

# **2017 Procedure-Specific Measures Updates and Specifications Report Hospital-Level 30-Day Risk-Standardized Readmission Measures**

**Isolated Coronary Artery Bypass Graft (CABG) Surgery – Version 4.0  
Elective Primary Total Hip Arthroplasty (THA) and/or Total Knee Arthroplasty  
(TKA) – Version 6.0**

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## Table of Contents

<b>TABLE OF CONTENTS .....</b>	<b>2</b>
<b>LIST OF TABLES .....</b>	<b>4</b>
<b>LIST OF FIGURES .....</b>	<b>5</b>
<b>1. HOW TO USE THIS REPORT .....</b>	<b>7</b>
<b>2. BACKGROUND AND OVERVIEW OF MEASURE METHODOLOGY .....</b>	<b>9</b>
2.1 Background on Readmission Measures .....	9
2.2 Overview of Measure Methodology .....	9
2.2.1 Cohort .....	9
2.2.2 Outcome .....	12
2.2.3 Planned Readmission Algorithm (Version 4.0 [ICD-10]) .....	13
2.2.4 Risk-Adjustment Variables .....	14
2.2.5 Data Sources .....	15
2.2.6 Measure Calculation .....	15
2.2.7 Categorizing Hospital Performance .....	16
<b>3. UPDATES TO MEASURES FOR 2017 PUBLIC REPORTING .....</b>	<b>18</b>
3.1 Rationale for Measure Updates .....	18
3.2 Detailed Discussion of Measure Updates .....	18
3.2.1 Updates to ICD-10-Based Measure Specifications .....	18
3.3 Changes to SAS Pack .....	20
<b>4. RESULTS FOR 2017 PUBLIC REPORTING .....</b>	<b>22</b>
4.1 Assessment of Updated Models .....	22
4.2 CABG Surgery Readmission 2017 Model Results .....	23
4.2.1 Index Cohort Exclusions .....	23
4.2.2 Frequency of CABG Surgery Model Variables .....	24
4.2.3 CABG Surgery Model Parameters and Performance .....	24
4.2.4 Distribution of Hospital Volumes and Readmission Rates for CABG Surgery .....	24
4.2.5 Distribution of Hospitals by Performance Category in the Three-Year Dataset .....	25
4.3 THA/TKA Readmission 2017 Model Results .....	30
4.3.1 Index Cohort Exclusions .....	30
4.3.2 Frequency of THA/TKA Model Variables .....	31
4.3.3 THA/TKA Model Parameters and Performance .....	31
4.3.4 Distribution of Hospital Volumes and Readmission Rates for THA/TKA ..	31
4.3.5 Distribution of Hospitals by Performance Category in the Three-Year Dataset .....	31

<b>5. GLOSSARY .....</b>	<b>37</b>
<b>6. REFERENCES .....</b>	<b>39</b>
<b>7. APPENDICES .....</b>	<b>41</b>
Appendix A. Statistical Approach to RSRRs for CABG Surgery and THA/TKA Measures	41
Hospital Performance Reporting .....	41
Creating Interval Estimates.....	42
Appendix B. Data QA .....	44
Phase I.....	44
Phase II.....	44
Phase III.....	44
Appendix C. Annual Updates.....	45
Appendix D. Measure Specifications.....	48
Appendix D.1 Hospital-Level 30-Day RSRR following CABG Surgery (NQF #2515)	48
Appendix D.2 Hospital-Level 30-Day RSRR following Elective Primary THA and/or TKA (NQF #1551).....	62
Appendix E. Planned Readmission Algorithm .....	69

## List of Tables

Table 4.2.1 – Frequency of CABG Surgery Model Variables over Different Time Periods.....	25
Table 4.2.2 – Hierarchical Logistic Regression Model Variable Coefficients for CABG Surgery over Different Time Periods .....	26
Table 4.2.3 – Adjusted OR and 95% CIs for the CABG Surgery Hierarchical Logistic Regression Model over Different Time Periods .....	27
Table 4.2.4 – CABG Surgery Generalized Linear Modeling (Logistic Regression) Performance over Different Time Periods .....	28
Table 4.2.5 – Distribution of Hospital CABG Surgery Admission Volumes over Different Time Periods....	28
Table 4.2.6 – Distribution of Hospital CABG Surgery RSRRs over Different Time Periods.....	28
Table 4.2.7 – Between-Hospital Variance for CABG Surgery .....	28
Table 4.3.1 – Frequency of THA/TKA Model Variables over Different Time Periods .....	32
Table 4.3.2 – Hierarchical Logistic Regression Model Variable Coefficients for THA/TKA over Different Time Periods.....	33
Table 4.3.3 – Adjusted OR and 95% CIs for the THA/TKA Hierarchical Logistic Regression Model over Different Time Periods .....	34
Table 4.3.4 – THA/TKA Generalized Linear Modeling (Logistic Regression) Performance over Different Time Periods.....	35
Table 4.3.5 – Distribution of Hospital THA/TKA Admission Volumes over Different Time Periods .....	35
Table 4.3.6 – Distribution of Hospital THA/TKA RSRRs over Different Time Periods .....	35
Table 4.3.7 – Between-Hospital Variance for THA/TKA.....	35
Table D.1.1 – ICD-10-PCS Codes Used to Identify Eligible CABG Procedures .....	49
Table D.1.2 – Risk Variables for CABG Surgery Measure .....	58
Table D.2.1 – ICD-10-PCS Codes Used to Identify Eligible THA/TKA Procedures.....	63
Table D.2.2 – Risk Variables for THA/TKA Measure.....	65
Table PR.1 – Procedure Categories That Are Always Planned (Version 4.0 [ICD-10] — CABG and THA/TKA Populations) .....	70
Table PR.2 – Diagnosis Categories That Are Always Planned (Version 4.0 [ICD-10] — CABG and THA/TKA Populations) .....	70
Table PR.3 – Potentially Planned Procedures (Version 4.0 [ICD-10] — CABG Population).....	70
Table PR.4 – Acute Diagnoses (Version 4.0 [ICD-10] — CABG Population).....	71
Table PR.5 – Potentially Planned Procedures (Version 4.0 [ICD-10] — THA/TKA Population).....	75
Table PR.6 – Acute Diagnoses (Version 4.0 [ICD-10] —THA/TKA Population).....	77

## List of Figures

Figure 4.2.1 – CABG Surgery Cohort Exclusions in the July 2013-June 2016 Dataset .....	23
Figure 4.2.2 – Distribution of Hospital 30-Day CABG Surgery RSRRs between July 2013 and June 2016 ..	29
Figure 4.3.1 – THA/TKA Cohort Exclusions in the July 2013-June 2016 Dataset .....	30
Figure 4.3.2 – Distribution of Hospital 30-Day THA/TKA RSRRs between July 2013 and June 2016 .....	36
Figure PR.1 – Planned Readmission Algorithm Version 4.0 (ICD-10) Flowchart.....	69

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## 1. HOW TO USE THIS REPORT

This report describes the Centers for Medicare & Medicaid Services' (CMS's) procedure-specific readmission measures used in the Hospital Inpatient Quality Reporting program and publicly reported on [Hospital Compare](#). The measures report hospital-level 30-day risk-standardized readmission rates (RSRRs) following isolated coronary artery bypass graft (CABG) surgery and RSRRs following an elective primary total hip arthroplasty (THA) and/or total knee arthroplasty (TKA) procedure. This report serves as a single source of information about these measures for a wide range of readers. Reports describing other [outcome](#) measures can be found on [QualityNet](#).

This report provides an overview of the measure methodology, methodology updates for 2017 public reporting, and the national results for 2017 public reporting. The appendices provide detailed specifications for each measure, including tables of the codes used for [cohort](#) derivation and risk adjustment, as well as a history of annual updates.

Specifically, the report includes:

- **[Section 2](#) - An overview of the CABG surgery and THA/TKA readmission measures:**
  - Background
  - Cohort inclusions and exclusions
    - Included and excluded hospitalizations
    - How transferred patients are handled
  - [Unplanned readmission](#) outcome
  - [Risk-adjustment variables](#)
  - Data sources
  - Readmission rate calculation
  - Categorization of hospitals' performance score
- **[Section 3](#) - 2017 measure updates**
- **[Section 4](#) - 2017 measure results**
- **[Section 5](#) - Glossary**

The Appendices contain detailed measure information, consisting of:

- [Appendix A](#): Statistical approach to calculating RSRRs;
- [Appendix B](#): Data quality assurance (QA);
- [Appendix C](#): Annual updates to the measures since measure development;
- [Appendix D](#): Measure specifications, including hyperlinks to certain ICD-10 code lists that are posted in supplemental Excel files on [QualityNet](#), due to volume; and,
- [Appendix E](#): Detailed overview of the [planned readmission](#) algorithm.

The original measure methodology reports and prior updates and specifications reports are available in the 'Measure Methodology' and 'Archived Resources' sections under the claims-based readmission measures page of [QualityNet](#).<sup>1-6</sup>

The measure methodology is also described in the peer-reviewed medical literature.<sup>7</sup>

For resources on quality improvement activities aimed at reducing readmission in general, and for more information about the cost and business case for making such improvements, refer to the 'Reducing Readmissions' section under the claims-based readmission measures page of [QualityNet](#).



## 2. BACKGROUND AND OVERVIEW OF MEASURE METHODOLOGY

### 2.1 Background on Readmission Measures

In December 2013, CMS began publicly reporting 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 began public reporting an additional readmission measure; namely, CABG surgery. This measure also includes admissions to non-federal acute care hospitals and critical access hospitals.

Results for both of these 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 (YNHHSC/CORE) to update the CABG surgery and THA/TKA readmission measures for 2017 public reporting through a process of measure reevaluation. Measures are reevaluated annually in order to improve them by responding to stakeholder input and incorporating advances in science or changes in coding.

### 2.2 Overview of Measure Methodology

The 2017 risk-adjusted readmission measures use specifications from the initial measure methodology reports with refinements to the measures, as listed in [Appendix C](#) and described in the prior measure updates and specifications reports.<sup>1-6</sup> An overview of the methodology is presented in this section.

The methodology for the Hospital Inpatient Quality Reporting measures described in this report is the same methodology that will be used to calculate excess readmissions for the CABG surgery and THA/TKA measures included in the Hospital Readmissions Reduction Program (HRRP); however, the hospitals included in the two programs differ slightly. More information about the HRRP can be found on [QualityNet's Hospital Readmissions Reduction Program](#) webpage and in the fiscal year 2013 – 2017 Inpatient Prospective Payment System (IPPS) [Final Rules](#) on the CMS website.

#### 2.2.1 Cohort

##### Index Admissions Included in the Measures

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

- Having a qualifying isolated CABG surgery or elective primary THA/TKA procedure during the index admission;
- Enrolled in [Medicare fee-for-service \(FFS\)](#) Part A and Part B for the 12 months prior to the date of the admission, and enrolled in Part A during the index admission;
- Aged 65 or over; and,

- Discharged alive from a non-federal short-term acute care hospital.

Isolated CABG surgeries are defined as those CABG 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;
- Head, neck, intracranial vascular procedures; or,
- Other chest and thoracic procedures.

The International Classification of Diseases, 10th Revision, Procedure Coding System (ICD-10-PCS) codes used to define a CABG surgery in claims for discharges on or after October 1, 2015 are listed in [Appendix D](#), in [Table D.1.1](#). The ICD-10-PCS codes for discharges on or after October 1, 2015 that are used to identify a concomitant valve or other major cardiac, vascular, or thoracic procedure and disqualify the admission from cohort inclusion are posted on [QualityNet](#) due to volume. ICD-9 code lists for discharges prior to October 1, 2015 can be found in the 2016 procedure-specific readmission measures updates and specifications report posted on [QualityNet](#).

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

- Fracture of the pelvis or lower limbs coded in the principal or secondary discharge diagnosis fields of the index admission;
- A concurrent partial hip arthroplasty procedure;
- A concurrent revision, resurfacing, or implanted device/prosthesis removal procedure;
- 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; or,
- Transfer from another acute care facility for the THA/TKA.

The ICD-10-PCS codes used to define a THA/TKA procedure in claims for discharges on or after October 1, 2015 are listed in [Appendix D](#), in [Table D.2.1](#). The ICD-10 codes for discharges on or after October 1, 2015 that are used to identify a THA/TKA procedure as non-elective or non-primary and disqualify the admission from cohort inclusion are posted on [QualityNet](#) due to volume. ICD-9 code lists for discharges prior to October 1, 2015 can be found in the 2016 procedure-specific readmission measures updates and specifications report posted on [QualityNet](#).

### Index Admissions Excluded from the Measures

The readmission measures exclude index admissions for patients:

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

For patients with more than one qualifying CABG surgery admission in the measurement period, the first CABG admission is selected for inclusion in the measure and the subsequent CABG admission(s) are excluded from the cohort.

Additional exclusion criteria for the THA/TKA cohort:

- Patients admitted for the index procedure and subsequently transferred to another acute care facility; or,
- Patients with more than two THA/TKA procedure codes during the index admission.

Additionally, for the THA/TKA cohort, admissions for THA/TKA within 30 days of discharge from a prior THA/TKA index admission are excluded as index admissions.

Thus, for both CABG surgery and THA/TKA, no hospitalization will be considered 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 other CMS readmission measures.

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, claims for patients not listed in the Medicare enrollment database, and records with invalid provider IDs.

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

### Patients Transferred between Hospitals

The measures consider multiple contiguous hospitalizations as a single acute episode of care. Transfer patients are identified by tracking claims for inpatient short-term acute care hospitalizations over time. To qualify as a transfer, the second inpatient admission must occur on the same day or the next calendar day following discharge from the first inpatient admission at a different short-term acute care hospital. Cases that meet this criterion are considered transfers regardless of whether or not the first institution indicates intent to transfer the patient in the discharge disposition code.

Admissions associated with transfers between acute care hospitals are not excluded from the CABG surgery readmission measure. A 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. In a series of one or more transfers, the readmission outcome is always assigned to the hospital that performed the first (“index”) CABG surgery, even if it is not the discharging hospital. For example, if a patient is admitted to Hospital A and undergoes CABG surgery, and then is transferred to Hospital B, an unplanned readmission within 30 days of discharge from the hospital B admission would be captured in Hospital A’s readmission outcome.

In contrast, admissions associated with transfers between acute care hospitals are excluded from the THA/TKA readmission measure, regardless of where the THA/TKA was performed. In cases where the THA/TKA procedure is performed at the receiving hospital, such procedures are not likely to be elective. When the THA/TKA procedure is performed at the transferring hospital, assignment of the outcome to the appropriate hospital is difficult.

## **2.2.2 Outcome**

### All-Cause Unplanned Readmissions

The measures are designed to capture unplanned 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 considered readmissions in the measure outcome. For more detail about how planned readmissions are defined, refer to [Section 2.2.3](#) and [Appendix E](#).

All unplanned readmissions are considered an outcome, regardless of cause. There are a number of reasons for assessing 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 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 that necessitates readmission. In this context, considering the readmission to be unrelated to the care the patient received for the THA/TKA during the index admission would be inappropriate.

### 30-Day Time Frame

The measures assess unplanned readmissions within a 30-day period from the date of discharge from an index admission. The measures use a 30-day time frame because older adult patients are more vulnerable to adverse health outcomes during this time. Readmission occurring within 30 days of discharge can be influenced by hospital care and the early transition to the non-acute care setting. The 30-day time frame is a clinically meaningful period for hospitals to collaborate with their communities in an effort to reduce readmissions.<sup>8</sup>

In determining whether an unplanned readmission occurred within 30 days of discharge from the index admission, the measures use the claim “FROM” date, which is the date the subsequent admission episode started (that is, the date the patient first received care at that hospital within three days of the admission). Thus, in the case where a patient began their unplanned readmission with an ED visit, observation stay, or care received in another outpatient location within the same facility, the case was converted to inpatient admission by that hospital within three days of that outpatient encounter, and the care is combined into one claim, the date the outpatient care started would be used for the 30-day time frame.

#### Multiple Readmissions

If a patient has more than one unplanned admission within 30 days of discharge from the index admission, only the first is considered a readmission. The measures assess a dichotomous yes or no outcome of whether each admitted patient has any unplanned readmission within 30 days. If the first readmission after discharge is planned, any subsequent unplanned readmission is not considered in the 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 4.0 [ICD-10])**

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 (for example, 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 the 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 CABG and THA/TKA readmission measures make a few modifications to the planned readmission algorithm, which are listed in [Appendix E](#).

For each measure, 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 illustrated in [Figure PR.1](#), 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 ([Table PR.1](#));
2. The principal diagnosis is in one of the diagnosis categories that are always planned ([Table PR.2](#)); or,
3. A procedure is performed that is one of the potentially planned procedures ([Table PR.3](#) and [Table PR.5](#), for CABG surgery and THA/TKA, respectively) and the principal diagnosis is not in the list of acute discharge diagnoses ([Table PR.4](#) and [Table PR.6](#), for CABG surgery and THA/TKA, respectively).

Note that the ICD-10-based Agency for Healthcare Research and Quality (AHRQ) [Clinical Classification Software \(CCS\)](#) categories and the singular ICD-10 codes listed in [Tables PR.1](#) through [PR.6](#) are used to identify planned readmissions in claims for discharges on or after October 1, 2015. ICD-9-based AHRQ CCS diagnosis and procedure category lists and singular ICD-9 code lists for discharges prior to October 1, 2015 can be found in the 2016 procedure-specific readmission measures updates and specifications report posted on [QualityNet](#).

#### **2.2.4 Risk-Adjustment Variables**

In order to account for differences in case mix among hospitals, the measures adjust for variables (for example, age, comorbid diseases, and indicators of patient frailty) that are clinically relevant and have relationships with the outcome. For each patient, risk-adjustment variables are obtained from inpatient, outpatient, and physician Medicare administrative claims data extending 12 months prior to, and including, the index admission.

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

The measures do not adjust for socioeconomic status (SES) because the association between SES and health outcomes can be due, in part, to differences in the quality of health care that groups of patients with varying SES receive. The intent is for the measures to adjust for patient demographic and clinical characteristics while illuminating important quality differences. As part of the National Quality Forum (NQF) endorsement process for these measures, we completed analyses for the two-year Sociodemographic Trial Period. Although univariate analyses found that the patient-level observed (unadjusted) readmission rates are higher for dual-eligible patients (for patients living in lower AHRQ SES Index census block groups) and African-American patients compared with all other patients, analyses in the context of a multivariable model demonstrated that the effect size of these variables was small, and that the c-statistics for the models are similar with and without the addition of these variables.

Refer to [Table D.1.2](#) and [Table D.2.2](#) in [Appendix D](#) of this report for the list of comorbidity risk-adjustment variables and the list of complications that are excluded from risk adjustment if they only occur during the index admission, for CABG surgery and THA/TKA, respectively. The [Condition Categories](#) (CCs) outlined in these tables are used to identify risk variables in claims for discharges on or after October 1, 2015 as well as discharges prior to October 1, 2015. The ICD-10 code lists referenced in the tables that are used to identify certain risk variables (for example, cardiogenic shock) in discharges on or after October 1, 2015 are posted on [QualityNet](#) due to volume. For a list of ICD-9 codes used to identify these variables in discharges prior to October 1, 2015, please refer to the 2016 procedure-specific readmission measures updates and specifications report posted on [QualityNet](#).

Note that CC mappings to ICD-10-CM codes (for discharges on or after October 1, 2015) and ICD-9 codes (for discharges prior to October 1, 2015) are available on the [QualityNet](#) website.

### 2.2.5 Data Sources

The data sources for these analyses are Medicare administrative claims and enrollment information for patients with hospitalizations between July 1, 2013 and June 30, 2016. 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 procedures between April 1, 2013 and March 31, 2016, due to the longer period of outcome assessment required to adequately capture complications up to 90 days following admission.

The datasets also contain associated inpatient, outpatient, and physician 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. Refer to the original methodology reports for further descriptions of these data sources and an explanation of the three-year measurement period.<sup>1,2</sup>

### 2.2.6 Measure Calculation

The measures estimate 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.<sup>9</sup> 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 effect](#). At the hospital level, the approach models the hospital-specific effects as arising from a normal distribution. The hospital effect represents the underlying risk of a readmission at the hospital, after accounting for patient risk. The hospital-specific effects are given a distribution to account for the clustering (non-independence) of patients within the same hospital.<sup>9</sup> If there were no differences among hospitals, then after adjusting for patient risk, the hospital effects 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.1.2](#) and [Table D.2.2](#) for the CABG surgery and THA/TKA measures, respectively) and the hospital-specific effect on the risk of readmission. The estimated hospital-specific effect is added to the sum of the estimated regression coefficients multiplied by patient characteristics. The results are log transformed and summed over all patients attributed to a hospital to calculate a predicted value. The “expected” number of readmissions (the denominator) is obtained in the same manner except a common effect using all hospitals in our sample is added in place of the hospital-specific effect. The results are log transformed and summed over all patients attributed to a hospital to calculate 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.

Multiplying the predicted over expected ratio by the national observed readmission rate transforms the ratio into a rate that can be compared to the national observed readmission rate. The hierarchical logistic regression models are described fully in [Appendix A](#) and in the original methodology reports.<sup>1,2</sup>

### **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 the National Rate” if the 95% interval estimate surrounding the hospital’s rate includes the national observed readmission rate.
- “Worse than the National Rate” if the entire 95% interval estimate surrounding the hospital’s rate is higher than the national observed readmission rate.
- “Better than the 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, “Number of Cases Too Small”. This category is used when 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 2017 PUBLIC REPORTING

#### 3.1 Rationale for Measure Updates

Annual 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. Modifications made to measure cohorts, risk models, and outcomes are informed by review of the most recent literature related to measure conditions or outcomes, feedback from various stakeholders, and empirical analyses including assessment of coding trends that reveal shifts in clinical practice or billing patterns. As this report describes, for 2017 public reporting, we made the following modification to the measures:

- Revised the measure specifications to accommodate the implementation of ICD-10 coding:
  - Identified the ICD-10 codes used to define each of the measure cohorts for discharges on or after October 1, 2015.
  - Updated the planned readmission algorithm, by using the most recent (2016) version of the AHRQ ICD-10 CCS and ICD-10 codes for certain “potentially planned procedures” and “acute diagnoses” to the algorithm specifications, for discharges on or after October 1, 2015.
  - Re-specified the risk models, updating the CC-based risk variables to the ICD-10-compatible Hierarchical Condition Categories (HCC) system version 22 and applying ICD-10 codes for certain risk variables (for example, cardiogenic shock) to the models.

As a part of annual reevaluation, we also undertook the following activities:

- Evaluated and validated model performance for the three years combined (July 2013-June 2016);
- Evaluated the stability of the risk-adjustment model over the three-year measurement period by examining the model variable frequencies, model coefficients, and the performance of the risk-adjustment model in each year (July 2013-June 2014, July 2014-June 2015, and July 2015-June 2016); and,
- Updated the measures’ SAS analytic package (SAS pack) and documentation.

#### 3.2 Detailed Discussion of Measure Updates

##### 3.2.1 Updates to ICD-10-Based Measure Specifications

###### Measure Re-specification

We re-specified the measures to accommodate the implementation of ICD-10 coding. Specifically:

- We expanded the cohort definitions to include ICD-10 codes for use with discharges on or after October 1, 2015. (Previously-specified ICD-9 codes continue to be used for discharges before October 1, 2015.)

- We updated the planned readmission algorithm for use with readmission claims for discharges on or after October 1, 2015:
  - The 2016 version of the AHRQ ICD-10 CCS was applied; and,
  - Certain “potentially planned procedures” and “acute diagnoses” previously defined using ICD-9 codes were re-defined using ICD-10 codes.
- We re-specified the risk models:
  - The CC-based risk variables were updated to the ICD-10-compatible Hierarchical Condition Categories (HCC) system version 22, maintained by RTI International; and,
  - Certain risk variables (for example, cardiogenic shock) previously defined using ICD-9 codes were re-defined using ICD-10 codes, for use with inpatient, outpatient, and/or physician Medicare administrative claims on or after October 1, 2015.

#### Rationale for Measure Re-specification

On October 1, 2015, the ICD-9 code sets used to report medical diagnoses and inpatient procedures were replaced by ICD-10 code sets. The Department of Health and Human Services (HHS) has mandated that ICD-10 codes be used by all HIPAA-covered entities for medical coding, effective for October 1, 2015+ discharges. More information on ICD-10 coding can be found on the [CMS website](#).

The procedure-specific readmission measures use Medicare FFS claims to define the measure cohorts, assess the readmission outcomes, and identify patient comorbidities for measure risk adjustment. In public reporting years prior to 2017, the measures exclusively used ICD-9 codes from claims. However, the measurement period for 2017 public reporting requires data from claims that include ICD-10 codes in addition to data from claims that include ICD-9 codes. Thus, re-specification of each of the above three components was warranted to accommodate ICD-10 coding.

The goal of this re-specification was to maintain the intent and validity of the measures.

#### The ICD-10 Transition Process

In developing the ICD-10 code lists that define the cohorts for the measures, we created cohort crosswalks using the General Equivalence Mappings (GEMs), a tool created by CMS and the Centers for Disease Control and Prevention (CDC) to assist with the conversion of ICD-9 codes to ICD-10 codes. To validate the cohort crosswalks, we compared cohort sizes using ICD-10 codes in a set of claims submitted between October 2015 and March 2016 with cohort sizes using previously-defined ICD-9 codes in a set of claims submitted between October 2014 and March 2015. We conducted clinical review to identify those codes appropriate for cohort definition.

In adopting the AHRQ ICD-10 CCS maps, experts examined both the condition and procedure code maps and created a crosswalk for the planned readmission algorithm. We subsequently examined frequencies of the “potentially planned procedures” and “acute diagnoses” re-defined using ICD-10 codes.

The risk variables were updated to the ICD-10-compatible HCC version 22 map. The intent was to keep the risk-adjustment model as similar as possible to the model previously defined using HCC version 12. Specifically:

- Experts examined the ICD-9 code-based HCC version 12 and version 22 maps and reviewed shifts that occurred (where an ICD-9 code had moved from one CC to another). Based on these examinations, they recommended new risk variables using version 22 CCs.
- Following re-specification of the risk variables using the HCC version 22 map, we ran risk-adjustment models on several outcome measures, to ensure testing of all variables where shifts in the ICD-9 codes included in the CCs had occurred.
- For each tested measure, we used the same claims dataset to calculate and compare two separate sets of measure results using two separate risk-adjustment models: One set using the previously-specified version 12 risk variables, and the other using the newly-specified version 22 risk variables. For this analysis we used the ICD-9-coded data from the 2016 measurement period.
  - We compared the frequencies and model coefficients of the two sets of risk-adjustment variables, to ensure that they were similar.
  - We compared the performance of each risk-adjustment model by calculating each model's c-statistic and predictive ability.
  - We examined the correlation in the risk-standardized outcome rates produced by the two risk-adjustment models, to ensure that they produced similar measure results.
  - We examined the degree to which the models produced similar risk-standardized outcome rates at the hospital level by assessing whether individual hospitals' risk-standardized rates fell into the same quintile in the distribution of risk-standardized rates calculated by each of the two models.
  - Based on the results of these analyses, we made minor modifications to the re-specified risk-adjustment variables to ensure that the performance of the risk-adjustment model was as similar as possible to the performance of the previously-specified model, and that the hospital-level results were as similar as possible.

The updated measure specifications can be found in [Appendix D](#).

### 3.3 Changes to SAS Pack

We revised the measure calculation SAS packs to reflect the re-specification done to accommodate the implementation of ICD-10 coding. The new SAS packs and documentation are available upon request by emailing [cmsreadmissionmeasures@yale.edu](mailto:cmsreadmissionmeasures@yale.edu). **Do NOT submit patient-identifiable information (for example, date of birth, Social Security number, health insurance claim number) to this address.**

The SAS packs describe the data files and data elements that feed the model software. Please be aware that CMS does not provide training or 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 packs, it is not possible to replicate the

RSRR 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 2017 PUBLIC REPORTING

### 4.1 Assessment of Updated Models

The readmission measures estimate hospital-specific 30-day all-cause RSRRs using hierarchical logistic regression models. Refer to [Section 2](#) for a summary of the measure methodology and model risk-adjustment variables. Refer to prior methodology and technical reports for further details.<sup>1-6</sup>

We evaluated the performance of the models using the July 2013 to June 2016 data for the 2017 reporting period. We examined the differences in the frequencies 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). We also computed between-hospital variance for each year of data and for the three-year combined period. If there were no systematic differences between hospitals, the between-hospital variance would be zero.

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

## 4.2 CABG Surgery Readmission 2017 Model Results

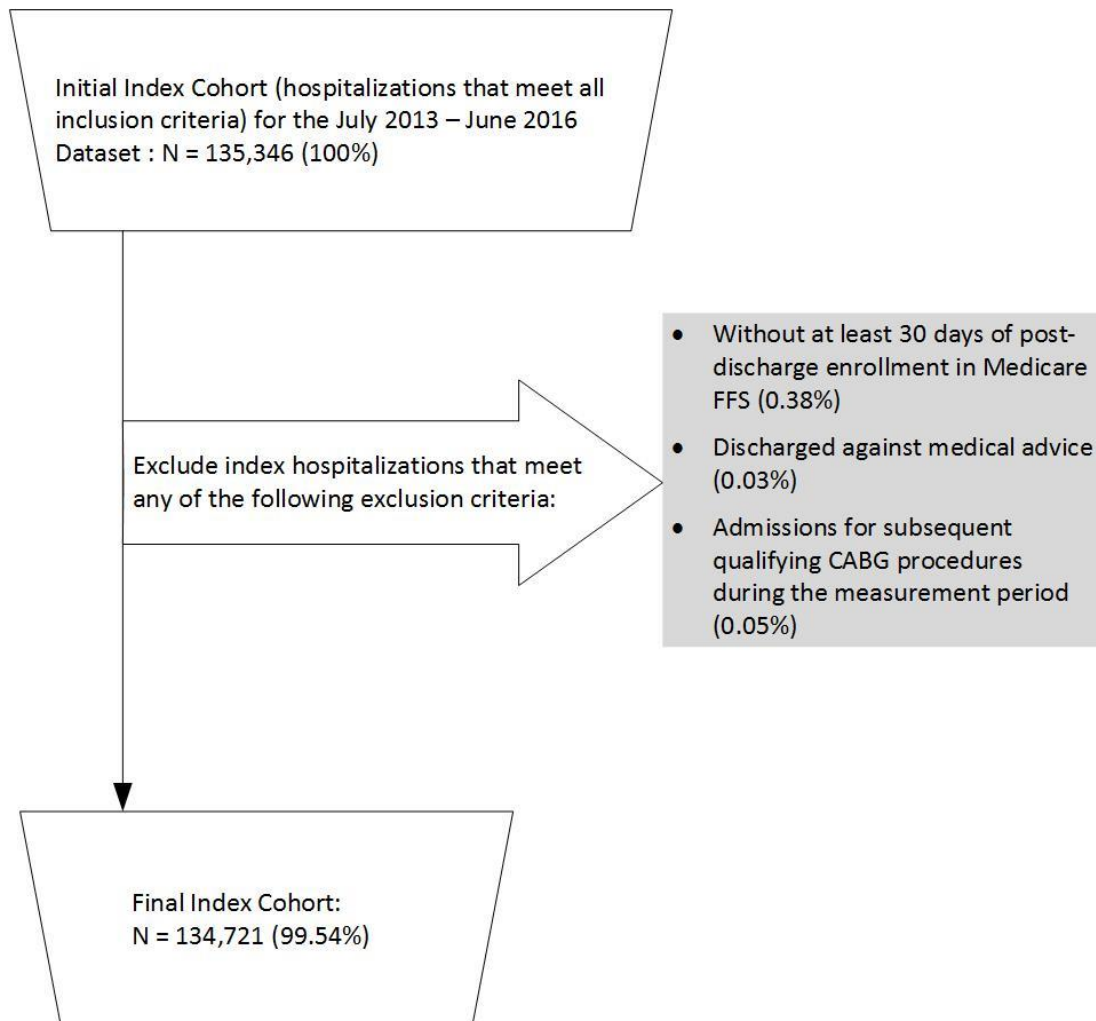
### 4.2.1 Index Cohort Exclusions

The exclusion criteria for this measure are presented in [Section 2.2.1](#). The percentage of CABG surgery admissions that met each exclusion criterion in the July 2013-June 2016 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 short-term acute care hospitalizations for Medicare patients:

- Aged 65 or over;
- With a qualifying isolated CABG procedure;
- Enrolled in Medicare FFS Part A and Part B 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 4.2.1 – CABG Surgery Cohort Exclusions in the July 2013-June 2016 Dataset**



#### 4.2.2 Frequency of CABG Surgery Model Variables

We examined the change in the frequencies of clinical and demographic variables. Frequencies of model variables were stable over measurement period. There were no notable changes (greater than 2% absolute change) in the frequencies.

Refer to [Table 4.2.1](#) for more detail. Note that the increases and decreases in some model variables may reflect not only changes in rates of comorbidities in the Medicare FFS population, but also changes due to ICD-10 code implementation effective with October 1, 2015+ discharges.

#### 4.2.3 CABG Surgery Model Parameters and Performance

[Table 4.2.2](#) shows hierarchical logistic regression model variable 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 CABG surgery 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 stable over the three-year time period; the c-statistic remained constant at 0.64 ([Table 4.2.4](#)).

#### 4.2.4 Distribution of Hospital Volumes and Readmission Rates for CABG Surgery

The national *observed* readmission rate in the combined three-year dataset was 13.8%. Between July 2013-June 2014 and July 2015-June 2016, the *observed* rate decreased from 14.2% to 13.2%.

[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-year period, from 14.2% (between July 2013 and June 2014) to 13.2% (between July 2015 and June 2016). The median hospital RSRR in the combined three-year dataset was 13.7% (interquartile range [IQR]: 13.1% - 14.5%). [Table 4.2.7](#) shows the between-hospital variance by individual year, as well as for the combined three-year dataset. Between-hospital variance in the combined dataset was 0.038 (Standard Error [SE]: 0.005).

[Figure 4.2.2](#) shows the overall distribution of the hospital RSRRs for the combined three-year dataset. The odds of all-cause readmission if a patient is treated at a hospital one standard deviation (SD) above the national rate were 1.48 times higher than the odds of all-cause readmission if treated at a hospital one SD below the national rate. If there were no systematic differences between hospitals, the OR would be 1.0.<sup>9</sup>



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

Of 1,184 hospitals in the study cohort, 6 performed “Better than the National Rate,” 1,020 performed “No Different than the National Rate,” and 8 performed “Worse than the National Rate.” 150 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 CABG Surgery Model Variables over Different Time Periods**

Variable	07/2013-06/2014	07/2014-06/2015	07/2015-06/2016	07/2013-06/2016
Total N	44,983	44,745	44,993	134,721
Mean age minus 65 (SD)	8.7 (5.7)	8.6 (5.7)	8.6 (5.6)	8.6 (5.7)
Male (%)	71.6	72.2	72.2	72.0
Cardiogenic shock	4.8	5.4	5.2	5.1
History of coronary artery bypass graft (CABG) or valve surgery	5.2	5.0	5.5	5.2
Cancer; metastatic cancer and acute leukemia (CC 8-14)	19.0	19.0	19.4	19.1
Diabetes mellitus (DM) or DM complications (CC 17-19, 122-123)	51.0	51.5	51.8	51.4
Protein-calorie malnutrition (CC 21)	4.3	4.1	3.9	4.1
Morbid obesity; other endocrine/metabolic/nutritional disorders (CC 22, 25-26)	93.2	93.8	94.3	93.7
Other significant endocrine and metabolic disorders; disorders of fluid/electrolyte/acid-base balance (CC 23-24)	16.6	17.1	17.5	17.1
Severe hematological disorders (CC 46)	0.6	0.5	0.6	0.6
Dementia or other specified brain disorders (CC 51-53)	5.7	5.5	5.9	5.7
Major psychiatric disorders (CC 57-59)	4.7	4.8	3.9	4.5
Hemiplegia, paraplegia, paralysis, functional disability (CC 70-74, 103-104, 189-190)	2.4	2.5	2.7	2.5
Polyneuropathy; other neuropathies (CC 75, 81)	15.5	16.3	16.7	16.2
Congestive heart failure (CC 85)	20.3	19.9	19.9	20.1
Specified arrhythmias and other heart rhythm disorders (CC 96-97)	30.3	30.5	30.2	30.3
Stroke (CC 99-100)	4.7	4.9	4.4	4.7
Cerebrovascular disease (CC 101-102, 105)	29.1	28.4	27.4	28.3
Vascular or circulatory disease (CC 106-109)	33.7	33.2	32.6	33.2
Chronic obstructive pulmonary disease (COPD) (CC 111)	25.8	25.2	24.8	25.2
Fibrosis of lung or other chronic lung disorders (CC 112)	4.0	4.0	3.7	3.9
Pneumonia (CC 114-116)	12.3	12.3	12.2	12.3
Other respiratory disorders (CC 118)	41.7	42.4	42.7	42.3
Dialysis status (CC 134)	1.9	2.0	2.1	2.0
Renal failure (CC 135-140)	27.2	28.5	29.2	28.3
Decubitus ulcer or chronic skin ulcer (CC 157-161)	3.6	3.6	3.5	3.6

**Table 4.2.2 – Hierarchical Logistic Regression Model Variable Coefficients for CABG Surgery over Different Time Periods**

Variable	07/2013-06/2014	07/2014-06/2015	07/2015-06/2016	07/2013-06/2016
Intercept	-2.409	-2.542	-2.488	-2.475
Age minus 65 (years above 65, continuous)	0.030	0.023	0.026	0.027
Male	-0.265	-0.225	-0.240	-0.243
Cardiogenic shock	0.331	0.316	0.406	0.356
History of coronary artery bypass graft (CABG) or valve surgery	-0.032	-0.015	0.018	-0.010
Cancer; metastatic cancer and acute leukemia (CC 8-14)	0.015	0.011	0.006	0.011
Diabetes mellitus (DM) or DM complications (CC 17-19, 122-123)	0.177	0.140	0.168	0.160
Protein-calorie malnutrition (CC 21)	0.292	0.264	0.269	0.277
Morbid obesity; other endocrine/metabolic/nutritional disorders (CC 22, 25-26)	-0.101	0.088	-0.059	-0.026
Other significant endocrine and metabolic disorders; disorders of fluid/electrolyte/acid-base balance (CC 23-24)	0.039	0.122	0.100	0.086
Severe hematological disorders (CC 46)	0.378	0.461	0.186	0.354
Dementia or other specified brain disorders (CC 51-53)	0.152	0.193	0.177	0.168
Major psychiatric disorders (CC 57-59)	0.069	0.187	0.148	0.136
Hemiplegia, paraplegia, paralysis, functional disability (CC 70-74, 103-104, 189-190)	-0.124	0.182	0.245	0.108
Polyneuropathy; other neuropathies (CC 75, 81)	0.150	0.085	0.119	0.118
Congestive heart failure (CC 85)	0.199	0.132	0.188	0.174
Specified arrhythmias and other heart rhythm disorders (CC 96-97)	0.092	0.129	0.125	0.117
Stroke (CC 99-100)	0.094	0.000	0.084	0.059
Cerebrovascular disease (CC 101-102, 105)	0.004	0.045	-0.038	0.006
Vascular or circulatory disease (CC 106-109)	0.131	0.083	0.117	0.113
Chronic obstructive pulmonary disease (COPD) (CC 111)	0.317	0.341	0.329	0.326
Fibrosis of lung or other chronic lung disorders (CC 112)	0.166	0.107	-0.094	0.067
Pneumonia (CC 114-116)	0.144	0.273	0.200	0.202
Other respiratory disorders (CC 118)	0.152	0.111	0.154	0.143
Dialysis status (CC 134)	0.398	0.314	0.402	0.370
Renal failure (CC 135-140)	0.317	0.267	0.202	0.264
Decubitus ulcer or chronic skin ulcer (CC 157-161)	0.242	0.254	0.216	0.236

**Table 4.2.3 – Adjusted OR and 95% CIs for the CABG Surgery Hierarchical Logistic Regression Model over Different Time Periods**

Variable	07/2013-06/2014 OR (95% CI)	07/2014-06/2015 OR (95% CI)	07/2015-06/2016 OR (95% CI)	07/2013-06/2016 OR (95% CI)
Age minus 65 (years above 65, continuous)	1.03 (1.03 - 1.04)	1.02 (1.02 - 1.03)	1.03 (1.02 - 1.03)	1.03 (1.02 - 1.03)
Male	0.77 (0.72 - 0.81)	0.80 (0.75 - 0.85)	0.79 (0.74 - 0.84)	0.78 (0.76 - 0.81)
Cardiogenic shock	1.39 (1.25 - 1.56)	1.37 (1.23 - 1.53)	1.50 (1.35 - 1.67)	1.43 (1.34 - 1.52)
History of coronary artery bypass graft (CABG) or valve surgery	0.97 (0.86 - 1.09)	0.99 (0.87 - 1.11)	1.02 (0.91 - 1.15)	0.99 (0.92 - 1.06)
Cancer; metastatic cancer and acute leukemia (CC 8-14)	1.02 (0.95 - 1.09)	1.01 (0.94 - 1.08)	1.01 (0.94 - 1.08)	1.01 (0.97 - 1.05)
Diabetes mellitus (DM) or DM complications (CC 17-19, 122-123)	1.19 (1.13 - 1.26)	1.15 (1.09 - 1.22)	1.18 (1.12 - 1.26)	1.17 (1.14 - 1.21)
Protein-calorie malnutrition (CC 21)	1.34 (1.19 - 1.50)	1.30 (1.16 - 1.47)	1.31 (1.16 - 1.48)	1.32 (1.23 - 1.41)
Morbid obesity; other endocrine/metabolic/nutritional disorders (CC 22, 25-26)	0.90 (0.81 - 1.01)	1.09 (0.97 - 1.23)	0.94 (0.83 - 1.07)	0.98 (0.91 - 1.04)
Other significant endocrine and metabolic disorders; disorders of fluid/electrolyte/acid-base balance (CC 23-24)	1.04 (0.97 - 1.12)	1.13 (1.05 - 1.22)	1.11 (1.02 - 1.19)	1.09 (1.04 - 1.14)
Severe hematological disorders (CC 46)	1.46 (1.10 - 1.93)	1.59 (1.16 - 2.16)	1.21 (0.87 - 1.67)	1.43 (1.20 - 1.70)
Dementia or other specified brain disorders (CC 51-53)	1.16 (1.05 - 1.30)	1.21 (1.09 - 1.35)	1.19 (1.07 - 1.33)	1.18 (1.11 - 1.26)
Major psychiatric disorders (CC 57-59)	1.07 (0.95 - 1.21)	1.21 (1.07 - 1.35)	1.16 (1.02 - 1.32)	1.15 (1.07 - 1.23)
Hemiplegia, paraplegia, paralysis, functional disability (CC 70-74, 103-104, 189-190)	0.88 (0.75 - 1.05)	1.20 (1.03 - 1.40)	1.28 (1.10 - 1.49)	1.11 (1.02 - 1.22)
Polyneuropathy; other neuropathies (CC 75, 81)	1.16 (1.08 - 1.25)	1.09 (1.01 - 1.17)	1.13 (1.05 - 1.21)	1.13 (1.08 - 1.17)
Congestive heart failure (CC 85)	1.22 (1.14 - 1.31)	1.14 (1.07 - 1.22)	1.21 (1.12 - 1.30)	1.19 (1.14 - 1.24)
Specified arrhythmias and other heart rhythm disorders (CC 96-97)	1.10 (1.03 - 1.17)	1.14 (1.07 - 1.21)	1.13 (1.06 - 1.21)	1.12 (1.09 - 1.17)
Stroke (CC 99-100)	1.10 (0.97 - 1.24)	1.00 (0.88 - 1.13)	1.09 (0.96 - 1.24)	1.06 (0.99 - 1.14)
Cerebrovascular disease (CC 101-102, 105)	1.00 (0.94 - 1.07)	1.05 (0.98 - 1.11)	0.96 (0.90 - 1.03)	1.01 (0.97 - 1.04)
Vascular or circulatory disease (CC 106-109)	1.14 (1.07 - 1.21)	1.09 (1.02 - 1.16)	1.12 (1.06 - 1.20)	1.12 (1.08 - 1.16)
Chronic obstructive pulmonary disease (COPD) (CC 111)	1.37 (1.29 - 1.46)	1.41 (1.32 - 1.50)	1.39 (1.30 - 1.48)	1.39 (1.34 - 1.44)
Fibrosis of lung or other chronic lung disorders (CC 112)	1.18 (1.04 - 1.34)	1.11 (0.98 - 1.26)	0.91 (0.79 - 1.05)	1.07 (0.99 - 1.15)
Pneumonia (CC 114-116)	1.16 (1.07 - 1.25)	1.31 (1.22 - 1.42)	1.22 (1.13 - 1.32)	1.22 (1.17 - 1.28)
Other respiratory disorders (CC 118)	1.16 (1.10 - 1.23)	1.12 (1.06 - 1.18)	1.17 (1.10 - 1.24)	1.15 (1.12 - 1.19)
Dialysis status (CC 134)	1.49 (1.26 - 1.76)	1.37 (1.16 - 1.61)	1.50 (1.27 - 1.76)	1.45 (1.32 - 1.59)
Renal failure (CC 135-140)	1.37 (1.29 - 1.46)	1.31 (1.23 - 1.39)	1.22 (1.15 - 1.31)	1.30 (1.26 - 1.35)
Decubitus ulcer or chronic skin ulcer (CC 157-161)	1.27 (1.12 - 1.45)	1.29 (1.13 - 1.46)	1.24 (1.09 - 1.42)	1.27 (1.18 - 1.36)

**Table 4.2.4 – CABG Surgery Generalized Linear Modeling (Logistic Regression) Performance over Different Time Periods**

Characteristic	07/2013-06/2014	07/2014-06/2015	07/2015-06/2016	07/2013-06/2016
Predictive ability, % (lowest decile – highest decile)	6.2 - 28.5	6.3 - 27.2	6.4 - 26.1	6.2 - 27.0
c-statistic	0.64	0.64	0.64	0.64

**Table 4.2.5 – Distribution of Hospital CABG Surgery Admission Volumes over Different Time Periods**

Characteristic	07/2013-06/2014	07/2014-06/2015	07/2015-06/2016	07/2013-06/2016
Number of hospitals	1,157	1,148	1,151	1,184
Mean number of admissions (SD)	38.9 (34.4)	39.0 (34.7)	39.1 (35.6)	113.8 (103.3)
Range (min. – max.)	1 - 266	1 - 276	1 - 286	1 - 828
25 <sup>th</sup> percentile	16	15	14	44
50 <sup>th</sup> percentile	28	29	29	83
75 <sup>th</sup> percentile	51	52	53	151

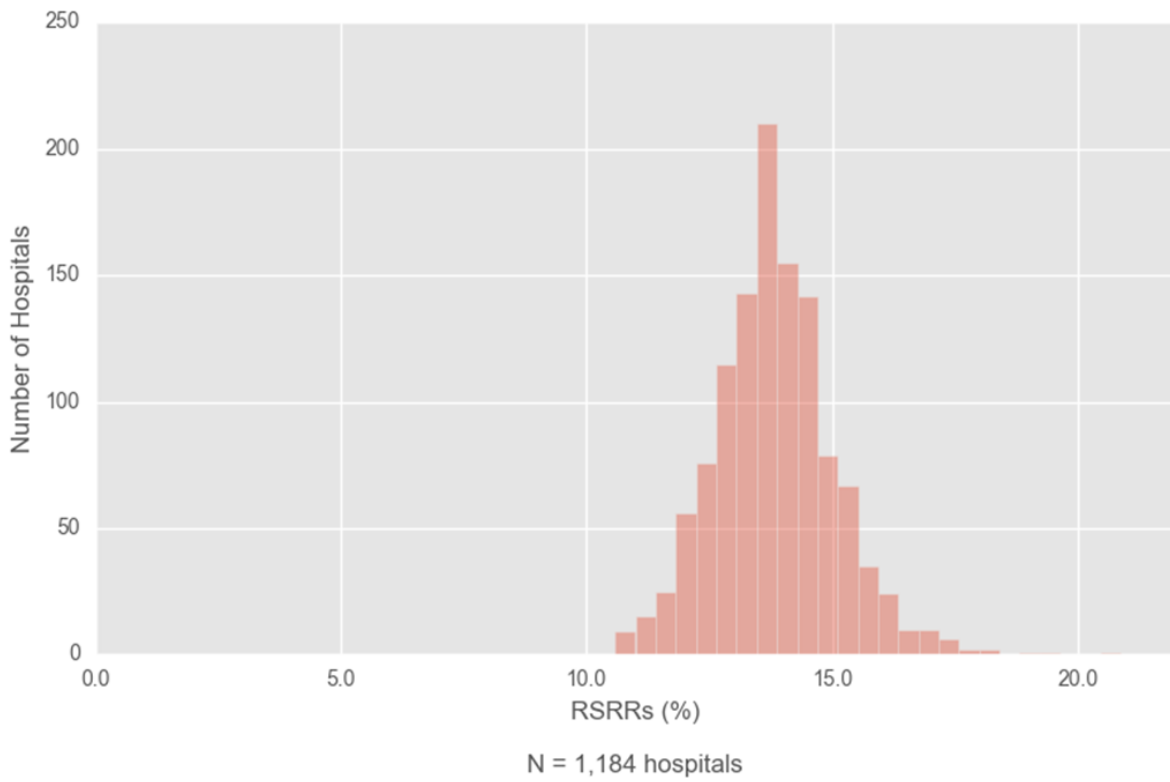
**Table 4.2.6 – Distribution of Hospital CABG Surgery RSRRs over Different Time Periods**

Characteristic	07/2013-06/2014	07/2014-06/2015	07/2015-06/2016	07/2013-06/2016
Number of hospitals	1,157	1,148	1,151	1,184
Mean (SD)	14.2 (0.7)	14.0 (1.1)	13.2 (0.9)	13.8 (1.2)
Range (min. – max.)	12.6 - 17.8	10.4 - 20.5	10.0 - 17.1	10.6 - 20.9
25 <sup>th</sup> percentile	13.8	13.3	12.6	13.1
50 <sup>th</sup> percentile	14.2	13.9	13.1	13.7
75 <sup>th</sup> percentile	14.6	14.7	13.7	14.5

**Table 4.2.7 – Between-Hospital Variance for CABG Surgery**

Characteristic	07/2013-06/2014	07/2014-06/2015	07/2015-06/2016	07/2013-06/2016
Between-hospital variance (SE)	0.028 (0.010)	0.054 (0.011)	0.044 (0.011)	0.038 (0.005)

**Figure 4.2.2 – Distribution of Hospital 30-Day CABG Surgery RSRRs between July 2013 and June 2016**



## 4.3 THA/TKA Readmission 2017 Model Results

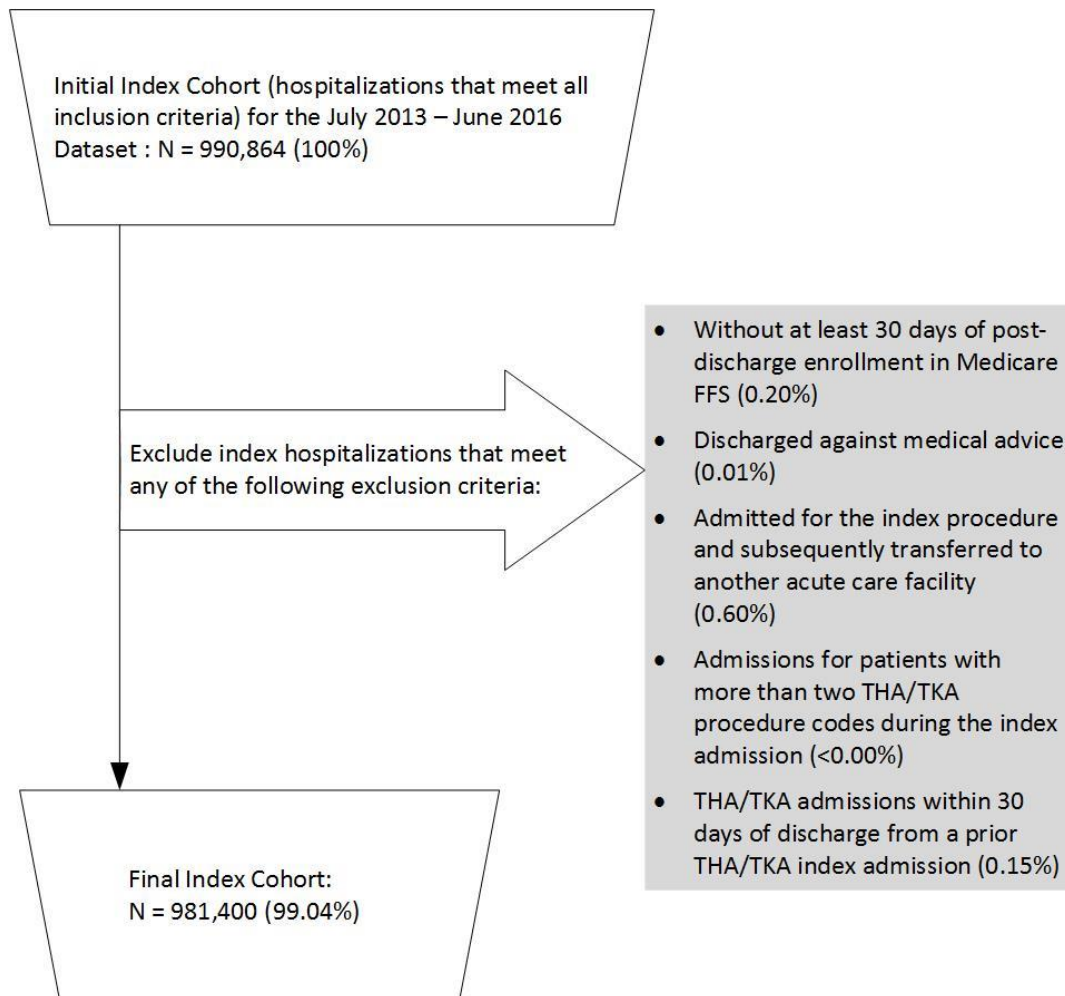
### 4.3.1 Index Cohort Exclusions

The exclusion criteria for this measure are presented in [Section 2.2.1](#). The percentage of THA/TKA admissions that met each exclusion criterion in the July 2013-June 2016 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 short-term acute care hospitalizations for Medicare patients:

- Aged 65 or over;
- With a qualifying elective primary THA/TKA procedure;
- Enrolled in Medicare FFS Part A and Part B 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 4.3.1 – THA/TKA Cohort Exclusions in the July 2013-June 2016 Dataset**



### 4.3.2 Frequency of THA/TKA Model Variables

We examined the change in the frequencies of clinical and demographic variables. Frequencies of model variables were stable over the measurement period. There were no large changes (greater than 2% absolute change) in the frequencies. However, the increases in frequencies of Morbid obesity and Renal failure observed in 2016 public reporting continue, but only by 0.8% and 1.1%, respectively, over the three-year period.

Refer to [Table 4.3.1](#) for more detail. Note that the increases and decreases in some model variables may reflect not only changes in rates of comorbidities in the Medicare FFS population, but also changes due to ICD-10 code implementation effective with October 1, 2015+ discharges.

### 4.3.3 THA/TKA Model Parameters and Performance

[Table 4.3.2](#) shows hierarchical logistic regression model variable coefficients by individual year and for the combined three-year dataset. [Table 4.3.3](#) shows the risk-adjusted ORs and 95% 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 stable over the three-year time period; the c-statistic remained constant at 0.66 ([Table 4.3.4](#)).

### 4.3.4 Distribution of Hospital Volumes and Readmission Rates for THA/TKA

The national *observed* readmission rate in the combined three-year dataset was 4.4%. Between July 2013-June 2014 and July 2015-June 2016, the *observed* rate decreased from 4.5% to 4.2%.

[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 4.5% (between July 2013 and June 2014) to 4.2% (between July 2015 and June 2016). The median hospital RSRR in the combined three-year dataset was 4.3% (IQR: 4.1% - 4.6%). [Table 4.3.7](#) shows the between-hospital variance by individual year, as well as for the combined three-year dataset. Between-hospital variance in the combined dataset was 0.050 (SE: 0.004).

[Figure 4.3.2](#) shows the overall distribution of the hospital RSRRs for the combined three-year dataset. The odds of all-cause readmission if a patient is treated at a hospital one SD above the national rate were 1.57 times higher than the odds of all-cause readmission if treated at a hospital one SD below the national rate. If there were no systematic differences between hospitals, the OR would be 1.0.<sup>9</sup>

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

Of 3,461 hospitals in the study cohort, 44 performed “Better than the National Rate,” 2,732 performed “No Different from the National Rate,” and 35 performed “Worse than the

National Rate.” 650 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 THA/TKA Model Variables over Different Time Periods**

Variable	07/2013-06/2014	07/2014-06/2015	07/2015-06/2016	07/2013-06/2016
Total N	318,849	320,009	342,542	981,400
Mean age minus 65 (SD)	9.5 (6.0)	9.4 (6.0)	9.3 (5.9)	9.4 (6.0)
Male (%)	37.3	37.2	37.5	37.3
Index admissions with an elective THA procedure	31.0	32.1	32.8	32.0
Number of procedures (two vs. one)	2.3	2.1	2.0	2.1
Other congenital deformity of hip (joint)	0.2	0.2	0.2	0.2
Post traumatic osteoarthritis	0.4	0.4	0.3	0.3
Severe infection; other infectious diseases (CC 1, 3-7)	17.6	17.5	17.6	17.6
Metastatic cancer or acute leukemia (CC 8)	0.5	0.5	0.5	0.5
Cancer (CC 9-14)	18.4	18.3	18.3	18.3
Diabetes mellitus (DM) or DM complications (CC 17-19, 122-123)	28.3	28.1	27.8	28.1
Protein-calorie malnutrition (CC 21)	0.7	0.7	0.7	0.7
Morbid obesity (CC 22)	8.0	8.4	8.8	8.4
Other significant endocrine and metabolic disorders; disorders of fluid/electrolyte/acid-base balance (CC 23-24)	12.0	12.0	12.0	12.0
Rheumatoid arthritis and inflammatory connective tissue disease (CC 40)	9.4	9.6	9.7	9.6
Severe hematological disorders (CC 46)	0.4	0.4	0.4	0.4
Dementia or other specified brain disorders (CC 51-53)	4.1	4.1	4.1	4.1
Major psychiatric disorders (CC 57-59)	4.7	4.8	4.7	4.7
Hemiplegia, paraplegia, paralysis, functional disability (CC 70-74, 103-104, 189-190)	1.0	1.0	1.2	1.1
Polyneuropathy; other neuropathies (CC 75, 81)	13.6	13.8	14.1	13.9
Congestive heart failure (CC 85)	8.5	8.3	8.2	8.3
Coronary atherosclerosis or angina (CC 88-89)	26.4	25.4	24.5	25.4
Hypertension (CC 95)	81.3	80.4	79.9	80.5
Specified arrhythmias and other heart rhythm disorders (CC 96-97)	24.2	24.3	24.5	24.3
Stroke (CC 99-100)	2.1	2.1	2.0	2.1
Vascular or circulatory disease (CC 106-109)	21.9	21.7	21.5	21.7
Chronic obstructive pulmonary disease (COPD) (CC 111)	13.1	12.6	12.2	12.6
Pneumonia (CC 114-116)	4.1	3.9	4.0	4.0
Dialysis status (CC 134)	0.2	0.2	0.2	0.2
Renal failure (CC 135-140)	12.5	12.9	13.6	13.0
Decubitus ulcer or chronic skin ulcer (CC 157-161)	2.5	2.4	2.3	2.4
Cellulitis, local skin infection (CC 164)	7.3	7.1	7.0	7.1
Other injuries (CC 174)	27.7	27.8	27.7	27.7
Major symptoms, abnormalities (CC 178)	62.0	62.4	62.8	62.4



**Table 4.3.2 – Hierarchical Logistic Regression Model Variable Coefficients for THA/TKA over Different Time Periods**

Variable	07/2013-06/2014	07/2014-06/2015	07/2015-06/2016	07/2013-06/2016
Intercept	-4.219	-4.256	-4.358	-4.263
Age minus 65 (years above 65, continuous)	0.036	0.039	0.038	0.038
Male	0.116	0.152	0.122	0.131
Index admissions with an elective THA procedure	0.080	0.131	0.124	0.114
Number of procedures (two vs. one)	0.186	0.381	0.351	0.312
Other congenital deformity of hip (joint)	-0.136	-0.016	0.111	0.000
Post traumatic osteoarthritis	0.160	-0.096	0.171	0.076
Severe infection; other infectious diseases (CC 1, 3-7)	0.086	0.057	0.041	0.060
Metastatic cancer or acute leukemia (CC 8)	0.105	0.192	0.189	0.164
Cancer (CC 9-14)	-0.014	-0.033	-0.023	-0.022
Diabetes mellitus (DM) or DM complications (CC 17-19, 122-123)	0.120	0.119	0.141	0.124
Protein-calorie malnutrition (CC 21)	0.293	0.044	0.209	0.183
Morbid obesity (CC 22)	0.270	0.277	0.353	0.302
Other significant endocrine and metabolic disorders; disorders of fluid/electrolyte/acid-base balance (CC 23-24)	0.139	0.172	0.169	0.159
Rheumatoid arthritis and inflammatory connective tissue disease (CC 40)	0.147	0.129	0.170	0.149
Severe hematological disorders (CC 46)	0.482	0.322	0.281	0.361
Dementia or other specified brain disorders (CC 51-53)	0.203	0.153	0.176	0.177
Major psychiatric disorders (CC 57-59)	0.262	0.321	0.311	0.301
Hemiplegia, paraplegia, paralysis, functional disability (CC 70-74, 103-104, 189-190)	0.214	0.193	0.124	0.174
Polyneuropathy; other neuropathies (CC 75, 81)	0.089	0.109	0.115	0.105
Congestive heart failure (CC 85)	0.260	0.184	0.229	0.223
Coronary atherosclerosis or angina (CC 88-89)	0.188	0.190	0.137	0.172
Hypertension (CC 95)	0.177	0.152	0.209	0.176
Specified arrhythmias and other heart rhythm disorders (CC 96-97)	0.119	0.151	0.156	0.143
Stroke (CC 99-100)	0.134	0.177	0.069	0.125
Vascular or circulatory disease (CC 106-109)	0.128	0.117	0.160	0.135
Chronic obstructive pulmonary disease (COPD) (CC 111)	0.318	0.320	0.349	0.326
Pneumonia (CC 114-116)	0.114	0.159	0.076	0.116
Dialysis status (CC 134)	0.625	0.697	0.498	0.603
Renal failure (CC 135-140)	0.308	0.314	0.287	0.301
Decubitus ulcer or chronic skin ulcer (CC 157-161)	0.145	0.182	0.195	0.173
Cellulitis, local skin infection (CC 164)	0.069	0.152	0.174	0.133
Other injuries (CC 174)	0.080	0.103	0.109	0.098
Major symptoms, abnormalities (CC 178)	0.153	0.133	0.134	0.139

**Table 4.3.3 – Adjusted OR and 95% CIs for the THA/TKA Hierarchical Logistic Regression Model over Different Time Periods**

Variable	07/2013-06/2014 OR (95% CI)	07/2014-06/2015 OR (95% CI)	07/2015-06/2016 OR (95% CI)	07/2013-06/2016 OR (95% CI)
Age minus 65 (years above 65, continuous)	1.04 (1.03 - 1.04)	1.04 (1.04 - 1.04)	1.04 (1.04 - 1.04)	1.04 (1.04 - 1.04)
Male	1.12 (1.08 - 1.16)	1.17 (1.12 - 1.21)	1.13 (1.09 - 1.17)	1.14 (1.12 - 1.16)
Index admissions with an elective THA procedure	1.08 (1.04 - 1.12)	1.14 (1.10 - 1.18)	1.13 (1.09 - 1.17)	1.12 (1.10 - 1.15)
Number of procedures (two vs. one)	1.21 (1.07 - 1.36)	1.46 (1.31 - 1.64)	1.42 (1.26 - 1.60)	1.37 (1.28 - 1.46)
Other congenital deformity of hip (joint)	0.87 (0.58 - 1.32)	0.98 (0.69 - 1.41)	1.12 (0.80 - 1.57)	1.00 (0.81 - 1.24)
Post traumatic osteoarthritis	1.17 (0.91 - 1.51)	0.91 (0.69 - 1.20)	1.19 (0.87 - 1.61)	1.08 (0.92 - 1.27)
Severe infection; other infectious diseases (CC 1, 3-7)	1.09 (1.05 - 1.14)	1.06 (1.01 - 1.11)	1.04 (1.00 - 1.09)	1.06 (1.04 - 1.09)
Metastatic cancer or acute leukemia (CC 8)	1.11 (0.90 - 1.38)	1.21 (0.99 - 1.49)	1.21 (0.99 - 1.47)	1.18 (1.05 - 1.33)
Cancer (CC 9-14)	0.99 (0.94 - 1.03)	0.97 (0.93 - 1.01)	0.98 (0.94 - 1.02)	0.98 (0.95 - 1.00)
Diabetes mellitus (DM) or DM complications (CC 17-19, 122-123)	1.13 (1.09 - 1.17)	1.13 (1.08 - 1.17)	1.15 (1.11 - 1.20)	1.13 (1.11 - 1.16)
Protein-calorie malnutrition (CC 21)	1.34 (1.16 - 1.54)	1.05 (0.89 - 1.22)	1.23 (1.07 - 1.42)	1.20 (1.10 - 1.31)
Morbid obesity (CC 22)	1.31 (1.24 - 1.39)	1.32 (1.25 - 1.40)	1.42 (1.35 - 1.50)	1.35 (1.31 - 1.40)
Other significant endocrine and metabolic disorders; disorders of fluid/electrolyte/acid-base balance (CC 23-24)	1.15 (1.10 - 1.21)	1.19 (1.13 - 1.25)	1.18 (1.13 - 1.24)	1.17 (1.14 - 1.21)
Rheumatoid arthritis and inflammatory connective tissue disease (CC 40)	1.16 (1.10 - 1.22)	1.14 (1.08 - 1.20)	1.19 (1.13 - 1.25)	1.16 (1.13 - 1.20)
Severe hematological disorders (CC 46)	1.62 (1.34 - 1.96)	1.38 (1.12 - 1.70)	1.32 (1.08 - 1.62)	1.44 (1.28 - 1.61)
Dementia or other specified brain disorders (CC 51-53)	1.23 (1.14 - 1.31)	1.17 (1.09 - 1.25)	1.19 (1.11 - 1.28)	1.19 (1.15 - 1.24)
Major psychiatric disorders (CC 57-59)	1.30 (1.21 - 1.39)	1.38 (1.29 - 1.47)	1.37 (1.28 - 1.46)	1.35 (1.30 - 1.41)
Hemiplegia, paraplegia, paralysis, functional disability (CC 70-74, 103-104, 189-190)	1.24 (1.09 - 1.41)	1.21 (1.06 - 1.39)	1.13 (1.00 - 1.29)	1.19 (1.10 - 1.28)
Polyneuropathy; other neuropathies (CC 75, 81)	1.09 (1.04 - 1.15)	1.12 (1.07 - 1.17)	1.12 (1.07 - 1.17)	1.11 (1.08 - 1.14)
Congestive heart failure (CC 85)	1.30 (1.23 - 1.37)	1.20 (1.14 - 1.27)	1.26 (1.19 - 1.33)	1.25 (1.21 - 1.29)
Coronary atherosclerosis or angina (CC 88-89)	1.21 (1.16 - 1.26)	1.21 (1.16 - 1.26)	1.15 (1.10 - 1.19)	1.19 (1.16 - 1.21)
Hypertension (CC 95)	1.19 (1.13 - 1.26)	1.16 (1.11 - 1.22)	1.23 (1.17 - 1.30)	1.19 (1.16 - 1.23)
Specified arrhythmias and other heart rhythm disorders (CC 96-97)	1.13 (1.08 - 1.17)	1.16 (1.12 - 1.21)	1.17 (1.12 - 1.22)	1.15 (1.13 - 1.18)
Stroke (CC 99-100)	1.14 (1.04 - 1.26)	1.19 (1.09 - 1.31)	1.07 (0.97 - 1.18)	1.13 (1.07 - 1.20)
Vascular or circulatory disease (CC 106-109)	1.14 (1.09 - 1.18)	1.12 (1.08 - 1.17)	1.17 (1.13 - 1.22)	1.14 (1.12 - 1.17)
Chronic obstructive pulmonary disease (COPD) (CC 111)	1.37 (1.31 - 1.44)	1.38 (1.32 - 1.44)	1.42 (1.36 - 1.48)	1.39 (1.35 - 1.42)
Pneumonia (CC 114-116)	1.12 (1.04 - 1.20)	1.17 (1.09 - 1.26)	1.08 (1.01 - 1.16)	1.12 (1.08 - 1.17)
Dialysis status (CC 134)	1.87 (1.48 - 2.35)	2.01 (1.61 - 2.51)	1.65 (1.30 - 2.08)	1.83 (1.60 - 2.09)
Renal failure (CC 135-140)	1.36 (1.30 - 1.42)	1.37 (1.31 - 1.43)	1.33 (1.28 - 1.39)	1.35 (1.32 - 1.39)
Decubitus ulcer or chronic skin ulcer (CC 157-161)	1.16 (1.06 - 1.26)	1.20 (1.10 - 1.31)	1.22 (1.11 - 1.33)	1.19 (1.13 - 1.25)
Cellulitis, local skin infection (CC 164)	1.07 (1.01 - 1.14)	1.16 (1.10 - 1.23)	1.19 (1.12 - 1.26)	1.14 (1.10 - 1.18)
Other injuries (CC 174)	1.08 (1.04 - 1.13)	1.11 (1.07 - 1.15)	1.12 (1.07 - 1.16)	1.10 (1.08 - 1.13)
Major symptoms, abnormalities (CC 178)	1.17 (1.12 - 1.21)	1.14 (1.10 - 1.19)	1.14 (1.10 - 1.19)	1.15 (1.12 - 1.18)

**Table 4.3.4 – THA/TKA Generalized Linear Modeling (Logistic Regression) Performance over Different Time Periods**

Characteristic	07/2013-06/2014	07/2014-06/2015	07/2015-06/2016	07/2013-06/2016
Predictive ability, % (lowest decile – highest decile)	1.7 - 10.4	1.6 - 10.6	1.6 - 10.2	1.7 - 10.4
c-statistic	0.66	0.66	0.66	0.66

**Table 4.3.5 – Distribution of Hospital THA/TKA Admission Volumes over Different Time Periods**

Characteristic	07/2013-06/2014	07/2014-06/2015	07/2015-06/2016	07/2013-06/2016
Number of hospitals	3,308	3,292	3,285	3,461
Mean number of admissions (SD)	96.4 (133.6)	97.2 (137.7)	104.3 (149.4)	283.6 (411.4)
Range (min. – max.)	1 - 2,556	1 - 2,778	1 - 3,021	1 - 8,355
25 <sup>th</sup> percentile	16	15	16	40
50 <sup>th</sup> percentile	50	50	53	138
75 <sup>th</sup> percentile	128	128	138	372

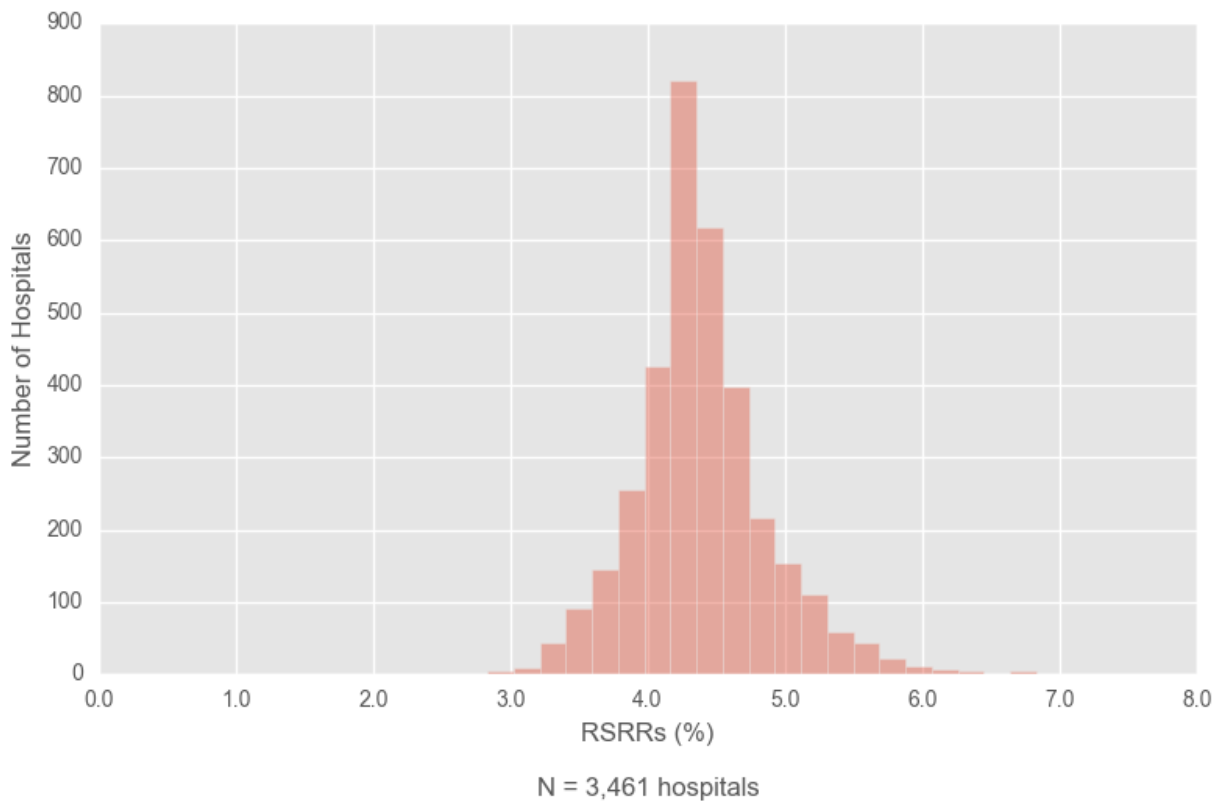
**Table 4.3.6 – Distribution of Hospital THA/TKA RSRs over Different Time Periods**

Characteristic	07/2013-06/2014	07/2014-06/2015	07/2015-06/2016	07/2013-06/2016
Number of hospitals	3,308	3,292	3,285	3,461
Mean (SD)	4.5 (0.4)	4.5 (0.3)	4.2 (0.4)	4.4 (0.5)
Range (min. – max.)	2.8 - 6.4	3.0 - 6.3	2.9 - 6.9	2.5 - 7.2
25 <sup>th</sup> percentile	4.3	4.3	4.0	4.1
50 <sup>th</sup> percentile	4.4	4.4	4.2	4.3
75 <sup>th</sup> percentile	4.6	4.6	4.4	4.6

**Table 4.3.7 – Between-Hospital Variance for THA/TKA**

Characteristic	07/2013-06/2014	07/2014-06/2015	07/2015-06/2016	07/2013-06/2016
Between-hospital variance (SE)	0.055 (0.007)	0.047 (0.007)	0.055 (0.007)	0.050 (0.004)

**Figure 4.3.2 – Distribution of Hospital 30-Day THA/TKA RSRRs between July 2013 and June 2016**



## 5. GLOSSARY

**C-statistic:** 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, an indication of perfect prediction. Perfect prediction implies that patients' outcomes can be predicted completely by their risk factors, and physicians and hospitals play no role in their patients' outcomes.

**Case mix:** The particular illness severity, age, and, for some measures, gender characteristics of patients with index admissions at a given hospital.

**Clinical Classification Software (CCS):** Software maintained by the AHRQ that groups thousands of individual procedure and diagnosis codes into clinically coherent, mutually exclusive procedure and diagnosis categories. AHRQ CCS categories are used to determine if a readmission is planned. AHRQ CCS procedure categories are used to define planned and potentially planned procedures. AHRQ CCS diagnosis categories are used to define acute diagnoses and complications of care that are considered unplanned, as well as a few specific types of care that are always considered planned (for example, maintenance chemotherapy). Mappings which show the assignment of ICD-9 and ICD-10 codes to the AHRQ CCS diagnosis and procedure categories are available on the [AHRQ website](#).

**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/ICD-10-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.<sup>10,11</sup> Mappings which show the assignment of ICD-9 and ICD-10-CM codes to the CCs are available on the [QualityNet](#) website.

**Confidence Interval (CI):** A CI is a range of values that describes the uncertainty surrounding an estimate. It is indicated by its endpoints; for example, a 95% CI for the OR associated with protein-calorie malnutrition noted as "1.09 – 1.15" would indicate that there is 95% confidence that the OR lies between 1.09 and 1.15.

**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 evaluation of relative hospital performance by accounting for patient risk factors. This statistical model accounts for the hierarchical structure of the data (patients clustered within hospitals are assumed to be correlated) and accommodates modeling of the association between outcomes and patient characteristics. Based on the hierarchical model, we can evaluate: (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 effect:** A measure of the hospital quality of care that is calculated through hierarchical logistic regression, taking into consideration how many patients were eligible for the cohort, these patients' risk factors, and how many were readmitted. The hospital-specific effect is the calculated random effect intercept for each hospital. 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 CABG surgery or elective THA/TKA 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 there is 95% confidence 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. 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 a short-term acute care hospital that is a scheduled part of the patient's plan of care. Planned readmissions are not captured in the outcomes of 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.

**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 the outcomes of these measures.

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## 7. APPENDICES

### Appendix A. Statistical Approach to RSRRs for CABG Surgery and THA/TKA 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 case mix and the average hospital-specific effect (that is, the average effect among all hospitals in the national sample). The predicted number of readmissions for each hospital is estimated using the same case mix but an estimated hospital-specific effect for that hospital. 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 effect. The predicted number of readmissions for each hospital is obtained by summing the predicted probabilities of readmissions for all patients in the hospital. The predicted 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 hospital-specific effect.

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  $j^{\text{th}}$  patient in the  $i^{\text{th}}$  hospital was readmitted (equal to 1 if readmitted within 30 days, 0 otherwise);  $\alpha_i$  represents the hospital-specific intercept,  $\mathbf{Z}_{ij} = (Z_{1ij}, Z_{2ij}, \dots, Z_{pij})$  the patient-specific covariates,  $\mu$  is the adjusted average hospital intercept across all hospitals in the sample, and  $\tau^2$  is the between-hospital variance component.<sup>12</sup> 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  $i^{\text{th}}$  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 (for example, higher than expected, as expected, or lower than expected).

### Creating Interval Estimates

Because the statistic described in Equation 5, that is,  $\widehat{RSRR}_i$ , 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. The estimated regression coefficients of the risk factors,  $\hat{\beta}^{(b)}$ .
  - 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,  $\{\hat{\alpha}_i^{(b)}, \widehat{var}(\alpha_i^{(b)}); i = 1, 2, \dots, I\}$
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 2.5<sup>th</sup> and 97.5<sup>th</sup> percentiles of the B estimates (or the percentiles corresponding to the alternative desired intervals).<sup>13</sup>

## **Appendix B. Data QA**

This production year required revision of all SAS packs to account for the ICD-10 code transition. In order to assure the quality of measure output, we utilized a multi-phase approach to QA of the readmission measures.

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 another contractor conducts that work.

### **Phase I**

The first step in this year's QA process started prior to the SAS pack revisions. We tested the conversion of the HCC map from version 12 to version 22 to ensure that the risk variables were well-aligned in both coding schemes. Following risk variable testing, we tested the impact of ICD-10 coding on the cohort inclusion and exclusion criteria, outcomes, and risk factors. We drew comparisons between the first six months of data from the start of the ICD-10 transition and the same six months in the prior year for ICD-9.

In general, we used both manual scan and descriptive analyses to conduct data validity checks, including cross-checking readmission information, distributions of ICD-9/ICD-10 codes, and frequencies of key variables.

### **Phase II**

Using a finalized list of ICD-10 coding changes, we updated the existing SAS packs to accommodate the post-transition data. To assure accuracy in the SAS pack revisions, two to three analysts/programmers independently wrote SAS code for any changes made in calculating the readmission measures: data preparation, cohort construction, hierarchical modeling, and calculation of RSRRs. This process highlighted any programming errors in syntax or logic and checked that new ICD-10 codes had been properly applied. Once this parallel programming process was complete, the analysts cross-checked their codes by analyzing datasets in parallel, checking for consistency of output, and reconciling any discrepancies. Finally, an additional analyst reviewed the finalized SAS code and recommended changes to the coding and readability of the SAS pack, where appropriate.

### **Phase III**

The last phase of QA involved reviewing the year-to-year changes in the risk variable frequencies, beta coefficients, and outcome rates for the measures. This was especially important this year as the final year of the three-year reporting period encompasses a large proportion of ICD-10 claims. This phase served as a final check, to ensure the ICD-10 code-based cohort, risk factor and outcome changes did not have an adverse impact on measure results.

## Appendix C. Annual Updates

Prior annual updates for the measures can be found in the annual updates and specifications reports available 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 for each measure. The measures receive a new version number for each subsequent year of public reporting.

### 2017

#### **2017 Measures Updates and Specifications Report (Version 6.0 - THA/TKA Readmission) (Version 4.0 - CABG Surgery Readmission)**

1. Revised the measure specifications to accommodate the implementation of ICD-10 coding:
  - Identified the ICD-10 codes used to define each of the measure cohorts for discharges on or after October 1, 2015.
  - Updated the planned readmission algorithm, by using the most recent (2016) version of the AHRQ ICD-10 CCS and ICD-10 codes for certain “potentially planned procedures” and “acute diagnoses” to the algorithm specifications, for discharges on or after October 1, 2015.
  - Re-specified the risk models, updating the CC-based risk variables to the ICD-10-compatible HCC system version 22 and applying ICD-10 codes for certain risk variables (for example, cardiogenic shock) to the models.
    - Rationale: The ICD-9 code sets used to report medical diagnoses and inpatient procedures were replaced by ICD-10 code sets on October 1, 2015. HHS mandated that ICD-10 codes be used for medical coding, effective October 1, 2015 discharges. The measurement period for 2017 public reporting required data from claims that include ICD-10 codes in addition to data from claims that include ICD-9 codes. Thus, re-specification was warranted to accommodate ICD-10 coding.
2. Updated the methodologies used to identify transfers to psychiatric and rehabilitation units, to ensure these transfers are not counted as readmissions for any hospital (as described in the [2013 update](#) below and the [2010 AMI, HF, and pneumonia readmission measures maintenance report](#).):
  - Psychiatric admissions – Previous criterion (2) and (3) apply. However, criterion (1) was modified slightly to:
    - (1) the admission being evaluated as a potential readmission has a psychiatric principal discharge diagnosis code (ICD-9-CM codes beginning with ‘29’, ‘30’ or ‘31’, for discharges prior to October 1, 2015, or ICD-10-CM codes beginning with ‘F’, for discharges on or after October 1, 2015);
  - Rehabilitation admissions – For discharges on or after October 1, 2015, the previous approach is replaced with:
    - (1) the index admission has a discharge disposition code to a rehabilitation hospital or rehabilitation unit from the index admission; and,
    - (2) the admission being evaluated as a potential readmission occurred on the same day as or the day following the index discharge.
    - Rationale: With the implementation of ICD-10 coding effective with October 1, 2015+ discharges, the ICD-9-code-based criterion developed in 2010 needed to be re-specified. For psychiatric admissions, defining “psychiatric diagnosis” with ICD-10-CM codes for October 1, 2015+ discharges was a simple solution, as mental health diagnosis codes all reside under the Category ‘F’ (Mental, Behavioral and

Neurodevelopmental disorders). However, for rehabilitation admissions, rehabilitation diagnosis codes are not coded consistently. Thus, re-defining the V57.0 ICD-9-CM code criterion with ICD-10-CM codes was not a viable option, and a different strategy was warranted.

## **2016**

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### **2016 Measures Updates and Specifications Report (Version 5.0 - THA/TKA Readmission) (Version 3.0 - CABG Surgery Readmission)**

1. Re-specified the measures by updating to CMS planned readmission algorithm version 4.0.
  - Rationale: Version 4.0 incorporates improvements made following a validation study of the algorithm using data from a medical record review and input from clinical experts. These changes improve the accuracy of the algorithm by decreasing the number of readmissions that the algorithm mistakenly designates as planned/unplanned by adding one procedure category and removing five procedure categories (only two of which apply to the CABG surgery and THA/TKA measures; the remaining three were only considered potentially planned procedures in the condition-specific and hospital-wide readmission measures).
2. Applied the 2015 version of the AHRQ CCS to the planned readmission algorithm.
  - Rationale: A 2015 version of the AHRQ CCS was released.
3. The exclusion criterion that addresses multiple CABG surgery admissions in a measurement period was re-coded in the 2016 version of the SAS code.
  - Rationale: The 2015 SAS code was incorrectly selecting the first CABG surgery admission for any patient with more than one CABG surgery within the measurement period and excluding the subsequent CABG surgery admissions within a 30-day time period, instead of excluding all subsequent CABG surgery admissions in the three-year measurement period. Analyses of the impact of this error demonstrated that these cases were extremely rare, and that recalculations were not warranted, as national results and overall measure performance rates would not change.

## **2015**

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

1. Applied updated AHRQ CCS version to the planned readmission algorithm.
  - Rationale: An updated version of the AHRQ CCS was released in 2014.

## **2014**

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

1. Re-specified 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. Applied updated AHRQ CCS version to the planned readmission algorithm.
  - Rationale: An updated version of the AHRQ CCS was released in 2013.

## 2013

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

1. Re-specified 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 admissions from the measure cohort.
    - ii. The mean risk-standardized readmission rate for the 2008 sample on page 54 was corrected.
4. Updated the methodology used to determine readmission outcome in cases of admission to psychiatric and rehabilitation hospital units.
  - Rationale: Psychiatric and rehabilitation units within short-term acute care hospitals in Maryland have the same type of provider ID number (or CMS certification number [CCN]) as the acute care hospital in which they are housed. Transfers to these units can therefore look like readmissions. In order to accurately assess readmissions in Maryland and allow for public reporting of Maryland readmission rates, methodologies to identify these cases were needed, to ensure these transfers are not counted as readmissions for any hospital. Rehabilitation admissions are identified by ICD-9-CM principal discharge diagnosis code (codes beginning with 'V57' indicate admission to a rehabilitation unit). A psychiatric admission is identified 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-CM codes beginning with '29', '30', or '31');
    - (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.Psychiatric/rehabilitation admissions identified as described above are not counted as readmissions. Note that we do not expect to see rehabilitation claims in hospital data from states other than Maryland.
  - The criteria for identifying such admissions are available in the 2010 AMI, HF, and pneumonia readmission measures maintenance report.

## Appendix D. Measure Specifications

### Appendix D.1 Hospital-Level 30-Day RSRR following CABG Surgery (NQF #2515)

#### Cohort

##### Inclusion Criteria for CABG Surgery Measure

- 1. Enrolled in Medicare FFS Part A and Part B for the 12 months prior to the date of admission, and enrolled in Part A during the index admission**  
Rationale: Claims data are consistently available only for Medicare FFS beneficiaries. 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 no Medicare Advantage patients are included in the measure.
- 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 short-term acute care hospital**  
Rationale: It is only possible for patients to be readmitted if they are discharged alive.
- 4. Having a qualifying isolated CABG procedure during the index admission**  
Rationale: Isolated CABG surgery is the procedure targeted for measurement ([Table D.1.1](#)). 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 ([ICD-10-PCS code list](#)) :
  - Valve procedures;
  - Atrial and/or ventricular septal defects;
  - Congenital anomalies;
  - Other open cardiac procedures;
  - Heart transplants;
  - Aorta or other non-cardiac arterial bypass procedures;
  - Head, neck, intracranial vascular procedures; and,
  - Other chest and thoracic procedures.

##### Exclusion Criteria for CABG Surgery Measure

- 1. Without at least 30 days post-discharge enrollment in Medicare FFS**  
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**  
Rationale: Providers did not have the opportunity to deliver full care and prepare the patient for discharge.
- 3. Admissions for 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 surgery admission for inclusion in the measure and exclude subsequent CABG surgery admissions from the cohort.

**Table D.1.1 – ICD-10-PCS Codes Used to Identify Eligible CABG Procedures**

Table D.1.1 below outlines the ICD-10-PCS codes used to identify CABG procedures in claims for discharges on or after October 1, 2015. ICD-9 code lists for discharges prior to October 1, 2015 can be found in the 2016 procedure-specific readmission measures updates and specifications report posted on [QualityNet](#).

ICD-10-PCS Codes	Description
0210093	Bypass Coronary Artery, One Artery from Coronary Artery with Autologous Venous Tissue, Open Approach
0210098	Bypass Coronary Artery, One Artery from Right Internal Mammary with Autologous Venous Tissue, Open Approach
0210099	Bypass Coronary Artery, One Artery from Left Internal Mammary with Autologous Venous Tissue, Open Approach
021009C	Bypass Coronary Artery, One Artery from Thoracic Artery with Autologous Venous Tissue, Open Approach
021009F	Bypass Coronary Artery, One Artery from Abdominal Artery with Autologous Venous Tissue, Open Approach
021009W	Bypass Coronary Artery, One Artery from Aorta with Autologous Venous Tissue, Open Approach
02100A3	Bypass Coronary Artery, One Artery from Coronary Artery with Autologous Arterial Tissue, Open Approach
02100A8	Bypass Coronary Artery, One Artery from Right Internal Mammary with Autologous Arterial Tissue, Open Approach
02100A9	Bypass Coronary Artery, One Artery from Left Internal Mammary with Autologous Arterial Tissue, Open Approach
02100AC	Bypass Coronary Artery, One Artery from Thoracic Artery with Autologous Arterial Tissue, Open Approach
02100AF	Bypass Coronary Artery, One Artery from Abdominal Artery with Autologous Arterial Tissue, Open Approach
02100AW	Bypass Coronary Artery, One Artery from Aorta with Autologous Arterial Tissue, Open Approach
02100J3	Bypass Coronary Artery, One Artery from Coronary Artery with Synthetic Substitute, Open Approach
02100J8	Bypass Coronary Artery, One Artery from Right Internal Mammary with Synthetic Substitute, Open Approach
02100J9	Bypass Coronary Artery, One Artery from Left Internal Mammary with Synthetic Substitute, Open Approach
02100JC	Bypass Coronary Artery, One Artery from Thoracic Artery with Synthetic Substitute, Open Approach
02100JF	Bypass Coronary Artery, One Artery from Abdominal Artery with Synthetic Substitute, Open Approach
02100JW	Bypass Coronary Artery, One Artery from Aorta with Synthetic Substitute, Open Approach
02100K3	Bypass Coronary Artery, One Artery from Coronary Artery with Nonautologous Tissue Substitute, Open Approach
02100K8	Bypass Coronary Artery, One Artery from Right Internal Mammary with Nonautologous Tissue Substitute, Open Approach

ICD-10-PCS Codes	Description
02100K9	Bypass Coronary Artery, One Artery from Left Internal Mammary with Nonautologous Tissue Substitute, Open Approach
02100KC	Bypass Coronary Artery, One Artery from Thoracic Artery with Nonautologous Tissue Substitute, Open Approach
02100KF	Bypass Coronary Artery, One Artery from Abdominal Artery with Nonautologous Tissue Substitute, Open Approach
02100KW	Bypass Coronary Artery, One Artery from Aorta with Nonautologous Tissue Substitute, Open Approach
02100Z3	Bypass Coronary Artery, One Artery from Coronary Artery, Open Approach
02100Z8	Bypass Coronary Artery, One Artery from Right Internal Mammary, Open Approach
02100Z9	Bypass Coronary Artery, One Artery from Left Internal Mammary, Open Approach
02100ZC	Bypass Coronary Artery, One Artery from Thoracic Artery, Open Approach
02100ZF	Bypass Coronary Artery, One Artery from Abdominal Artery, Open Approach
0210493	Bypass Coronary Artery, One Artery from Coronary Artery with Autologous Venous Tissue, Percutaneous Endoscopic Approach
0210498	Bypass Coronary Artery, One Artery from Right Internal Mammary with Autologous Venous Tissue, Percutaneous Endoscopic Approach
0210499	Bypass Coronary Artery, One Artery from Left Internal Mammary with Autologous Venous Tissue, Percutaneous Endoscopic Approach
021049C	Bypass Coronary Artery, One Artery from Thoracic Artery with Autologous Venous Tissue, Percutaneous Endoscopic Approach
021049F	Bypass Coronary Artery, One Artery from Abdominal Artery with Autologous Venous Tissue, Percutaneous Endoscopic Approach
021049W	Bypass Coronary Artery, One Artery from Aorta with Autologous Venous Tissue, Percutaneous Endoscopic Approach
02104A3	Bypass Coronary Artery, One Artery from Coronary Artery with Autologous Arterial Tissue, Percutaneous Endoscopic Approach
02104A8	Bypass Coronary Artery, One Artery from Right Internal Mammary with Autologous Arterial Tissue, Percutaneous Endoscopic Approach
02104A9	Bypass Coronary Artery, One Artery from Left Internal Mammary with Autologous Arterial Tissue, Percutaneous Endoscopic Approach
02104AC	Bypass Coronary Artery, One Artery from Thoracic Artery with Autologous Arterial Tissue, Percutaneous Endoscopic Approach
02104AF	Bypass Coronary Artery, One Artery from Abdominal Artery with Autologous Arterial Tissue, Percutaneous Endoscopic Approach
02104AW	Bypass Coronary Artery, One Artery from Aorta with Autologous Arterial Tissue, Percutaneous Endoscopic Approach
02104J3	Bypass Coronary Artery, One Artery from Coronary Artery with Synthetic Substitute, Percutaneous Endoscopic Approach
02104J8	Bypass Coronary Artery, One Artery from Right Internal Mammary with Synthetic Substitute, Percutaneous Endoscopic Approach
02104J9	Bypass Coronary Artery, One Artery from Left Internal Mammary with Synthetic Substitute, Percutaneous Endoscopic Approach
02104JC	Bypass Coronary Artery, One Artery from Thoracic Artery with Synthetic Substitute, Percutaneous Endoscopic Approach
02104JF	Bypass Coronary Artery, One Artery from Abdominal Artery with Synthetic Substitute, Percutaneous Endoscopic Approach
02104JW	Bypass Coronary Artery, One Artery from Aorta with Synthetic Substitute, Percutaneous Endoscopic Approach

ICD-10-PCS Codes	Description
02104K3	Bypass Coronary Artery, One Artery from Coronary Artery with Nonautologous Tissue Substitute, Percutaneous Endoscopic Approach
02104K8	Bypass Coronary Artery, One Artery from Right Internal Mammary with Nonautologous Tissue Substitute, Percutaneous Endoscopic Approach
02104K9	Bypass Coronary Artery, One Artery from Left Internal Mammary with Nonautologous Tissue Substitute, Percutaneous Endoscopic Approach
02104KC	Bypass Coronary Artery, One Artery from Thoracic Artery with Nonautologous Tissue Substitute, Percutaneous Endoscopic Approach
02104KF	Bypass Coronary Artery, One Artery from Abdominal Artery with Nonautologous Tissue Substitute, Percutaneous Endoscopic Approach
02104KW	Bypass Coronary Artery, One Artery from Aorta with Nonautologous Tissue Substitute, Percutaneous Endoscopic Approach
02104Z3	Bypass Coronary Artery, One Artery from Coronary Artery, Percutaneous Endoscopic Approach
02104Z8	Bypass Coronary Artery, One Artery from Right Internal Mammary, Percutaneous Endoscopic Approach
02104Z9	Bypass Coronary Artery, One Artery from Left Internal Mammary, Percutaneous Endoscopic Approach
02104ZC	Bypass Coronary Artery, One Artery from Thoracic Artery, Percutaneous Endoscopic Approach
02104ZF	Bypass Coronary Artery, One Artery from Abdominal Artery, Percutaneous Endoscopic Approach
0211093	Bypass Coronary Artery, Two Arteries from Coronary Artery with Autologous Venous Tissue, Open Approach
0211098	Bypass Coronary Artery, Two Arteries from Right Internal Mammary with Autologous Venous Tissue, Open Approach
0211099	Bypass Coronary Artery, Two Arteries from Left Internal Mammary with Autologous Venous Tissue, Open Approach
021109C	Bypass Coronary Artery, Two Arteries from Thoracic Artery with Autologous Venous Tissue, Open Approach
021109F	Bypass Coronary Artery, Two Arteries from Abdominal Artery with Autologous Venous Tissue, Open Approach
021109W	Bypass Coronary Artery, Two Arteries from Aorta with Autologous Venous Tissue, Open Approach
02110A3	Bypass Coronary Artery, Two Arteries from Coronary Artery with Autologous Arterial Tissue, Open Approach
02110A8	Bypass Coronary Artery, Two Arteries from Right Internal Mammary with Autologous Arterial Tissue, Open Approach
02110A9	Bypass Coronary Artery, Two Arteries from Left Internal Mammary with Autologous Arterial Tissue, Open Approach
02110AC	Bypass Coronary Artery, Two Arteries from Thoracic Artery with Autologous Arterial Tissue, Open Approach
02110AF	Bypass Coronary Artery, Two Arteries from Abdominal Artery with Autologous Arterial Tissue, Open Approach
02110AW	Bypass Coronary Artery, Two Arteries from Aorta with Autologous Arterial Tissue, Open Approach
02110J3	Bypass Coronary Artery, Two Arteries from Coronary Artery with Synthetic Substitute, Open Approach
02110J8	Bypass Coronary Artery, Two Arteries from Right Internal Mammary with Synthetic Substitute, Open Approach

ICD-10-PCS Codes	Description
02110J9	Bypass Coronary Artery, Two Arteries from Left Internal Mammary with Synthetic Substitute, Open Approach
02110JC	Bypass Coronary Artery, Two Arteries from Thoracic Artery with Synthetic Substitute, Open Approach
02110JF	Bypass Coronary Artery, Two Arteries from Abdominal Artery with Synthetic Substitute, Open Approach
02110JW	Bypass Coronary Artery, Two Arteries from Aorta with Synthetic Substitute, Open Approach
02110K3	Bypass Coronary Artery, Two Arteries from Coronary Artery with Nonautologous Tissue Substitute, Open Approach
02110K8	Bypass Coronary Artery, Two Arteries from Right Internal Mammary with Nonautologous Tissue Substitute, Open Approach
02110K9	Bypass Coronary Artery, Two Arteries from Left Internal Mammary with Nonautologous Tissue Substitute, Open Approach
02110KC	Bypass Coronary Artery, Two Arteries from Thoracic Artery with Nonautologous Tissue Substitute, Open Approach
02110KF	Bypass Coronary Artery, Two Arteries from Abdominal Artery with Nonautologous Tissue Substitute, Open Approach
02110KW	Bypass Coronary Artery, Two Arteries from Aorta with Nonautologous Tissue Substitute, Open Approach
02110Z3	Bypass Coronary Artery, Two Arteries from Coronary Artery, Open Approach
02110Z8	Bypass Coronary Artery, Two Arteries from Right Internal Mammary, Open Approach
02110Z9	Bypass Coronary Artery, Two Arteries from Left Internal Mammary, Open Approach
02110ZC	Bypass Coronary Artery, Two Arteries from Thoracic Artery, Open Approach
02110ZF	Bypass Coronary Artery, Two Arteries from Abdominal Artery, Open Approach
0211493	Bypass Coronary Artery, Two Arteries from Coronary Artery with Autologous Venous Tissue, Percutaneous Endoscopic Approach
0211498	Bypass Coronary Artery, Two Arteries from Right Internal Mammary with Autologous Venous Tissue, Percutaneous Endoscopic Approach
0211499	Bypass Coronary Artery, Two Arteries from Left Internal Mammary with Autologous Venous Tissue, Percutaneous Endoscopic Approach
021149C	Bypass Coronary Artery, Two Arteries from Thoracic Artery with Autologous Venous Tissue, Percutaneous Endoscopic Approach
021149F	Bypass Coronary Artery, Two Arteries from Abdominal Artery with Autologous Venous Tissue, Percutaneous Endoscopic Approach
021149W	Bypass Coronary Artery, Two Arteries from Aorta with Autologous Venous Tissue, Percutaneous Endoscopic Approach
02114A3	Bypass Coronary Artery, Two Arteries from Coronary Artery with Autologous Arterial Tissue, Percutaneous Endoscopic Approach
02114A8	Bypass Coronary Artery, Two Arteries from Right Internal Mammary with Autologous Arterial Tissue, Percutaneous Endoscopic Approach
02114A9	Bypass Coronary Artery, Two Arteries from Left Internal Mammary with Autologous Arterial Tissue, Percutaneous Endoscopic Approach
02114AC	Bypass Coronary Artery, Two Arteries from Thoracic Artery with Autologous Arterial Tissue, Percutaneous Endoscopic Approach
02114AF	Bypass Coronary Artery, Two Arteries from Abdominal Artery with Autologous Arterial Tissue, Percutaneous Endoscopic Approach
02114AW	Bypass Coronary Artery, Two Arteries from Aorta with Autologous Arterial Tissue, Percutaneous Endoscopic Approach

ICD-10-PCS Codes	Description
02114J3	Bypass Coronary Artery, Two Arteries from Coronary Artery with Synthetic Substitute, Percutaneous Endoscopic Approach
02114J8	Bypass Coronary Artery, Two Arteries from Right Internal Mammary with Synthetic Substitute, Percutaneous Endoscopic Approach
02114J9	Bypass Coronary Artery, Two Arteries from Left Internal Mammary with Synthetic Substitute, Percutaneous Endoscopic Approach
02114JC	Bypass Coronary Artery, Two Arteries from Thoracic Artery with Synthetic Substitute, Percutaneous Endoscopic Approach
02114JF	Bypass Coronary Artery, Two Arteries from Abdominal Artery with Synthetic Substitute, Percutaneous Endoscopic Approach
02114JW	Bypass Coronary Artery, Two Arteries from Aorta with Synthetic Substitute, Percutaneous Endoscopic Approach
02114K3	Bypass Coronary Artery, Two Arteries from Coronary Artery with Nonautologous Tissue Substitute, Percutaneous Endoscopic Approach
02114K8	Bypass Coronary Artery, Two Arteries from Right Internal Mammary with Nonautologous Tissue Substitute, Percutaneous Endoscopic Approach
02114K9	Bypass Coronary Artery, Two Arteries from Left Internal Mammary with Nonautologous Tissue Substitute, Percutaneous Endoscopic Approach
02114KC	Bypass Coronary Artery, Two Arteries from Thoracic Artery with Nonautologous Tissue Substitute, Percutaneous Endoscopic Approach
02114KF	Bypass Coronary Artery, Two Arteries from Abdominal Artery with Nonautologous Tissue Substitute, Percutaneous Endoscopic Approach
02114KW	Bypass Coronary Artery, Two Arteries from Aorta with Nonautologous Tissue Substitute, Percutaneous Endoscopic Approach
02114Z3	Bypass Coronary Artery, Two Arteries from Coronary Artery, Percutaneous Endoscopic Approach
02114Z8	Bypass Coronary Artery, Two Arteries from Right Internal Mammary, Percutaneous Endoscopic Approach
02114Z9	Bypass Coronary Artery, Two Arteries from Left Internal Mammary, Percutaneous Endoscopic Approach
02114ZC	Bypass Coronary Artery, Two Arteries from Thoracic Artery, Percutaneous Endoscopic Approach
02114ZF	Bypass Coronary Artery, Two Arteries from Abdominal Artery, Percutaneous Endoscopic Approach
0212093	Bypass Coronary Artery, Three Arteries from Coronary Artery with Autologous Venous Tissue, Open Approach
0212098	Bypass Coronary Artery, Three Arteries from Right Internal Mammary with Autologous Venous Tissue, Open Approach
0212099	Bypass Coronary Artery, Three Arteries from Left Internal Mammary with Autologous Venous Tissue, Open Approach
021209C	Bypass Coronary Artery, Three Arteries from Thoracic Artery with Autologous Venous Tissue, Open Approach
021209F	Bypass Coronary Artery, Three Arteries from Abdominal Artery with Autologous Venous Tissue, Open Approach
021209W	Bypass Coronary Artery, Three Arteries from Aorta with Autologous Venous Tissue, Open Approach
02120A3	Bypass Coronary Artery, Three Arteries from Coronary Artery with Autologous Arterial Tissue, Open Approach
02120A8	Bypass Coronary Artery, Three Arteries from Right Internal Mammary with Autologous Arterial Tissue, Open Approach

ICD-10-PCS Codes	Description
02120A9	Bypass Coronary Artery, Three Arteries from Left Internal Mammary with Autologous Arterial Tissue, Open Approach
02120AC	Bypass Coronary Artery, Three Arteries from Thoracic Artery with Autologous Arterial Tissue, Open Approach
02120AF	Bypass Coronary Artery, Three Arteries from Abdominal Artery with Autologous Arterial Tissue, Open Approach
02120AW	Bypass Coronary Artery, Three Arteries from Aorta with Autologous Arterial Tissue, Open Approach
02120J3	Bypass Coronary Artery, Three Arteries from Coronary Artery with Synthetic Substitute, Open Approach
02120J8	Bypass Coronary Artery, Three Arteries from Right Internal Mammary with Synthetic Substitute, Open Approach
02120J9	Bypass Coronary Artery, Three Arteries from Left Internal Mammary with Synthetic Substitute, Open Approach
02120JC	Bypass Coronary Artery, Three Arteries from Thoracic Artery with Synthetic Substitute, Open Approach
02120JF	Bypass Coronary Artery, Three Arteries from Abdominal Artery with Synthetic Substitute, Open Approach
02120JW	Bypass Coronary Artery, Three Arteries from Aorta with Synthetic Substitute, Open Approach
02120K3	Bypass Coronary Artery, Three Arteries from Coronary Artery with Nonautologous Tissue Substitute, Open Approach
02120K8	Bypass Coronary Artery, Three Arteries from Right Internal Mammary with Nonautologous Tissue Substitute, Open Approach
02120K9	Bypass Coronary Artery, Three Arteries from Left Internal Mammary with Nonautologous Tissue Substitute, Open Approach
02120KC	Bypass Coronary Artery, Three Arteries from Thoracic Artery with Nonautologous Tissue Substitute, Open Approach
02120KF	Bypass Coronary Artery, Three Arteries from Abdominal Artery with Nonautologous Tissue Substitute, Open Approach
02120KW	Bypass Coronary Artery, Three Arteries from Aorta with Nonautologous Tissue Substitute, Open Approach
02120Z3	Bypass Coronary Artery, Three Arteries from Coronary Artery, Open Approach
02120Z8	Bypass Coronary Artery, Three Arteries from Right Internal Mammary, Open Approach
02120Z9	Bypass Coronary Artery, Three Arteries from Left Internal Mammary, Open Approach
02120ZC	Bypass Coronary Artery, Three Arteries from Thoracic Artery, Open Approach
02120ZF	Bypass Coronary Artery, Three Arteries from Abdominal Artery, Open Approach
0212493	Bypass Coronary Artery, Three Arteries from Coronary Artery with Autologous Venous Tissue, Percutaneous Endoscopic Approach
0212498	Bypass Coronary Artery, Three Arteries from Right Internal Mammary with Autologous Venous Tissue, Percutaneous Endoscopic Approach
0212499	Bypass Coronary Artery, Three Arteries from Left Internal Mammary with Autologous Venous Tissue, Percutaneous Endoscopic Approach
021249C	Bypass Coronary Artery, Three Arteries from Thoracic Artery with Autologous Venous Tissue, Percutaneous Endoscopic Approach
021249F	Bypass Coronary Artery, Three Arteries from Abdominal Artery with Autologous Venous Tissue, Percutaneous Endoscopic Approach
021249W	Bypass Coronary Artery, Three Arteries from Aorta with Autologous Venous Tissue, Percutaneous Endoscopic Approach



ICD-10-PCS Codes	Description
02124A3	Bypass Coronary Artery, Three Arteries from Coronary Artery with Autologous Arterial Tissue, Percutaneous Endoscopic Approach
02124A8	Bypass Coronary Artery, Three Arteries from Right Internal Mammary with Autologous Arterial Tissue, Percutaneous Endoscopic Approach
02124A9	Bypass Coronary Artery, Three Arteries from Left Internal Mammary with Autologous Arterial Tissue, Percutaneous Endoscopic Approach
02124AC	Bypass Coronary Artery, Three Arteries from Thoracic Artery with Autologous Arterial Tissue, Percutaneous Endoscopic Approach
02124AF	Bypass Coronary Artery, Three Arteries from Abdominal Artery with Autologous Arterial Tissue, Percutaneous Endoscopic Approach
02124AW	Bypass Coronary Artery, Three Arteries from Aorta with Autologous Arterial Tissue, Percutaneous Endoscopic Approach
02124J3	Bypass Coronary Artery, Three Arteries from Coronary Artery with Synthetic Substitute, Percutaneous Endoscopic Approach
02124J8	Bypass Coronary Artery, Three Arteries from Right Internal Mammary with Synthetic Substitute, Percutaneous Endoscopic Approach
02124J9	Bypass Coronary Artery, Three Arteries from Left Internal Mammary with Synthetic Substitute, Percutaneous Endoscopic Approach
02124JC	Bypass Coronary Artery, Three Arteries from Thoracic Artery with Synthetic Substitute, Percutaneous Endoscopic Approach
02124JF	Bypass Coronary Artery, Three Arteries from Abdominal Artery with Synthetic Substitute, Percutaneous Endoscopic Approach
02124JW	Bypass Coronary Artery, Three Arteries from Aorta with Synthetic Substitute, Percutaneous Endoscopic Approach
02124K3	Bypass Coronary Artery, Three Arteries from Coronary Artery with Nonautologous Tissue Substitute, Percutaneous Endoscopic Approach
02124K8	Bypass Coronary Artery, Three Arteries from Right Internal Mammary with Nonautologous Tissue Substitute, Percutaneous Endoscopic Approach
02124K9	Bypass Coronary Artery, Three Arteries from Left Internal Mammary with Nonautologous Tissue Substitute, Percutaneous Endoscopic Approach
02124KC	Bypass Coronary Artery, Three Arteries from Thoracic Artery with Nonautologous Tissue Substitute, Percutaneous Endoscopic Approach
02124KF	Bypass Coronary Artery, Three Arteries from Abdominal Artery with Nonautologous Tissue Substitute, Percutaneous Endoscopic Approach
02124KW	Bypass Coronary Artery, Three Arteries from Aorta with Nonautologous Tissue Substitute, Percutaneous Endoscopic Approach
02124Z3	Bypass Coronary Artery, Three Arteries from Coronary Artery, Percutaneous Endoscopic Approach
02124Z8	Bypass Coronary Artery, Three Arteries from Right Internal Mammary, Percutaneous Endoscopic Approach
02124Z9	Bypass Coronary Artery, Three Arteries from Left Internal Mammary, Percutaneous Endoscopic Approach
02124ZC	Bypass Coronary Artery, Three Arteries from Thoracic Artery, Percutaneous Endoscopic Approach
02124ZF	Bypass Coronary Artery, Three Arteries from Abdominal Artery, Percutaneous Endoscopic Approach
0213093	Bypass Coronary Artery, Four or More Arteries from Coronary Artery with Autologous Venous Tissue, Open Approach
0213098	Bypass Coronary Artery, Four or More Arteries from Right Internal Mammary with Autologous Venous Tissue, Open Approach

ICD-10-PCS Codes	Description
0213099	Bypass Coronary Artery, Four or More Arteries from Left Internal Mammary with Autologous Venous Tissue, Open Approach
021309C	Bypass Coronary Artery, Four or More Arteries from Thoracic Artery with Autologous Venous Tissue, Open Approach
021309F	Bypass Coronary Artery, Four or More Arteries from Abdominal Artery with Autologous Venous Tissue, Open Approach
021309W	Bypass Coronary Artery, Four or More Arteries from Aorta with Autologous Venous Tissue, Open Approach
02130A3	Bypass Coronary Artery, Four or More Arteries from Coronary Artery with Autologous Arterial Tissue, Open Approach
02130A8	Bypass Coronary Artery, Four or More Arteries from Right Internal Mammary with Autologous Arterial Tissue, Open Approach
02130A9	Bypass Coronary Artery, Four or More Arteries from Left Internal Mammary with Autologous Arterial Tissue, Open Approach
02130AC	Bypass Coronary Artery, Four or More Arteries from Thoracic Artery with Autologous Arterial Tissue, Open Approach
02130AF	Bypass Coronary Artery, Four or More Arteries from Abdominal Artery with Autologous Arterial Tissue, Open Approach
02130AW	Bypass Coronary Artery, Four or More Arteries from Aorta with Autologous Arterial Tissue, Open Approach
02130J3	Bypass Coronary Artery, Four or More Arteries from Coronary Artery with Synthetic Substitute, Open Approach
02130J8	Bypass Coronary Artery, Four or More Arteries from Right Internal Mammary with Synthetic Substitute, Open Approach
02130J9	Bypass Coronary Artery, Four or More Arteries from Left Internal Mammary with Synthetic Substitute, Open Approach
02130JC	Bypass Coronary Artery, Four or More Arteries from Thoracic Artery with Synthetic Substitute, Open Approach
02130JF	Bypass Coronary Artery, Four or More Arteries from Abdominal Artery with Synthetic Substitute, Open Approach
02130JW	Bypass Coronary Artery, Four or More Arteries from Aorta with Synthetic Substitute, Open Approach
02130K3	Bypass Coronary Artery, Four or More Arteries from Coronary Artery with Nonautologous Tissue Substitute, Open Approach
02130K8	Bypass Coronary Artery, Four or More Arteries from Right Internal Mammary with Nonautologous Tissue Substitute, Open Approach
02130K9	Bypass Coronary Artery, Four or More Arteries from Left Internal Mammary with Nonautologous Tissue Substitute, Open Approach
02130KC	Bypass Coronary Artery, Four or More Arteries from Thoracic Artery with Nonautologous Tissue Substitute, Open Approach
02130KF	Bypass Coronary Artery, Four or More Arteries from Abdominal Artery with Nonautologous Tissue Substitute, Open Approach
02130KW	Bypass Coronary Artery, Four or More Arteries from Aorta with Nonautologous Tissue Substitute, Open Approach
02130Z3	Bypass Coronary Artery, Four or More Arteries from Coronary Artery, Open Approach
02130Z8	Bypass Coronary Artery, Four or More Arteries from Right Internal Mammary, Open Approach
02130Z9	Bypass Coronary Artery, Four or More Arteries from Left Internal Mammary, Open Approach
02130ZC	Bypass Coronary Artery, Four or More Arteries from Thoracic Artery, Open Approach



ICD-10-PCS Codes	Description
02130ZF	Bypass Coronary Artery, Four or More Arteries from Abdominal Artery, Open Approach
0213493	Bypass Coronary Artery, Four or More Arteries from Coronary Artery with Autologous Venous Tissue, Percutaneous Endoscopic Approach
0213498	Bypass Coronary Artery, Four or More Arteries from Right Internal Mammary with Autologous Venous Tissue, Percutaneous Endoscopic Approach
0213499	Bypass Coronary Artery, Four or More Arteries from Left Internal Mammary with Autologous Venous Tissue, Percutaneous Endoscopic Approach
021349C	Bypass Coronary Artery, Four or More Arteries from Thoracic Artery with Autologous Venous Tissue, Percutaneous Endoscopic Approach
021349F	Bypass Coronary Artery, Four or More Arteries from Abdominal Artery with Autologous Venous Tissue, Percutaneous Endoscopic Approach
021349W	Bypass Coronary Artery, Four or More Arteries from Aorta with Autologous Venous Tissue, Percutaneous Endoscopic Approach
02134A3	Bypass Coronary Artery, Four or More Arteries from Coronary Artery with Autologous Arterial Tissue, Percutaneous Endoscopic Approach
02134A8	Bypass Coronary Artery, Four or More Arteries from Right Internal Mammary with Autologous Arterial Tissue, Percutaneous Endoscopic Approach
02134A9	Bypass Coronary Artery, Four or More Arteries from Left Internal Mammary with Autologous Arterial Tissue, Percutaneous Endoscopic Approach
02134AC	Bypass Coronary Artery, Four or More Arteries from Thoracic Artery with Autologous Arterial Tissue, Percutaneous Endoscopic Approach
02134AF	Bypass Coronary Artery, Four or More Arteries from Abdominal Artery with Autologous Arterial Tissue, Percutaneous Endoscopic Approach
02134AW	Bypass Coronary Artery, Four or More Arteries from Aorta with Autologous Arterial Tissue, Percutaneous Endoscopic Approach
02134J3	Bypass Coronary Artery, Four or More Arteries from Coronary Artery with Synthetic Substitute, Percutaneous Endoscopic Approach
02134J8	Bypass Coronary Artery, Four or More Arteries from Right Internal Mammary with Synthetic Substitute, Percutaneous Endoscopic Approach
02134J9	Bypass Coronary Artery, Four or More Arteries from Left Internal Mammary with Synthetic Substitute, Percutaneous Endoscopic Approach
02134JC	Bypass Coronary Artery, Four or More Arteries from Thoracic Artery with Synthetic Substitute, Percutaneous Endoscopic Approach
02134JF	Bypass Coronary Artery, Four or More Arteries from Abdominal Artery with Synthetic Substitute, Percutaneous Endoscopic Approach
02134JW	Bypass Coronary Artery, Four or More Arteries from Aorta with Synthetic Substitute, Percutaneous Endoscopic Approach
02134K3	Bypass Coronary Artery, Four or More Arteries from Coronary Artery with Nonautologous Tissue Substitute, Percutaneous Endoscopic Approach
02134K8	Bypass Coronary Artery, Four or More Arteries from Right Internal Mammary with Nonautologous Tissue Substitute, Percutaneous Endoscopic Approach
02134K9	Bypass Coronary Artery, Four or More Arteries from Left Internal Mammary with Nonautologous Tissue Substitute, Percutaneous Endoscopic Approach
02134KC	Bypass Coronary Artery, Four or More Arteries from Thoracic Artery with Nonautologous Tissue Substitute, Percutaneous Endoscopic Approach
02134KF	Bypass Coronary Artery, Four or More Arteries from Abdominal Artery with Nonautologous Tissue Substitute, Percutaneous Endoscopic Approach
02134KW	Bypass Coronary Artery, Four or More Arteries from Aorta with Nonautologous Tissue Substitute, Percutaneous Endoscopic Approach

ICD-10-PCS Codes	Description
02134Z3	Bypass Coronary Artery, Four or More Arteries from Coronary Artery, Percutaneous Endoscopic Approach
02134Z8	Bypass Coronary Artery, Four or More Arteries from Right Internal Mammary, Percutaneous Endoscopic Approach
02134Z9	Bypass Coronary Artery, Four or More Arteries from Left Internal Mammary, Percutaneous Endoscopic Approach
02134ZC	Bypass Coronary Artery, Four or More Arteries from Thoracic Artery, Percutaneous Endoscopic Approach
02134ZF	Bypass Coronary Artery, Four or More Arteries from Abdominal Artery, Percutaneous Endoscopic Approach

### **Risk Adjustment**

**Table D.1.2 – Risk Variables for CABG Surgery Measure**

The CCs outlined in [Table D.1.2](#) below are used to identify risk variables in claims for discharges on or after October 1, 2015 as well as discharges prior to October 1, 2015.

The ICD-10 codes used to identify the Cardiogenic shock and History of CABG or valve surgery risk variables in discharges on or after October 1, 2015 are posted on [QualityNet](#) due to volume; hyperlinks to these lists are provided in the table. For a list of ICD-9 codes used to identify these variables in discharges prior to October 1, 2015, please refer to the 2016 procedure-specific readmission measures updates and specifications report posted on [QualityNet](#).

Description of Risk Variable	CCs and/or ICD-10 Codes Included	Variables Not Used in Risk Adjustment if Occurred Only during Index Admission (indicated by “X”)
Age minus 65 (years above 65, continuous)	n/a	
Male	n/a	
Cardiogenic shock	<a href="#">ICD-10-CM code list</a>	
History of coronary artery bypass graft (CABG) or valve surgery	<a href="#">ICD-10-CM code list</a> and <a href="#">ICD-10-PCS code list</a>	
Cancer; metastatic cancer and acute leukemia (CC 8-14)	Metastatic cancer or acute leukemia (CC 8),	
	Lung and other severe cancers (CC 9)	
	Lymphoma and other cancers (CC 10)	
	Colorectal, bladder, and other cancers (CC 11)	
	Breast, prostate, and other cancers and tumors (CC 12)	
	Other respiratory and heart neoplasms (CC 13)	
	Other digestive and urinary neoplasms (CC 14)	
Diabetes mellitus (DM) or DM complications (CC 17-19, 122-123)	Diabetes with acute complications (CC 17)	X
	Diabetes with chronic complications (CC 18)	
	Diabetes without complications (CC 19)	
	Proliferative diabetic retinopathy and vitreous hemorrhage (CC 122)	

Description of Risk Variable	CCs and/or ICD-10 Codes Included	Variables Not Used in Risk Adjustment if Occurred Only during Index Admission (indicated by "X")
	Diabetic and other vascular retinopathies (CC 123)	
Protein-calorie malnutrition (CC 21)	Protein-calorie malnutrition (CC 21)	
Morbid obesity; other endocrine/metabolic/nutritional disorders (CC 22, 25-26)	Morbid obesity (CC 22)	
	Disorders of lipid metabolism (CC 25)	
	Other endocrine/metabolic/nutritional disorders (CC 26)	
Other significant endocrine and metabolic disorders; disorders of fluid/electrolyte/acid-base balance (CC 23-24)	Other significant endocrine and metabolic disorders (CC 23)	
	Disorders of fluid/electrolyte/acid-base balance (CC 24)	X
Severe hematological disorders (CC 46)	Severe hematological disorders (CC 46)	
Dementia or other specified brain disorders (CC 51-53)	Dementia with complications (CC 51)	
	Dementia without complications (CC 52)	
	Nonpsychotic organic brain syndromes/conditions (CC 53)	
Major psychiatric disorders (CC 57-59)	Schizophrenia (CC 57)	
	Major depressive, bipolar, and paranoid disorders (CC 58)	
	Reactive and unspecified psychosis (CC 59)	
Hemiplegia, paraplegia, paralysis, functional disability (CC 70-74, 103-104, 189-190)	Quadriplegia (CC 70)	
	Paraplegia (CC 71)	
	Spinal cord disorders/injuries (CC 72)	
	Amyotrophic lateral sclerosis and other motor neuron disease (CC 73)	
	Cerebral palsy (CC 74)	
	Hemiplegia/hemiparesis (CC 103)	X
	Monoplegia, other paralytic syndromes (CC 104)	X
	Amputation status, lower limb/amputation complications (CC 189)	X
	Amputation status, upper limb (CC 190)	X
Polyneuropathy; other neuropathies (CC 75, 81)	Myasthenia gravis/myoneural disorders and Guillain-Barre syndrome/inflammatory and toxic neuropathy (CC 75)	
	Polyneuropathy, mononeuropathy, and other neurological conditions/injuries (CC 81)	
Congestive heart failure (CC 85)	Congestive heart failure (CC 85)	X
Specified arrhythmias and other heart rhythm disorders (CC 96-97)	Specified heart arrhythmias (CC 96)	X
	Other heart rhythm and conduction disorders (CC 97)	X
Stroke (CC 99-100)	Cerebral hemorrhage (CC 99)	X
	Ischemic or unspecified stroke (CC 100)	X
Cerebrovascular disease (CC 101-102, 105)	Precerebral arterial occlusion and transient cerebral ischemia (CC 101)	X

Description of Risk Variable	CCs and/or ICD-10 Codes Included	Variables Not Used in Risk Adjustment if Occurred Only during Index Admission (indicated by “X”)
	Cerebrovascular atherosclerosis, aneurysm, and other disease (CC 102)	
	Late effects of cerebrovascular disease, except paralysis (CC 105)	
Vascular or circulatory disease (CC 106-109)	Atherosclerosis of the extremities with ulceration or gangrene (CC 106)	X
	Vascular disease with complications (CC 107)	X
	Vascular disease (CC 108)	X
	Other circulatory disease (CC 109)	X
Chronic obstructive pulmonary disease (COPD) (CC 111)	Chronic obstructive pulmonary disease (COPD) (CC 111)	
Fibrosis of lung or other chronic lung disorders (CC 112)	Fibrosis of lung or other chronic lung disorders (CC 112)	
Pneumonia (CC 114-116)	Aspiration and specified bacterial pneumonias (CC 114)	X
	Pneumococcal pneumonia, empyema, lung abscess (CC 115)	X
	Viral and unspecified pneumonia, pleurisy (CC 116)	
Other respiratory disorders (CC 118)	Other respiratory disorders (CC 118)	
Dialysis status (CC 134)	Dialysis status (CC 134)	X
Renal failure (CC 135-140)	Acute renal failure (CC 135)	X
	Chronic kidney disease, stage 5 (CC 136)	
	Chronic kidney disease, severe (stage 4) (CC 137)	
	Chronic kidney disease, moderate (stage 3) (CC 138)	
	Chronic kidney disease, mild or unspecified (stages 1-2 or unspecified) (CC 139)	
	Unspecified renal failure (CC 140)	X
Decubitus ulcer or chronic skin ulcer (CC 157-161)	Pressure ulcer of skin with necrosis through to muscle, tendon, or bone (CC 157)	X
	Pressure ulcer of skin with full thickness skin loss (CC 158)	X
	Pressure ulcer of skin with partial thickness skin loss (CC 159)	X
	Pressure pre-ulcer skin changes or unspecified stage (CC 160)	X
	Chronic ulcer of skin, except pressure (CC 161)	

## **Outcome**

### **Outcome Criteria for CABG Surgery Measure**

**Unplanned readmission, from any cause, within 30 days from the date of discharge from an index admission.**

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 who are scheduled for elective or necessary procedures within 30 days of discharge. From a patient perspective, an unplanned readmission from any cause is an adverse event. Outcomes occurring within 30 days of discharge can be influenced by hospital care and the early transition to the non-acute care setting. The 30-day time frame is a clinically meaningful period for hospitals to collaborate with their communities to reduce readmissions.

## Appendix D.2 Hospital-Level 30-Day RSRR following Elective Primary THA and/or TKA (NQF #1551)

### Cohort

#### Inclusion Criteria for THA/TKA Measure

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

Rationale: Claims data are consistently available only for Medicare FFS beneficiaries. 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 no Medicare Advantage patients are included in the measure.

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 short-term acute care hospital**

Rationale: It is only possible for patients to be readmitted if they are discharged alive.

4. **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.2.1](#)).

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

- **Fracture of the pelvis or lower limbs 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 ([ICD-10-CM code list](#)).

- **A concurrent partial hip arthroplasty procedure**

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 ([ICD-10-PCS code list](#)).

- **A concurrent revision, resurfacing, or implanted device/prosthesis removal procedure**

Rationale: Revision procedures may be performed at a disproportionately small number of hospitals and are associated with higher mortality, complication, and readmission rates. Resurfacing procedures are a different type of procedure involving only the joint's articular surface and are typically performed on younger, healthier patients. Elective procedures performed on patients undergoing removal of implanted device/prostheses procedures may be more complicated ([ICD-10-PCS code list](#)).

- **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. These patients may require more technically complex arthroplasty procedures and may be at increased risk for readmission ([ICD-10-CM code list](#)).

- **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 ([ICD-10-CM code list](#)).

- **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 Measure

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

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 admission**

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.

5. **THA/TKA admissions within 30 days of discharge from a prior THA/TKA index admission**

Rationale: Additional THA/TKA admissions within 30 days are excluded as index admissions because they are part of the outcome. A single admission does not count as both an index admission and a readmission for another index admission.

**Table D.2.1 – ICD-10-PCS Codes Used to Identify Eligible THA/TKA Procedures**

Table D.2.1 below outlines the ICD-10-PCS codes used to identify THA/TKA procedures in claims for discharges on or after October 1, 2015. ICD-9 code lists for discharges prior to October 1, 2015 can be found in the 2016 procedure-specific readmission measures updates and specifications report posted on [QualityNet](#).

ICD-10-PCS Codes	Description
OSR9019	Replacement of Right Hip Joint with Metal Synthetic Substitute, Cemented, Open Approach
OSR901A	Replacement of Right Hip Joint with Metal Synthetic Substitute, Uncemented, Open Approach
OSR901Z	Replacement of Right Hip Joint with Metal Synthetic Substitute, Open Approach
OSR9029	Replacement of Right Hip Joint with Metal on Polyethylene Synthetic Substitute, Cemented, Open Approach
OSR902A	Replacement of Right Hip Joint with Metal on Polyethylene Synthetic Substitute, Uncemented, Open Approach
OSR902Z	Replacement of Right Hip Joint with Metal on Polyethylene Synthetic Substitute, Open Approach
OSR9039	Replacement of Right Hip Joint with Ceramic Synthetic Substitute, Cemented, Open Approach
OSR903A	Replacement of Right Hip Joint with Ceramic Synthetic Substitute, Uncemented, Open Approach

ICD-10-PCS Codes	Description
0SR903Z	Replacement of Right Hip Joint with Ceramic Synthetic Substitute, Open Approach
0SR9049	Replacement of Right Hip Joint with Ceramic on Polyethylene Synthetic Substitute, Cemented, Open Approach
0SR904A	Replacement of Right Hip Joint with Ceramic on Polyethylene Synthetic Substitute, Uncemented, Open Approach
0SR904Z	Replacement of Right Hip Joint with Ceramic on Polyethylene Synthetic Substitute, Open Approach
0SR90J9	Replacement of Right Hip Joint with Synthetic Substitute, Cemented, Open Approach
0SR90JA	Replacement of Right Hip Joint with Synthetic Substitute, Uncemented, Open Approach
0SR90JZ	Replacement of Right Hip Joint with Synthetic Substitute, Open Approach
0SRB019	Replacement of Left Hip Joint with Metal Synthetic Substitute, Cemented, Open Approach
0SRB01A	Replacement of Left Hip Joint with Metal Synthetic Substitute, Uncemented, Open Approach
0SRB01Z	Replacement of Left Hip Joint with Metal Synthetic Substitute, Open Approach
0SRB029	Replacement of Left Hip Joint with Metal on Polyethylene Synthetic Substitute, Cemented, Open Approach
0SRB02A	Replacement of Left Hip Joint with Metal on Polyethylene Synthetic Substitute, Uncemented, Open Approach
0SRB02Z	Replacement of Left Hip Joint with Metal on Polyethylene Synthetic Substitute, Open Approach
0SRB039	Replacement of Left Hip Joint with Ceramic Synthetic Substitute, Cemented, Open Approach
0SRB03A	Replacement of Left Hip Joint with Ceramic Synthetic Substitute, Uncemented, Open Approach
0SRB03Z	Replacement of Left Hip Joint with Ceramic Synthetic Substitute, Open Approach
0SRB049	Replacement of Left Hip Joint with Ceramic on Polyethylene Synthetic Substitute, Cemented, Open Approach
0SRB04A	Replacement of Left Hip Joint with Ceramic on Polyethylene Synthetic Substitute, Uncemented, Open Approach
0SRB04Z	Replacement of Left Hip Joint with Ceramic on Polyethylene Synthetic Substitute, Open Approach
0SRB0J9	Replacement of Left Hip Joint with Synthetic Substitute, Cemented, Open Approach
0SRB0JA	Replacement of Left Hip Joint with Synthetic Substitute, Uncemented, Open Approach
0SRB0JZ	Replacement of Left Hip Joint with Synthetic Substitute, Open Approach
0SRC0J9	Replacement of Right Knee Joint with Synthetic Substitute, Cemented, Open Approach
0SRC0JA	Replacement of Right Knee Joint with Synthetic Substitute, Uncemented, Open Approach
0SRC0JZ	Replacement of Right Knee Joint with Synthetic Substitute, Open Approach



ICD-10-PCS Codes	Description
OSRD0J9	Replacement of Left Knee Joint with Synthetic Substitute, Cemented, Open Approach
OSRD0JA	Replacement of Left Knee Joint with Synthetic Substitute, Uncemented, Open Approach
OSRD0JZ	Replacement of Left Knee Joint with Synthetic Substitute, Open Approach

## Risk Adjustment

**Table D.2.2 – Risk Variables for THA/TKA Measure**

The CCs outlined in [Table D.2.2](#) below are used to identify risk variables in claims for discharges on or after October 1, 2015 as well as discharges prior to October 1, 2015.

The ICD-10 codes used to identify certain risk variables (for example, Post traumatic osteoarthritis) in discharges on or after October 1, 2015 are posted on [QualityNet](#) due to volume; hyperlinks to these lists are provided in the table. For a list of ICD-9 codes used to identify these variables in discharges prior to October 1, 2015, please refer to the 2016 procedure-specific readmission measures updates and specifications report posted on [QualityNet](#).

Description of Risk Variable	CCs and/or ICD-10 Codes Included	Variables Not Used in Risk Adjustment if Occurred Only during Index Admission (indicated by “X”)
Age minus 65 (years above 65, continuous)	n/a	
Male	n/a	
Index admissions with an elective THA procedure	ICD-10-PCS codes OSR9019, OSR901A, OSR901Z, OSR9029, OSR902A, OSR902Z, OSR9039, OSR903A, OSR903Z, OSR9049, OSR904A, OSR904Z, OSR90J9, OSR90JA, OSR90JZ, OSRB019, OSRB01A, OSRB01Z, OSRB029, OSRB02A, OSRB02Z, OSRB039, OSRB03A, OSRB03Z, OSRB049, OSRB04A, OSRB04Z, OSRB0J9, OSRB0JA, OSRB0JZ	
Number of procedures (two vs. one)	n/a	
Other congenital deformity of hip (joint)	<a href="#">ICD-10-CM code list</a>	
Post traumatic osteoarthritis	<a href="#">ICD-10-CM code list</a>	
Severe infection; other infectious diseases (CC 1, 3-7)	HIV/AIDS (CC 1)	
	Bacterial, fungal, and parasitic central nervous system infections (CC 3)	
	Viral and late effects central nervous system infections (CC 4)	
	Tuberculosis (CC 5)	
	Opportunistic infections (CC 6)	
	Other infectious diseases (CC 7)	X
Metastatic cancer or acute leukemia (CC 8)	Metastatic cancer or acute leukemia (CC 8)	
Cancer (CC 9-14)	Lung and other severe cancers (CC 9)	
	Lymphoma and other cancers (CC 10)	

Description of Risk Variable	CCs and/or ICD-10 Codes Included	Variables Not Used in Risk Adjustment if Occurred Only during Index Admission (indicated by "X")
	Colorectal, bladder, and other cancers (CC 11)	
	Breast, prostate, and other cancers and tumors (CC 12)	
	Other respiratory and heart neoplasms (CC 13)	
	Other digestive and urinary neoplasms (CC 14)	
Diabetes mellitus (DM) or DM complications (CC 17-19, 122-123)	Diabetes with acute complications (CC 17)	X
	Diabetes with chronic complications (CC 18)	
	Diabetes without complications (CC 19)	
	Proliferative diabetic retinopathy and vitreous hemorrhage (CC 122)	
	Diabetic and other vascular retinopathies (CC 123)	
Protein-calorie malnutrition (CC 21)	Protein-calorie malnutrition (CC 21)	
Morbidity obesity (CC 22)	Morbid obesity (CC 22)	
Other significant endocrine and metabolic disorders; disorders of fluid/electrolyte/acid-base balance (CC 23-24)	Other significant endocrine and metabolic disorders (CC 23)	
	Disorders of fluid/electrolyte/acid-base balance (CC 24)	X
Rheumatoid arthritis and inflammatory connective tissue disease (CC 40)	Rheumatoid arthritis and inflammatory connective tissue disease (CC 40)	
Severe hematological disorders (CC 46)	Severe hematological disorders (CC 46)	
Dementia or other specified brain disorders (CC 51-53)	Dementia with complications (CC 51)	
	Dementia without complications (CC 52)	
	Nonpsychotic organic brain syndromes/conditions (CC 53)	
Major psychiatric disorders (CC 57-59)	Schizophrenia (CC 57)	
	Major depressive, bipolar, and paranoid disorders (CC 58)	
	Reactive and unspecified psychosis (CC 59)	
Hemiplegia, paraplegia, paralysis, functional disability (CC 70-74, 103-104, 189-190)	Quadriplegia (CC 70)	
	Paraplegia (CC 71)	
	Spinal cord disorders/injuries (CC 72)	
	Amyotrophic lateral sclerosis and other motor neuron disease (CC 73)	
	Cerebral palsy (CC 74)	
	Hemiplegia/hemiparesis (CC 103)	X
	Monoplegia, other paralytic syndromes (CC 104)	X
	Amputation status, lower limb/amputation complications (CC 189)	X
	Amputation status, upper limb (CC 190)	X

Description of Risk Variable	CCs and/or ICD-10 Codes Included	Variables Not Used in Risk Adjustment if Occurred Only during Index Admission (indicated by “X”)
Polyneuropathy; other neuropathies (CC 75, 81)	Myasthenia gravis/myoneural disorders and Guillain-Barre syndrome/inflammatory and toxic neuropathy (CC 75)	
	Polyneuropathy, mononeuropathy, and other neurological conditions/injuries (CC 81)	X
Congestive heart failure (CC 85)	Congestive heart failure (CC 85)	X
Coronary atherosclerosis or angina (CC 88-89)	Angina pectoris (CC 88)	
	Coronary atherosclerosis/other chronic ischemic heart disease (CC 89)	
Hypertension (CC 95)	Hypertension (CC 95)	
Specified arrhythmias and other heart rhythm disorders (CC 96-97)	Specified heart arrhythmias (CC 96)	X
	Other heart rhythm and conduction disorders (CC 97)	X
Stroke (CC 99-100)	Cerebral hemorrhage (CC 99)	X
	Ischemic or unspecified stroke (CC 100)	X
Vascular or circulatory disease (CC 106-109)	Atherosclerosis of the extremities with ulceration or gangrene (CC 106)	X
	Vascular disease with complications (CC 107)	X
	Vascular disease (CC 108)	X
	Other circulatory disease (CC 109)	X
Chronic obstructive pulmonary disease (COPD) (CC 111)	Chronic obstructive pulmonary disease (COPD) (CC 111)	
Pneumonia (CC 114-116)	Aspiration and specified bacterial pneumonias (CC 114)	X
	Pneumococcal pneumonia, empyema, lung abscess (CC 115)	X
	Viral and unspecified pneumonia, pleurisy (CC 116)	X
Dialysis status (CC 134)	Dialysis status (CC 134)	X
Renal failure (CC 135-140)	Acute renal failure (CC 135)	X
	Chronic kidney disease, stage 5 (CC 136)	
	Chronic kidney disease, severe (stage 4) (CC 137)	
	Chronic kidney disease, moderate (stage 3) (CC 138)	
	Chronic kidney disease, mild or unspecified (stages 1-2 or unspecified) (CC 139)	
	Unspecified renal failure (CC 140)	X
Decubitus ulcer or chronic skin ulcer (CC 157-161)	Pressure ulcer of skin with necrosis through to muscle, tendon, or bone (CC 157)	X
	Pressure ulcer of skin with full thickness skin loss (CC 158)	X
	Pressure ulcer of skin with partial thickness skin loss (CC 159)	X

Description of Risk Variable	CCs and/or ICD-10 Codes Included	Variables Not Used in Risk Adjustment if Occurred Only during Index Admission (indicated by "X")
	Pressure pre-ulcer skin changes or unspecified stage (CC 160)	X
	Chronic ulcer of skin, except pressure (CC 161)	
Cellulitis, local skin infection (CC 164)	Cellulitis, local skin infection (CC 164)	X
Other injuries (CC 174)	Other injuries (CC 174)	X
Major symptoms, abnormalities (CC 178)	Major symptoms, abnormalities (CC 178)	

## **Outcome**

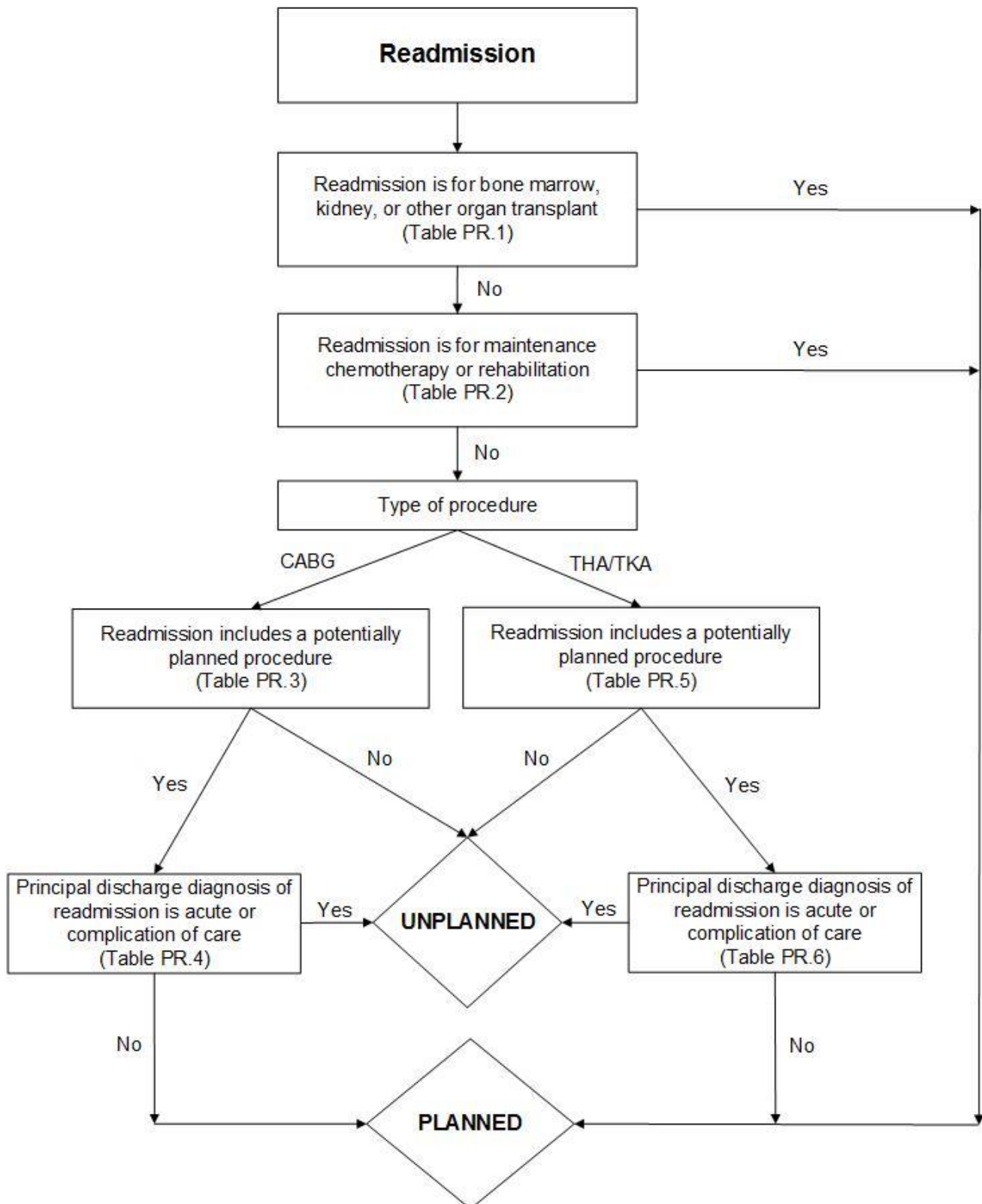
### **Outcome Criteria for the THA/TKA Readmission Measure**

**Unplanned readmission, from any cause, within 30 days from the date of discharge from an index admission.**

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 who are scheduled for elective or necessary procedures within 30 days of discharge. From a patient perspective, an unplanned readmission from any cause is an adverse event. Outcomes occurring within 30 days of discharge can be influenced by hospital care and the early transition to the non-acute care setting. The 30-day time frame is a clinically meaningful period for hospitals to collaborate with their communities to reduce readmissions.

## Appendix E. Planned Readmission Algorithm

Figure PR.1 – Planned Readmission Algorithm Version 4.0 (ICD-10) Flowchart



## Planned Readmission Algorithm Version 4.0 (ICD-10) Tables – CABG and THA/TKA Measures

Note that the ICD-10-based AHRQ CCS categories listed in Tables [PR.1](#) through [PR.6](#) below and the singular ICD-10 codes listed in Tables [PR.3](#) through [PR.6](#) are used to identify planned readmissions in claims for discharges on or after October 1, 2015. The ICD-9-based AHRQ CCS categories and singular ICD-9 code lists for discharges prior to October 1, 2015 can be found in the 2016 procedure-specific readmission measures updates and specifications report posted on [QualityNet](#).

**Table PR.1 – Procedure Categories That Are Always Planned (Version 4.0 [ICD-10] — CABG and THA/TKA Populations)**

AHRQ CCS Procedure	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 (other than bone marrow corneal or kidney)

**Table PR.2 – Diagnosis Categories That Are Always Planned (Version 4.0 [ICD-10] — CABG and THA/TKA Populations)**

AHRQ CCS Diagnosis	Description
45	Maintenance chemotherapy; radiotherapy
194	Forceps delivery [Included only in all-payer population, not Medicare]
196	Other pregnancy and delivery including normal [Included only in all-payer population, not Medicare]
254	Rehabilitation care; fitting of prostheses; and adjustment of devices [Excluding the following ICD-10-CM codes for CABG only: Z44.001, Z44.002, Z44.009, Z44.011, Z44.012, Z44.019, Z44.021, Z44.022, Z44.029, Z44.101, Z44.102, Z44.109, Z44.111, Z44.112, Z44.119, Z44.121, Z44.122, Z44.129, Z44.8, Z44.9, Z45.1, Z46.82]

**Table PR.3 – Potentially Planned Procedures (Version 4.0 [ICD-10] – CABG Population)**

Procedure Category/ICD-10-PCS Codes	Description
<b>AHRQ CCS Procedure Categories</b>	
1	Incision and excision of CNS
3	Excision destruction or resection of intervertebral disc
5	Insertion of catheter or spinal stimulator and injection into spinal canal
9	Other OR therapeutic nervous system procedures
10	Thyroidectomy; partial or complete
12	Therapeutic endocrine procedures
33	Other OR procedures on mouth and throat
36	Lobectomy or pneumonectomy
38	Other diagnostic procedures on lung and bronchus
40	Other diagnostic procedures on the respiratory system and mediastinum
51	Endarterectomy; vessel of head and neck
52	Aortic resection; replacement or anastomosis

Procedure Category/ICD-10-PCS Codes	Description
53	Varicose vein stripping; lower limb
59	Other OR procedures on vessels of head and neck
66	Procedures on spleen
67	Other procedures; hemic and lymphatic systems
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
172	Skin graft
175	Other OR therapeutic procedures on skin subcutaneous tissue fascia and breast
<b>ICD-10-PCS Codes</b>	
0CBS4ZZ, 0CBS7ZZ, 0CBS8ZZ	Laryngectomy
0B5N0ZZ, 0B5N3ZZ, 0B5N4ZZ, 0B5P0ZZ, 0B5P3ZZ, 0B5P4ZZ, 0BW10FZ, 0BW13FZ, 0BW14FZ	Revision of tracheostomy, scarification of pleura
0TC03ZZ, 0TC04ZZ, 0TC13ZZ, 0TC14ZZ, 0TC33ZZ, 0TC34ZZ, 0TC43ZZ, 0TC44ZZ	Nephrostomy
0T9030Z, 0T9130Z	Kidney procedures
GZB0ZZZ, GZB1ZZZ, GZB2ZZZ, GZB3ZZZ, GZB4ZZZ	Electroshock therapy

**Table PR.4 – Acute Diagnoses (Version 4.0 [ICD-10] – CABG Population)**

Diagnosis Category/ICD-10-CM Codes	Description
<b>AHRQ CCS Diagnosis Categories</b>	
1	Tuberculosis
2	Septicemia (except in labor)
3	Bacterial infection; unspecified site

Diagnosis Category/ICD-10-CM Codes	Description
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 and secondary hypertension
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 tuberculosis 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



Diagnosis Category/ICD-10-CM Codes	Description
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

Diagnosis Category/ICD-10-CM Codes	Description
663	Screening and history of mental health and substance abuse codes
670	Miscellaneous mental health disorders
<b>ICD-10-CM Codes</b>	
A36.81, A39.50, A39.51, A39.52, A39.53, B33.20, B33.21, B33.22, B33.23, B37.6, B58.81, I01.0, I01.1, I01.2, I01.8, I01.9, I02.0, I09.0, I09.89, I09.9, I30.0, I30.1, I30.8, I30.9, I31.0, I31.1, I31.2, I31.4, I32, I33.0, I33.9, I39, I40.0, I40.1, I40.8, I40.9, I41, I51.4	Peri-; endo-; and myocarditis; cardiomyopathy
I21.01, I21.02, I21.09, I21.11, I21.19, I21.21, I21.29, I21.3, I21.4	Acute myocardial infarction (without subsequent MI)
I44.0, I44.1, I44.2, I44.30, I44.39, I44.4, I44.5, I44.60, I44.69, I44.7, I45.0, I45.10, I45.19, I45.2, I45.3, I45.4, I45.5, I45.6, I45.81, I45.9	Conduction disorders
I49.49, I47.9, I49.3, I49.8, I49.9, R00.0, R00.1	Dysrhythmia
I09.81, I50.1, I50.20, I50.21, I50.23, I50.30, I50.31, I50.33, I50.40, I50.41, I50.43, I50.9	Congestive heart failure; nonhypertensive

Diagnosis Category/ICD-10-CM Codes	Description
K80.00, K80.01, K80.12, K80.13, K80.30, K80.31, K80.32, K80.33, K80.36, K80.37, K80.42, K80.43, K80.46, K80.47, K80.62, K80.63, K80.66, K80.67, K81.0, K81.2, K83.0	Biliary tract disease
K85.0, K85.1, K85.2, K85.3, K85.8, K85.9	Pancreatic disorders
Z44.001, Z44.002, Z44.009, Z44.011, Z44.012, Z44.019, Z44.021, Z44.022, Z44.029, Z44.101, Z44.102, Z44.109, Z44.111, Z44.112, Z44.119, Z44.121, Z44.122, Z44.129, Z44.8, Z44.9, Z45.1, Z46.82	Fitting and adjustment of select devices

**Table PR.5 – Potentially Planned Procedures (Version 4.0 [ICD-10] —THA/TKA Population)**

Procedure Category/ICD-10-PCS Codes	Description
<b>AHRQ CCS Procedure Categories</b>	
1	Incision and excision of CNS
3	Excision destruction or resection of intervertebral disc
5	Insertion of catheter or spinal stimulator and injection into spinal canal
9	Other OR therapeutic nervous system procedures
10	Thyroidectomy; partial or complete
12	Therapeutic endocrine procedures
33	Other OR procedures on mouth and throat
36	Lobectomy or pneumonectomy
38	Other diagnostic procedures on lung and bronchus
40	Other diagnostic procedures on the respiratory system and mediastinum
43	Heart valve procedures
44	Coronary artery bypass graft (CABG)
45	Percutaneous transluminal coronary angioplasty (PTCA) with or without stent placement
49	Other OR heart procedures
51	Endarterectomy; vessel of head and neck
52	Aortic resection; replacement or anastomosis

Procedure Category/ICD-10-PCS Codes	Description
53	Varicose vein stripping; lower limb
56	Other vascular bypass and shunt; not heart
59	Other OR procedures on vessels of head and neck
66	Procedures on spleen
67	Other procedures; hemic and lymphatic systems
74	Gastrectomy; partial and total
78	Colorectal resection
79	Excision (partial) of large intestine (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
132	Other OR therapeutic procedures; female organs
142	Partial excision bone
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
172	Skin graft
175	Other OR therapeutic procedures on skin subcutaneous tissue fascia and breast
<b>ICD-10-PCS Codes</b>	
OCBS4ZZ, OCBS7ZZ, OCBS8ZZ	Laryngectomy
OB5N0ZZ, OB5N3ZZ, OB5N4ZZ, OB5P0ZZ, OB5P3ZZ, OB5P4ZZ, OBW10FZ, OBW13FZ, OBW14FZ	Revision of tracheostomy, scarification of pleura
OTC03ZZ, OTC04ZZ, OTC13ZZ, OTC14ZZ, OTC33ZZ, OTC34ZZ, OTC43ZZ, OTC44ZZ	Nephrostomy
OT9030Z, OT9130Z	Kidney procedures
GZB0ZZZ, GZB1ZZZ, GZB2ZZZ, GZB3ZZZ, GZB4ZZZ	Electroshock therapy

**Table PR.6 – Acute Diagnoses (Version 4.0 [ICD-10] —THA/TKA Population)**

Diagnosis Category/ICD-10-CM Codes	Description
<b>AHRQ CCS Diagnosis Categories</b>	
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 and secondary hypertension
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 tuberculosis 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

Diagnosis Category/ICD-10-CM Codes	Description
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 disorders
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
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

Diagnosis Category/ICD-10-CM Codes	Description
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 amnesic 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 mental health disorders
<b>ICD-10-CM Codes</b>	
A36.81, A39.50, A39.51, A39.52, A39.53, B33.20, B33.21, B33.22, B33.23, B37.6, B58.81, I01.0, I01.1, I01.2, I01.8, I01.9, I02.0, I09.0, I09.89, I09.9, I30.0, I30.1, I30.8, I30.9, I31.0, I31.1, I31.2, I31.4, I32, I33.0, I33.9, I39, I40.0, I40.1, I40.8, I40.9, I41, I51.4	Peri-; endo-; and myocarditis; cardiomyopathy
I21.01, I21.02, I21.09, I21.11, I21.19, I21.21, I21.29, I21.3, I21.4	Acute myocardial infarction (without subsequent MI)
I44.0, I44.1, I44.2, I44.30, I44.39, I44.4, I44.5, I44.60, I44.69, I44.7, I45.0, I45.10, I45.19, I45.2, I45.3, I45.4, I45.5, I45.6, I45.81, I45.9	Conduction disorders
I47.9, I49.3, I49.49, I49.8, I49.9, R00.0, R00.1	Dysrhythmia

Diagnosis Category/ICD-10- CM Codes	Description
I09.81, I50.1, I50.20, I50.21, I50.23, I50.30, I50.31, I50.33, I50.40, I50.41, I50.43, I50.9	Congestive heart failure; nonhypertensive
K80.00, K80.01, K80.12, K80.13, K80.30, K80.31, K80.32, K80.33, K80.36, K80.37, K80.42, K80.43, K80.46, K80.47, K80.62, K80.63, K80.66, K80.67, K81.0, K81.2, K83.0	Biliary tract disease
K85.0, K85.1, K85.2, K85.3, K85.8, K85.9	Pancreatic disorders