) because the association between SES and health outcomes can be due, in part, to differences in the quality of healthcare patients with varying SES receive. The intent is for the measures to adjust for patient demographic and clinical characteristics while illuminating important quality differences. Additionally, recent analyses show that hospitals caring for high proportions of low SES patients perform similarly on the measures to hospitals caring for low proportions of low SES patients.⁶

Refer to [Table D.1.9](#) and [Table D.2.2](#) in [Appendix D](#) of this report for the list of comorbidity risk-adjustment variables, and [Table D.1.10](#) and [Table D.2.3](#) for the list of complications that are excluded from risk adjustment if occurring during the index admission for THA/TKA and CABG, respectively.

2.2.5 Data Sources

The data sources for these analyses are Medicare administrative claims data and enrollment information for patients with hospitalizations between July 1, 2011 and June 30, 2014. The period for public reporting of the THA/TKA readmission measure differs from the complementary THA/TKA complication measure, which includes admissions for elective THA/TKA between April 1, 2011 and March 31, 2014, due to the longer period of outcome assessment required to adequately capture complications up to 90 days following admission.

The datasets for both readmission measures also contain associated inpatient, outpatient, and provider Medicare administrative claims for the 12 months prior to the index admission and one month subsequent to the index admission for patients admitted in this time period. See the original methodology reports for further descriptions of these data sources and an explanation of the three-year measurement period.^{1,4}

2.2.6 Measure Calculation

The measures estimates hospital-level 30-day all-cause RSRRs following each procedure using hierarchical logistic regression models. In brief, the approach simultaneously models data at the patient and hospital levels to account for the variance in patient outcomes within and between hospitals.⁷ At the patient level, it models the log-odds of hospital readmission within 30 days of discharge using age, sex, selected clinical covariates, and a hospital-specific intercept. At the hospital level, the approach models the hospital-specific intercepts as arising from a normal distribution. The hospital intercept represents the underlying risk of a readmission at the hospital, after accounting for patient risk. The hospital-specific intercepts are given a distribution to account for the clustering (non-independence) of patients within the same hospital.⁷ If there were no differences among hospitals, then after adjusting for patient risk, the hospital intercepts should be identical across all hospitals.

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

The “predicted” number of readmissions (the numerator) is calculated using the coefficients estimated by regressing the risk factors (Table D.1.9 and Table D.2.2 for the THA/TKA and CABG measures, respectively) and the hospital-specific intercept on the risk of readmission. The estimated hospital-specific intercept is added to the sum of the

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

This calculation transforms the ratio of predicted over expected into a rate that is compared to the national observed readmission rate. The hierarchical logistic regression models are described fully in [Appendix A](#) and in the original methodology reports.^{1,4}

2.2.7 Categorizing Hospital Performance

To categorize hospital performance, CMS estimates each hospital’s RSRR and the corresponding 95% interval estimate. CMS assigns hospitals to a performance category by comparing each hospital’s RSRR interval estimate to the national observed readmission rate. Comparative performance for hospitals with 25 or more eligible cases is classified as follows:

- “No different than U.S. national rate” if the 95% interval estimate surrounding the hospital’s rate includes the national observed readmission rate.
- “Worse than U.S. national rate” if the entire 95% interval estimate surrounding the hospital’s rate is higher than the national observed readmission rate.
- “Better than U.S. national rate” if the entire 95% interval estimate surrounding the hospital’s rate is lower than the national observed readmission rate.

If a hospital has fewer than 25 eligible cases for a measure, CMS assigns the hospital to a separate category: “The number of cases is too small (fewer than 25) to reliably tell how well the hospital is performing.” If a hospital has fewer than 25 eligible cases, the hospital’s readmission rates and interval estimates will not be publicly reported for the measure.

[Section 4](#) describes the distribution of hospitals by performance category in the U.S. for this reporting period.

3. UPDATES TO MEASURES FOR 2015 PUBLIC REPORTING

3.1 Rationale for Measure Updates

Measure reevaluation ensures that the risk-standardized readmission models are continually assessed and remain valid, given possible changes in clinical practice and coding standards over time, while allowing for model refinements. Annual measure reevaluation is informed by review of the most recent literature related to measure conditions or outcomes, feedback from various stakeholders, and an assessment of coding trends that reveal shifts in clinical practice or billing patterns. As this report describes, for 2015 public reporting, we undertook the following measure reevaluation activities:

- Updated the Agency for Healthcare Research & Quality (AHRQ) Clinical Classifications Software (CCS) to the 2014 version;
- Validated the performance of each procedure-specific model and its corresponding risk-adjustment variables in three recent one-year time periods (July 2011-June 2012, July 2012-June 2013, and July 2013-June 2014);
- Evaluated and validated model performance for the three years combined (July 2011-June 2014); and
- Updated the measures' SAS analytic package and documentation.

No methodological changes to the measures were made for 2015 public reporting.

The Condition Category Groups (CC) of ICD-9-CM codes were not updated this year due to the upcoming transition to International Statistical Classification of Diseases and Related Health Problems 10th Revision (ICD-10).

3.2 Changes to SAS Analytic Package (SAS Pack)

We made minor refinements to the measure calculation SAS analytic package. The new SAS analytic packages and documentation are available upon request by emailing cmsreadmissionmeasures@yale.edu. **Do NOT submit patient-identifiable information (e.g., date of birth, Social Security number, health insurance claim number, etc.) to this address.**

The SAS analytic packages describe the data files and data elements that feed the model software. Please be aware that CMS does not provide training and technical support for the software. CMS has made the SAS pack available to be completely transparent regarding the measure calculation methodology. However, note that even with the SAS pack it is not possible to replicate the risk-standardized readmission rate calculation without the data files which contain longitudinal patient data from the entire national sample of acute care hospitals to estimate the individual hospital-specific effects, the average hospital-specific effect, and the risk-adjustment coefficients used in the equations.

4. RESULTS FOR 2015 PUBLIC REPORTING

4.1 Assessment of Updated Models

The procedure-specific readmission measures estimate hospital-specific 30-day all-cause RSRRs using hierarchical logistic regression models. See [Section 2](#) for a summary of the measure methodology and model risk-adjustment variables. Refer to prior methodology and technical reports for further details.^{1,4}

We evaluated the performance of the models using the July 2011 to June 2014 data for 2015 reporting. We examined differences in the frequency of patient risk factors and the model variable coefficients.

For each of the procedures, we assessed logistic regression model performance in terms of discriminant ability for each year of data and for the three-year combined period. We computed two summary statistics to assess model performance: the predictive ability and the area under the receiver operating characteristic (ROC) curve (c-statistic). The c-statistic is an indicator of the model's discriminant ability or ability to correctly classify those who have and have not been readmitted within 30 days of discharge. Potential values range from 0.5, meaning no better than chance, to 1.0, meaning perfect discrimination. A c-statistic of 1.0 indicates perfect prediction, implying patients' outcomes can be predicted completely by their risk factors, and physicians and hospitals play no role in patients' outcomes.

The results of these analyses for the THA/TKA and CABG readmission measures are presented in [Section 4.2](#) and [Section 4.3](#), respectively.

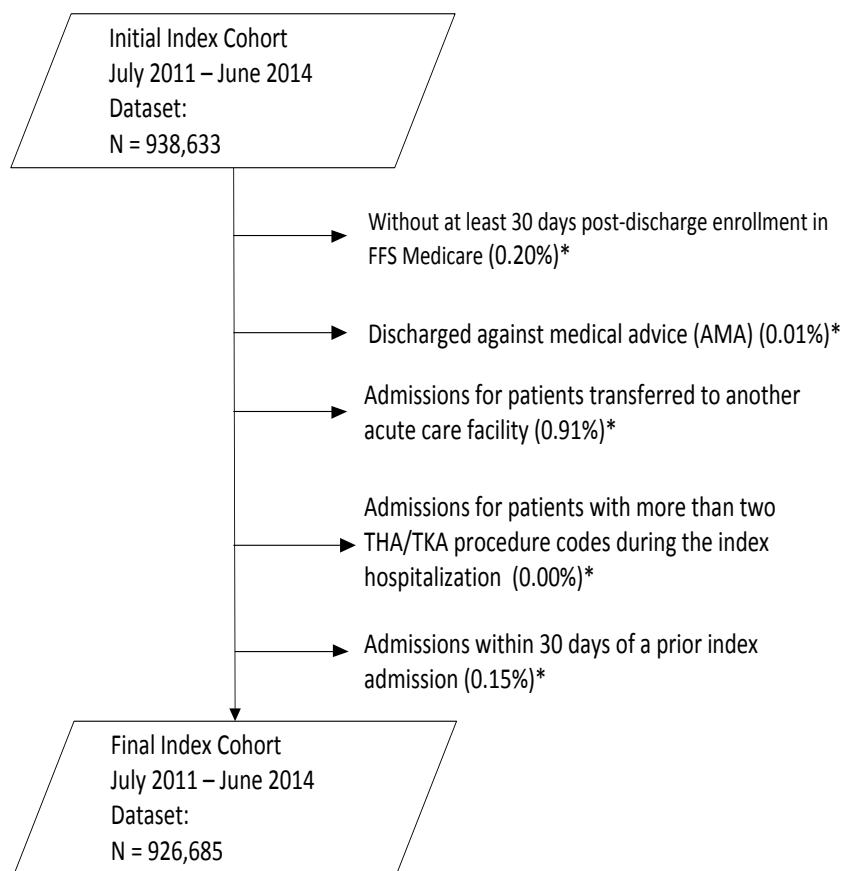
4.2 THA/TKA Readmission 2015 Model Results

4.2.1 Index Cohort Exclusions

The exclusion criteria for the measure are presented in [Section 2.2.1](#). The percentage of THA/TKA patients meeting each exclusion criterion in the July 2011-June 2014 dataset is presented in [Figure 4.2.1](#).

Admissions may have been counted in more than one exclusion category because the categories are not mutually exclusive. The index cohort includes hospitalizations for Medicare FFS patients aged 65 or over with a THA/TKA; enrolled in Part A and Part B Medicare for the 12 months prior to the date of admission, and enrolled in Part A during the index admission; and who were alive at discharge.

Figure 4.2.1 – THA/TKA Cohort Exclusions in the July 2011-June 2014 Dataset



4.2.2 Frequency of THA/TKA Model Variables

We examined the change in both observed readmission rates and frequency of clinical and demographic variables (Table 4.2.1). Between July 2011-June 2012 and July 2013-June 2014, the observed readmission rate decreased from 5.27% to 4.45%.

The frequency of some model variables increased, which may reflect an increased rate of comorbidity in the FFS population, but is also due, in part, to increased coding opportunities on administrative claims. In the 2012 update to the measures, we increased the number of diagnosis and procedure codes to align with version 5010 format changes Department of Health and Human Services (DHHS) required. Hospitals could begin to submit up to 25 diagnosis and procedure codes starting in 2010. Over time, more hospitals submitted more codes, which translated into increased frequencies for some model variables. Notable increases occurred in index admissions with an elective THA procedure

(as compared to an elective TKA procedure) (30.0% to 31.0%), and for morbid obesity (5.4% to 6.3%). Notable decreases occurred in mean age (9.9 to 9.5, calculated as Mean age minus 65), in index admissions with coronary atherosclerosis or angina (28.6% to 26.4%), and for chronic obstructive pulmonary disease (COPD) (14.1% to 13.1%). Refer to [Table 4.2.1](#) for more detail.

4.2.3 THA/TKA Model Parameters and Performance

[Table 4.2.2](#) shows hierarchical regression model coefficients by individual year and for the combined three-year dataset. [Table 4.2.3](#) shows the risk-adjusted odds ratios (ORs) and 95% confidence intervals (CIs) for the THA/TKA readmission model by individual year and for the combined three-year dataset. Overall, the variable effect sizes were relatively constant across years. In addition, model performance was consistent over the three years; the area under the ROC curve (c-statistic) was also stable over the three years ([Table 4.2.4](#)).

4.2.4 Distribution of Hospital Volumes and RSRRs

[Table 4.2.5](#) shows the distribution of hospital admission volumes and [Table 4.2.6](#) shows the distribution of hospital RSRRs. The mean RSRR decreased over the three years, from 5.3% between July 2011 and June 2012 to 4.5% between July 2013 and June 2014. The median hospital RSRR in the combined three-year dataset was 4.8% (Interquartile Range (IQR) 4.6% - 5.2%). [Table 4.2.7](#) shows the between-hospital variance by individual year and for the combined three-year dataset. Between-hospital variance in the combined dataset was 0.054 (Standard Error (SE): 0.004). If there were no systematic differences between hospitals, the between-hospital variance would be 0.

[Figure 4.2.2](#) shows the overall distribution of the hospital RSRRs for the combined dataset. The odds of all-cause readmission if treated at a hospital one standard deviation above the national rate were 1.59 times higher than the odds of all-cause readmission if treated at a hospital one standard deviation below the national rate. If there were no systematic differences between hospitals, the OR would be 1.0.

4.2.5 Distribution of Hospitals by Performance Category in the Three-Year Dataset

Of 3,498 hospitals in the study cohort, 49 performed “better than the U.S. national rate,” 2721 performed “no different from the U.S. national rate,” and 49 performed “worse than the U.S. national rate.” 679 were classified as “number of cases too small” (fewer than 25) to reliably tell how well the hospital is performing.

Table 4.2.1 – Frequency of THA/TKA Model Variables Over Different Time Periods

Variable	07/2011-06/2012	07/2012-06/2013	07/2013-06/2014	07/2011-06/2014
Total N	302,352	306,937	317,396	926,685
Observed readmission rate (%)	5.3	4.9	4.5	4.9
Mean age minus 65 (SD)	9.9 (6.0)	9.7 (6.0)	9.5 (6.0)	9.7 (6.0)
Male (%)	36.4	36.7	37.3	36.8
THA procedure	30.0	30.5	31.0	30.5
Number of procedures (two vs. one)	2.4	2.3	2.3	2.3
History of infection (CC 1, 3-6)	17.9	17.9	17.7	17.9
Metastatic cancer or acute leukemia (CC 7)	0.6	0.6	0.6	0.6
Cancer (CC 8-12)	18.7	18.4	18.4	18.5
Diabetes mellitus (DM) or DM complications (CC 15-20, 119, 120)	29.0	28.7	28.2	28.6
Protein-calorie malnutrition (CC 21)	0.8	0.8	0.7	0.7
Disorders of fluid/electrolyte/acid-base (CC 22-23)	13.0	13.1	13.0	13.0
Rheumatoid arthritis and inflammatory connective tissue disease (CC 38)	9.2	9.3	9.2	9.2
Severe hematological disorders (CC 44)	0.6	0.4	0.4	0.5
Dementia or other specified brain disorders (CC 49-50)	4.4	4.2	4.1	4.2
Major psychiatric disorders (CC 54-56)	4.6	4.6	4.7	4.6
Hemiplegia, paraplegia, paralysis, functional disability (CC 67-69, 100-102, 177-178)	1.7	1.7	1.6	1.7
Polyneuropathy (CC 71)	6.8	7.1	7.3	7.0
Congestive heart failure (CC 80)	9.1	8.6	8.5	8.7
Coronary atherosclerosis or angina (CC 83-84)	28.6	27.3	26.4	27.4
Hypertension (CC 89, 91)	83.3	82.8	82.2	82.8
Specified arrhythmias and other heart rhythm disorders (CC 92-93)	23.9	23.9	24.2	24.0
Stroke (CC 95-96)	2.1	2.1	2.1	2.1
Vascular or circulatory disease (CC 104-106)	22.7	22.2	21.9	22.3
Chronic obstructive pulmonary disease (COPD) (CC 108)	14.1	13.5	13.1	13.5
Pneumonia (CC 111-113)	4.2	4.1	4.1	4.1
Dialysis status (CC 130)	0.2	0.2	0.2	0.2
Renal failure (CC 131)	8.5	8.8	9.1	8.8
Decubitus ulcer or chronic skin ulcer (CC 148-149)	2.5	2.4	2.5	2.5
Cellulitis, local skin infection (CC 152)	7.7	7.6	7.4	7.6
Other injuries (CC 162)	28.3	28.1	27.8	28.0
Major symptoms, abnormalities (CC 166)	51.9	51.3	50.3	51.2
Morbid obesity (ICD-9 code 278.01)	5.4	5.9	6.2	5.8
Other congenital deformity of hip (joint) (ICD-9 code 755.63)	0.2	0.2	0.2	0.2
Post traumatic osteoarthritis (ICD-9 codes 716.15, 716.16)	0.4	0.4	0.4	0.4

Table 4.2.2 – Hierarchical Logistic Regression Model Variable Coefficients for THA/TKA Over Different Time Periods

Variable	07/2011-06/2012	07/2012-06/2013	07/2013-06/2014	07/2011-06/2014
Intercept	-4.055	-4.187	-4.213	-4.138
Age minus 65 (years above 65, continuous)	0.032	0.035	0.036	0.035
Male	0.159	0.164	0.120	0.148
THA procedure	0.088	0.104	0.077	0.091
Number of procedures (two vs. one)	0.311	0.349	0.189	0.295
History of infection (CC 1, 3-6)	0.144	0.061	0.080	0.094
Metastatic cancer or acute leukemia (CC 7)	0.133	0.095	0.096	0.110
Cancer (CC 8-12)	-0.032	-0.019	-0.017	-0.022
Diabetes mellitus (DM) or DM complications (CC 15-20, 119, 120)	0.125	0.146	0.119	0.129
Protein-calorie malnutrition (CC 21)	0.223	0.258	0.296	0.252
Disorders of fluid/electrolyte/acid-base (CC 22-23)	0.121	0.095	0.130	0.113
Rheumatoid arthritis and inflammatory connective tissue disease (CC 38)	0.133	0.153	0.150	0.146
Severe hematological disorders (CC 44)	0.227	0.219	0.492	0.309
Dementia or other specified brain disorders (CC 49-50)	0.142	0.206	0.189	0.177
Major psychiatric disorders (CC 54-56)	0.208	0.274	0.266	0.247
Hemiplegia, paraplegia, paralysis, functional disability (CC 67-69, 100-102, 177-178)	0.157	0.136	0.152	0.152
Polyneuropathy (CC 71)	0.129	0.123	0.165	0.137
Congestive heart failure (CC 80)	0.204	0.190	0.257	0.216
Coronary atherosclerosis or angina (CC 83-84)	0.184	0.169	0.190	0.182
Hypertension (CC 89, 91)	0.230	0.259	0.211	0.231
Specified arrhythmias and other heart rhythm disorders (CC 92-93)	0.163	0.162	0.115	0.147
Stroke (CC 95-96)	0.086	0.159	0.132	0.123
Vascular or circulatory disease (CC 104-106)	0.087	0.154	0.129	0.122
Chronic obstructive pulmonary disease (COPD) (CC 108)	0.263	0.285	0.321	0.288
Pneumonia (CC 111-113)	0.137	0.183	0.109	0.144
Dialysis status (CC 130)	0.735	0.726	0.588	0.677
Renal failure (CC 131)	0.238	0.226	0.257	0.236
Decubitus ulcer or chronic skin ulcer (CC 148-149)	0.166	0.178	0.141	0.160
Cellulitis, local skin infection (CC 152)	0.121	0.123	0.063	0.105
Other injuries (CC 162)	0.116	0.097	0.080	0.099
Major symptoms, abnormalities (CC 166)	0.168	0.159	0.161	0.162
Morbid obesity (ICD-9 code 278.01)	0.328	0.276	0.284	0.291
Other congenital deformity of hip (joint) (ICD-9 code 755.63)	-0.335	-0.181	-0.172	-0.221
Post traumatic osteoarthritis (ICD-9 codes 716.15, 716.16)	0.119	-0.143	0.134	0.038

Table 4.2.3 – Adjusted OR and 95% CIs for the THA/TKA Hierarchical Logistic Regression Model Over Different Time Periods

Variable	07/2011-06/2012 OR (95% CI)	07/2012-06/2013 OR (95% CI)	07/2013-06/2014 OR (95% CI)	07/2011-06/2014 OR (95% CI)
Age minus 65 (years above 65, continuous)	1 (1.03-1.04)	1 (1.03-1.04)	1 (1.03-1.04)	1 (1.03-1.04)
Male	1.2 (1.13-1.21)	1.2 (1.14-1.22)	1.1 (1.09-1.17)	1.2 (1.14-1.18)
THA procedure	1.1 (1.05-1.13)	1.1 (1.07-1.15)	1.1 (1.04-1.12)	1.1 (1.07-1.12)
Number of procedures (two vs. one)	1.4 (1.23-1.51)	1.4 (1.27-1.58)	1.2 (1.07-1.36)	1.3 (1.26-1.43)
History of infection (CC 1, 3-6)	1.2 (1.11-1.2)	1.1 (1.02-1.11)	1.1 (1.04-1.13)	1.1 (1.07-1.13)
Metastatic cancer or acute leukemia (CC 7)	1.1 (0.94-1.38)	1.1 (0.9-1.34)	1.1 (0.9-1.35)	1.1 (1-1.25)
Cancer (CC 8-12)	1 (0.93-1.01)	1 (0.94-1.02)	1 (0.94-1.03)	1 (0.95-1)
Diabetes mellitus (DM) or DM complications (CC 15-20, 119, 120)	1.1 (1.09-1.17)	1.2 (1.11-1.2)	1.1 (1.08-1.17)	1.1 (1.11-1.16)
Protein-calorie malnutrition (CC 21)	1.2 (1.09-1.43)	1.3 (1.13-1.48)	1.3 (1.17-1.55)	1.3 (1.19-1.39)
Disorders of fluid/electrolyte/acid-base (CC 22-23)	1.1 (1.08-1.18)	1.1 (1.05-1.15)	1.1 (1.09-1.19)	1.1 (1.09-1.15)
Rheumatoid arthritis and inflammatory connective tissue disease (CC 38)	1.1 (1.08-1.2)	1.2 (1.11-1.23)	1.2 (1.1-1.23)	1.2 (1.12-1.19)
Severe hematological disorders (CC 44)	1.3 (1.07-1.47)	1.2 (1.02-1.52)	1.6 (1.35-1.98)	1.4 (1.23-1.51)
Dementia or other specified brain disorders (CC 49-50)	1.2 (1.08-1.23)	1.2 (1.15-1.32)	1.2 (1.13-1.3)	1.2 (1.15-1.24)
Major psychiatric disorders (CC 54-56)	1.2 (1.15-1.32)	1.3 (1.23-1.41)	1.3 (1.22-1.4)	1.3 (1.23-1.33)
Hemiplegia, paraplegia, paralysis, functional disability (CC 67-69, 100-102, 177-178)	1.2 (1.06-1.3)	1.1 (1.03-1.27)	1.2 (1.04-1.3)	1.2 (1.09-1.24)
Polyneuropathy (CC 71)	1.1 (1.08-1.2)	1.1 (1.07-1.2)	1.2 (1.11-1.25)	1.1 (1.11-1.18)
Congestive heart failure (CC 80)	1.2 (1.17-1.29)	1.2 (1.15-1.27)	1.3 (1.23-1.36)	1.2 (1.21-1.28)
Coronary atherosclerosis or angina (CC 83-84)	1.2 (1.16-1.25)	1.2 (1.14-1.23)	1.2 (1.16-1.26)	1.2 (1.17-1.23)
Hypertension (CC 89, 91)	1.3 (1.19-1.33)	1.3 (1.23-1.37)	1.2 (1.17-1.3)	1.3 (1.22-1.3)
Specified arrhythmias and other heart rhythm disorders (CC 92-93)	1.2 (1.13-1.22)	1.2 (1.13-1.22)	1.1 (1.08-1.17)	1.2 (1.13-1.18)
Stroke (CC 95-96)	1.1 (0.99-1.2)	1.2 (1.07-1.29)	1.1 (1.03-1.26)	1.1 (1.07-1.19)
Vascular or circulatory disease (CC 104-106)	1.1 (1.05-1.13)	1.2 (1.12-1.21)	1.1 (1.09-1.18)	1.1 (1.1-1.16)
Chronic obstructive pulmonary disease (COPD) (CC 108)	1.3 (1.25-1.36)	1.3 (1.27-1.39)	1.4 (1.32-1.44)	1.3 (1.3-1.37)
Pneumonia (CC 111-113)	1.1 (1.07-1.23)	1.2 (1.12-1.29)	1.1 (1.04-1.2)	1.2 (1.11-1.2)
Dialysis status (CC 130)	2.1 (1.66-2.62)	2.1 (1.63-2.63)	1.8 (1.42-2.28)	2 (1.72-2.25)
Renal failure (CC 131)	1.3 (1.21-1.33)	1.3 (1.19-1.32)	1.3 (1.23-1.36)	1.3 (1.23-1.3)
Decubitus ulcer or chronic skin ulcer (CC 148-149)	1.2 (1.09-1.28)	1.2 (1.1-1.3)	1.2 (1.05-1.26)	1.2 (1.12-1.23)
Cellulitis, local skin infection (CC 152)	1.1 (1.07-1.19)	1.1 (1.07-1.2)	1.1 (1-1.13)	1.1 (1.07-1.15)
Other injuries (CC 162)	1.1 (1.08-1.16)	1.1 (1.06-1.14)	1.1 (1.04-1.13)	1.1 (1.08-1.13)
Major symptoms, abnormalities (CC 166)	1.2 (1.14-1.23)	1.2 (1.13-1.22)	1.2 (1.13-1.22)	1.2 (1.15-1.2)
Morbid obesity (ICD-9 code 278.01)	1.4 (1.3-1.48)	1.3 (1.24-1.41)	1.3 (1.25-1.42)	1.3 (1.29-1.39)
Other congenital deformity of hip (joint) (ICD-9 code 755.63)	0.7 (0.44-1.15)	0.8 (0.56-1.25)	0.8 (0.55-1.28)	0.8 (0.62-1.03)
Post traumatic osteoarthritis (ICD-9 codes 716.15, 716.16)	1.1 (0.89-1.43)	0.9 (0.66-1.14)	1.1 (0.88-1.48)	1 (0.9-1.2)

Table 4.2.4 – THA/TKA Generalized Linear Modeling (Logistic Regression) Performance Over Different Time Periods

Characteristic	07/2011-06/2012	07/2012-06/2013	07/2013-06/2014	07/2011-06/2014
Predictive ability, % (lowest decile – highest decile)	2.1 – 11.6	1.7 – 11.0	1.8 – 10.4	1.8 – 10.9
c-statistic	0.65	0.65	0.66	0.65

Table 4.2.5 – Distribution of Hospital THA/TKA Admission Volumes Over Different Time Periods

Characteristic	07/2011-06/2012	07/2012-06/2013	07/2013-06/2014	07/2011-06/2014
Number of hospitals	3,348	3,331	3,307	3,498
Mean number of admissions (SD)	90.3 (123.8)	92.1 (127.9)	96 (133.2)	264.9 (376.4)
Range (min. – max.)	1 – 2,291	1 – 2,408	1 – 2,549	1 – 7,248
25 th percentile	14	15	15	38
50 th percentile	48	47	49	131
75 th percentile	120.5	122	128	356

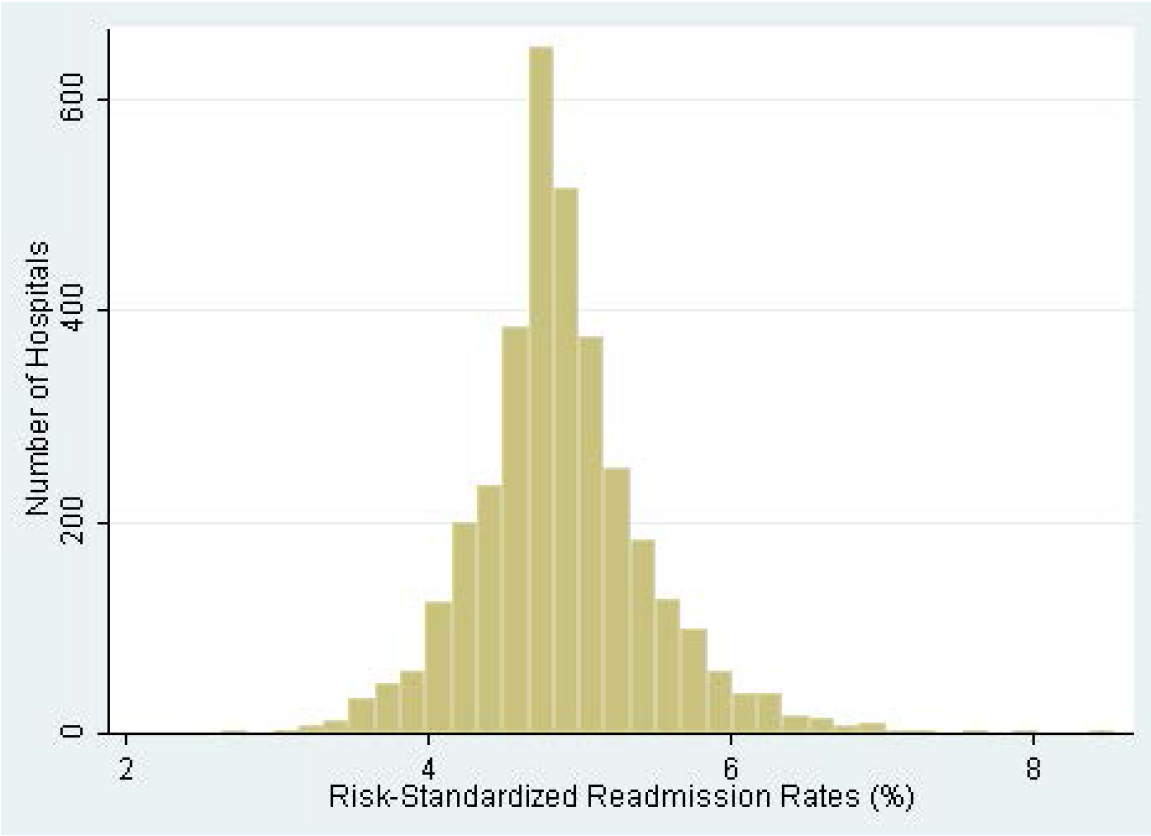
Table 4.2.6 – Distribution of Hospital THA/TKA RSRRs Over Different Time Periods

Characteristic	07/2011-06/2012	07/2012-06/2013	07/2013-06/2014	07/2011-06/2014
Number of hospitals	3,348	3,331	3,307	3,498
Mean (SD)	5.3 (0.4)	4.9% (0.5)	4.5 (0.4)	4.9 (0.6)
Range (min. – max.)	3.6 – 7.6	2.9% – 7.3	2.8 – 6.4	2.6 – 8.5
25 th percentile	5.1	4.6	4.3	4.6
50 th percentile	5.2	4.8	4.4	4.8
75 th percentile	5.5	5.1	4.6	5.2

Table 4.2.7 – Between-Hospital Variance for THA/TKA

	07/2011-06/2012	07/2012-06/2013	07/2013-06/2014	07/2011-06/2014
Between-hospital variance (SE)	0.050 (0.006)	0.059 (0.007)	0.054 (0.007)	0.054 (0.004)

Figure 4.2.2 – Distribution of Hospital 30-Day THA/TKA RSRRs Between July 2011 and June 2014



N= 3,498 hospitals

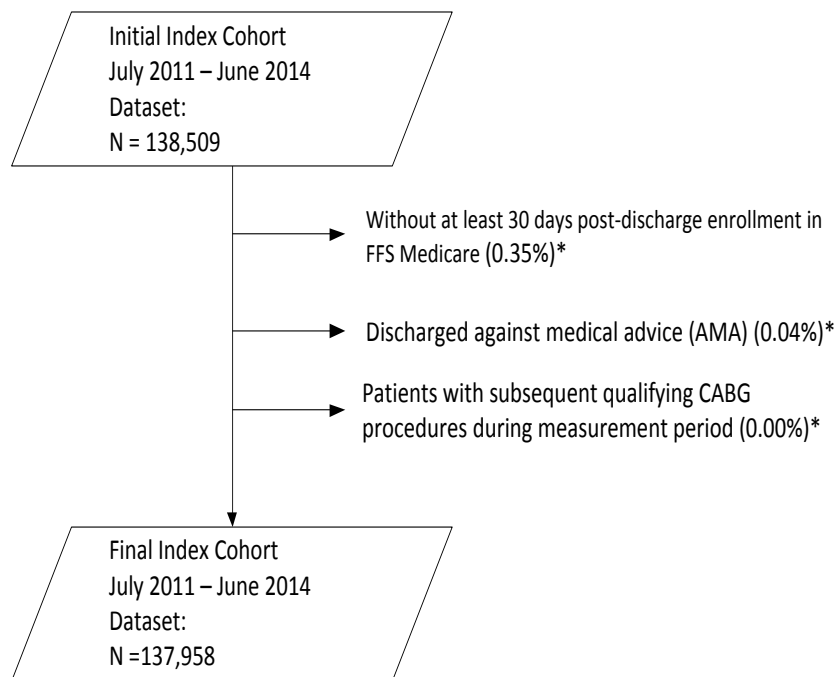
4.3 CABG Readmission 2015 Model Results

4.3.1 Index Cohort Exclusions

The exclusion criteria for the measure are presented in [Section 2.2.1](#). The percentage of CABG patients meeting each exclusion criterion in the July 2011-June 2014 dataset is presented in [Figure 4.3.1](#).

Admissions may have been counted in more than one exclusion category because the categories are not mutually exclusive. The index cohort includes hospitalizations for Medicare FFS patients aged 65 or over with a CABG; enrolled in Part A and Part B Medicare for the 12 months prior to the date of admission, and enrolled in Part A during the index admission; and were alive at discharge.

Figure 4.3.1 – CABG Cohort Exclusions in the July 2011-June 2014 Dataset



4.3.2 Frequency of CABG Model Variables

We examined the change in both observed readmission rates and frequency of clinical and demographic variables ([Table 4.3.1](#)). Between July 2011-June 2012 and July 2013-June 2014, the observed readmission rate decreased from 15.7% to 14.1%.

The frequency of some model variables increased, which may reflect an increased rate of comorbidity in the FFS population, but is also due, in part, to increased coding opportunities on administrative claims. In the 2012 update to the measures, we increased the number of diagnosis and procedure codes to align with version 5010 format changes DHHS required. Hospitals could begin to submit up to 25 diagnosis and procedure codes starting in 2010. Over time, more hospitals submitted more codes, which translated into increased frequencies for some model variables. Notable increases occurred in index admissions with diabetes mellitus (DM) and DM complications (49.5% to 51.0%), polyneuropathy (9.8% to 11.3%), specified arrhythmias and other heart rhythm disorders (29.1% to 30.2%), and renal failure (16.3% to 17.8%). Notable decreases occurred in index admissions with COPD (27.0% to 25.8%) and cerebrovascular disease (29.4% to 28.1%). Refer to [Table 4.3.1](#) for more detail.

4.3.3 CABG Model Parameters and Performance

[Table 4.3.2](#) shows model variable coefficients by individual year and for the combined three-year dataset. [Table 4.3.3](#) shows the risk-adjusted odds ratios (ORs) and 95% CIs for the CABG readmission model by individual year and for the combined three-year dataset. Overall, the variable effect sizes were relatively constant across years. In addition, model performance was consistent over the three years; the area under the ROC curve (c-statistic) remained stable over the three-year period. ([Table 4.3.4](#)).

4.3.4 Distribution of Hospital Volumes and RSRRs

[Table 4.3.5](#) shows the distribution of hospital admission volumes and [Table 4.3.6](#) shows the distribution of hospital RSRRs. The mean RSRR decreased over the three-year period, from 15.7% between July 2011 and June 2012 to 14.1% between July 2013 and June 2014. The median hospital RSRR in the combined three-year dataset was 14.9% (IQR 14.2% - 15.7%). [Table 4.3.7](#) shows the between-hospital variance by individual year and for the combined three-year dataset. Between-hospital variance in the combined dataset was 0.036 (SE: 0.005). If there were no systematic differences between hospitals, the between-hospital variance would be 0.

[Figure 4.3.2](#) shows the overall distribution of the hospital RSRRs for the combined dataset. The odds of all-cause readmission if treated at a hospital one standard deviation above the national rate were 1.46 times higher than the odds of all-cause readmission if treated at a hospital one standard deviation below the national rate. If there were no systematic differences between hospitals, the OR would be 1.0.

4.3.5 Distribution of Hospitals by Performance Category in the Three-Year Dataset

Of 1,199 hospitals in the study cohort, 6 performed “better than the U.S. national rate,” 1040 performed “no different from the U.S. national rate,” and 16 performed “worse than the U.S. national rate.” 132 were classified as “number of cases too small” (fewer than 25) to reliably tell how well the hospital is performing.

Table 4.3.1 – Frequency of CABG Model Variables Over Different Time Periods

Variable	07/2011-06/2012	07/2012-06/2013	07/2013-06/2014	07/2011-06/2014
Total N	47,768	45,428	44,762	137,958
Observed readmission rate (%)	15.7	15.0	14.1	14.9
Mean age minus 65 (SD)	8.9 (5.7)	8.9 (5.7)	8.9 (5.7)	8.8 (5.7)
Male (%)	69.5	70.5	71.7	70.5
History of prior CABG or valve surgery	5.4	5.5	5.2	5.3
Cardiogenic shock (ICD-9 Code 785.51)	4.5	4.5	4.8	4.6
Chronic obstructive pulmonary disease (COPD) (CC 108)	27.0	26.2	25.8	26.4
Renal failure (CC 131)	16.3	17.3	17.8	17.1
Diabetes mellitus (DM) or DM complications (CC 15-20, 119-120)	49.5	50.3	51.0	50.3
Other endocrine/metabolic/nutritional disorders (CC 24)	93.0	93.6	94.0	93.5
Congestive heart failure (CC 80)	19.8	19.9	20.3	20.0
Specified arrhythmias and other heart rhythm disorders (CC 92-93)	29.1	29.4	30.2	29.6
Other lung disorders (CC 115)	34.7	33.4	32.8	33.7
Major psychiatric disorders (CC 54-56)	4.5	4.5	4.7	4.6
Vascular or circulatory disease (CC 104-106)	33.8	33.2	33.8	33.6
Disorders of fluid/electrolyte/acid-base (CC 22-23)	18.4	18.7	18.9	18.7
Pneumonia (CC 111-113)	12.6	12.8	12.4	12.6
Cerebrovascular disease (CC 97-99, 103)	29.4	28.3	28.1	28.6
Polyneuropathy (CC 71)	9.8	10.4	11.3	10.5
Protein-calorie malnutrition (CC 21)	4.7	4.7	4.3	4.6
Severe hematological disorders (CC 44)	0.9	0.6	0.6	0.7
Fibrosis of lung or other chronic lung disorders (CC 109)	4.7	4.4	4.0	4.4
Decubitus ulcer or chronic skin ulcer (CC 148-149)	3.3	3.5	3.6	3.5
Dialysis status (CC 130)	1.8	2.0	1.9	1.9
Hemiplegia, paraplegia, paralysis, functional disability (CC 67-69, 100-102)	3.4	3.4	3.4	3.4
Stroke (CC 95-96)	4.8	4.7	4.7	4.8
Dementia or other specified brain disorders (CC 49-50)	5.8	5.8	5.7	5.7
Cancer (CC 7-12)	19.5	19.2	19.0	19.2

Table 4.3.2 – Hierarchical Logistic Regression Model Variable Coefficients for CABG Over Different Time Periods

Variable	07/2011-06/2012	07/2012-06/2013	07/2013-06/2014	07/2011-06/2014
Intercept	-2.201	-2.229	-2.353	-2.258
Age minus 65 (years above 65, continuous)	0.029	0.021	0.031	0.027
Male	-0.331	-0.210	-0.252	-0.269
History of prior CABG or valve surgery	0.072	-0.012	-0.047	0.010
Cardiogenic shock (ICD-9 Code 785.51)	0.359	0.243	0.333	0.316
Chronic obstructive pulmonary disease (COPD) (CC 108)	0.297	0.268	0.333	0.297
Renal failure (CC 131)	0.213	0.248	0.278	0.243
Diabetes mellitus (DM) or DM complications (CC 15-20, 119-120)	0.116	0.147	0.188	0.146
Other endocrine/metabolic/nutritional disorders (CC 24)	0.006	-0.015	-0.121	-0.037
Congestive heart failure (CC 80)	0.130	0.192	0.211	0.176
Specified arrhythmias and other heart rhythm disorders (CC 92-93)	0.115	0.122	0.088	0.109
Other lung disorders (CC 115)	0.061	0.027	0.115	0.071
Major psychiatric disorders (CC 54-56)	0.189	0.222	0.080	0.165
Vascular or circulatory disease (CC 104-106)	0.113	0.098	0.128	0.113
Disorders of fluid/electrolyte/acid-base (CC 22-23)	0.104	0.096	0.034	0.081
Pneumonia (CC 111-113)	0.156	0.224	0.148	0.171
Cerebrovascular disease (CC 97-99, 103)	-0.042	-0.076	-0.010	-0.041
Polyneuropathy (CC 71)	0.205	0.138	0.174	0.171
Protein-calorie malnutrition (CC 21)	0.264	0.250	0.299	0.273
Severe hematological disorders (CC 44)	0.348	0.325	0.345	0.352
Fibrosis of lung or other chronic lung disorders (CC 109)	-0.065	0.101	0.164	0.056
Decubitus ulcer or chronic skin ulcer (CC 148-149)	0.265	0.335	0.232	0.275
Dialysis status (CC 130)	0.472	0.244	0.383	0.367
Hemiplegia, paraplegia, paralysis, functional disability (CC 67-69, 100-102)	0.058	0.153	-0.09421	0.042
Stroke (CC 95-96)	0.045	-0.012	0.098	0.043
Dementia or other specified brain disorders (CC 49-50)	0.147	0.056	0.155	0.118
Cancer (CC 7-12)	0.051	0.008	0.019	0.029

Table 4.3.3 – Adjusted OR and 95% CIs for the CABG Hierarchical Logistic Regression Model Over Different Time Periods

Variable	07/2011-06/2012 OR (95% CI)	07/2012-06/2013 OR (95% CI)	07/2013-06/2014 OR (95% CI)	07/2011-06/2014 OR (95% CI)
Age minus 65 (years above 65, continuous)	1.03 (1.03-1.03)	1.02 (1.02- 1.03)	1.03 (1.03, 1.04)	1.03 (1.03, 1.03)
Male	0.72 (0.68-0.76)	0.81 (0.77- 0.86)	0.78 (0.73, 0.82)	0.77 (0.74, 0.79)
History of prior CABG or valve surgery	1.08 (0.97-1.20)	0.99 (0.88- 1.11)	0.96 (0.85, 1.08)	1.01 (0.95, 1.08)
Cardiogenic shock (ICD-9 Code 785.51)	1.43 (1.29-1.60)	1.28 (1.14- 1.43)	1.40 (1.25, 1.56)	1.37 (1.29, 1.46)
Chronic obstructive pulmonary disease (COPD) (CC 108)	1.35 (1.27-1.42)	1.31 (1.23- 1.39)	1.40 (1.31, 1.48)	1.35 (1.30, 1.39)
Renal failure (CC 131)	1.24 (1.15-1.33)	1.28 (1.19-1.38)	1.32 (1.23-1.42)	1.28 (1.22-1.33)
Diabetes mellitus (DM) or DM complications (CC 15-20, 119-120)	1.12 (1.07-1.18)	1.16 (1.10-1.22)	1.21 (1.14-1.28)	1.16 (1.12-1.20)
Other endocrine/metabolic/nutritional disorders (CC 24)	1.01 (0.91-1.12)	0.99 (0.88-1.10)	0.89 (0.79-1.00)	0.96 (0.90-1.03)
Congestive heart failure (CC 80)	1.14 (1.07-1.22)	1.21 (1.13-1.30)	1.24 (1.15-1.32)	1.19 (1.15-1.24)
Specified arrhythmias and other heart rhythm disorders (CC 92-93)	1.12 (1.06-1.19)	1.13 (1.06-1.20)	1.10 (1.03-1.16)	1.12 (1.08-1.15)
Other lung disorders (CC 115)	1.06 (1.02-1.12)	1.03 (0.97-1.09)	1.12 (1.06-1.19)	1.07 (1.04-1.11)
Major psychiatric disorders (CC 54-56)	1.21 (1.08-1.35)	1.25 (1.11-1.40)	1.08 (0.96-1.22)	1.18 (1.10-1.26)
Vascular or circulatory disease (CC 104-106)	1.12 (1.06-1.19)	1.10 (1.04-1.17)	1.14 (1.07-1.21)	1.12 (1.08-1.16)
Disorders of fluid/electrolyte/acid-base (CC 22-23)	1.11 (1.04-1.19)	1.10 (1.03-1.18)	1.04 (0.96-1.11)	1.08 (1.04-1.13)
Pneumonia (CC 111-113)	1.17 (1.09-1.26)	1.25 (1.16-1.35)	1.16 (1.07-1.26)	1.19 (1.14-1.24)
Cerebrovascular disease (CC 97-99, 103)	0.96 (0.90-1.02)	0.93 (0.87-0.99)	0.99 (0.93-1.05)	0.96 (0.93-0.99)
Polyneuropathy (CC 71)	1.23 (1.13-1.33)	1.15 (1.06-1.25)	1.19 (1.10-1.29)	1.19 (1.13-1.24)
Protein-calorie malnutrition (CC 21)	1.30 (1.17-1.45)	1.28 (1.15-1.43)	1.35 (1.20-1.51)	1.31 (1.23-1.40)
Severe hematological disorders (CC 44)	1.42 (1.13-1.78)	1.39 (1.03-1.86)	1.41 (1.06-1.89)	1.42 (1.22-1.66)
Fibrosis of lung or other chronic lung disorders (CC 109)	0.94 (0.84-1.05)	1.11 (0.98-1.25)	1.18 (1.04-1.33)	1.06 (0.99-1.13)
Decubitus ulcer or chronic skin ulcer (CC 148-149)	1.30 (1.15-1.48)	1.40 (1.24-1.58)	1.26 (1.11-1.43)	1.32 (1.23-1.42)
Dialysis status (CC 130)	1.60 (1.36-1.89)	1.28 (1.09-1.50)	1.47 (1.24-1.73)	1.44 (1.31-1.59)
Hemiplegia, paraplegia, paralysis, functional disability (CC 67-69, 100-102)	1.06 (0.93-1.21)	1.17 (1.02-1.33)	0.91 (0.79-1.05)	1.04 (0.96-1.13)
Stroke (CC 95-96)	1.05 (0.93-1.17)	0.99 (0.87-1.12)	1.10 (0.97-1.25)	1.04 (0.97-1.12)
Dementia or other specified brain disorders (CC 49-50)	1.16 (1.05-1.28)	1.06 (0.95-1.18)	1.17 (1.05-1.30)	1.13 (1.06-1.20)
Cancer (CC 7-12)	1.05 (0.99-1.12)	1.01 (0.94-1.08)	1.02 (0.95-1.09)	1.03 (0.99-1.07)

Table 4.3.4 – CABG Generalized Linear Modeling (Logistic Regression) Performance Over Different Time Periods

Characteristic	07/2011-06/2012	07/2012-06/2013	07/2013-06/2014	07/2011-06/2014
Predictive ability, % (lowest decile – highest decile)	6.8 – 29.4	7.7 – 27.9	6.3 – 27.7	6.9 – 28.1
c-statistic	0.63	0.63	0.64	0.63

Table 4.3.5 – Distribution of Hospital CABG Admission Volumes Over Different Time Periods

Characteristic	07/2011-06/2012	07/2012-06/2013	07/2013-06/2014	07/2011-06/2014
Number of hospitals	1,174	1,162	1,157	1,199
Mean number of admissions (SD)	40.7 (35.8)	39.1 (34.7)	38.7 (34.3)	115.1 (102.9)
Range (min. – max.)	1 - 262	1 - 246	1 - 265	1 - 739
25 th percentile	16	15	16	44
50 th percentile	31	29	28	85
75 th percentile	55	53	51	155

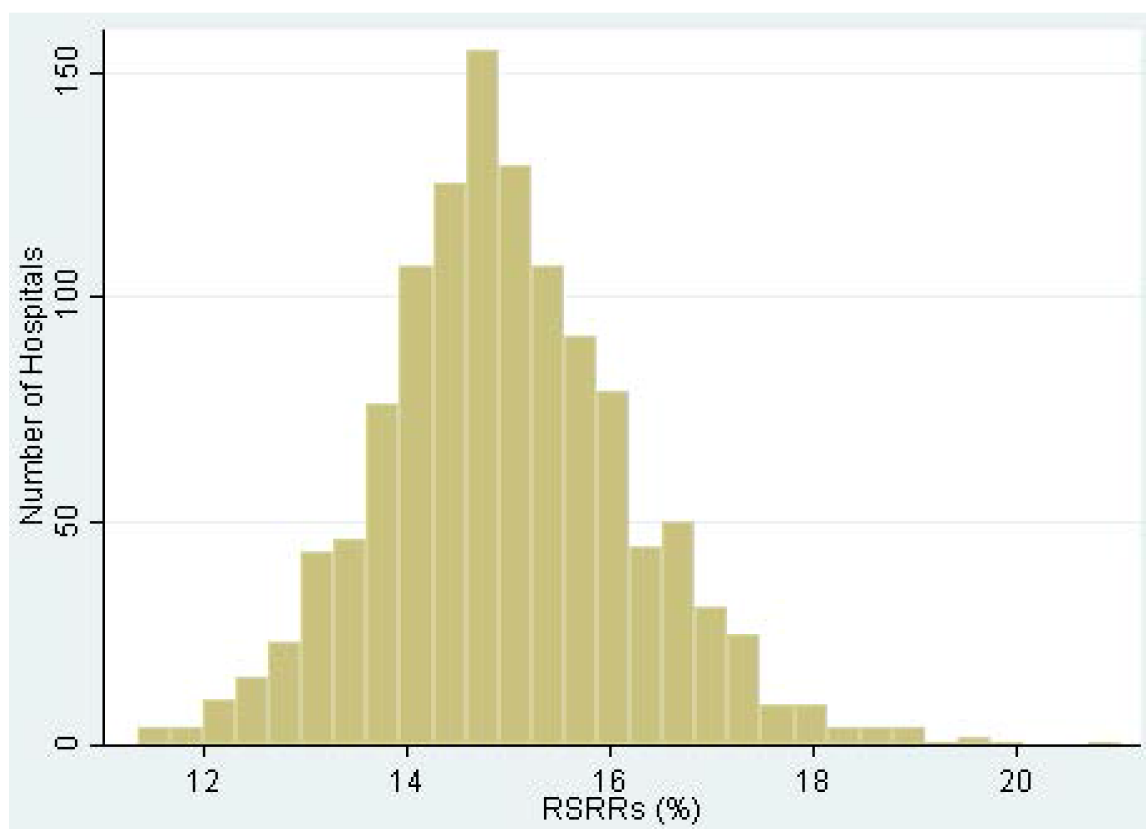
Table 4.3.6 – Distribution of Hospital CABG RSRRs Over Different Time Periods

Characteristic	07/2011-06/2012	07/2012-06/2013	07/2013-06/2014	07/2011-06/2014
Number of hospitals	1,174	1,162	1,157	1,199
Mean (SD)	15.7 (1.2)	15.0 (0.8)	14.1 (0.52)	15.0 (1.3)
Range (min. – max.)	12.4 - 20.4	12.0 - 18.5	12.8 – 17.0	11.4 - 21.0
25 th percentile	15.0	14.5	13.8	14.2
50 th percentile	15.6	14.9	14.1	14.9
75 th percentile	16.4	15.4	14.4	15.7

Table 4.3.7 – Between-Hospital Variance

	07/2011-06/2012	07/2012-06/2013	07/2013-06/2014	07/2011-06/2014
Between-hospital variance (SE)	0.046 (0.010)	0.033 (0.009)	0.022 (0.009)	0.0356 (0.005)

Figure 4.3.2 – Distribution of Hospital 30-Day CABG RSRRs Between July 2011 and June 2014



N= 1,199 hospitals

5. GLOSSARY

Cohort: The index admissions used to calculate the measure after inclusion and exclusion criteria have been applied.

Comorbidities: Medical conditions that the patient had in addition to his/her primary reason for admission to the hospital.

Complications: Medical conditions that may have occurred as a consequence of care rendered during hospitalization.

Condition Categories (CCs): Groupings of ICD-9-CM diagnosis codes in clinically relevant categories, from the Hierarchical Condition Categories (HCCs) system. CMS uses the grouping but not the hierarchical logic of the system to create risk factor variables. Description of the CCs can be found at http://www.cms.hhs.gov/Reports/downloads/pope_2000_2.pdf.

Confidence Interval (CI): A CI is a range of probable values for an estimate that characterizes the amount of associated uncertainty. For example, the 95% CIs for the ORs associated with risk-adjustment variables in the model indicates there is 95% confidence that the OR lies between the lower and the upper limit of the interval. The 95% CI serves as a proxy for statistical significance for ORs; if the CI does not contain the value of 1.0 the association is considered statistically significant.

Expected readmissions: The number of readmissions expected based on average hospital performance with a given hospital's case mix.

Hierarchical model: A widely accepted statistical method that enables fair evaluation of relative hospital performance by accounting for patient risk factors and the number of patients that a hospital treats. This statistical model accounts for the structure of the data (patients clustered within hospitals) and calculates (1) how much variation in hospital readmission rates overall is accounted for by patients' individual risk factors (such as age and other medical conditions); and (2) how much variation is accounted for by hospital contribution to readmission risk.

Hospital-specific intercept: A measure of the hospital quality of care calculated based on the hospital's actual readmission rate relative to hospitals with similar patients, considering how many patients it served, its patients' risk factors, and how many were readmitted. The hospital-specific effect will be negative for a better-than-average hospital, positive for a worse-than-average hospital, and close to zero for an average hospital. The hospital-specific effect is used in the numerator to calculate "predicted" readmissions.

Index admission: Any admission included in the measure calculation as the initial admission for a qualifying elective THA/TKA or CABG procedure and evaluated for the outcome.

Interval estimate: Similar to a CI. The interval estimate is a range of probable values for the estimate that characterizes the amount of associated uncertainty. For example, a 95% interval estimate for a readmission rate indicates that CMS is 95% confident that the true value of the rate lies between the lower and the upper limit of the interval.

Medicare fee-for-service (FFS): Original Medicare plan in which providers receive a fee or payment for each individual service provided directly from Medicare. All services rendered are unbundled and paid for separately. Only beneficiaries in Medicare FFS, not in managed care (Medicare Advantage), are included in the measures.

National observed readmission rate: All included hospitalizations with the outcome divided by all included hospitalizations.

Odds ratio (OR): The ORs express the relative odds of the outcome for each of the predictor variables. For example, the OR for Protein-calorie malnutrition (CC 21) represents the odds of the outcome for patients with that risk variable present relative to those without the risk variable present. The model coefficient for each risk variable is the log (odds) for that variable.

Outcome: The result of a broad set of healthcare activities that affect patients' well-being. For the readmission measures, the outcome is readmission within 30 days of discharge.

Planned readmissions: A readmission within 30 days of discharge from an acute care hospital that is a scheduled part of the patient's plan of care. Planned readmissions are not counted as outcomes in these measures.

Predicted readmissions: The number of readmissions within 30 days predicted based on the hospital's performance with its observed case mix, also referred to as "adjusted actual" readmissions.

Procedure Category: A group of related procedure codes, as grouped by the AHRQ CCS.

Risk-adjustment variables: Patient demographics and comorbidities used to standardize rates for differences in case mix across hospitals.

Unplanned readmissions: Acute clinical events a patient experiences that require urgent rehospitalization. Unplanned readmissions are counted as outcomes in these measures.

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7. APPENDICES

Appendix A. Statistical Approach to Risk-Standardized Readmission Rates for THA/TKA and CABG Measures

We estimate the hospital-specific RSRRs using hierarchical generalized linear models. This strategy accounts for within-hospital correlation of the observed outcome and accommodates the assumption that underlying differences in quality across hospitals lead to systematic differences in outcomes. We model the probability of readmission as a function of patient age and clinically relevant comorbidities with an intercept for the hospital-specific random effect.

We use the following strategy to calculate hospital-specific RSRRs, which we calculate as the ratio of a hospital's "predicted" readmissions to "expected" readmissions multiplied by the national observed readmission rate. The expected number of readmissions for each hospital is estimated using its patient mix and the average hospital-specific intercept (i.e., the average intercept among all hospitals in the sample). The predicted number of readmissions for each hospital is estimated given the same patient mix but an estimated hospital-specific intercept. Operationally, the expected number of readmissions for each hospital is obtained by summing the expected probabilities of readmissions for all patients in the hospital. The expected probability of readmission for each patient is calculated via the hierarchical model, which applies the estimated regression coefficients to the observed patient characteristics and adds the average of the hospital-specific intercept. The predicted number of readmissions for each hospital is calculated by summing the predicted probabilities for all patients in the hospital. The predicted probability for each patient is calculated through the hierarchical model, which applies the estimated regression coefficients to the patient characteristics observed and adds the hospital-specific intercept.

More specifically, we use a hierarchical logistic regression model to account for the natural clustering of observations within hospitals. The model employs a logit link function to link the risk factors to the outcome with a hospital-specific random effect:

$$h(Y_{ij}) = \alpha_i + \beta Z_{ij} \quad (1)$$

$$\alpha_i = \mu + \omega_i; \quad \omega_i \sim N(0, \tau^2) \quad (2)$$

Where $h(\cdot)$ is a logit link, Y_{ij} is whether the j^{th} patient in the i^{th} hospital was readmitted (equal to 1 if readmitted within 30 days, 0 otherwise); α_i represents the hospital-specific intercept, $Z_{ij} = (Z_{1ij}, Z_{2ij}, \dots, Z_{pij})$ the patient-specific covariates, μ is the adjusted average hospital intercept across all hospitals in the sample, and τ^2 is the between-hospital variance component.⁸ This model separates within-hospital from between-hospital variation. The hierarchical logistic regression models are estimated using the SAS software system (SAS 9.3 GLIMMIX).

Hospital Performance Reporting

Using the selected set of risk factors, we fit the hierarchical generalized linear model defined by Equations (1) - (2) and estimate the parameters, $\hat{\mu}, \{\hat{\alpha}_1, \hat{\alpha}_2, \dots, \hat{\alpha}_I\}, \hat{\beta}$, and $\hat{\tau}^2$ where i is the total number of hospitals. We calculate a standardized outcome measure, RSRR, for each hospital by computing the ratio of the predicted number of readmissions to the expected number of readmissions, multiplied by the national observed readmission rate, \bar{y} . Specifically, we calculate

$$\text{Predicted} \quad \hat{y}_{ij}(Z_{ij}) = h^{-1}(\hat{\alpha}_i + \hat{\beta}Z_{ij}) \quad (3)$$

$$\text{Expected} \quad \hat{e}_{ij}(Z_{ij}) = h^{-1}(\hat{\mu} + \hat{\beta}Z_{ij}) \quad (4)$$

$$\widehat{RSRR}_i = \frac{\sum_{j=1}^{n_i} \hat{y}_{ij}(Z_{ij})}{\sum_{j=1}^{n_i} \hat{e}_{ij}(Z_{ij})} \quad (5)$$

n_i is the number of index hospitalizations for the i^{th} hospital.

If the “predicted” number of readmissions is higher (or lower) than the “expected” number of readmissions for a given hospital, its \widehat{RSRR}_i will be higher (or lower) than the national observed readmission rate. For each hospital, we compute an interval estimate of \widehat{RSRR}_i to characterize the level of uncertainty around the point estimate using bootstrapping simulations, as described in the next section. The point estimate and interval estimate are used to characterize and compare hospital performance (e.g., higher than expected, as expected, or lower than expected).

Creating Interval Estimates

Because the statistic described in Equation 5, i.e., \widehat{RSRR}_i , is a complex function of parameter estimates, we use the re-sampling technique, bootstrapping, to derive an interval estimate. Bootstrapping has the advantage of avoiding unnecessary distributional assumptions.

Algorithm:

Let I denote the total number of hospitals in the sample. We repeat steps 1-4 below for B times, where B is the number of bootstrap samples desired:

1. Sample I hospitals with replacement.
2. Fit the hierarchical generalized linear model using all patients within each sampled hospital. If some hospitals are selected more than once in a bootstrapped sample, we treat them as distinct so that we have I random effects to estimate the variance components. At the conclusion of Step 2, we have:

- a. $\hat{\beta}^{(b)}$ (the estimated regression coefficients of the risk factors).
 - b. The parameters governing the random effects, hospital adjusted outcomes, distribution, $\hat{\mu}^{(b)}$ and $\hat{\tau}^2(b)$.
 - c. The set of hospital-specific intercepts and corresponding variances, $\{\hat{\alpha}_i^{(b)}, \widehat{var}(\hat{\alpha}_i^{(b)}); i = 1, 2, \dots, I\}$
3. We generate a hospital random effect by sampling from the distribution of the hospital-specific distribution obtained in Step 2c. We approximate the distribution for each random effect by a normal distribution. Thus, we draw $\hat{\alpha}_i^{(b*)} \sim N(\hat{\alpha}_i^{(b)}, \widehat{var}(\hat{\alpha}_i^{(b)}))$ for the unique set of hospitals sampled in Step 1.
 4. Within each unique hospital i sampled in Step 1, and for each case j in that hospital, we calculate $\hat{y}_{ij}^{(b)}$, $\hat{e}_{ij}^{(b)}$, and $\widehat{RSRR}_i(Z)^{(B)}$ where $\hat{\beta}^{(b)}$ and $\hat{\mu}^{(b)}$ are obtained from Step 2 and $\hat{\alpha}_i^{(b*)}$ is obtained from Step 3.

Ninety-five percent interval estimates (or alternative interval estimates) for the hospital-standardized outcome can be computed by identifying the 2.5th and 97.5th percentiles of the B estimates (or the percentiles corresponding to the alternative desired intervals).⁹

Appendix B. Data Quality Assurance (QA)

We use a two-phase approach to internal QA for the readmission measure reevaluation process. These phases are described below. Refer to [Figure B.1](#) for a detailed outline of Phase I and [Figure B.2](#) for a detailed outline of Phase II.

This section represents QA for the subset of the work CORE conducted to maintain and report these readmission measures. It does not describe the QA to process data and create the input files, nor does it include the QA for the final processing of production data for public reporting, because that work is conducted by another contractor.

Phase I

The first step in the QA process is to ensure the validity of the input data files. No new variables that impacted the measures were added to the input files; thus, our main task was to ensure that variable frequencies and distributions in the newly created input data files were consistent with data from the prior time period.

In general, we use both manual scan and descriptive analyses to conduct data validity checks, including cross-checking readmission information, distributions of ICD-9-CM codes, and frequencies of key variables. The results are reviewed for accuracy and changes compared to data from prior data sources. Any new variable constructs and other changes in formatting to the input files are also verified. We share our QA findings with our data extraction contractor as needed.

To assure accuracy in SAS analytic package coding, two analysts independently write SAS code for any changes made in calculating the measures: data preparation, sample selection, hierarchical modeling, and calculation of RSRRs. This process highlights any programming errors in syntax or logic. Once the parallel programming process is complete, the analysts crosscheck their codes by analyzing datasets in parallel, checking for consistency of output, and reconciling any discrepancies.

Phase II

A third analyst reviews the finalized SAS code and recommends changes to the coding and readability of the SAS analytic package, where appropriate. The primary analyst receives the suggested changes for possible re-coding or program documentation.

This phase also compares prior years' risk-adjustment coefficients and variable frequencies to enable us to check for potential inconsistencies in the data and the impact of any changes to the SAS analytic package.

Figure B.1 – CORE QA Phase I

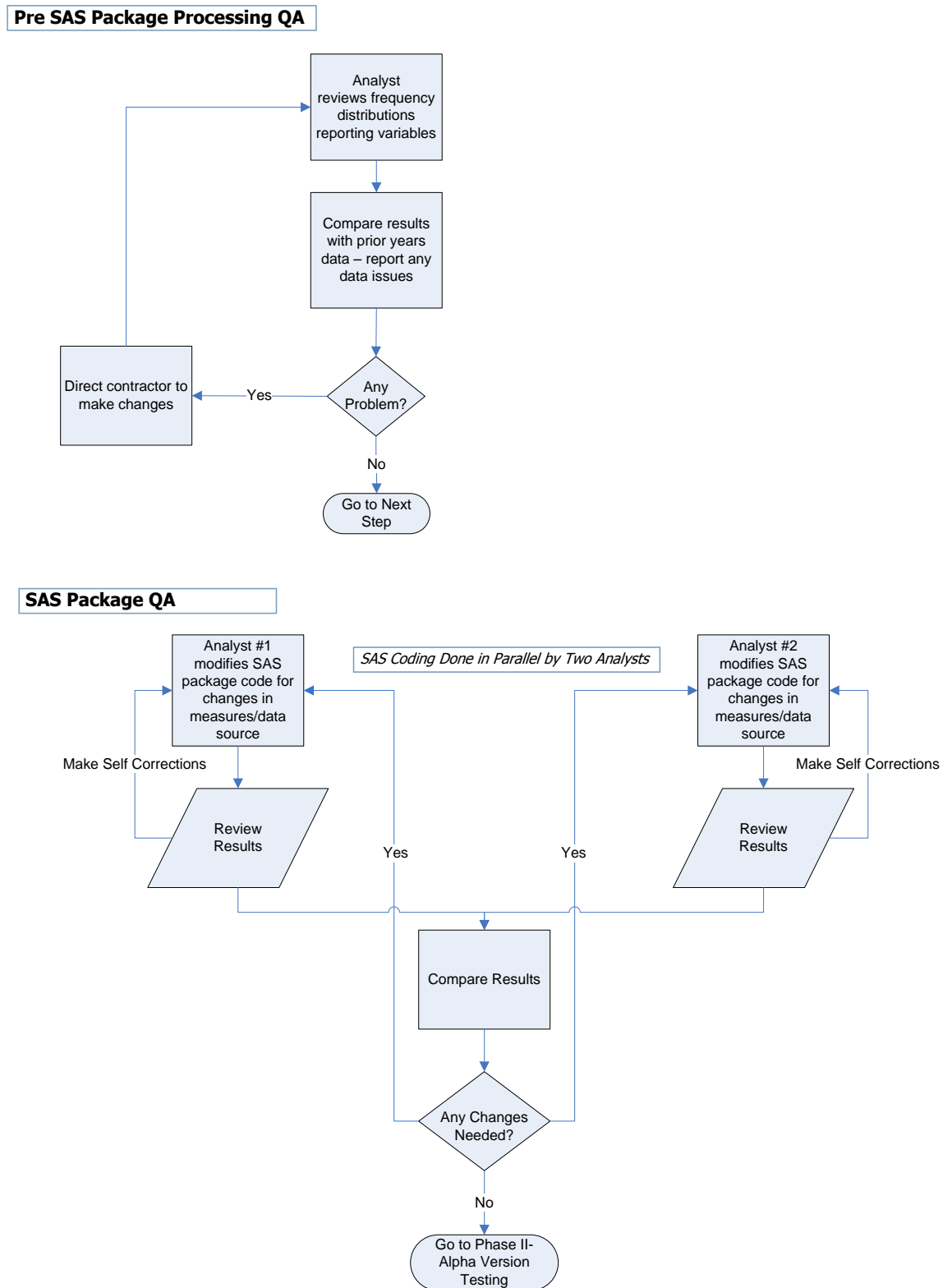
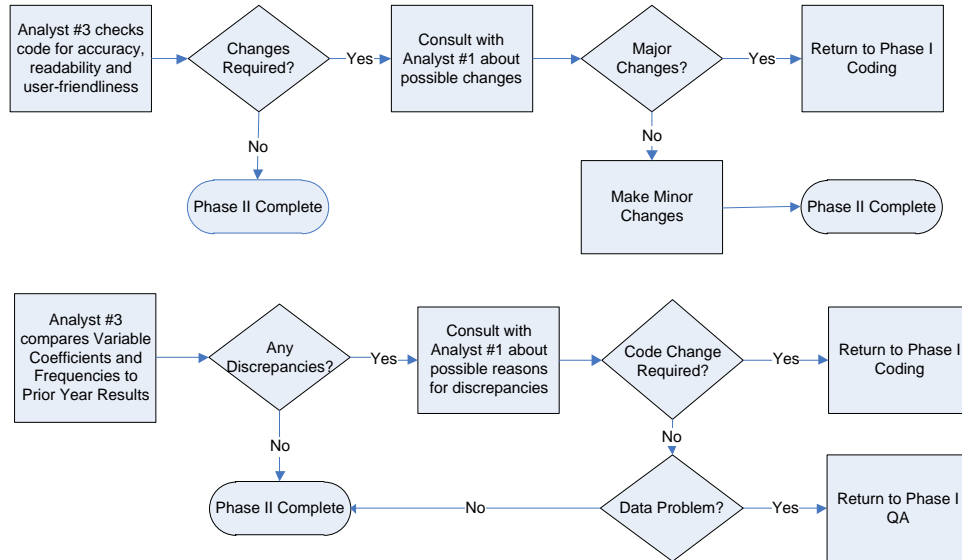


Figure B. 2 – CORE QA Phase II

Results Testing – Alpha Version



Appendix C. Annual Updates

Prior annual updates for the measures can be found in the annual updates and specifications reports on *QualityNet*. For convenience, we have listed all prior updates here under the reporting year and corresponding report. In 2013, CMS began assigning version numbers to its measures. The measure specifications in the original methodology report are considered version 1.0. The measures receive a new version number for each subsequent year of public reporting.

2015

2015 Measures Updates and Specifications Report (Version 4.0- THA/TKA Readmission) (Version 2.0- CABG Readmission)

1. Updated version of the AHRQ CCS software
 - Rationale: An updated version of the AHRQ CCS software was released in 2014.

2014

2014 Measures Update and Specifications Report THA/TKA Readmission (Version 3.0)

1. Respecified the measure by adding the CMS planned readmission algorithm (version 3.0).
 - Rationale: Version 3.0 incorporates improvements made following a validation study of the algorithm using data from a medical record review. These changes improve the accuracy of the algorithm by decreasing the number of readmissions that the algorithm mistakenly designated as planned by removing two procedure categories and adding several acute diagnoses.
2. Updated measure specifications to not include all patients with a secondary diagnosis of fracture during index admission in the measure cohort.
 - Rationale: These procedures are presumably not elective THA/TKA procedures, and the cohort aims to include only elective THA/TKA procedures.
3. Updated version of the AHRQ CCS software.
 - Rationale: An updated version of the AHRQ CCS software was released in 2013.

2014 Dry Run Technical Report CABG Readmission (Version 1.0)

1. Updates and rationales for the 2014 dry run.
 - Rationale: The report describes the CABG readmission measure, which was specified for the dry run period in 2014. The report includes details on the initial measure development and validation process.

2013

2013 Measure Updates and Specifications Report THA/TKA Readmission (Version 2.0)

1. Respecified the measure by adding a planned readmission algorithm.
 - Rationale: Unplanned readmissions are acute clinical events a patient experiences that require urgent rehospitalization. In contrast, planned readmissions are generally not a signal of quality of care. Including planned readmissions in a readmission measure could create a disincentive to provide appropriate care to patients scheduled for elective or necessary procedures within 30 days of discharge.
2. Updated CC map.
 - Rationale: Prior to 2014, the ICD-9-CM CC map was updated annually to capture all relevant comorbidities coded in patient administrative claims data.

3. Changes from prior methodology report.
 - Rationale: There were two changes from the original methodology report.
 - i. Table A3 contains the updated listing of the ICD-9-CM codes for fractures, malignant neoplasms, revisions, and other procedures that exclude patients from the measure cohort.
 - ii. The mean risk-standardized readmission rate for the 2008 sample on page 54 was corrected.
4. Planned readmission algorithm handling of admissions to psychiatric and rehabilitation hospitals.
 - Rationale: Psych and rehab hospitals in Maryland have the same provider ID number as acute care hospitals. Therefore, readmissions are not counted if the patient has a principal diagnosis code beginning with a “V57” (indication of admission to a rehab unit) or if all three of the following criteria are met: (1) the admission being evaluated as a potential readmission has a psychiatric principal discharge diagnosis code (ICD-9 codes 290-319); (2) the index admission has a discharge disposition code to a psychiatric hospital or psychiatric unit from the index admission; and (3) the admission being evaluated as a potential readmission occurred during the same day as or the day following the index discharge.
 - The criteria for identifying such admissions are available in the 2010 AMI, HF, and pneumonia readmission measures maintenance report.

2012

2012 Dry Run Technical Report THA/TKA Readmission (Version 1.0)

1. Updates and rationales for the September 2012 dry run.
 - Rationale: The report describes the THA/TKA readmission measure, which was specified for the dry run period in 2012. The report includes an appendix with details on the initial measure development and validation process.

Appendix D. Measure Specifications

Appendix D.1 THA/TKA

Cohort

Inclusion Criteria for THA/TKA Readmission Measure

1. Enrolled in Medicare FFS

Rationale: Claims data are consistently available only for Medicare FFS beneficiaries.

2. Aged 65 or over

Rationale: Medicare patients younger than 65 usually qualify for the program due to severe disability. They are not included in the measure because Medicare patients younger than 65 are considered to be too clinically distinct from Medicare patients 65 and over.

3. Discharged alive from a non-federal acute care hospital

Rationale: Patients who are alive are eligible for a readmission.

4. Enrolled in Part A and Part B Medicare for the 12 months prior to the date of admission, and enrolled in Part A during the index admission

Rationale: The 12-month prior enrollment criterion ensures that patients were Medicare FFS beneficiaries and that their comorbidities are captured from claims data for risk adjustment. Medicare Part A is required at the time of admission to ensure that no Medicare Advantage patients are included in the measure.

5. Having a qualifying elective primary THA/TKA procedure during the index admission

Rationale: Elective primary THA or TKA is the procedure targeted for measurement ([Table D.1.1](#)).

Elective primary THA/TKA procedures are defined as those procedures not having any of the following:

- **Femur, hip, or pelvic fractures coded in the principal or secondary discharge diagnosis fields of the index admission**
Rationale: Patients with fractures have a higher mortality, complication, and readmission rates, and the procedures are typically not elective ([Table D.1.2](#)).
- **Partial hip arthroplasty (PHA) procedures (with a concurrent THA/TKA)**
Rationale: Partial arthroplasty procedures are done primarily for hip fractures and are typically performed on patients who are older, frailer, and who have more comorbid conditions ([Table D.1.3](#)). Partial knee arthroplasty procedures are not distinguished by ICD-9-CM codes and are therefore currently not captured by the THA/TKA readmission measure.
- **Revision procedures with a concurrent THA/TKA**
Rationale: Revision procedures may be performed at a disproportionately small number of hospitals and are associated with higher mortality, complication, and readmission rates ([Table D.1.4](#)).
- **Resurfacing procedures with a concurrent THA/TKA**
Rationale: Resurfacing is a different type of procedure involving only the joint's articular surface. Resurfacing procedures are typically performed on younger, healthier patients ([Table D.1.5](#)).
- **Mechanical complication coded in the principal discharge diagnosis field of the index admission**

Rationale: A complication coded as the principal discharge diagnosis suggests that the procedure was more likely the result of a previous procedure and indicates the complication was present on admission. These patients may require more technically complex arthroplasty procedures and may be at increased risk for complications, particularly mechanical complications ([Table D.1.6](#)).

- **Malignant neoplasm of the pelvis, sacrum, coccyx, lower limbs, or bone/bone marrow or a disseminated malignant neoplasm coded in the principal discharge diagnosis field**
Rationale: Patients with these malignant neoplasms are at increased risk for readmission, and the procedure may not be elective ([Table D.1.7](#)).
- **Removal of implanted devices/prostheses**
Rationale: Elective procedures performed in these patients may be more complicated ([Table D.1.8](#)).
- **Transfer from another acute care facility for the THA/TKA**
Rationale: The THA/TKA readmission measure does not include admissions for patients transferred in to the index hospital, as they likely do not represent elective THA/TKA procedures.

Exclusion Criteria for THA/TKA Readmission Measure

1. **Without at least 30 days of post-discharge enrollment in FFS Medicare**
Rationale: The 30-day readmission outcome cannot be assessed in this group since claims data are used to determine whether a patient was readmitted.
2. **Discharged against medical advice (AMA)**
Rationale: Providers did not have the opportunity to deliver full care and prepare the patient for discharge.
3. **Admitted for the index procedure and subsequently transferred to another acute care facility**
Rationale: Patients admitted for the index procedure and subsequently transferred to another acute care facility are excluded, as determining to which hospital the readmission outcome should be attributed is difficult.
4. **With more than two THA/TKA procedure codes during the index hospitalization**
Rationale: Although clinically possible, it is highly unlikely that patients would receive more than two elective THA/TKA procedures in one hospitalization, which may reflect a coding error.

Table D.1.1 – ICD-9-CM Codes Used to Identify Eligible THA/TKA Procedures

ICD-9-CM Codes	Description
81.51	Total hip replacement
81.54	Total knee replacement

Table D.1.2 – ICD-9-CM Codes for Fractures That Disqualify an Admission From Inclusion in the Measure

ICD-9-CM Codes	Description
733.10	Pathological fracture unspecified site
733.14	Pathological fracture of neck of femur
733.15	Pathological fracture of other specified part of femur
733.19	Pathological fracture of other specified site
733.81	Malunion of fracture
733.82	Nonunion of fracture
733.95	Stress fracture of other bone
733.96	Stress fracture of femoral neck
733.97	Stress fracture of shaft of femur
808.0	Closed fracture of acetabulum
808.1	Open fracture of acetabulum
808.2	Closed fracture of pubis
808.3	Open fracture of pubis
808.41	Closed fracture of ilium
808.42	Closed fracture of ischium
808.43	Multiple closed pelvic fractures with disruption of pelvic circle
808.44	Multiple closed pelvic fractures without disruption of pelvic circle
808.49	Closed fracture of other specified part of pelvis
808.51	Open fracture of ilium
808.52	Open fracture of ischium
808.53	Multiple open pelvic fractures with disruption of pelvic circle
808.54	Multiple open pelvic fractures without disruption of pelvic circle
808.8	Closed unspecified fracture of pelvis
820.00	Closed fracture of intracapsular section of neck of femur, unspecified
820.01	Closed fracture of epiphysis (separation) (upper) of neck of femur
820.02	Closed fracture of midcervical section of neck of femur
820.03	Closed fracture of base of neck of femur
820.09	Other closed transcervical fracture of neck of femur
820.10	Open fracture of intracapsular section of neck of femur, unspecified
820.11	Open fracture of epiphysis (separation) (upper) of neck of femur
820.12	Open fracture of midcervical section of neck of femur
820.13	Open fracture of base of neck of femur
820.19	Other open transcervical fracture of neck of femur
820.20	Closed fracture of trochanteric section of neck of femur
820.21	Closed fracture of intertrochanteric section of neck of femur
820.22	Closed fracture of subtrochanteric section of neck of femur
820.30	Open fracture of trochanteric section of neck of femur, unspecified
820.31	Open fracture of intertrochanteric section of neck of femur
820.32	Open fracture of subtrochanteric section of neck of femur
820.8	Closed fracture of unspecified part of neck of femur
820.9	Open fracture of unspecified part of neck of femur
821.00	Closed fracture of unspecified part of femur
821.01	Closed fracture of shaft of femur
821.10	Open fracture of unspecified part of femur
821.11	Open fracture of shaft of femur

ICD-9-CM Codes	Description
821.20	Closed fracture of lower end of femur, unspecified part
821.21	Closed fracture of condyle, femoral
821.22	Closed fracture of epiphysis, lower (separation) of femur
821.23	Closed supracondylar fracture of femur
821.29	Other closed fracture of lower end of femur
821.30	Open fracture of lower end of femur, unspecified part
821.31	Open fracture of condyle, femoral
821.32	Open fracture of epiphysis, lower (separation) of femur
821.33	Open supracondylar fracture of femur
821.39	Other open fracture of lower end of femur

Table D.1.3 – ICD-9-CM Codes for Partial Hip Replacement That Disqualify an Admission From Inclusion in the Measure

ICD-9-CM Codes	Description
81.52	Partial hip replacement

Table D.1.4 – ICD-9-CM Codes for THA and TKA Revisions That Disqualify an Admission From Inclusion in the Measure

ICD-9-CM Codes	Description
81.53	Revision of hip replacement, not otherwise specified
81.55	Revision of knee replacement, not otherwise specified
81.59	Revision of joint replacement of lower extremity, not elsewhere classified
00.70	Revision of hip replacement, both acetabular and femoral components
00.71	Revision of hip replacement, acetabular component
00.72	Revision of hip replacement, femoral component
00.73	Revision of hip replacement, acetabular liner and/or femoral head only
00.80	Replacement of knee replacement, total (all components)
00.81	Replacement of knee replacement, tibial component
00.82	Revision of knee replacement, femoral component
00.83	Revision of knee replacement, patellar component
00.84	Revision of total knee replacement, tibial insert (liner)

Table D.1.5 – ICD-9-CM Codes for Resurfacing Procedures That Disqualify an Admission From Inclusion in the Measure

ICD-9-CM Codes	Description
00.85	Resurfacing hip, total, acetabulum and femoral head
00.86	Resurfacing hip, partial, femoral head
00.87	Resurfacing hip, partial, acetabulum

Table D.1.6 – ICD-9-CM Codes for Mechanical Complications That Disqualify an Admission From Inclusion in the Measure

ICD-9-CM Codes	Description
996.40	Unspecified mechanical complication of internal orthopedic device, implant and graft
996.41	Mechanical loosening of prosthetic joint
996.42	Dislocation of prosthetic joint
996.43	Broken prosthetic joint implant
996.44	Peri prosthetic fracture around prosthetic joint
996.45	Peri prosthetic osteolysis
996.46	Articular bearing surface wear of prosthetic joint
996.47	Other mechanical complication of prosthetic joint implant
996.49	Other mechanical complication of other internal orthopedic device, implant, and graft
996.77	Other complications due to internal joint prosthesis
996.78	Other complications due to other internal orthopedic device implant and graft

Table D.1.7 – ICD-9-CM Codes for Malignant Neoplasms That Disqualify an Admission From Inclusion in the Measure

ICD-9-CM Codes	Description
170.6	Malignant neoplasm of pelvic bones, sacrum, and coccyx
170.7	Malignant neoplasm of long bones of lower limb
170.9	Malignant neoplasm of bone and articular cartilage, site unspecified
195.3	Malignant neoplasm of pelvis
195.5	Malignant neoplasm of lower limb
198.5	Secondary malignant neoplasm of bone and bone marrow
199.0	Disseminated malignant neoplasm without specification of site

Table D.1.8 – ICD-9-CM Codes for Removal of Devices/Prosthesis That Disqualify an Admission From Inclusion in the Measure

ICD-9-CM Codes	Description
78.65	Removal of implanted devices from bone, femur
78.66	Removal of implanted devices from bone, patella
78.67	Removal of implanted devices from bone, tibia and fibula
80.05	Arthrotomy for removal of prosthesis without replacement, hip
80.06	Arthrotomy for removal of prosthesis without replacement, knee
80.09	Arthrotomy for removal of prosthesis without replacement, other specified sites

Risk Adjustment

Table D.1.9 – Risk Variables for the THA/TKA Measure

Variable	Description
n/a	Age minus 65 (years above 65, continuous)
n/a	Male
n/a	THA procedure
n/a	Number of procedures (two vs. one)
ICD-9 code 755.63	Other congenital deformity of hip (joint)
ICD-9 codes 716.15, 716.16	Post traumatic osteoarthritis
ICD-9 code 278.01	Morbid obesity
CC 1, 3-6	History of infection
CC 7	Metastatic cancer or acute leukemia
CC 8-12	Cancer
CC 15-20, 119-120	Diabetes mellitus (DM) or DM complications
CC 21	Protein-calorie malnutrition
CC 22-23	Disorders of fluid/electrolyte/acid-base
CC 38	Rheumatoid arthritis and inflammatory connective tissue disease
CC 44	Severe hematological disorders
CC 49, 50	Dementia or other specified brain disorders
CC 54-56	Major psychiatric disorders
CC 67-69, 100-102, 177-178	Hemiplegia, paraplegia, paralysis, functional disability
CC 71	Polyneuropathy
CC 80	Congestive heart failure
CC 83-84	Coronary atherosclerosis or angina
CC 89, 91	Hypertension
CC 92-93	Specified arrhythmias and other heart rhythm disorders
CC 95-96	Stroke
CC 104-106	Vascular or circulatory disease
CC 108	Chronic obstructive pulmonary disease (COPD)
CC 111-113	Pneumonia
CC 130	Dialysis status
CC 131	Renal failure
CC 148-149	Decubitus ulcer or chronic skin ulcer
CC 152	Cellulitis, local skin infection
CC 162	Other injuries
CC 166	Major symptoms, abnormalities

Table D.1.10 – Complications of Care Variables Not Used in Risk Adjustment If Occurring Only During the Index Admission of THA/TKA Measure

(Includes the subset of risk variables From Table D.1.9 that are not used in risk adjustment if occurring only during the index admission)

Variable	Description
CC 6	Other infectious diseases
CC 17	Diabetes with acute complications
CC 23	Disorders of fluid/electrolyte/acid-base
CC 80	Congestive heart failure
CC 92	Specified heart arrhythmias
CC 93	Other heart rhythm and conduction disorders
CC 95	Cerebral hemorrhage
CC 96	Ischemic or unspecified Stroke
CC 100	Hemiplegia/hemiparesis
CC 101	Cerebral palsy and other paralytic syndromes
CC 102	Speech, language, cognitive, perceptual
CC 104	Vascular disease with complications
CC 105	Vascular disease
CC 106	Other circulatory disease
CC 111	Aspiration and specified bacterial pneumonias
CC 112	Pneumococcal pneumonia, emphysema, lung abscess
CC 113	Viral and unspecified pneumonia, pleurisy
CC 130	Dialysis status
CC 131	Renal failure
CC 148	Decubitus ulcer of skin
CC 152	Cellulitis, local skin infection
CC 162	Other injuries
CC 177	Amputation status, lower limb/amputation
CC 178	Amputation status, upper limb
CC 179	Post-surgical states/aftercare/elective

Outcome

Outcome Criteria for the THA/TKA Readmission Measure

1. 30-day time frame

Rationale: Outcomes occurring within 30 days of discharge can be influenced by hospital care and early transition to the outpatient setting. The use of the 30-day time frame is a clinically meaningful period for hospitals to collaborate with their communities to reduce readmissions.

2. All-cause unplanned readmission

Rationale: From a patient perspective, an unplanned readmission from any cause is an adverse event.

3. Unplanned readmission

Rationale: Planned readmissions are generally not a signal of quality of care. Including planned readmissions in a readmission measure could create a disincentive to provide appropriate care to patients scheduled for elective or necessary procedures within 30 days of discharge.

Cohort

Inclusion Criteria for CABG Readmission Measure

1. Enrolled in Medicare FFS

Rationale: Claims-data are consistently available only for Medicare FFS beneficiaries.

2. Aged 65 or over

Rationale: Medicare patients younger than 65 usually qualify for the program due to severe disability. They are not included in the measure because Medicare patients younger than 65 are considered to be too clinically distinct from Medicare patients 65 and over.

3. Discharged alive from a non-federal acute care hospital

Rationale: Patients who are alive are eligible for a readmission.

4. Enrolled in Part A and Part B Medicare for the 12 months prior to the date of admission, and enrolled in Part A during the index admission

Rationale: The 12-month prior enrollment criterion ensures that patients were Medicare FFS beneficiaries and that their comorbidities are captured from claims for risk adjustment. Medicare Part A is required at the time of admission to ensure that no Medicare Advantage patients are included in the measure.

5. Having a qualifying isolated CABG procedure during the index admission

Rationale: Isolated CABG is the procedure targeted for measurement ([Table D.2.1](#)). Isolated CABG procedures are defined as those procedures performed without concomitant valve or other major cardiac, vascular, or thoracic procedures, because they represent a population of patients with higher risk. These procedure groups include:

- Valve procedures;
- Atrial and/or ventricular septal defects;
- Congenital anomalies;
- Other open cardiac procedures;
- Heart transplants;
- Aorta or other non-cardiac arterial bypass procedures; and
- Head, neck, intracranial vascular procedures.

Exclusion Criteria for CABG Readmission Measure

1. Without at least 30 days post-discharge enrollment in FFS Medicare

Rationale: The 30-day readmission outcome cannot be assessed in this group since claims data are used to determine whether a patient was readmitted.

2. Discharged against medical advice (AMA)

Rationale: Providers did not have the opportunity to deliver full care and prepare the patient for discharge.

3. With subsequent qualifying CABG procedures during the measurement period

Rationale: CABG procedures are expected to last for several years without the need for revision or repeat revascularization. A repeat CABG procedure during the measurement period likely represents a complication of the original CABG procedure and is a clinically more complex and

higher risk surgery. Therefore, we select the first CABG admission for inclusion in the measure and exclude subsequent CABG admissions from the cohort.

Table D.2.1– ICD-9-CM Codes Used to Identify Eligible CABG Procedures

ICD-9-CM Codes	Description
36.1x	Aortocoronary bypass for heart revascularization, not otherwise specified
36.11	(Aorto) coronary bypass of one coronary artery
36.12	(Aorto) coronary bypass of two coronary arteries
36.13	(Aorto) coronary bypass of three coronary arteries
36.14	(Aorto) coronary bypass of four or more coronary arteries
36.15	Single internal mammary- coronary artery bypass
36.16	Double internal mammary- coronary artery bypass
36.17	Abdominal- coronary artery bypass
36.19	Other bypass anastomosis for heart revascularization

Risk Adjustment

Table D.2.2– Risk Variables for the CABG Measure

Variable	Description
n/a	Age
n/a	Male
ICD-9 diagnosis codes: V42.2, V43.3, V45.81, 414.02, 414.03, 414.04, 414.05, 414.06, 414.07, 996.02, 996.03 ICD-9 procedure codes: 39.61	History of Prior CABG or Valve Surgery
ICD-9 code 785.51	Cardiogenic shock
CC 7-12	Cancer
CC 15-20, 119, 120	Diabetes mellitus (DM) or DM complications
CC 21	Protein-calorie malnutrition
CC 22-23	Disorders of fluid/electrolyte/acid-base
CC 24	Other endocrine/metabolic/nutritional disorders
CC 44	Severe hematological disorders
CC 49-50	Dementia or other specified brain disorders
CC 54-56	Major psychiatric disorders
CC 67-69, 100-102, 177-178	Hemiplegia, paraplegia, paralysis, functional disability
CC 71	Polyneuropathy
CC 80	Congestive heart failure
CC 92-93	Specified arrhythmias and other heart rhythm disorders
CC 95-96	Stroke
CC 97-99, 103	Cerebrovascular disease
CC 104-106	Vascular or circulatory disease
CC 108	Chronic obstructive pulmonary disease (COPD)
CC 109	Fibrosis of lung or other chronic lung disorders
CC 111-113	Pneumonia

Variable	Description
CC 115	Other lung disorders
CC 130	Dialysis status
CC 131	Renal failure
CC 148-149	Decubitus ulcer or chronic skin ulcer

Table D.2.3 – Complications of Care Variables Not Used in Risk Adjustment If Occurring Only During the Index Admission of CABG Measure

(Includes the subset of risk variables from **Table D.2.2** that are not used in risk adjustment if occurring only during the index admission)

Variable	Description
CC 17	Diabetes with acute complications
CC 23	Disorders of fluid/electrolyte/acid-base
CC 24	Other endocrine/metabolic/nutritional disorders
CC 80	Congestive heart failure
CC 92	Specified heart arrhythmias
CC 93	Other heart rhythm and conduction disorders
CC 95	Cerebral hemorrhage
CC 96	Ischemic or unspecified stroke
CC 97	Precerebral arterial occlusion and transient cerebral ischemia
CC 100	Hemiplegia/hemiparesis
CC 101	Cerebral palsy and other paralytic syndromes
CC 102	Speech, language, cognitive, perceptual
CC 104	Vascular disease with complications
CC 105	Vascular disease
CC 106	Other circulatory disease
CC 111	Aspiration and specified bacterial pneumonias
CC 112	Pneumococcal pneumonia, emphysema, lung abscess
CC 113	Viral and unspecified pneumonia, pleurisy
CC 130	Dialysis status
CC 131	Renal failure
CC 148	Decubitus ulcer of skin
CC 177	Amputation status, lower limb/amputation
CC 178	Amputation status, upper limb

Outcome

Outcome Criteria for CABG Measure

1. 30-day time frame

Rationale: Outcomes occurring within 30 days of discharge can be influenced by hospital care and early transition to the outpatient setting. The use of the 30-day time frame is a clinically meaningful period for hospitals to collaborate with their communities to reduce readmissions.

2. All-cause unplanned readmission

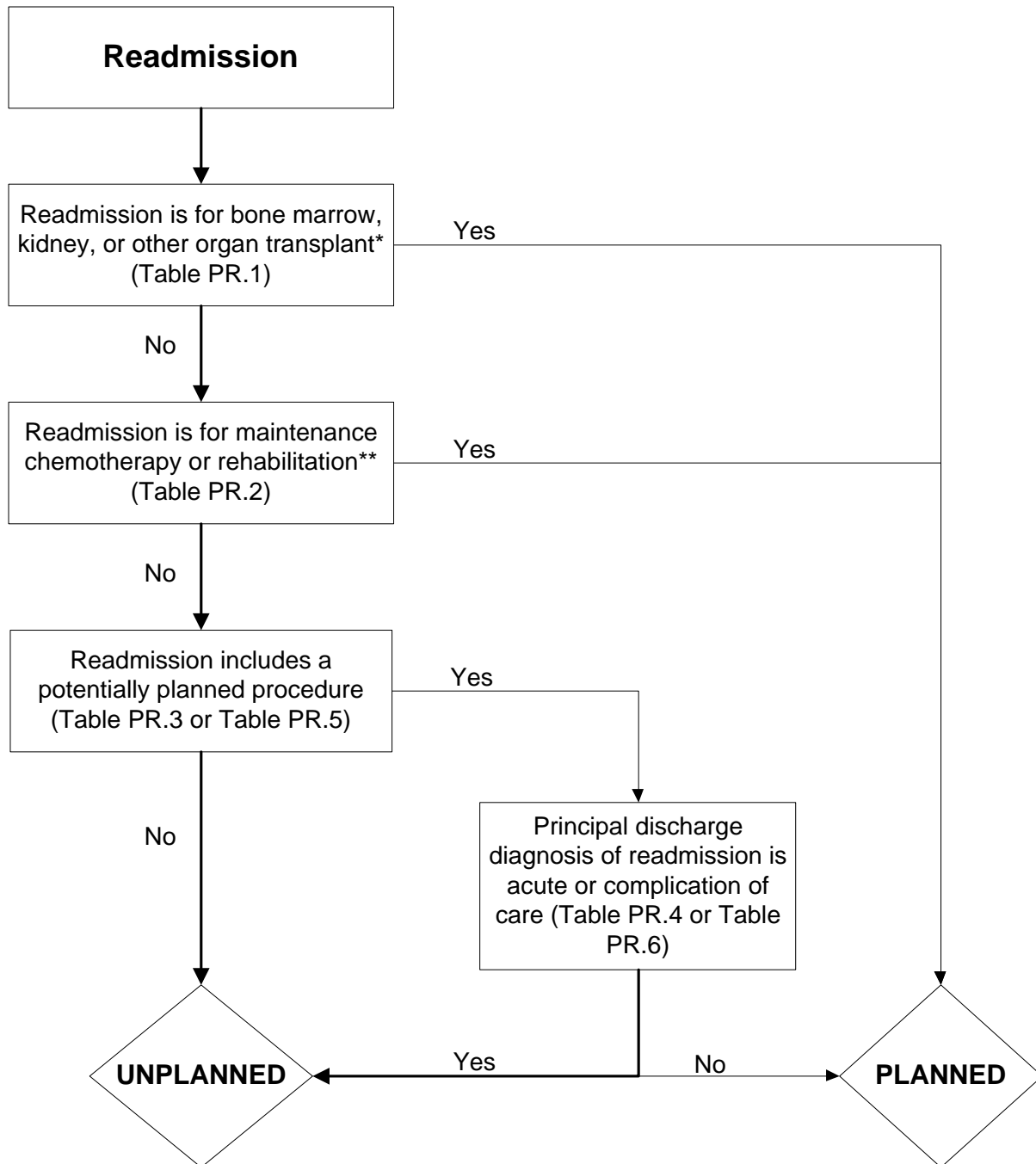
Rationale: From a patient perspective, an unplanned readmission from any cause is an adverse event.

3. Unplanned readmission

Rationale: Planned readmissions are generally not a signal of quality of care. Including planned readmissions in a readmission measure could create a disincentive to provide appropriate care to patients scheduled for elective or necessary procedures within 30 days of discharge.

Appendix E. Planned Readmission Algorithm

Figure PR.1– Planned Readmission Algorithm Version 3.0 Flowchart



Planned Readmission Algorithm Version 3.0 Tables – THA/TKA and CABG Measures

Table PR.1 – Procedure Categories That are Always Planned (Version 3.0—THA/TKA and CABG Populations)

Procedure CCS	Description
64	Bone marrow transplant
105	Kidney transplant
134	Cesarean section (Included only in all-payer population, not Medicare)
135	Forceps; vacuum; and breech delivery (Included only in all-payer population, not Medicare)
176	Other organ transplantation

Table PR.2 – Diagnosis Categories That are Always Planned (Version 3.0—THA/TKA and CABG Populations)

Diagnosis CCS	Description
45	Maintenance chemotherapy
194	Forceps delivery (Included only in all-payer population, not Medicare)
196	Normal pregnancy and/or delivery (Included only in all-payer population, not Medicare)
254	Rehabilitation (includes only V52.0, V52.1, V52.4, V52.8, V52.9, V53.8, and V58.82 - refer to Appendix C – Annual Updates for more detail)

Table PR.3 – Potentially Planned Procedure Categories (Version 3.0—THA/TKA Population)

Procedure CCS	Description
3	Laminectomy; excision intervertebral disc
5	Insertion of catheter or spinal stimulator and injection into spinal
9	Other OR therapeutic nervous system procedures
10	Thyroidectomy; partial or complete
12	Other therapeutic endocrine procedures
33	Other OR therapeutic procedures on, unspecified; mouth and pharynx
36	Lobectomy or pneumonectomy
38	Other diagnostic procedures on lung and bronchus
40	Other diagnostic procedures of respiratory tract and mediastinum
43	Heart valve procedures
44	Coronary artery bypass graft (CABG)
45	Percutaneous transluminal coronary angioplasty (PTCA)
49	Other OR heart procedures
51	Endarterectomy; vessel of head and neck
52	Aortic resection; replacement or anastomosis
53	Varicose vein stripping; lower limb
56	Other vascular bypass and shunt; not heart
59	Other OR procedures on vessels of head and neck
62	Other diagnostic cardiovascular procedures
66	Procedures on spleen
67	Other therapeutic procedures; hemic and lymphatic system
74	Gastrectomy; partial and total
78	Colorectal resection
79	Local excision of large intestine lesion (not endoscopic)
84	Cholecystectomy and common duct exploration
85	Inguinal and femoral hernia repair
86	Other hernia repair
99	Other OR gastrointestinal therapeutic procedures
104	Nephrectomy; partial or complete
106	Genitourinary incontinence procedures
107	Extracorporeal lithotripsy; urinary
109	Procedures on the urethra
112	Other OR therapeutic procedures of urinary tract
113	Transurethral resection of prostate (TURP)
114	Open prostatectomy
119	Oophorectomy; unilateral and bilateral
120	Other operations on ovary
124	Hysterectomy; abdominal and vaginal
129	Repair of cystocele and rectocele; obliteration of vaginal vault

Procedure CCS	Description
132	Other OR therapeutic procedures; female organs
152	Arthroplasty knee
153	Hip replacement; total and partial
154	Arthroplasty other than hip or knee
158	Spinal fusion
159	Other diagnostic procedures on musculoskeletal system
166	Lumpectomy; quadrantectomy of breast
167	Mastectomy
169	Debridement of wound; infection or burn
170	Excision of skin lesion
172	Skin graft
ICD-9 Codes	Description
30.1, 30.29, 30.3, 30.4, 31.74, 34.6	Laryngectomy, revision of tracheostomy, scarification of pleura (from Procedure CCS 42- Other OR Rx procedures on respiratory system and mediastinum)
55.03, 55.04	Percutaneous nephrostomy with and without fragmentation (from Procedure CCS 103- Nephrotomy and nephrostomy)
94.26, 94.27	Electroshock therapy (from Procedure CCS 218- Psychological and psychiatric evaluation and therapy)

Table PR.4 – Acute Diagnosis Categories (Version 3.0—THA/TKA Population)

Diagnosis CCS	Description
1	Tuberculosis
2	Septicemia (except in labor)
3	Bacterial infection; unspecified site
4	Mycoses
5	HIV infection
7	Viral infection
8	Other infections; including parasitic
9	Sexually transmitted infections (not HIV or hepatitis)
54	Gout and other crystal arthropathies
55	Fluid and electrolyte disorders
60	Acute posthemorrhagic anemia
61	Sickle cell anemia
63	Diseases of white blood cells
76	Meningitis (except that caused by tuberculosis or sexually transmitted disease)
77	Encephalitis (except that caused by tuberculosis or sexually transmitted disease)
78	Other CNS infection and poliomyelitis
82	Paralysis
83	Epilepsy; convulsions
84	Headache; including migraine
85	Coma; stupor; and brain damage
87	Retinal detachments; defects; vascular occlusion; and retinopathy
89	Blindness and vision defects
90	Inflammation; infection of eye (except that caused by tuberculosis or sexually transmitted disease)
91	Other eye disorders
92	Otitis media and related conditions
93	Conditions associated with dizziness or vertigo
99	Hypertension with complications
100	Acute myocardial infarction (with the exception of ICD-9 codes 410.x2)
102	Nonspecific chest pain
104	Other and ill-defined heart disease
107	Cardiac arrest and ventricular fibrillation
109	Acute cerebrovascular disease
112	Transient cerebral ischemia
116	Aortic and peripheral arterial embolism or thrombosis
118	Phlebitis; thrombophlebitis and thromboembolism
120	Hemorrhoids
122	Pneumonia (except that caused by TB or sexually transmitted disease)
123	Influenza
124	Acute and chronic tonsillitis

Diagnosis CCS	Description
125	Acute bronchitis
126	Other upper respiratory infections
127	Chronic obstructive pulmonary disease and bronchiectasis
128	Asthma
129	Aspiration pneumonitis; food/vomitus
130	Pleurisy; pneumothorax; pulmonary collapse
131	Respiratory failure; insufficiency; arrest (adult)
135	Intestinal infection
137	Diseases of mouth; excluding dental
139	Gastroduodenal ulcer (except hemorrhage)
140	Gastritis and duodenitis
142	Appendicitis and other appendiceal conditions
145	Intestinal obstruction without hernia
146	Diverticulosis and diverticulitis
148	Peritonitis and intestinal abscess
153	Gastrointestinal hemorrhage
154	Noninfectious gastroenteritis
157	Acute and unspecified renal failure
159	Urinary tract infections
165	Inflammatory conditions of male genital organs
168	Inflammatory diseases of female pelvic organs
172	Ovarian cyst
197	Skin and subcutaneous tissue infections
198	Other inflammatory condition of skin
201	Infective arthritis and osteomyelitis
204	Other non-traumatic joint injuries
207	Pathological fractures
225	Joint disorders and dislocations; trauma-related
226	Fracture of neck of femur (hip)
227	Spinal cord injury
228	Skull and face fractures
229	Fracture of upper limb
230	Fracture of lower limb
231	Other fractures
232	Sprains and strains
233	Intracranial injury
234	Crushing injury or internal injury
235	Open wounds of head; neck; and trunk
236	Open wounds of extremities
237	Complication of device; implant or graft

Diagnosis CCS	Description
238	Complications of surgical procedures or medical care
239	Superficial injury; contusion
240	Burns
241	Poisoning by psychotropic agents
242	Poisoning by other medications and drugs
243	Poisoning by nonmedicinal substances
244	Other injuries and conditions due to external causes
245	Syncope
246	Fever of unknown origin
247	Lymphadenitis
249	Shock
250	Nausea and vomiting
251	Abdominal pain
252	Malaise and fatigue
253	Allergic reactions
259	Residual codes; unclassified
650	Adjustment disorders
651	Anxiety disorders
652	Attention-deficit, conduct, and disruptive behavior disorders
653	Delirium, dementia, and amnestic and other cognitive disorders
656	Impulse control disorders, NEC
658	Personality disorders
660	Alcohol-related disorders
661	Substance-related disorders
662	Suicide and intentional self-inflicted injury
663	Screening and history of mental health and substance abuse codes
670	Miscellaneous disorders
ICD-9 codes	Description
Acute ICD-9 codes within Diagnosis CCS 97: Peri-; endo-; and myocarditis; cardiomyopathy	
032.82	Diphtheritic myocarditis
036.40	Meningococcal carditis, unspecified
036.41	Meningococcal pericarditis
036.42	Meningococcal endocarditis
036.43	Meningococcal myocarditis
074.20	Coxsackie carditis, unspecified
074.21	Coxsackie pericarditis
074.22	Coxsackie endocarditis
074.23	Coxsackie myocarditis
112.81	Candidal endocarditis
115.03	Infection by Histoplasma capsulatum, pericarditis
115.04	Infection by Histoplasma capsulatum, endocarditis

Diagnosis CCS	Description
115.13	Infection by Histoplasma duboisii pericarditis
115.14	Histoplasma duboisii, endocarditis
115.93	Histoplasmosis, unspecified, pericarditis
115.94	Histoplasmosis, unspecified, endocarditis
130.3	Myocarditis due to toxoplasmosis
391.0	Acute rheumatic pericarditis
391.1	Acute rheumatic endocarditis
391.2	Acute rheumatic myocarditis
391.8	Other acute rheumatic heart disease, unspecified
391.9	Acute rheumatic heart disease, unspecified
392.0	Rheumatic chorea with heart involvement
398.0	Rheumatic myocarditis
398.90	Rheumatic heart disease, unspecified
398.99	Other Rheumatic heart diseases
420.0	Acute pericarditis in diseases classified elsewhere
420.90	Acute pericarditis, unspecified
420.91	Acute idiopathic pericarditis
420.99	Other acute pericarditis
421.0	Acute and subacute bacterial endocarditis
421.1	Acute and subacute infective endocarditis in diseases classified elsewhere
421.9	Acute endocarditis, unspecified
422.0	Acute myocarditis in diseases classified elsewhere
422.90	Acute myocarditis, unspecified
422.91	Idiopathic myocarditis
422.92	Septic myocarditis
422.93	Toxic myocarditis
422.99	Other acute myocarditis
423.0	Hemopericardium
423.1	Adhesive pericarditis
423.2	Constrictive pericarditis
423.3	Cardiac tamponade
429.0	Myocarditis, unspecified
Acute ICD-9 codes within Diagnosis CCS 105: Conduction disorders	
426.0	Atrioventricular block, complete
426.10	Atrioventricular block, unspecified
426.11	First degree atrioventricular block
426.12	Mobitz (type) II atrioventricular block
426.13	Other second degree atrioventricular block
426.2	Left bundle branch hemiblock
426.3	Other left bundle branch block
426.4	Right bundle branch block
426.50	Bundle branch block, unspecified

Diagnosis CCS	Description
426.51	Right bundle branch block and left posterior fascicular block
426.52	Right bundle branch block and left anterior fascicular block
426.53	Other bilateral bundle branch block
426.54	Trifascicular block
426.6	Other heart block
426.7	Anomalous atrioventricular excitation
426.81	Lown-Ganong-Levine syndrome
426.82	Long QT syndrome
426.9	Conduction disorder, unspecified
Acute ICD-9 codes within Diagnosis CCS 106: Dysrhythmia	
427.2	Paroxysmal tachycardia, unspecified
427.69	Premature beats
427.89	Other specified cardiac dysrhythmias
427.9	Cardiac dysrhythmia, unspecified
785.0	Tachycardia, unspecified
Acute ICD-9 codes within Diagnosis CCS 108: Congestive heart failure; nonhypertensive	
39891	Rheumatic heart failure
398.91	Rheumatic heart failure (congestive)
428.0	Congestive heart failure, unspecified
428.1	Left heart failure
428.20	Systolic heart failure, unspecified
428.21	Acute systolic heart failure
428.23	Acute on chronic systolic heart failure
428.30	Diastolic heart failure, unspecified
428.31	Acute diastolic heart failure
428.33	Acute on chronic diastolic heart failure
428.40	Combined systolic and diastolic heart failure, unspecified
428.41	Acute combined systolic and diastolic heart failure
428.43	Acute on chronic combined systolic and diastolic heart failure
428.9	Heart failure, unspecified
Acute ICD-9 codes within Diagnosis CCS 149: Biliary tract disease	
57400	Calculus of gallbladder with acute cholecystitis without mention of obstruction
574.00	Calculus of gallbladder with acute cholecystitis, without mention of obstruction
574.30	Calculus of bile duct with acute cholecystitis, without mention of obstruction
574.31	Calculus of bile duct with acute cholecystitis, with obstruction
574.60	Calculus of gallbladder and bile duct with acute cholecystitis, without mention of obstruction
574.61	Calculus of gallbladder and bile duct with acute cholecystitis, with obstruction
574.80	Calculus of gallbladder and bile duct with acute and chronic cholecystitis, without mention of obstruction
574.81	Calculus of gallbladder and bile duct with acute and chronic cholecystitis, with obstruction
575.0	Acute cholecystitis
575.12	Acute and chronic cholecystitis

Diagnosis CCS	Description
576.1	Cholangitis
Acute ICD-9 codes with Diagnosis CCS 152: Pancreatic disorders	
577.0	Acute pancreatitis

Table PR.5 - Potentially Planned Procedure Categories (Version 3.0 – CABG Population)

Procedure CCS	Description
3	Laminectomy; excision intervertebral disc
5	Insertion of catheter or spinal stimulator and injection into spinal
9	Other OR therapeutic nervous system procedures
10	Thyroidectomy; partial or complete
12	Other therapeutic endocrine procedures
33	Other OR therapeutic procedures on nose; mouth and pharynx
36	Lobectomy or pneumonectomy
38	Other diagnostic procedures on lung and bronchus
40	Other diagnostic procedures of respiratory tract and mediastinum
51	Endarterectomy; vessel of head and neck
52	Aortic resection; replacement or anastomosis
53	Varicose vein stripping; lower limb
59	Other OR procedures on vessels of head and neck
62	Other diagnostic cardiovascular procedures
66	Procedures on spleen
67	Other therapeutic procedures; hemic and lymphatic system
74	Gastrectomy; partial and total
78	Colorectal resection
85	Inguinal and femoral hernia repair
86	Other hernia repair
99	Other OR gastrointestinal therapeutic procedures
104	Nephrectomy; partial or complete
106	Genitourinary incontinence procedures
107	Extracorporeal lithotripsy; urinary
109	Procedures on the urethra
112	Other OR therapeutic procedures of urinary tract
113	Transurethral resection of prostate (TURP)
114	Open prostatectomy
119	Oophorectomy; unilateral and bilateral
120	Other operations on ovary
124	Hysterectomy; abdominal and vaginal
129	Repair of cystocele and rectocele; obliteration of vaginal vault
132	Other OR therapeutic procedures; female organs
152	Arthroplasty knee
153	Hip replacement; total and partial
154	Arthroplasty other than hip or knee
158	Spinal fusion
166	Lumpectomy; quadrantectomy of breast
167	Mastectomy
170	Excision of skin lesion
172	Skin graft

ICD-9 Codes	Description
30.1, 30.29, 30.3, 30.4, 31.74, 34.6	Laryngectomy, revision of tracheostomy, scarification of pleura (from Procedure CCS 42- Other OR Respiratory procedures on respiratory system and mediastinum)
55.03, 55.04	Percutaneous nephrostomy with and without fragmentation (from Procedure CCS 103- Nephrotomy and nephrostomy)
94.26, 94.27	Electroshock therapy (from Procedure CCS 218- Psychological and psychiatric evaluation and therapy)

Table PR.6 - Acute Diagnosis Categories (Version 3.0 – CABG Population)

Diagnosis CCS	Description
1	Tuberculosis
2	Septicemia (except in labor)
3	Bacterial infection; unspecified site
4	Mycoses
5	HIV infection
7	Viral infection
8	Other infections; including parasitic
9	Sexually transmitted infections (not HIV or hepatitis)
54	Gout and other crystal arthropathies
55	Fluid and electrolyte disorders
60	Acute posthemorrhagic anemia
61	Sickle cell anemia
63	Diseases of white blood cells
76	Meningitis (except that caused by tuberculosis or sexually transmitted disease)
77	Encephalitis (except that caused by tuberculosis or sexually transmitted disease)
78	Other CNS infection and poliomyelitis
82	Paralysis
83	Epilepsy; convulsions
84	Headache; including migraine
85	Coma; stupor; and brain damage
87	Retinal detachments; defects; vascular occlusion; and retinopathy
89	Blindness and vision defects
90	Inflammation; infection of eye (except that caused by tuberculosis or sexually transmitted disease)
91	Other eye disorders
92	Otitis media and related conditions
93	Conditions associated with dizziness or vertigo
99	Hypertension with complications
100	Acute myocardial infarction (with the exception of ICD-9 codes 410.x2)
102	Nonspecific chest pain
104	Other and ill-defined heart disease
107	Cardiac arrest and ventricular fibrillation
109	Acute cerebrovascular disease
112	Transient cerebral ischemia
116	Aortic and peripheral arterial embolism or thrombosis
118	Phlebitis; thrombophlebitis and thromboembolism
120	Hemorrhoids
122	Pneumonia (except that caused by TB or sexually transmitted disease)
123	Influenza
124	Acute and chronic tonsillitis
125	Acute bronchitis
126	Other upper respiratory infections
127	Chronic obstructive pulmonary disease and bronchiectasis
128	Asthma
129	Aspiration pneumonitis; food/vomitus
130	Pleurisy; pneumothorax; pulmonary collapse
131	Respiratory failure; insufficiency; arrest (adult)
135	Intestinal infection

137	Diseases of mouth; excluding dental
139	Gastroduodenal ulcer (except hemorrhage)
140	Gastritis and duodenitis
142	Appendicitis and other appendiceal conditions
145	Intestinal obstruction without hernia
146	Diverticulosis and diverticulitis
148	Peritonitis and intestinal abscess
153	Gastrointestinal hemorrhage
154	Noninfectious gastroenteritis
157	Acute and unspecified renal failure
159	Urinary tract infections
165	Inflammatory conditions of male genital organs
168	Inflammatory diseases of female pelvic organs
172	Ovarian cyst
197	Skin and subcutaneous tissue infections
198	Other inflammatory condition of skin
225	Joint disorders and dislocations; trauma-related
226	Fracture of neck of femur (hip)
227	Spinal cord injury
228	Skull and face fractures
229	Fracture of upper limb
230	Fracture of lower limb
232	Sprains and strains
233	Intracranial injury
234	Crushing injury or internal injury
235	Open wounds of head; neck; and trunk
237	Complication of device; implant or graft
238	Complications of surgical procedures or medical care
239	Superficial injury; contusion
240	Burns
241	Poisoning by psychotropic agents
242	Poisoning by other medications and drugs
243	Poisoning by nonmedicinal substances
244	Other injuries and conditions due to external causes
245	Syncope
246	Fever of unknown origin
247	Lymphadenitis
249	Shock
250	Nausea and vomiting
251	Abdominal pain
252	Malaise and fatigue
253	Allergic reactions
259	Residual codes; unclassified
650	Adjustment disorders
651	Anxiety disorders
652	Attention-deficit, conduct, and disruptive behavior disorders
653	Delirium, dementia, and amnestic and other cognitive disorders
656	Impulse control disorders, NEC
658	Personality disorders
660	Alcohol-related disorders

661	Substance-related disorders
662	Suicide and intentional self-inflicted injury
663	Screening and history of mental health and substance abuse codes
670	Miscellaneous disorders
ICD-9 codes	Description
Acute ICD-9 codes within Diagnosis CCS 97: Peri-; endo-; and myocarditis; cardiomyopathy	
032.82	Diphtheritic myocarditis
036.40	Meningococcal carditis, unspecified
036.41	Meningococcal pericarditis
036.42	Meningococcal endocarditis
036.43	Meningococcal myocarditis
074.20	Coxsackie carditis, unspecified
074.21	Coxsackie pericarditis
074.22	Coxsackie endocarditis
074.23	Coxsackie myocarditis
112.81	Candidal endocarditis
115.03	Infection by Histoplasma capsulatum, pericarditis
115.04	Infection by Histoplasma capsulatum, endocarditis
115.13	Infection by Histoplasma duboisii pericarditis
115.14	Histoplasma duboisii, endocarditis
115.93	Histoplasmosis, unspecified, pericarditis
115.94	Histoplasmosis, unspecified, endocarditis
130.3	Myocarditis due to toxoplasmosis
391.0	Acute rheumatic pericarditis
391.1	Acute rheumatic endocarditis
391.2	Acute rheumatic myocarditis
391.8	Other acute rheumatic heart disease, unspecified
391.9	Acute rheumatic heart disease, unspecified
392.0	Rheumatic chorea with heart involvement
398.0	Rheumatic myocarditis
398.90	Rheumatic heart disease, unspecified
398.99	Other Rheumatic heart diseases
420.0	Acute pericarditis in diseases classified elsewhere
420.90	Acute pericarditis, unspecified
420.91	Acute idiopathic pericarditis
420.99	Other acute pericarditis
421.0	Acute and subacute bacterial endocarditis
421.1	Acute and subacute infective endocarditis in diseases classified elsewhere
421.9	Acute endocarditis, unspecified
422.0	Acute myocarditis in diseases classified elsewhere
422.90	Acute myocarditis, unspecified
422.91	Idiopathic myocarditis
422.92	Septic myocarditis
422.93	Toxic myocarditis
422.99	Other acute myocarditis
423.0	Hemopericardium
423.1	Adhesive pericarditis
423.2	Constrictive pericarditis
423.3	Cardiac tamponade
429.0	Myocarditis, unspecified

Acute ICD-9 codes within Diagnosis CCS 105: Conduction disorders	
426.0	Atrioventricular block, complete
426.10	Atrioventricular block, unspecified
426.11	First degree atrioventricular block
426.12	Mobitz (type) II atrioventricular block
426.13	Other second degree atrioventricular block
426.2	Left bundle branch hemiblock
426.3	Other left bundle branch block
426.4	Right bundle branch block
426.50	Bundle branch block, unspecified
426.51	Right bundle branch block and left posterior fascicular block
426.52	Right bundle branch block and left anterior fascicular block
426.53	Other bilateral bundle branch block
426.54	Trifascicular block
426.6	Other heart block
426.7	Anomalous atrioventricular excitation
426.81	Lown-Ganong-Levine syndrome
426.82	Long QT syndrome
426.9	Conduction disorder, unspecified
Acute ICD-9 codes within Diagnosis CCS 106: Dysrhythmia	
427.2	Paroxysmal tachycardia, unspecified
427.69	Other premature beats
427.89	Other specified cardiac dysrhythmias
427.9	Cardiac dysrhythmia, unspecified
785.0	Tachycardia, unspecified
Acute ICD-9 codes within Diagnosis CCS 108: Congestive heart failure; nonhypertensive	
398.91	Rheumatic heart failure (congestive)
428.0	Congestive heart failure, unspecified
428.1	Left heart failure
428.20	Systolic heart failure, unspecified
428.21	Acute systolic heart failure
428.23	Acute on chronic systolic heart failure
428.30	Diastolic heart failure, unspecified
428.31	Acute diastolic heart failure
428.33	Acute on chronic diastolic heart failure
428.40	Combined systolic and diastolic heart failure, unspecified
428.41	Acute combined systolic and diastolic heart failure
428.43	Acute on chronic combined systolic and diastolic heart failure
428.9	Heart failure, unspecified
Acute ICD-9 codes within Diagnosis CCS 149: Biliary tract disease	
574.00	Calculus of gallbladder with acute cholecystitis, without mention of obstruction
574.01	Calculus of gallbladder with acute cholecystitis, with obstruction
574.30	Calculus of bile duct with acute cholecystitis, without mention of obstruction
574.31	Calculus of bile duct with acute cholecystitis, with obstruction
574.60	Calculus of gallbladder and bile duct with acute cholecystitis, without mention of obstruction
574.61	Calculus of gallbladder and bile duct with acute cholecystitis, with obstruction
574.80	Calculus of gallbladder and bile duct with acute and chronic cholecystitis, without mention of obstruction
574.81	Calculus of gallbladder and bile duct with acute and chronic cholecystitis, with obstruction

575.0	Acute cholecystitis
575.12	Acute and chronic cholecystitis
576.1	Cholangitis
Acute ICD-9 codes with Diagnosis CCS 152: Pancreatic disorders	
577.0	Acute pancreatitis